

**GSECL**

**1X800 MW WANAKBORI STPP**



**VOLUME - IIB & III**

**TECHNICAL SPECIFICATION**

**FOR**

**AIR CONDITIONING SYSTEM**

**SPECIFICATION NO.: - PE-TS-408-553-A001  
REV. - 0  
NOVEMBER 2015**



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

*Signature*  
S.A. KHAN  
MUKESH KASINATH



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
INDEX**

**SPECIFICATION No: PE-TS-408-553-A001**

**VOLUME: II B & III**

**REV. 00**

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मुकुण्ड कौशिक  
 S.A. ICFEIN  
 20-11-2018



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
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MURKESH KADSIKAR  
 S.A. ICFM  
 20-11-2018



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: II B

REV. 00

**VOLUME II B**

*Mukesh K. S. Sinha*  
MUKESH K. S. SINHA  
*S. A. Khan*  
S. A. KHAN  
*Sharma*



1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
INTENT OF SPECIFICATION

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SHEET : 1 OF 3

SECTION-A

INTENT OF SPECIFICATION

*Signature*  
D. M. M. A. S.

*Signature*  
S. A. K. P. N. J.

*Signature*  
MUKESH K. SINGH



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
INTENT OF SPECIFICATION**

**SPECIFICATION No: PE-TS-408-553-A001**

**VOLUME: II B**

**SECTION : A**

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**SHEET : 2 OF 3**

**1.0 INTENT OF SPECIFICATION**

- 1.1 The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation , security / safety at site , Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, Performance and guarantee testing and handing over to BHEL's customer of Ventilation system as per details in different sections / volumes of this specification and various pre award agreements for 1X800 MW WANAKBORI STP at Wanakbori, Gujarat.
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, performance and guarantee testing of Air Conditioning system.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5 The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification **within 10 days of receipt of tender documents.** In absence of

*Signature*  
*Signature*  
MUKESH KADSIKAM  
S.A. ICFM



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
INTENT OF SPECIFICATION**

**SPECIFICATION No: PE-TS-408-553-A001**

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any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in Vol – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, Section - C shall prevail over section – D, however more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser / Employer, consultant, please referred relevant clause(s) of GCC.

*Handwritten signatures and names:*  
MUKESH KADSIWANI  
S.A. KAPLAN  
S. A. KAPLAN



**1x800 MW WANAKBORI STPP**  
**AIR CONDITIONING SYSTEM**  
**PROJECT INFORMATION WITH WIND AND**  
**SEISMIC DESIGN CRITERIA**

SPECIFICATION No: PE-TS-408-553-A001

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**SECTION: B**

**PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN**  
**CRITERIA**

*Signature*  
D. M. M. A. A.

*Signature*  
S. A. K. P. A. N. J.

*Signature*  
MUKESH K. SINGH M

**VOLUME : IIA**

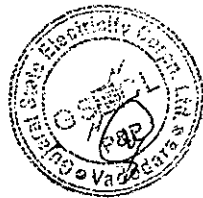
**SECTION-II**

**PROJECT SYNOPSIS AND GENERAL INFORMATION**

*Mukesh*  
MUKESH K. SINGH

*S.A. ICHHAN*  
S.A. ICHHAN

*10-11-11*  
10-11-11



DEVELOPMENT CONSULTANTS  
(K9213R-EPC-SPC-001-Vol-IIA-Sec-1&2)

028



VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Supercritical Thermal Power Project would be set up by Gujarat State Electricity Corporation Limited (GSECL) at Kheda district of Gujarat.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

The proposed site is located in Kheda district about 13 kilometers from the nearest commercial town of Balasinor & 10 kilometers from Sevalia town. The National Highway, NH-08, connecting Dakor – Godhra is about 10 kilometers from the site. The State Highway SH – 59 connecting Balasinor – Sevalia is about 2 Kilometers from the site. Nearest railway station to the existing site is Sevalia, located about 8 kilometers from the site on Anand – Godhara main broad gauge line of Western Railway.

Nearby Air Ports are Ahmedabad at a distance of about 110 kilometers from the site and Vadodara at a distance of about 85 kilometers from the site.

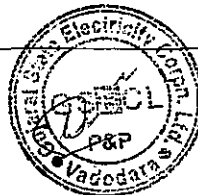
3.00.00 LAND

The proposed extension unit will be developed in the existing Wanakbori Thermal Power Station and will be located north east side of the existing plot in the Kheda District of Gujarat. The land of the proposed plant will be filled in upto a desired level. Existing Ash Pond/ Dyke area will be utilized for the extension unit.

4.00.00 SOURCE OF COAL

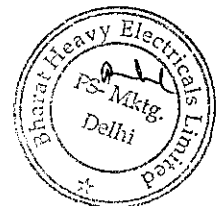
Indian coal would be sourced from captive mines Machha Kata in Talcher, State – Orissa which are situated about 1800 Kms from the project site. GSECL will arrange for transportation of the coal required for the extension unit from these captive mines by the existing railway facilities for delivery of coal supply to the Wanakbori power station.

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029

V IIA/S-2 : 1



Handwritten notes and signatures on the left margin, including 'Balasinor', 'S.A. ICHMAN', 'S.A. M-A-Y', 'MUKESH K. SINGH', and 'MUKESH'.

CONTENT

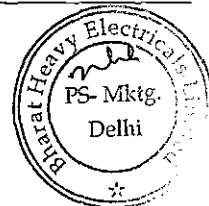
CLAUSE NO.	DESCRIPTION
1.00.00	INTRODUCTION
2.00.00	APPROACH TO SITE
3.00.00	LAND
4.00.00	SOURCE OF COAL
5.00.00	SOURCE OF WATER
6.00.00	ASH DISPOSAL AREA
7.00.00	SALIENT DESIGN DATA

*Mukesh*  
*S.A. ICHMAN*  
*MUKESH K.S. SINGH*



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030



5.00.00 SOURCE OF WATER

The water required for the new unit shall be obtained from River Mahi, flowing by the side of the existing Wanakbori Power Station.

One (1) new jackwell will be installed on Mahi river for supply of water for new plant. In addition, existing Canal Water and Jackwell Water will have interconnection with new plant to cater plant water requirement of new plant.

6.00.00 ASH DISPOSAL AREA

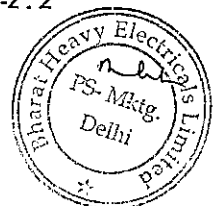
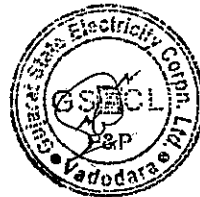
Existing Ash Pond / Dyke area will be utilized for the extension unit. Fly ash silos will be located outside plant boundary wall (but within GSECL land) in the vicinity of the Ash Dyke area.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL	:	72 M
Max. daily average temp	:	34 °C
Min. daily average temp	:	11.7 °C
Max. Ambient air temp. (daily)	:	34°C
Max. Ambient air temp. (yearly)	:	30°C
Max. Ambient air temp.	:	42°C
Wet bulb temperature	:	28°C
Relative Humidity	:	RH varies within a range from 50% to 95%.
Average annual rainfall	:	750 mm

[Metrological data of Vadodara is attached for reference].



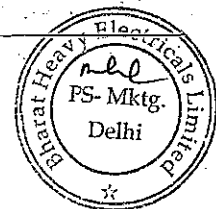
*Handwritten notes:*  
Bharat  
Sudhakar  
Sudhakar  
MUKESH K. SINGH

*Shree*  
S.A. ICHMAN ID M-MAY  
*Shree*  
S.A. ICHMAN  
MUKESH KAP SINGH

VOLUME : IIA  
SECTION-IX  
SALIENT DESIGN DATA  
[TABLE-I TO TABLE-VII]



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TABLE-IV	ANALYSIS OF COAL
TABLE-V	ASH ANALYSIS
TABLE-VI	FUEL OIL ANALYSIS
TABLE-VII	CLIMATOLOGICAL TABLE OF BARODA

*Shree*  
S. A. ICHMAN

*Baroda*  
S. A. ICHMAN

*Mukesh*  
MUKESH K. SINGH



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(K9213R-EPC-SPC-001-Vol-IIA-Sec-9)

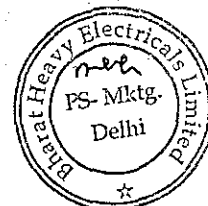


TABLE-I

CLARIFIED WATER ANALYSIS  
(As Received)

Page 1 of 2

CONSTITUENTS	As	CONTENT	Jan-March	April-June	July-Sept	Oct-Dec
Calcium Hardness	CaCO3	ppm	70	62	57	64
Magnesium Hardness	CaCO3	ppm	63	78	52	65
Sodium + Potassium	CaCO3	ppm	-	-	-	-
Iron in Solution.	CaCO3	ppm	0.032	0.030	0.025	0.032
Manganese in Solution	CaCO3	ppm	-	-	-	-
Hydrogen (FMA)	CaCO3	ppm	64	68	36	40
TOTAL CATIONS	CaCO3	ppm	180	197	147	165
Bicarbonate	CaCO3	ppm	137	145	105	123
Carbonate	CaCO3	ppm	0	0	0	0
Hydroxide	CaCO3	ppm	-	-	-	-
Sulphate	CaCO3	ppm	14	16	18	14
Chloride	CaCO3	ppm	29	35	24	28
Nitrate	CaCO3	ppm	-	-	-	-
Fluoride	CaCO3	ppm	-	-	-	-
TOTAL ANIONS	CaCO3	ppm	200	215	160	185
Colloidal Silica	SiO <sub>2</sub>	ppm	-	-	-	-
Dissolved Silica	SiO <sub>2</sub>	ppm	18	16	12	20
Conductivity at 25°C	-	Micro siemens/cm (maximum)	367	400	302	321
pH value at 25°C	-		7.87	7.76	7.71	7.75
Total Suspended solids	-	ppm (maximum)	294	320	242	257
Turbidity		NTU (maximum)	2	2	5	2

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V.IIA/S-9 : 1

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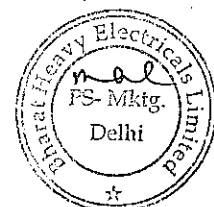


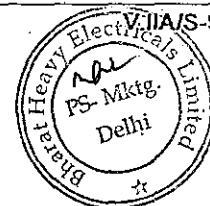
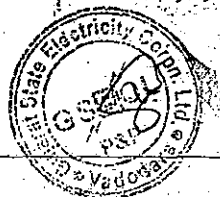
TABLE-I

CLARIFIED WATER ANALYSIS

CONSTITUENTS	As	CONTENT
Calcium	CaCO <sub>3</sub>	85.0 ppm
Magnesium	CaCO <sub>3</sub>	94.0 ppm
Sodium + Potassium	CaCO <sub>3</sub>	75.0 ppm
	CaCO <sub>3</sub>	
Iron in Solution.	Fe	0.05 ppm
Hydrogen (FMA)	CaCO <sub>3</sub>	- ppm
TOTAL CATIONS (except iron)	CaCO <sub>3</sub>	254.0 ppm
Bicarbonate	CaCO <sub>3</sub>	160.0 ppm
Carbonate	CaCO <sub>3</sub>	- ppm
Hydroxide	CaCO <sub>3</sub>	- ppm
Sulphate	CaCO <sub>3</sub>	20.0 ppm
Chloride	CaCO <sub>3</sub>	52.0 ppm
Nitrate	CaCO <sub>3</sub>	22.0 ppm
Phosphate		- ppm
Fluoride	CaCO <sub>3</sub>	0.0 ppm
TOTAL ANIONS	CaCO <sub>3</sub>	254.0 ppm
Reactive Silica	SiO <sub>2</sub>	22.0 ppm
Colloidal Silica	SiO <sub>2</sub>	0.0 ppm
Conductivity at 25°C	-	440 Micro siemens/cm (maximum)
pH value at 25°C	-	7.5 – 8.0
Turbidity		Not to exceed 15 NTU (maximum)

Note: The above Clarified Water Analysis shall be considered for DM Plant Design.

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MUKESH K. SINGH  
 S.A. ICHMAN  
 S.M. M.A.

TABLE-II

RAW WATER ANALYSIS  
(As Received)

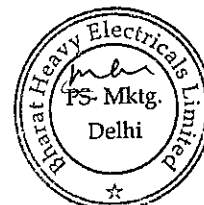
Source : River Mahi (Jack-well/ canal)

Page 1 of 2

(1) Jack-well/Canal Water Parameters

Sl. No.	Parameter	Unit	Result
1	pH	Unit	8.42
2	Turbidity	NTU	2.2
3	Conductivity	$\mu$ Mhos/cm	440
4	Total alkalinity as CaCO <sub>3</sub>	ppm	152
5	Chloride as Cl	ppm	33
6	Total hardness as CaCO <sub>3</sub>	ppm	134
7	Calcium Hardness as CaCO <sub>3</sub>	ppm	52
8	Magnesium Hardness as CaCO <sub>3</sub>	ppm	82
9	Silica as SiO <sub>2</sub>	ppm	20
10	Total Dissolved solids as such	ppm	308.42
11	Sulphate as SO <sub>4</sub>	ppm	12
12	Iron as Fe	ppm	0.031
13	Potassium		Not present
14	TSS	ppm	1-2

M. S. ...  
 S. A. ...  
 MUKESH K. SINGH



(2) Hypothetical Combination of Ions

Page 2 of 2

Sl. No.	Parameter	As	CONTENT ppm
1	Calcium Hardness	CaCO <sub>3</sub>	52
2	Magnesium Hardness	CaCO <sub>3</sub>	82
3	Sodium	CaCO <sub>3</sub>	79
4	Iron in Solution.	Fe	-
5	Manganese in solution	CaCO <sub>3</sub>	-
6	Total Cations	CaCO <sub>3</sub>	213
7	Bicarbonate	CaCO <sub>3</sub>	152
8	Carbonate	CaCO <sub>3</sub>	2
9	Hydroxide		-
10	Sulphate	SO <sub>4</sub>	12.5
11	Chloride	CaCO <sub>3</sub>	46.48
12	Nitrate	NO <sub>3</sub>	-
12	Fluoride	-	-
13	Total Anions	-	213

MUKESH K. SINGH  
 S.A. ICHMAN  
 ID M-MAY



DEVELOPMENT CONSULTANTS  
(K9213R-EPC-SPC-001-Vol-IIA-Sec-9)

V.IIA/S-9: 4

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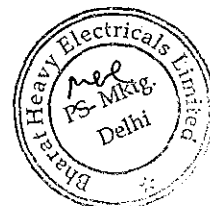
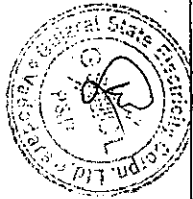


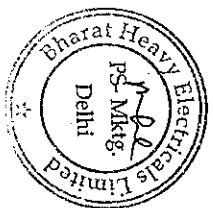
TABLE-III

ESTIMATION OF CONSUMPTIVE WATER REQUIREMENT

Consumption Points	DM Water (m3/hr)	Filtered Water (m3/hr)	Clarified Water (m3/hr)	Raw Water (m3/hr)	REMARKS
Heat Cycle Make-up	72*				*Note: Heat Cycle Make-up is 3% of BMCR steam flow.
Make-up Requirement for DMCW System	0.5				
Chemical Feed System	0.5				
Condensate Polishing Unit	4				
Neutralisation Pit	6				
<b>-Total (a to e)</b>	<b>83</b>	<b>83</b>			
Portable Water Requirement		2			
Backwash of Filter		2			
<b>-Total (1 + 2)</b>		<b>87</b>	<b>87</b>		
Ventilation System Requirement			17		C.O.C : 5 CTBD : 372
CC Plant Requirement			10		
Fire Water System			-		
HP Gland Sealing System			90		
Backwash Return			(-) 2		
<b>-Total (1 + 2 + 3)</b>			<b>202</b>	<b>202</b>	
Service Water				25	
HT Make-up requirement				1884	
<b>AND TOTAL (1 to 4)</b>				<b>2111</b>	<b>(Say 21.0 Cusec)</b>



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MUKESH KA SINGH

SIA-ICHAN

DM-MAX

TABLE-IV  
ANALYSIS OF COAL  
PROXYMATE ANALYSIS

No.	Description	Designed Coal	Worst Coal
1.	Fixed Carbon	28.83%	26%
2.	Volatile Matter (VM)	26.61%	22.00%
3.	Moisture	10.80%	10.0%
4.	Ash	33.76%	42.00%
5.	Gross calorific value	3850 Kcal/kg	3500 Kcal/kg

ULTIMATE ANALYSIS

No.	Description	Designed Coal	Worst Coal
1.	Carbon	40.34%	35.87%
2.	Hydrogen	2.61%	2.66%
3.	Sulphur	0.80%	0.90%
4.	Nitrogen	0.97%	0.72%
5.	Oxygen (by diff.)	10.72%	7.85%
6.	Moisture	10.8%	10%
7.	Ash	33.76%	42.00%
8.	Grindability Index (HGI)	66	50
9.	Ash Fusion Temperature (deg C) (IDT)	1350	1160

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V.IIA/S-9 : 6

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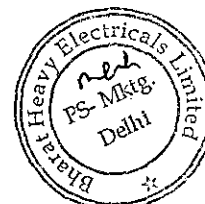
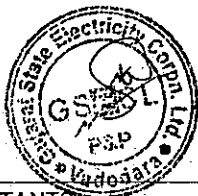


TABLE-V

ASH ANALYSIS  
(As Received)

Sl. No.	Characteristic	Result
1.	Silicon dioxide (SiO <sub>2</sub> ) plus Aluminium Oxide (Al <sub>2</sub> O <sub>3</sub> ) plus Iron Oxide (Fe <sub>2</sub> O <sub>3</sub> ) present by mass Min.	93.3 – 95.7
2.	Silicon dioxide (SiO <sub>2</sub> ), percent by mass Min.	58.4 – 63.0
3.	Total sulphur as sulphur trioxide (SO <sub>3</sub> ) percent by mass Max.	0.31 – 0.76
4.	Available alkalis as sodium Oxide (Na <sub>2</sub> O) in percent by mass Max.	Nil
5.	Loss on ignition, in percent by mass Max.	0.31 – 0.87
6.	Moisture content %	0.026 – 0.132
7.	Ash fusion temp. (Deg C) (IDT)	1350 / 1160
8.	Hemispherical (Deg C)	1400
9.	Fusion temp. (Deg C)	1400
10.	Lead (as pb)	0.14 µg/g
11.	Arsenic (as As)	0.01 µg/g
12.	Mercury (as Hg)	0.04 µg/g

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 S.D. ICHHAN  
 ID M-MAX



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V.IIA/S-9 : 7

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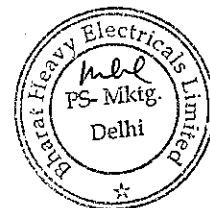


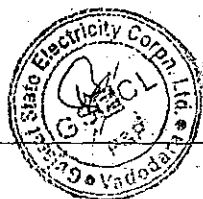
TABLE-VI  
FUEL OIL ANALYSIS

Page 1 of 2

Sl. No.	Parameters	Unit	LDO	LSHS	HSD
1.0	Density at 15 degC	gm/l	0.8682	0.9708	0.8297
2.0	Water Content	%v/v	0.15	0.10	0.05
3.0	Sediment	%w/w	0.06	0.04	0.02
4.0	Total Sediment	mg/100ml	—	—	0.94
5.0	Redwood Vis. 37.8	Second	30.0	—	—
6.0	Kinematics Vis 38	cst	6.80	—	—
7.0	Kinematics Vis 100 C	cst	—	68.00	—
8.0	Kinematics Vis 40 C	cst	—	—	2.08
9.0	Flash Point (PMCC)	Deg. C	75	>93	41
10.0	Pour Point	Deg. C	9	27	6
11.0	Acidity -Inorganic	mg KOH/g	Nil	—	Nil
12.0	Acidity -Total	mg KOH/g	—	—	0.13
13.0	Ash	%wt	0.01	0.01	—
14.0	Sulphur Cont. Total	%Mass	0.46	1.14	0.11
15.0	C RES RAMSBOTT. MTD	%Mass	0.53	—	0.21
16.0	Smoke Point	Mm	7.00	—	—
17.0	Gross C.V	Kcal/Kg	—	—	—

MUKESH K. SINGH  
 S.A. ICHAN  
 ID M-MA

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TABLE-VI

FUEL OIL ANALYSIS – FURNACE OIL FO

Page 2 of 2

Sl. No.	Parameters	Unit	FO
1.0	Acidity –Inorganic in mg. KOH/g	mg. KOH/g	0.0000
2.0	Ash	Wt%	0.059
3.0	Density at 15 degC	Kg/m <sup>3</sup>	954.8
4.0	Flash Point (PMCC)	Cell	69.0
5.0	Calorific Value Net in	Kcal / Kg	9818
6.0	Gross Calorific Value	Kcal/kg.	10402
7.0	Water Content	Vol%	0.20
8.0	Kinematics Viscosity @50°C summer	cst	134.0
9.0	Pour Point Summer	Cel	18.0
10.0	Sediment	Wt%	0.10
11.0	Sulphur Total	Wt%	0.680

MUKESH KAPSI  
 S.D. ICHMAN  
 S.D. M. M. A.



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V:IIA/S-9:9

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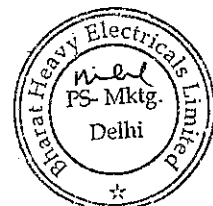


TABLE-VII  
CLIMATOLOGICAL TABLE OF BARODA

STATION : Baroda 42747 LAT: 22 18 N LONG: 73 15 E HT. ABOVE M.S.L. 34 METERS DATA 1951 TO 1980

MN	SLP	Mean Temperature						Extremes			Cloud				Rainfall					WS
		DB	WB	MAX	MIN	HIGH	LOW	MAX DT	MIN DT	RH	VP	TOT	LOW	TOT RAINY	WET	DRY	HEAVY	DAY		
1	1011.8 1008.5	13.8 27.9	10.9 17.8	30.3	12.0	34.3	7.5	36.2 25 1961	-1.1 15 1935	67 10.7 33 12.4	1.1 0.3 1.1 0.1	1.2	0.1	53.6 1920	0.0	33.0	05	4.0		
2	1010.3 1006.7	16.2 31.4	12.3 18.7	33.0	13.8	37.9	8.9	41.7 28 1953	1.7 10 1950	61 11.2 25 11.3	0.9 0.2 0.9 0.2	0.6	0.1	33.0 1898	0.0	33.0	10	4.1		
3	1008.5 1004.3	22.1 35.8	16.3 20.5	37.1	18.4	41.5	13.1	44.4 26 1973	6.7 03 1936	53 13.8 20 11.7	1.1 0.2 1.2 0.2	2.2	0.2	44.3 1967	0.0	21.0	23	4.2		
4	1005.9 1001.4	27.3 39.1	20.7 22.5	40.2	22.9	43.9	18.4	45.9 25 * 1979	11.7 16 1955	53 19.2 20 14.1	1.1 0.2 1.2 0.2	0.9	0.1	83.3 1947	0.0	71.4	18	4.8		
5	1003.1 998.3	29.9 39.8	24.6 24.9	40.9	26.5	44.5	23.2	46.7 11 1960	18.9 05 1939	64 26.8 27 19.3	1.7 1.2 0.7 0.3	4.4	0.3	153.9 1917	0.0	59.7	29	8.7		
6	999.4 995.4	29.3 35.3	26.0 26.6	37.1	27.0	41.5	23.5	45.6 06 * 1979	20.2 19 1978	76 30.9 51 27.8	4.5 2.9 3.4 2.0	146.8	5.6	527.8 1913	0.0	177.4	06	10.3		
7	998.1 995.3	27.4 30.8	25.8 26.5	32.7	25.7	36.9	23.5	40.6 05 1962	21.1 19 1943	88 31.8 72 31.1	6.5 4.0 6.4 4.0	297.6	13.8	899.0 1950	4.8	247.4	24	8.4		
8	999.8 997.0	26.4 29.9	25.1 26.1	31.5	25.0	34.6	23.4	37.4 30 1979	22.2 01 1976	90 30.9 74 30.6	6.7 3.8 6.5 3.9	284.7	12.0	748.5 1933	0.3	250.7	05	7.1		
9	1003.6 1000.2	26.3 31.5	24.5 25.7	33.2	24.3	37.0	22.4	41.1 30 * 1951	18.9 29 1938	86 29.4 63 28.2	4.3 2.4 4.0 2.4	141.7	7.1	575.4 1945	0.0	372.1	24	5.1		
10	1007.5 1004.0	25.0 33.3	21.5 23.9	36.0	21.3	38.5	16.7	41.7 13 1951	11.7 30 1955	72 22.9 44 22.2	1.5 0.6 1.4 0.6	22.0	1.3	272.3 1917	0.0	153.2	29	3.0		
11	1010.5 1007.2	20.4 30.5	16.4 21.2	34.3	16.7	37.2	12.9	39.6 02 1966	7.2 30 1938	64 15.5 41 17.8	1.3 0.4 1.3 0.4	16.2	0.7	212.4 1979	0.0	64.6	22	3.0		
12	1011.9 1008.7	15.6 28.0	12.7 19.1	31.4	13.4	34.5	9.6	36.8 01 1980	3.3 22 1937	70 12.5 40 15.1	1.3 0.2 1.3 0.2	4.4	0.2	43.4 1978	0.0	43.4	01	3.6		
YR	1005.9	23.3	19.7	34.8	20.6	44.8	6.9	46.7	-1.1	70 21.3	2.7 1.4	922.7	41.5	1666.0	133.1	372.1		5.5		
LY	1002.3	32.8	22.8							43 20.1	2.5 1.2			1976	1899					
YRS	30	30	30	30	30	30	30	48	48	30 29	30 22	30	30	93	93	93		30		
		30	30							30 29	30 22									

\* Occurred More Than Once

DEVELOPMENT CON  
(K9213R-EPC-SPC-001)

V.II/AS-IX: 10

MUKESH KASINGH

S.A. KHAN

S.D. M. M. M.

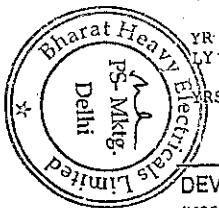
STATION : Baroda

42747 .. contd

MN	Weather							Wind speed				% Wind Direction				Total Cloud				Low cloud				Visibility											
	PPT	HAIL	THUN	FOG	D.STM	SQUA	62	61	19	0	N	NE	E	SE	S	SW	W	NW	0	0	T-2	3-5	6-7	8	0	T-2	3-5	6-7	8	F8	<1	1-4	4-10	10-20	>20
1	0.3	0.0	0.1	0.5	0.0	0.0	0	0	19	12	13	39	2	2	1	3	1	3	36	20	5	3	2	1	28	2	1	0	0	0	0.3	1.7	2.0	25.6	1.4
2	0.3	0.0	0.1	0.2	0.0	0.0	0	0	17	11	10	31	1	2	2	7	2	4	41	20	4	3	1	0	26	1	1	0	0	0.2	1.6	2.3	23.9	0.0	
	0.2	0.0	0.2	0.0	0.0	0.0	0	0	19	12	7	15	1	3	5	16	5	7	41	20	5	4	2	0	29	1	1	0	0	0.0	0.5	0.7	29.8	0.0	
	0.2	0.0	0.5	0.0	0.0	0.0	0	0	22	8	5	5	1	2	6	29	10	12	30	19	5	3	2	1	27	2	1	0	0	0.0	0.1	0.1	29.7	0.1	
5	0.4	0.0	0.6	0.0	0.3	0.0	0	0	28	3	1	1	1	1	5	57	17	7	10	15	6	7	3	0	19	4	6	2	0	0.0	0.0	0.0	30.8	0.2	
6	7.6	0.0	3.3	0.0	0.1	0.2	0	0	28	2	0	1	0	2	10	61	16	1	9	2	6	9	7	6	6	8	12	4	0	0.0	0.0	0.3	29.6	0.1	
7	18.8	0.0	2.1	0.0	0.0	0.1	0	0	27	4	0	0	0	1	8	62	14	0	15	0	2	5	8	16	4	4	14	8	1	0.0	0.0	0.2	30.8	0.0	
8	17.8	0.0	1.8	0.0	0.0	0.0	0	0	26	5	1	0	0	0	7	55	20	1	16	0	1	4	8	18	4	4	13	9	1	0.0	0.1	0.8	29.2	0.9	
9	10.2	0.0	2.6	0.0	0.0	0.0	0	0	23	7	2	3	0	2	5	37	18	6	27	4	6	6	6	8	12	4	8	5	1	0.0	0.1	0.2	29.3	0.4	
10	1.6	0.0	1.4	0.2	0.0	0.0	0	0	17	14	6	16	3	6	4	12	3	3	47	17	7	4	2	1	26	2	2	1	0	0.0	0.2	0.3	29.7	0.8	
11	1.1	0.0	0.3	0.2	0.0	0.0	0	0	17	13	11	33	4	3	1	2	0	1	45	18	6	3	2	1	27	1	2	0	0	0.1	0.3	0.4	28.3	0.9	
12	0.3	0.0	0.2	0.2	0.0	0.0	0	0	20	11	9	15	3	2	1	8	10	16	36	14	11	3	2	1	20	9	2	0	0	0.0	0.0	0.0	0.5	30.5	
	0.3	0.0	0.2	0.2	0.0	0.0	0	0	20	11	12	43	3	1	1	1	0	1	38	19	5	4	2	1	29	1	1	0	0	0.0	1.3	1.3	27.4	1.0	
							0	0	21	10	17	24	4	1	0	2	4	16	32	17	7	3	3	1	28	2	1	0	0	0.0	0.0	0.0	0.6	30.4	



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YR	58.8	0.0	13.2	1.3	0.4	0.3	0	0	263	102	6	16	1	2	5	29	9	4	28	154	58	55	45	53	237	34	62	29	3	0	0.6	5.9	8.6	344.1	5.8	
RS							0	5	297	63	6	12	2	1	2	26	16	17	18	150	78	43	53	41	219	67	53	24	2	0	0.0	1.1	1.1	22.6	340.2	
			26																																	

DEVELOPMENT CONSULTANTS  
(K9213R-EPC-SPC-001-Vol-IIA-Sec

V.II/A/S-IX : 11

MUKESH K. SINGH

S.A. ICHAN

D. H. MATH

Gujarat State Electricity Corporation Ltd  
1x800 MW Supercritical Thermal Power Project

EPC Bid Document  
K9213R-EPC-SPC-001

STATION : Baroda (A) 42748 LAT: 22 20 N LONG: 73 16 E HT. ABOVE M.S.L. 38 METERS DATA 1952 TO 1980

MN	SLP	Mean Temperature						Extremes		Cloud		Rainfall						
		DB	WB	MAX	MIN	HIGH	LOW	MAX DT	MIN DT	RH	VP	TOT LOW	TOT RAINY	WET	DRY	HEAVY	DAY	WS
1	1011.5 1008.1	15.2 27.6	11.3 17.3	29.4	12.2	33.4	7.2	35.8 13 1979	2.8 22 1962	59 10.3 31 11.5	1.2 0.1 1.2 0.1	1.3 0.1 1953	0.1	15.8 1953	0.0	14.0	07 1953	7.6
2	1010.0 1006.3	17.8 30.9	12.4 17.8	32.1	13.9	36.6	8.8	40.6 28 1953	3.9 10 1950	50 10.2 23 9.9	1.0 0.3 1.0 0.3	0.7 0.1 1961	0.1	11.0 1961	0.0	6.0	02 1961	7.6
3	1008.1 1003.9	23.2 35.1	16.5 20.0	36.4	18.2	40.5	13.0	43.9 29 1977	9.3 08 1979	48 13.4 21 11.2	1.1 0.2 1.3 0.2	1.2 0.2 1967	0.2	21.4 1967	0.0	11.5	25 1967	7.5
4	1005.6 1000.9	27.8 38.5	20.8 21.8	39.5	22.8	42.9	18.2	45.9 29 1979	14.4 15 1955	51 19.0 19 12.8	1.2 0.3 1.5 0.3	0.3 0.0 1978	0.0	8.2 1978	0.0	8.2	25 1978	8.3
5	1002.7 997.7	29.9 39.0	24.6 24.5	40.3	26.5	43.7	22.9	46.1 20 1955	19.4 27 1974	64 26.6 29 19.0	1.9 1.6 0.9 0.5	3.7 0.2 1974	0.2	50.1 1974	0.0	40.9	29 1956	14.6
6	999.0 994.9	29.3 34.6	26.1 26.6	36.7	26.8	40.9	23.2	45.6 06 1979	17.1 03 1980	77 31.0 54 28.1	4.9 3.4 3.9 2.5	129.7 5.0 1976	5.0	439.0 1976	0.0	187.3	06 1976	18.0
7	997.7 994.7	27.4 30.2	25.8 26.5	32.4	25.6	36.2	23.5	39.6 02 1968	22.2 28 1952	88 32.0 75 31.6	6.6 4.1 6.5 3.9	290.7 12.6 1976	12.6	605.6 1976	60.8	162.0	11 1976	15.2
8	999.5 996.5	26.5 29.3	25.2 26.0	31.3	24.9	34.4	23.2	39.1 16 1969	21.7 16 1956	90 31.0 76 30.8	6.8 3.9 6.5 3.8	274.4 11.8 1978	11.8	657.4 1978	38.5	277.1	05 1956	12.6
9	1003.2 999.7	26.5 30.9	24.6 25.4	32.7	24.2	36.5	22.2	41.1 29 1951	18.1 25 1972	85 29.4 65 28.1	4.7 2.6 4.5 2.6	147.0 7.2 1958	7.2	456.4 1958	0.3	221.6	07 1970	9.1
10	1007.2 1003.7	26.0 32.9	21.7 23.0	35.4	21.1	37.9	16.5	41.2 15 1980	12.8 27 1960	67 22.6 41 20.2	1.7 0.6 1.8 0.8	21.6 1.3 1956	1.3	143.9 1956	0.0	71.1	01 1954	6.2
11	1010.3 1006.9	21.7 30.2	16.7 20.2	33.4	16.7	36.2	12.4	39.4 01 1980	6.0 26 1968	58 15.0 37 15.6	1.6 0.4 1.5 0.5	16.5 0.7 1979	0.7	190.1 1979	0.0	61.4	04 1962	6.7
12	1011.7 1008.3	17.3 28.0	13.3 18.3	30.7	13.7	33.5	9.5	37.2 06 1968	6.4 30 1977	61 12.1 36 13.3	1.5 0.1 1.6 0.2	3.3 0.2 1978	0.2	34.2 1978	0.0	34.2	01 1978	7.0
YR	1005.5	24.1	19.9	34.2	20.6	44.1	6.8	46.1	2.8	67 21.1	2.9 1.5	911.1 39.4	1721.7	314.9	277.1		10.0	
LY	1001.8	32.3	22.3							42 19.3	2.7 1.3		1976	1972				
YRS	29	29	29	29	29	29	29	31	31	29 28	29 16	30 30	31	31	31	31	29	
										29 28	29 16							

DEVELOPMENT CON  
(K9213R-EPC-SPC-001)

V.II/VS-IX: 12

MUKESH K. SINGH

S. A. KHAN

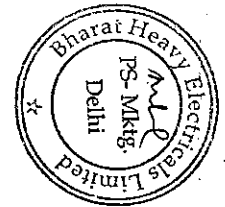
D. M. JAIN

STATION : Baroda (A) 42748 .. contd

MN	Weather						Wind speed				% Wind Direction					Total Cloud					Low cloud					Visibility									
	PPT	HALL	THUN	FOG	D.STM	SQUA	62	61	19	0	N	NE	E	SE	S	SW	W	NW	0	0	T-2	3-5	6-7	8	0	T-2	3-5	6-7	8	F8	<1	1-4	4-10	10-20	>20
1	0.2	0.0	0.1	0.2	0.0	0.0	0	1	20	10	34	20	2	4	2	1	1	4	32	19	6	4	2	0	30	1	0	0	0	0	0.3	2.8	14.2	13.1	0.6
2	0.2	0.0	0.1	0.2	0.0	0.0	0	1	18	9	25	18	4	8	5	4	2	5	29	19	4	3	2	0	26	1	1	0	0	0	0.1	2.1	12.1	13.1	0.6
3	0.2	0.0	0.3	0.1	0.1	0.0	0	2	22	7	14	12	4	9	11	12	6	8	24	18	7	4	2	0	28	2	1	0	0	0	0.1	1.3	10.8	18.0	0.8
4	0.1	0.0	0.5	0.0	0.1	0.0	0	2	24	4	12	5	1	2	10	25	14	20	11	19	6	4	1	0	27	2	1	0	0	0	0.0	0.4	9.8	18.9	0.9
5	0.4	0.0	0.9	0.0	0.3	0.2	0	8	22	1	4	1	0	0	8	46	26	10	5	13	7	8	3	0	16	6	7	2	0	0	0.0	0.1	6.1	23.5	1.3
6	7.1	0.0	4.1	0.0	0.2	0.2	0	10	20	0	1	1	0	2	15	51	25	3	2	1	3	10	11	5	4	6	15	5	0	0	0.0	0.7	9.0	19.3	1.0
7	16.7	0.0	3.5	0.0	0.1	0.2	0	6	25	0	0	1	0	2	14	56	22	2	3	0	0	6	13	12	1	6	17	6	1	0	0.0	1.5	14.4	14.5	0.6
8	17.0	0.0	2.7	0.0	0.0	0.0	0	3	27	1	1	0	0	1	9	55	27	4	3	0	1	3	12	15	2	6	16	6	1	0	0.0	1.4	14.2	14.8	0.6
9	9.9	0.0	3.0	0.2	0.0	0.1	0	1	25	4	4	3	1	3	9	32	27	10	11	3	5	7	10	5	9	7	10	4	0	0	0.0	0.9	11.3	15.3	2.5
10	1.7	0.0	1.6	0.3	0.0	0.0	0	1	23	7	11	15	8	14	11	6	5	6	24	13	8	5	4	1	23	4	3	1	0	0	0.1	0.7	8.5	18.3	3.4
11	1.0	0.0	0.3	0.1	0.0	0.0	0	1	21	8	25	26	11	5	2	0	1	2	28	15	7	4	3	1	26	2	2	0	0	0	0.1	1.0	7.8	18.2	2.9
12	0.3	0.0	0.2	0.1	0.0	0.0	0	1	22	8	33	27	5	4	1	0	0	3	27	16	7	5	2	1	29	1	1	0	0	0	0.1	1.2	11.9	15.9	1.9
YR	54.8	0.0	17.3	1.2	0.8	0.7	0	37	269	59	14	11	3	5	8	24	13	6	16	136	61	63	65	40	221	44	74	24	2	0	0.8	14.1	130.1	202.9	17.1
LY							0	73	269	23	11	8	2	1	5	24	19	23	7	132	76	61	64	32	205	76	66	16	2	0	0.4	3.2	35.2	192.8	133.4
YRS			27					24						26								19				19									
								25						27								19				19									



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DEVELOPMENT CONSL  
(K9213R-EPC-SPC-001-Vol.

V.II/AS-9:13

*Mukesh K. Singh*  
**MUKESH K. SINGH**

*S. A. Ichman*  
**S. A. ICHMAN**

*D. H. M. A. Y.*  
**D. H. M. A. Y.**

## Seismic Location

The project site lies in zone III as defined in IS: 1893 (Part 1)-2002. All the structures shall be designed complying with the requirements specified in IS: 1893 (Part-1) -2002 and (Part-4) - 2005.

## Wind Pressure

Wind force on structures has been considered as per the provisions of IS: 875 (part-3)-1987. The basic wind speed of 39 m/sec at height of 10m above the ground level and wind assumed to blow in any direction and the most unfavorable condition shall be considered for design.

  
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S.A. KHAN

  
D.K. SINGH



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
TECHNICAL SPECIFICATION**

**SPECIFICATION No: PE-TS-408-553-A001**

**VOLUME: II B**

**SECTION : C**

**REV. 00**

**SECTION: C**

**TECHNICAL SPECIFICATIONS**

*MUKESH*  
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*S.A. KHAN*  
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*D.M. JAY*  
D.M. JAY



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-408-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

**SPECIFIC TECHNICAL REQUIREMENT**

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**MUKESH K. SINGH**

*S.A. Khan*  
**S.A. KHAN**

*Idhar*  
**IDHAR**



**1x800 MW WANAKBORI STPP  
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**1. INTRODUCTION**

**1.1** The purpose of the system is to provide air-conditioning system for different areas of 1 x 800 MW, WANAKBORI TPS under the scope of BHEL.

**2. SYSTEM DESCRIPTION**

**2.1 MAIN POWER HOUSE BUILDING. (AC PLANT – 1)**

**2.1.1** A Central Chilled water type air conditioning plant is provided to cater to the air conditioning requirements of the Service building of Different floor i.e. 0m, 4.25m, 8.5m and 12.7m and following areas of Control Building adjacent to Power House.

- Unit Control Room.
- Control Equipment room.
- Shift –Charge room.
- Engineer's room.
- Computer room.
- UPS room
- All Laboratory room i.e. chemical, Electrical, Instrument and office area on operating floor.
- Telephone exchange room on operating floor.
- SWAS (Dry) panel room.
- Conference room on operating floor.
- Library on operating floor.
- AC Plant Control room located in the Central Control Building – AC shall be provided with Fan coil unit.
- In case any of the above area is not in the vicinity of the control room areas the same shall be air conditioned through split AC's. Further, Fan Coil Units (FCU) shall be provided for SWAS room.

The air conditioning plant for Turbine Building and attached Service Building shall comprise of one (1) number working Vapour Absorption chiller and 2 numbers (2X50 %) stand by screw chiller. The condenser cooling & chilled water shall be circulated through these units by means of 3 x 50% horizontal centrifugal pump sets and 3 x 50% FRP cooling towers. The chilled water produced by the chilling units shall be circulated to the air handling units by means horizontal centrifugal pump sets. 2 AHU Room located adjacent to air-conditioned areas in Power House Building (each AHU room shall contain 2 x 50% capacity AHU). The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting (Zn coating conform to IS: 277 with 180 g/sq.m. of zinc coating) and extruded Aluminium grilles / diffusers with volume control dampers and supporting frames. The return air is led back to the AHU Room in ducts for air conditioned areas at 17.0M level in control tower, For balance areas, i.e air conditioned areas at 8.5M level in control tower, the return air is collected above the false ceiling/return air duct depending upon the feasibility and led back to the AHU rooms which acts as mixing plenum for return and fresh air.

Acoustic insulation of first 5 m of duct from AHU outlet shall be provided.

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**2.1.2** The central chilled water plant, condenser water & chilled water pumps for AC plant shall be housed in AC Plant Room at 0.0 M level between E-G Bay, grid 2-4 of Power House Building.

**2.1.3** The AHUs for this AC Plant would be located as under:

- One number AHU Room at 8.5 M level of Power House Building in E-F Bay, grid 2-3 for AC areas at 8.5 m level.
- One number AHU Room at 24.0 M level of Power House Building in B-C Bay, grid 2-5 for AC areas at 17 m level.
- One number AHU room at each floor of service building.

**2.1.4** The Cooling Towers, Make-up water Storage Tank, Booster pump & Expansion Tank shall be located at 32.5 M level of power house.

**2.1.5** 5T electric hoist with monorail for AC plant shall be provided by BHEL for the AC Plant room only for maintenance purpose

**2.2 ESP control room (AC plant - 2)**

**2.2.1** The air conditioning plant shall comprise of (3 x 50%) water Cooled precision AC to air-condition areas in ESP Control Room. The conditioned air from water Cooled precision AC is distributed to the air-conditioned areas by galvanized sheet steel ducting (Zn coating conform to IS: 277 with 180 g/sq.m. of zinc coating) and extruded Aluminum grilles / diffusers. The return air is collected above the false ceiling and led back to the PAC room which acts as mixing plenum for return and fresh air. Condenser cooling water required for these package units shall be supplied from main plant ACW system through Non-chemical water treatment device.

**NOTE: Above locations of equipment are tentative which may change during detail engineering to suit the layout.**

**2.3 SPLIT TYPE AIR CONDITIONERS**

**2.3.1** Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of PLC control rooms under BHEL scope.

**3. DESIGN INPUT / CRITERIA**

**3.1 System design criteria**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 5.01.00 TO Clause no. 5.09.00

For winter heating load calculation, 50% of equipment load as available in the room shall be considered.

**4. BRIEF SCOPE**

Scope of work shall be as per specification no. K9213R-SPC-001-VOL-2K/4, SECTION-I.

**4.1 System Capacity:**

The air conditioning system shall include the following:-

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S.A. - ICHAW  
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**4.1.1 AC Plant – 1 (Central Control Room building and service building).**

To meet the AC requirement, 1 (one) number working of 320 TR (actual capacity) VAM and 2 (Two) nos. stand by each of 160 TR (actual capacity) water cooled screw chillers shall be provided.

**4.1.2 AC plant-2 (ESP Control room)**

To meet the AC requirement, 3 X 20 TR (actual capacity) water cooled Precision AC (3 X 50 %) shall be provided.

**4.2 EQUIPMENT'S TO BE PROVIDED FOR DIFFERENT AC PLANT**

**4.2.1 AC Plant-1**

**4.2.1.1** One (1) no. Vapour Absorption (working) complete with all accessories as described here in after.

**4.2.1.2** TWO (2) nos. Screw chilling machines (standby) complete with all accessories as described here in after (2x50 %).

**4.2.1.3** Three (3) Nos. Horizontal Split Casing Centrifugal Condenser Water Pump Sets (2 W + 1 SB) each complete with all accessories.

**4.2.1.4** Three (3) Nos. Horizontal Split Casing Centrifugal Chilled Water Pump Sets (2W + 1 SB) each complete with all accessories.

**4.2.1.5** Three (3) Nos. Fibre glass reinforced plastic (FRP) construction Cooling Towers (2W + 1 SB) each CT complete with all accessories i.e. fan, motor, FRP basin, nozzles, level switch, make up connection, drains, piping, valves & fittings, strainer, ladder and supporting structure etc.

**4.2.1.6** Air Handling Units (AHUs).

- 3 x 50% sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of Central Control Room, Central Equipment Room, Conference Room, Shift Incharge Room, Computer Room etc at 17.0 M level of Control Tower.
- 2 x 100 % sheet metal cabinet type (double skin) air handing units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of Electrical Equipment Room battery charger room UPS panel room etc. at 8.5 M.
- 2 x 50 % sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories as described hereinafter, to match the AC load of each floor of service building.

**4.2.1.7** Electrode type humidifier in each AHU room (1x100 %).

**4.2.1.8** Lot – Pre-filters (inside the pre-filter section of the AHUs at suction side)

**4.2.1.9** Lot - Fine filters (shall be provided at discharge of each individual AHUs and fresh air fan).

**4.2.1.10** Condenser water piping.

- Lot- condenser water piping interconnecting condensers, cooling tower, pumps etc. complete with strainers, valves, fittings etc. Black steel pipe conforming to IS-1239, upto 150 NB, Part I, heavy grade or IS-3589 (6.35 mm thk), 200 NB and above depending upon pipe size shall be used.

**4.2.1.11** Chilled water piping

- Lot- chilled water piping with insulation interconnecting chiller, air-handling units and pumps sets complete with valves and fittings such as elbows, tees, reducers,

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flanges etc. Black steel pipe conforming to IS-1239, upto 150 NB part I, heavy grade or IS-3589 (min. 6mm thk), 200 NB and above depending upon pipe size shall be used.

- One No. FRP chilled water expansion tank with insulation complete with valve, Level Gauge, Level Switch, Make-up connection, overflow and drain etc.

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S. A. I. KHAN

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**4.2.1.12** Lot-Drain water piping out of MS pipes conforming to IS-1239, Part I, heavy grade and galvanised as per IS:4736, from various equipment's like chillers, pumps, AHUs, cooling tower area etc. up to the nearest drain point. (Within the room & for Cooling tower up to nearest drain point or rain water pipe on the roof)

Drain piping from Chillers, Chilled water pumps, AHUS, FCUs etc. shall be thermally insulated

**4.2.1.13** 1X100 % duty smoke exhaust fan in each AHU room and PAC Room with duct and Isolating Damper.

**4.2.1.14** One number non chemical water treatment equipment in condenser water line

**4.2.1.15** Make up water tank made of G.I / FRP complete with valves, level gauge, level switch, make up connection, over flow and drain etc.

**4.2.1.16** Fire dampers

The supply and return air ducts shall be provided with motor operated fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance and as well as for emergency operation. The operation of these automatic dampers shall be interlocked the fire alarm system. Provision of manual overriding operation through latch shall also be kept with the Motorized Fire Damper.

**4.2.1.17** Lot – GSS Ducting sheet metal work including thermal insulation on complete supply air duct & return air duct and acoustic insulation for initial length of 5m from the AHU outlet.

**4.2.1.18** 1X100% Duty fresh air fan with pre-filter & fine filter in all AHU Rooms.

**4.2.1.19** Duct mounted Electric Strip heater shall be provided for Each AHU room in common discharge of AHU.

**4.2.2 AC Plant-2 for ESP unit -1**

**4.2.2.1** (3 x 50%) water Cooled Precision AC unit complete with all accessories as described here in after.

**4.2.2.2** Fire dampers

The supply and return air ducts shall be provided with motor operated fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance and as well as for emergency operation. The operation of these automatic dampers shall be interlocked the fire alarm system. Provision of manual overriding operation through latch shall also be kept with the Motorized Fire Damper.

**4.2.2.3** Lot – GSS Ducting (class 180) of zinc coating sheet metal work including thermal insulation on complete supply air duct & return air duct and acoustic insulation for initial length of 5m from the AHU outlet.

**4.2.2.4** 1X100% Duty fresh air fan with pre-filter & fine filter in Precision AC room.

**4.2.2.5** 1X100% Duty smoke exhaust fan in Precision AC room

**4.3 AC EQUIPMENT CONSTRUCTIONAL DETAIL**

**4.3.1 Water Cooled Vapour Absorption Chiller:**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.03.01

VAM shall be provided with Suitable PRDS with all accessories and Plunger pumps (1R+1S)

The minimum COP and IPLV of VAM shall be 1.00 and 1.05 respectively as per ARI.

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**4.3.2 Water Cooled Screw Chiller Package:**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.03.02.

IKW/TR of screw chillers shall not be more than 0.7 at 100%

**4.3.3 CONDENSER WATER PUMP SETS**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.04.01 to Clause no. 6.04.12.

**4.3.4 CHILLED WATER PUMP SETS**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.04.01 to Clause no. 6.04.12.

**4.3.5 AIR HANDLING UNIT (Double SKIN TYPE)**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.08.01.

**4.3.6 STRIP HEATER & HUMIDIFICATION PACKAGE**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.14.01 to Clause no. 6.14.02.

**4.3.7 COOLING TOWER**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.05.01 to Clause no. 6.05.19.

**4.3.8 PIPING**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.06.00.

**4.3.9 VALVES & ACCESSORIES**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.07.00.

**4.3.10 AIR FILTERS**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.09.01 to Clause no. 6.09.02.

**4.3.11 SHEET METAL WORK**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.10.01 to Clause no. 6.10.12

**4.3.12 INSULATION**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.11.01 to Clause no. 6.11.02.

**4.3.13 PRECISION / SPLIT AC UNITS**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no. 6.12.01 to Clause no. 6.12.03.

Split ACs of capacity 1.5 TR and 2 TR shall be Minimum BEE Rating 5 Star. Local isolator / MCB shall be provided with split units. Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners, and FCUs. Each split unit shall also be provided with suitable rating stabiliser. Single phase electrical feeders of

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following ratings shall be provided for split units. Bidder to ensure the suitability as per these feeder requirement.

Capacity of Split AC	Single phase feeder
1.5 TR	2.2 KW
2TR	3.0 KW

**5 CONTROL PHILOSOPHY**

**5.1** The operation of the AC plant shall be done by microprocessor-based panel mounted on the chiller package and also from the common PLC based Control panel located in the AC PLANT-1 Room. Further, overall control of both AC & ventilation system shall be done from common PLC based control panel located in the AC PLANT-1 Room. Control panel shall also be provided with solid –state annunciation, start-stop push buttons, indication lamps & interlocks. The AC Plant compressor can be started only when its associated condenser fan, chilled water pumps are in operation.

**5.1.1** Skid mounted microprocessor based control panel for Chiller Package.

**5.1.2** Stop / trip Annunciation for all the equipment's (Fan, Pumps, Chillers and safety interlocks) shall be provided in local control panel. Following controls is also required to be built up in the common control panel.

**5.1.3** Cooling tower fans, make up Water Booster Pumps and FCUs shall also be operated from their individual local Push-button stations.

**5.2 SAFETY CONTROLS**

All necessary measuring – control instruments & control system shall be provided. With following compressor & evaporator interlock in the control panel of the Chiller Package.

- a) High discharge pressure cut-out (HP)
- b) Low suction pressure cut out (LP)
- c) Oil pressure cut-out (OP)
- d) Chilled water flow switch & Condenser water flow switch
- e) Anti-freeze thermostat (AFT)
- f) Airstat / safety thermostat with heaters of the AHU's
- g) Heater for compressors, which will be energized during compressor idling time. This safety control shall be actuated through the built-in Microprocessor based control panel for each chiller.
- h) Safety controls of Screw chillers will also include Over/Under voltage and voltage unbalance protection, Single phase & Phase reversal preventor, over/under current and current unbalance protection and others as per manufacturer's standard.
- i) Low oil level cut out, High winding temperature cut out through PTC sensors (for screw chillers).
- j) Cut out due to overload of all drive motors, Low cooling tower sump water level, Stopping of AHU fans in case of fire in the respective zone, Auto Control against

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Crystallization for VAM, Short circuit protection, High Steam Pressure cut out for VAM.

- k) Closing of fire dampers at the air supply duct from AHUs in case of fire with the sense from room mounted fire/smoke detector.

**5.3 OPERATING CONTROL**

All operating control as necessary shall be provided. However following minimum control shall be provided. Central chilled water system shall have the following controls:

- 5.3.1 Automatic capacity control system.
- 5.3.2 Automatic unloaded starting device
- 5.3.3 Operating Thermostat
- 5.3.4 Unloading solenoid valves (if applicable)
- 5.3.5 3 way flow control valve at the AHU's
- 5.3.6 Operation / Sequence Interlock of the Air conditioning system shall be as under:
  - 5.3.6.1 Condenser fan is started.
  - 5.3.6.2 The Air Handling Unit is started.
  - 5.3.6.3 Chiller Pump is started
  - 5.3.6.4 Chilling unit is started
  - 5.3.6.5 Room temperature control with the help of modulating 3-way chilled water flow regulating valve with the cooling coil of AHUs / FCUs through the central PLC system, getting sense from the temperature sensor and associated transmitter placed in the return air path.
  - 5.3.6.6 Room RH control with the help of humidifiers (if required) & duct mounted re-heaters shall be provided.
  - 5.3.6.7 Chilled water temp. Control based on the room load with the help of operating temperature sensor and controlling steam control valve of VAM or through compressor's automatic unloading mechanism for screw chillers through the built-in Microprocessor based control panel of VAM / Packaged Screw Chiller. This control shall also be possible through the central PLC system.
  - 5.3.6.8 In case of tripping of VAM -1 or non-availability of steam during unit under shut down, change over from VAM-1 to SCM- 1 / SEM-2 should be in auto mode.

**5.4 INTERFACE WITH DCS**

Following soft link signals shall be provided in the DCS for monitoring purpose:

- 5.4.1 AC Plant On / Off Status.
- 5.4.2 General AC Plant Warning
- 5.4.3 The operation of the air conditioners shall be done from local start–stop push button.

**5.5 POWER SUPPLY ARRANGEMENT**

The power supply (rated voltage, frequency, and phase) of the equipment's will be 415V +/- 10%, 3ph, 50 Hz +/- 5% or 240V +/- 10%, 1ph, 50 Hz +/- 5% as the case may be.

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**6 PAINTING SCHEDULE**

As per DCPL specification no. K9213R-SPC-001, Volume: IIK/4, Section-I, Clause no.12.01.00 to Clause no.12.03.00.

**7 SPECIFIC REQUIREMENT**

Efficiency of centrifugal fan and pump shall not be less than 70%.

Electrical feeder suitable for following motor rating shall be provided for following equipment. Vendor to ensure that motor rating is not more than the rating mentioned below.

Sr. no.	Items	Motor rating (Kw)
1.	VAM	7
2.	Screw Chiller (150 TR)	130
3.	Chilled Water Pump (105 CMH / 35M head) (min.)	18.6
4.	Condenser Water Pump (150 CMH / 30M head) ((min.)	22.5
5.	AHU for CCR room.	40
6.	AHU for UPS room.	30
7.	AHU for service building.	12.5
8.	Cooling Tower	11
9.	Fresh Air Fan	2.5
10.	Precision AC	45
11.	Air Cooled PAC 15TR	21
12.	Air Cooled PAC 10TR	16

**Note**

Only single feeder shall be provided for equipment as mentioned above. In case of multiple feeders are required for any equipment, the required arrangement for multiple feeders shall be done by vendor.

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**8 GENERAL**

- 1) Basis of design all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.
- 2) Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.
- 3) All drawings and documents shall be computer based.
- 4) All commissioning spares & consumables for trouble free operation shall be provided Vendor to include level gauge & level switch for each tank for alarm & trip of the pumps. Also include one no. Pressure switch for each pump
- 5) Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 6) Indicative list of makes is enclosed as per Annexure-I however these equipments / items shall be subject to Customer & BHEL approval during detail engineering Stage.
- 7) Inserts or any support arrangement for fixing ducting, fans, piping etc. shall not be provided by BHEL. Necessary supports may be taken from nearest structure / walls / roofs / floors etc. by Vendor.
- 8) Fixing frame works for diffusers and grilles in the scope of Vendor.
- 9) Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.
- 10) Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipments etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items.
- 11) Drain piping within room up to the drain point to be provided by the Vendor.
- 12) Vendor to furnish schedule of power and control cables. Vendor to furnish cable termination details interconnection drawings etc. during detail engineering stage.
- 13) The tools and machine required for erection of equipment shall be arranged by Vendor.
- 14) Tools & tackles as required for regular maintenance shall be supplied by Vendor.
- 15) Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.
- 16) Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.
- 17) Temperature gauges shall be provided with thermo wells and fixing arrangement.

*Handwritten signatures and names:*  
S. A. KISHAN  
MUKESH K. SINGH



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
SPECIFIC TECHNICAL REQUIREMENT**

**SPECIFICATION No: PE-TS-408-553-A001**

**VOLUME: II B**

**SECTION : C 1**

**REV. 00**

- 18) Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.
- 19) Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.
- 20) Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.
- 21) Besides the system performance as above, bidder shall guarantee major technical parameters of various equipments as per design basis / details furnished.
- 22) The guarantee tests shall cover but not limited to the following rated parameters for smooth operation of ventilation system.
  - Design dry bulb temperature and relative humidity of conditioned air, Auxiliary power consumption, Vibration and noise level etc.
  - Performance test of the Ventilation system shall be carried out at site after proper installation. The site test shall include performance testing of equipment for 72 continuous hours in summer or monsoon and 24 continuous hours in winter. Bidder, as may be required to carry out site tests shall arrange all instruments, tools etc.
  - All calibrated instruments to be used for the tests at manufacturer's works/site shall be arranged by the bidder. Any Electrical/C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provide free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 23) For motorized fire damper / 3 Way valve actuators / motorised valves, power supply shall be derived by vendor from respective control panels. BHEL shall not provide any feeder for them. Suitable transformer shall be provided by bidder (if required) to drive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
- 24) Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.
- 25) Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to PLC / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope. Only those items shall be provided free of cost which are categorically listed in the Electrical scope sheet of technical specification.
- 26) In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
- 27) Bidder to note that BHEL reserve the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.

*Handwritten signatures and names:*  
S.A. ICHHAN  
S.A. ICHHAN  
MUKESH K.S. SINGH



**1x800 MW WANAKBORI STPP  
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- 28) Quality requirements in the Technical specification are minimum requirements for inspection and testing. Vendor to note that quality plans are subject to Customer approval during detail engineering stage. Standard QP format is enclosed in the technical specification.
- 29) The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.
- 30) Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.
- 31) Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners to secure the equipment obtain parameters related to vibration and noise.
- 32) Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
- 33) RCC foundation of cooling tower shall be provided by BHEL. However, steel beam / joist etc as required shall be supplied by air-conditioning plant supplier.
- 34) Air-conditioning plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.
- 35) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 36) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- 37) The bidder's proposal shall be for equipment in accordance with the tech. Specification.
- 38) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification.
- 39) Necessary duct mounted Booster fan (if required) to maintain the static pressure for Precision AC shall be provided without any implication.

**9 EXCLUSION**

Items of works listed below are excluded from scope of the air-conditioning plant supplier.

- a) Construction of AC plant room, air handling unit room, foundations for AC equipments.
- b) False ceiling, drop ceiling.
- c) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of AC system vendor.
- d) Provision of drain traps / points,
- E) FOR ELECTRICAL SCOPE, REFER ELECTRICAL SCOPE MATRIX SHEET.



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
CUSTOMER SPECIFICATIONS**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: II B

SECTION : C 2

REV. 00

**SECTION: C 2**

**CUSTOMER SPECIFICATIONS**

*Signature*  
S.A. KHAN  
MUKESH KASINIGAM



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
CUSTOMER SPECIFICATIONS  
TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: II B

SECTION : C 2A

REV. 00




**SECTION: C 2A**

**CUSTOMER SPECIFICATIONS  
TECHNICAL REQUIREMENT**

*Signature*  
D. M. M. A. S.

*Signature*  
S. A. K. P. H. A. N.

*Signature*  
MUKESH KASINIGAM

  
S.D. MATHUR  
  
S.D. ICHHAN  
  
MUKESH K.S. SINGH

**VOLUME : IIK/4**

**SECTION-I**

**TECHNICAL SPECIFICATION  
FOR  
AIR CONDITIONING SYSTEM**

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VOLUME: IIK/4

SECTION – I

AIR CONDITIONING SYSTEM

1.00.00 INTRODUCTION

1.01.00 The purpose of the system is to provide Air Conditioning System for the different areas of 1X 800 MW Supercritical Thermal Power Plant (Unit #8 at Wanakbori Thermal Power Station, Gujrat).

Various control rooms in power station, housing a group of sophisticated and precision control panels and desks call for controlled environment for proper functioning and for the comfort of working personnel.

2.00.00 SYSTEM DESCRIPTION

2.01.00 The air conditioning system shall cover the following areas as a minimum :

- a. CONTROL BUILDING ADJACENT TO POWER HOUSE
  - i. Unit Control Room
  - ii. Control Equipment Room (CER)
  - iii. Shift Charge Engineers' Rooms
  - iv. Computer Room
  - v. Uninterrupted Power Supply (UPS) Room
  - vi. Steam and Water Analyzer (SWAS) Panel Room (Dry Panel)
  - vii. All Laboratory Rooms
  - viii. Other Office areas Telephone Exchange Room, Conference Hall and library etc, if any, on the operating floor
  - ix. AC Plant Control room located in the Central Control Building.
- b. SERVICE AND TECHNICAL BUILDING
  - Maintenance Office areas, lecture rooms and any other areas needs Air Conditioning.
- c. ESP Control Room.
- d. Ash Handling Plant Control Room
- e. Switchyard Control Room.
- f. DM plant control room, office and Laboratory area.
- g. Coal Handling Plant control room
- h. Any other Rooms / Cubicles housing Programmable Logic Controllers (PLC) Panels and other Input / Output (I/O) modules
- i. Rooms having the equipment required controlled temperature by nature for their operating feature.

- j. Any other area required for Air conditioning and if as per manufacturer's requirement any Switchgear room requires Air conditioning, the same shall be provided by the tenderer.

All the buildings described above shall preferably be provided with separate air conditioning systems because they may be far apart from each other.

2.02.00 For the Turbine Building and the attached Service Building, one Common Central Chilled Water Plant shall be provided with individual Air Handling Units / Fan-Coil Units (as applicable) for the Unit Control Room, Control Equipment Room, Shift Charge Engineer's Room, Computer Room, Uninterrupted Power Supply (UPS) Room, SWAS (Dry Panel) Room, all Laboratory Rooms and other Office areas, Telephone Exchange Room, Conference Hall, and Library etc, if any, on the operating floor.

The Central Chilled Water Plant shall consist of Vapour Absorption Machine with stand-by Packaged type Screw chillers, condenser water pumps, chilled water pumps, induced draft cooling towers and controls & instrumentation.

2.03.00 Water Cooled Precision air Conditioners of 3 x 50% capacity shall be provided for the ESP Control room, AHP Control room and DM Plant Control room and its associated office and Laboratory. Condenser cooling water for these Air Conditioners shall be supplied from main plant ACW system through Non-Chemical Water Treatment Device. Provision of a Fresh Air unit consisting of Air Inlet Louver with Bird Screen, Dry panel HDPE filters, Tube Axial Flow Fan with Drive Motor, Volume control damper, Supports and supporting structures etc. shall be provided for each PAC Room.

2.04.01 Air Cooled Packaged Units (Precision Type) will be used for air conditioning of CHP Control room. Provision of a Fresh Air unit consisting of Air Inlet Louver with Bird Screen, Dry panel HDPE filters, Tube Axial Flow Fan with Drive Motor, Volume control damper, Supports and supporting structures etc. shall be provided for this PAC Room.

2.04.02 Air cooled non duct able Split Air Conditioners shall be provided for air conditioning of the Switch Yard Control room of substation building. Required no. of suitable capacity should be selected with at least one unit as stand-by.

2.05.00 Air cooled non duct able Split Air Conditioners shall be provided for Rooms / cubicles housing Programmable Logic Controllers (PLC) and other Input / Output (I/O) modules or any other area required for Air conditioning. Required no. of suitable capacity should be selected with one unit as stand-by.

2.06.00 The systems described above are only minimum requirement. Any other area/areas, if felt by the Bidder himself or by the Purchaser/their consultant, or if demanded by the process/equipment should be air conditioned, shall be included in Bidder's scope of work.

2.07.00 The foregoing and subsequent clauses specify the equipment/system for general guidance only. Any other equipment and /or materials necessary to ensure safe and satisfactory erection, commissioning and operation of the plant shall be supplied.

- 2.08.00 The air conditioning requirement for different areas are as follows:
- 2.08.01 One Common Central chilled water plant consisting of one Vapour Absorption Chiller, 2x50% capacity stand-by Packaged Screw Chilling Units associated with 3x50 % capacity Chilled water pumps, 3x50 % capacity Condenser water pumps, 3x50 % capacity Cooling towers to serve the Unit Control room, Control Equipment room, Computer room, UPS room, SWAS (Dry Panel) room and Shift Charge Engineer's room, Battery Charger Rooms, AVR Room, if any, Other Office areas telephone exchange room, Conference Hall, library and Laboratory etc, if any, in the control building and all the floors of the attached Service Building.

Normally the Vapour Absorption Chiller will be in operation for Central Air Conditioning system. Two nos. Packaged Screw type water chilling units will act as stand-by to Vapour Absorption Chiller. Out of three nos. each of chilled water pumps, condenser water pumps and Cooling Towers, one unit will act as stand-by. Clarified water shall be used as the make-up of cooling tower. This condenser cooling water will be treated through the Non-Chemical Water Softening Equipment installed in the common header of Condenser water pump outlets.

- 2.08.02 Unit control room & Shift Charge Engineer's room Computer room, Control Equipment Room and UPS room in the Control Building will be served by 1 no. AHU room housing at least 2 nos. each of 50% capacity AHUs.

For SWAS room and AVR Rooms, if any, Other Office areas telephone exchange room, Conference Hall, library and Laboratory etc, if any, and the attached Service Building individual AHUs/ Fan Coil Units shall be provided. Each floor of Service Building shall have separate AHUs. For each room/area at least 2 nos. AHU/FCU shall be provided.

- 2.08.03 1x100% capacity Fresh Air Unit consisting of Air Inlet Louver with Bird Screen, Dry panel HDPE filters, Tube Axial Flow Fan with Drive Motor, Volume control damper, Supports and supporting structures etc. shall be provided for each AHU Room.

- 2.08.04 1x100 % capacity Electrode Type Humidifier with associated controls and accessories shall be provided in each AHU room of TG Building.

- 2.08.05 Provision of Duct mounted Electric Strip heater and High Efficiency Filter shall also be kept with the common supply duct from the AHUs of Control Building critical areas like Unit Control Room, Shift Charge Engineer's Room, Computer Room, Control Equipment Room and UPS Room. Duct mounted Electric Strip heater shall be provided with the common supply duct of each floor of Service building.

- 2.08.06 Smoke Evacuation system consisting of smoke exhaust fan with ducting, motorized isolating dampers and rain protection cowl with bird screen shall be located in AHU rooms of Control Building and Service Building and each PAC unit room of other auxiliary buildings like ESP Control Building, AHP Control Building, DM Plant Control Building, CHP Control Building.

3.00.00 SCOPE OF WORK

Scope has been defined under subsequent Clauses.

3.01.00 Central Chilled water plant  
(Common for Control Building and Service Building)

The central chilled water plant consists of the following equipment:

3.01.01 Vapour Absorption type Water Chilling system of adequate capacity and comprising:

- a) One(1) No. Package type Steam fired, double effect/stage Vapour Absorption Machine consisting of Evaporator, Absorber, High temperature Generator, Low temperature Generator, Condenser, Heat Exchangers, Refrigerant Pump with Drive Motor, Absorbent Pump with Drive Motor, Purge Unit, all internal pipes with valves, Steam trap, fully charged with refrigerant and Lithium Bromide Absorbent and built in Microprocessor based Control panel etc.
- b) Adequately sized drive motor/s for above pumps, suitable for 415V  $\pm$  10%, 3 phase, 50Hz  $\pm$  5% AC. AC Supply for guaranteed rating at 50 Deg.C.
- c) One(1) No. Steam flow regulating valve (modulating type) with sensors and electronic controls.
- d) One(1) No. Pressure Reducing and De-superheating Station (PRDS), Steam piping with isolating valves, fittings, strainer, safety valves, pressure gauges as shown in the SLFD, 50mm thick fiber-glass / mineral wool / equal thermal insulation covered with 30G GI sheet, hangers/supports.
- e) One no. insulated Condensate tank with two nos. (1R+1S) condensate transfer pump and associated drive motors. Condensate tank and condensate transfer pumps shall be suitably insulated with at least 25 mm thick thermal insulation of fibre glass / mineral wool or equal covered with 30 G GI Sheet.
- e) Condensate piping with isolating valves, fittings, Steam trap and 25mm thick thermal insulation of fiber glass / mineral wool or equal covered with 30 G GI Sheet, hangers / supports.
- f) Equipment drain water connection with siphon and valves, fittings etc. up to the nearest drain point with proper insulation shall also be included.

3.01.02 Two (2) Nos. (both units will act as stand-by to the Vapour Absorption Chiller) Water Cooled Screw Chiller Unit of adequate capacity and each consisting of:

- a) One (1) / Two (2) Nos. Screw Compressors (As per Manufacturer's standard).

Type: Rotary Screw type, hermetic/semi- hermetic, directly driven, R-134a duty.

Accessories include suction and discharge shut-off valves, discharge check valve, Oil Separator, oil heater, HP, LP, Low oil level cutout, high winding temperature cutout through PTC sensors, Motor overload cutout, liquid Injection system, integrated pressure relief valve, oil service valve, Step less Automatic capacity control arrangement with automatic unloaded starting device, Anti Recycle device, Heater, Setting and Overhauling tools, foundation bolts, vibration isolating device etc.

Adequately sized Induction Motor (for the above compressors) suitable for  $415V \pm 10\%$ , 3 phase,  $50Hz \pm 5\%$  AC. AC Supply.

b) One(1) No. Refrigerant Condenser.

Type :Water cooled, horizontal, shell and tube R-134a duty & capacity to match the above compressor with integrally finned copper tubes with steel shell having adequate surface area to cater to the requirement of the above compressor & to provide sub-cooling by 2 Deg. C at least.

Design fouling factor : Not less than .0002 Hr. Sq. M.  $^{\circ}C/Kcal$  (001 Hr-Sq. ft  $^{\circ}F/ BTU$ ).

Heat removal and water flow rate : To be calculated and furnished by the Bidder.

Accessories : Relief valve, vent connection with valve, De-scaling connection, charging connection, water flow switch, drain connection with valve. Thermo-well connections on water side, liquid trap etc.

c) One(1) No. Refrigerant Chiller.

Type : Horizontal shell and tube direct expansion/flooded type R-134a/water duty with copper tube having adequate surface area to provide superheating by 3 Deg.C.

Design fouling factor : Not less than 0.00013 hr-Sq. m.  $C/Kcal$  (0.00065 hr-Sq. ft. Deg. F./ BTU).

Heat removal and Water flow rate : To be calculated and furnished by the Bidder.

Accessories : Liquid and water connection provided with thermo-wells, water flow switch, pressure gauge connections.

*(Handwritten signatures and names)*  
MUKESH KADSI  
S.A. ICHAW  
S.M. M.A.

At least 39 mm thick insulation of Aluminium foil faced Nitrile Rubber /XLPE or equal, with removable type insulated flange cover, water side drain connection with valve in every portion of the chiller isolated by baffle plates.

- d) Piping & Auxiliaries : Common base frame for compressor, condenser, chiller unit fabricated of M.S. angles, channels etc. anchor bolts, nuts, hot gas piping, cold gas piping, liquid refrigerant piping all of seamless steel or ERW steel pipes, insulation of cold gas piping with minimum 39 mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal liquid valves, muffler if needed, gauges and instrument piping, filters, drier, moisture indicator isolating valves etc. as may be required for safe and trouble free operation. The entire chiller package assembly shall be installed with spring type vibration isolation devices ... (One set for each chiller unit)

Equipment drain water connection with siphon and valves, fittings etc. up to the nearest drain point with proper insulation shall also be included.

- e) Controls : Electronic expansion valve, solenoid valve in the refrigerant circuit, operating temperature sensor and anti freeze thermostat/sensor.

Microprocessor based control panel of each chiller unit will provide safety against high & low refrigerant pressure, low oil pressure, freezing of chilled water, overload, winding heating and single phasing and phase reversal of compressor by means of high & low pressure transmitter, oil pressure transmitter, temperature sensors & transmitter, O/L relays, Thermistor relays, etc. and other safety Controls including Over/Under voltage and voltage unbalance protection, over/under current and current unbalance protection and others as per manufacturer's standard.

It will also provide capacity control by sensing low chilled water return temperature through operating temperature sensor and motorized sliding valve. Other safety devices like flow switches for the condensers and chillers, compressor unloaded starting device shall also be provided through Microprocessor based control panel. (One set for each chiller). Such Microprocessor based Control Panel shall be provided with 20% extra properly wired I/O units.

- f) Oil and Refrigerant : First charge of refrigerant R-134a and oil for the above chiller units.

*Handwritten signatures and names:*  
Sudhakar  
Sudhakar  
MUKESH KADSIWANI

3.01.03 Condenser cooling water piping of MS ERW (heavy grade) complete with valves, fittings, hangers / supports. between cooling towers and condensers (of Vapour Absorption Chiller and Screw Chiller Units) including the condenser cooling water pumps complete with valves, bends, strainers, fittings, instruments, hangers and supports etc. Equipment drain water connection and valves, fittings etc. up to the nearest drain point shall also be included. A single line diagram in this connection is to be furnished by the Bidder.

3.01.04 Chilled water piping connecting the chillers(of Vapour Absorption Chiller and Screw Chiller Units), chilled water pumps and cooling coils of air handling units / FCUs and expansion tank, complete with valves, bends, strainers, fittings, instruments, hangers and supports, insulation etc. A single line diagram in this connection is to be furnished by the Bidder.

The insulation shall be at least 39mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal (Refer elsewhere for detailed specification of insulation). For Chilled water drain pipes the insulation thickness shall be at least 26 mm.

3.01.05 Make up water piping of medium class GI complete with fittings, hangers / supports from Make-up Water tank to various points of consumption like cooling tower sumps, expansion tank and Humidifiers.

3.01.06 **Three (3) Nos. (2 working + 1 Stand-by) Condenser Cooling Water Pumps** to meet the requirement of the CHW plant of Control Building and Service Building.

Type : Centrifugal, horizontally split casing, single stage directly coupled to electric motor and mounted on a common base frame.

Speed : Preferably not more than 1500 rpm.

Capacity and Head : To be calculated and furnished by the Bidder.

Duty : Continuously running.

Accessories : Pressure gauges at suction and discharge, isolating valves, all integral piping, required for sealing, cooling etc. strainers, check valves, flexible coupling guard, foundation bolts and nuts etc. and other standard accessories as may be necessary for successful operation. Vibration isolators shall also be supplied. Condenser water pumps shall be provided with mechanical seals.

Motor for the above : Adequately sized TEFC, squirrel cage induction motor, suitable for 415 V  $\pm$  10%, 3 pH, 50 Hz  $\pm$  5% supply.

3.01.07 **Three (3) Nos. (2 working + 1 stand-by) Chilled Water Circulating Pumps for all areas.**

- Type : Centrifugal, horizontally split casing, single stage directly coupled to electric motor and mounted on a common base frame.
- Speed : Preferably not more than 1500 rpm.
- Capacity and Head : To be calculated and furnished by the Bidder.
- Accessories : Pressure gauges at suction and discharge, isolating valves, all integral piping required for sealing, cooling etc. strainers, check valves, flexible coupling guard, foundation bolts and nuts, complete insulation with minimum 39 mm thick Nitrile Rubber /X LPE or equal with 24G aluminium sheet cladding. For the pumps, vibration isolators shall also be supplied. Chilled water pumps shall be provided with mechanical seals.
- Duty : Continuously running.

Adequately sized, TEFC squirrel cage induction motor suitable for 415 V  $\pm$  10%, 3 Phase, 50 Hz  $\pm$ 5% supply for the above.

3.01.08 **Three (3) Nos. 2 working + 1 stand-by) Cooling Tower Induced draft cross/counter flow type to meet the requirement of the Central Chilled water plant. Design Wet bulb temp. will be 28.3 °C with a approach (Max.) of 4.0 °C.**

Construction of various components will be as under:

- Casing : FRP
- Louver : FRP
- Fill : PVC
- Drift eliminator : PVC
- Strainer : Brass wire mesh
- Headers and pipe connection : G.I.
- Basin : R.C.C./FRP
- Nuts and Bolts etc. : Suitable corrosion resistant material i.e. G.I. or cadmium plated.

Accessories include supports, supporting structure, make-up water piping with float valve, drain connection with siphon and valve, over flow and quick fill connections etc.

3.01.09 Expansion Tank

The expansion tank shall be made of G.I or FRP and shall be of adequate thickness & suitably reinforced. It shall be complete with make-up connection with float valve, quick fill connection, overflow connection and drain connection with valve. The tank shall be provided with level gauge glass and shall be completely insulated with 6 mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal. The capacity shall be selected based on 1.2% of circulated chilled water capacity. Filtered water shall be supplied as make-up.

3.01.10 **Make-up water Tank**

The Make-up water tank shall be made of G.I or FRP and shall be of adequate thickness & suitably reinforced. It shall be complete with make-up connection with float valve, quick fill connection, overflow connection and drain connection with valve. The tank shall be provided with level gauge glass. This tank will supply make-up water to Cooling towers, Expansion tank and humidifiers. The tank size is to be designed based on capacity to hold water for 15 minutes of make-up water requirement for above.

3.01.11 **Two (2) Nos. (1R+ 1S) Make-up Water Booster pumps.**

Mono block type centrifugal pump to supply make-up water from the Make-up water tank to the Cooling towers, Expansion tank and humidifiers, each complete with drive motor, common base plate, isolating valves, non return valve etc.

3.01.12 **One (1) No. on line Non-chemical water treatment equipment** to suit the common condenser water header. The equipment shall be complete with flanges at ends and supports.

3.02.00 **Air Handling Units/Fan Coil Units with controls**

Number and individual capacities of Air Handling Units/Fan Coil Units should be calculated and furnished by the Bidder. Each A.H.U. shall consist of the following:

3.02.01 **DIDW Centrifugal Fan** having forward/backward curved blades and belt driven by TEFC squirrel cage Induction motor suitable for AC 415V ± 10%, 3 Ph, 50 Hz ±5% supply shall be provided. M.S. Scroll casing of the fan will be suitably painted.

Accessories include V-belts with pulleys, belt guard, supporting frame, volume control damper etc.

NOTE : For small FCUs single phase motors shall be used.

3.02.02 **1 No. Cooling Coil** will be provided in each AHU. The cooling coil will be chilled water circulating type.

Construction will be seamless copper tubes with aluminium fins, number of fins as per manufacturer's standard but not greater than five (5) per Cm. [thirteen (13) per inch].

Design fouling factor will be 0.00013 hr-Sq. m.- °C/Kcal.

3.02.03 Panel type dry HDPE filter having an efficiency of 90% down to 10 micron size particles will be provided. A differential pressure sensor shall be provided across the filters to initiate alarm when the pressure difference across the filters exceeds a pre determined value, warranting cleaning /replacement of filters.

3.02.04 AHU will have Double skin G.I casing (Sand witted panel with internal insulation of min. 25mm thick TF quality Expanded polystyrene/ PUF) with inspection facilities, supports made in a 16-G M.S. structure of sectionalized construction with one coat of rust proof anticorrosive paints followed by two coat of final paint and complete with insulated SS drain pan, insulated drain piping etc. The AHU's shall be cabinet type with Fan section, Coil section and filter section. Adequate space between Filter section and Coil section shall be kept for maintenance purpose and proper air flow. Fan section also shall have adequate maintenance space all around the fan and motor.

3.02.05 One set of operating controls consisting of motorized modulating 3-way mixing valve with cooling coils of AHUs and FCUs with temperature sensor, transmitter and actuator for controlling the flow of chilled water, will be provided. Small FCUs shall have multi-speed motor.

3.03.00 **Fresh air system**

Fresh air unit shall consist of a tube axial flow/centrifugal fan with drive motor, inlet louver with bird screen, dry panel HDPE filters, high efficiency filter for critical areas, volume control damper, supports, supporting structures etc. 1 x100% capacity Fresh air unit shall be provided in each AHU room/PAC room. A differential pressure sensor shall be provided across each set of filters to initiate alarm when the pressure difference across the filters exceeds a pre determined value, warranting cleaning /replacement of filters.

For Fan coil unit, there shall be provision for suitable arrangement of fresh air intake from the nearest evaporative cooling units. For Service Building and other non-critical areas, fresh air opening with air inlet louver and a volume control damper shall be provided in the AHU room.

3.04.00 **High efficiency filter**

High efficiency filter having an efficiency of 99 % down to 5 microns mounted in supply air duct is to be provided for air conditioning of all control rooms and allied area. A differential pressure sensor shall be provided across the filters to initiate alarm when the pressure difference across the filters exceeds a pre determined value, warranting cleaning /replacement of filters.

3.05.00 **Electrode type humidifier**

Electrode humidifier consists of high temperature Polypropylene water tank, electrodes, auto flash cycle activated on demand from the microprocessor based control system with humidity sensor, located in the AHU room. This Humidifier shall also be complete with make up connection with float valve, overflow connection and drain connection with valve.

3.06.00 **Electric strip heaters**

Electric strip heaters will be of adequate capacity mounted in supply air duct with thermostat, humidistat, air stat/safety thermostat and controlling temperature sensor etc. (For winter heating purpose and for monsoon reheat purpose.)

3.07.00 **Smoke exhaust system**

Smoke Evacuation system consisting of smoke exhaust fan with ducting and motorized isolating dampers with cowl & bird screen shall be located in AHU rooms of Control Building and Service Building and all other auxiliary buildings served with PAC units. The fan and motor shall be designed to withstand a temperature of 400 Degree C for 2 hours.

3.08.00 **Duct work**

Duct work includes:

- a) G. I. Duct having zinc deposition of at least 180 gm/m<sup>2</sup>.
- b) Damper with control arrangement at each branch off and wherever necessary.
- c) All supply & return air grilles and diffusers made of extruded aluminum powder coated and complete with volume control dampers (for SA grilles/ diffusers only) and supporting frames.
- d) Flexible connections of rubberized canvas.
- e) Hangers and supports.
- f) Sealing compound and jointing gasket for ducts.
- g) 13 mm thick Aluminium foil faced Nitrile Rubber /XLPE or equal or equivalent thermal insulation for the entire air conditioning ducting.
- h) Acoustic insulation of 25 mm thick fiber glass covered with Fiber glass cloth and perforated aluminum sheet with 30% perforation shall be provided in the ducting up to a length of 5 M from the air handling unit outlet.
- i) Motorized fire damper with sensors, control etc. at strategic locations, as required. Provision of manual overriding operation through latch shall also be kept with the Motorized Fire Damper.

3.09.00 **Water Cooled Precision Air Conditioners**

(Applicable for ESP Control room AHP Control room and DM Plant Control room and its associated office and Laboratory)

Water Cooled Precision Air Conditioners shall be complete with scroll compressors (suitable for R-410/407c refrigerant) and water cooled shell and tube condensers, interconnecting refrigerant piping (duly insulated) between condensers and PAC units, evaporator fans with highly efficient EC motors and their controls, high efficiency filters, cooling coils with electronic expansion valve,

electrode type humidifiers with controls, electric strip heaters, thermally and acoustically lined powder coated MS casing, insulated SS drain pan, insulated drain piping, and built-in microprocessor based control panel, for the ESP cum VFD Control room.

Such Air Conditioners will be associated with air distribution system consisting of a GI duct - work as elaborated above, Non Chemical Water Treatment Equipment at the inlet to the condensers of PAC. Condenser cooling water will be fed to the condenser from the Plant ACW system.

3x50% capacity Precision AC Units are to be provided each for each PAC room.

Provision of introducing fresh air into the PAC unit room shall be kept through Fresh Air Unit as described in clause no. 2.03.00 above.

3.10.00

**Air Cooled Precision Air Conditioners**

(Applicable for Switch Yard Control room and CHP Control room)

Air Cooled Precision Air Conditioners shall be complete with scroll compressors (suitable for R-407C / 410A refrigerant) and remote air cooled condensers, interconnecting refrigerant piping (duly insulated) between outdoor condensers and indoor PAC units, evaporator fans with highly efficient EC motors and their controls, high efficiency filters, cooling coils with electronic expansion valve, insulated SS drain pan electrode type humidifiers with controls, electric strip heaters and built-in microprocessor based control panel thermally and acoustically lined powder coated MS casing and insulated drain piping. Such Air Conditioners will be associated with air distribution system consisting of a GI duct - work as elaborated above.

3x50% capacity Precision AC Units are to be provided each for each PAC room.

Provision of introducing fresh air into the PAC Unit Room shall be kept through Fresh air unit as described in Clause No. 2.03.00 above.

3.11.00

**Air Cooled Non Duct-able Split Air Conditioners**

(Applicable for rooms/ cubicles housing PLC and other I/O units, computer room and any other area requiring air conditioning)

Air Cooled Non Duct-able Split Air Conditioners shall be complete with hermetically sealed rotary compressors and air cooled condensers in the outdoor units with powder coated GI casing, built-in electrical items & supports and Indoor units housing dry panel type HDPE filters, cooling coils, evaporator fans with two speed drive motors, all encased in powder coated GI casings with swiveling type supply air grilles and decorative RA grilles and interconnecting refrigerant piping (duly insulated) between outdoor and indoor units and insulated drain piping, microprocessor based cordless remote control panel and 240V, single phase MCB with connecting cable for each split unit.

Required no. of suitable capacity should be selected with one unit as stand-by for all rooms/ cubicles housing PLC and other I/O units/ computer room.

3.12.00 **Electrical Work**

3.12.01 **One (1) 415 V Motor Control Centre Cum PDB (MCC CUM PDB)** for operation and control of the complete AC system required for the Power House Building and the associated Service Building. The MCC cum PDB shall be located in the central Air-Conditioning Plant room. Each MCC CUM PDB shall be fed by 2x100% incoming feeders, which shall be located at either end of the panel. MCC cum Power Distribution Board shall house with Incoming Circuit Breaker, AL Bus Bars, Outgoing starter switch fuse units for CW & CHW pumps, cooling tower fans, Make-up water booster pumps, AC Plant Room Ventilation fans, Outgoing switch fuse units for Vapour Absorption Machine / Screw chillers, FCU for AC Plant Control Room and LSPs (one for each AHU room and each Fan-Coil unit).

3.12.02 **One (1) no. Local Starter Panel (LSP)** for each AHU room of Power House Building and attached Service Building. This LSP will house In-coming SFU, AL Bus Bars, outgoing starter switch fuse unit for all drives located in AHU room (AHU Fans, Smoke Exhaust Fans, 3 Way Mixing Valves, Fresh Air Fans and Fire Damper etc) and SFU for heaters humidifiers and FCUs.

3.12.03 One (1) no. Power Distribution Board housing Incoming Switch fuse unit, outgoing switch fuse units for PAC Unit, AL Bus Bars, Outgoing Switch fuse unit with starter with Fresh Air fans, Outgoing Switch fuse unit with starter for motorized fire dampers of 240 V +/- 10% single-phase AC power supply. Outgoing Switch Fuse Unit for Heater & Humidifier.

3.12.04 For other **Auxiliary Buildings** (served by Non duct able Split units) each AC unit will be provided with a MCB with RECEPTACLE with AC power supply from nearest power source. For detail s pecification VOLUME : II-F shall be referred to.

3.12.05 All the Electrical items as described above shall be as per relevant volume of the technical specification on electrical work.

3.12.06 **DDC Based Control Panel**

Control, monitoring, operating and safety controls & interlocks, indication and audio-visual annunciation for all AC equipment of the Central Chilled Water Plant and AHU rooms shall be activated from central DDC based Control Panel located in the AC plant room.

Power shall be fed to this DDC Panel from the MCC cum PDB located in the Central AC plant room. This DDC panel shall be interfaced with the MCC cum PDB, Individual Microprocessor based Control panels of Chillers and LSPs located in AHU rooms.

This DDC panel shall be associated with two nos. Work stations (Engineering and Operating).

3.12.07 Local Push Button Stations

Local Push Button Stations shall be provided for each drive motor and equipment (Cooling Tower Fan Motors, FCUs and Make-up Water Booster Pump Motors etc.), suitably located near drives and equipment of each AC system. LPBS shall consist of one no. emergency Red Stop P.B (pressed to latch and turn to release type) for each drive.

Local Push Button Stations shall be as per the relevant Volume of the electrical specification.

For Other detail VOLUME : II-F shall be referred to.

3.12.08 Drive Motors

- i) Motors shall be supplied with mounting and coupling hard wares such as base plate, coupling, coupling guard, anchor bolts & nuts, all hardware etc.
- ii) Design ambient temperature of all motors for air conditioning system shall be 50°C.
- iii) All Motors shall have Class F insulation and temperature rise limited to Class B as per IS:325.
- iv) The motor nameplate kilowatt rating multiplied by the motor nameplate service factor shall be at least 15% greater than the driven equipment operating range maximum brake kilowatt.
- v) Motors rated 30 KW and above shall be provided with space heater suitable for 240 V, 50 Hz, 1 Ph. AC.
- vi) Motors rated up to 250 watts shall be suitable for 240 V, 50 Hz, 1 Ph. AC. Motors rated above 250 watts and up to 160 KW shall be suitable for 415V±10%, 3-Phase, 50Hz±5% AC.
- vii) Motors rated above 110 KW shall be fed by Air Circuit Breaker and others of lower rating shall be fed by SFU.
- viii) All motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather proof construction.
- ix) All drive motors shall be as per relevant Volume of the Electrical Specification.

3.12.09 All Power, Control and Instrumentation cabling as required and conforming to the requirement of relevant Volume of Electrical Specification. All LT Cables shall be FRLS type.

3.12.10 Grounding of all electrical items as per relevant Volume of Electrical Specification

3.13.00 Suspended Ceiling work with supporting grids, hangers etc. for all the air conditioned areas. The Suspended Ceiling shall be complete with 12mm thick

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GYPSUM board at various elevations including supplying, fixing snap grid systems of approved manufacturer with 40 mm X 50 mm cross tees and 40 mm X 50 mm end channels including MS hangers, cleats, supports, turn-buckles, ties placed around 1200 mm (Max.) centre to centre for forming frame work to support snap grid systems and lighting fixtures including all ancillary work at site like providing of various cut outs, holes, recess, trap door (removable panels), wherever shown, welding to reinforcement to hangers, if required, grouting of hangers and complete with all finish in super decorating manner, providing openings for lighting and air conditioning fixtures including painting of all structural with two coats of approved primer and final paint and also complete with all materials as per working drawings, and direction of engineers.

3.14.00

**Under-deck Insulation work for all the air conditioned areas.**

Roofs of AC spaces are insulated with 25 mm thick EPS (Under-deck) for roofs not exposed to Sun and 50mm thick EPS (Under-deck) for roofs exposed to Sun.

3.15.00

**Supply, Erection, Testing and Commissioning**

3.15.01

Erection, testing and commissioning of all the equipment and accessories mentioned herein above including supply of all grouting pieces, all matching flanges, connecting flanges, valves and other fittings bolts, nuts, gaskets and supporting arrangement as required, are included in the scope of work.

3.15.02

Base plate and foundation plates including anchor bolts, nuts, loose fittings etc. for equipment and as would be necessary for erection and complete anchoring of steel materials for the pipes, hangers and supports for water chilling unit and other equipment, are to be supplied.

3.15.03

At least 39 mm thick Aluminium foil faced Nitrile rubber / XLPE insulation on refrigerant piping as required for the Precision type PAC units and 26 mm thick similar insulation for Non Duct-able Split units.

3.15.04

Supply, erection, testing and commissioning of all electrical drives and equipment mentioned herein above including supply erection, testing and commissioning of cables, cable trays, grounding of all drives and equipment for each AC plant and system as required for efficient and trouble-free operation and successful commercial operation, are included in the scope of work.

Erection, testing and commissioning of electrical drive motors and equipment shall be as per relevant volume of the specification.

3.16.00

**Consumables**

All consumables such as grease and lubricating oil for one year's trouble free operation after handing over, are to be included.

3.17.00 **Spare parts**

Supply of recommended spare parts for three years trouble free operation and maintenance is to be included.

3.18.00 **Special tools and tackles**

Supply of special tools and tackles including tool box required for operation, maintenance and overhauling of the system is to be done.

3.19.00 **Documents**

Drawing, data, characteristic curves and instruction manuals for the equipment and system as detailed herein after and as described in the relevant volume of the specification are required.

3.20.00 **Training Of Purchaser's Personnel**

Contractor is to arrange for training of purchaser's personnel for operation and maintenance of the plant and equipment supplied.

3.21.00 **General**

Above clauses specify the equipment for general guidance only. Any other equipment and/or materials necessary to ensure safe and satisfactory erection, commissioning and operation of the plant shall be supplied.

4.00.00 **CONTROL PHILOSOPHY**

4.01.00 **Chilled Water Air Conditioning System**

The chilled water plant shall operate with 1x100% (normally working) Vapour Absorption Machine, 2 x 50% capacity Packaged Screw Chiller unit (normally standby), 3x50% capacity (Two nos. working and one no. Standby) condenser water (CW) pumps, 3x50% capacity (Two nos. working and one no. Standby) chilled water (CHW) pumps, 3x50% capacity (Two nos. working and one no. Standby) induced draft-cooling towers.

All the equipment of this system shall be operated from the DDC system work stations located in the AC plant room. Furthermore cooling tower fans, make up Water Booster Pumps and FCUs shall also be operated from their individual local Push-button stations.

One no. Local starter Panel shall be installed in each AHU room which will feed power to all the AHU fans, motors of 3-way mixing valves of AHUs, Fresh air fans (wherever applicable), Smoke Exhaust fans (wherever applicable) and their motorized isolating dampers, Fire damper motors, Electric heaters and Humidifiers and FCUs of SWAS rooms, UPS Room. This equipment located in each AHU room shall be operated and controlled from the workstations through DDC system located in the AC Plant Room as well as from these Local Starter Panels.

FCU/s for AC Plant Control room shall be operated from the workstations through DDC system and from their local Push-Button stations.

The VAM & Packaged Screw Chilling units shall incorporate microprocessor based control panel, which will also be interfaced with the DDC system.

The VAM / Packaged Screw Chilling units can be started only when its associated cooling tower fan, condenser & chilled water pumps are in operation.

All the drives of the AC systems shall be manually started / restarted through DDC from the work stations after any trip.

The chilled water system shall be provided with the following safety & operating controls:

i) Operating Control:

Room temperature control with the help of modulating 3-way chilled water flow regulating valve with the cooling coil of AHUs / FCUs through the central DDC system, getting sense from the temperature sensor and associated transmitter placed in the return air path.

Chilled water temp. Control based on the room load with the help of operating temperature sensor and controlling steam control valve of VAM or through compressor's automatic unloading mechanism for screw chillers through the built-in Microprocessor based control panel of VAM / Packaged Screw Chiller. This control shall also be possible through the central DDC system.

Room RH control with the help of humidifiers (if required) & duct mounted re-heaters through the central DDC system getting sense from the RH & Temperature sensors and their associated transmitters placed in the return air path inside AHU rooms.

ii) Safety Control:

The chilled water system shall be incorporated with the following safety controls and interlocks:

- High discharge pressure cutout (HP).
  - Low suction pressure cutout (LP).
  - Low oil level cutout
  - High winding temperature cutout through PTC sensors
- } Applicable for  
Screw Chillers

Low chilled water temperature cutout by anti-freeze thermostat /temperature sensor for VAM / Screw chiller.

Cutout due to low flow of chilled water & condenser water by flow switches.

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Cutout due to overload of all drive motors.

High air temperature cutout by safety thermostat / temperature sensor for duct mounted electric heaters.

Low cooling tower sump water level cutout for CW pumps. (Alarm for low water level in expansion tank & humidifier as applicable shall be provided).

Stopping of AHU fans in case of fire in the respective zone through the central DDC system.

Auto Control against Crystallization for VAM.

Short circuit protection.

High Steam Pressure cut out for VAM.

Closing of fire dampers at the air supply duct from AHUs in case of fire with the sense from room mounted fire/smoke detector through zonal fire panel and the DDC system.

Heater for compressors, which will be energized during compressor idling time. This safety control shall be actuated through the built-in Microprocessor based control panel of each Screw chiller.

Safety controls of Screw chillers will also include Over/Under voltage and voltage unbalance protection, Single phase & Phase reversal preventor, over/under current and current unbalance protection and others as per manufacturer's standard.

iii) Interlocks:

The system components shall be interlocked with one another in the following way:

The VAM / Screw Compressor shall not start unless:

At least one cooling tower fan is running.

At least one condenser water pump is running.

At least one chilled water pump is running.

The duct mounted electric strip heater shall not be energized unless the respective AHU fans are running.

All the above Interlocking shall be actuated through the DDC Panel.

On-Off-trip status for all the drives, electric heaters & humidifiers (if required) shall be available at the work stations of the DDC Panel located in the respective AC plant rooms.

Motors of fire dampers provided in supply air duct of AHU shall remain energized in normal condition to effect opening of dampers. In the

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event of fire, the motors of fire dampers will be de-energized and the damper will close due to spring action, the relevant AHU fan motors will be tripped at the same time. These dampers shall be operated through the DDC Panel getting signal from relevant duct mounted smoke detectors / fire alarm panel.

Provision for one common audio annunciation for any kind of malfunctioning in AC plant shall be kept through a hooter located in the AC Plant Control Room and suitably interfaced with the DDC Panel.

The control system shall comprise central DDC Panels with two workstations located in the AC Plant control room.

The basic function of the system is as follows: -

To closely control and monitor inside temperature and humidity condition inside the air-conditioned spaces.

To optimize / minimize energy consumption by automated operation.

To provide centralized monitoring and control for various mechanical facilities including sequential start / stop of the whole AC system.

To generate maintenance data and alarms.

To maintain records of plant operation.

Programmed start / stop of individual AHU as per operating requirements and for maintaining the room temperature / RH by controlling the 3 way mixing valves at chilled water line, humidifier and duct heater.

Programmed start / stop of individual FCU as per operating requirements and for maintaining the room temperature by controlling the 3 way mixing valves at chilled water line.

Safe and reliable operation, supervision & control, alarm & event management and optimization, maintenance management of the entire AC system shall be accomplished with the DDC system.

The DDC system shall be interfaced with:

The Air Conditioning MCC.

The Microprocessor based control panels of VAM / Screw Chiller.

The LSPs located in each AHU rooms.

The Temperature and RH sensors and their associated transmitters located in the AHU rooms.

The Temperature sensors located in the rooms served by FCUs.

The zonal fire panels/ duct mounted smoke detectors.

The two work stations and the Hooter.

4.02.00 **Air Conditioning System With Water-Cooled Precision Air Conditioner**

This system will operate round the clock for ESP Control Rooms, Ash Handling Plant Control room, DM Plant Control room with associated office and Laboratory.

Water Cooled Precision Air Conditioners of 3x50% (Two nos. working and one no. Standby) capacity shall be provided for ESP Control Rooms, Ash Handling Plant Control room, DM Plant Control room with associated office and Laboratory.

Condenser cooling water for the Precision Air Conditioners shall be supplied directly from the ACW system.

The Precision Air Conditioners shall be operated from the respective unit mounted microprocessor based control console.

i) Operating Control

The Precision Air Conditioners shall have following operating controls:

- ON / OFF thermostatic control of the compressor of Precision Air Conditioners to maintain the desired room temperature.
- Superheat control by means of electronic expansion valve, wherever applicable.
- Room RH control (wherever required) with the help of humidifier & heater installed within AC units getting sense from the humidistat placed in the return air path.

ii) Safety Control

The compressor of each Precision Air Conditioner shall be incorporated with the following safety controls and interlocks:

- High refrigerant pressure cutout.
- Low refrigerant pressure cutout.
- Low Oil Pressure Cut out (if applicable).
- Cutout due to overload of all drive motors.
- Stopping of evaporator fans in case of fire in the respective zone.
- Closing of fire dampers at the supply duct from Precision Air Conditioners in case of fire with the sense from duct/room mounted fire/smoke detector through zonal fire panel.

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- Low condenser water flow cutout.

iii) Interlocks

The system components shall be interlocked with one another in the following way:

The compressor shall not start unless:

- a) Condenser water flow is low.
- b) The evaporator fans are running.

The electric strip heater shall not be energized unless the respective evaporator fans are running. The Strip heaters will trip with the help of safety thermostat in case the temperature of air at the downstream side of the heaters exceeds a pre-determined value.

On-Off-trip indications for all the drives & electric heaters shall be provided at the unit mounted microprocessor based control console.

4.03.00

Air Conditioning System With Air-Cooled Precision Air Conditioner

This system will operate round the clock for Switch Yard Control room and Coal Handling Plant Control Room.

Air Cooled Precision Air Conditioners of 3x50% (Two nos. working and one no. Standby) capacity shall be provided for Coal Handling Plant Control Room.

The Precision Air Conditioners shall be operated from the respective unit mounted microprocessor based control console.

i) Operating Control

The Precision Air Conditioners shall have following operating controls:

- ON / OFF thermostatic control of the compressor of Precision Air Conditioners to maintain the desired room temperature.
- Superheat control by means of electronic expansion valve, wherever applicable.
- Room RH control (wherever required) with the help of humidifier & heater installed within AC units getting sense from the humidistat placed in the return air path.

ii) Safety Control

The compressor of each Precision Air Conditioner shall be incorporated with the following safety controls and interlocks:

- High refrigerant pressure cutout.
- Low refrigerant pressure cutout.
- Low Oil Pressure Cut out (if applicable).
- Cutout due to overload of all drive motors.
- Stopping of evaporator fans in case of fire in the respective zone.
- Closing of fire dampers at the supply duct from Precision Air Conditioners in case of fire with the sense from duct/room mounted fire/smoke detector through zonal fire panel.

iii) Interlocks

The system components shall be interlocked with one another in the following way:

The compressor shall not start unless:

- a) The condenser fans are running.
- b) The evaporator fans are running.

The electric strip heater shall not be energized unless the respective evaporator fans are running. The Strip heaters will trip with the help of safety thermostat in case the temperature of air at the downstream side of the heaters exceeds a pre-determined value.

On-Off-trip indications for all the drives & electric heaters shall be provided at the unit mounted microprocessor based control console.

4.04.00

**Non Duct Able Split Air Conditioners**

Non-duct able Split air-conditioners will be controlled from the unit mounted Control panel or from the cordless hand operated remote.

5.00.00

**DESIGN CRITERIA**

5.01.00

The following criteria shall be considered for determining the capacity of air conditioning system and selection of individual equipment.

The bidder shall calculate independently based on following design parameters and satisfy himself regarding inside conditions and confirm the same.

Outdoor design condition : Summer : 43.3 Deg. C (DB),  
25.6 Deg. C (WB)

Monsoon : 32.2 Deg. C DB,  
28.3 Deg. C WB

Winter : 15.6 Deg. C DB,  
10.6 Deg. C WB

Inside design condition : 22.0 Deg. C  $\pm$  1 Deg. C DB & RH 55 %  $\pm$  5% for critical areas like control room, control equipment rooms, control room, UPS rooms, AVR rooms etc.

24.0 Deg. C  $\pm$  1 Deg. C DB & RH not exceeding 60% for the non-critical areas like offices, conference room, SWAS room, battery charger room, telephone exchange etc. and the areas served by split / window air conditioners.

For service building the inside conditions shall be 24.0 Deg. C  $\pm$  1 Deg. C DB & RH not exceeding 60% in all seasons except winter. In winter a DB temperature of 22.0 Deg. C shall be maintained.

Any equipment/process demanding any other (less) temperature shall be provided with.

Floor area : As per actual layout

Roof area : As per actual layout

Glass area : As per actual layout. All windows in the Air Conditioned shall be provided with light coloured Venetian blind

Lighting load : 21.4 Watt/sq.m (or actual) for all areas except shift charge engineer's room & technical building & administrative building where 16 watt per sq.m (or actual) shall be considered.

Occupancy : One (1) person in 12 sq.m (or actual)

Equipment/Panel load : As actual.

Solar load : Solar and transmission load through walls, roofs, doors, windows, glazing, floors etc. should be considered.

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- Ventilation Air : Fresh air at the rate of 1.5 air changes per hour for the control rooms and 1 air change per hour for office areas or at least 34 Cu. M / Hr. per person, whichever is higher, should be considered to achieve pressurization of air conditioned space and to meet the ventilation requirement of occupants.
- Other loads : Heat load due to AHU fan motor, duct friction etc. shall be considered while finding total heat load.
- Plant sizing : Plant sizing is to be done by allowing 5% margin on total sensible and latent heat calculated on the basis of above design considerations. An overall margin of 10% on calculated cooling load shall be considered in selecting Plant capacity.

Bidder is to furnish the necessary sizing calculation for selecting quantities and individual capacity of the Air Handling units/Fancoi units/Water cooled precision PACS/Air cooled precision PACS/ Non ductable split Units.

All Condenser cooling water pumps and chilled water pumps, AHUS and FCUS shall have further, 10% margin on their flow capacities.

- Insulation : Roof over AC space exposed to sun will be provided with 50 mm thick expanded polystyrene or equivalent. Roof over AC spaces not exposed to sun will be provided with similar insulation of 25mm thickness.

- 5.02.00 Individual air handling equipment shall be provided for individual facilities. Chilled water flow control valve (3 way), strip heater and electrode humidifier are provided for maintaining inside conditions.
- 5.03.00 All water piping for the make-up at cooling tower sump, Electrode humidifiers, Expansion tank and Make-up water tank etc. shall be provided by the bidder. Such make-up water piping shall be taken from the nearest clarified water header.
- 5.04.00 Electric power supply will be 415V  $\pm$  10%, 3 phase, 50 Hz.  $\pm$  5% A C.
- 5.05.00 The basic proposal by the bidder shall be for equipment strictly according to the technical specification. The location of air conditioning equipment, layout of ducting, piping etc. shall be designed by the bidder and approved by the Consultants/Owner.

5.06.00 The bidder shall satisfy himself regarding the refrigerating capacity required for maintaining the end conditions inside AC spaces before submitting the offer. For this purpose, Clause 4.01.00 shall be referred to, where the basis of computing air-conditioning load is furnished. The bidder shall have to guarantee the end conditions mentioned in Clause 4.01.00.

5.07.00 **Codes and Standards**

Design, manufacture, inspection and testing of the equipment covered by the specification shall unless otherwise specified conform to the latest edition of the standards and codes including all addenda mentioned below :

IS-659	:	Safety code for air-conditioning
IS-660	:	Safety code for mechanical refrigeration
ASHRAE-23	:	Standard method of testing and rating [67 Standards] air conditioner.
AR1-450-6	:	Standards for water cooled refrigerant Condenser.
ASME Sec. VII	:	Unfired pressure vessels
IS-4503	:	Shell and tube type heat exchanger.
ASHRAE 22-72	:	Method of testing for rating water cooled refrigerant condenser.
ANSI-8-31.5	:	Refrigeration piping.
ANSI-8-9.1	:	Safety code for mechanical refrigeration.
AR1-410	:	Standard for air cooling and air heating coils.
AR1-210	:	Standard for unitary air conditioning equipment.
IS-3588	:	Specification for electrical axial flow fans.
AMCA-210	:	Methods of performance test for fans.
BS-2831	:	Methods of test for air filters used in AC and general ventilation.
IS-4671	:	Expanded polystyrene for thermal insulation purpose.
IS-702	:	Industrial bitumen.
IS-1239	:	Heavy class Pipes for sizes upto 150 mm dia.
IS-8188	:	For Water conditioning.
IS-325	:	3 phase induction motors.
IS-4029	:	Guide line for testing 3 phase induction motor.

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IS-210	:	Specification grey iron casting.
IS-2062	:	Structural steel
AMCA-Bulletin No.	:	Standard code of testing centrifugal and axial 210 flow fans
IS-2825	:	Code of practice for welding mild steel
IS-2676	:	Dimensions for wrought aluminum and aluminum alloy sheets and strips.
ASHRAE Code	:	for various filter
IS-655	:	Specification for metal air ducts
BS-4735	:	Horizontal Burning for XLPE insulation
BS- 4370 Part-1	:	Dimensional Stability for XLPE Insulation
ASTM D 1056	:	Water Absorption for XLPE Insulation

Pump design and testing should correspond to the procedure mentioned in IS-1520.

5.08.00 The refrigerant for Split units and window conditioners shall be R-22 as per ARI designation.

5.09.00 For requirements of materials of construction, 5.00.00 of this section shall be referred to.

5.10.00 Special Note

In case any discrepancy is found between requirements of this section and those mentioned in other sections, stipulations of this section shall prevail.

## 6.00.00 DESIGN AND CONSTRUCTIONAL REQUIREMENT

### 6.01.00 General instruction to the tenderer

6.01.01 The Tenderer shall refer only to those of the following clauses which are applicable for this particular project as detailed in clause 1.00.00 and 2.00.00 of this specification. The clauses which are not applicable for this project shall be ignored.

### 6.02.00 General design and constructional requirement

6.02.01 All the equipment shall be capable of withstanding the stresses which may be experienced during normal operation and test.

- 6.02.02 All the equipment shall be designed to permit inter-changeability of parts and ease of access during inspection, maintenance, installation and repair of various parts.
- 6.02.03 All parts subject to substantial temperature changes shall be designed and supported such as to permit free expansion or contraction without resulting in leakages, harmful distortion, misalignment or play.
- 6.02.04 Proposals for repair or any similar operations involving the plugging, welding, boring or addition of metal to the original castings shall be submitted to the Purchaser/Consulting Engineer and approval shall be received before any such work is carried out. Drawing showing details and locations of such modifications shall be submitted to the Purchaser/Consulting Engineer for his records.
- 6.02.05 All equipment shall be heavy duty type suitable for installation in heavy industries and for long period of uninterrupted service.
- 6.02.06 All materials used shall conform to the specification and shall be new and first class in all respects.
- 5.02.07 Anchor bolts, nuts and seating steel work shall be supplied with the equipment. Only hexagonal nuts shall be used for holding down the equipment, with proper lock nuts. All bolt holes shall be spot faced for nuts. In specific cases where not necessary, spot facing may be omitted.
- 6.02.08 Casting and welding shall conform to their respective specifications and shall be free from flaws and objectionable imperfections, machined true and in a workmanlike manner.
- 6.02.09 The separate pieces of equipment shall be marked with unit number. The assembly drawings shall indicate part number of each equipment and unit number for easy correlation.
- 6.02.10 Coupling guards and belt guards shall be furnished as applicable.
- 6.02.11 All equipment, ducts, pipes, controls etc. shall be fully treated against corrosion and sealed against moisture, sand and dust ingress.
- 6.02.12 All plant including ducts and pipes as well as machines shall be vibration isolated, or otherwise treated so that :
- No excessive vibration is felt in the floors or walls of the rooms served by any machine.
  - The mechanically induced vibration levels in floors, walls and ceilings of rooms are sufficiently small as to limit the radiation of the sound level to the rooms within acceptable levels.

6.03.00 Packaged Chillers

6.03.01 VAPOUR ABSORPTION MACHINE

- A. The vapour absorption machine shall be steam fired, packaged, factory assembled and tested and shall be complete in all respects. The steam required for the units shall be tapped off from the auxiliary steam header or from any other suitable location in such a way that even when any of the unit is under shutdown, operation of the unit shall not be jeopardized. It shall consist of high temperature generator, low temperature generator / condenser assembly, evaporator / absorber assembly with eliminators, regenerative heat exchangers, purge recovery units, absorbent pumps, refrigerant pumps. All interconnecting piping, valves and other accessories, micro processor based control panel incorporating controls safety & interlocks, required charge of lithium bromide solution and refrigerant for all the units, cooling/heating switch valves, structural mounting base for all components etc.
- B. High Temperature Generator shall consist of tube of Stainless Steel and shall be supported properly in the shell and complete with required accessories and safety devices. The shell shall be fabricated from MS Plate as per IS 2062 and of welded construction.
- C. Low Temperature Generator cum Condenser shall be housed in common welded carbon steel shell with one compartment for generator and the other for condenser with eliminators between the two sections to avoid Lithium bromide carry over, separate tube bundles and tube sheets for each section, required accessories and safety devices etc. The tube of generator and condenser shall be of stainless steel and method of construction shall be similar to that of the high temperature generator.
- D. Evaporator cum Absorber shall be complete in all respects with necessary supports and accessories housed in common fabricated carbon steel shell but with separate compartments for each section, separate tube boundless fitted in the respective tube sheets. The evaporator and absorber tubes shall be of copper to ensure total leak proof construction under the high working vacuum of the system. Method of construction shall be similar to that of the high temperature generator. The assembly shall be complete with necessary supports, base and accessories and safety provisions.
- E. Regenerative Heat Exchangers shall be designed for maximum heat exchange between the low temperature absorbent from the absorber and the high temperature absorbent released from the generator. There shall be at least one low temperature and one high temperature heat exchangers along with condensate drain.
- F. Purge Recovery Unit shall be sized to remove all non-condensable gases by vacuum into the storage provided for this purpose. Those should be ejected into the atmosphere by the suitable vacuum pump provided with each absorption unit. The unit shall include all the necessary piping and valves.

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- G. The condensate from the unit shall be collected in a condensate storage tank and shall be returned to the desired point through Pump.
- H. The refrigerant and absorbent pumps shall be canned motor type and shall be complete with motor of adequate capacity. For each absorption unit, refrigerant and absorbent pumps shall be provided. The material of construction for shaft and impeller of the pump shall be Stainless Steel. Both the pumps shall be complete with isolating valves, to enable on-line maintenance. Circulation fluid shall be used as cooling and lubricating medium.
- I. Necessary corrosion inhibitor shall be of non-toxic type. Chromate based inhibitors shall not be used.
- J. Apart from full charge of refrigerants and lithium bromide solution filled into the system, lithium bromide solution shall be supplied as spare quantity with the main supply.
- K. The whole unit shall be given anti-corrosion (both internal and external) treatment and three coats of epoxy painting over a coating of suitable primer.
- L. Microprocessor based controls shall be provided as per manufacturer standard practice along with necessary instrumentation, devices with facility to interface with central DDC panel and to meet the requirement of all system operations and controls.
- M. Valves, Instruments other fittings etc. along with VAM.  
150 mm dial type temperature gauges at the inlet and outlet of the condenser and chiller respectively.  
150 mm dial type pressure gauges at the inlet and outlet of the condenser and chiller respectively.  
Water flow switch at outlet of the each condenser and chiller.  
Globe valve for flow regulation at the outlet of condenser and chiller respectively.  
Gate valves at the inlet of condenser and chiller respectively.  
Steam flow regulating valve and isolating valve at the steam supply line.  
Steam trap and condensate drain valve at the outlet of steam circuit.

6.03.02 PACKAGED SCREW CHILLER

- A. Refrigerant Compressors (Twin Screw Type)
- I. The compressor may be designed either for direct or for indirect drive.

- II. The compressor assembly shall be adequately designed for minimum vibration and noise disturbances.
- III. The shaft seal shall be of proven design.
- IV. All safety devices against high-pressure refrigerant, low-pressure refrigerant and low oil pressure shall be provided, High winding temperature through PTC sensor. The compressor units must be provided with oil pressure regulator.
- V. The horsepower of the compressor motor shall be sized for 115% of maximum rated power required for the unit including the drive loss.
- VI. The compressors shall be provided with built-in-unloaded starting device. The compressor shall have automatic capacity control device preferably built-in-type to match reduced refrigeration load.
- VII. Capacity control must be achieved by use of slide valve, which provides fully modulating capacity control from 100% to 10% (20%, at least) of full load. The slide valve shall be actuated by oil pressure controlled by external solenoid valves.
- VIII. The oil separator should be effective enough to incur gravity drop out of oil from the refrigerant gas before it enters the condenser.

B. Heat Exchangers (Condensers and Chillers)

- I. All condensers shall be of shell and tube type with water in the tubes and refrigerant in the shell.
- II. All chillers for chilled water plant shall also be shell and tube type with water either in tubes or outside the tubes.
- III. The heat exchanger shall be designed for a minimum working pressure of 10.5 kg/cm<sup>2</sup> gauge on the water side and 11.3 kg/cm<sup>2</sup> on the refrigerant side and shall generally conform to the latest ASME CODE for unfired pressure vessels Section-VIII. The design pressure shall have a reasonable margin over the maximum working pressure.
- IV. The average velocity of water in tubes shall not be more than 2.5 m/sec.
- V. Water heads or refrigerant heads of the heat exchangers shall be as not to allow leakage of fluid from one pass to the other.
- VI. Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating.
- VII. The overall fouling factor for the condensers and chillers shall be 0.0002 and 0.00013 Hr.M<sup>2</sup> °C /K Cal respectively.

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- VIII. The condensers shall be designed to provide at least 2 °C sub cooling of refrigerant under rated design condition. The water chillers also shall be designed to superheat the refrigerant by at least 3 °C under rated design condition.
- IX. Testing and other design feature of the heat exchanger shall meet the requirements of TEMA Class-C heat exchangers or approved equal.
- X. The heat exchangers shall have open able water boxes for ease in maintenance.
- XI. The tube for water chillers shall be of deoxidised copper with or without integral fins. The tubes for the condensers shall also be copper with integral fins. The tube wall thickness at any point shall not be less than 18 SWG.
- XII. The baffle plates and the tube sheets shall be made of steel. The shell shall be made up of seamless tube or shall be fabricated from flange quality steel plate (ASTM-A285 Grade-C). The tube support plates shall be made of flange quality carbon steel plates and shall be as per TEMA Standard.
- XIII. The heat exchangers shall be provided with vent valve, relief valve, and/or safety fusible plug on refrigerant side and vent valve and drain valve on water side (at every section of the baffled shell of heat exchanger).
- XIV. The tenderer shall quote packaged units having compressor, condenser and chiller assembly together in a single framework and mounted on a common base plate. Provision for refrigerant charging and chemical cleaning of water tubes shall be provided.
- XV. Each heat exchanger shall be provided with water flow switch. This shall be interlocked with the control of the individual refrigeration system/corresponding compressor drive.
- XVI. All the heat exchangers shall be provided, with standard connections like thermo wells, inspection valve and antifreeze thermostat / temperature sensor and external equaliser connection for expansion valves for chiller. Insulation shall be terminated in such a manner that it will not be damaged during removal of bolts, covers etc. Separate covers similar to flange covers shall be constructed to facilitate easy removal.

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6.04.00 **Water Pumps**

6.04.01 Each pump shall be of horizontal split casing centrifugal type, directly coupled to electric drive motor and mounted on a common base plate. Pumps having motor of 5 HP capacity or below can be of mono-block construction, provided its materials of construction are as per 2.03.04 below and motor is as per desired motor specification.

The pump shall be complete with casing, impeller, renewable type wearing rings, shaft, shaft sleeve, bearings, stuffing box, Mechanical Seal (if applicable), cowlings, base plate etc. as applicable. The design pressure for the casing shall not be less than 16 bar for chilled water pumps.

6.04.02 Pump head-capacity characteristics shall be gradually rising from operating to shut off point without any zone of instability. The pump BHP-flow characteristics shall be preferably be non-over loading type beyond rated capacity point.

6.04.03 Operating speed of the pump shall not preferably be more than 1500 rpm. Vibration isolations of efficiency 90% (approx.) shall be provided.

6.04.04 Material of the pump shall preferably as follows (all material shall be of tested quality).

- a) Casing : Cast Iron, as per IS 210, Gr. FG 260 for both CHW & CW pumps. (As per manufacturer's Standard)
- b) Impeller : Bronze to IS: 318 Grade 2
- c) Shaft : Carbon Steel C-45.
- d) Shaft sleeve : Bronze
- e) Wearing ring : Bronze
- f) Base Plate : Cast Iron

6.04.05 Pumps shall be provided with suitable bearings sized adequately to take the maximum possible unbalance load occurring due to all mechanical and hydraulic reasons.

6.04.06 Pump and drives shall be directly coupled through a flexible coupling. Suitable coupling guard shall be provided for each pump.

6.04.07 Each pump shall be completed with pressure gauge at the suction and discharge, isolating valves, all integral piping required for sealing and cooling, casing drain and vent connections etc. The pressure gauge of pump will be connected with a siphon and a two-position brass cock.

6.04.08 The rated BHP of the motor shall provide for 15% margin over the rated BHP of the pump. For other electrical particulars of the motor refer detailed specification of the motors.

6.04.09 The design of the pumps shall conform to the relevant IS Code.

- 6.04.10 Major rotating components of the pumps like impellers, balancing drums etc. shall be individually balanced statically and finally each pump shall be dynamically balanced.
- 6.04.11 The critical speed of the pump shall be at least 20% above the operating speed.
- 6.04.12 All pumps and motors shall be aligned properly, and bolted and doweled to a common base frame.
- 6.05.00 **Induced Draft Cooling Towers**
- 6.05.01 The cooling towers shall be cross flow induced draft type with FRP casing & sump with air entry on all four sides and air discharge on top. The fan motor shall be easily accessible from outside and out of moist air stream.
- The internals shall be of stainless steel SS or MS epoxy painted to withstand corrosive atmosphere. The tower shall be of low height, suitable for round the clock operation at location in the space shown in the applicable drawings. The tenderer shall confirm that the tower supplied by them can be accommodated in the space shown in the drawing.
- 6.05.02 Cooling tower shall be of sufficient capacity to cool the rated amount of water through the specified range at the design W.B. temperature.
- 6.05.03 The structural frame work of the tower including all members and connections shall be designed for operating loads and prevailing wind pressure. Steel members shall be MS epoxy painted and be of sufficient size to safely withstand all imposed loads.
- 6.05.04 FRP casing sheets shall be clamped on close centre to the structural steel members. Rubber neoprene gaskets must be used on all bolted joints as a seal against water leakage.
- 6.05.05 Louvers shall be of fixed type.
- 6.05.06 The fan deck shall be of ample strength to support all loads normally encountered in operation and maintenance. Stiffeners shall be provided on the under side.
- 6.05.07 Galvanised steel ladder with safety cage and hand railing shall be provided in such a number and locations as necessary to give safe and complete access to all parts to tower requiring occasional inspection or adjustment. An access door shall be provided for fan deck and the cell for ready access to the interior parts of the tower.
- 6.05.08 Fills shall be of extended area of formed PVC suitable to withstand hot water temperature of 55°C.
- 6.05.09 Louvers and drift eliminators shall be of PVC/FRP construction.
- 6.05.10 Eliminators shall be provided in removable sections & installed in the cell of the tower. The number of deflection in the eliminators shall be so arranged as to reduce drift loss to 0.2% of the water circulated.

6.05.11 The water distribution system shall be open basin with gravity feed nozzles. The system shall be self draining and non-clogging and designed for flexible operation and ready accessibility. All main piping connection shall be brought out and end in flanges, to flexible connection.

6.05.12 The cold water basin shall be of F.R.P. construction. The basin shall be complete with float valve for make up water control, a drain and overflow connection. The make-up water supply pipe shall be positioned at least double the pipe diameter above the maximum water level in the basin. The water basin shall be constructed such as to provide a coarse strainer of Brass wire mesh easily accessible from outside.

6.05.13 Fan shall be of the propeller type, cast aluminium and multi bladed aerofoil construction with adjustable pitch. The entire fan assembly shall be statically balanced. Outlet velocity of air shall be not less than 610 meters per minutes and the fan tip speed shall not exceed 4570 meters per minute.

6.05.14 Each fan shall be either direct driven or gear driven. Where reduction gears are used, housing shall be of heavy cast iron construction with large oil reservoir and complete with supply of oil.

6.05.15 Fan motors shall be of the totally enclosed fan cooled type and of the required capacities. Motor shall preferably be located outside the moist air stream.

6.05.16 Fan drive shaft using reduction gearing shall be dynamically balanced and connected through flexible couplings.

6.05.17 The mechanical equipment assembly shall be adequately supported on the fan deck.

6.05.18 Fan discharge hatch shall be covered with galvanised wire mesh to prevent birds nesting during idle periods.

6.05.19 All nuts, bolts and fasteners used in the cooling tower shall be stainless steel / Nickel or chrome plated.

6.06.00 **Piping**

A. Refrigerant Piping

- I. Refrigerant piping shall be of M.S. seamless (as per IS-1239, Part-I heavy grade) or copper tube (IS-5493). Welding rings shall be used for smaller pipes. Weld preparation of joints, cleaning of pipes shall be carried out as per relevant code.
- II. Pressure drop in hot gas, liquid and suction lines should not exceed the value corresponding to 2 °F (1.1 Deg C) change in saturation temperature of the fluid.
- III. Velocity in the discharge and suction pipe of the refrigerant shall not be too high as to create undue vibration and noise, velocity in the vertical length of discharge and suction pipe of the refrigerant shall be high enough to carry the entrained oil in the refrigerant, even in case of unit running at lowest partial



- V. All bolts and nuts for flange connection shall be hexagonal carbon steel type as per IS-1363 and with the material and other requirements as per IS-1367. All threaded valves shall be provided with nipples and flanged pairs on both sides to permit flanged connections for ease of removal / replacement of valves.
- VI. Bends, fittings fabricated at site are not acceptable. The Contractor shall use the standard fittings / bends, as per IS-1239, Part-II.
- VII. Spacing and location of hanger shall conform to preferred engineering practice. Hangers and supports shall be made up of structural steel sections. The design of the hangers and supports shall provide for suitable protection to insulation on the pipes, wherever applicable. All materials for anchoring the hangers with reinforced concrete work or building structural beams and columns shall be furnished by the Bidder. The supports within the plant room shall be of structural/pipe supports from the floor, provided by the A.C. Contractor.
- VIII. The flanged joints for water line will use canvas, impregnated rubber gasket. Compressed fiber gaskets shall be used with flat face flanges and raised face slip-on flanges. Spiral wound gaskets shall be used with raised face flanges, except for raised face slip-on flanges. Gaskets containing asbestos are not acceptable.

Gaskets shall be suitable for the design pressures and temperatures: -

- i) Compressed Fiber Gaskets: Compressed fiber gaskets shall be in accordance with ANSI B16.21, and materials shall be suitable for a maximum working pressure of 40 bar and a maximum working temperature of 400° C. Gaskets shall be dimensioned to suit the contact facing. They shall be full faced for flat face flanges and shall extend to the inside edge of the boltholes on raised face flanges. Gaskets for plain finished surfaces shall be not less than 1.6 mm thick and for serrated surfaces shall be not less than 2.4 mm thick.
- ii) Spiral Wound Gaskets: Spiral wound gaskets shall be constructed of a continuous stainless steel ribbon wound into a spiral with non-asbestos filler between adjacent coils. The gasket shall be inserted into a steel gauge ring whose outside diameter shall fit inside the flange bolts properly positioning the gasket. The gauge ring shall serve to limit the compression of the gasket to the proper value. Compressed gasket thickness shall be 3.3 mm ±0.1 mm.
- iii) Ring Joint Gaskets: Ring joint gaskets shall be octagonal in cross section and shall have dimensions conforming to ANSI B16.20. Material shall be suitable for the service conditions encountered and shall be softer than the flange material.
- iv) Rubber Gaskets: Rubber gasket materials shall be cloth inserted sheet rubber and shall conform to ANSI B16.21. They shall be full face and 1.6mm thick.


The material should be able to withstand adequate strength in compression without damage. Pipe lines should be such installed that any equipment or valves can be removed by disconnecting flange bolts and nuts union joints. If necessary, a short piece joint to be installed for easy removal. All threads for screwed joints should be properly made. The threads will be covered to make a leak proof joint. Pipes passing through any building structure will pass through a pipe sleeve. The thickness of pipe sleeve will be not less than the thickness of the passing pipe itself. A rubber grommet or such other material will protect pipes entering any equipment.

- v) All drainpipes will use 'tee' fitting instead of elbows or bends. 'Tee' fitting should be such installed that the plug can be removed and any section of pipe can be cleaned. Drain valves will be located at lowest point of pipelines. If necessary more than one drain valve will be installed to facilitate complete drainage from pipe. Condensate drain piping shall be insulated as per the specification.
- vi) Water filling valve and air vent shall be installed on the highest point of pipeline. If necessary more than one valve is to be installed for satisfactory operation or maintenance of the plant. In case of insulated pipes the connections for pressure gauge, thermometer, drain valve, purge valve, filling valve and any such other accessories, the connection should be long enough such that the requisite pipe insulation can be carried out on the main pipe. The connecting pipes or fittings will be insulated separately if necessary. Location of instruments, fittings, fixtures shall be as in single line flow diagram. Location / sizes of air vents are also indicated.
- vii) The insulation will be fixed as per manufacturer's recommendation. Where valves, pipe fittings etc. occur, access to both shall be provided. Flange insulation shall be in two halves for easy removal without affecting insulation covering adjacent parts. Insulation of valves shall be with provision of aluminium valve boxes with hinged cover / halves.
- viii) Piping arrangement and alignment shall be as per layout.

C. Steam Piping

- I. **Steam piping** shall be of ASTM-A Carbon Steel Grade-B with 50mm thick fibreglass / mineral wool / equal thermal insulation covered with 30G GI sheet and spring hangers / supports.
- II. All the **hangers/supports** shall be designed to provide the required supporting efforts and allow pipe line movement with thermal changes without causing overstress. Hangers and supports shall be capable of carrying the sum of all concurrently acting loads.
- III. Hydraulic test pressure of the steam line shall be two times of operating pressure.

- IV. Steam piping shall be complete with isolating valves, fittings, strainer, safety valves and pressure gauges as shown in the SLFD.
- V. **Condensate piping** shall be complete with isolating valves, fittings, 25mm thick thermal insulation of fiber glass / mineral wool or equal covered with 30 G GI Sheet, hangers / supports.
- VI. Steam line flanges are of welded as per IBR.
- VII. All **valves** shall be of approved make and type and shall have cast/ forged steel bodies with covers and glands of approved construction.
- VIII. Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the latest editions of codes as specified or approved equivalent and acceptable to IBR.
- IX. All **regulating valves** shall be designed to prevent erosion of the valve plugs and seats when the valves are operated partially opened. The valves shall have contoured plug.
- X. **The safety relief valves** shall be direct spring loaded type and shall be provided with casing levers. The valves shall be of rugged construction suitable for long periods of uninterrupted service. The safety relief valves shall conform to the requirements of ASME Boiler and pressure vessel code, Section-VIII and IBR as applicable and shall be installed as per recommended rules for the design of safety valve installations in ANSI B31.1.
- XI. **Steam traps** with strainers will be used in the drain lines from various steam pipes such that only condensed steam can be drained.
- XII. The steam traps shall be inverted bucket or thermo-dynamic type complete with integral or separate strainers. The internal components of traps shall be of AISI-316 stainless steel construction. Material of construction of the body shall be selected by the Bidder based on the service conditions stipulated. Steam drain traps shall be provided with strainers, inlet and discharge valves and by-passes and test cocks. Materials and other details of these valves shall meet the specified requirement.

  
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XIII. All **Y-type strainers**, wherever provided with steam traps or otherwise, shall have AISI-316 stainless steel screen of not more than 20 mesh size. Screen open area shall be at least three (3) times the pipe internal cross-sectional area. The strainer shall have a screwed blow-off connection with a removable plug. Material of construction of the body shall be selected by the bidder based on the duty conditions specified.

XIV. All traps and strainers shall have socket weld ends as per ANSI B16.11 for size NB 50 mm and smaller and butt weld ends as per B 16.25 for size NB 65 mm and above.

6.07.00

### Valves & Accessories

#### A. GENERAL

Valve pressure classes, sizes, types, body materials, and end preparations shall generally be as described herein. Special features and special application valves shall be utilized where required.

Valves specified to have flanged, socket-welded, or screwed connections shall have ends prepared in accordance with the applicable ANSI standards. Steel flanges shall be raised face type unless otherwise required. Cast iron and bronze flanges shall be flat-faced type. Butt-welding ends shall be prepared in accordance with 2.11.5 Butt Weld End Preparation and Piping Fit-Up.

Steel body gate, globe, angle, and check valves shall be designed and constructed in accordance with ANSI B16.34 as applicable. Valve bodies and bonnets shall be designed to support the valve operators (hand wheel, gear, or motor) with the valve in any position, without external support.

#### B. Steel Body Valves 50 mm and Smaller

Steel body valves 50 mm and smaller shall have forged steel bodies. Forged steel valves complying with the standards and specifications listed in Table 126.1 of ANSI B31.1 shall be used within the manufacturer's specified pressure temperature ratings with the following limitations. The use of Class 1500, 2500, and 4500 forged steel valves shall be limited in accordance with the pressure temperature ratings specified in ANSI B16.34, and the criteria established in MSS SP-84.

Class 800, 1500, 2500 and 4500 forged steel valves shall be constructed as follows: -

- a) Class 800 valves shall have bolted bonnet joints. Class 1500, 2500 and 4500 valves shall have pressure seal, integral, or breech lock bonnet joints. Gate, globe, and angle valves shall have outside screw and yoke construction.
- b) All valves, except gate valves, shall have seats of the integral type. Gate valves shall have renewable seats.

- c) Class 1500, 2500, and 4500 valves shall be of loose back seat design.
- d) Class 1500, 2500, and 4500 globe valves shall be of the Y-pattern type.
- e) Valve ends shall be socket-weld type unless otherwise required.
- f) Except as otherwise required, check valves shall be of the guided piston or swing disk type. All check valves shall be designed for installation in either horizontal piping or vertical piping with upward flow.

C. Steel Body Valves 65 mm and Larger

Steel body valves 65 mm and larger shall have cast steel bodies. The face-to-face and end-to-end dimensions shall conform to ANSI B16.10. The use of these valves shall be in accordance with the pressure temperature ratings specified in ANSI B16.34 as applicable.

Gate, globe, and angle valves shall be provided with back seating construction; and shall be of outside screw and yoke construction. Gate valves 100 mm and larger shall have flexible wedge disks. Split disks shall not be permitted. Valves shall have full size ports, except where venturi ports are specifically permitted to Engineer's approval. The use of valves with venturi ports shall be limited to selected large diameter, high-pressure valve applications.

Class 150, 300, and 400 valves 65 mm and larger shall be constructed as follows: -

- i) Bonnet joints shall be of the bolted flanged type having flat face flange facings for Class 150 valves; and male and female facings for Class 300 and 400 valves.
- ii) Body ends shall be butt weld type unless otherwise required.

Class 800, 900, 1500, 2500, and 4500 valves 65 mm and larger shall be constructed as follows: -

- i) Bonnet joints shall be of the pressure seal or breech-lock type.
- ii) All Class 800, 900, 1500, 2500, and 4500 valves shall have grease-lubricated antifriction bearing yoke sleeves.
- iii) Body ends shall be butt weld type unless otherwise required.

Check valves used on pump discharge installations, and on other applications in which the valves may be subjected to significant reverse flow water hammer or fluid surges, shall be of the non slam tilting disk type. All other check valves shall be of the guided piston, swing disk, or double disk spring check type. The use of double disk spring check valves shall be limited to 350 mm and larger cold-water services. All check valves shall be designed for installation in either horizontal or vertical piping with upward flow. Stop check valves, where specified, shall be Y-pattern globe type.

D. Iron Body Valves

Iron body gate, globe, and check valves shall have iron bodies with bronze trim. The face-to-face dimensions shall be in accordance with ANSI B16.10. These valves shall have flanged bonnet joints. Gate and globe valves shall be of the outside screw and yoke construction. Body seats shall be of the renewable type. Gate valves shall be of the wedge disk type. Lined cast iron body diaphragm and check valves used with lined piping shall be flanged body with liner and diaphragm material suitable for the service.

E. Butterfly Valves

Rubber-seated butterfly valves shall be generally constructed in accordance with AWWA C504 Standard for Rubber-Seated Butterfly Valves. The valves shall also generally conform to the requirements of MSS Standard Practice SP-67, Butterfly Valves. Valves of the wafer or lug wafer type shall be designed for installation between two ANSI flanges. Valves with flanged ends shall be faced and drilled in accordance with ANSI B16.1. The selected use of butterfly valves shall be in accordance with the pressure temperature ratings specified in AWWA C504, the pressure temperature ratings specified by the manufacturer as per the following criteria: -

- a) Butterfly valves shall generally be used for 150 mm and larger cold-water services only.
- b) Butterfly valves for buried service shall be of cast iron body material and shall be equipped with flanged ends.
- c) Cast iron butterfly valves shall have pressure class selected based on the piping design pressure as follows:

Piping Design Pressure	Valve Class
i) 1.8 bar and below	Class 25
ii) Above 1.8 bar to 5.2 bar	Class 75
iii) Above 5.2 bar to 10.3 bar	Class 150

- d) Cast iron butterfly valves shall be limited to use with piping systems having a design temperature of 50° C or less.
- e) Butterfly valves for other than buried service shall be of carbon steel or cast iron body material depending on the service application. Valves 600 mm and larger in size shall be equipped with flanged ends. Valves 500 mm and smaller in size shall be of the wafer type, or lug wafer type, if used with steel piping; and shall be flanged if used with other piping materials (cast iron, etc.).

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- f) Carbon steel butterfly valves shall be limited to use with piping systems having a design temperature of 65° C or less. Carbon steel butterfly valves shall have pressure class selected in accordance with the pressure temperature ratings specified in ANSI B16.34 for 600 mm and smaller valves. Valves 750 mm and larger in size shall be selected and specified based on the piping design pressure and temperature, without reference to a specific pressure class.

Metal seated or Teflon seal ring seated butterfly valves for special service applications shall be of the wafer or lug wafer type; and shall be designed for installation between ANSI flanges. The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer.

F. Bronze Body Valves

Bronze gate and globe valves 50 mm and smaller shall have union bonnet joints and screwed ends. Bronze gate and globe valves used in control air service shall have brazed joint ends. Gate valves shall be inside screw, rising stem type with solid wedge disks. Globe valves shall have renewable seats and disks.

Bronze check valves 50 mm and smaller shall be Y-pattern swing disk type or guided piston type designed for satisfactory operation in both horizontal piping and vertical piping with upward flow.

Bronze valves 65 mm and larger shall have bolted flange bonnet joints and flanged ends. Gate and globe valves shall be of the outside screw rising stem construction. Gate valves shall have either integral or renewable seats. Globe valves shall have renewable seats.

The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer and in accordance with the criteria established in MSS SP-80. Bronze valves shall generally be Class 200, and shall be limited to service with piping systems having design pressures of 14 bar or less, and design temperatures of 65 ° C or less.

Bronze valves shall generally be limited to a size of 80 mm or less.

G. Plug Valves

Plug valves shall be of the eccentric, lubricated, or Teflon sleeve plug type, as required by the service. Plug valve bodies shall conform to the requirements of ANSI for dimensions, material thickness, and material specifications. Bonnets shall be of the bolted flange type. Body ends shall be flanged, faced, and drilled for installation between ANSI flanges. The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer.

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H. Ball Valves

All ball valves shall have full area ports, Teflon seats & seals, and chrome plated carbon steel or stainless steel balls. Ball valve bodies 50 mm and smaller shall have threaded end connections. Ball valves 65 mm and larger shall have flanged ends. The valves shall not require lubrication. The use of these valves shall be in accordance with the pressure temperature ratings specified by the manufacturer.

I. CHECK VALVES

These shall be swing check type with material of construction as given in 2.06.00 (D) above. The body shall be of cast iron with flanged ends.

J. FLOW REGULATING-CUM-MEASURING VALVES

These are special valves to be installed at the outlet of each cooling coil/heating coil as shown in drawings. The Contractor shall also supply measurement it including manometer. The valves shall be of variable orifice design double regulating type. The valve shall have measurement ports for connecting the manometers. The Contractor shall supply all calibration charts etc. The valve shall have provision for locking at pre set flow condition and it shall be possible to close the valve and again open up to this pre set point. The valves shall be of gun-metal/bronze construction.

K. 3-WAY MIXING VALVES

These are special valves to be installed at the outlet of each AHU heating coil as shown in drawings. The motor shall be actuator based controlled. The valve shall operate from the sense of the room thermostat. The Contractor shall also supply measurement kit including manometer. The valves shall be of variable orifice design double regulating type. The valve shall have measurement ports for connecting the manometers. The Contractor shall supply all calibration charts etc. The valve shall have provision for locking at pre-set flow condition and it shall be possible to close the valve and again open up to this pre set point. The valves shall be of gunmetal / bronze construction.

L. REFRIGERANT VALVES

All refrigerant valves as may be applicable shall have Brass body with flange connection or sweat connection for welding or brazing to pipe. For copper pipes size 5/8" and below flare connection will be acceptable. The valve body and bonnet connection shall have bolted and welded connection.

It is preferable to have Teflon gland packing for the valves construction of the discs of the valves shall be either globe or angle type. The valve seat shall have white metal lining or any equivalent soft replaceable lining. The valves shall be of tested quality. Leak proof-ness of the valves shall be tested at minimum 1.5 times the design pressure for the system but not less than 35 Kg / Sq. Cm.

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6.08.00 Air Handling Equipment

6.08.01 Air Handling Units

A. FAN

The fans shall be forward/backward curve bladed centrifugal type. The number of fans per unit shall be as per standard of the manufacturer. The impeller and the scroll casing of the fans shall be made of steel and protected with suitable painting as per Manufacturer's standard.

The fan shaft shall be of Carbon steel. Bearing shall be heavy-duty self-aligning type. The fans shall be dynamically balanced. The motor shall be adequately rated to prevent overload.

B. DRIVE

Centrifugal fans shall be equipped with V-belt drive and belt tensioning arrangement. All belts shall be sized with 1.1 service factor. All belt drive shall be equipped with removable guards to avoid accidental hazards. There shall be a minimum of two belts per drive.

C. DRY FILTER

The filter media shall be designed to hold dust and prevent it from being dislodged by vibration or other cause and passing through filter.

The filters shall be of dry panel type. The filter shall have G.I. frames of adequate thickness but not less than 20 SWG suitable for long use in an industrial plant. The filters may be in panels of sizes about 600 mm x 600 mm for easy handling of the same. The face velocity of air across the filters shall not exceed 2.5m/sec and maximum limitation pressure drop will be 6 mm of WG. Filter thickness will be at least 50 mm. The efficiency shall be about 90% down to 10-micron size particles.

D. COOLING COIL

The cooling coil for chilled water shall consist of seamless copper tubes with aluminium fins. There shall be preferably only one cooling coil per AHU or as per manufacturer's standard.

The cooling coil for chilled water plant shall be equipped with manually operated flow regulating valve with provision for flow balancing at site to control the chilled water flow. This cooling coil shall be designed for chilled water / air duty. Counter-flow process of heat transfer shall be considered in the design requirement. The flow factor of 0.001 hr. Sq. Ft. - °F / BTU (0.0002 hr - Sq. M °C / Kcal) shall be taken in the design of the cooling coil. Number of rows shall be minimum 4 and shall follow even number for any particular coils to facilitate connection of water/refrigerant only on one side of the unit.

Fin design shall be chosen for the duty to be performed with special attention to the possibility of lint accumulation. However, in any case,

number of fins in the coils shall not exceed 13 / Inch. Velocity of air across the coils shall be limited to 2.5 m/sec.

In case of chilled water-cooling coil, arrangement for air purging and water draining from the coil is to be provided.

E. CASING

- a) The casing shall be of double skin type GI with at least 25mm thick PUF insulation (density approximately 35Kg/ M<sup>3</sup>) in between two skins (made of 24 G GI sheet) and complete with supply air outlets with volume control dampers and flexible connections, structural frame work with supports and serrated rubber pads as vibration isolators and shall be provided with thermal break at the joints of different sections. Outer skin of the AHU shall be powder coated.
- b) Base frames shall be supplied for floor mounted type units. Drain pans shall be in SS-304 construction having at least 65mm depth and shall be fabricated in such a way to form the slope towards drain point.
- c) The main structure of the Unit (i.e. framework) shall be in extruded aluminium construction. The structural members shall have industrial anodized finish to form scratch proof, corrosion resistant, smooth finish surface. The structural member shall have a thermal break between inner & outer surface to minimize heat loss. The sealing surface of the extrusions shall be provided with the groove to hold the gasket. The gasket shall be of synthetic construction having tubular shape for proper sealing. The inner face of the panels shall be flushed with inner face of the extrusions to minimize the corners.
- d) Panels of the casing shall be fitted reasonably airtight with suitable gaskets with cams or similar fastenings for easy opening.
- e) Necessary arrangement shall be provided on the casing for measuring temperature and pressure in a cooling coil.
- f) Easily open able inspection doors shall be provided at required locations for easy maintenance. The Doors shall have handles and hinges in glass filled nylon construction.
- g) The Lock shall be flushed type to minimize projections. Locks shall have proper arrangement to secure the doors tightly.

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6.08.02 Fan Coil Units

- A. The fan coil units shall be of reputed make – horizontal type for ceiling suspension. The units shall be complete with chilled water coil, one or more centrifugal fans and motors, cleanable HDPE filters, double wall insulated condensate drain pan with 15 mm thick expanded polystyrene (self extinguishing quality) insulation sandwiched between top and bottom sheets of drain pan and 18 gauge sheet steel casing panels. Horizontal fan coil units shall be provided with auxiliary secondary condensate drain pans.
- B. Access panels shall have positive locking fasteners for easy removals. The filters shall be mounted at the rear section of the cabinet with filter box.
- C. All cooling coils shall be standard three row staggered seamless copper tube with aluminium plate fins mechanically bonded to copper tubes. Tubes shall be aluminium 10 mm O.D. and wall thickness shall be minimum 0.5 mm. All bends and joints shall be enclosed within the insulated end sections of the base unit for protection against sweating. Each coil shall be provided with an air vent and drain plug. All coils shall be factory tested at 21 kg. Per Sq. cm. air pressure while submerged in water. Fin spacing shall not be less than 10 fins per inch. Tubes shall be mechanical / hydraulically expanded for thermal contact resistance with fans.
- D. Fans shall be centrifugal, forward-covered, and direct driven by shaded pole motor.
- E. All fans coil units shall be equipped with copper piping connection and manual air vent at the cooling coil. Other accessories shall be wall mounted thermostat for individual unit, containing two speed and ON / Off control for fan speed, motorized three-way diverting/mixing valve for individual unit, Y-strainer, ball valve and globe valve, adjustable discharge air grilles.
- F. The fan coil unit shall be selected for the lowest operating noise level. It should offer capacity at the lower speed.

6.09.00 Air Filters

6.09.01 Pre-Filters

The filter media shall be designed to hold dust and prevent it from being dislodged by vibration or other cause and passing through filter.

The filters shall be of HDPE construction. The filter shall have G.I. frames of adequate thickness but not less than 20 SWG suitable for long use in an industrial plant. The filters may be in panels of sizes about 600 mm x 600 mm for easy handling of the same. The face velocity of air across the filters shall not exceed 2.5m/sec and maximum limitation pressure drop will be 6 mm of WG. Filter thickness will be at least 50 mm. The efficiency shall be about 90% down to 10-micron size particles.

6.09.02 High Efficiency Filters

The filters shall be having efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fiber or cotton fabric or fabric-like material sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling.

The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall not exceed 1.5 m/sec.

High efficiency filters shall be provided with differential pressure switch with alarm.

6.10.00 **Duct Work**

6.10.01 Velocity of air in any section of the supply duct shall not exceed 8 m/sec.

6.10.02 Sheet metal thickness for AC duct shall conform to IS-655.

6.10.03 The general layout of the ducting location and number of air grilles and diffusers etc. shall conform to the specific requirements of individual areas of application so as to ensure proper air distribution of all the zones. The same shall be subject to approval by the Engineer.

6.10.04 Where dimensional locations are not indicated on the drawings, the Contractor will be responsible for the final arrangement and routing of the ductwork. Variations in duct sizes may be made as acceptable to the Owner if the cross-sectional area remains the same and the revised aspect ratio is less than four. Ductwork will be arranged to minimize pressure drop using low-loss fittings and transitions. Where radius elbows are used for duct turns, the radius ratio will not be less than 1.5 wherever possible. Where space limitations require a bend with a radius ratio of 0.75 or less, not less than two turning vanes will be installed in the bend.

6.10.05 All ductwork for supply of air inclusive of accessories such as damper, vanes, access doors etc. shall be fabricated from G.I. sheet of at least grade 180 as per IS 277 or aluminium sheet. The ductwork shall be properly reinforced to prevent sagging, buckling or vibration. Interior of all ducts shall be smooth and free from obstruction. All duct sections shall be cross-broken.

6.10.06 The construction of ducts shall conform to IS : 655/ASHRAE/SMACNA as far as applicable, unless otherwise stated here.

6.10.07 JOINTS

- a) All longitudinal joints for the ducts will be Pittsburgh Lock seam type.
- b) Transverse joints for the low-pressure ducting shall be continuous around the four sides, the corner closure are required. The type of transverse joints shall be as follows:

Large side mm	Type of transverse joints
Up to 600	25 mm wide pocket, drive or S-slip
601 - 1000	85 mm wide, bar s-slip or pocket slip.
1001 – 2250	40 mm x 40 mm x 6 mm M.S. angle connection

- c) The low-pressure ducting work shall be provided with intermediate transverse bracing continuous around the four sides between the joints according to the following sizes:

Large side mm	Bracing
0 - 450	None
451 - 1500	40 mm x 40 mm x 6 mm angle 1200 from joints.
1501 and above	40 mm x 40 mm 6 mm angle 600 mm from joints.

- d) RIVETING AND SEALING

All joints, slips and seams shall be made secure by re-verting on centres not exceeding 150 mm. All transverse stiffeners and all reinforced bar slip joints shall cross at corners and be riveted. All bar slip joints and angle iron bracing shall be riveted on centres not exceeding 75 mm.

- e) All construction joints and duct seams shall be reasonably sealed with bitumastic cold emulsion or equivalent vapour seal.

6.10.08 HANGERS AND SUPPORTS

- a) All ductwork shall be provided with adequate hangers or supports to ensure rigid support and to prevent vibration. Spacing of duct supports shall not exceed 3 m centres.
- b) Hangers shall be suspended from the building steel with provision for necessary auxiliaries, or special steel members, or by hooks fixed to the embedded plates provided in the ceiling.
- c) Hangers for all ducts shall be trapeze type with the shelf construction from 35 mm x 35 mm x 5 mm angle iron and hung by two steel rods each of not less than 10 mm dia. for ducts, with larger side less than 2250 mm while for those greater than 2250 mm shall be with 50 x 50 x 5 angles and rods not less than 16 mm dia.

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- d) All hangers and supports shall be as per drawings / specifications. When vertical ducts pass through floor slab, they shall be supported by means of collars, constructed of steel structural angles securely fastened about the girth of the duct and bitumastic compound between the horizontal leg of the supporting angle and the floor. The duct aspect ratio shall not be more than 4: 1. Turning vanes are required to be provided with bend more than 45 Deg.

#### 6.10.09 ACCESS DOORS

All main ductwork shall be accessible throughout using tight fitted hinged access doors. Doors shall have to be cemented on sponge rubber gaskets. Angle joints shall be provided with felt or rubber gaskets for leak-tightness of the joints.

Access doors/panels are to be provided at following places:

- Near each fire damper
- Near each heater coil
- Near each filter bank

In case access doors are to be installed in the insulated ducts, the access door panel should be suitably insulated, such that it can be operated without damaging the duct insulation and there should be no condensation either on the access doors or on the duct when the plant is running.

#### 6.10.10 FLEXIBLE CONNECTION

Rubber impregnated canvas or equal flexible connections of at least 150 mm length shall be provided at each connection between ductwork and fan units.

#### 6.10.11 DAMPERS

##### i) SPLITTER DAMPER

Splitter dampers in branch take off shall be provided. Dampers blades shall be minimum 16 SWG thick. Alternatively catcher shall be provided in right angle tee of ducts.

##### ii) FIRE DAMPER

Fire dampers shall be provided as per the requirement mentioned elsewhere in the specification. The fire dampers shall be of motorised / solenoid/fusible link type operated by smoke detectors of the zone fire fighting system. The fire damper shall be smoke-tight type and shall have 120 min. fire rating. Provision shall be kept for manual operation of the damper.

- Blade thickness : At least 16G CRCA
- Frame : At least 40 x 40 x 3 mm Angle.

Motorised Fire Dampers shall be rated for 240 V, 50 Hz, 1 Ph., AC supply. Motor for Fire dampers shall be continuously rated. These Dampers shall close on de-energisation and open on energisation of Motor. Provision shall be kept for manual operation of the Damper.

Fire dampers will be provided at the supply/exhaust duct for fire-rated walls/floors as required by National Fire Protection Association (NFPA) and International Building Code (IBC).

iii) ACTUATORS

The actuators will be UL listed.

Dampers will be equipped with operators of sufficient power to control dampers, without flutter or hunting, through the entire operating range at air velocities at least 20 percent greater than maximum design velocity. Operators will have sufficient power on closure to provide tight sealing against maximum system pressures. Damper actuators will be designed to provide a minimum of 200 percent of the torque required to operate the damper and to meet the air leakage criteria. Damper actuators will not be less than 2.26 N-m (20 inch-pounds). Each damper section will contain one or more damper actuators. Jack-shafting of the section is not permitted.

Operators functioning in sequence with other operators will have adjustable operating ranges and set points.

Spring-return operators will be provided for two-position control or on reversible operators where required for fail-safe operation.

Electric motor operators for modulating control will be reversible type.

Locations where temperatures fall below minimum operating temperature of operator will be heated.

When dampers are installed on ducts to be externally thermally insulated, each damper operator will be equipped with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Standoff mounting items will be integral with the operator or standard accessory of damper manufacturer.

iv) OPPOSED MULTIPLE LOUVRE DAMPER

Opposed multiple louvers dampers shall be provided at the fan outlets and wherever mentioned in the drawings, specification and fan schedule. Each blade of the dampers shall be provided with bronze, gunmetal or nylon bearing at each end of its spindle. The spindle with bearing shall be mounted in a strong structural framework. Operating lever with fixing device for keeping the damper at the desired position shall be fitted for the manually operated dampers.

Operating level will be fixed on an indicator to show the percentage of opening of the damper in all cases except for the application with grilles and nozzles.

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Velocity across the dampers shall not exceed 10 m/sec. Damper blades at fan outlet shall be made up of 16 gauge M.S.

6.10.12 DIFFUSERS, GRILLES, REGISTERS - CONVENTIONAL DESIGN

Design of grilles & diffusers shall be such as to create desired throw and spread of air and shall be approved by the purchaser/engineer.

All diffusers and grilles shall be made up of powder coated sheet steel with finish painting. Design of all diffusers and grilles shall be made by the Contractor matching with the lighting and other fittings and to be approved by the Engineer. Each supply air diffusers shall be fitted with opposed blade damper, built-in vanes and louvers arranged as per manufacturer's standard design.

Side throw type supply registers shall have two sets of adjustable louvers with opposed blade dampers. The front of louvers shall be horizontal to provide horizontal deflection and the rear set of vertical louvers shall adjust vertical deflection. The dampers shall have horizontal opposed blades regulated by an operating lever in the frame. All wall type exhaust / return air grilles shall have one set of louvers in the front. The louvers shall be fitted such as to remain in position by friction grip. All supply air grilles shall have one set of opposed multiple louver dampers at the inlet. The dampers shall be gang operated and will have a device to keep the dampers fixed in one position.

The grille frame and louvers shall be manufactured of at least 20 SWG GI sheet and 22 SWG M.S. respectively. No grilles should by any chance make any rattling sound during continuous operation. All grilles shall match the decor of the space.

All grilles/diffusers shall be fitted with suitable gasket to prevent air leakage.

6.11.00 **Insulation**

6.11.01 Thermal Insulation

- A. The following items are to be insulated:
- I. Refrigerant suction piping from the evaporator coil outlet up to the compressor inlet shall be insulated with minimum 39 mm thick aluminium foil faced Nitrile rubber/ X LPE for Screw type Package Water Chilling Unit and 26 mm Nitrile Rubber/XLPE with 30G Aluminium sheet Cladding for Precision/ Split Air Conditioner. For better efficiency of operation the liquid line running side by side with the suction line may be insulated together with the suction line already mentioned.
  - II. Double skin Casing of the cabinet type air-handling unit with at least 25 mm thick Poly Urethane Foam (PUF)/ EPS sandwiched between them.
  - III. Supply air duct and part of the return air duct passing through non conditioned space, if any, with at least 13mm thick aluminium foil faced Nitrile Rubber / XLPE Insulation.

- IV. Entire chilled water-piping, valves, chilled water circulating pumps, and chillers with 39 mm thick aluminium foil faced Nitrile rubber/XLPE.

The portion of Chilled water piping exposed to atmosphere shall be insulated with 50 mm thick (TF quality) expanded polystyrene and finished with chicken wire mesh, 12 mm thick sand-cement plaster and an overall cladding of 30G Al. sheet.

- V. Drain Piping from AHU/Precision ACs /Split AC unit/ FCU and Chillers shall be insulated with 13 mm/ 6mm (for FCU and Split units) thick aluminium foil faced Nitrile Rubber/ XLPE.

- VI. Screw type Packaged Chiller and Chilled Water Pump shall be insulated with 39 mm thick aluminium foil faced Nitrile Rubber/ XLPE.

- VII. Chilled water Expansion tank drain piping with 6 mm thick aluminium foil faced Nitrile Rubber/XLPE.

- VIII. Insulation of Precision AC Unit/ Split AC Unit shall be as per manufacture's standard.

- IX. Steam piping and other hot surfaces shall be insulated with 50mm thick fibre-glass / mineral wool / equal thermal insulation covered with 30G GI sheet.

- X. Condensate piping shall be insulated with 25 mm thick fibre-glass / mineral wool / equal thermal insulation covered with 30G GI sheet.

- XI. Roof of AC spaces shall be insulated with 25 mm thick EPS (under deck) for not exposed to sun and 50mm thick EPS (under deck) for exposed to sun.

- B. Insulation shall be fixed as per manufacturer's recommendation. Due care shall be taken to avoid damage to vapour arresters and insulation.
- C. Extra insulation thickness shall be provided at duct pipe hangers and special care shall be taken to seal the insulation and hanger member penetrations and instruments and accessories tapings.
- D. Special care shall be taken to provide satisfactory insulation for valves, flanges, vessel connections etc. with proper facility for maintenance and inspection.
- E. Insulated ducts crossing the floors shall have to be normally protected from damage and water splashing by providing suitable cladding up to 300 mm from the floor level.

6.11.02 Acoustic Insulation

All supply air ducts in the air conditioning system shall be insulated acoustically up to a length of 6 metre from the blower mouth with 25 mm thick fibre glass of density 48 Kg / m<sup>3</sup>, insulation from inside of the duct. For protection against erosion, the insulation mass shall be covered with fibreglass cloth and 30G perforated aluminium sheet provided with 30% perforation area. The protective covering shall be securely fixed to avoid dislodgement of the insulation.

6.12.00 **Precision / Split AC Units**

6.12.01 Water Cooled Precision Air Conditioners

A. Compressor

The compressor shall be hermetically sealed scroll type medium speed, single acting type designed for R-407C/410A duty. The compressor shall be complete with crank case heater (to be energised when compressor is on off cycle).

The compressor shall have proper lubrication system. Safety devices viz. high-pressure switch, low-pressure switch, low oil pressure (if applicable) shall be provided and such devices shall be electronically operated. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 110% of the rated power required for the unit including drive loss.

Capacity control shall be devised by providing at least two compressors.

B. Condenser

All condensers shall be of shell and tube type with water in the tubes and refrigerant in the shell.

The heat exchanger shall be designed for a minimum working pressure of 10.5 kg/cm<sup>2</sup> gauge on the water side and 19.0 / 27.0 kg/cm<sup>2</sup> for R-407C / 410A on the refrigerant side and shall generally conform to the latest ASME CODE for unfired pressure vessels Section- VIII. The design pressure shall have a reasonable margin over the maximum working pressure.

The average velocity of water in tubes shall not be more than 2.5 m/sec.

Water heads or refrigerant heads of the heat exchangers shall be as not to allow leakage of fluid from one pass to the other.

Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating.

The overall fouling factor for the condensers shall be 0.0002 Hr.M<sup>2</sup>C/K.Cal.

The condensers shall be designed to provide at least 2 °C sub cooling of refrigerant under rated design condition.

Testing and other design feature of the heat exchanger shall meet the requirements of TEMA Class-C heat exchangers or approved equal.

The heat exchangers shall have open able water boxes for ease in maintenance.

The tubes for the condensers shall also be copper with integral fins. The tube wall thickness at any point shall not be less than 18 SWG.

The baffle plates and the tube sheets shall be made of steel. The shell shall be made up of seamless tube or shall be fabricated from flange quality steel plate (ASTM-A285 Grade-C). The tube support plates shall be made of flange quality carbon steel plates and shall be as per TEMA Standard.

The heat exchangers shall be provided with vent valve, relief valve, and/or safety fusible plug on refrigerant side and vent valve and drain valve on water side (at every section of the baffled shell of heat exchanger).

The tenderer shall quote packaged units having compressor, condenser and evaporator assembly together in a single framework and mounted on a common base plate. Provision for refrigerant charging and chemical cleaning of water tubes shall be provided.

Each heat exchanger shall be provided with water flow switch. This shall be interlocked with the control of the individual refrigeration system/corresponding compressor drive.

All the heat exchangers shall be provided, with standard connections like thermo wells, inspection valve and antifreeze thermostat and external equaliser connection for expansion valves. Insulation shall be terminated in such a manner that it will not be damaged during removal of bolts, covers etc. Separate covers similar to flange covers shall be constructed to facilitate easy removal.

The design pressure shall have a reasonable margin over the maximum working pressure.

C. Evaporator Cooling Coil

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

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The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by electronic expansion valve. Temperature control shall be through microprocessor based control panel. Insulated condensate drain pan of SS construction shall be provided within the unit.

The unit shall be factory assembled, wired, with inter connecting refrigerant piping and built-in microprocessor based control console and tested as per the relevant code.

The cooling coil shall be to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the tenderer.

D. Evaporator Fan

The fan shall be heavy duty DIDW centrifugal type statically and dynamically balanced with forward/ backward curve blade, directly driven by high efficiency EC motors. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts. The fan motor shall be mounted within the cabinet. Motor horsepower shall be sized for 120% of the rated power required.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

E. High Efficiency Filter

A set of High efficiency filters will be located inside the PAC unit cabinet. The filters shall be high efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fiber or cotton fabric or fabric-like material sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling them.

The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall preferably not exceed 1.5 m/sec.

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F. Humidifier

The humidifier shall be of Electrode type and shall be placed inside the PAC unit cabinet. The humidifier shall be electronically controlled through the built-in microprocessor based control panel of the unit. A provision of make-up water connection with the humidifier shall be kept with the Unit cabinet.

G. Electric Strip Heater

The PAC unit will be provided with built-in electric strip heater electronically controlled through the built-in microprocessor based control panel of the unit.

Such control includes both operating and safety controls with the sense of air temperature at the RA path and at the downstream side of the heater respectively.

H. Casing and Cabinet

All components shall be housed in a welded sheet metal cabinet of double skin of not less than 22 G thick MS powder coated sheets. The gap between two skins is filled up with at least 25mm thick PUF/ EPS insulation. Different sections will be constructed with framework and connected with each other in an airtight manner through gaskets, thermal barriers and sealant.

Removable panels shall be constructed of framed 1.6 mm sheet steel with angle iron framing. Units shall be provided with 316 L.S.S. fasteners for easy removal and access for servicing. Air handling section of evaporator shall be provided with an acoustic lining of 25 mm thick fiberglass covered with fiber glass cloth and perforated aluminium sheet on the inside surface of the unit casing.

The return air opening shall be on the front face with a matching grille of same colour finish.

6.12.02 Air Cooled Precision Air Conditioners

A Compressor

The compressor shall be hermetically sealed scroll type medium speed, single acting type designed for R-407C/410A duty. The compressor shall be complete with crank case heater (to be energised when compressor is on off cycle).

The compressor shall have proper lubrication system. Safety devices viz. high-pressure switch, low-pressure switch, low oil pressure (if applicable) shall be provided and such devices shall be electronically operated. Manual reset on safety cut out shall be provided. The horsepower for the compressor motor shall be adequately sized or 110% of the rated power required for the unit including drive loss.

Capacity control shall be devised by providing at least two compressors.

B Condenser (Outdoor Unit)

The Condenser shall be of Air Cooled type and shall be constructed of copper tube with aluminum fins. Tubes shall be designed for a minimum working pressure of 30 kg/ sq. cm. The condenser shall be complete with fans with drive motors and shall be provided with charging connection, safety relief valve and standard accessories, all encased in a powder coated GI casing with built-in electrical items and supporting frame. The condenser shall have the matching capacity with the compressor. There shall be a provision of isolating switch for the fans.

C Evaporator Cooling Coil

The cooling coil shall be direct expansion type with multi-row deoxidised copper tubes with aluminium fins. Air velocity across the coil shall be limited to 2.5 m/sec. The coils shall be pressure tested and thoroughly dehydrated before assembling.

The coil shall be placed to make the system draw through type. Refrigerant feed control shall be by electronic expansion valve. Temperature control shall be through microprocessor based control panel. Insulated condensate drain pan of SS construction shall be provided within the unit.

The unit shall be factory assembled, wired, with inter connecting refrigerant piping and built-in microprocessor based control console and tested as per the relevant code.

The cooling coil shall be to produce the capacity required under specified coil condition and air quantity. Heat load calculation to check the system selection shall be carried out and submitted by the tenderer.

D. Evaporator Fan

The fan shall be heavy duty DIDW centrifugal type statically and dynamically balanced with forward/ backward curve blade, directly driven by high efficiency EC motors. Fan wheels and casing shall be constructed of steel and mounted on steel shaft. The bearings shall be ball bearing type mounted on vibration absorbing rubber mounts. The fan motor shall be mounted within the cabinet. Motor horsepower shall be sized for 120% of the rated power required.

The supply fan shall be sized to deliver the required air quantity against the total external static pressure required for the system application, after taking care of all internal static pressure requirements of the units.

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E. High Efficiency Filter

A set of High efficiency filters will be located inside the PAC unit cabinet. The filters shall be high efficiency of 99% down to 5 microns. The filters shall be of cleanable type construction of reinforced glass fiber or cotton fabric or fabric-like material sandwiched in between two galvanized wire netting arrangement in a uniformly corrugated form to increase the surface area.

The filters shall have G.I. frames of adequate thickness suitable for long use in an industrial plant. The filters may be in panels of size about 600 x 600 for easy handling them.

The filter panels shall be mounted on the ladder type angle iron holding frames. The frames shall be designed strong enough to take the load of double the pressure drop in dirty condition of the filters. Face velocity of air across the filters shall preferably not exceed 1.5 m/sec.

F. Humidifier

The humidifier shall be of Electrode type and shall be placed inside the PAC unit cabinet. The humidifier shall be electronically controlled through the built-in microprocessor based control panel of the unit. A provision of make-up water connection with the humidifier shall be kept with the Unit cabinet.

G. Electric Strip Heater

The PAC unit will be provided with built-in electric strip heater electronically controlled through the built-in microprocessor based control panel of the unit.

Such control includes both operating and safety controls with the sense of air temperature at the RA path and at the downstream side of the heater respectively.

H. Casing and Cabinet

All components shall be housed in a welded sheet metal cabinet of double skin of not less than 22 G thick MS powder coated sheets. The gap between two skins is filled up with at least 25mm thick PUF/ EPS insulation. Different sections will be constructed with framework and connected with each other in an airtight manner through gaskets, thermal barriers and sealant.

Removable panels shall be constructed of framed 1.6 mm sheet steel with angle iron framing. Units shall be provided with 316 L.S.S. fasteners for easy removal and access for servicing. Air handling section of evaporator shall be provided with an acoustic lining of 25 mm thick fiberglass covered with fiber glass cloth and perforated aluminium sheet on the inside surface of the unit casing.

The return air opening shall be on the front face with a matching grille of same colour finish.

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S. A. I. Khan  
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6.12.03 Non-Duct able Split Type Air Conditioning Units

A. General

- I. The split type room air conditioner consists of two units one Indoor unit (Evaporator) & an Outdoor unit (Condenser). It will be complete with all components to perform filtering and cooling of air in all seasons except winter. The refrigerant condenser will be air-cooled. The unit will be suitable for wall mounting.
- II. The unit shall have normal rating capacity as per the schedule mentioned elsewhere in the specification measured at a room temperature 24 °C DB and RH not exceeding 65% under design outside conditions specified elsewhere. The capacity variation should not be more than 5%.

B. Indoor Unit

- I. The indoor unit consists of panel type dry filter, cooling coil, evaporator fan etc.
- II. The filter is panel type dry having an efficiency of 90% down to 10-micron size Particles. The filter media shall be designed to hold dust, sand and prevent it from being dislodged by vibration or other cause and passing through filter. The face velocity of air across the filters shall not exceed 2.5 m / sec.
- III. Cooling coil will be direct expansion type made of seamless copper tubes with aluminum fins, number of fins as per manufacturer's standard but not more than 13 per inch & R22. The coils should be located at the suction side of the Evaporator Fans. Velocity of air across the coils shall be limited to 2.5 m/sec.
- IV. Piping accessories like Hot gas piping, cold gas piping and liquid refrigerant pipeline all made of copper complete with at least 26 mm thick Aluminium foil faced Nitrile rubber / XLPE or equivalent insulation interconnecting indoor and outdoor units, liquid line valves, liquid refrigerant piping, gauges and instruments, filter-drier, moisture indicator, isolating valves etc., shall be provided as may be required for safe and trouble free operation.
- V. The evaporator fan shall be Centrifugal, DIDW with forward Curved blades directly driven by TEFC squirrel cage induction motor operating in AC 240 V  $\pm$  10%, 1 Ph, 50 Hz  $\pm$  5% supply, with 3- step speed control. The evaporator fan shall be both statically and dynamically balanced.

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- VI. Sheet metal casing with inspection facilities, made of Powder coated M.S. sheet and complete with suitable refrigerant pipe connections, insulated drain pan, insulated drain piping, supply and return air opening with decorative grilles with automatically swiveling louvers (for supply air grilles). The casing should be insulated inside to prevent condensation. This shall be provided from inside surface to limit the noise.

C. Outdoor Unit

- I. The outdoor unit shall consist of a compressor, air cooled condenser with liberally sized aluminium finned copper tube coil and low noise directly driven fan and totally enclosed weather proof motor housed in power coated MS casing.
- II. The Compressor shall be rotary type with R-22 refrigerant of specified capacity & motor. The compressor assembly shall be adequately designed for minimum vibration and noise disturbances. The compressor rotor assembly shall be dynamically balanced. The shaft seal shall be of proven design. The horsepower for the compressor motor shall be sized for 115% of rated power required for the unit including the drive loss.
- III. Accessories like Suction and discharge valves, safety valve, HP and LP cut out switches, powder coated sheet metal casing, vibration-isolating device, foundation bolts, built in Electricals like starters, switch fuse units, relays, contactors. The speed of the compressor should not exceed 1500 rpm.
- IV. Air-cooled condenser with directly driven axial flow fan & adequately sized drive motors (TEFC squirrel cage Induction type) with relief valve, hot gas connection, charging connection with valve, louver at the intake & exhaust of air, and other standard accessories. The condenser fan shall be both statically and dynamically balanced.
- V. The heat exchangers shall be designed for a minimum design test pressure of 20.33 Kg/m<sup>2</sup> on the refrigerant pipe. The design pressure shall have a reasonable margin over the maximum working pressure. Tube supports of adequate strength shall be provided to prevent the tubes from sagging and vibrating. The condensers shall be designed to provide at least 4 °C sub cooling of refrigerant under rated design condition. The unit should be operating free from any vibration and noise.
- VI. The piping will be thermally insulated wherever required such that there is no condensation on the outside of the piping. The insulation will be of Aluminium foil faced X LPE or Nitrile rubber or equivalent.

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- VII. Refrigerant piping shall be either of M.S. seamless (as per IS-1239, Part-I heavy grade) or copper tube (IS-5493) or ASA-9-31.5). Pressure drop in hot gas, liquid and suction lines should not exceed the value corresponding to 2 °F change in saturation temperature of the refrigerant. Velocity in the discharge and suction pipe of the refrigerant shall not be so high as to create undue vibration and noise, velocity in the vertical length of discharge and suction pipe of the refrigerant shall be high enough to carry the entrained oil in the refrigerant, even in case of unit running at lowest partial capacity. Instrument piping for gauges, switches etc. shall be of copper only.
- VIII. All the above equipment along with the electrical items like starter, contactor and other controls shall be encased in a powder coated MS casing. The casing shall be complete with supports fabricated out of MS angles, & sheets (duly painted), anchor bolts, nuts etc. The entire unit shall be installed with rubber pad type vibration isolators.
- IX. All refrigerant valves as may be applicable shall have steel or brass body with flange connection or socket connection for welding or brazing to pipe. For copper pipes size 5/8" and below flare connection will be acceptable. It is preferable to have the stems of rising stems inside screw type. The valve body and bonnet connection shall have bolted or welded connection.
- X. It is preferable to have Teflon gland packing for the valves. The construction of the discs of the valves shall be either globe or angle type. The valve seat shall have white metal lining or any equivalent soft replaceable lining. The valves shall be of tested quality. Leak tightness of the valves shall be tested at minimum 1.5 times the design pressure for the system.

6.13.00 **Fresh Air System**

6.13.01 For critical areas like control room, control equipment room etc., outside fresh air will be inducted into the AHU room/ PAC room through a Fresh Air system consisting of an inlet louver, dry panel type filter, a fan with a short duct (if necessary), SA register and mixed with the return air in AHU room/ PAC room.

For other non-critical areas like service building fresh air will be inducted in the AHU room through the wall mounted rain protection cowl with bird screen and a volume control damper.

6.13.02 Energy Recovery Ventilator (ERV)

Fresh air system for the SWAS rooms and Conference room and other areas served by FCUs / Non Duct-able Split Air Conditioners, involves Energy Recovery Ventilators (ERV).

ERV shall consist of inlet fresh air fan motor set and room air exhaust fan motor set with individual ducts with grilles/cowls, a molecular sieve coated aluminium energy recovery wheel along with drive motor for exchange of heat between fresh air and room exhaust air, powder coated sheet metal casing insulated with 13 mm closed cell high density insulation, washable synthetic pre-filters, brush seals to minimize cross contamination, corded remote control panel. The ERV will be suitably mounted on the inside wall of the conditioned space.

6.14.00 **Miscellaneous Items**

6.14.01 HEATER

A. STRIP HEATER

- I. Heating equipment wherever required shall be electrical type. All frame members, control box cover and associated sheet metal parts are to be heavy gauge steel with corrosion resistance treatment. Heating equipment may be required for winter heating as well as for reheating. Reheating heaters may be used for winter heating also.
- II. Electric heaters will be fin-tube type of specified KW rating, with fins permanently brazed to metal sheath. The metal sheath and fins will be of G.I. sheet material.
- III. Wherever electric heaters are installed in the ductwork, size of ducts should be suitably increased to offset the additional resistance created by the heaters. All heaters shall be mounted on such insulators that there shall be no leakage current under all weather condition including high humidity operation. The mounting frame shall be suitably grounded by earth wires / earth leads of two points.
- IV. An air stat is to be installed such that in case there is no circulation of air over the heater coils the heaters will be de-energised. Wherever the heaters are installed in the ductwork the terminal block will be such positioned in a junction box that it will be outside the ductwork in an accessible position. The junction box will be vermin proof, rat proof and provided with a hinged cover. A caution plate as per I.E. rules will also be provided. Access door will be provided in the duct near the heating coil for easy inspection and removal / replacement / fixing of individual strip heaters. The capacity of heaters will be distributed over three phases.
- V. In case of reheating the heater will be controlled by humidity sensor & humidity transmitter and in case of winter heaters it will be controlled by temperature sensor & temperature transmitter.

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B. Electric Room Heater

Electric Room Heaters shall be with High / Low control.

Electric Room Heaters shall be suitable for AC 240 V  $\pm$  10%, 1 Ph, 50 Hz  $\pm$  5% supply.

6.14.02 Electrode Humidifier

A. Electrode humidifier consists of high temperature Polypropylene water tank, electrodes, auto flash cycle activated on demand from the microprocessor based control system with humidity sensor, located in the AHU / PAC room. Such Humidifier shall be controlled by its own stand-alone microprocessor based control panel. Alarm indication will be provided for low water level in the water tank.

B. Whenever the relative humidity of the conditioned space reaches the minimum allowable percentage of humidity, the humidifier shall be energized to restore the relative humidity. The humidifier shall be such controlled that it shall not exceed the maximum allowable limit of relative humidity in the conditioned space. The humidifier shall be sized and designed accordingly.

6.14.03 Non Chemical Water Treatment Equipment

A. The water treatment equipment is a 1 M long pipeline, which once installed, stops the formation of scale in the heat exchange zones completely.

B. The water treatment equipment consists of Metal Cell and Core and is installed on line after the pumps and before the heat exchange zone. The distance of the heat exchange zone should not be more than 30 M and there should not be any static area between the water treatment equipment and heat exchange area.

6.15.00 False Ceiling

6.15.01 SCOPE

The work under this Section shall include the supply and installation of suspended ceiling using GYPSUM boards together with the suspension system as shown on drawing or specified in Schedule with all materials labour and equipment. The work shall also include providing of openings in the ceiling for lighting, air conditioning diffusers etc. as shown on drawings or instructed by the Engineer.

6.15.02. INSTALLATION

A. Suspension System

General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural walls, slabs and beams or trusses.

All members of the suspension system shall be of sufficient strength and rigidity to carry the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be securely fixed to walls. All drillings of structural concrete or welding to steel for installation of the suspension system shall be included in the rate. All M S sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

Metal Grid Suspension System

Aluminium grid ceiling system shall be "Beadlock" as manufactured by W A Beard shell and Co. Pvt. Ltd. or approved equal. Steel grid ceiling system shall be jolly snap grid as manufactured by Anil Hardboards Ltd. or approved equal.

Angle cleats or other suitable fixing device shall be fixed to the structural beam or slab above for fixing of hangers. Main runners shall be hung by MS flats, angles or 12 g or heavier galvanized tie wire hangers at maximum 1.2 centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings.

The cross tees shall intersect main runners in pattern shown on drawing and positively looked together with intersection clips. All perimeter areas shall have angle mouldings fixed to vertical wall surfaces & end tees shall rest on the moulding, unless otherwise shown on drawings.

B. CEILING PANELS

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For exposed grid ceiling system, tile hold down clips shall be used at the rate of minimum one per 1.2 meter length of perimeter. These shall however be omitted in access panels which shall be located as per the instruction of the Engineer.

For concealed grid ceiling system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Where shown on drawings and schedule of items, 6 mm thick cement: lime: sand surface of ceiling boards and finished in a true and even surface without undulations suitable for subsequent painting. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

6.15.03 ACCEPTANCE CRITERIA

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from sags, warps, figures or damaged boards. Joints, exposed grids etc. shall be in true lines and symmetrically placed in manner shown on drawings. Cut outs for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.

6.15.04 RATES

Shall be lump sum rates for complete items called for in the "Schedule of Items". No extra payment will be made for arrangement for lighting fixtures, air conditioning diffusers, access panels, etc. The rate shall include all cutting and wastage from standard size sheets, boards, runners, etc.

6.16.00 Controls & Instrumentation

6.16.01 Control System

A. All control shall be electrical / electronic type depending upon the requirement & as specified under the specification.

B. Chilled Water System Controls

All safety controls against high refrigerant pressure, low refrigerant pressure, low oil pressure, high and low voltage, compressor over-load and protection against freezing of the water chiller, low flow condenser cooling water & chilled water shall be provided.

All safety controls against antifreeze protection, pump cavitations, motor protection etc. shall be provided.

Operating thermostat/ temperature sensor sensing outlet water temperature of chiller shall be provided for each compressor. This thermostat/ temperature sensor shall control the liquid line solenoid valve in conjunction with the capacity controller for Screw type. Automatically operated heaters with safety thermostats & automatic unloaded starting device shall be provided for the compressor. Antifreeze thermostat to trip off respective compressor shall be provided for each compressor.

C. Direct Expansion System Controls

All devices for automatic refrigerant flow control by thermostatic expansion valve sensed by the superheat in suction line, solenoid valves in the liquid line to operate in conjunction with automatic capacity control of compressor by room thermostat (as applicable) sensing from the inside temperature of the conditioned space is to be provided. High pressure and low-pressure cut out, low oil pressure cut out (if applicable), high and low voltage protection, compressor motor overload protection shall be provided. Automatically operated crank case heater with safety thermostats shall be provided for reciprocating compressors.

D. Air Handling Unit Controls

The temperature of all conditioned spaces shall be maintained / controlled by a modulating type 3 way mixing valve. The modulating motor will be operated by getting sense from the temperature sensor and associated transmitter placed in the return air path. There shall also be control valves in the chilled water line (for chilled water units) for manual control of chilled water flow into the cooling coil. These control valves shall be flow regulating cum measuring type with precision adjustment arrangement.

E. Annunciations

Audio-visual alarm facility is envisaged of the system. Details of the annunciation system shall be as detailed elsewhere in PART-C

6.16.02

**Miscellaneous Instruments**

- A. The pressure indicators and temperature indicators shall have minimum 150 mm size dial. The pressure gauges shall be Bourdon type and complete with isolating/valves. The pressure gauge shall conform to IS: 3624 and temperature gauge as per BS: 1041.
- B. Water flow switch shall be vane actuator type or differential pressure type, with adjustable actuation set point. The level switch shall be ball float operated magnetic type complete with cage. The switch case shall be weather proof conforming to NEMA-4.
- D. Apart from the thermostat, pressure switches, level switches and level indicators specified in this tender document, the local instruments shall also be furnished as a part of the system as shown in drawings enclosed and as per functional requirement.
- E. The range of controls and instruments should be such that the operating ranges are preferably in the mid scale. The accuracy should not be less than + 1% of full scale deflection. The repeatability of readings shall be + 1%. The differential in controls should be such that the equipment is able to operate at desired settings or maintain desired condition.
- F. The scale of pressure indicators for refrigerants units will be in kg/cm<sup>2</sup>. Saturation temperature of the refrigerant in use, at the corresponding pressure should also be indicated in the scale. The suction and oil

gauge shall be compound gauge. The scale of pressure indicator for pumps will be in meter. The temperature indicator's scale will be in °C. The range should be such that even when the equipment is idle and the temperature of the medium is at such variance, the indicator will not be damaged.

- G. All instruments should be such selected and installed that they are easily readable from the floor.

7.00.00 **SPECIAL TOOLS**

The supplier shall furnish a complete set of all special tools, wrenches etc. with necessary toolboxes as required for erection, operation & maintenance, overhaul or complete replacement of any equipment supplied under this specification. The supplier shall enclose a list of such tools recommended by them.

8.00.00 **SPARE PARTS**

8.01.00 The supplier shall furnish and quote the Mandatory spare parts for the complete Air Conditioning System Equipment as per the list attached in the other part of the specification.

9.00.00 **TESTING AND INSPECITON AT MANUFACTURER'S WORKS**

9.01.00 The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of the applicable codes.

9.02.00 Following tests shall be carried out during and after completion of different component parts as applicable and in accordance with the requirements of the applicable codes.

9.03.00 Material analysis and testing shall be carried out.

9.04.00 Hydraulic test for pressure parts including piping of VAM & its components, pumps, compressors & its components, vessels etc.

9.05.00 Dynamic balancing of all the rotating parts is to be done.

9.06.00 Performance test of Vapor Absorption Chiller, pump, compressors, condenser, cooling towers and air handling units shall be done as per code procedure.

9.07.00 Tests on motors as per Indian Standard IS-325 and IS-4029.

9.08.00 Other tests, as necessary and recommended by the manufacturer.

Test certificates and reports shall be made available to the Purchaser / Engineer on the above tests, for approval and before despatch of equipment.

The representatives of Purchaser / Engineer shall be given full access to all tests. The Tenderer shall inform the Purchaser / Engineer within 21 days prior to important shop tests so that if the Purchaser / Engineer so desires, their representatives can witness the tests.

Cost of conducting all shop tests shall be borne by the supplier.

10.00.00 **FIELD TEST**

10.01.00 Overall performance of the air conditioning system with peak summer and monsoon outside conditions as well as individual equipment shall be tested after complete installation at site. Duration of such test shall be 72 hours. This test shall be carried out to determine whether the plant meets the performance requirements specified here in and shall include measurements of all parameters under various outside conditions and establishment of correct supply of equipment. All testing and calibrating instruments required for this purpose shall be supplied by the contractor.

10.02.00 Inspection and testing of duct work

All component and duct work supplied shall be subjected to inspection and testing as per relevant codes and standard.

10.03.00 All ductwork shall be carefully examined to determine their performance with the specification with respect of dimensions, materials, marking, leakage, workmanship and other requirement.

10.04.00 The contractor shall give assistance for all site tests of the equipment according to prescribed procedure laid down by the Manufacturer / Engineer.

11.00.00 **PERFORMANCE GUARANTEE, TOLERANCE, PENALTY AND RECORDS**

11.01.00 The tenderer shall have to guarantee the performance of individual equipment as specified in the specification. Notwithstanding the capacities mentioned in the specification the tenderer shall have to guarantee maintenance of the inside conditions in accordance with "Performance and Material Requirement" clause mentioned in the specification.

11.02.00 **Rectification of deficient performance**

If the shop / site performance tests indicate the failure of the guaranteed performance of the equipment concerned, the tenderer will be given sometime to make good the deficiency at his own cost by incorporating the necessary modification, alteration and replacement.

11.03.00 **Test Records**

The certificates and records of the above mentioned tests should be submitted to the Purchaser for approval. The manufacturer shall maintain records of all tests required in the specification for at least 5 years. A list of records shall be submitted to the Purchaser on completion of the job. The Purchaser shall be able to obtain certified copies of such records at any time.

12.00.00 **SPECIAL CLEANING, PROTECTION & PAINTING**

12.01.00 Internal surface of all parts shall be cleaned to remove loose scale and dirt. The external surface of the motor and end shield shall be sand blasted to remove all rust, scale etc. All sharp edge shall also be removed. Welded rods, studs and other foreign objects shall be removed prior to final assembly. Excess oil and grease shall be removed by wiping.

12.02.00 All parts shall be painted with two (2) coats of rust preventing paint. One (1) coat of final paint shall be applied over and above the rust proof paint before despatch of material.

12.03.00 All equipment shall be boxed / crated or otherwise protected for shipment. Dry nitrogen desiccant and other protection shall be provided as may be necessary.

13.00.00 **DOCUMENTS, DATA TO BE FURNISHED WITH TENDER PROPOSAL**

13.01.00 Beside submitting the enclosed Proposal Exhibit Sheets duly filled in, the proposal shall also include the following drawings, curves and information wherever applicable.

Preliminary cooling and heating load calculation is to be furnished.

13.02.00 Preliminary equipment layout drawings of the air conditioning plant room, AHU room and preliminary ducting layout drawing are to be furnished.

13.03.00 Manufacturer's catalogue and literatures incorporating outline and sectional drawings and ducting data for the following equipment:

Vapour Absorption Machine

Screw Compressor

Water-cooled Condensers

Chiller

Air handling unit (Fan, cooling coil & filter)

Drive motors for various equipment as applicable

Condenser cooling & chilled water pumps

Cooling tower

Non chemical water treatment

Water-cooled precision air conditioner

- Air-cooled precision air conditioner  
Air-cooled Non Duct able Split Air-conditioner  
Fan Coil Unit  
Energy Recovery Ventilator (ERV)
- Motor  
Direct Digital Controller
- 13.04.00 Manufacturer's selection chart for the following equipment:  
Vapour Absorption Machine  
Water-cooled Screw Chiller
- AHU  
Water-cooled precision air conditioner  
Air-cooled precision air conditioner  
Air-cooled Non Duct-able Split Unit
- Pump  
Cooling Tower  
Energy Recovery Ventilator (ERV)
- Fan  
Fan Coil Unit
- 13.05.00 Manufacturer's catalogues and literatures on air conditioning system, instruments and controls.
- 13.06.00 Sectional drawings for air diffusers and grilles, as applicable.
- 13.07.00 Manufacturer's data sheets for filters and refrigerant.
- 13.08.00 Drive list
- 13.09.00 A detailed experience list about supply for system of similar type for similar application mentioning in each case the salient technical parameters, date of commissioning and name of customers.
- 13.10.00 A comprehensive write-up and / or brochure on details of manufacturing and testing facilities in the shop of the manufacturer.
- 13.11.00 Any other relevant data and particulars.
- 14.00.00 **POST AWARD DOCUMENTS, DATA TO BE FURNISHED**
- 14.01.00 **Description of the system offered**
- 14.02.00 Sizing calculations for all equipment and accessories which include cooling and heating load calculations, system pressure drop calculations, duct sizing calculations, pump capacity calculation, calculations for AHUs/FCUs and fresh air fans.

- 14.03.00 Particulars of drawings, data, instruction manual and Drive List.
- 14.03.01 Equipment layout drawing for  
Vapour Absorption Machine  
Packaged Screw Chiller  
Air conditioning plant room  
Air handling unit room  
Cooling Tower  
Pump  
Expansion Tank  
Make-up Water Tank  
Water-cooled precision air conditioner  
Air-cooled precision air conditioner  
Air-cooled Non Duct-able Split Unit  
Fan Coil Unit
- 14.03.02 Schematic flow and instrumentation diagram of the complete system indicating the limits of supply and erection.
- 14.03.03 Ducting layout drawing showing the details of duct sizes, duct joints, duct insulation, duct supports, diffusers, grilles, dampers etc.
- 14.03.04 Layout drawings showing the route of Steam piping, refrigerant piping and cooling water piping with details of insulation hangers, supports etc.
- 14.03.05 Outline drawings incorporating all principal dimensions, civil foundation drawings and weight etc. and also sectional drawings incorporating data of material of construction wherever applicable for following equipments:  
Vapour Absorption Machine  
Water-cooled Screw Chilling Unit  
Air handling unit  
Water-cooled precision air conditioner  
Air-cooled precision air conditioner  
Air-cooled Non Duct-able Split Air conditioner  
Drive motor for above equipment as applicable  
Cooling tower  
Expansion tank  
Make-up Water Tank  
Energy Recovery Ventilator (ERV)  
Fan coil unit

- 14.03.06 Drawings and data sheets of each of Equipment and Instruments.
- 14.03.07 Drawings and data sheets for air filters, refrigerant / filter drier.
- 14.03.08 Write up on system interlock and / or interlock block diagram.
- 14.03.09 Electrical schematic and wiring diagram for control panel and the system as applicable with back-up write-up.
- 14.03.10 Control panel / Switchgear outline drawings, bill of instruments and drawings showing construction of control panel / switchgear.
- 14.03.11 Reflected False Ceiling Plan indicating detail of supports/ hangers, grids, fixing detail of Grilles and diffusers and lighting fixtures etc.
- 14.03.12 Fixing/ application detail of under deck insulation indicating type and thickness and weight of insulation.
- 14.03.13 Other drawings and data.
- 14.03.14 Material test certificates.
- 14.03.15 Shop test reports and certificates.
- 14.03.16 Operation, maintenance and overhauling manuals shall be provided as per following specification.

#### OPERATION AND MAINTENANCE MANUAL

The successful tenderer, shall prepare, during the project execution stage a manual giving details of operation and maintenance instructions. The manual will be comprehensive manual and will be provided by the Engineer. The manual shall cover but not limited to the following aspects:

- i) Equipment description with design particulars.
- ii) Installation and Maintenance Instruction including preventive maintenance requirements.
- iii) Instruction for pre-commissioning check-up, operation.
- iv) Trouble shooting.
- v) Spare Parts list.
- vi) Lubricant and lubrication schedule
- vii) Control logic and inter connection and calibration of controls.
- viii) System description
- ix) Necessary drawings, illustration
- x) List of manufacturer's name and catalogues
- xi) Safety instructions.

The manual shall be securely bound in hard back durable folder with proper indexing and separators.



**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
PROJECT SPECIFIC GENERAL  
REQUIREMENTS**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: II B

SECTION : C 2B

REV. 00

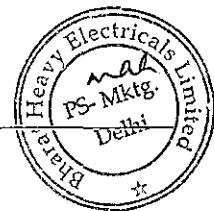
**SECTION: C 2B**

**CUSTOMER SPECIFICATIONS  
PROJECT SPECIFIC GENERAL REQUIREMENTS**

*Mukesh K. S. Sinha*  
MUKESH K. S. SINHA  
*S. A. Khan*  
S. A. KHAN  
*Sharma*  
SHARMA

*Signature*  
S.D. ICHMAN  
MUKESH K.S. SINGH

VOLUME : IIA  
SECTION-IV  
GENERAL TECHNICAL REQUIREMENTS



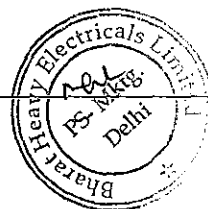
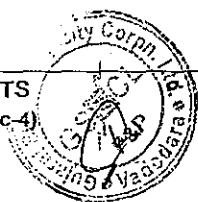
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*Handwritten signatures and names:*  
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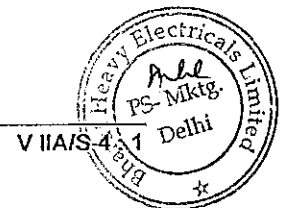
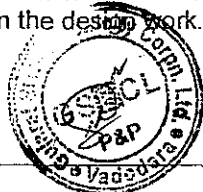
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SECTION-IV

GENERAL TECHNICAL REQUIREMENTS

- 1.00.00 **CODES AND STANDARDS**
- 1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.
- 1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.
- 1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.
- 1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.
- 1.05.00 All latest codes & standards shall be considered upto the base date. The base date to be considered for codes and standards is fifteen (15) days prior to opening of price bid.
- 1.06.00 Successful Bidder to furnish two (2) sets of latest International Codes and Standards which have been used for their plants, equipments and system. IS Codes, ASME codes, ASTM codes need not to be furnished. However, International Performance Test Codes shall be furnished as applicable.
- 2.00.00 **RESPONSIBILITY FOR DESIGN**
- 2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

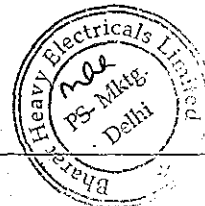
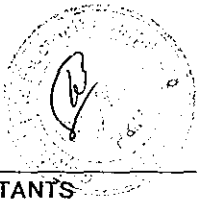
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- 2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.
- 2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.
- 2.04.00 Bidder shall comply with the requirements of CPCB and MOEF along with specification requirements whichever is stringent.
- 2.05.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.
- 2.06.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.

3.00.00 **NAME PLATES (RATING PLATES)**

- 3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
- 3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.
- 3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.
- 3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.



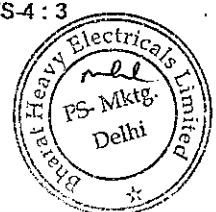
- 4.00.00 SAFETY AND SECURITY
- 4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.
- 4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.
- 4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.
- 4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.
- 5.00.00 GUARDS
- 5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.
- 5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.
- 5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.
- 5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.
- 5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

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6.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

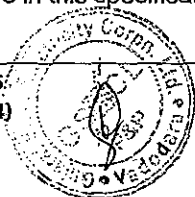
Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

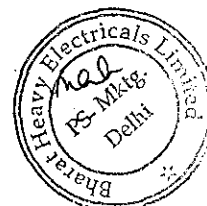
- a) The minimum width of clear access corridors around equipment shall be one (1) meter.
- b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
- c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of two (2) meters shall be maintained between the floor and any overhead piping/cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.

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- f) All rail/road crossings for pipe/cable racks shall be done with minimum 7 meters clear headroom. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.
- g) Cubicle for operating personnel shall be located at safe place near the equipment.
- h) All underground cables in the plant shall be placed in covered reinforced concrete cable trenches. Pipes shall in general be routed above ground and on pedestals, and at road crossings, pipe racks shall be provided. Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.
- i) Concept of various mechanical and electrical equipment location and building dimensions as shown in Plot Plan/Floor Plan drawing are to be adhered to.

However, size of buildings & facilities as stated above, shall be finalized by EPC Contractor considering the basic design criteria of layout as indicated in the specification.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

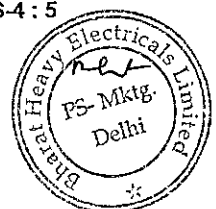
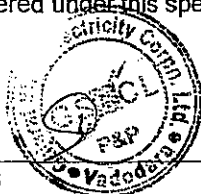
7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance.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

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

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



*Handwritten notes and signatures on the left margin:*  
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PS-Mktg. Delhi  
S.A. ICHMAN  
MUKESH K. SINGH

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 **MATERIALS**

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Engineer to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 **LUBRICATION**

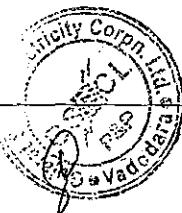
9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

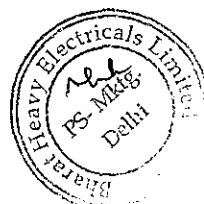
9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

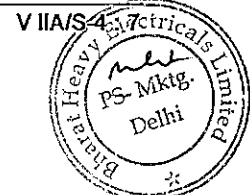


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- 9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.
- 10.00.00 **LUBRICANTS AND CONTROL FLUIDS**
- 10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and fill COD of respective units.
- 10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.
- 10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.
- 11.00.00 **OPERATION AND MAINTENANCE**
- 11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.  
The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.
- 11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.
- 11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
- 11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.
- 11.05.00 On completion of commissioning; a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

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11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 **PLANT LIFE AND MODE OF OPERATION**

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum  
(Based on HPT metal temperature)

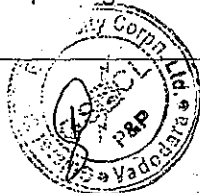
- |   |   |              |
|---|---|--------------|
| Cold start-up (>50 hrs. shutdown)                 | : | 20 per year  |
| Warm start-up (between 10 to 50 hrs. of shutdown) | : | 40 per year  |
| Hot start-up (less than 10 hrs. shutdown)         | : | 180 per year |

13.00.00 **PACKAGING & MARKING**

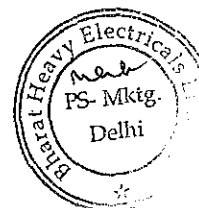
All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

- |    |   |   |             |
|----|---|---|-------------|
| a) | Width of the Package<br>(from centre-line of rails<br>- 1.6 metres on both sides) | : | 3.2 Meters  |
| b) | Height of the package from rail top   | : | 4.47 Meters |



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The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services if the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00

#### PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

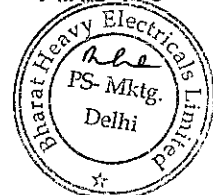
Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

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All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 PAINTING

15.01.00 General

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner.

All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.

All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat.

Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment.

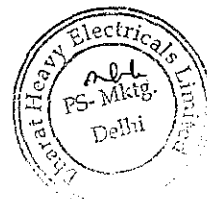
Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use.

Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel.

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The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished.

Shop primer for steel and iron surfaces which will have a continuous operating temperature below 35 Deg.C shall be selected by the Contractor, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35 Deg.C.

The colour scheme shall be submitted during execution of contract for approval by the Purchaser/Engineer.

15.02.00 Preparation

Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying.

Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed.

The priming coat shall be applied without delay.

15.03.00 Damaged Paintwork

Any damaged paintwork shall be made good as follows :

- a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
- b) A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the original damage.
- c) The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming.

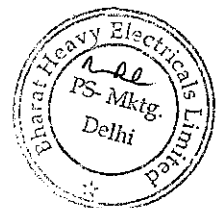
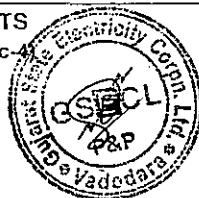
15.04.00 Painting Systems

The requirements for the dry film thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.

- a) Surfaces Subject To Weathering

All surfaces shall have a minimum of four coats of paint made up as follows :

Primer coat	:	35 micron DFT
Tie coat	:	35 micron DFT



Finishing coat (2 Nos.) : 35 micron DFT per coat

The total minimum DFT shall be 140 micron.

b) Surfaces Inside Buildings

All surfaces shall have a minimum of three coats of paint made up as follows:

Primer coat : 35 micron DFT

Tie coat : 35 micron DFT

Finishing coat (2 Nos.) : 25 micron DFT per coat

The total minimum DFT shall be 120 micron.

The type and colour of primer & finish coat shall be selected by the Contractor after approval by the Owner.

For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this specification.

16.00.00 COLOUR CO-ORDINATION & FINISH

16.01.00 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.02.00 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification.

16.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

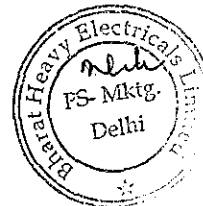
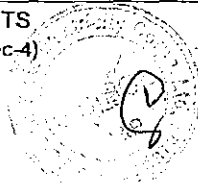
16.04.00 Final colours and finishes shall be to the Approval of the Engineer.

17.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.



17.01.01 For Liquid Effluent

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

17.01.02 For Air Emission

- a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm<sup>3</sup> (with worst coal and one field out).
- b) NO<sub>x</sub> - 365 ppm Max. or 750 mg/Nm<sup>3</sup> (Equivalent NO<sub>2</sub>).
- c) SO<sub>2</sub> - Concentration based standard 2000 mg/Nm<sup>3</sup> Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

NO<sub>x</sub> and SO<sub>2</sub> limitations are based on the World Bank Norms.

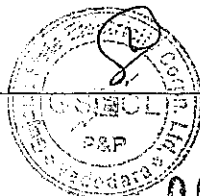
In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

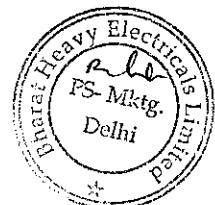
17.02.00 Noise Level Requirement

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.



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An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

18.00.00 INSPECTION AND TESTING

18.01.00 Inspection and Tests during Manufacture

18.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

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

18.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

18.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

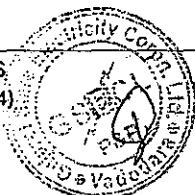
The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

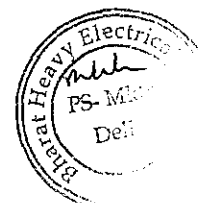
18.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.

18.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

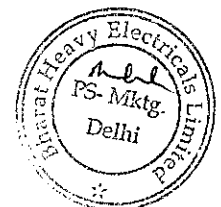
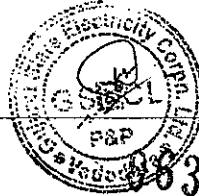
Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.



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- 18.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser as per Owner's approved QAP. The certificates shall include tests for mechanical properties and chemical analysis of representative material.
- 18.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.
- 18.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.
- 18.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.
- 18.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.
- 18.02.00 Performance Tests at Site
- 18.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 18.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 18.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 18.03.00 For details of specific tests required on individual equipment refers to respective section of this specification.



19.00.00 TRAINING OF OWNER'S PERSONNEL

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

19.01.00 Training at Contractor's Premises

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

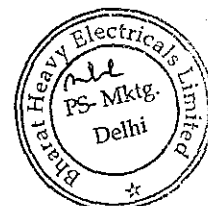
The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
	<u>60 heads</u>	<u>60</u>

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.



The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to :

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

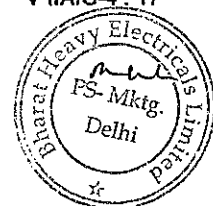
The Contractor shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

#### 19.02.00 Operation and Maintenance Training at Site

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

- a) One (1) for Steam Generator and Auxiliaries ;
- b) One (1) for Turbine Generator and Auxiliaries ;
- c) One (1) for Electrical Works ;
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).



19.03.00 **On-the-Job Training**

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

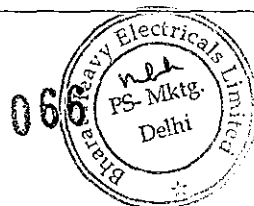
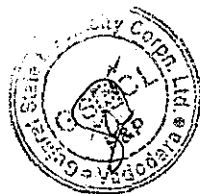
The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

20.00.00 **DEVIATIONS**

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

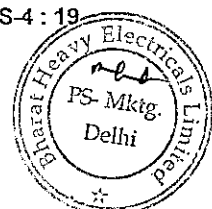
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ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission (IEC) Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).
- x) Electric Power Research Institute (EPRI).



- y) Standards of Manufacturer's Standardization Society (MSS).
- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Dept. of Environment, Govt. of India
- hh) Central Board of Irrigation and Power (CBIP) Publications.
- ii) The Air Prevention and Control of Pollution Act.
- jj) The Environmental Protection Act
- kk) The Public Liability Insurance Act.
- ll) The Forest Conservation Act
- mm) The Wildlife protection Act.
- nn) The EIA Notification, 1994.
- oo) IS: 14665-Specification for Electric Traction Lift
- pp) Any other statutory Codes/Standards/Regulations

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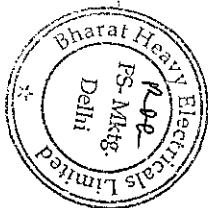


ANNEXURE-II

SCHEDULE OF PERMITS & CLEARANCES

Sl. No.	Clearances	Authority	Responsibility
1.0	<b>STATUTORY CLEARANCES</b>		
1.1	Pollution clearance, water and air [Sec.25 of the Water (Prevention & Control of Pollution) Act, 1974 as amended in 1988, and Sec. 21 of the Air (Prevention & Control of Pollution) Act, 1981 as amended in 1987]	Gujarat State Pollution Control Board	Owner-Consent to establish the project. Contractor - Permission for operation
1.2	Environmental clearance	Ministry of Environment & Forest, Government of India	Owner
1.3	Aviation Clearance	Airport Authority of India, New Delhi.	Owner
2.0	<b>NON-STATUTORY CLEARANCES</b>		
2.1	Land availability at Plant area	Govt. of Gujarat / Private land Owner, if any	Owner
2.2	Land for Transportation of Coal	Govt. of Gujarat / Private Land Owner, if any	Owner
2.3	Transportation of Fuel (Secondary Fuel)	Department of Petroleum and Natural Gas, Ministry of Railways, Shipping and Surface Transport	Owner
2.4	Rights & right to access of all public roads from manufacturer's works to site,	Concerned Authorities	Contractor
3.0	<b>OTHER CLEARANCES/ APPROVALS</b>		
3.1	Approval and Registration of steam generator as per Indian Boiler Regulation	Chief Inspectorate of Boilers	Contractor
3.2	Approval as per Indian Electricity Act and Rules for Electrical Installation	Electrical Inspectorate	Contractor
3.3	Approval as per Indian Petroleum Act and Petroleum Rules for storage of petroleum products.	Chief Controller of Explosives	Contractor
3.4	Approval as per gas cylinder rules and handling and transport of compressed gases	Chief Controller of Explosives	Contractor
3.5	a) Collection, storage and disposal of waste during construction till handing over of the project.	Gujarat State Pollution Control Board	Contractor

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Sl. No.	Clearances	Authority	Responsibility
	b) Site clearances, safe report and safety audit during construction till handing over of the project.	Gujarat State Pollution Control Board	Contractor
3.6	Approval of Fire Protection Scheme	Authorised Agencies approved by Insurance Regulatory Development Authority, New Delhi (IRDA)	Contractor
3.7	Consent for use of the site for the construction and operation of the Power Station and Fuel Facility	Directorate of Town and Planning of Government of Gujarat	Owner
3.8	Consent for the development of Project Site and the Township site	Directorate of Town and Planning of Government of Gujarat	Owner
3.9	Approval of the proposed design and construction of power station	Chief Inspector of Factories of Government of Gujarat	Contractor
3.10	Allocation / approval of electric supply for bulk construction power	Gujarat State Electricity Dept.	Owner
3.11	Carriage entrance to property	Municipal Corporation: Assistant Engineer, Roads or concerned authorities	Contractor
3.12	Approval of building layout with fire safety concerns and receipt of No Objection Certificate	Municipal Corporation: Chief Fire Officer or concerned authorities	Contractor
3.13	No Objection Certificate regarding air & fugitive emissions	Municipal Corporation: Executive Engineer and Gujarat Pollution Control Board	Contractor
3.14	No objection Certificate for Chimney and Registration	Inspector of Smoke Nuisance	Contractor
3.15	No Objection Certificate for sewage water treatment and associated plumbing	Municipal Corporation: Executive Engineer, Sewerage and Planning or concerned authorities	Contractor
3.16	To review the frequency used for Power Line Carrier Communication (PLCC) system to ensure no interference with other power line users	Postal Tele communication Coordination Committee (PTCC)	Owner-PLCC Contractor- Wireless equipment (postal telecommunication)
3.17	No objection certificate for plant layout with regard to electrical equipment, operational safety	Chief Electrical Engineer of Gujarat	Contractor
3.18	No Objection Certificate for storage of construction Materials and chemicals, etc.	Municipal Corporation: Assistant Engineer, Factory Department	Contractor

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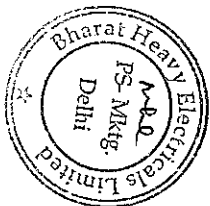
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Sl. No.	Clearances	Authority	Responsibility
3.19	No Objection Certificate for storage of construction fuel oils and chemicals, etc.	Commissioner of Police	Contractor
3.20	No Objection Certificate for storage of Distillate Oil	Chief Controller of Explosives	Contractor
3.21	No Objection Certificate for road opening and asphaltting Work including traffic Work.	Municipal Corporation: Assistant Engineer, Roads or concerned authorities	Contractor
3.22	Local approval for operating the plant	Municipal Corporation: Ward Office or concerned authorities	Not applicable
3.23	Local approval of Architectural plans for township	Municipal Corporation or concerned authorities	Owner
3.24	Consent under the Factories Act, 1948 relating to fire fighting capacities	Directorate of Town and Planning of Government of Gujarat	Contractor
3.25	Clearance of Lifts	Inspector of Lifts, Govt. of Gujarat	Contractor
3.26	Approvals / clearances for labour / man power like License from labour commissioner for Construction labour, Registration of Workers or exemption to be claimed if group insurance taken for some, etc.	Concerned Authorities	Contractor
3.27	Any other clearances	Appropriate Authorities	Contractor
3.28	Export Authorisation (Export license)	Appropriate Authorities of exporting country	Contractor

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ANNEXURE-III

CRITERIA FOR LAYOUT

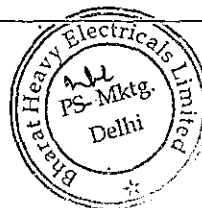
PLOT PLAN LAYOUT REQUIREMENTS

ITEM	SPECIFICATION REQUIREMENT
A. Site conditions to be considered	
1. Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B. Layout Requirements	
1. Maximum permissible slope in	
a) Rail track	1 in 400
b) Road	1 in 30
c) Sides of unpaved embankment	1 in 2
2. Required road width	
a) Main roads Refer Vol. II-G.	
b) Auxiliary interconnections Refer Vol. II-G.	
c) Road to the power house unloading bay :	
• Only for entry to the unloading bay	Yes
• To pass through the unloading bay	No
3. Required minimum horizontal distance between the nearest points of	
a) Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b) Electrical transformer and any other	As per the Tariff Advisory building/facility Committee Rules
c) Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules
d) Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

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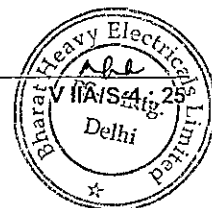


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ITEM	SPECIFICATION REQUIREMENT
4. Required minimum vertical clearance	
a) Under pipes/cable racks at road crossings	7.0 Metres
b) Soil coverage over underground pipes	1.0 Metre (minimum)
c) Pipe/Cable trench	Not Acceptable
5. Railway Wagon clearance	Rules of the Indian Railways
6. Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7. Required level, above the local developed grade level, of	
a) top of all roads	150 mm
b) all outdoor paved areas	150 mm
c) Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d) Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.

#### BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

- A. Minimum clear space required at all working and walking areas for operating & maintenance personnel
1. Horizontal, in all directions
    - a) Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C. 1200 mm
    - b) Adjacent to any other plant facilities (including walls/structures) 1000 mm
  2. Vertical (head-room clearance)
    - a) Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items. 2.0 Metre
    - b) Under any other plant facilities (including structures, pipes etc.) 2.0 Metre



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ITEM SPECIFICATION REQUIREMENT

- |    |  |   |
|----|--|---|
| 3. | For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.  | Minimum 500 mm clear in all direction from the outer edges of the equipment   |
| 4. | Minimum clear hand space required for  |   |
| a) | The application of thermal insulation  | 100 mm  |
| b) | Welding work   | 150 mm  |
| c) | Bolt tightening  | 150 mm  |
| B. | Floors, platforms, staircase, ladders, walls, doors & windows  |   |
| 1. | Statutory Requirement  | As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc. |
| 2. | Operation & Maintenance Requirement  |   |
| a) | Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required. | Yes   |
| b) | Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.     | Yes   |
| 3. | Plinth level of all buildings, above the local developed for power house building.   | 300 mm, however, 500 mm grade level   |
| 4. | Minimum access opening required (with rolling shutter) transportation,   | 3.5M wide x 4M high or, wherever entry of truck, for material more depending upon the is envisaged equipment size to be handled.      |

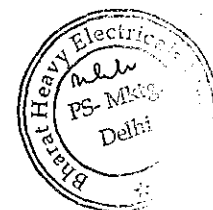
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 S. A. ICHMAN  
 MUKESH K. SINGH



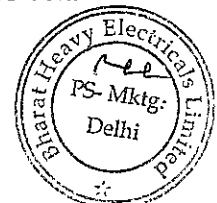
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ITEM	SPECIFICATION REQUIREMENT
C. Other Maintenance Requirement	
1. Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2. Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel air oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3. Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4. Crane Approach  Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D. Central Control Room  All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration.	
However, as a guide line, following features are given :	
a) False ceiling and false flooring shall be provided.	
b) Uniform height, colouring schemes for cabinets etc. shall be available.	

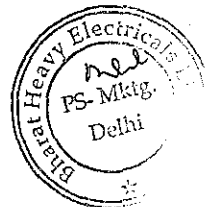


ITEM SPECIFICATION REQUIREMENT

- c) The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.
  - d) No opening shall be provided from Boiler side.
  - e) Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.
  - f) Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.
  - g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.
  - h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.
  - i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.
- E. Toilet and drinking water facility

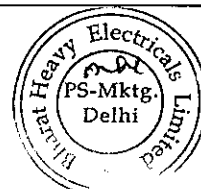
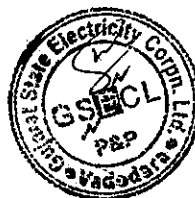
Required in all buildings and on all floors wherever operating personnel are to be deployed.

MUKESH K. SINGH  
 S.A. ICHMAN  
 ID M-MAK



*Signature*  
Sudhakar  
MUKESH KADSIWANI

**SECTION-4**  
**SPECIAL CONDITIONS FOR**  
**ERECTION AND CONSTRUCTION**



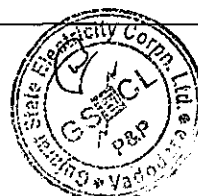
SECTION-4

SPECIAL CONDITIONS FOR  
ERECTION AND CONSTRUCTION

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SECTION-4

SPECIAL CONDITIONS FOR  
ERECTION AND CONSTRUCTION

1.0 GENERAL

The following items shall supplement the conditions in the other Sections of this Volume.

2.0 SCOPE OF WORK

2.1 Erection Work

The Contractor shall prepare erection drawings and obtain approval of the same from the Owner as applicable.

The Contractor shall receive the imported Goods, if any, at the port of entry, clear them through Customs and make damage report through port broker. The Contractor shall arrange for payment at prescribed rate of Customs Duties, if required by the Owner, which will be reimbursed by the Owner against Contractor's valid documents upto the overall amount specified in the price bid and agreed.

The Contractor shall transport all imported Goods & indigenous goods from port of entry, from manufacturer's works to the Site and unload all Goods at the Site. Crane services shall be provided by the Contractor, if necessary. All storage at port of entry or at railway station shall be at Contractor's cost.

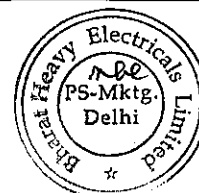
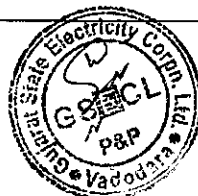
The Contractor shall be responsible for complete installation as per approved drawings, testing, commissioning, trial run of the Plant at the Site and putting the Plant into commercial operation including finish painting work.

All machinery and tools for transportation and erection shall be provided by the Contractor at his cost.

The Goods after receipt at the Site, shall be checked and verified against the shipping documents and all claims made and replacement or repair order against loss or damage in transit shall be intimated to the Owner. The Goods shall remain under the custody of the Contractor until the Plant is taken over by the Owner upon completion of the Work. The Contractor shall take adequate steps to ensure safety and protection of such Goods. Necessary stores receipt certificates shall be issued to the Owner after the Goods are checked and certified.

No Goods pertaining to the Contract shall be removed from the Site without the consent in writing by the Owner.

The Contractor shall be responsible for replacement, free of cost to the Owner, of any material damaged due to improper storage.



The Contractor shall be responsible for setting up correct reference lines for the purpose of fixing alignments of various equipment. The Contractor shall be responsible for replacement, free of cost to the Owner, of any goods damaged/lost/broken down in any point of operation due to any reason whatsoever while under the custody of the Contractor.

The Contractor shall arrange for, at his cost, all consumables, paints, lubricants, etc. as required.

The contractor shall arrange at his own cost for approvals, clearances, registration, inspections etc. from but not limited to Government authorities, statutory authorities, e.g. Factory Inspector, Boiler Inspector, Electrical Inspector, Explosive Inspector, Municipal corporation, ESI authorities, Labour authorities etc. for design, engineering, supply, erection and commissioning etc.

All surplus/unused materials/scrap materials left after completion of project shall become property of Contractor, provided the materials were brought by the Contractor and the payment was not made for the same by Owner.

2.2

### Civil, Structural and Architectural Works

The Contractor shall be responsible for the preparation of the design and all drawings and obtain approval of the same from the Owner when required.

The Contractor shall be responsible for the survey and true and proper setting out of the Works and for the correctness of the positions, levels, dimensions and alignments of the all parts of the Works and shall provide all necessary survey grid-pillars, bench-marks, instruments, appliances and labour in connection therewith. If at any time during the progress of the Works any error shall appear or arise in the positions, levels, dimensions or alignments of any part of the Works, the Contractor, on being required to do so by the Owner/Engineer, shall at his own expense rectify such errors to the satisfaction of the Owner/Engineer. The checking of the setting out of any line or level by the Owner/Engineer or the Engineer's representative shall not in any way relieve the Contractor of his responsibility for the corrections thereof. The Contractor shall carefully protect and preserve all survey grid-pillars, bench marks, site rails, pegs and other things used in setting out the Works.

The Contractor shall be responsible for all civil, structural and architectural Works as required for the installation of the Plant and its sub-systems and other facilities.

The Contractor shall arrange for supply of all Goods at his cost.

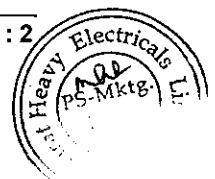
3.0

### INSURANCE

In addition to the conditions stipulated in Section-3 of this Volume, the Contractor shall also arrange for insurance coverage as under :

a) **Workmen's Compensation Insurance**

This insurance shall protect the Contractor against all claims applicable



under the Workmen's Compensation Act (Government of India). This policy shall also cover the Contractor against claims for injury, disability, disease or death of his or his sub-contractor's employees, which for any reason are not covered under the Workmen's Compensation Act. The liabilities shall not be less than :

Workmen's Compensation : As per statutory provisions  
Employee's liability : As per statutory provisions

b) **Comprehensive General Liability Insurance**

The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and sub-contractors from riots, strikes civil commotion and terrorism.

The hazards to be covered will pertain to all the works and areas where the Contractor, his sub-contractor(s), his agents(s) and his employee(s) have to perform work pursuant to the Contract.

The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

4.0

**WORK AT SITE**

In the execution of the Work, no persons other than the Contractor, or his duly appointed representative, sub-contractor(s) and workmen employed by him and his sub-contractor(s) shall be allowed to do work at the Site, except by the special permission, in writing, of the Owner or his representative. Access to the Work at all times shall be accorded to the Engineer and representatives of the Owner.

The Contractor shall at all times and at his own cost take sufficient precautions to ensure the safety of public and guard the Site deemed necessary.

The Work at Site shall be carried out without interference with Owner's activities.

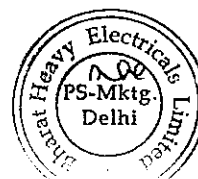
No female labour shall be allowed during dark hours.

The Contractor shall not employ for the purpose of executing the Works, any person who is below the age of eighteen (18) years. The Contractor shall pay to each labourer, for the work done by such labourer, wages, not less than the wages paid for similar work in the district.

5.0

**MANUFACTURER'S SUPERVISION**

If the Contractor is not the manufacturer, he may be required to work under the guidance of the manufacturer's technical personnel. However, this will not



relieve the Contractor of his responsibility for the correctness of work done or quality of workmanship.

6.0 **CONTRACTOR'S REPRESENTATIVE**

6.1 The Contractor shall employ the necessary competent representatives at the Site, whose name shall have previously been communicated in writing to the Owner/Engineer by the Contractor to supervise the erection of the Plant. The required representatives shall be present at the Site during working hours, and any written orders or instructions which the Owner/Engineer or his duly authorised representative may give to such representative of the Contractor, shall be deemed to have been given to the Contractor.

6.2 The Contractor's representative employed for the purpose of the work at the Site shall be stationed at the Site when the Owner informs the Contractor in writing to that effect.

7.0 **FOREIGN PERSONNEL**

The Contractor shall bear all expenses in connection of any foreign personnel he plans to bring into India for the performance of the Works.

If the Contractor requires the assistance of the Owner, to the extent possible, to obtain any necessary travel permits for the foreign personnel, the Contractor shall provide the Owner with all necessary data on such foreign personnel. The Contractor shall allow the Owner a reasonable time prior to the proposed date of departure of the foreign personnel, to enable the Owner to provide the assistance required.

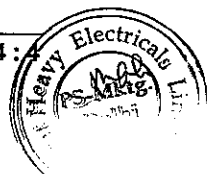
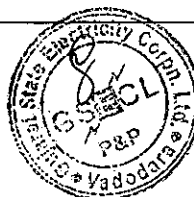
The Owner shall assist the Contractor to the extent possible in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Competent Authorities.

The Contractor and the foreign personnel shall abide by statutory laws, rules & regulations in force in India at the time thereof & shall not in any way interfere with Indian political and/or religious affairs. The Contractor's foreign personnel shall work and live in close co-operation & co-ordination with their co-workers and the community and shall not engage themselves in any other employment either part time or full time nor shall they take part in any local politics.

The Contractor shall pay all taxes due in India for the foreign personnel employed by the Contractor for their work in connection with this Contract. The Contractor shall obtain at his own cost "work permits" required from competent authorities to enable the foreign personnel to work in India.

8.0 **PROGRAMME OF WORK AND PROGRESS REPORT**

The Contractor shall, as required from time to time, submit to the Owner erection and construction schedules in the form of PERT network or bar chart showing the time-table the Contractor proposes to follow to carry out the work with dates and estimated completion times for various parts (milestones) of the Work. Such schedules shall be approved by the Owner, prior to the



commencement of the Work at the Site.

During the progress of the work, the Contractor shall submit copies of monthly progress reports and photographs and such other reports on the erection and construction Works and his site organisation, as the Owner/Engineer may direct. The format of the progress report shall be decided upon by the Contractor with the approval of the Owner. However, if at any time the Owner desires to change the format or requires any additional information, the Contractor shall comply. The Contractor shall also submit an anticipated one (1) months programme at the beginning of each month describing in detail the anticipated programme for the following month. The Contractor shall also submit from time to time, a list of various categories of his employees. Monthly progress reports shall be submitted by the tenth (10th) day of the month following the reporting month.

9.0 **INDEMNITY**

The Contractor shall, except if and so far as the Contract provides otherwise, indemnify the Owner against all losses and claims in respect of injuries or damage to any person, material or plant, or damage to any property whatsoever but not limited to third party damages which may arise out of or in consequence of the execution of the Works, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in relation thereto.

10.0 **CLEAN UP WORK AT SITE**

The Contractor shall without any additional payment at all times keep the working and storage areas used by him and/or his sub-contractor(s) free from accumulation of waste materials or rubbish. If these materials are not removed by the Contractor within forty-eight (48) hours, after being requested by the Owner, these will be removed by others and the cost of the same will be charged to the Contractor. Any inflammable materials shall be removed forthwith on request by the Owner.

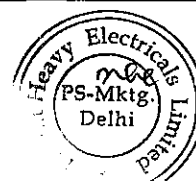
On completion of erection and construction work, the Contractor shall remove or dispose of in a satisfactory manner all temporary structures, packing cases, waste and debris and leave the premises in a condition satisfactory to the Owner. All surplus earth shall be removed beyond the Plant area and dumped in a place(s) as directed by the Owner/Engineer.

11.0 **CO-ORDINATION WITH THE OWNER'S ENGINEERS**

The Contractor shall at all times work in co-ordination with the Owner's Engineers and afford them every facility to become familiar with the erection and maintenance of the equipment and construction work.

12.0 **MATERIALS HANDLING AND STORAGE**

The Contractor shall be responsible for examining the shipment and shall notify the Owner immediately of any damage, shortage, discrepancy, etc. for the



purpose of Owner's information only.

The Contractor shall maintain an accurate and exhaustive record detailing of all Goods received by him for the purpose of erection and keep such record open for inspection by the Owner at any time.

All electrical panels, control gear motors and such other devices shall be properly dried by heating before they are installed and energised. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.

All the electrical equipment such as motors, generators etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values shall be maintained by the Contractor. Such records shall be open for inspection by the Owner/Engineer.

The Contractor shall ensure that all the packing materials and protection devices used for the Goods during transit and storage are removed before the Goods are installed.

The consumables and other supplies which are likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality during the storage period.

All the materials stored in the open or dusty locations must be covered with suitable weatherproof and flameproof covering material wherever applicable.

If the materials belonging to the Contractor are stored in area other than those earmarked for him, the Owner will have the right to have them moved to the area earmarked for the Contractor at the Contractor's cost.

The Contractor shall be responsible for providing suitable covered storage facilities to store all Goods which require covered storage. Normally, all the electrical equipment such as motors, control gear, generators, exciter and consumables like electrodes, lubricants, etc. shall be stored in the covered storage space. In addition, the Owner, may direct the Contractor to move certain other materials which in his opinion will require covered storage and the Contractor shall strictly comply with his instruction.

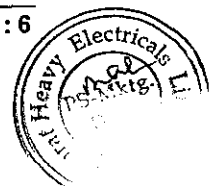
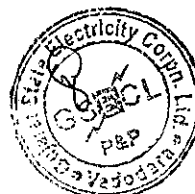
13.0 **LABOUR AND LABOUR LAWS**

13.1 **Recruitment of Local Labour**

Local labourers shall be engaged for unskilled work. Preference may also be given for appointment of local labourers in semi-skilled and skilled categories, if such suitable labourers are available.

13.2 **Labour Laws and Local Regulations**

The Contractor shall abide by the prevailing labour laws and shall have to



obtain a labour license from the appropriate authority as per the law at his cost and shall indemnify the Owner against any financial and other obligation in connection with labourers employed by him. On obtaining the labour license, the Contractor at the appropriate time, shall submit a certified photocopy of the same to the Owner.

13.3 **Wages and Working Hours and Conditions**

The Contractor shall pay wages and observe hours and conditions of labour not less favourable than those established for the trade or industry in the district where the work is carried out. In the absence of any wages, hours or conditions of labour so established, the Contractor shall pay wages and observe hours and conditions of labour which are not less favourable than the general level of wages and hours and conditions observed by other contractors whose general circumstances in the trade or industry in which he is engaged are similar.

13.4 **Contractor to furnish return of labour employed**

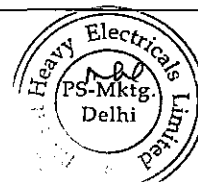
The Contractor shall, if required by the Owner/Engineer, deliver to the Owner/Engineer or to his office a return in such form and at such intervals as the Owner/Engineer may prescribe, showing in detail classes of labour employed and the number employed within each class by the Contractor from time to time on the Site and such information in respect of construction machinery as the Owner/Engineer may require.

13.5 **The Contractor shall make his own arrangements for the engagement of all labour and provide on the Site in so far as the Contract otherwise provides, for the transport, housing, feeding and payment thereof.**

The Contractor shall, so far as is reasonably practical, having regard to local conditions, provide on the Site, to the satisfaction of the Owner/Engineer an adequate supply of drinking and other water for the use of his staff and labour.

13.6 **Other Requirements**

- a) The Contractor shall not, other than in accordance with the Statutes, Ordinances and Government Regulation or Orders currently in force, import, sell, give, barter or otherwise dispose of any alcoholic liquor, or drugs, or permit or suffer any such importation, sale, gift, barter or disposal by his sub-contractor(s), agents or employees.
- b) The Contractor shall not give, barter or otherwise dispose of to any person or persons any arms or ammunition of any kind or permit the same as aforesaid.
- c) The Contractor shall in all dealings with labour in his employment have a due regard for all recognised festivals, days of rest and religious or other customs.
- d) In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with any regulations, orders and requirements as may be made by the Government, or the local municipal or sanitary authorities for the purpose of dealing with and overcoming the same.



- e) The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his employees.
- f) The Contractor shall be responsible for observance by his sub-contractor(s) of the foregoing provisions.

14.0 **PROTECTION AND CARE OF WORKS**

14.1 The Contractor shall in connection with the Works provide and maintain at his own cost all temporary works, lights, guards, fencing and watching when and where necessary or required by the Owner/Engineer or by any competent statutory or other authority for the protection of the Works.

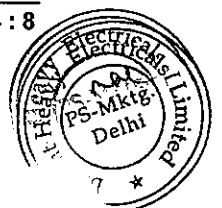
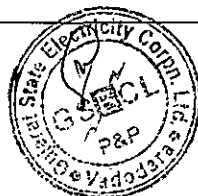
14.2 From the commencement to the completion of the Works, the Contractor shall take full responsibility for the care of the Works and of all temporary works. If any damage, loss or injury happens to the Works or to any part thereof or to any temporary work from any cause whatsoever (save and except the "Force Majeure" as defined earlier) the Contractor shall at his own cost repair and make good the same so that at completion the works shall be in good order and condition and in conformity in every respect with the requirements of the Contract Documents and the Owner/Engineer's written instructions. The Contractor shall also be liable for any damage to the Works caused by him in the course of any operations he carries out for the purpose of complying with his obligations under the Contract Documents.

15.0 **OWNERSHIP OF ARTICLES OF VALUE DISCOVERED AT SITE**

All fossils, contains, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall be deemed to be the absolute property of the Owner. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging the same, and shall immediately, upon discovery thereof and before removal, inform the Owner/Engineer of such discovery and carry out, at the expense of the Owner the Engineer's orders concerning the removal of the same.

16.0 **CONVENIENCE OF PUBLIC**

All operations necessary for the execution of the Works and for the Construction of any temporary work shall, so far as compliance with the requirements of the Contract permit, be carried on so as not to interfere unnecessarily or improperly with the public convenience of access to use public or private roads and foot paths or to use properties whether in the possession of the Owner or of any other person. The Contractor shall indemnify the Owner in respect of all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in relation to any violation by the Contractor of the above.



17.0 PREVENTION OF EXTRAORDINARY TRAFFIC AND PROTECTION OF HIGHWAY

The Contractor shall use reasonable means to prevent the highways or bridges communicating with or on the routes to the Site from being subjected to extraordinary traffic by traffic of the Contractor or any of his sub-contractors. In particular the Contractor shall select routes, choose and use vehicles and restrict and distribute loads, so that any such extraordinary traffic as will inevitably arise shall be limited as far as reasonably possible, and so that no unnecessary damage or injury may be caused to such highways and bridges. If it is found necessary for the Contractor to move over part of highway or bridge, one or more loads, where the moving of such load will in all probability damage the highway or bridge unless means of protection or strengthening are carried out, then the Contractor shall, before moving the load on to such highway or bridge, give notice to the Owner of the weight and other particulars of the load to be moved, and his proposals for protecting or strengthening the said highway or bridge. The Contractor shall also carry out the protection and strengthening of the highway or bridge as required.

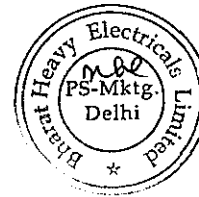
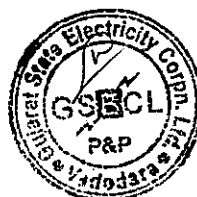
18.0 WORK MATERIALS AND PLANT

18.1 Materials and Workmanship

All construction materials, structural steel and workmanship shall be of the respective types described in the Contract Documents, and shall be subjected from time to time to such tests as stipulated in the approved quality assurance plan. The Contractor shall establish on site testing facilities as required by him. Collection of samples and testing as specified in the Contract Documents including special tests, if any, shall be carried out by the Contractor at his cost.

18.2 Examination of the Works

No work shall be covered up or put out of view without the approval of the Owner/Engineer and the Contractor shall afford full opportunity for the Owner/Engineer to examine and assess any work which is about to be covered up or put out of view, and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Owner/Engineer whenever any such work or foundation is ready for examination. The Contractor shall uncover any part or parts of the Works, make openings in or through the same as the Owner/ Engineer may from time to time direct and shall reinstate and make good such part or parts to the satisfaction of the Owner/Engineer. If any such part or parts have been covered up or put out of view after compliance with the requirements of this item and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating and making good the same, shall be borne by the Owner as mutually agreed upon but in any other cases all the such expenses shall be borne by the Contractor or may be deducted by the Owner from any money due or which may become due to the Contractor.



18.3 **Improper Work and Material**

The Owner/Engineer shall during the progress of the works have the right to order in writing from time to time:

- a) The removal from the Site within such time or times as may be specified in the Contract Documents of any materials which in the opinion of the Owner/Engineer are not in accordance with the Contract Documents.
- b) The substitution of proper and suitable materials, and
- c) The removal and proper re-execution (notwithstanding any previous test thereof or interim payment thereof) of any work which in respect of materials or workmanship is not, in the opinion of the Owner/Engineer, in accordance with the Contract Documents.

In case of default on the part of the Contractor in carrying out orders, the Owner shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Owner or may be deducted by the Owner from any money due or which may become due to the Contractor.

18.4 **Temporary Arrangement**

The Contractor shall bear all expenses and charges for special or temporary way-leaves required by him in connection with access to the Site.

19.0 **ERECTION/CONSTRUCTION TOOLS, TACKLES AND MACHINERY**

19.1 **Tools, Tackles and Machinery**

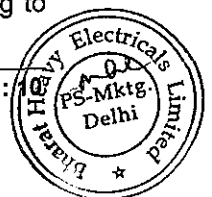
The Contractor shall provide all construction/erection machinery, tools, tackles and scaffolding required for the Works. A detailed list of the above, together with their capacities and present conditions, etc. shall be submitted to the Owner/Engineer at least three (3) months before the commencement of Site work.

19.2 **Exclusive use of Machinery**

All erection and construction machinery, temporary works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Work, and the Contractor shall not remove the same or any part thereof for any other use.

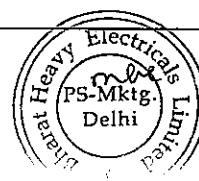
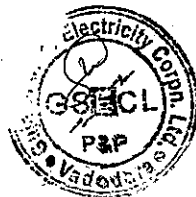
20.0 **URGENT REPAIR WORK**

If, by reason of any accident or failure or other event occurring in connection with the Works, either during the execution of the Works or during the Warranty period, any remedial or repair work is necessary, then the Contractor shall take necessary remedial action. If however the Contractor is unable or unwilling to



do such repairs, the Owner may use his own or other workmen to do the repairs. The cost of repairs so done shall be charged to the Contractor or may be deducted by the Owner from any money due or which may become due to the Contractor.

*Signature*  
S.A. ICHHAN  
S.A. ICHHAN  
MUKESH K.S. SINGH

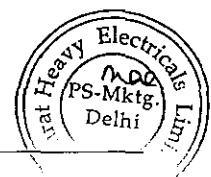


  
D. M. M. S.

  
S. A. ICHHAN

  
MUKESH K. SINGH

## SECTION-3 GENERAL CONDITIONS



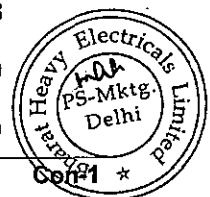
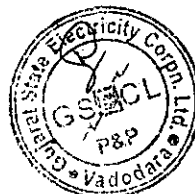
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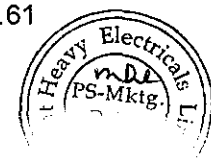
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MUKESH K.S. SINGH  
 S.D. - ICHMAN  
 S.D. - M.A.



### SECTION-3 GENERAL CONDITIONS

#### 1.0 APPLICATION

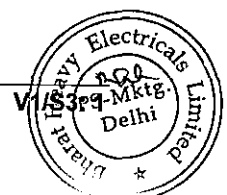
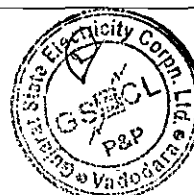
These General Conditions shall govern the Works.

#### 2.0 DEFINITION OF TERMS AND INTERPRETATION

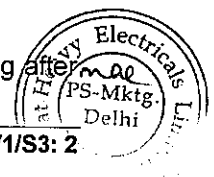
##### 2.1 Definitions:

- In this Contract (as defined below), unless the context requires otherwise, the words and expressions defined below shall have the meaning hereinafter assigned to them.
- "**Advance Payment Bank Guarantee**" shall have the meaning assigned to the term under Clause 8.2 of this GCC.
- "**Annexure**" shall mean all appendices; annexure, tables and schedules annexed to this Contract or incorporated by reference herein and shall include all amendments and revisions thereto made by mutual agreement of the Owner and Contractor in accordance with the provisions contained in this Contract.
- "**Acceptance Test/Performance Guarantee Test**" for equipment /system shall mean such tests as are required to determine and demonstrate guaranteed capacity, efficiency and operating characteristics of the equipment /system Plant as stipulated in the Contract Document.
- "**Applicable Laws**" shall mean Constitution of India, all laws, treaties, ordinances, rules, directives, regulations and amendments thereto made from time to time and in force and effect in India, judgments, decrees, injunctions, writs and orders of any court, arbitrator or authority, rules, regulations, orders and interpretations of any Governmental Instrumentality, court or statutory or other body having jurisdiction over the subject matter of the Contract, as may be in effect at the time of performance of Work hereunder by the Contractor, provided, however, that if at any time the Applicable Laws are less stringent than the standards set forth in the Contract, Contractor shall not be excused from meeting the standards set forth herein.
- "**Approved**" and "**Approval**", where used in the Contract shall mean respectively, approved by and the approval of the Owner or the Owner's Representative in writing.

When the words 'Approved', 'Approval', 'subject to Approval', 'Satisfactory', 'Equal to', 'Proper', 'Requested', 'As directed', 'Where directed', 'When directed', 'Determined by', 'Accepted', 'Permitted', or words and phrases of like import are used the approval, judgment, direction etc is understood to be a function of the Owner or the Owner's Representative.



- **"Auxiliary Power Consumption"** shall mean the electrical energy (in kW) consumed by all the equipments, systems etc. forming part of the Plant and provided by the Contractor in pursuance of the Contract over a period of one hour i.e. difference of Gross Power measured at Generator Terminals and Net Power measured at 400 KV side of Generator Transformers, when the Plant is operating at rated capacity (guaranteed) measured in accordance with the procedures detailed in the Technical Specifications.
- **"Bidder"** shall mean duly established reputed organizations, manufacturers, etc. having requisite financial and technical capability and experience of participating in the Bid invited by the Owner for the Works. [
- **"Bank Guarantee" or "Performance Bank Guarantee" or "Bonds"** shall mean the primary, irrevocable, and unconditional on demand bank guarantees from Indian nationalized bank, to be furnished by the Contractor as a security for his performance under the Contract and the Advance Payment payable to the Contractor in accordance with Clauses of the General Conditions of Contract.
- **"Cause"** in relation to the revocation or amendment of any Permit shall mean any fact or circumstance, including without limitation any default, neglect or failure to abide by any of the terms and conditions of such Permit, which legally entitles the issuing authority to revoke the Permit or make the relevant amendment in its terms and conditions.
- **"Ceiling"** shall mean an upper limit for payment inclusive of applicable taxes & duties, by the Owner to the Contractor for various services rendered in pursuant to Contract as well as deduction towards Liquidated Damages for delay in Commercial Operations or otherwise shortfall in Performance Guarantee
- **"Contractor"** shall have the meaning assigned to the term in the Contract Agreement and shall include its legal successors in title approved by the Owner, who satisfy the qualification criteria set forth in the Tender Document,
- **"Contract" or "EPC Contract"** shall mean the Contract Agreement, Contract and such further documents as may be expressly incorporated in the Contract by reference and all amendments in writing made to any of them in accordance with the provisions contained in this behalf in the Contract and executed by duly authorized representatives of the Parties and shall include such other document that the Parties may have agreed in writing.
- **"Consultant"** shall mean Development Consultants Pvt. Ltd., Consulting Engineers, whose office is situated at GR. HQ.: 24 Park Street, Kolkata – 700 016, or any other agency (engaged for specific purpose) appointed by the Owner for the Project implementation and shall include their duly authorized representatives.
- **"Change in Law"** shall mean the occurrence of any of the following after

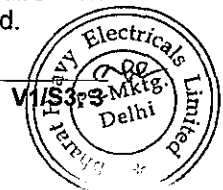


[please insert the date]:

- (a) the enactment of any new Applicable Law.
- (b) any modification or repeal of any existing Applicable Law or any new or modified directive or order there under,
- (c) Any change in the interpretation or enforcement of any Applicable Laws by a competent legislature of Government Agency in India which is contrary to the existing accepted application or interpretation thereof, provision for which has not been made elsewhere in the Agreement.

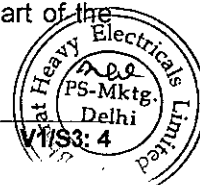
provided that "Change in Law" shall not include

- (i) any change in the interpretation or application of any Applicable Law except as provided in (c) above; and
  - (ii) any enactment, modification, repeal, interpretation or application of any Applicable Law of India which increases market prices of goods, commodities, labour and services in general.
- **"Change Order"** shall mean a written order from the Owner to the Contractor after the Commencement Date of the Contract requiring a change in any part of the Work that may involve:
    - (a) a change in the scope of Work,
    - (b) additional work, or
    - (c) the omission of a portion of the Work, and
    - (d) if appropriate, an adjustment in one or more of the (i) Contract Price, (ii) Guaranteed Commercial Operation Date, (iii) Milestone Payment Schedule, (iv) any of the Performance Guarantees, or (v) any provision/scope of this Contract including any Appendices or Schedules hereto.
  - **"Codes" or "Indian Standards and Codes"** shall mean the latest applicable Indian and international technical codes and standards, whether required by statute or not.
  - **Commencement Date or Zero Date** shall mean the date on which the Contractor is to commence performance of Work or its obligations under the Contract as specified in the Notice to Proceed delivered by the Owner to the Contractor under and in accordance with the Contract.
  - **"Commissioning"** shall mean the first successful operation of each equipment / systems provided by the Contractor, and the Plant as a whole at full load (after the Mechanical Completion), without any problem/interruption, in accordance with the Contract, after all initial adjustments, cleaning, re-assembly, and Trial Run, as required on completion of installation of Plant at site, have been completed.



- **"Commercial Operation"** shall mean, operation of the Plant upon Commissioning and successful completion of all the Tests before Commercial Operation.
- **"Commercial Operation Date"** or **COD** shall mean the date mentioned in the Provisional Acceptance Certificate which will be issued by the Owner, upon the satisfactory completion of reliability run and Plant entering into Commercial Operation, and the Plant becoming available for continuous operation on 24X7 basis for commercial sale of power by Owner.
- **"Company Contractor"** shall mean any Person other than the Contractor under contract with the Owner with respect to the Project.
- **"Completed Performance Test"** shall mean with respect to each equipment / systems / Plant, the Performance Test conducted in accordance with the contract during which the equipment / systems / Plant and the operation thereof comply with all Applicable Laws and the Performance Guarantees and which are established as completed Performance Test in accordance with the provisions of the contract in this behalf herein.
- **"Confidential Information"** shall mean information now or hereafter owned by or otherwise within the possession or control of a Party, including patented and unpatented inventions, business and trade secrets, know-how, techniques, data, specifications, as-built drawings, blue prints, flow sheets, designs, engineering information, Construction information, operation criteria, and other intangible information related to the Project.
- **"Consequential Damages"** shall mean indirect, punitive, special or incidental damages, the loss of profits or revenue, loss of use of the Equipment or any associated equipment, cost of capital and/or financing, down time costs, loss of opportunity, loss of goodwill, and claims of customers for such damages, except the damages provided under the Contract.
- **"Consignee"** shall mean the authorised representative or officer of the Owner to whom the Equipment is required to be delivered in the manner indicated in the Contract and whose identity shall have been notified by the Owner in good and sufficient time having regard to the Contractor's schedule for the delivery of the Equipment.
- **"Consumables"** shall mean all lubricants, lubrication and control oils, greases, filters, jointing & packing materials, hardware, demineralising resins and water treatment chemicals etc. required for operation of the Plant.
- **"Contract Agreement"** shall mean the agreement signed by the Parties to which these General Conditions of Contract, Schedule of Liquidated Damages and other documents and agreements forming part of the Contract are scheduled.

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- " **Project Network/ Master Network**" shall mean the Network covering details like:

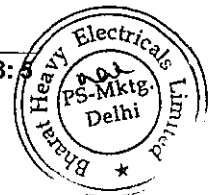
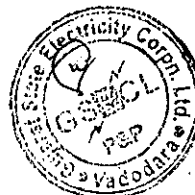
design, engineering & manufacturing and procurement schedule for the Equipment identifying all systems and Equipment and milestone dates for manufacture, assembly, inspection/ shop testing, shipment and delivery.

erection, Commissioning and testing schedule till Take-Over,

design, engineering, Construction, fabrication schedule for the Project identifying all buildings, structures and milestone dates for various Construction activities.

Bar chart covering critical and parallel activities indicating period

- **Contract Period** shall mean the period from the Commencement Date/ Zero Date till Take Over of the Plant. Provided that the expiry of the Contract Period shall not affect the obligations of the Contractor beyond the Contract Period, as specified under the Contract
- "**Contractor's Works**" or "**Manufacturer's Works**" shall mean the places which are used by the Contractor or any of its sub-vendor/sub-contractor for the manufacture of Equipment for the Plant or performance of Work, designated by Contractor and communicated to the Owner.
- "**Contractor's Equipment**" shall mean all machinery, apparatus, equipment, appliances, materials, items and other things of whatsoever nature required for the execution and completion of the Works, performance of the Contractor's obligations under the contract including Work, establishing of Performance Guarantees, and the remedying of any defects and deficiencies, but does not include Equipment and other things intended to form or forming part of the Plant.
- "**Contractor Permits**" shall mean all those Permits, required by the Contractor from any Government Instrumentality for the performance of any of the obligations of and Work by the Contractor under the Contract, including without limitation, all registrations and licenses required to permit the Contractor to do business in the jurisdiction where it has to perform any part of the work, inclusive of all the Permits, authorizations, consents and approvals required solely for Construction, Commissioning, testing operation of the Plant and transmission of electricity to GETCO.
- "**Contractor's Representative**" shall mean the person named as such in the Contract or other person appointed from time to time by the Contractor in his place in accordance with the Contract, , and such appointment communicated to the Owner,.
- "**Country**" shall mean India, where the works are to be executed and to which Equipment are to be delivered.
- "**CIF Price**" shall mean delivery free of expenses to the Owner on board the



vessel at the port of entry including the insurance and freight charges.

- **"Contract Document"** shall mean and include the General Conditions of Contract, Special Conditions of Contract, Minutes Of Meeting dated [insert] between Owner and the Contractor, the Final Proposal of Contractor dated [insert] as accepted by the Owner, Specifications, Schedules, Annexures, Drawings, Schedule of Prices and Schedule of Quantities submitted by the Successful Bidder, Letter of Intent, Notice to Proceed issued by the Owner, subsequent amendments to the foregoing in accordance with the terms of the Contract.

- **"Contract Price"** shall mean the agreed sum of money stated in the Contract to be paid to the Contractor for the successful completion of the Works and obligations, in accordance with the terms of the Contract.

**"Day"** or **"Days"** shall mean a Gregorian calendar day

- **"Defects Liability Certificate"** shall mean the certificate, which the Owner shall issue to the Contractor when the Warranty Period or Extended Defects Correction Period, which ever is later, for the Plant including Equipments has expired, and the Contractor has fulfilled all his obligations under the Contract for such defects.

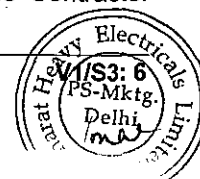
- **"Directive or Owner's Instructions"** shall mean any requirement, instruction, clarification, direction, order, regulation, code, standard or rule of any Competent Authority, which is legally binding and any modification, extension or replacement issued by the Owner or the Consultant in writing to the Contractor from time to time during the subsistence of the contract.

- **"Documents"** shall mean all design documents, engineering documents, drawings, calculations, computer software (programs), computer diskettes and tapes, audio and video tapes, samples, patterns, models, Construction documents, erection documents, quality plans, inspection reports, field quality plans and test reports, operation and maintenance manuals, and other manuals, and all other data and information to be submitted by the Contractor and shall include without limitation engineering, design and Construction drawings, data sheets, specifications, plans, bills of materials and estimates etc.

- **"Drawings" shall mean**

- a) Drawing furnished by the Consultant/Owner .
- b) Supplementary drawings if any furnished by the Consultant/ Owner to clarify and to define in greater detail the intent of the Contract.
- c) Drawing submitted by the Contractor with his Final Proposal provided such drawings are acceptable to the Consultant/ Owner.
- d) Drawing furnished by the Consultant/Owner to the Contractor

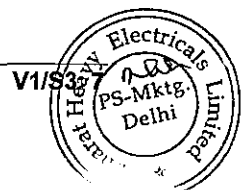
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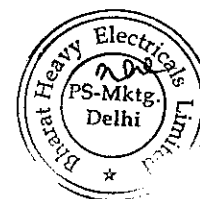
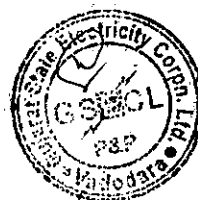
during the progress of Work.

- e) Engineering data and drawings submitted by the Contractor during the progress of Work, provided such engineering data and drawings are acceptable to the Consultant/Owner.

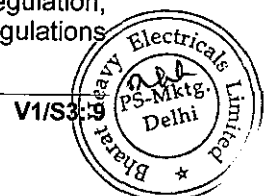
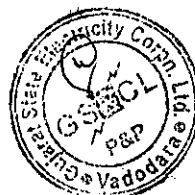
- "Engineer" shall mean an officer of the Owner as may be duly appointed and authorised in writing by the Owner for the purpose of the Contract.
- "Equipment" or "Equipments" or "Equipment(s)" shall mean all of plant, systems, equipments, and Materials specified in Schedule to be supplied under the Contract and such other equipment and materials as may be agreed between the Owner and the Contractor, necessary for incorporation in the Plant.
- "Extended Defects Correction Period" shall mean, in relation to any individual item of Work or Equipment comprised in the Works, which has been rectified, repaired, or replaced, twelve (12) months from the date of such rectification, repair or replacement or twenty four (24) months from the date of COD of the Plant whichever is later.
- "Ex-Works" shall have the meaning ascribed thereto under Incoterms.
- "Facility" or "Plant" shall mean the **1x800 MW** supercritical thermal power plant including , all the Equipments, together with all auxiliaries, and related buildings and Civil works of the said power plant to be constructed at Wanakbori, Kheda District, Gujarat, India, as an integrated whole, including without limitation all systems and sub-systems thereof and related facilities, including without limitation any and all appliances, parts, instruments, appurtenances, accessories and other property that may be incorporated or installed in or attached to or otherwise become part of the Plant or as envisaged in the Contract or which otherwise constitutes a part of the Plant and located on Site.
- "Facility Site" or "Site" shall mean land at Wanakbori, Kheda District, Gujarat, India, owned by Owner on which the Facility will be located, as more particularly identified on the site plan and as described in drawings attached to Contract hereto as Annexure [insert].
- **TAKE OVER CERTIFICATE** shall mean, in relation to the Plant, the certificate issued by the Owner confirming the Owner's Take Over of the Plant as being complete in every respect in accordance with clause No. 20.0 of the General Conditions of Contract, after Provisional Plant Acceptance Certificate is issued and liquidation of the punch lists and pending issues, after completion, synchronization and placed in Commercial operation in accordance with the contract, except for the warranty in respect of Plant/Equipments under the Extended Defects Correction Period, Latent Defects and Warranty for Mandatory Spares.



- **"Final Proposal"** shall mean the document containing the final technical & commercial proposal of Contractor for the Plant as may be modified in accordance with the provisions of the Tender Document, and agreed to in writing by the Owner and shall include but not be limited to technical information, data, documents and drawings forming part thereof, annexed as Annexure [inesrt] to the Contract.
- **"Financial Closure"** shall mean the date on which the Financing Documents providing for funding by the Lenders have become effective.
- **"Financing Documents"** shall mean any and all agreement or agreements, notes, bonds, indentures, political risk insurance policies, credit agreements, debt repayment or refinancing instruments, reimbursement agreements, mortgages, security agreements, guarantees, registration statements, disclosure statements, subordination agreements, partnership agreements, lease agreements, participation agreements and other documents relating to the Construction, interim or long-term financing (and any refinancing of the same) of the Project, including any modifications, extensions, renewals or replacements of the same entered into by the Owner for the provision of finance in connection with the Project.
- **"First Synchronisation"** shall mean electrical connection of plant to the Grid by Interconnection of the Facility for the first time after matching of voltage, phase sequence and frequency after satisfactory Commissioning of TG and STG.
- **"Force Majeure"** shall have the meaning setforth in clause 28.0 of these General Conditions of the contract.
- **"Foreign Currency"** shall mean a freely convertible currency such as US \$, Japanese Yen, Pound Sterling, Swiss Francs & Euro specified in the Schedule of Prices and Schedule of Delivery in which the Contract Price is payable, but not Indian Rupees.
- **"F.O.B"** shall mean delivery free of cost to the Owner on board the vessel at the port of shipment.
- **"F.O.R. Destination"** shall mean delivery free of expenses to the Owner on board rail wagons at the railway siding at the Site or its nearest railway station including the insurance coverage.
- **"F.O.R. Works"** shall mean loaded and stowed or trimmed free of expenses to the Owner on board rail wagons at the Contractor's Works siding or it's nearest railway station for transportation.
- **"F.O.R. Site"** shall mean delivery free of expenses to the Owner at his Site.
- **"GUVNL"** shall mean Gujarat Urja Vikas Nigam Limited including its successors in title and assigns of its interest.
- **"General Conditions of Contract"** or **"GCC"** shall mean these Conditions of Contract' as amended in accordance with the provisions contained in this behalf herein.

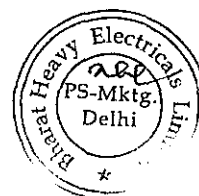


- **"Guaranteed Commercial Operation Date"** shall mean the date by which the Contractor has guaranteed to make the Plant ready for Commercial Operation after successful completion of Reliability Run.
- **"Guaranteed DM Water Consumption"** shall mean the guaranteed demineralised water consumption for the plant operation as stated at CL3.02.01 of VOL IIA/S-10
- **"Good Engineering Practices"** shall mean those practices, methods, acts, techniques and standards as may be followed or employed in the performance of the work and discharge of its obligations by the Contractor and which (i) are generally accepted internationally for use in the electric utility industry, taking into account conditions in India, in connection with power plants of the same or similar size and type as the Plant, (ii) are commonly used in prudent electric utility engineering, construction, project management and operations, and (iii) would be expected to result in performance of the services and completion of Works in a manner consistent with Applicable Laws, Applicable permits, reliability, safety, environmental protection, economy and expediency.
- **"Government Instrumentality" or "Competent Authority"** shall mean the Government of India, the Government of Gujarat, or any political subdivision, ministry, department, agency, corporation, commission or any regional, local or municipal authority or governmental body thereof or any other governmental or statutory body under the direct or indirect control of the Government of India or Government of Gujarat, or of any political subdivision, ministry, department, agency, corporation, commission, or any regional, local or municipal authority or governmental body thereof, and shall include without limitation any other governmental or statutory body in India having jurisdiction over the Plant or over the performance of any part of Work or the Works or any obligation of the Contractor or the Owner under the contract.
- **"Grid"** shall mean the system of electrical transmission and distribution of GETCO interconnecting different generating stations, transmission lines, sub-stations, circuits, transformers, switchgear and other equipment upto and on the GETCO side of the Interconnection Point.
- **"GETCO"** shall mean the Gujarat Energy Transmission Corporation Limited.
- **"Goods"** shall mean Equipment to be supplied under the Contract
- **"Reliability Run"** shall mean the first continuous operation of the Plant with sub-systems under varying loads to demonstrate satisfactory operation for a specified period (14 days) after completion of successful Initial Operations and conditions as specified elsewhere in the Contract.
- **"Hazardous Materials"** shall mean (i) hazardous materials, hazardous wastes, hazardous substances, toxic substances or contaminants as those terms are defined under any environmental law or regulation, including, but not limited to, Applicable Laws, and in the regulations



adopted or promulgated pursuant thereto; (ii) petroleum and petroleum products including crude oil and any fractions thereof; (iii) any other hazardous, radioactive, toxic or noxious substance, material, pollutant, or solid, liquid or gaseous waste; and (iv) any substance that, whether by its nature or its use, is subject to regulation under any environmental law or with respect to which any applicable environmental law or any Governmental Instrumentality requires environmental investigation, monitoring or remediation.

- **"Incoterms"** shall mean **"International Rules for the Interpretation of Trade Terms,"** as adopted by the International Chamber of Commerce (the "ICC") and as in force on the date of invitation of the bids. All matters relating to the Construction and interpretation of Incoterms shall be resolved by reference to the Guide to Incoterms.
- **"Taxes"** shall mean all taxes, duties, and cess imposed by the Government of India or any of its subdivisions (including value added tax), excise, storage and consumption taxes, service tax, import duties and customs duty and fees, license fees, sales and/or purchase taxes, octroi, entry tax, and labour cess applicable to any portion of the Works or Supplies, or any other tax, duty or fee of similar nature irrespective of the nomenclature used for the same
- **"Personal Taxes"** shall mean all taxes on income, profit, other real and personal property and franchise taxes, as well as personal income taxes of the Parties or any authorised persons acting on behalf of the Parties; and all applicable national, state and local payroll, social security, workers' compensation, employment taxes and contributions imposed by Applicable Law with respect to or measured by compensation (wage, salaries or other) paid to employees of the Parties, including taxes, health and welfare funds, pensions and annuities, disability insurance and all other similar social payments.
- **"Initial Operation"** with respect the Plant shall mean all operations undertaken as part of "Commissioning" after completion of "Preliminary Operation" first synchronization and upto commencement of "Trial Run". It shall be the first integral operation of the Plant including all Equipment / Systems, and shall include first light up / initial equipment rolling, equipment stretch-out, dry-out and operational chemical cleaning, no-load / partial load / full load runs for mechanical / electrical tryout and gathering of operational data; calibration, setting and Commissioning of control systems; and shutdown inspection and adjustment after running trials of the Plant including the Equipment.
- **"Inspector"** shall mean the authorized representatives appointed by the Owner or the Consultant for purpose of the inspection of Equipments for the purposes of the Contract.
- **"Interim Payment Certificate"** shall mean any payment certificate other

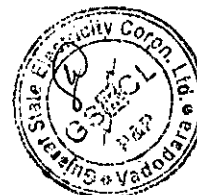
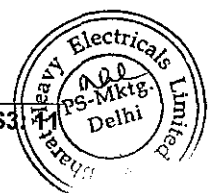


than Final Payment Certificate, issued by the Owner or Owner's Representative pursuant to clause 8.12.1 other than the final payment certificate.

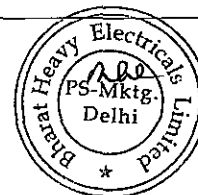
- **"Interconnection Facility"** shall mean all the facilities to be provided by the GETCO on the Site on GETCO's side of the Interconnection Point the location of which is specified in the Technical Specifications.
- **"Interconnection Point"** shall mean the 400kV Switchyard outgoing gantry from where the power is evacuated to the Grid by GETCO.
- **"Intellectual Property Rights" or "IP Rights"** shall mean copyright, all rights conferred under statute or common law in relation to inventions (including patents), registered trademarks, registered designs, circuit layouts, confidential information and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields
- **"Latent Defect"** shall mean the defects in design, materials and could not have been found prior to expiry of the Warranty Period mean a defect, which was in existence during the applicable Warranty period but was not reasonably discoverable during such Warranty period.
- **"Lenders"** shall mean those banks, firms or institutions who make available, from time to time, financing for the Project and whose identities have been notified to the Contractor.
- **"Letter of Intent" or "Lol"** shall mean the formal communication in writing by the Owner to the Contractor of the acceptance of the Contractor's Bid.
- **"Lien(s)"** shall mean any lien, claim, charge, encumbrance, cause of action, security interest, mortgage or other possessory or non-possessory interest in, on or against real, tangible or intangible property as administered under Applicable Law arising out of, due to, or otherwise as a result of the Contractor's acts or omissions, including any lien recorded or held by any Sub-Contractor or any other person entitled to a lien under Applicable Law.
- **"Limits of Rejection"** shall mean the limits prescribed to each of the Performance Guarantees, which if not adhered to, the Project shall be liable for rejection
- **"Liquidated Damages"** shall have the meaning as specified in 11.0 of the GCC.
- **"Local Currency"** shall mean the Indian Rupees.
- **"Manufacturer"** shall mean any entity or firm who is the producer and furnisher to the Contractor of any material or designer and fabricator of any equipment I systems which is to be incorporated in or forms part of the plant / works.
- **"Mandatory Spares"** shall mean the mandatory spares, and maintenance tools and tackles for the Plant, as specified in the Specifications, to be supplied by the Contractor under the Contract.

DEVELOPMENT CONSULTANTS  
(K9213R\_EPC-SPC-001\_V1\_S3.doc) July 09 2012)

V1/S3

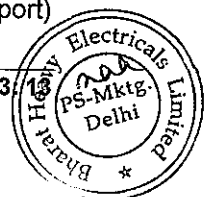
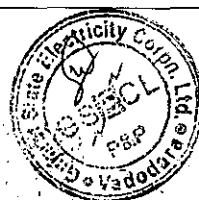


- **"Materials"** shall mean things of all kinds to be provided and incorporated in the Plant by the Contractor, including the items which are to be supplied by the Contractor under the Contract.
- **"Mechanical Completion"** shall mean with respect to the Plant, the completion of all works by the Contractor including completion of Construction, erection, installation, calibration and construction; testing services with respect to all mechanical, electrical, civil & structural, instrumentation and control systems (including Equipment) of the Plant, and the Plant has achieved a state of readiness for "Preliminary Operation". The existence of Punch List and pending issues items which do not prevent or adversely affect the Plant performance and safety, from being in a state of readiness for "Preliminary Operation" shall not be construed as preventing the Plant, from achieving Mechanical Completion.
- **"Milestone Payment Schedule"** shall mean the document, provided in Annexure [insert] hereof which sets forth (i) payments to be made by the Owner to the Contractor on schedule specified therein, and (ii) links each such payment with Project Milestones commencing on the Commencement Date. The Milestone Payment Schedule divides the contract price payment among certain progress milestones and may otherwise be adjusted from time to time in accordance with the contract.
- **"Month"** shall mean a month according to Gregorian calendar.
- **"Monthly Progress Report"** or **"Progress Report"** shall mean a progress report meeting the requirements set forth in clause 29 of the specification hereto.
- **"Notice to proceed"** or "NTP" shall mean the Owner's letter or notification intimating the Contractor to commence the Works.
- **"Notice in Writing"** or **"Written Notice"** shall mean a notice in writing, typed or printed or hand written characters, sent (unless delivered personally or otherwise proved to have been received) by registered post or by any agreed system of electronic transmission to the last known private or business address or registered office of the addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered.
- **"Operation Manual"** shall have the meaning set forth in Specification hereof.
- **"Owner"** or **"Purchaser"** shall mean Gujarat State Electricity Corporation Limited (GSECL) and shall, unless repugnant to the context thereof, include its successors, assigns as well as authorized officers & representatives.
- **"Owner's Representative"** shall mean the person appointed by the Owner from time to time and notified as such to the Contractor to act as Owner's Representative for the purposes of the Contract.
- **"Owner's Instructions"** or **"Owner's Representative's Instructions"**



shall mean any drawings, specifications, instructions, details, directions and explanations, in writing issued by the Owner or by the Owner's Representative /Consultant from time to time during the subsistence of the Contract

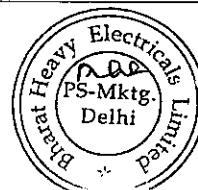
- **"Owner or Purchaser"** shall mean Gujarat State Electricity Corporation Limited and shall include its successor(s) and assigns.
- **"Prime Bidder"** shall mean a reputed organization who submits a Bid and assumes single point responsibility acting by himself or on behalf of his associates. The Prime Bidder will be the party who will be contractually bound to the Owner.
- **"Owner Permits"** shall mean those Permits, No Objection Certificate (NOC), authorizations, consents and approvals required by the Owner to own, possess, operate and maintain the Plant and to generate electrical energy there from,
- **"Party"** shall mean either of the Owner or Contractor individually and **"Parties"** shall mean Owner and Contractor collectively.
- **"Permanent Works"** shall mean the permanent works, equipment and materials including all civil, electrical, control & instrumentation and mechanical works to be designed, engineered, manufactured, supplied, installed, erected, executed, Commissioned in accordance with the Contract and which form part of the Plant.
- **"Performance Guarantees"** shall mean the guaranteed capacity, efficiency and operating characteristics of the Plant as stipulated in Schedule of the Contract and Specifications.
- **"Performance Guarantee Tests"** shall mean, the tests specified in the Specifications and Schedule of the Contract to be conducted by the Contractor after entry into Commercial Operation of the Plant at the Site by the Contractor, other than the Tests before Commercial Operation, which shall be performed to demonstrate the achievement of Performance Guarantees, and shall be successfully conducted within three (3) Months of entry into Commercial Operation of the Plant.
- **"Performance Test"** with respect to the equipment/systems of the Plant shall mean the test to establish their design / rated performance conducted at site by the Contractor in accordance with the provisions of the contract.
- **"Permit"** shall mean any valid permit, authorization, license, registration, approval, consent, waiver, exemption, variance, franchise or any similar order of or from of any Government Instrumentality, court or other body having jurisdiction over the matter in question.
- **"Person"** shall mean any individual, corporation, partnership, association, joint stock company, trust, unincorporated organisation, joint venture, government or political subdivision or agency thereof.
- **"Port of Entry"** shall mean the final destination in India (sea or airport)



where customs duty, port and other handling charges are paid on imported materials.

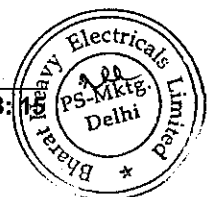
- "Power Purchase Agreement" shall mean the Agreement between the Owner and the GUVNL for sale of electrical energy generated by the Facility to GUVNL.
- "Preliminary Operation" shall include all activities undertaken as part of Commissioning after Mechanical Completion up to commencement of Initial Operation and shall include mechanical and electrical checkouts, adjustments, calibration of instruments and protection devices, Commissioning of sub / supporting systems and static chemical cleaning of the Plant.
- "Project" or "Plant" shall mean the Facility and the work as an integrated whole, all as described in greater detail in the specification hereto.
- "Project Documents" shall mean the Power Purchase Agreement, the Financing Documents, the Contract, any Operation and Maintenance agreement in respect of the Plant, all fuel purchase agreements, all fuel transportation agreements and all other contracts relating to the Plant entered into by the Owner and shall include all Drawings and documents
- "Protocol" shall mean the statement of readings of any or all of Tests Before Commercial Operation and/or Performance Guarantee Test or any other tests performed by the Contractor under the Contract (which test has been witnessed by the Owner) and jointly signed by Owner and/or his representative or Inspector and Contractor and/or his representative.
- "Provisional Acceptance Certificate" shall mean the certificate issued by the Owner to the Contractor evidencing achievement of the COD by the Contractor.
- "Prudent Utility Practices" shall mean those practices, methods, equipment specifications and standards of safety and performance, as the same may change from time to time, as are generally accepted for use in electricity generating utilities taking into account conditions in India and commonly used in prudent electricity generation utility engineering and operations including design, engineering Construction, erection, Commissioning, operation and maintenance of power generating stations and equipment comprised therein lawfully, safely, efficiently and economically for facilities of the type and size similar to the Plant and that generally conforms to the Equipment manufacturer's operation and maintenance guidelines.
- "Punch List" shall mean the list in respect of the equipment / systems supplied / erected / commissioned, first prepared by Owner at the time of issuance of Provisional Acceptance Certificate of the equipment / systems, and thereafter periodically revised by Owner as necessary, which list shall set forth certain items of Work which remain to be performed by the Contractor in order to ensure that the Plant fully complies with all of the standards and requirements set forth in the Contract.

*Signature*  
S.A. ICHMAN  
S.A. ICHMAN  
MUKESH K.S. SINGH



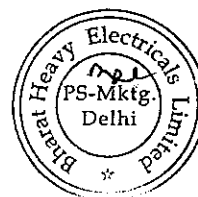
Provided, the Punch List and pending issues shall not include any items of work, alone or in the aggregate, the non-completion of which prevents the Plant as a whole from (a) being used for its intended purposes as described in the Contract in accordance with Applicable Laws and Applicable Permits or (b) being legally, safely and reliably placed in commercial operation

- "QA Programme" shall mean the comprehensive quality control and quality assurance programme to be followed by the Contractor in executing the Supplies, Construction/ Erection of the Works.
- "Risk Transfer Date" shall, subject to the obligation of the Contractor including, without limitation, in relation to the Performance Guarantee Test (and consequences of failure thereof including rejection) and Warranty, mean the date on which the Owner assumes the care and custody of the Equipment/Plant or the Plant enters in to Commercial Operation whichever is earlier.
- "Schedule" shall mean collectively all the schedules including Project Schedule, Milestone Schedule and other schedules pertaining to the work and the Plant as detailed in the Contract.
- "Specifications" or "EPC Specification" or "Technical Specification" shall mean collectively, the description of the scope, the Owner's requirements, design criteria, technical requirements, Final Proposal, drawings, programme of work Project Schedule, all Appendices to the contract, Appendices to these General Conditions of contract, Performance Guarantees, all terms and stipulations of the contract, and such amendments and revisions, as may be made in the Tender Documents or to the contract and all written agreements made after the execution of the contract by the Parties, or which may pertain to the method and manner of performing the work under the contract as agreed.
- "Sub-contractor" shall mean any Person (other than the Contractor or the Owner) to whom any part of the Works has been sub-contracted by the Contractor in accordance with the Contract and with prior approval of the Owner, or with whom the Contractor has entered into any contract for the supply of any Equipment in connection with the Works and with prior approval of the Owner, and shall include its legal successors in title or permitted assigns, and unless otherwise stated, all the Sub-contractors and suppliers to such Person and the term Sub-Contract shall be construed accordingly.
- "Supplies" shall mean the supply of the Equipment and the Mandatory Spares by the Contractor in connection with the performance of its obligations under the Contract, including all incidental activities thereto,
- "Site" shall mean the land and other places including existing roads and paths put at the disposal of the Contractor by the Owner in connection with the execution of the Contract.



- **"Synchronisation"** shall mean electrical connection of the Plant to the Grid by means of the Interconnection Facility for the first time where the Plant and the Grid are matched in voltage, phase and frequency, after satisfactory Commissioning.
- **"Take Over" or "Taking Over"** shall mean taking-over of the whole Plant by the Owner for the purpose envisaged under the Contract after Commercial Operation Date and after successful completion of Performance Guarantee Tests complete within three months from the Commercial Operation of the Plant and successful completion of Tests Before Take Over, as well as liquidation and completion of pending items specified in Punch List in pursuant of the Contract.
- **"Temporary Works"** shall mean all temporary works of every kind (other than Contractor's Equipment) required for the execution and completion of the Works and the remedying of any defects.
- **"Tender Documents"** shall mean the documents for Invitation to Bid together with all amendments thereto and clarifications, if any, issued by the Owner or the Consultant from time to time in respect thereof.
- **"Tests before Commercial Operation"** shall mean in relation to the Plant, all tests prescribed in the Specification and any other tests agreed between the Owner and Contractor to be undertaken by the Contractor.
- **"Tests before Take Over" shall mean** the tests prescribed in the 'Specification', and any other such tests as may be agreed between the Owner and Contractor or instructed as a Change Order, which has to be carried out by the Contractor before the Plant is Taken Over.
- **"Tonne"** shall mean 1,000 Kilogram weight.
- **"Transmission Facilities"** shall mean all of the facilities to be located off the Site and to be constructed by or for the GETCO to connect the Interconnection Facilities to the Grid.
- **"Reliability Run Test" or "Trial Run"** of the Plant shall mean the -Period of 14 days of continuous operation after Synchronization, or extended period thereof if any as more particularly defined at Vol-II A/S-10/CL2.02.02 .
- **"Tests on Completion"** shall mean such tests as are prescribed in the Specifications and/or other tests as mutually agreed upon by the Owner and the Contractor to be carried out by the Contractor to prove satisfactory performance of the Works.
- **"Ton"**, shall mean 1,000 Kilogram weight, "Gallon" shall mean Imperial gallon, unless otherwise mentioned specifically.
- **"Unexpected Archaeological Condition"** shall mean uncovering or revealing of an unknown historical or archaeological site at or contiguous to the Site during performance of the Contract that was not

*Handwritten notes:*  
Mukesh K. Singh  
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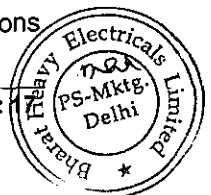
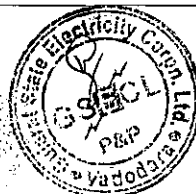


shown or indicated in the Subsurface Investigation and which Contractor could not have reasonably been expected to be aware of.

- "Unpriced Technical Bid" shall mean the unpriced technical bid submitted by the Successful Bidder as part of its Final Proposal
- "Variation" shall mean alterations, amendments, omissions, additions, or variations of the Equipment or the Supplies as agreed.
- "Warranty" shall mean all guarantees and warranties provided or agreed to be provided under the Contract for and in respect of the equipment, work, components, materials, Supplies and parts and works forming part of or incorporated in the Plant or relating thereto supplied or provided by the Contractor and shall include any guarantee or warranty provided or furnished by a sub-Contractor under a sub-contract.
- "Warranty Engineer" shall mean, the engineer deputed by the Contractor and staying at site, to be responsible for looking after / supervising Operation and Maintenance practices during warranty period.
- "Week" shall mean a continuous period of seven (7) Days.
- "Wilful Misconduct" shall mean that the Contractor has intentionally concealed the defect in full knowledge of the serious consequences that may flow from its existence and the defect is one, which the Owner could not have discovered on careful examination of the Plant at the time of commencement of Commercial Operation or during the Warranty Period.
- "Work" or "Works" shall mean the works and services involving engineering, procurement, Supplies, construction, installation, erection, Commissioning of the Plant and shall include all Permanent Works comprised in or forming part of the Plant and the temporary works or either of them as appropriate, and any other works required to be performed by the Contractor under the Contract.
- "Warranty Period" shall have the meaning assigned to the term under Clause 21.2 of the GCC, during which the Contractor shall bear all cost covering repair and/or replacement of any defective part of the Plant/ Equipment supplied, works done and services rendered under the Contract.

## 2.2 Interpretation of Bid Document

- 1) General Conditions shall be read in conjunction with Instructions to Bidders, special Conditions, Technical Specifications, Drawings and other documents forming part of the Bid Document wherever permissible or the context so requires.
- 2) Notwithstanding the sub-division of the Bid Document into sections and volumes, every part of each shall be deemed to be supplementary to and complementary of each other.
- 3) All headings and marginal notes to the items of the General Conditions



or to the Specifications or to any other document forming part of the Bid Document are solely for the purpose of giving a concise indication of the general subject matter thereof and not a summary of the contents thereof and they shall never be deemed to be part thereof or be used in the interpretation or construction thereof.

- 4) Wherever it is mentioned in the Bid that the Contractor shall perform certain work or provide certain facilities it is understood that the Contractor shall do so at his cost and the price shall be deemed to have included the cost of such performances and provisions so mentioned.
- 5) The materials, designs and workmanship shall satisfy the applicable standards, specifications contained herein and codes referred to. Where the Bid Document stipulates requirements in addition to those contained in the standards and codes, those additional requirements shall also be satisfied.
- 6) For the purposes of the Contract including General Conditions of Contract, the expression "legally, safely and reliably placed in commercial operation" shall mean that the Facility, will operate in the manner intended as described in the contract, in accordance with all Applicable Laws and Applicable Permits, and without undue risk of damage or injury to the Plant or Persons.
- 7) Words incorporating the singular only shall also include the plural and vice -versa where the context requires.
- 8) "Writing" shall include any manuscript typed or hand-written or printed statement, including E- Mail and facsimile transmission under or over signature or seal as the case may be.

2.3

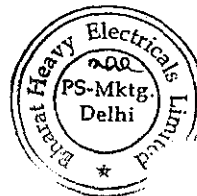
**Priority of documents**

For the purpose of interpretation of the Contract, especially in the event of any inconsistency, the following order of precedence shall apply:

**Order of Precedence:**

The order of precedence shall be the order in which the documents are listed below:

- i) The Contract Agreement
- ii) Letter of Award duly accepted by the Contractor together with its amendments, if any.
- iii) Pre Award Minutes of Meeting, Resolutions to Deviations / Clarifications
- iv) Pre-bid clarifications issued by the Owner and Amendments to Tender specifications
- v) General Conditions, ITB, Special conditions for erection and Construction
- vi) Technical Specifications
- vii) Contractor's Bid Proposal

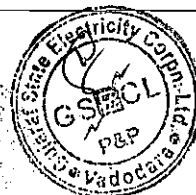


3.0 SCOPE OF WORK

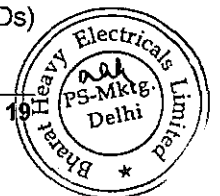
3.1 The scope of work, if not otherwise mentioned in the Contract, shall be on the basis of a single Contractor's responsibility, completely covering all the equipment specified under the accompanying Technical Specifications. The Works include the following: -

- a) Detailed design of all the equipment and sub-systems as per Specifications;
- b) Complete manufacture of all the Equipment including shop assembly and testing as per Specifications, supply of special tools and tackles and services necessary for satisfactory execution of the Contract;
- c) Providing Engineering Drawings, Data and operation manual, etc. for Owner's/Consultant's approval.
- d) Packing and transportation of the Goods from the Manufacturer's Works to the Site including freight charges, insurance coverage;
- e) Supply of Mandatory Spares;
- f) Receipt, unloading, storage, preservation and conservation of the Goods at the Site;
- g) Erection, Testing and Commissioning, trial run of all the equipment at the Site, Tests on Completion, putting into Commercial Operation;
- h)
  - i) Performance Guarantee Tests on successful completion of Reliability Run
  - ii) Reliability Test shall commence after completion of Commissioning of the Plant. Length of such operation shall be as specified in [VOL-IIA/S-10/CI 2.02.02 PAGE 3] of the Contract.
- i) Providing construction, erection, testing and commissioning supervision personnel to supervise the work, erection, testing and Commissioning of the Plant;
- j) All civil works including supply of all materials and temporary works etc. as needed;
- k) Structural work including supply of all materials, Consumables and temporary works etc. as needed;
- l) Architectural works as approved by the Owner;
- m) Providing three sets of as commissioned Drawings, three sets of as commissioned data/specification/parameter sheets duly signed by the relevant competent authority, and five sets of Compact disks (CDs) should be submitted prior to Take Over.

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Provided that all Works shall be done as per the requirements of the Contract including, without limitation, the Drawings and Documents approved by the Owner and the Specifications.

Provided further that the Contractor shall, unless specifically excluded in the Contract, perform all such Work and/or supply all such items and materials not specifically mentioned in the Contract but are required for attaining Commercial Operation of the Plant as if such work and/or items and materials were expressly mentioned in the Contract and in a manner that ensures that the Plant is fit for the purpose intended.

3.2 **STANDARD OF CARE**

The Contractor shall execute and complete the Works in a safe, prudent and reliable manner in strict accordance with the Contract and with Good Engineering Practices.

4.0 **CONTRACT PRICE**

4.1 The Contract Price shall be for the entire scope of the Work with the breakdowns as specified in Schedule of Prices.

The Contract Price shall be lump-sum and firm, and valid for the entire period of the Contract.

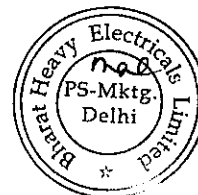
4.2 The price for the Goods of origin outside India shall be the CIF Price.

4.3 **Taxes and Duties**

4.3.1 For the Goods of Indian origin, all Taxes shall be deemed to be included in the Contract Price. However excise duty, sales tax, works contract tax, octroi, and similar taxes as payable on finished goods and included in the Contract Price shall be indicated separately considering exemptions which may ordinarily be available/applicable at the prevailing structured rate. Further, Service Tax on Service portion of the Contract will be indicated separately. The normal prevailing rates of aforesaid taxes and duties and exemptions/concessions to the same with concessional rates shall be indicated. In case of delay in delivery not attributable to the Owner, any increase in the rates of aforesaid taxes beyond the scheduled date of delivery shall be to the Contractor's account. The amount of aforesaid taxes paid shall be reimbursed to the Contractor by the Owner upon presentation of documentary evidence upto the limit indicated in the bid offer.

4.3.2 The Taxes and Duties mentioned in Clause 4.3.1 for direct dispatch able items to Site from bidder's Sub Contractors, Sub Vendors, JV Companies whose works are located within India shall be reimbursed by the Owner upon presentation of documentary evidence upto the limit indicated in the bid offer.

4.3.3 In the case where Equipment have been listed under the schedule of items of foreign origin (to be imported) and such list have been accepted by the Owner, the responsibility of obtaining an import license, taking procedures thereon and payment of Taxes will rest with the Contractor though technically Owner will remain as an Importer. The Contractor shall prepare all required documents for



the Owner to make application for such import license and extend all possible assistance to the Owner for expeditious clearance of the license as and when requested by the Owner. The Contractor shall also arrange for payment of Taxes against any consignment on behalf of the Owner and the amount paid towards Taxes will be reimbursed by the Owner to the Contractor in Indian Rupee on presentation of documentary evidence as per Contract. In the case of delay in delivery not attributable to the Owner, any increase in the Taxes, port handling and port clearing charges as well burden due to rise in foreign exchange rate shall be to the Contractor's account.

The Bidder is to furnish a detailed list of imported equipment and materials and quantities against each item along with his Bid.

4.3.4 In the case of raw materials, components, sub-assemblies and other equipment and materials imported by the Indian Contractor for value addition, construction materials and Consumables, if any, all such import duties and levies payable shall be deemed to have been included in the Contract Price and no separate claim on this behalf will be entertained by the Owner.

4.3.5 Additionally, the Contractor shall bear and shall be liable for the payment of its Personal Taxes.

4.3.6 The Contractor and all its expatriate personnel shall be responsible for the timely and prompt filing of all returns, documents, estimates, accounts, information and details complete and accurate in all respects as may be required under the applicable laws/regulations of India by the appropriate authorities in India. In case the Contractor or any of its expatriate personnel do not comply with the above requirements, which results in any penalty, interest or other liability, the same shall be borne by the Contractor.

4.3.7 GSECL will arrange C Forms as applicable on quarterly basis. Also TDS certificate will be issued on quarterly basis.

4.3.8 Taxes and duties in the proposal shall be the rates prevailing fifteen (15) days prior to the date of opening of Techno Commercial Bid.

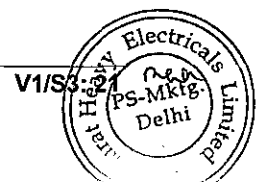
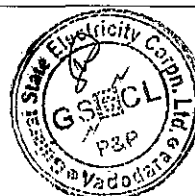
#### 4.4 Price Adjustment for Quantity Variation in the Works and Change Order

4.4.1 Quantities of Equipment required by the Specification may be in certain cases, subject to variation pursuant to the Change Order in accordance with the procedure set out in this Clause 4.4.

#### 4.4.2 Changes

(i) Owner shall have the right at any time by written notice to Contractor to make changes to the Work, whether such changes are modifications, alterations, deletions or additions. Contractor agrees to effect such changes in the Work as Owner may from time to time request subject to mutual agreement. The Change Order shall be limited within +/- 15% of Total Contract Price.

(ii) Any request by Owner for a change shall be delivered to Contractor in writing and shall be sufficiently definite and detailed to give Contractor an adequate basis on which to prepare a preliminary change order pursuant to Clause 4.4.3.



(iii) Upon receipt of Owner's request for a change, Contractor shall prepare a preliminary change order and deliver the same to Owner within ten (10) days time or any reasonable time mutually agreed following Contractor's receipt of such request.

(iv) Throughout the performance of the Works Contractor shall have a continuing obligation to suggest to Owner for Owner's consideration:

(a) All such changes as Contractor considers desirable; and

(b) Such other changes known to Contractor as may be necessary to incorporate significant new developments in technology which are applicable or appropriate to the Plant.

(c) Contractor shall submit any such suggestion in the form of a preliminary change order pursuant to Article 4.4.3.

4.4.3 Preliminary Change Orders

(i) Each preliminary change order submitted by Contractor to Owner pursuant to Clause 4.4.2 or any other express provision of the Contract shall be in writing and be accompanied by such information and data as will be reasonably required by Owner to evaluate properly the proposed execution of the work in question, the effect, if any, on the Work, scope of Work, an adjustment in one or more of the (i) Contract Price, (ii) Guaranteed Commercial Operation Date, (iii) Milestone Payment Schedule, (iv) any of the Performance Guarantees, or (v) any provision/scope of the Contract.

(ii) Owner shall reject or approve at its sole discretion each preliminary change order as expeditiously as proper consideration of the nature of the change may reasonably permit.

(iii) The cost of all work involved in preparing the information and data required to accompany the preliminary change order involved and for any additional analytical or investigative work requested by Owner in connection therewith is included in the Contract Price.

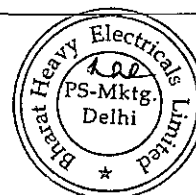
4.4.4 Change Orders

(i) Except as provided in Clause 4.4.5, Contractor shall not act upon any preliminary change order unless the Owner has executed a written Change Order.

(ii) Any adjustment of the Contract Price pursuant to the Change Order shall take into account, among other things, the elimination or avoidance of Work to be performed resulting from the changes in the Work and from assistance given by Owner.

4.4.5 Performance of Change Order pending agreement

If Owner and Contractor fail to agree on the effect of a Change Order and as a result a Change Order is not executed, Owner may nevertheless require Contractor to perform the Work as changed by delivering to Contractor a Change Order signed by Owner and Contractor shall complete all work specified in such Change Order and the dispute shall be resolved as provided in Clause 39:



The Owner shall pay to the Contractor in accordance with the Contract, such amount as has been ascertained by Owner as payable for such Change Order pending the resolution of the dispute. Contractor's performance of the Work as changed shall not prejudice either party's position regarding the effects of such change.

4.4.6 Variations in Contract Price

Except as otherwise provided in the Contract any increase or reduction of the Contract Price resulting from any Change Order shall be for the account of Owner, provided that no increase in the Contract Price shall be granted with respect to a change if:

(1) The providing of the additional services is necessary in order for Contractor to satisfy its responsibility to make the Plant operable and capable of performing as contemplated under the Contract and to ensure that the Plant when completed and the Work is performed in accordance with the Contract;

(2) The additional services are required because of delays attributable to Contractor, to late deliveries of Equipment or Contractor's Equipment or to labour shortages or relate to any rectification or remedy of defects or deficiencies required under the Contract;

(3) The additional services are required because of a breach of any of the Guaranteed Commercial Operation Date and Performance Guarantees or Warranties under the Contract; or

(4) The change relates to re-performance of any of the Work because of Contractor's failure to follow Owner's Specifications.

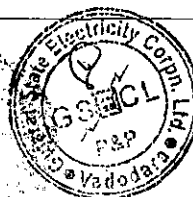
It is clarified that any adjustments in the Contract Price shall be made only in accordance with this Clause 4.4.

4.4.7 Not Considered Changes

Without prejudice to any other provision of the Contract, the following shall not be considered under any circumstances as changes in or within the Work, nor shall any of the following be taken into account when calculating the effect upon the Contract Price of changes in or within the Work nor shall any of the following of themselves be considered the basis for any adjustment of the Contract Price:

- (1) Any escalation in the cost of Equipment or labour;
- (2) Any increase in manpower hourly rates;
- (3) Currency fluctuations in respect of costs included within the Contract Price; and
- (4) Any change in the sourcing of Equipment.

4.4.8 The Work shall be subject to further detailing by the Parties from time to time and that, such detailing shall not be considered as a change in Work. In addition, a request by Owner that Contractor perform services or provide Equipment or Contractor's Equipment not specifically included within the Scope of Work shall not be considered a request for a change in the Work if it is required to make the Plant operable and capable of performing as specified in the Contract.



5.0 TIME : THE ESSENCE OF CONTRACT

The time and date of completion of the Work as stipulated in the Contract Document and the Guaranteed Commercial Operation Date shall be deemed to be the essence of the Contract. The Contractor shall so organize his resources and perform so as to complete the Work not later than the aforesaid date.

The Contractor shall submit a PERT network showing various key phases of the Work such as design, procurement, manufacturing, shipment, and field erection and construction activities within thirty (30) days after the date of receipt of Notice to Proceed. This network where applicable shall indicate the interface facilities to be provided by the Owner and the dates by which such facilities are needed by the Contractor and also the programme for phase wise release of Work Site for erection work as may be needed by Contractor.

The Contractor shall discuss the network so submitted with the Owner and the same shall be finalized pursuant to such discussions. The agreed network may be in the form as submitted or in revised form in line with the outcome of discussions and shall form part of the Contract Document.

The above PERT network shall be reviewed and periodic review reports shall be submitted by the Contractor to the Owner as directed by him.

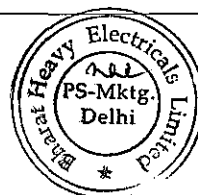
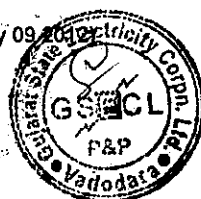
The Contractor shall make available to the Owner detailed manufacturing, delivery, erection, testing and commissioning programmes in line with the agreed PERT network in the form of PERT or Bar Chart as desired by the Owner within ninety (90) days from the date of receipt of Notice to Proceed. During performance of the Contract, such programmes shall be renewed, updated and submitted to the Owner as and when needed by him or periodically as specified by him. If in the opinion of the Owner/Engineer proper progress is not maintained, suitable changes shall be made in the Contractor's operation to ensure proper progress.

5.0A TRANSFER OF TITLE AND RISK

5.0A1 The legal title (but not risk which shall be transferred on the Risk Transfer Date) of the Equipment dispatched from any country outside India, shall be passed on to the Owner on the point of embarkation. However, the physical possession of such goods will remain in the hands of the Contractor for performance of the balance Scope of Work. The Contractor shall submit, in such form and within such time as required by the Owner, an indemnity bond indemnifying the Owner from any loss or damage to the equipment/material for the period between point and embarkation and the Taking Over the Plant by the Owner.

The transfer of title of goods shall take place when the goods in deliverable country/state are placed on board vessel for onward transmission to the Owner. The clean Bill of Lading issued by the Master of the Vessel shall be indicative of such deliverable country/state. Risk shall however continue to be that of the Consignor/Contractor upto the Taking Over of the Plant.

5.0A2 The Contractor shall remain responsible for, and shall bear the risk of loss or damage to, the Equipment in its possession and the Plant from the Commencement Date until the Risk Transfer Date. Provided that the transfer of risk shall be without prejudice to the obligation of the Contractor under the Contract.



6.0 PERFORMANCE BANK GUARANTEE FOR DUE PERFORMANCE OF THE WORK

6.1 The Contractor, upon receipt of Notice to Proceed from Owner shall furnish a Performance Bank Guarantee in the form specified as per Annexure-D as the performance security, for an amount equal to 17.5% of the total Contract Price under the Contract for diligent and due fulfillment by the Contractor of all obligations under the terms and conditions of the Contract. The initial Performance Bank Guarantee of 17.5% will be permitted to be reduced to 10% on completion of Reliability Run, completion of Performance Guarantee Test, and /payment of liquidated damages,(if applicable ) whichever is later.

6.2 The Performance Bank Guarantee shall be liable to be invoked towards and claims and/or damages due to the Owner for failure of the Contractor to meet his obligations under the Contract. The Bank Guarantee shall be valid until it is released at the end of Warranty Period as stipulated in Clause 21 of this Section.

6.3 However, the amount of the Performance Bank Guarantee, after expiry of the Warranty Period, may be reduced in proportion to the Work released from Warranty obligations at the discretion of the Owner.

The Performance Bank Guarantee amount in case of divisible Contract shall be 17.5% of the total value of the Contract for the faithful performance of the Contract in accordance with the Contract Document. The guarantee amount shall be payable to the Owner in the currency of the consideration of the Contract without any condition whatsoever and their Guarantee shall be irrevocable.

6.4 In addition to the grounds specified above, The Performance Bank Guarantee is shall be liable to be invoked in the event:

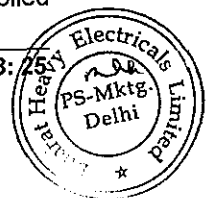
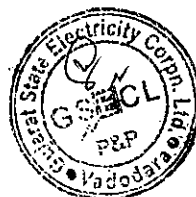
- a) The Owner has obtained an award in arbitration and the amount awarded has not been paid within thirty (30) days after the award, or
- b) The Contractor has gone into liquidation or has been declared bankrupt, or
- c) Any other reason which may adversely affect the contractual obligations of the Contractor.

Performance Guarantee is intended to secure the satisfactory performance by the Contractor of the entire Contract.

7.0 SUPPLY, ERECTION CONTRACT/DIVISIBLE CONTRACT

Notwithstanding anything stated elsewhere in the Bid Document, the Contract to be awarded is on the basis of Supply- Erection Contract (Divisible Contract) with single point responsibility. In the mode of contracting on the basis of Supply-Erection, the supply portion of the Contract will relate to the supply of the Plant and the erection portion will relate to port clearance, port handling, inland transportation, insurance, storage, unloading, erection, construction, testing, commissioning, Engineering, Project Management etc. as will be defined in the Contract Document.

In the case of a divisible contract, the title of ownership of Goods to be supplied



shall pass on to the Owner on dispatch Ex-works/F.O.B. However, until the Work is completed in all respects and the Plant is taken over by the Owner, the Goods shall remain within the custody of the Contractor. The above arrangement shall not in any way dilute the responsibility of the Contractor for the successful commissioning of the Plant and completion of other works as per Bid Specifications and both the contracts shall contain a cross default clause, namely, that a breach of one contract shall automatically be classified as a breach of the other contract, which will confer a right on the Owner to levy LD from other contractor and to terminate also the other contract as well at the risk and cost of the Contractor.

8.0 **TERMS OF PAYMENT**

8.1 The terms of payment for the price components of the Supplies of Equipment and Mandatory Spares, civil and architectural works, and erection are detailed in the Contract Agreement.

8.1.1 Initial Advance

The advance in accordance with the provisions of Clause 8.4, 8.5, 8.6, 8.7, and 8.8 of these GCC (each of such advance being referred to as "Advance Payment") will be paid on fulfillment of all of the following conditions by the Contractor:

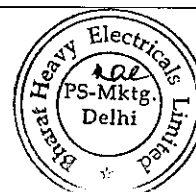
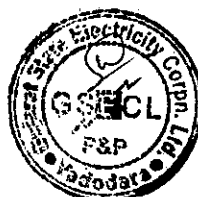
- i) Signing of Contract Agreement;(Agreement shall be signed within 45 days from the date of acceptance of LOA)
- ii) Submission of an unconditional Performance Security (Performance Bank Guarantee) as per clause -6.0 of the General Conditions;
- iii) Submission of an unconditional additional Performance Guarantee /by concerned entity, as prescribed by the Owner;
- iv) Submission of a preliminary Project network schedule indicating major milestones based on the Work schedule.
- v) Submission of Advance Payment Bank Guarantee as per clause-8.2 below.

Submission of detailed Project Network Schedule shall be made within 45 days from the date of signing of Contract.

8.2 **Documentation and Bank Guarantee for Advance Payment**

The Contractor shall furnish the following documentation as a condition for making request for Advance Payment.

- i) Invoice for amount of Advance Payment in original and five (5) copies.
- ii) Bank guarantee in the proforma attached with Volume-1, Section-2, Annexure-I-I for an amount equivalent to the aggregate amount of Advance Payment ("**Advance Payment Bank Guarantee**") with one (1) copy of original bank guarantee valid upto Take Over of Plant issued or counter guaranteed/confirmed by any Indian Nationalized Bank or its foreign branch. The charges for counter guarantee/confirmation, if any, shall be to Contractor's account.



- iii) Advance Payment Bank Guarantee for Advance Payment shall be denominated proportionately in currencies of contract or US Dollars.

### 8.3 Adjustment of Advance Payment

The Advance Payment made shall be adjusted against the progress payments, progressively at the same rate of advance i.e., if 10% advance paid, 10% of the invoice value of the progress payment will be adjusted against making progress payment. Upon each such recovery, the value of the Advance Payment Bank Guarantee shall be reduced progressively by the amount of advance so recovered by Owner from Contractor's progress payments. Apportioning the break-up of other payments shall be as further detailed below. All further payments under the Contract shall be made as stipulated in the Contract Agreement. Reduction of Advance Payment Bank Guarantee shall be permitted every six months i.e. January and July of each year based on records available with GSECL.

### 8.4 Design Engineering Charges

Design engineering charges component will be paid as per detailed break-up as set forth in the contract after issue of certification of completion of same by Contractor to Owner and acceptance thereof by Owner/Owner's representative in following installments:

- i) 0 to 5% (max 5%) of Design Engineering Charges as Advance Payment on fulfillment of conditions in sub-clauses-8.1 and 8.2
- ii) 75% (cumulative not exceeding 80%) of Design Engineering Charges as progress payment on approval of drawings and document – payable in 36 monthly equated installments.
- iii) 7% (cumulative not exceeding 87%) of Design Engineering Charges on certification of successful completion of Reliability Run of Plant as per specification by Owner.
- iv) 6% (cumulative not exceeding 93%) of Design Engineering Charges on Final Plant Acceptance/Take- Over of Plant and also submission of as built drawings.
- v) 7% (cumulative not exceeding 100%) of Design Engineering Charges on Satisfactory completion of warranty period.

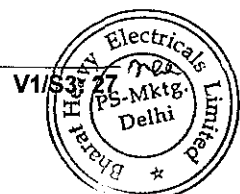
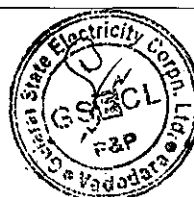
Contractor acknowledges that certification or its acceptance by the Owner's representative shall not, however, relieve or absolve in way or manner the Contractor from the performance of work and other obligations under the Contract including Performance Guarantee and Warranty obligations under the Contract.

### 8.5 Project Management Charges

Project Management charges component will be paid as per detailed break-up in following installments:

- i) 0-5% (max 5%) of Project Management charges as Advance Payment on fulfillment of conditions in sub-clauses-8.1 and 8.2

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- ii) 75% (cumulative not exceeding 80%) of Project Management charges on equal monthly installments for the Contract Period.
- iii) 7% (cumulative not exceeding 87%) of Project Management Charges on certification of successful completion of Reliability Run of plant as per specification by Owner;
- iv) 6% (cumulative not exceeding 93%) of Project Management charges on Take Over of plant.
- v) 7% (cumulative not exceeding 100%) of Project Management Charges on Satisfactory completion of warranty period and also submission of as built drawings, O & M manuals etc.

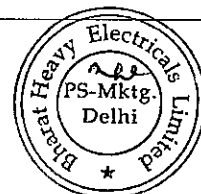
8.6

**Supply Price**

For Supplies of Equipments, the payments shall be linked with the despatch of materials and shall only be made after production of all despatch documents as specified in Letter of credit (L/C) conditions in case of supplies of non Indian origin and / or in the relevant contract conditions which will, inter-alia, include 3 original Bills of Lading in case of CIF supplies and the equipment Material Despatch Clearance Certificate issued by the Owner/Owner's representative after inspection if applicable.

- i) Supply price component will be paid as per break-up below:

Item No.	Time of Payment	% Component FOB/Ex-Works Price	Condition to be fulfilled
1.0	Advance Payment	0-5% (max 5%)	As per clauses-8.1 and 8.2 of this General Condition.
2.0	Advance Payment against placement of orders for major equipments.		
a)	Evidence of order placement of all major equipment/system	0-5% (cumulative not exceed 10%)	Evidence of order placement for all major items to be ordered within first 6 months from zero date as per L1 schedule shall be considered-
b)	Despatch of Equipment/system from Manufacturer's Works	55% (cumulative not exceeding 65%)	Production of invoices and satisfactory evidence of shipment for major orders and submission of Material Despatch Clearance Certificate and Inspection Certificate as per quality assurance program.



Item No.	Time of Payment	% Component FOB/Ex-Works Price	Condition to be fulfilled
3.0	Receipt of equipment /system	15% (cumulative not exceeding 80%)	Verification and certification by the Owner / Owner's representative of the equipment / system received and stored at 'Site'
4.0	Successful Completion of Reliability Run	7% (cumulative not exceeding 87%)	Certification of successful completion of Reliability Run of plant as per contract by Owner.
5.0	Successful completion of Performance tests	6% (cumulative not exceeding 93%)	Take Over of Plant
6.0	Warranty Charges	2% 7% (cumulative not exceeding 100%)	Satisfactory completion of Warranty Period and Extended Defects Correction Period, as evidenced by issuance of Defects Liability Certificate, and also submission of O & M manuals, As built drawings etc.

- ii) The Ocean Freight and Marine Insurance Charges and the in-land transportation and Marine insurance charges shall be paid to Contractor on pro-rata basis to the FOB price of component shipped on evidence of activities having been carried out. The aggregate of all such pro-rata payment shall not exceed the total amount identified in contract price provided, however, wherever equipment wise above mentioned charges have been identified in contract the payment of such charges shall be based on such charges identified in contract against evidence of activity having been carried out.

8.7

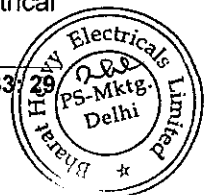
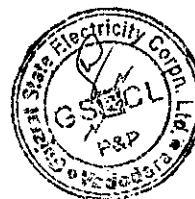
**Erection, testing and Commissioning Price**  
(Excluding civil & architectural works)

In case of erection, progress payments shall only be made after the issue of Certificates by the Owner / Owner's representative, as detailed under:

- i) 0-5% (max 5%) of total erection, testing and commissioning price as Advance Payment and fulfillment of conditions in sub-clauses -8.1 and 8.2 above and on establishment of site office by the Contractor at site.
- ii) 75%(cumulative not exceeding 80%) of the erection, testing and commissioning price will be made as progressive payments against progressive erection on tonnage basis for mechanical and electrical

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items and successful completion of quality check points. Separate basis for cabling and instrumentation, which will be finalized between Owner and Contractor prior to contract award. Progress payments shall only be made after the issue of Certificates by the Owner/Owner's representative, one for the quantum of work completed and the other by the Field Quality Surveillance representative for the successful completion of quality check points involved in the quantum of work billed.

- iii) 7% (cumulative not exceeding 87%) of the erection, testing and commissioning price on successful completion of Reliability Run of Plant as per contract.
- iv) 6% (cumulative not exceeding 93%) of the erection, testing and commissioning price on Take Over of plant.
- v) 7% (cumulative not exceeding 100%) of the erection, testing and commissioning price on satisfactory completion of warranty period.

Further break-up of erection activities of the above identified equipment for progressive payments shall be as setforth in Milestone payment schedule.

8.8

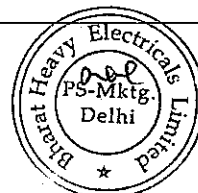
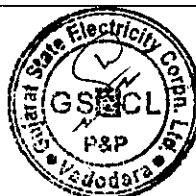
#### Civil, Structural and Architectural Price

- i) 0-5% (max 5%) of total civil, structural & architectural price as Advance Payment and fulfilment of conditions in sub-clauses 8.1 and 8.2 above and on establishment of site office by the Contractor at site.
- ii) 75% (cumulative not exceeding 80%) progressive payment on certification by the Owner/Owner's representative on the basis of the work performed of total civil, structural and architectural price of the package as per the payment stages as setforth in Milestone Payment Schedule.
- iii) 7% (cumulative not exceeding 87%) of total civil, structural and architectural price component on successful completion of Reliability Run as per contract.
- iv) 6% (cumulative not exceeding 93%) of total civil, structural and architectural price component on Taking Over.
- v) 7% (cumulative not exceeding 100%) of the total civil, structural and architectural price component on satisfactory completion of warranty period.

8.9

#### Mandatory Spare Price

- i) The FOB Ex-works including packing and forwarding charges price component of Mandatory Spares shall be paid as indicated below:
  - a) 75% of price component for Mandatory Spares after submission of material despatch clearance and inspection certificate, despatch to Site and submission of requisite shipping documents. An indicative list of the shipping documents is given under Clause 9.3 of these GCC.



- b) 25% of price component for Mandatory Spares on receipt and storage at Site and physical verification by the Owner/Owner's Representative.
- ii) The ocean freight and marine insurance charges and the inland transportation and insurance charges shall be paid to the Contractor pro-rata to the value of Mandatory Spares received at Site on production of invoices by the Contractor.
- iii) Tools and tackles Prices: This shall form part of Supply Price and shall be claimed under supply payment.

Quantity variation in spares: The Purchaser may vary the quantity of mandatory spares to be ordered provided the ordered quantity results in a "whole number" or a "complete set". Order for spares with quantity expressed as a fraction will not be made. Variation in quantities, indicated in percentage or LOT will not be made. However, complete deletion of any item can be made.

8.10 **Not Used**

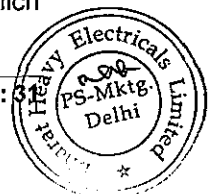
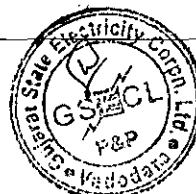
8.11 **Schedule of Payments**

Based on the terms of payment in clauses mentioned above and work schedule payment of Contract Price component linked with achievement of Milestones shall be paid in accordance with Milestone Payment Schedule. The Milestone payment schedule specifies the installments of Contract Price, and the Milestones to be achieved and the payment thereunder shall be subject to the following:

- i) The installments quoted in the Milestone payment Schedule may be modified by Owner / Owner's representative if progress is not as scheduled.
- ii) Payment shall be made on the date which is the later of (i) accomplishment of a milestone and (ii) the date fixed for accomplishment of such a milestone as set out in the Milestone Payment Schedule.
- iii) Submission of documentation/data to Owner/Owner's representative for approval.
- iv) Submission of monthly progress reports and updated Network Schedule

8.12 **Application for Interim Payment Certificates and Claim for Payments**

8.12.1 The Contractor shall submit a statement (the **Interim Payment Certificate**"), in six copies to the Owner/Owner's representative after the end of each month before the tenth day of the next month, in a form approved by the Owner/ Owner's representative, showing the amounts to which the Contractor considers himself to be entitled, together with supporting documents which



shall include the detailed report on the progress during the month. In order to be eligible for payment, the Interim Payment Certificate shall include the following items, as applicable, which shall be expressed in the currencies in which the contract price is payable, in the sequence listed:

- i) The estimated contract value of the Design and construction documents produced and the Works executed up to the end of the month (including variations but excluding items described in subparagraphs (iv) to (vii) below);
- ii) Certification from Owner/Owner's representative that the applicable Work has been performed and that the quality of Work described in the Interim Payment Certificate is in line with contract;
- iii) If there is any pending or threatened dispute, regarding Work covered by such request or payment as a result of which Contractor intends to withhold payment from such sub-Contractor, a report detailing such dispute and circumstances thereof;
- iv) Any amounts to be added and deducted for which Change Order has been issued;
- v) Any amounts to be added and deducted for the Advance Payments and repayments in accordance with clause 8.3 above;
- vi) Any other additions or deductions which may have become due in accordance with the Contract including, without limitation, deduction on account of liquidated damages.
- vii) The deduction of the amounts certified in all previous Interim Payment Certificates.
- viii) Any other information that the Owner/Owner's representative may reasonable request.

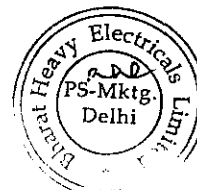
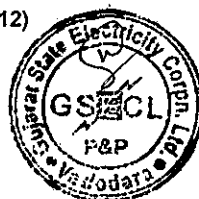
8.12.2 Contractor shall raise its consolidated invoices/bills only once a month.

### 8.13 Mode of Payment

8.13.1 For supply of Equipment and Mandatory Spares:

The mode of payment by Owner to the Contractor shall be mutually agreed before finalization of Contract. The same may be by way of establishing an irrevocable Letter of Credit (L/C) in favour of the Contractor through a bank in case of supplies of Non-Indian origin directly to Owner and through a nationalized bank to be nominated by the Contractor in case of Indian Supplies only for payments due on despatch of equipment or by way of direct disbursement of loans. The payment will be made through usance L/C as per credit period of payment specified in the specification. The L/C format will be mutually decided during finalization of Contract.

The value of L/C will be as per payment schedule for each quarter and valid for a quarter. It will be the responsibility of the Contractor to utilize the L/C to the fullest extent. In case L/C has been established by the Owner and not utilized by the Contractor, all reinstatement charges for the L/C for further period necessitated due to non-utilization of L/C will be to the account of the



Contractor.

All L/C charges shall be to Owner's account except L/C charges for confirmation by Contractor's bank which will be borne by the Contractor. For non-Indian supplies, Contractor shall be responsible for all permits, licenses and the like from respective authorities necessary for export of equipment from the respective countries to the Owner.

8.13.2 For Other Payments

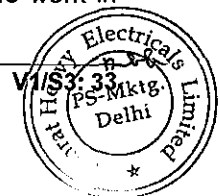
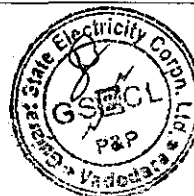
The payment of advance(s), price adjustment, any other supply payment, ocean freight, marine insurance, Taxes (wherever admissible), inland transportation (including port handling), insurance, civil and architectural works and for the erection portion of the Works shall be made direct to the Contractor by the Owner.

8.13.3 Unless otherwise agreed by the parties, payments by Owner to Contractor, shall be made in currencies as per Schedule of Prices by cheque to an account or accounts designated by Contractor and maintained by Contractor or by such other person or entity at a bank or banker in Vadodara, Gujarat, India in writing. Extra Work shall be paid in accordance with the applicable Change Order as part of the work under the Contract. Once all acts necessary to initiate the relevant wire transfer have been completed within the time specified for such payments, any delays within the international or domestic banking system in the transfer of such payments to Contractor's account or accounts as aforesaid shall not give rise to a claim that Owner has breached its payment obligations hereunder.

Payment will be made in the respective currencies quoted by the bidder for onshore supply for import content of raw material of onshore supply. Bidder shall have to provide the drawdown schedule in respective currencies & to include in price bid accordingly.

8.13.4 The Owner shall pay the amount certified in each Interim Payment Certificate within 30 days from the date on which the Owner/Owner's representative received the Contractor's statement and supporting documents and the Owner shall pay the amount certified in the Final Payment certificate within 120 days from the date of issue of the Take Over certificate.

8.13.5 Pursuant to this clause-8.0, if the commercial banks are closed due to a public holiday, period as above shall be extended to the first business day after the end of the period concerned. In addition, unless the parties otherwise agree, Owner shall not be obligated to pay, in respect of any request for payment, any amount in excess of 100% of the cumulative amount anticipated to be paid for work completed to such date, as set forth in the projected payment schedule as per Schedule of Prices. If any request for payment does not comply in all material respects with the Contract, Owner shall inform Contractor about the same within 15 days following the receipt of such request for payment, and Contractor shall re-submit such request for payment. If less than the full amount is paid, Owner shall state in writing the reasons for paying such lesser sum. Any dispute regarding Owner's payment of a lesser sum than that set forth in a request for payment must be raised by Contractor within 30 days of receipt of such payment, or Contractor's right to dispute such payment is waived. During the pendency of any such Dispute and the resolution thereof, Contractor shall continue to perform the work in



accordance with the provisions set forth herein.

8.14 **Payments Withheld**

8.14.1 Owner shall have the right to withhold from any payment due to Contractor, including the final payment, such amounts as Owner reasonably deems necessary or appropriate to protect it because of any one or more of the following reasons:

- i) Defects in any work, which might affect Owner's ability to operate Unit or Plant as contemplated herein, whether or not payment has been made therefor;
- ii) The filing of a any vendor/tradesman's lien or similar encumbrance in respect of the work or the plant (or any portion thereof);
- iii) A dispute as to the accuracy or completeness of any request for payment received by Owner pursuant to this clause-8.0 within 90 days of receipt thereof or payment made thereunder;
- iv) Contractor's failure to deliver any Performance Securities and additional performance to Owner as in the Contract;
- v) Any requirement in accordance with Applicable Laws to withhold any Taxes payable by Contractor in respect of the work or any part thereof; and
- vi) Contractor's failure to make payments to sub-Contractors or workers for work, including amounts withheld by Contractor because of disputes between Contractor and such Persons.

8.14.2 In addition to the provisions of this clause-8.0 which relates to the recovery by the Owner of any amounts that the Owner may have paid, for which the Contractor is liable under the contract, the Owner shall also be entitled to recover all the dues in terms of the contract including liquidated damages for delay, liquidated damages for the shortfall in the guaranteed performance parameters, etc by way of deductions from the payments due to the Contractor or that may become due to the Contractor in future or from any securities/guarantees under the contract and/or otherwise.

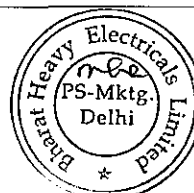
8.14.3 Notwithstanding any dispute that Contractor may have, and regardless of the basis thereof or grounds there for, Contractor agrees that it will, for so long as the Contract has not been terminated diligently prosecute the Work up to Take over of Plant, all in accordance with the terms of the Contract.

9.0 **SHIPPING PARTICULARS**

9.1 The Contractor shall be responsible for the correct appraisal of freight rates, weights and volumes of structural's or machinery as the case may be. The Owner shall not be liable to pay any warehouse or wharf age charges due to the necessity of storing Goods awaiting shipment.

9.2 All consignments shall be addressed to and the bill of lading and other shipping documents shall be made in the name of the Consignee.

9.3 After shipment is effected, the following documents shall be forwarded to the



Consignee by registered air mail/courier services.

- |      |  |   |
|------|--|---|
| i)   | The original bill of lading in duplicate and four (4) non-negotiable copies of the same. |   |
| ii)  | F.O.B. invoices  | Six (6) copies including one (1) original |
| iii) | Freight invoice & freight details  | Six (6) copies including one (1) original |
| iv)  | Insurance premium receipts or certificates   | - Ditto -                                 |
| v)   | Packing list   | - Ditto -                                 |
| vi)  | Certificate of origin  | Six (6) copies including one (1) original |

10.0 **DELIVERY TERMS**

10.1 When the Goods are ready for shipment, the Owner should be notified by the Contractor through fax or email. Notification of dispatch and delivery in regard to each and every consignment shall be made to the Owner immediately after dispatch and delivery in case of delivery at either the Site or at the port of entry as applicable at least forty-eight (48) hours ahead of actual delivery. The Contractor shall further supply to the Consignee an invoice and packing list of all Goods dispatched or delivered by him and other shipping particulars. All packages, containers, bundles and loose materials forming part of each and every consignment shall be described fully in the packing list, and full details of the contents of packages and quantity of goods shall be submitted to the Owner.

10.2 For the Goods imported by the Contractor, the Contractor shall deliver the Goods at CIF price. The Contractor shall also make all arrangements to deliver the Goods to the location specified in Technical Specifications.

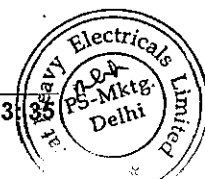
11.0 **LIQUIDATED DAMAGES**

11.1 **Delay**

Scheduled dates for Commissioning will be as specified in Schedule [insert] of the Contract. If the Contractor fails to achieve Commissioning within the time fixed thereof, he shall be liable to pay liquidated damages for the delay at the rate of half percent (½%) of the total Contract Price per week of delay. The total amount of liquidated damage on account of delay shall not exceed 10% of the Total Contract Price considering all types of Contracts including supply and erection.

11.2 **Failure to meet Performance Guarantees**

The liquidated damage for non fulfillment of Performance Guarantees will be as indicated below.



Sl. No.	Item	Value
1.	For increase in each Kcal/KWh of weighted average plant overall heat rate.	Rs. 7.5 Crores
2.	For every KW shortfall in gross power output at generator terminal	Rs. 100,000
3.	For increase in Auxiliary Power Consumption per KW	Rs. 200,000
4.	<del>For every m<sup>3</sup>/hr increase in DM water consumption</del>	<del>Rs. 1 Crore</del>

The total amount of liquidated damage for non fulfillment of Performance Guarantee shall be maximum 10% of the Contract Price considering all types of Contracts including supply and erection.

11.3 The total amount of liquidated damages on account of delay in Commissioning and non-fulfillment of Performance Guarantees shall not in any case exceed fifteen percent (15%) of the total Contract Price. The Owner shall deduct the amount of such liquidated damage from any money due or which may become due to the Contractor under the Contract, and/or recover such liquidated damage from the Performance Guarantee of the Contractor. To be entitled to impose the liquidated damage, the Owner will not be required to prove that he has incurred such amount as actual damages.

Liquidated damages to be paid in currency of the Contract Price on Pro-rata basis.

11.4 Rejection  
If the total aggregate liquidated damages for short fall in Performance Guarantees of all parameters (shortfall in HR, power output, DM water consumption, Auxiliary Power Consumption) will be higher than 10% of the Contract Price then the Owner may at its option, either,

(a) Reject the Equipment/plant and recover the payments already made

Or

(b) Terminate the Contract pursuant to GCC 24.0 and recover the payments already made;

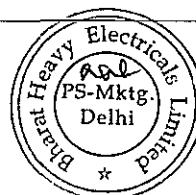
Or

© Accept the equipment after levy of liquidated damages in accordance with the provisions specified in GCC 11.0 of Contract Agreement.

12.0 **SHOP ASSEMBLY AND INSPECTION**

12.1 Shop Assembly

Shop Assembly to the largest extent feasible shall be performed by the Contractor to assure proper fitting of the various parts, and for checking the correctness of clearances and dimensions. Parts thus assembled shall be match-marked for reassembly at the Site, prior to dismantling for shipment. A detailed description of the intended shop assemblies shall be submitted along with a quality assurance plan.



12.2 Inspection before Shipment

No Goods shall be shipped before all tests and inspections have been carried out according to the Approved quality assurance plan unless otherwise instructed by the Owner.

The acceptance of any Goods prior to shipment shall in no way relieve the Contractor of any of his responsibilities for meeting all the requirements of the Specification and shall not prevent subsequent rejection if such Goods are found to be defective.

Incase inspection of Equipment/Goods needs visiting foreign countries, cost of 10 man visits shall be considered in the contract..All expenditure including that for travel shall be borne by bidder.

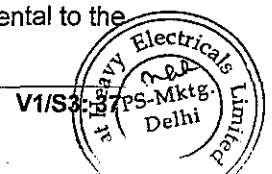
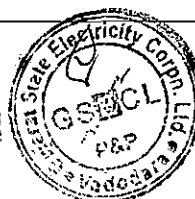
13.0 **CONTRACTOR'S DRAWINGS AND DATA**

- 13.1 a) The Contractor shall be responsible for developing detailed Drawings to adopt equipment and materials to be supplied to the requirements indicated in the Specification and shall submit a list of such Drawings and a programme for submission of these Drawings and documents within ninety (90) days from the date of receipt of the Notice to Proceed.
- b) The Contractor shall also provide the Owner with the following Drawings and documents in the number of copies mentioned in Technical Specifications as per agreed schedule.
- i) Technical particulars conforming to the Specifications.
  - ii) Outline drawings of major equipment together with weights and sufficient overall dimensions.
  - iii) Other drawings and documents as indicated in the Technical Specifications.
- c) The Contractor shall, prior to submitting the Drawings and documents, submit to the Owner two copies of the Codes and Standards other than Indian Standards and Codes which shall govern the Works.

13.2 Copyright in the Owner's requirements and other documents issued by the Owner or the Owner's Representative to the Contractor shall (as between the parties) remain the property of the Owner.

The copyright in all drawings, documents and other materials containing data and information furnished to the Owner by the Contractor herein shall remain vested in the Contractor or, if they are furnished to the Owner directly or through the Contractor by any third party, including suppliers of materials, the copyright in such materials shall remain vested in such third party. The Owner shall however be free to reproduce all drawings, documents and other material furnished to the Owner for the purpose of the Contract including, if required, for operation and maintenance of the Facility

13.3 The Contractor shall indemnify the Owner in case of breach of this clause by the Contractor. If these documents are received by a third party from the Contractor and the third party makes use of these documents detrimental to the



Owner or use these documents for their personal gain, the Contractor shall compensate the Owner for the loss suffered as well as for the value of gain derived by third party.

14.0 **MISTAKES IN DRAWINGS**

The Contractor shall be responsible for and shall pay for any alterations of the Work due to any discrepancies, errors or omissions in the Drawings or other particulars supplied by him whether such Drawings or particulars have been Approved by the Engineer or not.

15.0 **MATERIALS AND WORKMANSHIP FOR MANUFACTURER**

All Goods to be supplied and all Works to be done by the Contractor under the Contract shall be manufactured and executed in the manner stipulated in the Specifications.

The Contractor shall use the best available materials for the Works. These materials shall be of recent manufacture, free from defects and imperfections and unused.

The highest standards of safety shall be adhered to during execution of the Works.

16.0 **COMPLETENESS OF EQUIPMENT**

The equipment supplied shall be complete in all respects. The Contractor shall not be eligible for any extra payment in respect of such mountings, fittings, fixtures and accessories if required for the safe and reliable operation of the equipment.

Parts of all similar equipment supplied shall be interchangeable with one another.

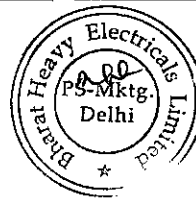
17.0 **CERTIFICATE OF THE OWNER**

Every application to the Owner for a certificate must be accompanied by a detailed invoice (in quadruplicate) setting forth in order of the schedule of quantities and prices as per Approved billing breakdowns of the Works executed and/or Goods ready for dispatch up to the date of claim. The certificate relating to such Goods and Work as in the reasonable opinion of the Engineer in accordance with the Specifications shall be issued within thirty (30) days of receipt of the application.

The Owner may, with any certificate, make any corrections or modifications to any previous certificates issued by him. The payments to be made against invoices under certification will be regulated and adjusted accordingly.

18.0 **OWNER'S DECISION**

In respect of all matters which are left to the decision of the Owner, including the granting or withholding of certificates; the Owner shall, if required to do so by the Contractor, give in writing a decision thereon and his reasons for taking such decision. If in the opinion of the Contractor, a decision made by the Owner



is not in acceptance with the meaning and intent of the Contract, the Contractor may file with the Owner within fifteen (15) days after receipt of the decision, a written objection to the decision. Failure to file such an objection within the allotted time will be considered to be acceptance of the Owner's decision and the decision shall become final and binding.

The Owner's decision and the filing of the written objection of the Contractor thereto shall be a condition precedent to the right to request for arbitration. It is the intent of the Contract Agreement that there shall be no delay in the execution of the Work in such cases and the decision of the Owner as given shall be promptly observed.

19.0

### CERTIFICATE NOT TO AFFECT THE RIGHT OF THE OWNER OR THE CONTRACTOR

No certificate of the Engineer on account, nor any sum paid on account by the Owner, nor any extension of time for the execution of the Work by the Contractor under the powers granted by item "Certificate of the Owner" shall affect or prejudice the rights of the Owner against the Contractor, or relieve the Contractor of his obligations for the due performance of the Contract or be interpreted as Approval of the Work done or of the Goods supplied. No certificate shall create the liability for the Owner to pay for alterations, amendments, variations or additional work not ordered in writing by the Owner, or discharge the liability of the Contractor for payment of damages, whether due, ascertained or certified or not or of any sum against the payment of which he is bound to indemnify the Owner, nor shall any such certificate nor the acceptance by him or any sum paid on account or otherwise, affect or prejudice the rights of the Owner against the Contractor.

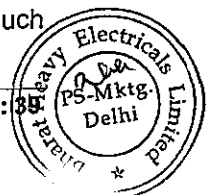
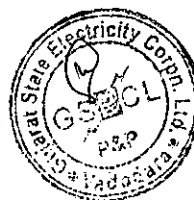
20.0

### OWNER ACCEPTANCE AND TAKE OVER CERTIFICATE

In order to achieve Owner acceptance, Contractor must certify to the satisfaction of Owner/Owner's representative that:

- i) Reliability Run Test and Performance Guarantee Test have been completed to the satisfaction of Owner.
- ii) All punch list and pending issues have been completed in accordance with the contract;
- iii) All the Contractor's and sub-Contractor's personnel, supplies, unused materials, waste, rubbish and temporary facilities located at or near such plant have been removed from such location,
- iv) All other provisions of and all items required by the Contract have been performed or delivered, as the case may be, in accordance with the Contract and in a manner satisfactory to Owner.
- v) Contractor has delivered to Owner a Project Completion certificate certifying satisfactorily completion of each of the conditions set forth in sub-clauses -20(i) to 20(iv) above.

Upon certification by Contractor of satisfactory completion of sub-clauses -20 (i) through 20(iv), Owner shall issue a Take over Certificate certifying such



matters within 60 (Sixty) days

21.0 **WARRANTY**

21.1 The Contractor hereby provides following Warranty in respect of the Equipment to be furnished by the Contractor:

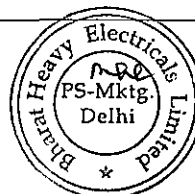
- a) All Equipment shall be new and in accordance with the Contract and shall be fit for the intended purposes,
- b) All Equipment shall be free from any defect due to faulty design, materials and/or workmanship.
- c) The Equipment shall perform satisfactorily and the performance and efficiencies of the specified Equipment shall not be less than the respective guaranteed values.
- d) The efficiencies, temperature rise and other performance data of all other Equipment shall be as per the Contract.
- e) All other Works including civil, structural and architectural works shall be in accordance with the Contract and free from any defect and omission.
- f) The Work will be designed so that the Plant is capable of being operated in a safe, reliable, economic and efficient manner, in accordance with the requirements of the Contract.

The Contractor undertakes to reaffirm the above Warranty, if so required by the Owner, in such forms as prescribed by the Owner and shall be signed by the Contractor and, if so required by the Owner, by Sub-contractor(s) of the Contractor.

If the Contractor finds, after his Tender is accepted, that a variation in work, construction technique or the quality of materials is necessary to fulfill the Warranty called for, such variations may be made with the approval of the Owner, provided the request for changes is made during execution of the contract Agreement and the changes are to be made without any increase in the price.

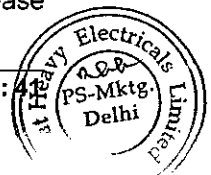
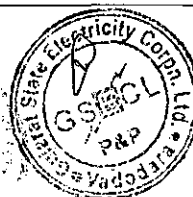
21.2 The Warranty shall be valid for a period of twelve (12) calendar months commencing from the date of Taking Over of the fully completed Plant at the discretion of the Owner. This period of the Warranty shall be referred to as the "Warranty Period".

21.3 During the Warranty Period, the Contractor's liability shall be limited to the replacement of any defective parts that may develop in Plant, of his own manufacture or those of his associate(s) and Sub-contractor(s) under the conditions provided for by the Contract under proper use and arising from faulty design, materials or workmanship. All such replacements of defective parts mentioned above shall be made free of cost at Site by the Contractor and the return of the defective parts to the Contractor's works shall be the Contractor's responsibility and shall be made at his expense. In the case of these defective parts which are not repairable at Site but are essential, in the Owner's opinion, for the commercial operation of the Plant or the Equipment, the Contractor shall replace at the Site, free of cost of the Owner the said defective parts before the



defective parts are removed to his Works in such a manner which will minimize interruption in the operation of the Plant and/or the Equipment. Provided always that such defective parts as are not repairable at Site, and are not essential in the meantime in the commercial use of the Plant, may be taken by the Contractor to the Contractor's works for repairs unless otherwise arranged. The decision to replace/repair the defective items shall be discussed and mutually agreed at appropriate stage.

- 21.4 The cost of any special or, general overhaul rendered necessary during Warranty Period due to defects in the Plant or defective Work shall be borne by the Contractor. The Owner will, however, render such assistance in this matter as will expedite the same.
- 21.5 If for rectification or replacement of any part of equipment or work due to defective materials, manufacture or design or workmanship, the services of the Contractor's personnel are requisitioned within the Warranty Period, these services shall be made available free of any cost to the Owner.
- 21.6 If it becomes necessary for the Contractor to replace or renew any defective portions of the Plant under this Clause, the provisions of this Clause will apply to the portions of the Plant so replaced or renewed until the expiration of **Extended Defects Correction Period**. Further, the Contractor shall ensure that the Performance Bank Guarantee shall remain outstanding or a replacement on-demand bank guarantee is delivered to the Owner in an amount equal to one hundred percent (100%) of the estimated value of each such item until the Extended Defects Correction Period applicable thereto has expired.
- 21.7 If any defect be not remedied within a reasonable time, the Owner may proceed to do the work at the Contractor's risk and expenses but without prejudice to any other rights which the Owner may have against the Contractor in respect of such defects.
- 21.8 If the replacements or renewals are of such character as may affect the efficiency of the Plant, the Owner shall have the right to give to the Contractor within one (1) month of such replacement or renewal, notice in writing that "tests on completion" be made, in which case such tests shall be carried out as provided in Clause on Tests on completion and Trial Run at the Site" in the Technical Specifications. Should such tests show that the Plant sustains the guarantee given in the Contract; the cost of the test shall be borne by the Owner. Should the guarantee be not sustained, the cost of the test shall be borne by the Contractor. Further, all necessary works will be carried out by the Contractor to achieve guarantee given in the contracts and perform tests to prove the same at his own cost.
- 21.9 Until the final certificate has been issued, the Contractor shall have the right of entry at his own risk and expenses by himself or his duly authorised representatives whose names shall previously have been communicated in writing to the Owner at all reasonable working hours of the Plant and taking notes there from and, if he desires, at his own expenses making any tests, subject to the approval of the Owner that will not be unreasonably withheld.
- 21.10 The issue of the Taking over Certificate shall in no way exempt the Contractor from the provisions of this Clause 21.
- 21.11 At the end of the Warranty Period, the liability of the Contractor shall cease



other than in respect of items which are subject to an Extended Defects Correction Period.

21.12 The Contractor shall provide, at the Site, at least one (1) control and instrumentation engineer, one (1) electrical engineer, one (1) mechanical engineer and one (1) operation expert during the Warranty Period without additional cost to the Owner.

21.13 The Contractor agrees that any item of Equipment replaced or rectified during the Warranty Period shall conform to the Technical Specifications of the corresponding original Equipment and if required by the Owner, the Contractor shall demonstrate such conformance through suitable means (to be decided by the Contractor at its sole discretion) including inspection by the Owner, shop testing or operation of the Equipment of which the replaced equipment/material constitutes a part.

21.14 **WARRANTY FOR SPARES**

In addition to the foregoing, the Contractor warrants that all spares supplied will be new and in accordance with the Contract and will be free from defects in design, material and workmanship and further guarantee as under:

For mandatory spares and two (2) years recommended spares:

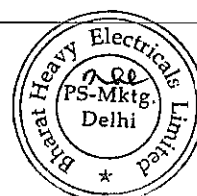
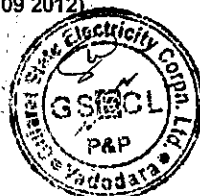
For item of spares ordered or to be ordered by the Owner for two (2) years operational requirement of the Plant which are manufactured as a continuous operation together with the corresponding main equipment/ component, the Warranty will be twelve (12) months from the Taking Over of the Plant under the Contract. In case of any failure in the original Equipment due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied shall be replaced without any extra cost to the Owner unless a joint examination and analysis by the Owner and the Contractor of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts. Such replaced spare parts will have the same Warranty as applicable to the replacement made for the defective original part/component.

21.15 **Latent Defects:**

Notwithstanding the issue of the Take Over Certificate, the Contractor shall be responsible for making good with all possible speed any Latent Defect in any Works /equipment of the plant which appears at any time before the expiry of defect liability period. And shall remedy such defect at its own cost and expense. The latent defect liability period shall be a minimum of 5 years from the end of defect liability period. The defects to which this applies are defects in design, materials or workmanship or defects arising from any act or omission of the Contractor done or omitted prior to Take-over of the portion of the Plant affected by the defects or during the Warranty Period which a reasonable examination at the end of the Warranty Period would not have disclosed.

22.0 **DEFAULT OF CONTRACTOR**

Termination upon Contractor's bankruptcy or default:



22.1 In the event the Contractor:

- (i) Contractor is adjudged a bankrupt or insolvent, or
- (ii) Contractor makes a general assignment for the benefit of its creditors, or
- (iii) A trustee or receiver is appointed for Contractor or for any of its property, or
- (iv) Contractor files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or similar laws, or
- (v) Contractor fails to supply sufficient skilled workers or suitable materials or Equipment, or fails to commence the Work or abandons the Work or part thereof or fails to rectify any Work done that has been objected or rejected to by the Owner or if it fails to make prompt payments when due to Subcontractors or for labour, materials or equipment, or
- (vi) Contractor otherwise commits a material breach of any of the terms of the Contract,

Then Owner may, without prejudice to any other right or remedy Owner may have hereunder or at law or in equity, at any time terminate the Contract upon 30 days' notice to Contractor, provided such event or breach is not remedied within such 30 days period or, if the breach or default cannot reasonably be cured within 30 days, such longer period (not to exceed 90 days) as may be reasonably necessary to cure such breach or default. Owner may terminate the Contract immediately upon notice to Contractor if Contractor disregards a material provision of any Applicable Law. Owner may terminate the Contract, upon 30 days' notice, if Contractor disregards any other provision of Applicable Law, provided any such failure is not remedied within such 30 days period. Contractor shall receive no Termination Payment or other cancellation payments in the event of a termination under this clause, but Contractor shall be entitled to any part of the Contract Price then due and payable for the Works already performed.

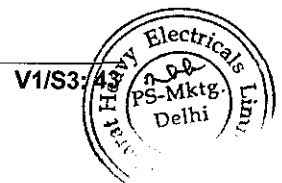
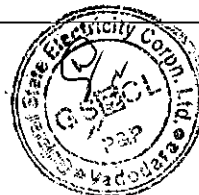
23. Not used

24. FORECLOSURE OF CONTRACT

**Termination for Owner's Convenience:**

Owner may at will for its convenience at any time and without cause, terminate the Contract upon 30 days prior written notice to the Contractor.

Immediately upon receipt of such notice, Contractor shall stop performance of the Works, stop all further sub-contracting or purchasing activity, and terminate Sub-contracts; handover all Documents, equipment, materials and spares relating to the Works prepared by the Contractor or procured from other sources up to the date of termination for which the Contractor has received payment equivalent to the value thereof and shall immediately order & commence demobilization and remove all Contractor's Equipment, which is on Site and repatriate all his staff and labour from the Site.



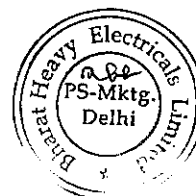
*Handwritten signatures and names:*  
Mukesh K. Singh  
Sudhakar  
Sudhakar  
Sudhakar  
Sudhakar

**Consequences of Termination.**

- 24.1 Termination for Contractor's bankruptcy or default under Clause 22
- 24.1.1 In the case of termination by Owner for default or bankruptcy under the circumstances contemplated by Clause 22, Contractor shall not, pending settlement of Owner's claims by reason of such termination, be entitled to receive any further payment and shall protect, defend, indemnify and hold Owner harmless from and against all Losses arising directly or indirectly from or incurred by reason of such termination and, in any event, Owner shall not be liable to Contractor for any amount of the Contract Price in excess of the percentage of Work actually completed by the termination date multiplied by the Contract Price ("Work Value").
- 24.1.2 In addition, should the aggregate amount of the Contract Price actually paid prior to termination exceed the Work Value, Contractor shall pay to Owner an amount equal to such excess within thirty (30) days after receipt of an invoice from Owner therefor.
- 24.1.3 Accrued or actual or potential liabilities of Contractor under the Contract, for acts and omissions with respect to Work partially or fully completed at the time of termination shall not be affected by any such termination.
- 24.1.4 In furtherance of the foregoing, Owner shall have the right (either with or without the use of Contractor's Equipment) to finish the Work itself or with the assistance of third parties and Contractor shall be liable for the excess of the total cost of the Work actually incurred by Owner to all parties, persons or entities over the price for the Work originally contracted for hereunder.
- 24.1.5 In particular, to complete the Work, Owner shall have the right to take possession of and use, or to permit any third party to use, all Contractor's Equipment on or about the Site which are the property of Contractor. Rent for use of equipment by Owner and indemnification thereof shall be provided by GSECL.
- 24.1.6 Upon completion of the Work, all such Contractor's Equipment shall be returned to Contractor, subject to the right of Owner (which shall constitute a lien on such Contractor's Equipment) to sell the same and apply the proceeds to any claim which Owner may then have against Contractor.
- 24.1.7 Owner shall have the right at its sole discretion to select third parties to assist in or undertake such completion of the Work, such selection to be based upon such criteria as Owner shall determine.
- 24.2 Termination for Owner's Convenience under Clause 24

Upon termination of the Agreement under Clause 24 (for Owner's Convenience), Contractor shall be entitled to be paid:

- (a) all actual documented costs incurred by Contractor, as audited and accepted by an independent certified public accounting firm of national reputation selected by Owner and acceptable to Contractor, incurred or that could not be avoided in connection with performance by Contractor



of Works as of the date of the Termination which were not previously paid for by Owner, and

- (b) all actual documented costs incurred by Contractor, if such cost is part of the Contract Price, in connection with the items procured/facilities executed by Contractor in connection with the services for which Contractor has not been paid, provided that such items are delivered to Owner at the Project Site together with all documents necessary to transfer title thereto to Owner (the 'Termination Payment').

As a condition precedent to receiving the Termination Payment, Contractor shall execute and deliver all such papers and take all such steps, including the legal assignment of Contractor's contractual rights, as Owner may require for the purpose of fully vesting in Owner all rights, title and interests of Contractor in and to all subcontracts, purchase orders, warranties, guarantees and other agreements.

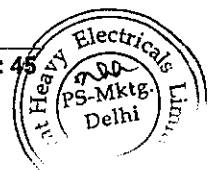
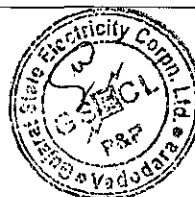
All claims by such contractors and Subcontractors to be due and owing for Services and other work performed prior to such date shall constitute debts between Contractor and Subcontractors, and Owner shall in no way be liable for such sums. Contractor shall include in all agreements and contracts entered into with contractors and Subcontractors a provision providing for the foregoing.

- 24.3 Upon any termination aforesaid, Owner may at its option elect to (a) assume responsibility for and take title (to the extent title has not previously passed to Owner) to and possession of the Plant and any or all work, materials or equipment remaining at the Facility Site, and (b) succeed automatically, without the necessity of any further action by Contractor, to the interests of Contractor in any or all contracts and Subcontracts entered into by Contractor with respect to the Plant

- 24.4 Surviving Obligations:  
Termination of the Contract (a) shall not relieve either Party of its obligations with respect to the confidentiality of Proprietary Information as set forth elsewhere (b) shall not relieve either Party of any obligation hereunder which expressly or by implication survives termination and (c) except as otherwise provided in any provision of the Contract expressly limiting the liability of either Party, shall not relieve either Party of any obligations or liabilities for loss or damage to the other Party arising out of or caused by acts or omissions of such Party prior to the effectiveness of such termination or arising out of such termination and shall not relieve Contractor of its obligations as to portions of the Works already performed or of obligations assumed by Contractor prior to the date of termination.

- 24.5 Verification of the Termination:  
Contractor shall, within 90 days of any such termination of the Agreement submit to Owner all invoices and other documentation as is sufficient to enable Owner to verify the performance of the Works and Contractor's costs associated therewith and to determine the amount of the Termination Payment. Termination Payment shall not include the costs of future anticipated profit or restocking charges.

Payment and Limitation of the Termination Payment. Owner shall pay the



Termination Payment to Contractor within 90 days of Owner's receipt of the documentation required under the clause: Verification of the Termination.

24.6 Limitation of Liability:

24.6.1 Payment of the Termination Payment shall be sole and exclusive liability of Owner, and the sole and exclusive remedy of Contractor, with respect to termination of the Contract pursuant to above clauses. In no event shall Owner have any further liability to Contractor in any such event for Consequential Damages.

24.6.2 (a) It is clarified here that except in cases of criminal negligence or wilful misconduct, the Contractor shall not be liable to the Owner, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Owner; and

(b) the aggregate liability of the Contractor to the Owner, whether under the Contract, in tort or otherwise, shall not exceed the total Contract Price, provided that this limitation shall not apply to any obligation of the Contractor to indemnify the Owner with respect to patent infringement.

For the avoidance of doubt it is hereby clarified that the Contractor's liability to pay the amounts pursuant to Clause 24.1.2 and/or Clause 24.1.4 shall not be excluded, or interpreted in any manner to be excluded under Clause 24.6.2(a) above, however such sums shall be considered towards the threshold for limitation of liability under Clause 24.6.2(b)

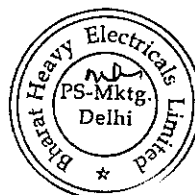
24.7 The Contract shall not be liable to be terminated except in accordance with the express provisions of the Contract.

25.0 **DEDUCTION FROM CONTRACT PRICE**

All costs, damages or expenses which the Owner may have paid, for which under the Contract, the Contractor is liable, will be claimed by the Owner. All such claims shall be billed by the Owner to the Contractor regularly as and when they fall due. Such bills shall be supported by appropriate and certified vouchers or explanations, to enable the Contractor to properly identify such claims. Such claims shall be paid by the Contractor within fifteen (15) days of the receipt of the corresponding bills and if not paid by the Contractor within the said period, the Owner may then deduct the amount, from any money due or becoming due by him to the Contractor under the Contract or may be recovered by actions of Law or otherwise, if the Contractor fails to satisfy the Owner of such claims.

26.0 **ASSIGNMENT OF CONTRACT**

The Contractor shall not assign its rights or obligations under the Contract without prior approval of the Owner. Any assignment in violation of this Clause shall be null and void. Further, such assignment, if approved by Owner, shall not relieve the Contractor from any obligations, duty, or responsibility under the Contract.



27.0 SUBCONTRACTING

27.1 Equipment

The Contractor may, after informing the Owner and getting his Approval, assign or subcontract any part of the Contract other than for raw materials, to manufacturers which are identified in Schedule [insert] of the Contract. Sub-contractor(s) not identified in Schedule [insert] of the Contract or any change in the identified sub-contractor(s) shall be subject to approval by the Owner. Provided that subcontracting shall not relieve the Contractor from any obligation, duty or responsibility under the Contract. Provided further that subcontracting to any subcontractor other than those identified in Schedule [insert] without prior approval of the Owner shall be null and void.

27.2 Erection Work

When the job of erection/construction is entrusted with the sub-contractor(s) the name/names of such sub-contractor(s) shall be approved by the Owner as elaborated above. Such subcontracting shall not relieve the Contractor from any obligation, duty or responsibility under the Contract.

27.3 Notwithstanding anything to the contrary contained herein, the Contractor shall remain solely responsible for and shall obtain all permits, licenses, approvals and authorisation as may be required under all applicable laws and regulations in India in respect of any award or performance of any transfer, sub-contract, sub-letting or assignment pursuant hereto.

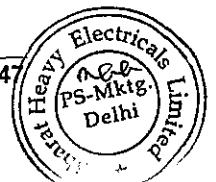
27.4 Notwithstanding any transfer, assignment or sub-letting with the approval of the Owner as aforesaid, the Contractor shall be and shall remain solely responsible and liable to the Owner for the quality, proper and expeditious execution and performance of the Works and for due performance and observance of all the conditions of the Contract in all respects, as if such transfer, assignment or sub-letting has not taken place and as if the Work so transferred, assigned or sub-let has been done directly by the Contractor.

28.0 FORCE MAJEURE

"Force Majeure Event" shall mean any event or circumstance or combination of events or circumstances referred to below that wholly or substantially prevents or unavoidably delays any Party in the performance of its obligations under the Contract, but only if and to the extent that such events and circumstances are not within the reasonable control, directly or indirectly, of the affected Party and could not have been avoided if the affected Party had taken reasonable care.

(a) Any cause which is beyond the control of Contractor or Owner, as the case may be (b) natural phenomenon including but not limited to weather conditions, floods, drought, earthquakes and epidemic (c) acts of any Governmental authority (domestic), including but not limited to war (declared or undeclared), revolution, quarantine, embargoes, licensing control or production or distribution restrictions (d) sabotage, riots and civil commotion (e) Nation wide or wide spread strikes or labour disputes extending beyond the Project site. (f) failure or delay in Contractor's source of supply due to force majeure causes enumerated at (a) to (e), provided that the Contractor proves to the satisfaction of the Owner that the supply from the alternate sources were not possible.

Any force majeure event which affects the Contractor's joint venture



partners/collaborators/joint venture company, who have executed the JDU, and which event satisfies the requirements of Clause 28 shall be treated as a "Force Majeure Event"

The following events are explicitly excluded from Force Majeure Events and are solely the responsibility of the affected party:

- i) any strike, work-to-rule action, go-slow, or similar labour difficulty which is not specifically, enumerated in the above clauses (a) to (f);
- ii) late delivery, of plant, machinery, equipment, materials, spare parts or Consumables for the Plant;
- iii) a delay in the performance of any contractor;
- iv) economic hardship;
- v) changes in Applicable Laws;
- vi) Force Majeure events which occur outside India and do not directly involve India comprising: (x) act of war (whether declared or undeclared), invasion armed conflict or act of foreign enemy blockade, embargo, resolution, riot, insurrection, civil commotion, act of terrorism, or politically motivated sabotage or kidnapping or (y) any event or circumstance of a nature analogous to any of the foregoing.

If the Contract is delayed or impeded in the execution of the work by circumstances of Force Majeure as herein defined, then the Contractor/Owner as the case may be, shall, within one week, give notice in writing to the Owner/ Contractor, of the existence of circumstances of Force Majeure, together with the evidence relied upon.

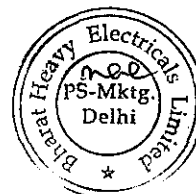
**Burden of Proof:** In the event that the Parties are unable in good faith to agree that a Force Majeure Event has occurred, the Parties shall submit the dispute to arbitration, provided that the burden of proof as to whether a force Majeure event has occurred shall be upon the Party claiming a Force Majeure Event.

**Effect of Force Majeure :** Neither party shall be considered to be in default or in breach of his obligations under the Contract to the extent that performance of such obligations is prevented by any circumstances of Force Majeure which arise after the Commencement Date.

In the event that Force Majeure circumstances continue for a period of more than one month, both the parties may discuss and mutually agree upon the future course of action which may include termination of Contract.

The Contractor shall request for extension of Time for Completion due to delay caused by Force Majeure. The Owner may agree to give extension in time as may be justified. However the Owner will not bear any additional cost whatsoever in connection with Force Majeure.

**Performance to Continue :** Upon the occurrence of any circumstances of any Force Majeure the Contractor shall endeavor to continue to perform his obligations under the Contract so far as reasonably practicable. The Contractor shall notify the Engineer of the steps he proposes to take including any reasonable alternative means for performance which is not prevented by Force Majeure. The Contractor shall not take any such steps unless directed so to do by the Engineer.



29.0 **PROGRESS REPORTS AND PHOTOGRAPHS**

The Contractor shall furnish three (3) prints each of monthly Progress Reports with photographs of the Works done in his shop . Photographs shall be taken when and where requested by the Owner. Adequate number of photographs shall be submitted indicating various stages of manufacture. Each photograph shall contain the date, the name of the Contractor and the title of the view taken.

Monthly Progress Report shall be submitted by the Contractor. These shall detail the status of design, drawings, procurement of raw materials and manufacture of the equipment and delivery of the equipment. The Owner shall advise the Contractor about the number of copies of progress schedule and photographs he has to submit each month together with the names and addresses of persons to whom they are to be sent. The Contractor shall also furnish actual progress against Works schedule and such other information as the Owner may require to satisfy himself about the timely manufacture and delivery of equipment and timely construction and erection works to suit the commissioning date.

30.0 **CONFIDENTIALITY AND PATENT RIGHTS**

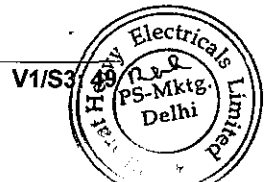
30.1 The Owner and the Contractor shall not, without the written consent of the other Party hereto, divulge to any third party any Confidential Information furnished directly or indirectly by the other Party hereto in connection with the Contract, whether such Confidential Information has been furnished prior to, during or following termination of the Contract. Notwithstanding the above, the Contractor may furnish to its Sub-contractor(s) such Confidential Information that it receives from the Owner to the extent required for the Sub-contractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Sub-contractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this Clause 30.1.

Notwithstanding the above, the Owner may furnish any Confidential Information and other information it receives from the Contractor, to its lenders, other financing parties and to its professional advisors to the extent the same is required directly in relation to the Project or financing of the Project, in which event the Owner shall obtain from such lenders, other financing parties and professional advisors, an undertaking of confidentiality similar to that imposed on the Owner under this Clause 30.1

30.2 Save as provided above, the Owner shall not use the Confidential Information received from the Contractor for any purpose other than the operation and maintenance of the Plant. Similarly, the Contractor shall not use the Confidential Information received from the Owner for any purpose other than the design and procurement of the Plant and Equipment, construction and commissioning of the Facility and provision of other services required for the performance of the Contract

30.3 The obligation of a Party under sub-Clauses 30.1 and 30.2 above, however, shall not apply to the Confidential Information which:

(a) now or hereafter enters the public domain through no fault of that Party



(b) can be proven to have been possessed by that Party at the time of disclosure and which was not previously obtained, directly or indirectly, from the other Party hereto

(c) otherwise lawfully becomes available to that Party from a third party that has no obligation of confidentiality

30.4 The provisions of this Clause 30 shall not in any way modify any undertaking of confidentiality given by either Party prior to the date of the Contract in respect of the Facility or any part thereof

30.5 The Contractor shall indemnify and hold harmless the Owner and its employees and officers from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Owner may suffer as a result of any infringement or alleged infringement of any patent, utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract by reason of: (a) the installation of the Facility by the Contractor or the use of the Facility in India; and (b) the sale of the power produced by the Facility in India.

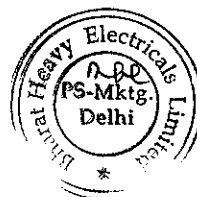
Such indemnity shall not cover: (i) any use of the Facility or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract; and (ii) any infringement resulting from the use of the Facility or any part thereof, or the power produced thereby in association or combination with any other equipment, plant or materials not supplied by the Contractor, pursuant to the Contract

30.6 If any proceedings are brought or any claim is made against the Owner arising out of the matters referred to in sub-Clause 30.5, the Owner shall promptly give the Contractor a notice thereof, and the Contractor may at its own expense and in the Owner's name conduct such proceedings or claim and enter into any negotiations for the settlement of any such proceedings or claim.

If the Contractor fails to notify the Owner within twenty-eight (28) days after receipt of such notice from the Owner that it intends to conduct any such proceedings or claim, then the Owner shall be free to conduct the same on its own behalf. Unless the Contractor has so failed to notify the Owner within the twenty-eight (28) day period, the Owner shall make no admission that may be prejudicial to the defense of any such proceedings or claim.

The Owner shall, at the Contractor's request, afford all available assistance to the Contractor in conducting such proceedings or claim, and shall be reimbursed by the Contractor for all reasonable expenses incurred in so doing.

30.7 The Owner shall indemnify and hold harmless the Contractor and its employees, officers and Sub-contractors from and against any and all suits, actions or administrative proceedings, claims, demands, losses, damages, costs, and expenses of whatsoever nature, including attorney's fees and expenses, which the Contractor may suffer as a result of any infringement or



alleged infringement of any patent (excluding any infringement or alleged infringement of any patent under Clause 30.5), utility model, registered design, trademark, copyright or other intellectual property right registered or otherwise existing at the date of the Contract arising out of or in connection with any design, data, drawing, specification, or other documents or materials provided or designed by or on behalf of the Owner (other than by the Contractor).

Such indemnity shall not cover: (i) any use of the design, data, drawing, specification, or other documents or materials or any part thereof other than for the purpose indicated by or to be reasonably inferred from the Contract; and (ii) any infringement resulting from the use of the design, data, drawing, specification, or other documents or materials or any part thereof in association or combination with any other design, data, drawing, specification, or other documents or materials not supplied by the Owner, pursuant to the Contract.

30.8 The provisions of this Clause 30 shall survive termination, for whatever reason, of the Contract

31.0 **BANKRUPTCY, ETC.**

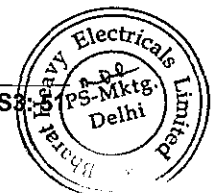
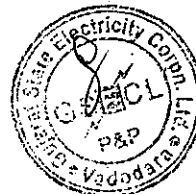
If the Contractor commits any act of bankruptcy or goes into liquidation (except for reconstruction purposes) or carries on its business under a receiver, the executors, successors, or other representatives in law of the estate of the Contractor or any such receiver, liquidator, or any person in whom the Contract may become vested, shall forthwith give notice thereof in writing to the Owner and shall for one month, during which he shall take all reasonable steps to prevent a stoppage of the work, have the option of carrying out the Contract subject to his or their providing such guarantee as may be required by the Owner but not exceeding the value of Works for the time being remaining unexecuted, provided however that nothing above said shall be deemed to relieve the Contractor or its successor of its obligation under the Contract under any circumstance. In the event of stoppage of the Works the Period of the option under this clause shall be fourteen (14) days only, provided that, should the above option be not exercised, the Contract may be terminated by the Owner by notice in writing to the Contractor, and the same power and provision reserved to the Owner by the item Default of Contractor shall apply.

32.0 **INDEMNIFICATION OF THE OWNER**

32.1 The Contractor shall indemnify the Owner of all liabilities incurred by the Owner due to any act or omission on the part of Contractor, his agent, representative, or sub-contractor(s) and causes harm/damage to other Contractor/representatives of the Owner or all or anybody rendering service to the Owner or is connected with the Owner's work in any manner whatsoever. The Contractor shall necessarily indemnify the Owner in all these respects.

The indemnity under this clause shall include all costs, charges, expenses on account of any claims, demands, actions and proceedings against the Owner in respect of such injuries, loss or damage.

32.2 Indemnification of the Contractor



The Owner shall fully indemnify, save harmless and defend the Contractor from and against any and all costs, charges, expenses on account of any claims, demands, actions and proceedings arising out of or resulting from claims by any third parties arising out of or related to the performance of Owner's obligations pursuant to this Contract to the extent caused by any act or omission on the part of the Owner, his agent, representative, or sub-contractor(s), provided that the foregoing obligation shall not apply to the extent such liabilities are caused by the acts or omissions of the Contractor, its agent, representative, or sub-contractor(s)

33.0 **CORRESPONDENCE**

The correspondence procedure will be developed mutually by the Owner and Contractor after award of Contract.

34.0 **CONTRACT AGREEMENT**

- a) The Successful Bidder will be called for Contract negotiations. A signed provisional Contract Agreement will be forwarded by the Bidder which shall be mutually discussed. The acceptable provisional agreement will be concluded within thirty (30) days. On receipt of this, the Owner will issue Notice to Proceed to Bidder. The final Agreement in six (6) originals shall be produced by the Contractor at his cost for signing within sixty (60) days.

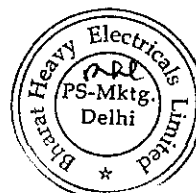
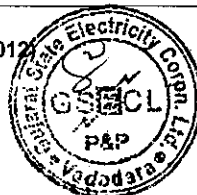
The Agreement will be signed in six (6) originals and the Contractor shall be provided with one (1) signed original and the rest will be retained by the Owner. The Contractor shall provide free of cost to the Owner all the engineering data, drawings and descriptive materials submitted with the Tender, complete set of his Tender and Tender Documents, copies of all the correspondences with the Owner, etc. in six (6) copies to form a part of the Contract Documents.

- b) **Contract Documents**

These Contract Conditions together with the Specification, Tender drawings and guaranteed technical particulars, Tender data with subsequent agreed modification thereof, Tender, all correspondences with the Owner and Signed Agreement and other supporting documents shall constitute the Contract Document(s). No variation or modification or terms and conditions of the Contract Documents or waiver of any of these terms and conditions shall be deemed valid unless agreed in writing and signed by the Owner and the Contractor.

- c) **Endorsement of Terms**

The failure of either party to endorse at any time any of the provisions of the Contract or any rights in respect thereto or to an option herein provided shall in no way be construed to be a waiver of such provisions, rights or option or in any way to affect the validity of the Contract. The exercise by either party of any of his rights herein shall not preclude or prejudice either party from exercising the same or any other right it may have hereunder.



35.0 NOTICE TO PROCEED AND EFFECTIVE DATE

35.1 Contractor shall commence Performance of Work on the date which the Owner specifies in Notice to Proceed (NTP) delivered for Commencement of the work (the "Commencement Date") which shall not be earlier than the date of issue of the Notice to Proceed. The Contractor shall perform its obligation in a manner that would ensure that the Commercial Operation of the Plant occurs within the Guaranteed Commercial Operation Date.

Before issue of NTP following conditions are to be complied with.

- (i) Signing of the Contract.
- (ii) Release of Advance payment.
- (iii) Unhindered & unencumbered access to the site as is where is basis

GSECL will issue LOA after ensuring issuance of NTP within 60 (sixty ) days

35.2 The Contract shall come into force on the date of Notice to Proceed.

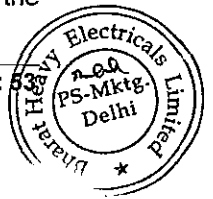
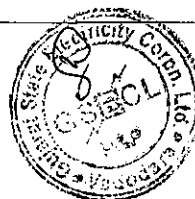
36.0 USE OF THE PLANT PRIOR TO OWNER ACCEPTANCE

Owner reserves the right to take possession of and use for any intended purpose, any portion or all of any delivered but as yet unaccepted Plant. The taking of possession at any time or use of any of such portion of Plant shall not be deemed to be an acknowledgement of Owner acceptance of Unit or the Plant, and shall not be exclusive with respect to Contractor until Owner acceptance of the Plant, has occurred. Owner shall provide Contractor with reasonable and timely access to complete its obligations hereunder. It is the expectation of the parties that any such modifications or repairs will be accomplished by Contractor with minimal interference with operation of the Plant.

37.0 INSURANCE

37.1 The Contractor at his cost shall arrange, secure and maintain all insurance as may be pertinent to the Works and obligatory in terms of law to protect his interest and interests of the Owner against all perils detailed herein. MCE (Marine cum Erection comprehensive ) insurance for the plant and equipment under contractor's scope shall be effective from the date of mobilization of site by the contractor. The form and the limit of such insurance as defined herein together with the underwriter in each case shall be as acceptable to the Owner. However, irrespective of such acceptance the responsibility to maintain adequate insurance coverage up to commercial Operation date shall be the Contractor's full responsibility. The Contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations. The insurance policies to be taken by the Contractor shall be in a joint name of the Owner and the Contractor. The Contractor shall, however, be authorised to deal directly with Insurance Company or Companies and shall be responsible in regard to maintenance of all insurance covers.

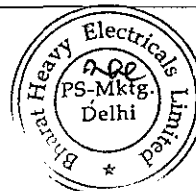
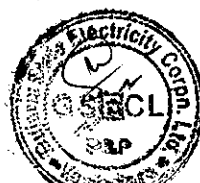
37.2 Any loss or damage to the equipment during handling, transportation, storage, erection, putting into satisfactory operation and all activities to be performed till such time the Plant is finally accepted by the Owner shall be to the account of the Contractor. The Contractor shall be responsible for raising of all claims and make good for the damage or loss by way of repairs and/or replacement of the Works, damaged or lost. The transfer of title shall not in any way relieve the



*Handwritten notes:*  
Mukesh K. Singh  
S.A. ICHMAN  
S.A. ICHMAN

Contractor of the above responsibilities during the period of the Contract. The Contractor shall provide the Owner with copy of all insurance policies and documents taken out by him in pursuance of the Contract. Such copies of documents shall be submitted to the Owner immediately after such insurance coverage. The Contractor shall also inform the Owner in writing at expiry/cancellation and/or change in any of such documents and ensure revalidation, renewal, etc. as may be necessary well in time.

- 37.3 Licenses/port clearances in respect of supplies to be made by the international Contractor from outside India required for purpose of replacement of equipment lost in transit and/or during storage shall be obtained by the Contractor on behalf of the Owner. The Contractor shall, however, be required to follow the procedure as may be laid down to facilitate arranging such licenses/clearances.
- 37.4 The perils required to be covered under the insurance shall include, but not limited to fire and allied risks, miscellaneous accidents (erection risks), workmen compensation risks, loss or damage in transit, theft, pilferage, riot and strike and malicious damages, civil commotion, weather conditions, accidents of all kinds, war risks (during ocean transportation only), Terrorism etc. Further insurance cover towards contamination from nuclear fuel/waste and ionizing radiations/radioactive is not envisaged. The scope of insurance shall be equivalent to the CIF value of equipment plus ten percent (10%) for all risks up to and including delivery of the equipment on CIF basis and for CIF value plus custom duty (as applicable on the cost of replacement) and additional ten percent (10%) of CIF value for all risks subsequent to delivery of goods on CIF Indian port basis. In case of indigenous supply, the scope of insurance shall be equivalent to FOR Site price inclusive of all Taxes plus ten percent (10%) for all risks. For the risks during the erection, the insurance cover to be taken shall be of appropriate value adequate to take care of all costs incurred till the erection. The insurance policies to be taken should be on replacement value basis including the Taxes (as applicable) on the replacement value. Notwithstanding the extent of insurance cover and the amount of claim available from the underwriters, the Contractor shall be liable to make good the full replacement/rectification value of all equipment and materials and to ensure their availability as per project requirements.
- 37.5 All costs on account of insurance liabilities covered under the contract will be included in Contract Price. However, the Owner may from time to time, during the pendency of the Contract, ask the Contractor in writing to limit the insurance coverage, risks and in such a case, the parties to the Contract will agree for a mutual settlement, for reduction in Contract Price to the extent of reduced premium amount. The Contractor, while arranging the insurance, shall ensure to obtain all discounts on premium which may be available for higher volume or for reason of financing arrangement of the Plant.
- 37.6 The Contractors shall ensure that for all activities to be performed in India viz. inland transportation, storage, erection, testing, commissioning, theft, pilferage, etc. till the equipment/plant is taken over by the Owner, the insurance cover shall only be taken from Indian Insurance Companies.
- 37.7 The clause entitled "Insurance" under the Section 4 of this Volume, covers the Additional insurance requirements for the portion of the Works to be performed at the Site.
- 37.8 In respect of insurance proceeds/claim settlements relating to claims raised/referred by the Contractor, the Owner shall give, from time to time, written



authorisation to the underwriter(s) to directly pay such proceeds/settlements to the Contractor as are in accordance with the provisions hereunder:

- i) Wherever total damage/loss of equipment/materials would occur, the Contractor will be entitled to payments received from the underwriters except the following amounts :
  - a) The amount paid to the Contractor under the Contract in respect of equipment/material damaged/lost (excluding the prorata Advance Payment).
  - b) Taxes which have already been paid by the Owner.

Subsequent payments, if any, due under the Contract shall be regulated by the relevant terms of payment, provided the claim money settled by the underwriter is more than the total of the amount as per (a) and (b) above. In the event of the claim money settled is less than the total of the amount in (a) and (b) above, the entire claim money settled will be retained by the Owner and the Contractor will forthwith pay the Owner the shortfall amount between the claim money and the total amounts as per (a) and (b) mentioned above.

- ii) In case of damage to any equipment/material during any stage, the Contractor upon rectification of the damaged equipment to the satisfaction of the Owner shall be paid to the extent of full claims settled by the underwriters. Subsequent payments, if any, due under the Contract shall be regulated by the relevant terms of payment.

37.9 The Contractor shall be responsible for making good any loss or damage at his own cost in a prompt manner, irrespective of the extent of settlement of claims by the insurers/underwriters or the time taken in settlement of such claims.

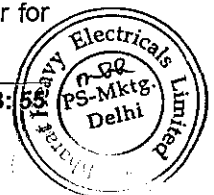
37.10 The Contractor shall ensure adequacy of the value of insurance covers irrespective of the coverage indicated under this clause.

38.0 **CONTRACTOR'S CARE OF THE WORKS**

38.1 The Contractor shall take full responsibility for the care of the Works from the Notice to Proceed until the date of issue of the Take Over Certificate when responsibility shall pass to the Owner. If the Owner's representative issues a Take Over Certificate for part of the Works, the Contractor shall cease to be responsible for the care of that part from the date of issue of such certificate of Take Over when responsibility shall pass to the Owner.

38.2 The Contractor shall take responsibility for the care of any outstanding Work which is required to be completed prior to the expiry of the Contract Period, until the Owner's representative confirms in writing that such outstanding work has been completed.

38.3 If any loss or damage happens to the Plant, during the period for which the Contractor is responsible, the Contractor shall rectify such loss or damage, at his cost, so that the Works conform with the Contract. Without prejudice to any other obligation of the Contractor under the Contract, the Contractor shall also be liable for any loss or damage to the Works caused by operations carried out by the Contractor prior to the expiry of the Contract Period in so far as such loss or damage is not covered under Insurance to be taken by the Owner for



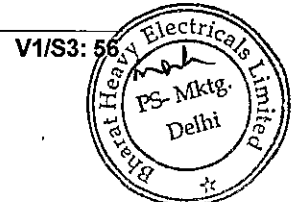
operation of Plant.

39.0 **ARBITRATION AND JURISDICTION**

39.1 **Arbitration**

- a) The Parties shall negotiate in good faith and attempt to resolve any dispute, controversy or claim arising out of or relating to the Contract or the breach, interpretation, termination or validity thereof (a "Dispute"); provided, however, that if the Parties are unable to resolve a Dispute within a period of [30] days from the date of first occurrence of the Dispute, such Dispute shall be settled by valid and binding arbitration conducted by three arbitrators in accordance with the UNCITRAL (United Nations Commission on International Trade Law ) rules.
- b) If a Dispute is not resolved by the good faith negotiation of the Parties, either Party may serve upon the other a written demand that such matter be resolved through arbitration, which written demand shall include a brief description of the Dispute and shall specify the name and address of an arbitrator selected by it. The other Party shall within 20 days of receipt of the arbitration demand select its arbitrator and provide the name and address of such arbitrator to the demanding Party and its arbitrator. The two selected arbitrators shall within 15 days of the selection of the second arbitrator select the third arbitrator, failing to do so, the arbitrators shall request the President of International Chamber of Commerce (ICC), promptly to appoint the third arbitrator in good standing of its association as the third arbitrator in accordance with ICC Appointing Authority Rules, 2003. Related costs of such appointment shall be borne by the defaulting party for the appointment of its arbitrator.
- c) The place of arbitration shall be Vadodara, Gujarat , India and the law applicable to the arbitration procedure shall be UNCITRAL. The English language shall be used throughout the arbitrage proceedings. Each Party shall bear its own arbitration proceeding expenses, including but not limited to counsel fees, except common expenses of arbitration which shall be shared equally. The Parties and the arbitrators shall proceed with the arbitration expeditiously and shall to the best of their ability conclude all proceedings there under, including any hearings, in order that a decision may be rendered by the arbitrators within 120 days from the filing of the demand for arbitration by the demanding Party.
- d) The decision of any two of the three arbitrators shall be final and binding. The parties agree that the decision and any award rendered by the arbitrators in connection with a Dispute :
- i) Shall be final and binding on the Parties and may be enforced in any court having jurisdiction over the Party against which enforcement is sought;
  - ii) Shall be the sole and exclusive remedy between the Parties regarding the Dispute and any claims, counterclaim issues or accountings presented or pled to the arbitrators in connection with the arbitration of the Dispute; and
  - iii) In the case of an award, shall be made and promptly paid in

*Signature*  
S.A. KHAN  
S.A. KHAN  
MUKESH K.S. SINGH



Rupees free of any tax, deduction or offset.

Any costs, fees or taxes incident to enforcing the decision or award shall be charged against the party resisting such enforcement. Any award shall include interest from the date of any damages incurred for breach or other violation of the Agreement, and from the date of the award until paid in full, at a rate to be fixed by the arbitrators.

- e) The provisions of this Clause shall survive the termination or expiration of the Contract. All notices by one Party in connection with an arbitration shall be delivered in accordance with instructions.
- f) The arbitrator shall have full powers to review and/or revise any decision, opinion, directions, certification or valuation of the Owner in consonance with the Contract, and neither party shall be limited in the proceedings before such arbitrators to the evidence or arguments put before the Owner for the purpose of obtaining the said decision.
- g) No decision given by the Owner in accordance with the foregoing provisions shall disqualify him as being called as a witness or giving evidence before the arbitrators on any matter whatsoever relevant to the dispute of difference referred to the arbitrators as aforesaid.
- h) Performance of the Contract shall continue during arbitration proceeding unless the Owner shall order the suspension thereof or any part thereof and if any such suspension shall be added to the Contract Price. No payments due or payable by the Owner shall be withheld on account or a pending reference to arbitration.

39.2 Subject to Clause 39.1 above, the Courts at [Gujarat] shall have the exclusive jurisdiction on any matter arising out of, under or in relation to the Contract.

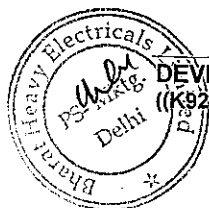
#### 40.0 SUSPENSION OF WORK

40.1 Owner's Right to Suspend:

40.1.1 Owner may at any time and from time to time and for any reason, by written notice to the Contractor, suspend furtherance performance of all or any part of the Works hereunder upon 10 days' prior written notice to Contractor (or, in emergency situations, upon such prior notice as circumstances permit) indicating (a) the portion of the Works the completion of which Owner has elected to defer, (b) Owner's estimate of the duration of such suspension, and (c) the effective date of such suspension of the Works.

Upon receipt of and consistent with the effective date of such notice, Contractor shall:

- (a) stop performance of further Works which Owner has elected to defer and shall continue to complete performance of the balance of the Works. During the period of such suspension Contractor shall properly care for and protect all Work in progress and all property of Owner which pursuant to the terms of the Contract is subject to the supervision of Contractor in whatever state of completion;
- (b) place no further subcontracts or purchase orders for materials, services, work or facilities in respect of the Work except to the extent expressly



requested by Owner; and

- (c) unless otherwise directed by Owner, use all reasonable endeavours to suspend on the most favourable terms available to Contractor all purchase orders, subcontracts and rental and lease agreements to the extent affected by such suspension and otherwise minimise any additional costs associated with such suspension.

40.1.2 Contractor shall promptly deliver to Owner copies of all such Work in progress and all such property as may be requested by Owner & mutually agreed. Owner may at any time terminate the suspension by written notice to Contractor specifying the effective date of termination and Contractor shall use its best efforts to resume performance of its obligations pursuant to the Contract immediately upon receipt of such notice. During the suspension period, the Contractor shall not be allowed to take all such properties outside the plant premises without Owner's permission.

40.1.3 During a suspension, Contractor shall not be entitled to payment of the Contract Price which would have otherwise been ordinarily payable during the relevant period of such suspension, except for such part of the Work which has been completed prior to the date of suspension specified in the notice of suspension.

40.1.4 Upon resumption by Contractor of all activities affected by a suspension, Owner shall resume payments of the Contract Price (it being understood that no interest shall be payable in respect of such resumed payments) with the payment dates therein adjusted to reflect the period during which scheduled payments were not made.

#### 40.2 Consequences of Suspension

40.2.1 Owner's instructions under Clause 40.1 shall be treated as instructions to carry out a change under Clause 4.4, except to the extent that the suspension instructed by Owner is necessary by reason of default, breach, failure or non-performance on the part of Contractor.

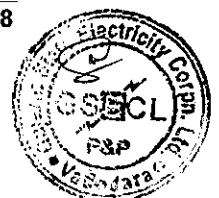
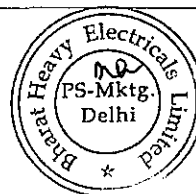
40.2.2 To the extent such instructions are treated as a request for a change under Clause 4.4 in accordance with the immediately preceding Clause 40.2.1, Contractor shall be entitled to submit to Owner a preliminary change order for a determination of an adjustment Guaranteed Commercial Operation Date, the Contract Price, the payment and milestone Schedule, the Project Schedule and the Performance Guarantees, as appropriate. Contractor shall mitigate to the fullest extent reasonably possible any additional expenses to be borne by Owner as a result of suspension of the Works pursuant to this clause.

40.2.3 Except as provided in this Clause 40.2.2 Contractor shall have no claim against Owner.

40.3 Contractor's Right to Suspend.

The Contractor shall have the right to suspend the relevant Works, for the reasons mentioned below, by giving twenty one (21) days' notice to the Owner upon occurrence of the following reasons:

- (a) If the Owner has failed to pay the Contractor, without reasonable cause, any



sum due to the Contractor under the Contract within thirty (30) days after the expiry of time within which payment of such amount was required to be made under the Contract;

- (b) If the Contractor is unable to carry out any of its obligations under the Contract for reasons solely attributable to the Owner, including but not limited to the Owner's failure to provide access to Site or failure to obtain any Applicable Permit necessary for the execution and/or completion of the Facility which the Owner is required to obtain as per the provisions of the Contract or as per Applicable Laws,

If the Contractor's suspends performance of the Works or the rate of progress is reduced pursuant to this Clause 40.3, then the Time for Completion shall be extended, and any and all additional costs or expenses incurred by the Contractor as a result of such suspension or reduction in the rate of progress shall be paid by the Owner to the Contractor in addition to the Contract upon resumption of Works, except where the suspension of the Works or reduction in the rate of progress is attributable to the Contractor's default or breach of Contract.

41.0

#### TRAINING OF OWNER'S PERSONNEL

The Contractor shall furnish all manuals, documentation and train Owner's Engineers/Personnel free of cost for safe, successful and reliable operation of the plant (for minimum 60 people).

The Contractor shall undertake to train free of charge, Engineering personnel selected and sent by the Owner at the works of the Contractor (not less than 60 man month duration). The period and the nature of training for the individual personnel shall be agreed upon mutually between the Contractor and the Owner. These engineering personnel shall be given special training in the shops, where the equipment will be manufactured and/or in their Collaborator's works and in any other plants where equipment manufactured by the Contractor or his Collaborator is under installation/operation or testing to enable those personnel to become familiar with the equipment being furnished by the Contractor.

All traveling expenses for the engineering personnel to be trained during the total period of training will be borne by the Owner. However, the Contractor shall provide necessary accommodation and local transport for such personnel.

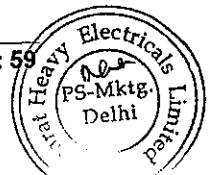
The Contractor shall also train Owner's Operation & Maintenance personnel to become proficient in operating the equipments and for routine maintenance/repair/replacement, lubrication, overhauling, adjustments, testing etc. of the plant and equipments.

42.0

#### AS-BUILT DRAWINGS

The Contractor shall furnish drawings and document in as-built condition as stipulated in the Specification.

On completion of the project, contractor should submit Three Sets of As commissioned drawings, Three Sets of as Installed Bill of Materials and Three Sets of As Commissioned Data/ Specification /Parameter Sheets Duly Signed



by the Competent Authority. (Note: This was earlier at definition of drg sr no (f) CI 2.1)

43.0 **REJECTION OF DEFECTIVE PLANT**

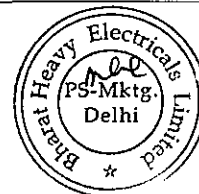
43.1 Without prejudice to the rights of the Owner elsewhere in the Contract, if the completed Plant or any portion thereof, before it is Taken Over under Clause "Taking Over" or during the Warranty Period, is found defective or fails to fulfill the requirements of the Contract, the Engineer shall give the Contractor notice setting forth particulars of such defects or failure, and the Contractor shall forthwith make the defective Plant good or alter the same to make it comply with the requirements of the Contract. Should he fail to do so within seven (7) days, the Owner after giving seven (7) days written notice may reject and replace at the cost of the Contractor the whole or any portion of the Plant, as the case may be, which is defective or fails to fulfill the requirements of the Contract.

43.2 In the event of such rejection, the Owner shall have the right to operate any and all Equipment and/or Plant as long as it is in operating conditions, whether or not, such Equipment has been accepted as complete and satisfactory, to enable him to obtain necessary replacement except that this shall not be construed to permit operation of any equipment which may become damaged by such operation before any required alterations or repairs and/or replacements have been made. All repairs or alterations or replacement required of the Contractor shall be made by the Contractor at such times as directed and in such a manner as will cause the minimum interruption in the use of the equipment by the Owner. Should the Contractor not so replace the rejected plant within the time frame as directed by the Engineer, up to the requirements of the Specification, the Contractor's full and extreme liability under this Clause will be satisfied by the repayment of all money paid by the Owner to him in respect of such plant plus dismantling, site clearance and disposal costs or should be replacement cost whichever is higher.

43.3 Nothing in this Clause shall be deemed to deprive the Owner or, effect any right under the Contract which he may otherwise have in respect of such defects or deficiencies or in any way relieve the Contractor of his obligation under the Contractor. Further, this Clause shall be in addition to and not in derogation of any other right of the Owner under the Contract.

44.0 **MOST FAVOURED CUSTOMER**

The Contractor agrees that Owner is and throughout the implementation of the Works will be "the most favoured customer" of the Contractor and all it's Associates. As such, Contractor confirms and agrees that no other customer of the Contractor or it's Associates will receive greater priority including provision of project personnel, resources and systems than Owner and Contractor hereby assures Owner that the successful, efficient and effective implementation of the Works is and will be the most important customer activity of Contractor and all its affiliates and associates. Contractor and all its affiliates shall not undertake any other project anywhere in the world if to do so, reasonably could be expected to have an adverse effect on the implementation of the Works.



45.0 CONTRACTOR'S ACCEPTANCE OF THE WORK AND SITE

45.1 Acceptance of the Work Generally

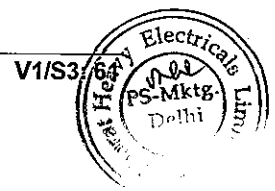
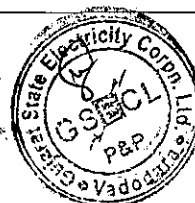
Contractor acknowledges that it has:

- (1) Entered into the Contract for the consideration set forth in the Contract and after due and careful inquiry.
- (2) Satisfied itself in respect of all pertinent matters which may bear upon the performance of the Contract and the Work, including:
  - (a) The nature and magnitude of the Work;
  - (b) The Applicable Laws and all environmental risks, conditions and applicable restrictions;
  - (c) The calculation and sufficiency of the Contract Price;
  - (d) Achievement of the Commercial Operation and Performance Guarantees;
  - (e) Quality and quantity of the Equipment and Contractor's Equipment required for the performance of the Work;
  - (f) Access to the Site;
  - (g) Availability of all labour and personnel;
  - (h) The character and quality of the Work to be performed;
  - (i) General and local conditions;
  - (j) Disposal, handling and storage of materials;
  - (k) All other pertinent, relevant or related matters and conditions.

45.2 Acceptance of the Site:

Bidder acknowledges that:

- (1) The Plant shall be designed and engineered for erection and installation and performance in accordance with the Contract at the Site; and
- (2) Bidder has satisfied itself as to all general, local and groundwater conditions at the Site and the areas adjacent thereto, including but not limited to:
  - (a) Sea, river and land transportation and access and right of way to the Site, including the availability and condition of roads and ports and rights-of-way, conditions affecting transportation, access and egress;
  - (b) Handling and storage of materials;
  - (c) Availability and quality of labour, sand, and rock;



- (d) Rainfall and other climatic conditions, tides, currents, soundings and ground water and other hydrological conditions (including the monsoons);
- (e) Topography, ground surface, subsurface
- (f) Equipment required by Bidder prior to and during performance of its obligations hereunder;
- (g) Availability of housing and other relevant social and urban infrastructure;
- (h) Any and all other pertinent, relevant or related matters and conditions.

45.3 No Claim for Actual Conditions

Contractor acknowledges that all appropriate allowances for the matters and conditions referred to in Articles 45.1 and 45.2 and those pertaining to the Work or to the Contract generally have been taken into account in calculating the Contract Price, and the other terms and conditions of the Contract.

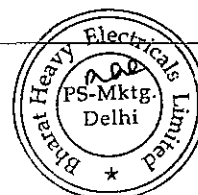
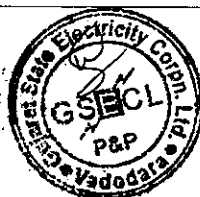
Contractor's failure to acquaint itself and consider any applicable condition, situation, requirement or other matter referred to in Articles 45.1 and 45.2 and those pertaining to the Work or to the Contract generally, will neither relieve it from the responsibility for successfully performing the Contract, nor entitle the Contractor to a Change Order, adjustment of Contract Price or Guaranteed Commercial Operation Date for reasons relatable to such failure.

45.4 Except as otherwise expressly stated in the Contract:

- (1) Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Work;
- (2) Contractor accepts total responsibility for having foreseen all difficulties and costs and expenses of successfully completing the Work; and
- (3) No increase in the Contract Price, or extension of the schedule based in whole or in part upon any discrepancy between the actual conditions encountered by Contractor and those which Contractor anticipated, or any unforeseen difficulties or costs generally, shall be considered by the Owner or effected.

45.5 The Contractor acknowledges that all engineering data and information and data and information relating to hydrological, geo-technical and sub-surface at the Site made available to the Contractor by the Owner in the Specifications, information made available to bidders during the bid process, generally or otherwise, directly and indirectly, are all solely for the convenience of the Contractor. The verification and interpretation of the same shall be at the sole risk and responsibility of Contractor.

Contractor agrees that the Owner shall have no liability for the adequacy, correctness, accuracy or completeness of such data and information. The Owner makes no representation or warranty, express or implied, as to the adequacy, accuracy, correctness or completeness of any such data or information.



Contractor further agrees that it shall protect, indemnify and hold Owner harmless from and against any and all Losses arising directly or indirectly from or incurred by reason of the use of any such data and information by any Person to whom Contractor has supplied such data and information or any portion thereof including the Contractor himself, his Subcontractors, and their respective employees, agents, personnel and consultants.

Furthermore, Contractor hereby waives any claims it may otherwise have against any Person that has prepared, compiled, provided or prepared any such data and information arising due to any reason whatsoever, including without limitation, from the use thereof by Contractor or by other Persons to whom Contractor has supplied such data and information.

Specifically and without limitation, Contractor agrees and warrants that it shall independently and fully verify, check and establish the adequacy, correctness, accuracy and completeness of all data and information which it may require for any purposes related directly or indirectly to the Contract, its obligations hereunder or for any other reasons, at its sole risk and cost.

46.0

#### Applicable Permits

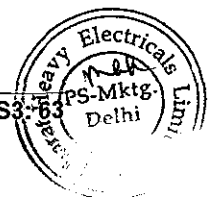
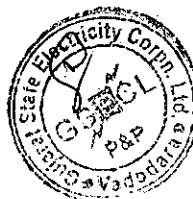
The Owner and the Contractor shall each be responsible for obtaining the Owner Permits and the Contractor Permits respectively. If the Contractor at any time becomes aware, whether as a result of notice from Owner or otherwise, of any Applicable Permit not obtained by the Contractor, the Contractor shall promptly give notice thereof to Owner and the Contractor shall be responsible for obtaining such Applicable Permit.

The Contractor shall be responsible for ensuring compliance with the terms and conditions of all Applicable Permits, whether obtained by the Owner or the Contractor.

The Contractor shall indemnify and hold harmless to the Owner and all Owner indemnified parties from and against any damages arising from and out of the securing of, or failure to secure, the Contractor Permits or failure to maintain the Owner Permits.

With respect to the Owner Permits, the Contractor shall provide support to Owner in obtaining all Owner Permits. Such Contractor support shall include:

- i. Attendance at meetings with Owner and third parties designated by Owner;
- ii. Preparation of permit applications or, as applicable, application to transfer permits to the Owner;
- iii. Assistance in preparation of responses to inquiries by governmental instrumentalities / agencies;
- iv. Assistance in presentations at hearing of governmental instrumentalities / agencies;
- v. Provision of all available information and documents required by Owner in connection with obtaining any Owner Permits; and



- vi. Such other services as Owner may request from time to time required for Owner permits.

47.0 **Law and Language**

The Contract and the respective rights, privileges, duties and obligations of the Owner and the Contractor hereunder shall be governed by the laws of the Republic of India.

48.0 **Stamp Duty**

Costs of stamp duty and other similar charges imposed by law on the Contract or any part thereof shall be borne by the Contractor.

49.0 **TERMINATION BY THE CONTRACTOR.**

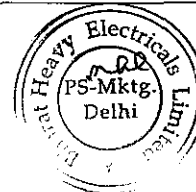
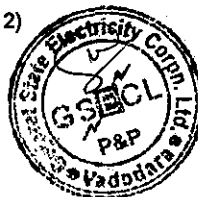
49.1 Upon the occurrence of any one or more of the following events, the Contractor may issue a notice of default to the Owner (the "Contractor's Preliminary Notice"):

- (a) If the Owner has failed to pay the Contractor any sum due to the Contractor under the Contract within sixty (60) days after the expiry of time agreed for payment of the said sum.
- (b) In case of prolonged suspension imposed by the Owner for a continuous period of 120 days that affects the whole of Works.
- (c) In case of prolonged suspension imposed by the Contractor under Clause 40.3 for a continuous period of 90 days that affects the whole of Works.
- (d) If the Owner is adjudged bankrupt or insolvent; or if the Owner makes a general assignment for the benefit of its creditors, or a trustee or a receiver is appointed for all or a substantial part of the Owner's assets, or if the Owner files a petition for reorganization under bankruptcy or other Applicable Laws.

if the Owner has not remedied or cured the default specified in the notice within 30 days of receipt of notice, then the Contractor shall have the right to terminate the Contract forthwith by issue of a notice of termination to the Owner.

Upon such termination the contractor shall be paid as per Clause no.24.2(a) & (b) i.e. Upon termination of the Agreement pursuant to Contractor's right to terminate, the Contractor shall be entitled to be paid :

- (a) all actual documented costs incurred by Contractor, as audited and accepted by an independent certified public accounting firm of national reputation selected by Owner and acceptable to Contractor, incurred or that could not be avoided in connection with performance by Contractor of Works as of the date of the Termination which were not previously paid for by



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Owner, and

(b) all actual documented costs incurred by Contractor, if such cost is part of the Contract Price, in connection with the item procured / facilities executed procured by Contractor in connection with the services for which Contractor has not been paid, provided that such items are delivered to Owner at the Project Site together with all documents necessary to transfer title thereto to Owner (the 'Termination Payment'). As a condition precedent to receiving the Termination Payment, Contractor shall execute and deliver all such papers and take all such steps, including the legal assignment of Contractor's contractual rights, as Owner may require for the purpose of fully vesting in Owner all rights, title and interests of Contractor in and to all subcontracts, purchase orders, warranties, guarantees and other agreements.

(c) All claims by such contractors and Subcontractors to be due and owing for Services and other work performed prior to such date shall constitute debts between Contractor and Subcontractors, and Owner shall in no way be liable for such sums. Contractor shall include in all agreements and contracts entered into with contractors and Subcontractors a provision providing for the foregoing.

The Contractor shall send a copy of the Contractor's Preliminary Notice to the Lenders and notwithstanding anything contained in this Clause or in any other Clause of the General Conditions of Contract or elsewhere, the Contractor's right to terminate the Contract shall be subject to the right of the Lenders to step-in and remedy the default or substitute the Owner; provided that the Lenders must exercise their right to remedy the default and/or substitute the Owner within a period of thirty (30) days from the date of receipt of the Contractor's Preliminary Notice, failing which the Contractor shall have the right to terminate the Contract upon the expiry of the said 30 days' period."

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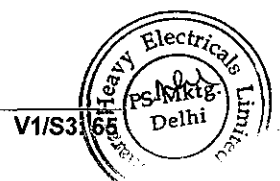
DEEMED COMPLETION

In case the Performance Guarantee Tests cannot be completed within 90 days of Trial Operation for reasons not attributable to Contractor, the Performance Guarantee Tests shall be deemed to be completed successfully and the unit shall be deemed to be Taken Over and payment linked to this activity shall be released to Contractor by Owner. Contractor shall conduct the Performance Guarantee Tests to establish that performance guarantees are met for the unit, using applicable correction curves. Contractor shall be allowed to demobilize its resources on deemed completion of Performance Guarantee Tests and remobilize at the expense of the Owner for carrying out the Performance Guarantee Tests at a later date. In any case, the Performance Guarantee Tests for the unit shall be conducted within 6 months of the Trial Operation of the unit

51.0

DEEMED COMMISSIONING

In case the Initial Operation cannot be completed within 30 days from Scheduled date for reasons not attributable to the Contractor, the Initial Operation shall deemed to be completed and payment linked to successful completion of Reliability Run shall be released to the Contractor by Owner

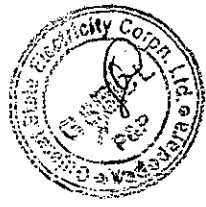


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CONTENT

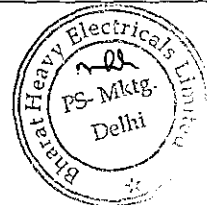
CLAUSE NO.	DESCRIPTION
1.00.00	PROJECT MANAGEMENT SERVICES
2.00.00	SITE SERVICES

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MUKESH K. SINGH



(DEVELOPMENT CONSULTANTS  
(K9213R-EPC-SPC-001-Vol-IIA-Sec-5)

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SECTION-V

PROJECT MANAGEMENT AND SITE SERVICES

1.00.00 PROJECT MANAGEMENT SERVICES

1.01.00 Responsibility

The Bidder shall identify a separate and independent project management team headed by a Project Manager for the execution of this project. Responsibilities of this project Management team shall cover the areas listed below :

- a) Planning and Monitoring
- b) Engineering Management
- c) Contracts Management
- d) Quality Assurance, Inspection & Expediting
- e) Construction Management
- f) Spares Management
- g) Erection & Commissioning Management

Detailed responsibilities in the above areas are discussed below :

1.02.00 Organisation

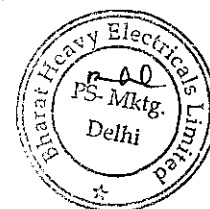
1.02.01 Headquarters

The headquarters of the project management team shall be headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. He should have adequate financial power and authority to give decision.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.00, who, in turn, will report to the Project Manager for all matters relative to this contract.

1.02.02 Central Co-ordination Cell

The central coordination cell shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or references made by Owner and his Consultants without having the need to refer to his headquarters each time.



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1.02.03 Site Organisation

The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.

1.02.04 Organisation Chart

The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.00 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.

1.03.00 Implementation Schedule

The schedule for the completion of the Project would be as follows :

Period in Months from Zero date (Taken as the date of issue of Notice to Proceed)

- |    |                      |           |
|----|----------------------|-----------|
| a) | Boiler Hydro-test    | By Bidder |
| b) | Boiler light up      | By Bidder |
| c) | Unit synchronisation | 45        |
| d) | Commercial operation | 48        |

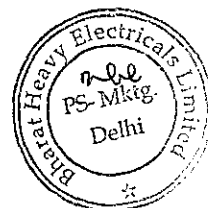
To achieve these targets, the Contractor shall furnish to the Owner, various schedules as defined below:

1.03.01 Engineering Schedules

These schedules shall cover various design submissions indicating different engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every plant/systems/ equipment item covered in the scope of this specification.

1.03.02 Manufacturing Schedule

The Contractor shall submit to the Engineer his manufacturing and delivery schedules for all equipment within thirty (30) days from the date of issue of the Letter of Award (LOA). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.



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1.03.03 Erection Schedules

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and will be subject to discussions/agreements with the Owner subsequent to the award of contract.

1.03.04 The successful Bidder shall have to provide all the above schedules (i.e. 1.03.01, 1.03.02 & 1.03.03) in a tabular form in addition to that in the form of L2 & L3 networks and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.03.05 The Contractor shall provide the Owner the original disc/software for all such schedules alongwith requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software, Primavera.

1.04.00 Detailed Responsibilities

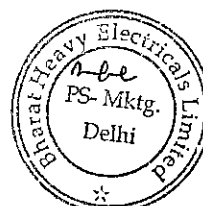
1.04.01 Planning & Monitoring

a) Planning

The Bidder shall prepare a Master Network Schedule in the form of PERT network.

The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/package in the areas of engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.



b) Monitoring & Progress Reporting

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) Detailed packagewise status of engineering submissions, quality plan submissions and approval, procurement manufacture and despatch.

The monthly report generated from the site office should necessarily include:

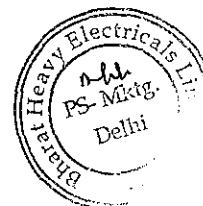
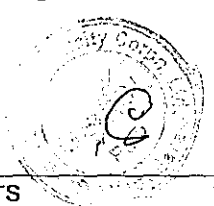
- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning.

In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.04.02 Engineering Management

Based on the master network for the project (L-1) the Contractor will prepare an exhaustive list of engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for engineering activities.

Based on (L-2) network, the Bidder shall further develop the Level-3 (L-3) network for engineering activities which will indicate schedule for data availability, drawing release date and document submission dates.



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Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Award and finalised within one (1) month thereafter.

All such networks shall be provided in MS PROJECT software as well as in other format / software suitable to Owner.

The engineering management team should also co-ordinate all interface engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related engineering documentation before the same is submitted to the Owner.

1.04.03 Contracts Management

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor will also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

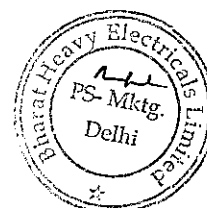
The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the customer hold points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacture can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of boughtout items, detailed shipping schedule and cash flow statement for Owner's approval.

1.04.04 Quality Assurance, Inspection and Expediting

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacture is commenced. The list of major suppliers would be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior to placement of Letter of Award. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner



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reserves the right to include vendors of his own choice. No further vendor approval will be given after six (6) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site upto erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05

#### Construction Management

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Award, the Contractor shall submit a programme of construction/erection/commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

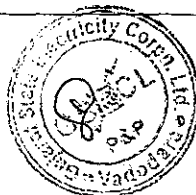
Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier.

1.04.06

#### Spares Management

Alongwith the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following:

- a) Mandatory spares
- b) Recommended spares



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While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised thereafter.

1.05.00 **Project Progress Review Meetings**

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution in respect of Wanakbori Thermal Power Plant (Unit-8) will be held initially atleast once in two (2) months at Vadodara/site or in the country (India) depending on the circumstances and mutual agreement. During peak period it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.

1.06.00 **Owner's Consultant**

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.01.00 above. The details of interaction and procedures for coordination between Owner/Owner's Consultant & Contractor/ Contractor's project management team shall be finalised during contract negotiations.

1.07.00 **Commissioning Management**

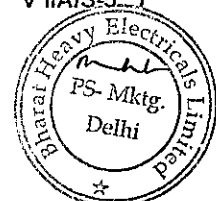
1.07.01 For commissioning of the various equipment/system covered under the scope of contract, Owner will form an organisation structure which may consist of the following committees. The Contractor shall nominate his representative on one or more of the committee as decided by the Owner:

- a) Steering Committee
- b) Commissioning Panel.
- c) Working Parties
- d) Testing Teams.

1.07.02 Commissioning documents shall be prepared by the Contractor in following manner and submitted for Owner's approval :

- a) Field Quality Plan

This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning :



- i) Establish design data against which Plant Performance will be compared.
  - ii) Set-out the testing objectives and proposals.
  - iii) Define the documentation required.
- b) Testing/Commissioning Schedule

These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results.

- c) Standard Check Lists

Standard check lists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

1.07.03

Test Reports

After the completion of commissioning activity of equipment/ systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-a-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

2.00.00

SITE SERVICES

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

2.01.00

Arranging material despatch from the shop by rail/road and/or sea as applicable.

2.02.00

Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc. from the time of despatch F.O.R. works/ F.O.B. port of shipment by Contractor till receipt of the same at site.

2.03.00

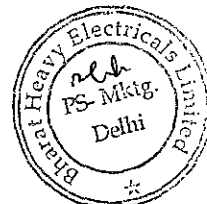
Unloading of materials at Railway Station/Railway Siding inside project area/ Road Transportation, transportation to site store, assessment of lost/ damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Engineer a report detailing all the receipts during the week as well as storing, preservation of material at site.

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(K9213R-EPC-SPC-001-Vol-IIA-Sec-5)

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- 2.04.00 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.
- 2.05.00 Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.
- 2.06.00 Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests.

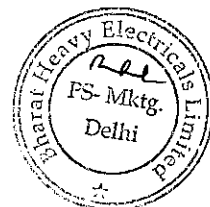
Apart from Boiler, proper chemical cleaning shall be carried out in following pipe lines/equipment before commissioning

- a) Deaerator
- b) Boiler feed suction, recirculation leak-off lines
- c) Boiler Feed discharge line by passing heaters
- d) Attemperation lines
- e) Condensate suction & discharge piping upto de-aerator by passing the feed water heaters.
- f) Fuel oil lines.

Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc. as necessary shall also be in the scope of the Bidder.

Safe disposal of effluent after chemical cleaning shall be done by the contractor.

- 2.07.00 Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of LDO, chemicals, lub oils upto COD.
- 2.08.00 For the purpose of erection and commissioning the Contractor's scope of work shall include but not be limited to the following :
- 2.08.01 Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.
- 2.08.02 Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.



- 2.08.03 Supply of all consumables, e.g. welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection work except those listed under exclusion elsewhere in this specification.
- 2.08.04 Construction of all civil/structural/architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.
- 2.08.05 All structural steel fabrication and erection work as detailed elsewhere in the specification.
- 2.08.06 Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.
- 2.08.07 Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives etc. for respective portions of work under the jurisdiction of such statutes or laws.
- 2.08.08 The Contractor shall provide 'Industrial Relations' unit and 'Medical' unit to take care of his erection staff and the Owner shall have no obligation in the regard.
- 2.08.09 The successful Bidder shall arrange for Tower crane of adequate capacity for speedy erection activities.
- 2.09.00 **Site Organisation**

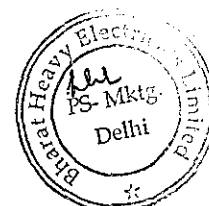
The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

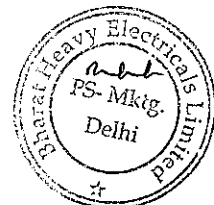
The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.



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- 2.10.00 **General Guidelines for Field Activities**
- 2.10.01 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.
- 2.10.02 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication.
- 2.10.03 The Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the Contractor, if called will also attend such meetings.
- 2.10.04 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall take necessary action to make good of such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Engineer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.
- 2.10.05 The Engineer shall however not be responsible for provision of additional labour and or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.
- 2.10.06 The works under execution shall be open to inspection & supervision by the Owner's engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.
- 2.10.07 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.



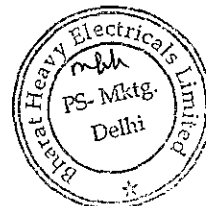
- 2.10.08 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.
- 2.10.09 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general engineering practice at site, cutting grinding, straightening, chamfering, filing, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.
- 2.10.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Engineer.
- 2.10.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Engineer, will have to be done by the Contractor.
- 2.10.12 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if :
- a) Product groups under which these items are re-leased are not covered in the scope of this tender.
  - b) Items are supplied by an agency other than the Contractor.
- 2.10.13 Preservation of all materials/equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc., shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints, etc., shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/paints on pressure parts/other equipment even after erection until completion of work shall be carried out by the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub. oil system, carryout the hydraulic test of oil coolers, etc.
- 2.10.14 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Engineer, with all the necessary tools & tackles, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.

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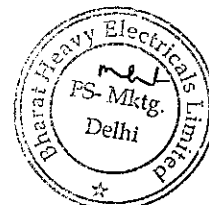
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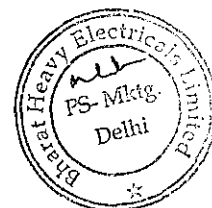
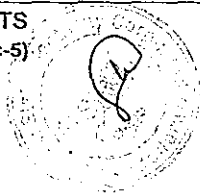
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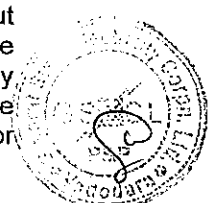
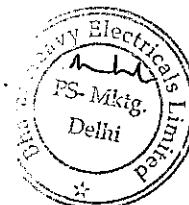
- 2.10.15 Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.
- 2.10.16 Equipment and material which are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.
- 2.10.17 Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc.
- 2.10.18 Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.
- 2.10.19 It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.
- 2.10.20 Structural materials required for the supporting/operating platforms required for the valves at various levels for the same operation of valves will be arranged by the Contractor.
- 2.10.21 For civil, structural and architectural works, volume IIG/1 & IIG/2 may be referred. For Instrumentation and Electrical works Vol. IIE and Vol. IIF/1 & F/2 may be referred.
- 2.11.00 **Safety**  
Safety and overall cleanliness of work site shall be given top priority.
- 2.11.01 The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.
- 2.11.02 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.
- 2.11.03 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor.



- 2.11.04 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources.
- 2.11.05 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be periodically done by the Contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.
- 2.11.06 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.
- 2.11.07 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.
- 2.11.08 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.
- 2.11.09 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.
- 2.11.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.
- 2.11.11 All safety precautions shall be taken for welding and cutting operations as per IS-818.
- 2.11.12 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.
- 2.12.00 **Taking Delivery & Storage**
- 2.12.01 The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the materials so issued shall be submitted to the Owner.
- 2.12.02 The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.
- 2.12.03 All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.



- 2.13.00 **Site Welding & Heat Treatment**
- 2.13.01 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ASME Section-IX for high pressure welds, shall be employed in the job.
- 2.13.02 All welders shall be tested and approved by Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Engineer shall be stamped by the welder on each joint done by them. The Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.
- 2.13.03 The Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.
- 2.13.04 All charges for testing of welders including destructive and non-destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.
- 2.13.05 All welded joints shall be subject to acceptance by Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.
- 2.13.06 Preheating/post heating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements, thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre-heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Engineer prior to the commencement of each cycle and handed over to Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo-chalks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition.
- 2.13.07 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of

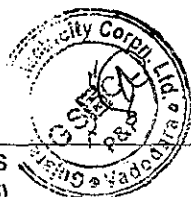


approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations.

- 2.13.08 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means, of electric induction coil or electric resistance coil.
- 2.13.09 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work.
- 2.13.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm the entire welding has to be carried out by TIG welding.
- Fillet weld shall be made by shielded metal arc process as per applicable codes.
- However, the Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times of the dia. of the electrode.
- In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.
- 2.13.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.
- 2.13.12 Each pass shall be cleared and freed of slag before the next pass is deposited.
- 2.13.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- 2.13.14 Each layer of welding shall have an even and smooth appearance.
- 2.13.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further any movement, shock or vibration during welding shall be avoided to prevent weld cracks.
- 2.13.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surfaced to be welded are wet from any cause.

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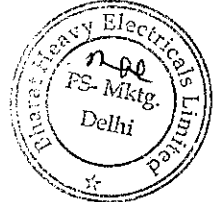


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- 2.13.17 Following will be stages of inspection during welding :
- a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Engineer.
  - b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.
  - c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.
- 2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.
- 2.14.00 For further details on procedures of work at site on civil, architectural, electrical and instrumentation & control services, refer Volume : II-E, II-F & II-G of this specification.

*Handwritten signatures and notes:*  
Mukesh K. Singh  
S. D. ICHHAN  
S. M. M. A. Y.



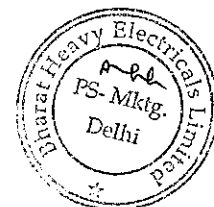
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S.A. KHAN  
S.A. KHAN  
MUKESH K.S. SINGH

VOLUME : IIA  
SECTION-VI  
ENGINEERING SERVICES



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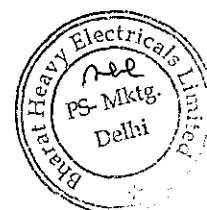
CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL
2.00.00	DESIGN COORDINATION MEETING
3.00.00	CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS
4.00.00	GUIDELINES FOR ENGINEERING SERVICES
5.00.00	OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS
6.00.00	PLANT HANDBOOK
7.00.00	CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE
8.00.00	TENDER STAGE DOCUMENT SUBMISSION

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(K9213R-EPC-SPC-001-Vol-IIA-Sec-6&7)

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VOLUME : IIA

SECTION-VI

ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Contractor shall be responsible for proper engineering and co-ordination of activities during various phases of execution of the contract. The Contractor shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Engineer or the Review Consultant shall interact on matters related to engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Contractor and shall be responsible for all engineering co-ordination. The Owner/Consultant/Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Contractor or on matters involving the Contractor, his manufacturing units and sub-vendors. For the purpose of expediting the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the contractors. However such interaction will not, under any circumstance, dilute the responsibility of the Contractor to provide a fully engineered and co-ordinated package under this contract.

1.02.00 On finalization of the contract, a procedure for exchange of engineering information will be mutually agreed and finalized between the Owner and the Contractor.

2.00.00 DESIGN COORDINATION MEETING

The Contractor and his sub-vendors will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the Owner during the period of execution of contract. The Contractor including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Kolkata or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

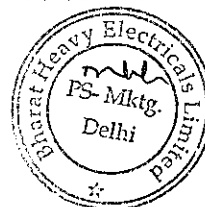
3.00.00 CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS

The Contractor shall agree to cooperate with the Owner's other Contractors and Consulting Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Engineer shall be provided with copies of all correspondences addressed by the Contractor to other Sub- contractors and Consulting Engineers in respect of such exchange of technical information.

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4.00.00 GUIDELINES FOR ENGINEERING SERVICES

4.01.00 Prior to commencement of the engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed engineering work.

4.02.00 Engineering work shall be performed on modern and proven concepts and internationally accepted good engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Contractor.

4.03.00 At any stage during the performance of assignment, the Contractor may be required to make certain changes/modification/improvements in design/drawing/other documents which are applicable to 800 MW Unit, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution / operation of similar units. Such changes / modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and scope of the Contractor.

4.04.00 During the course of review of detailed engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.

4.05.00 During the course of review of detailed engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants engineered by the Bidder. In case Owner so desires the Bidder shall submit such data and information to the Owner.

4.06.00 It is not the intent to give details of every single task covered in the total engineering work to be carried out by Contractor, however, all engineering work required for the satisfactory completion of the plant/systems as specified shall be carried out by the Contractor. Broadly, the following are the minimum requirements in respect of scope of major items of work:

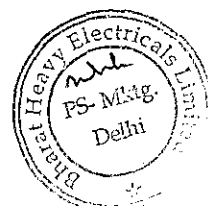
4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations / floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Contractor from time to time, as detailed designs are developed, shall be submitted for Owner's / Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.

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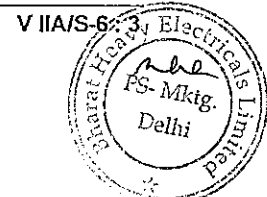


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- 4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-contractors.
- 4.06.03 Review of sub-contractor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.
- 4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings; details of embedments etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope, Terminal Points & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.
- 4.06.05 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant.
- 4.06.06 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting.
- 4.06.07 Sizing of all piping and equipment as per the stipulated design criteria; carrying out of flexibility analysis/dynamic analysis as necessary; hangers & support engineering.
- 4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.
- 4.06.09 Certification and submission of final as-built drawings for all areas.
- 4.06.10 Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.
- 4.06.11 All erection and assembly drawings which may be required at site.
- 4.06.12 For all bought out item packages, the Contractor shall provide complete material / component list along with detail specification, drawings, component part no. etc. during detail engineering stage prior to final approval. Such approved drawing/document shall be made available at site in adequate number prior to commencement of work. Moreover, such document/drawing shall be provided in soft form (CD)
- 4.06.13 Preparation of necessary documentation, design calculations etc. required for submission to statutory authorities like IBR, Chief Electric Inspector etc.

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5.00.00 OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS

5.01.00 The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.

5.02.00 The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

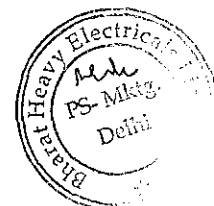
- a) A complete inventory of all main items of plant, with identification details.
- b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
- c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.
- d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.
- e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.
- f) Manufacturer's literature.

5.03.00 The instruction manual shall be subject to the approval of Owner.

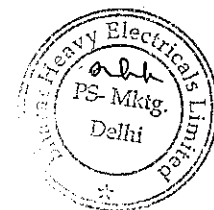
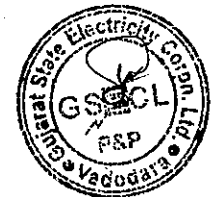
6.00.00 PLANT HANDBOOK

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the letter of award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms.

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MUKESH K.S. SINGH



- 7.00.00 **CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE**
- 7.01.00 Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document.
- The documents shall be divided into two categories : a) for approval and b) for information/further engineering and co-ordination by the Owner.
- In preparing this schedule, the Contractor shall allow four (4) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.
- This document submission schedule shall require approval by the Owner/Engineer.
- 7.02.00 All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation.
- All dimensions shall be in metric units.
- All notes, markings etc. shall be in English.
- 7.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval / information of the Owner/Engineer.
- 7.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:
- List of sub-vendors (from Owner only)
  - System scheme and instrumentation diagrams
  - Design basis justifying selection of equipment & process parameters where not specified in the Contract
  - Equipment data sheets and general arrangement drawings
  - Materials of construction
  - Layout drawings.
  - Operation logic diagrams.
  - Typical control circuit.
  - Drawings of Instrumentation and control.



7.05.00 Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.

- a) Equipment foundation drawings.
- b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
- c) Predicted performance curves of equipment.
- d) Various bills of quantity, schedules etc.
- e) Piping fabrication drawings, isometrics etc.
- f) Panel wiring diagrams.
- g) Instruction/Operation manuals.
- h) Service manuals and trouble shooting guide for C & I system including field instruments.
- i) Cable schedule and interconnection chart.
- j) Drive/feederwise control scheme showing all external interfaces.

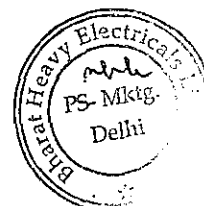
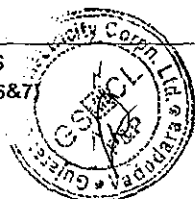
In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.

7.06.00 Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document:

- a) Approved.
- b) Approved except as noted, forward final drawing
- c) Approved except as noted, resubmission required.
- d) Disapproved.
- e) For information/reference only.

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document.

Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/ Engineer.



The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements.

The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

7.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

7.08.00 For review by the Consulting Engineer, the Contractor shall furnish soft copies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorised revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

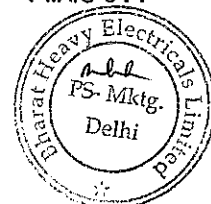
7.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.

7.10.00 For details of documentation for Civil, Structural and Architectural works, Vol. II-G may be referred.

8.00.00 **TENDER STAGE DOCUMENT SUBMISSION**

8.01.00 The Bidder shall submit along with his bid all documents/drawings as requested in respective specifications. The documents shall include but not be limited to the following :

- a) All Bid proposal sheets duly filled up.
- b) Detailed experience list and financial resources of the prime bidder his collaborators/associates in this bid as well as the sub-vendors proposed.
- c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.
- d) List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.



- e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.
- f) L-1 network indicating target dates for intermediate milestones and final commissioning of equipment supplied; This network shall be supplemented by a detailed write-up on proposal procedure of project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.
- g) List of suppliers for all bought out items.

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S.A. KHAN

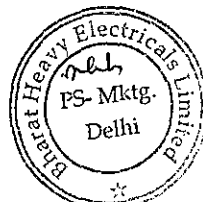
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MUKESH K. SINGH



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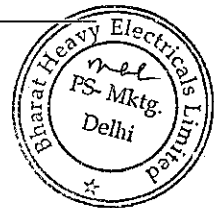


*Handwritten signatures and names on the left margin:*  
Mukesh K. Singh  
Sudhakar  
M. M. M. M.

**VOLUME : IIA**  
**SECTION-VII**  
**QUALITY ASSURANCE REQUIREMENTS**



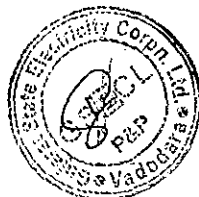
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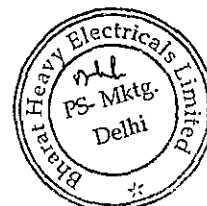
CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	QUALITY ASSURANCE PROGRAMME
2.00.00	GENERAL REQUIREMENTS QUALITY ASSURANCE
3.00.00	QUALITY ASSURANCE DOCUMENTS
4.00.00	INSPECTION, TESTING & INSPECTION CERTIFICATES
	ANNEXURES
ANNEXURE-I	FORMAT OF QUALITY ASSURANCE PROGRAMME
ANNEXURE-II	FIELD WELDING SCHEDULE

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SECTION-VII

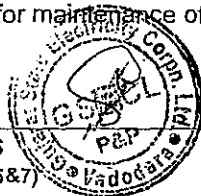
QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

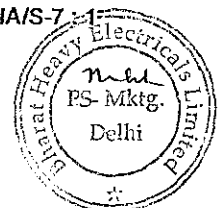
1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following :

- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.

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- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.

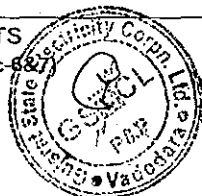
2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.

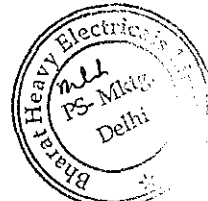
2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised representative for approval and dispositioning.

2.05.00 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/ Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

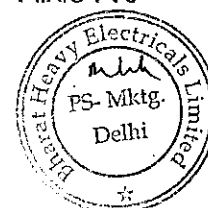
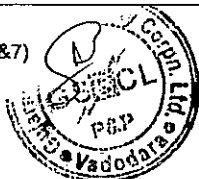
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- 2.06.00 Materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report as per Owner's approved QAP. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- 2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
- 2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.
- All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.
- For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.
- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-1A (of American Society of non-destructive examination). Results of NDT shall be properly recorded and submitted for approval.
- 2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalised with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.
- 2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed.
- Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject an equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.
- 2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.



2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.

2.14.00 For quality assurance of all civil works refer to the specifications for civil works.

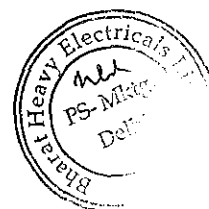
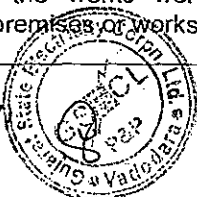
3.00.00 **QUALITY ASSURANCE DOCUMENTS**

3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms of the following Quality Assurance documents within three (3) weeks after despatch of the equipment :

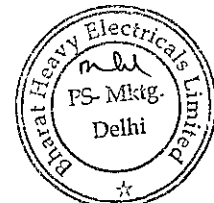
- a) Material mill test reports on components as specified by the specification.
- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
  - i) When some important repair work is involved to make the job acceptable.
  - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Engineer, his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.



- 4.02.00 The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.
- 4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Engineer/Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/Inspector or to his authorised representative to accomplish testing.
- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.



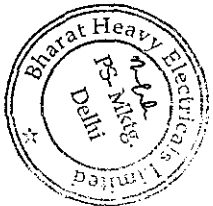
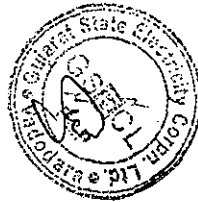
ANNEXURE-I

FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company/ Contractor	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____			QP No. : _____ Date _____						
	Contractor : _____			Rev. No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

Note: All the information for QAP as stipulated above shall be finalized and agreed during contract execution.

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*Mukesh K.S. Singh*  
MUKESH K.S. SINGH

*S.A. Khan*  
S.A. KHAN

*D.M. Malik*  
D.M. MALIK

ANNEXURE-II

FIELD WELDING SCHEDULE

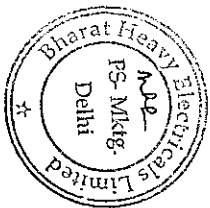
PROJECT : FWS NO :  
 CONTRACTOR : REV NO. :  
 PACKAGE : FIELD WELDING CODE :  
 SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method Quantum	NDT Specification Number	Acceptance Norm Ref.	Remarks
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The Field Welding Schedule should be submitted for :

- o Pressure Parts
- o Tanks/Vessels
- o Piping
- o Heavy/Important Structural Steel
- o Heat Exchangers
- o Bus Ducts

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MUKESH KA. SINGH

S. A. KHAN

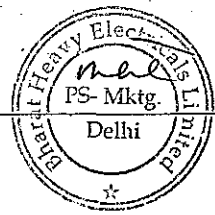
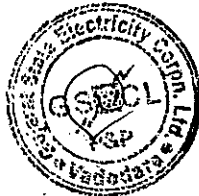
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*Mukesh*  
S.A. ICHAN  
MUKESH K.S. SINGH

VOLUME : IIA

SECTION - X

PERFORMANCE GUARANTEES AND TESTS



1.04.00 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.05.00 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.06.00 **Performance/Acceptance Tests**

1.06.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.06.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.06.03 For instrument inaccuracies during PG Test, refer subsequent clauses of this section.

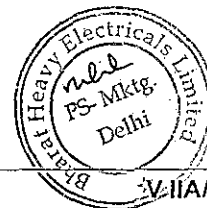
1.06.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.

2.00.00 **START-UP, INITIAL OPERATION, RELIABILITY RUN AND PERFORMANCE TESTS**

2.01.00 The Contractor shall provide commissioning & start-up supervisory engineering staff specially identified for the period commencing with start-up and extending from initial operation to all performance tests. During this period, the Contractor shall furnish the calibration devices, special test instruments, etc. required to prepare for and conduct the performance tests. The Owner will associate his operating personnel and necessary supporting staff and shall make available the main fuel; i.e. coal and the system electrical load.

Contractor's commissioning, & start-up supervisory engineering personnel shall conduct training for the Owner's personnel prior to and during this period and shall train them so that they will be able to operate and maintain the new equipment satisfactorily after acceptance by the Owner.

2.02.00 The following field inspections and tests shall be carried out in the sequence detailed below, and the successful performance and completion of all the tests taken together shall constitute the Owner acceptance tests. The Contractor shall provide supervisory services during field inspection and tests.



2.02.01 Inspection and Checking of the Units

After completion of erection and/or installation, and before being put into operation, the unit and all its appurtenances shall be thoroughly cleaned and then inspected, for correctness and completeness of installation and acceptability for placing in operation. All piping system shall be flushed, chemically cleaned, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be subject to Owner's approval.

The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each system, as it is completed by construction and turned over to the commissioning (start-up) engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule.

On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the complete equipment shall be placed on Initial Operation during which period the complete equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

When the equipment is operating properly, its characteristics shall be recorded on the start-up report sheets. Copies of typical start-up report shall be given to the Owner. Start-up reports for all equipment shall be completed before the start of the Reliability Run.

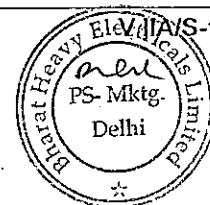
2.02.02 Initial Operation, Reliability Run

The plant shall be on Reliability Run during which period all necessary adjustments shall be made while operating over the full load range enabling the plant to be made ready for performance and guarantee tests.

The duration of Reliability Run of the complete plant & equipment in the automatic mode of control shall be fourteen (14) days out of which atleast seventy two (72) hours shall be in continuous operation on full load or any other duration as may be agreed to between the Owner and the Contractor. The Reliability Run shall be considered successful, provided such item of the equipment can be operated, continuously at the specified operating characteristics for the period of Reliability Run.

For the period of Reliability Run, the time of operation with minimum 85% load shall be counted, minor interruptions not exceeding one(1) to Two(2) hours at a time caused during the continuous operation shall not affect the total duration of Reliability Run. Maximum number of such interruption during the reliability run shall be four(4). However, if in the opinion of the Owner, the interruption is long, the Reliability Run shall be prolonged for the period equivalent to the duration of interruption.

A Reliability Run report comprising observations and recordings of various parameters to be measured, in respect of the above run shall be prepared by the Contractor. This report besides recording the details of the various observations during operation shall also include the dates of start and finish of the Reliability Run and shall be signed by the representatives of both the parties. The report shall have sheets, recording and print out of all the details of



interruption occurred, adjustments made, any minor repairs done during the Reliability Run. Based on the observations, necessary modifications/repairs to the plant shall be carried out to the full satisfaction of the Owner to enable the later to accord permission to carry out Performance and Guarantee Tests on the plant. However, minor defects which do not endanger the safe operation of the equipment shall not be considered as reasons for with holding the aforesaid permission.

Should any major failure or interruption occur in any portion of the plant due to or arising from faulty design, materials, workmanship or omissions or incorrect erection, sufficient to prevent safe and full commercial use of the plant, the reliability run shall be considered void and the reliability test period of 14 days shall recommence after the Contractor has remedied the cause of defect.

2.02.03

Performance and Guarantee Test

- a) The final tests as to the performance and guarantees shall be conducted at site, after the reliability run, by the Contractor with full involvement of the Owner. The necessary operating inputs shall be provided by the Owner. The Contractor's engineering staff for commissioning and start-up shall ensure that the equipment are ready for such tests. The Owner shall associate his necessary supporting staff with the Contractor to carry out the various activities related to PG tests. The necessary labour/supporting staff etc. shall be provided by the Contractor. Such tests will be conducted within a period of two (2) months after the successful completion of Reliability Run. Any extension of time beyond the above two (2) months shall be mutually agreed upon.
- b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the performance guarantees.

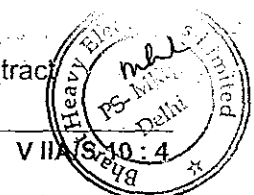
The Contractor shall submit the test procedure for Owner's approval within twelve (12) months from the date of letter of award of the contract. The test shall be carried out by the test grade instruments as stipulated in the applicable test code. These instruments shall be calibrated by the Contractor in a laboratory duly approved by Owner. Batch calibration will not be acceptable. The available instrumentation and control equipment in the plant if found suitable could also be used with the prior approval of the Owner after calibrations in the plant/outside laboratory. The tests will be conducted at the specified load points, and as near the specified cycle conditions as practicable. Proper corrections in calculations to take into account the conditions which do not correspond to the specified conditions will be applied in the test report as brought out under the respective sections of the specification.

The contractor shall submit for Purchaser's approval the detailed Performance Test procedure containing the following :

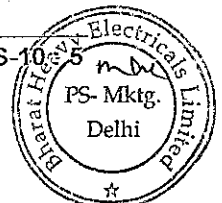
- i. Object of the test
- ii. Scope
- iii. Various guaranteed parameters & tests as per contract



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- iv. Method of conductance of test and test code
  - v. Duration of test, frequency of readings & number of test runs.
  - vi. Method of calculation
  - vii. Correction curves
  - viii. Instrument list consisting of range, accuracy, least count and location of instruments.
  - ix. Scheme showing measurement points
  - x. Sample calculation
  - xi. Acceptance criteria
  - xii. Any other information required for conducting the test.
- c) All special test grade instruments, including flow nozzles etc., equipment, tools and tackles, required for the successful completion of the Performance and Guarantee Tests shall be brought for the purpose of test, free of cost by the Contractor.
- d) The guaranteed performance figures of the equipment shall be proved by the Contractor during these Performance and Guarantee Tests. The Contractor shall submit a detailed test report in the manner, already agreed to within one (1) month time of completion of the test, for Owner's approval. Should the Owner's assessment of these tests show any deterioration from the guaranteed values the Contractor/Owner shall modify the equipment as required to enable it to meet the guarantees. In such case Performance and Guarantee Tests shall be repeated after one (1) month, from the date the equipment is ready for retest and all costs for modifications including labour, materials and the cost of additional testing to prove that the equipment meets the guarantees, shall be borne by the Contractor.
- e) The specific tests to be conducted on equipment have been brought out in the technical specifications. The procedure to be submitted by the Contractor should include the detailed methodology to conduct these tests/verify the guarantees offered by the Contractor notwithstanding whether these attract liquidated damages or not.
- f) The test results shall be considered as calculated from test observations with only corrections as are provided in the code ASME PTC-6.
- The guaranteed parameters shall be without any tolerance or allowance values. Uncertainty analysis shall not be used to adjust test results.
- g) The Bidder shall establish the following modes of operation to the satisfaction of the Owner before acceptance test :
- i. Operation of each system by remote manual control.
  - ii. Operation of the entire system in integrated manner on auto control.



iii. Operation of the entire plant with auto-control loops fully implemented including different modes of load control with the help of control system.

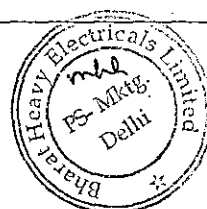
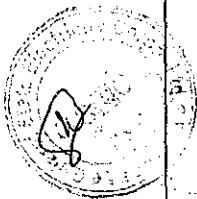
h) Ten (10) copies of the test reports are to be furnished by the Contractor to the Owner backed up with jointly signed data sheets.

Wherever it is not practicable to conduct the performance guarantee test at site, and an accurate test to prove the guaranteed parameter has already been conducted in the shop test, such a test may not be repeated, if so agreed by the Owner. However, in such cases, should there be any short fall in the performance during shop tests, the liquidated damages will be calculated on that basis.

3.00.00

**SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]**

Sl. No.	Plant/ System	Parameter for Performance Guarantee	Liquidated Damages
3.01.00	Plant		
3.01.01	Guaranteed Output	800 MW Continuous output at 100% TMCR, at Generator terminals (excluding excitation power), at 0.85 power factor lagging and at rated hydrogen pressure and 39°C cooling water temperature for Generator, under rated steam conditions at Turbine Inlet ( $250 \pm 3 \text{ kg/cm}^2$ , $566 \pm 3^\circ\text{C}$ , $593^\circ\text{C}$ ) and CW temperature of 33°C for condenser and with zero percent make-up.	As per Volume-I.
3.01.02	Guaranteed Overall Heat Rate	Overall Heat rate in Kcal/Kwh at 100% & 80% TMCR under rated steam conditions at turbine inlet & design condenser vacuum and cooling water temperature of 33 deg C with zero make up. (Refer Note-1 for estimation of overall Heat Rate)	As per Volume-I.
3.01.03	Guaranteed Total Auxiliary Power Consumption	Total Auxiliary power consumption (kW) of the plant on the basis of measured output at Generator terminals minus sent out power measured downstream of Generator Transformer and station transformer at 100% TMCR with rated steam conditions and design condenser vacuum with zero make-up and with 34°C ambient air temperature and 65% RH (Refer Note 2, 3 & 4 for the basis of computation of Auxiliary power)	As per Volume-I.



Sl. No.	Plant/ System	Parameter for Performance Guarantee	Liquidated Damages
3.02.00	System		
3.02.01	Guaranteed DM Water Consumption	Continuous consumption of DM water in m <sup>3</sup> /hr.	As per Volume-I.

**Note :**

1. For items 3.01.02, Overall Heat Rate shall be estimated as follows :

$$a) \quad \text{Overall Heat Rate} = \frac{\text{Turbine Cycle Heat Rate}}{\text{Boiler Efficiency}}$$

For estimation of turbine cycle heat rate, refer Cl. No. 4.01.00 in Vol-II-C-Sec.01.

$$b) \quad \text{Guaranteed Overall Heat rate} = \frac{\text{HR at 80\% TMCR x 1955 hrs} + \text{HR at 100\% TMCR x 6320 hrs}}{(1955 + 6320)}$$

2. For computation of Auxiliary Power, output measured at Generator terminals minus sent out power measured downstream of Generator Transformer, applicable Losses (No load loss + Load loss+ auxiliary loss for coolers) for Station Transformers, Unit Transformers and Bus duct losses shall be considered.

3. For intermittent running auxiliaries i.e., AC & Ventilation system, and outdoor area illumination, a duty factor of 0.5 shall be considered.

4. For computation of auxiliary power consumption of Ash Handling Plant, Bidder to follow the methodology as below :

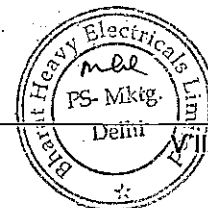
- Duty factor for Lean Slurry Bottom Ash System shall be considered as 0.3.
- Duty factor for Dry Fly Ash System shall be considered as 0.6.
- Duty factor for HCSD & Ash Water Recovery System shall be considered as 1.0.

5. For auxiliary power consumption of coal handling plant following shall be considered :

- Total power consumption of all conveyor drives and other equipments shall be at the guaranteed design capacity of 1400 MTPH with flow path from Wagon Tippler to Boiler Bunker.

Single Stream Operation.

Duty Factor = 0.5.



6. Power consumption for Fire Pumps, Sump Pumps and Fuel oil transfer system drives, Elevators, EOT Cranes shall not be considered in the Auxiliary Power consumption estimate.
7. Heat Rate of TG Cycle : Maximum 1850 Kcal/Kwh with Steam Turbine driven BFP.
8. Steam Generator Efficiency : More than 87%
9. Auxiliary Power Consumption shall be limited to 6% with Steam Turbine driven BFP.
10. Bidder has to furnish the expected availability of plant & plant reliability.

4.00.00 **SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES FOR VARIOUS EQUIPMENT WHICH INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING [CATEGORY-B]:**

4.01.00 **Steam Generator**

4.01.01 Capacity in T/hr of steam at rated steam parameters at superheater outlet (with any combination of mills working as per Owner's discretion) and the coal being fired within range specified, corresponding to 100% BMCR at 1% make up, 33 deg.C CW temperature and auxiliary steam consumption.

Bidder shall consider necessary provision for demonstration of steam generation at 100% BMCR condition.

4.01.02 Efficiency in percentage at 100% & 80% TMCR and 34 deg. C ambient air temperature and 65% RH with zero make-up, design condenser vacuum while firing the design coal at rated steam parameters at Superheater and Reheater outlet and rated excess air and with any combination of mills working as per Owner's discretion.

4.01.03 Air heater air-in-leakage after 3000 hrs. of operation from taking over date. To be demonstrated.

4.01.04 NOx emission.

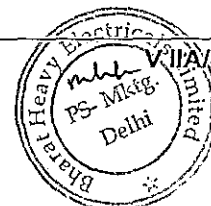
NOx emission from the unit – shall not be more than 365 ppm or 750 mg/Nm<sup>3</sup> (equivalent NO<sub>2</sub>) at the ESP outlet at 6% excess oxygen.

4.01.05 Mill capacity at rated fineness.

4.01.06 Gas tightness efficiency of Guillotine dampers.

4.01.07 Bidder to demonstrate the steam parameters at 30% load without HFO/LDO support (only coal firing). No fuel oil support shall be required at 30% of BMCR and above.

4.01.08 Performance characteristics of pumps, fans, etc. viz; capacity, head developed etc.



- 4.01.09 Capabilities of all drives.
- 4.01.10 Margins on fans. Through operation of single fan at a time.
- 4.01.11 Equal load sharing of pumps/fans while running in parallel shall be demonstrated.
- 4.01.12 Run back capabilities.
- 4.01.13 Ramp/sudden load change withstand capability. Sudden load throw off typically 25%, 50%, 75% and 100% shall be demonstrated.
- 4.01.14 Life of mill wear parts
- 4.01.15 Steam Temperature Imbalance

The Bidder shall guarantee and demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10 Deg.C.

- 4.01.16 SH/RH Attemperation System

The Bidder shall guarantee and demonstrate that the spray water flow to SH attemperation system does not exceed the value considered for design (to be indicated in the bid) while maintaining the rated SH outlet steam temperature at BMCR. The Bidder shall also guarantee and demonstrate that the RH temperature is maintained at the rated value without any spray water requirement, for the secondary attemperation system, at all loads for which the specified RH steam temperature is required to be maintained at the rated value.

- 4.02.00 Electrostatic Precipitator

- 4.02.01 Pressure drop across the electrostatic precipitator.

- 4.02.02 Collection efficiency and outlet dust concentration shall be as per cl. no. 3.01.00 of Section-II in Volume-II-B.

- 4.03.00 Turbine Generator

- 4.03.01 Turbine Generator-Set Capability

The steam turbine generator unit shall be capable of delivering continuously at generator terminals the output as indicated by the Bidder in the following heat balances detailed out elsewhere with equipment specification submitted alongwith the bid.

- a) Output corresponding to top HP heaters out of operation (for 1x100% HP heater configuration).
- b) Output corresponding to one string of HP heater out of operation (for 2x50% HP heaters configuration).
- c) Output corresponding to all HP heaters out of operation.

- d) Output corresponding to VVO rating, at rated steam conditions with condenser CW temperature 33°C & design condenser vacuum with zero make-up.
- e) Output corresponding to overpressure operation of the boiler-turbine-generator set, at rated main steam and hot reheat steam temperature with condenser CW temperature corresponding to design Condenser vacuum with zero make-up.

4.03.02 Operating Frequency Range

As per the stipulations of Cl. No. 7.06.00 Vol. II-C, Section-I.

4.03.03 Constant Pressure and Sliding Pressure Operation

The constant pressure operation and sliding pressure operation from 30% turbine MCR to VVO condition of the unit in conjunction with the steam generator, HP-LP bypass system and instrumentation & control system shall be demonstrated.

In sliding pressure mode of operation, during quick load increase the idle control valve (s) must respond rapidly to pick up 20% of operating load, so that immediate increase of boiler pressure is not required. The load response capability shall be demonstrated in steps of 5 %.

Change-over from constant pressure mode to sliding pressure mode and vice-versa shall also be demonstrated.

4.03.04 Start-up, Loading, Unloading and Shutdown Capabilities

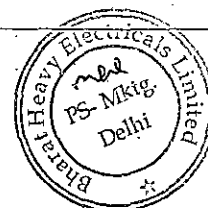
Start-up, loading, unloading and shutdown characteristics and startup time and loading capabilities for the steam turbine generator and steam generator both operating as a unit for cold start conditions (greater than 36 hours shutdown), warm start conditions (between 8 and 36 hours shutdown) and hot start conditions (less than 8 hours shutdown) under constant pressure and variable pressure mode and suitability for cyclic operation as indicated by the Bidder in the offer and accepted by the Owner shall be demonstrated ensuring the parameters of vibration, differential expansion, etc.

4.03.05 Vacuum Pulling time

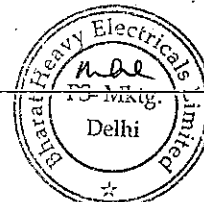
Vacuum pulling time from condenser at atmospheric pressure to rated vacuum compatible to start Steam Turbine

4.03.06 Sudden Total Loss of External Load

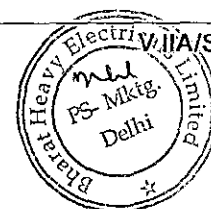
On occasions, the steam turbine generator system may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip on overspeed but shall continue in operation under the control of its speed governor to supply power for the plant auxiliary load station transformers, while staying within the prescribed permissible limits of steam metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity acceptable to the Owner.



- 4.03.07 Capacity with Reduced Hydrogen Pressure  
Generator shall be capable of operating at reduced capacity at reduced generator hydrogen pressure in accordance with values furnished by the Bidder in his proposal and accepted by the Owner.
- 4.03.08 HP/LP Bypass Capabilities
- i. HP/LP bypass capacity and capabilities under various modes of operation shall be demonstrated.
  - ii. Condenser performance with HPLP Bypass operating at rated conditions.
- 4.03.09 Lube Oil Purification System - Capacity and Purity  
Lube oil purification system capacity and the purity of purified oil at the outlet of the centrifuge and the outlet of the polishing filter, shall be demonstrated. If purity check is not possible at site, this shall be carried out at Vendor's works.
- 4.03.10 Extraction and CRH NRVs  
Operation of the valves under turbine trip and high water level in the heaters, shall be demonstrated.
- 4.03.11 The performance of the condenser, i.e., the back pressure achieved at design CW flow and inlet temp. and cleanliness factors, VWO heat load shall be demonstrated.
- 4.03.12 Temp. of condensate at outlet of condenser shall not be less than saturation temp. corresponding to the condenser pressure at all loads.
- 4.03.13 Oxygen content in condensate at hot-well outlet shall not exceed 0.015 cc/litre over the entire load range and shall be determined according to an internationally approved codes/standard.
- 4.03.14 When one half of the condenser is isolated, condenser capability shall be demonstrated to take at least 60% T.G. load under TMCR conditions.
- 4.04.00 Deaerator
- 4.04.01 The dissolved oxygen content in feed-water measured at deaerator outlet shall not exceed 0.005 cc/litre at all loads from no load to VWO condition with 1% cycle make-up with normal pressure and overpressure with incoming condensate presumed to be saturated with oxygen (without any chemical dosing).
- 4.04.02 Free carbon dioxide in deaerator effluent shall be non-traceable at all loads from zero to VWO with 1% cycle make-up with normal pressure according to ASTM standards.



- 4.05.00 **Power Cycle Pumps**  
Performance of each pump (flow, head, vibration, noise, parallel operation) to be demonstrated.
- 4.06.00 **Automatic On Line Turbine Testing (ATT) System**  
Demonstrated without disturbing normal operation.
- 4.07.00 **Coal Handling Plant**  
Refer Cl. No. 11.00.00 in Volume-II-K/1.
- 4.08.00 **Condensate Polishing Unit**  
Bidder shall ensure that condensate temperature for CPU shall not go beyond 50°C during normal steady state operation.
- 4.09.00 **DM Plant**  
Performance Gurantee of DM plant shall be in accordance with Cl. No. 8.04.00 in Section-1, Volume-II-K/3.
- 4.10.00 **Instrumentation and Control**  
The Bidder shall demonstrate that the Instrumentation and Control system meets all the functional/performance requirements, specified in technical specifications.
- 4.11.00 **Noise Level**  
The Bidder shall demonstrate Noise Level of various plants/equipments/ systems as per Clause no. 17.02.00 in Section-IV of Volume-II-A.
- 5.00.00 **PERFORMANCE/ACCEPTANCE TESTS PROCEDURES**
- 5.01.00 **Steam Generator**  
The performance tests shall be conducted in accordance with the latest version of ANSI PTC 4.0 except for the specific requirements brought out herein below. This test may be done simultaneously or immediately after P-G test of Turbine Generator set. During this test, Boiler unit shall be fully on automatic control under steady load condition.
- 5.01.01 The efficiency tests shall be carried out with the steam generator operating at the guaranteed point condition i.e. corresponding to 100%, 80% Turbine rated loads, or at the agreed loads as near these as possible, with the boiler operating at the rated excess air, rated SH/RH attemperation flows, flue gas temperature, coal fineness, etc. corresponding to the loads on boiler. At control load, the stable and efficient operation of the unit with the rated excess air, rated mill outlet coal fineness, while achieving the rated S/H, R/H steam parameters shall be demonstrated by the Contractor to the satisfaction of the Owner.



- 5.01.02 For finding out the performance values, two sets of consistent reading shall be taken and the average of the above values shall be considered for the guarantee purpose.
- 5.01.03 Corrections shall be applied to the tested efficiency, to correct it to the design conditions, for variations in the following parameters only :
- a) Feed water temperature at economiser inlet.
  - b) Ambient air temperature
  - c) Relative humidity of ambient air.
  - d) Hydrogen in coal.
  - e) Moisture in coal.
  - f) Gross calorific value of coal.

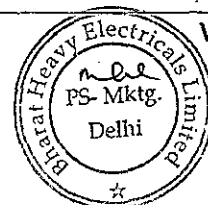
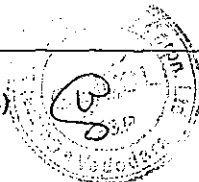
The Bidder shall furnish correction curves, for Owner's approval, covering the expected ranges of variations for all these parameters for the range of coals specified.

- 5.01.04 In all other aspects, not spelt out above, or in specifications, where ANSI code stipulates agreement between the parties concerned before the test, Bidder shall get these approved by the Owner.
- 5.01.05 No negative tolerance on account of instrument in-accuracies or otherwise shall be allowed on the guaranteed values.
- 5.01.06 Performance tests shall also be conducted to prove the steam generating capacity of the steam generator at rated parameters at stipulated loads.
- 5.01.07 Necessary write ups, schemes, instrument schedules, detailed procedures clearly indicating periods of tests, frequency of observations, etc. shall be prepared and submitted for all the tests for Owner's review and shall be got specifically approved from the Owner within one year of L.O.A. issue.

5.02.00 **Mill Performance Warranty**

- 5.02.01 Performance testing shall be done on the mill towards establishing its capacity specified at the specified fineness applying corrections for the variations in coal characteristics i.e. HGI, moisture, etc.

- 5.02.02 The Bidder shall guarantee a capacity output not less than the offered value, at each mill outlet, with coal fineness of not less than 70% through 200 mesh and not less than 98% through 50 mesh screen, when grinding coal having specified grindability index, total moisture content including surface moisture, etc. Bidder shall guarantee that the above capacity will be maintained and demonstrated with the originally installed grinding elements in nearly wornout condition as mutually agreed for the purpose of ascertaining wear life of any of the wear parts or when pulveriser grinding elements have successfully completed the specified guaranteed hours of operation as mentioned by the



Bidder, whichever is earlier. During the above mentioned operating period of the mill, manufacturer's operation instructions will be followed and mill will be operated with the specified range of coal without any such readjustment that requires a shutdown of the mill or reduction of the load and/or any replacement of any mill wear parts.

For the purpose of testing to demonstrate the capacity, if grindability and surface moisture vary from those given above, the pulveriser measured capacity shall be corrected using the capacity correction curves furnished by the Bidder alongwith the offer. HGI vs grindability factor curve shall be furnished for HGI variations upto a value above which the capacity remains constant.

Capacity guarantee shall be conducted on all the mills. However, should the results of test as conducted above indicate that deficiency in capacity guarantee is observed in case of one or two mills only and that Owner is further, convinced that such deficiency does not occur out of reasons attributable to mill manufacture and supplier, Owner may waive off the requirement of demonstration of capacity guarantee for such mills only.

5.02.03

Mill Wear part life guarantee

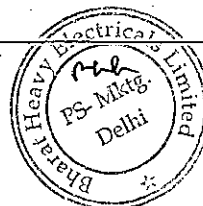
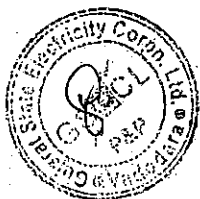
The Bidder shall guarantee the wear life of all wear parts of the mill when grinding the specified range of coals. For this purpose the wear parts shall be defined as those parts of the mill which are in contact with coal or coal dust and are likely to wear out during the operation of the mill (except for the grinding media balls). The guarantee shall be demonstrated on each mill after establishing successful operation of the mill continuously for a period of not less than 24 hours at or near its guaranteed rated capacity. The establishment of the guarantee will be based on actual total hours of operation of the mill regardless of the specified range of coal or fuel loading. The mill wear parts shall be considered to have passed their guaranteed operating life when they have demonstrated their capability to meet the full load rated capacity of the mill at the rated power consumption at the end of the guarantee trial period. In case any of the wear parts has worn out to such an extent that either the normal and safe operation of the mill is jeopardised if it is not replaced/repaired or its continued use may lead to exposure or wear of other parts which are not meant for the purpose, that part shall be deemed to have completed its life for the purposes of checking the short fall in wear life even if there is no reduction in mill rated capacity and rated power consumption shall be as quoted by the Bidder when grinding the coal having parameters specified in Vol-II-A, Section-IX and achieving the grind fineness of not less than 70% through 200 mesh and 98% through 50 mesh.

5.03.00

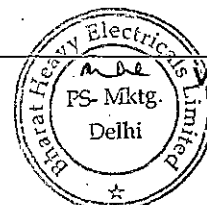
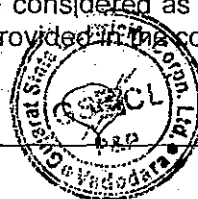
Electrostatic Precipitator

5.03.01

The performance test on electrostatic precipitator will commence after completion of reliability run along with the testing of Boiler and Turbine. During the interval between the commencement of trial operation and the commencement of performance test only routine maintenance shall be carried out. No physical or chemical cleaning of ESP shall be permitted during this period or immediately before the conductance of the performing tests.



- 5.03.02 The test efficiency shall be based on the overall performance of the electrostatic precipitator over a mutually agreed period of operation under the conditions given in this specification and following the normal operation of the unit including rapping and normal soot blowing and/or warm up guns. Outlet dust concentration of ESP shall be as specified in relevant section under Steam Generator subject to applicable modification adopted by Environmental Department, Government of India, at the time of project execution.
- 5.03.03 The performance tests shall be carried out in accordance with Method-17 of EPA (Environmental Protection Agency of USA) code. The details of the tests shall, however be mutually agreed upon between the OWNER and the CONTRACTOR.
- 5.03.04 All calibration procedures and standards shall be subjected to the approval of the Owner. The protecting tubes, pressure connections and other test connections required for conducting guarantee test and maintenance testing shall conform to the relevant codes. The Bidder shall fully elaborate, in his proposal, the provisions made to this effect. Method of measurement for all air leakage test and power consumption test proposed by the Bidder shall be clearly indicated in his offer, and shall be subject to Owner's approval.
- 5.04.00 **Turbine Generator**
- 5.04.01 The performance test for the turbine generator set shall be conducted in accordance with the latest edition of ASME-PTC-6 - full scale test method.
- The test results shall be considered as calculated from test observations with only corrections as are provided in the Code PTC-6.
- The guaranteed parameters shall be without any tolerance or allowance values. Uncertainty analysis shall not be used to adjust test results.
- For determination of primary flow to the turbine, low beta ratio throat tap nozzle assembly including required machined straight length meeting the requirements of ASME-PTC-6 shall be provided.
- 5.04.02 The performance tests shall be carried out to determine compliance with the following heat balance conditions :
- a) 100% TMCR condition under rated steam parameters at condenser CW temperature 33°C and design condenser vacuum with zero make-up.
  - b) 80% TMCR condition under rated steam parameters, at condenser CW temperature 33°C and design condenser vacuum with zero make-up.
- 5.04.03 The test heat rate under the above load conditions shall be computed as per relevant clause of T.G. Specification.
- The performance test shall be carried out with Turbine driven BFPs in service. To account for the conditions during the conductance of the test which do not correspond to the specified conditions, necessary corrections shall be applied.
- 5.04.04 The test results shall be considered as calculated from test observations with only corrections as are provided in the code ASME PTC-6.



The guaranteed parameters shall be without any tolerance or allowance values. Uncertainty analysis shall not be used to adjust test results.

5.04.05 The tests shall be arranged in a manner such that the Owner's operation is not disrupted. Duplicate test run will be performed at the 100% and 80% unit loads. The test results of corrected heat rate of the duplicate test runs shall agree within 0.25%. If they differ by more than 0.25% a third test shall be run at the same test points. Corrected results of anyone of the three test runs which deviates from the corrected average heat rate of all the runs by more than 0.25%, shall be eliminated, otherwise the results of the test with the highest heat rate figure will be considered.

The test for TG test capacity shall be carried out alongwith the heat rate test. Instrumentation and other details shall comply as above.

5.04.06 Condenser

Performance test for the condenser shall be conducted in accordance with the latest edition of ASME PTC-12.2. The condenser pressure shall be measured at 300 mm above the top row of tubes under VWO condition, zero make-up and design CW flow and CW inlet temperature corresponding to guranteed vacuum. The cleanliness factor shall be determined in accordance with the latest edition of ASME PTC-12.2.

5.04.07 Feed Water Heaters and Drain Cooler

Performance test for feed water heaters shall be conducted in accordance with the latest edition of ASME PTC-12.1.

5.04.08 Deaerator

Performance test for deaerator shall be conducted in accordance with the latest edition of ASME PTC-12.3.

The dissolved oxygen content in feed water at outlet of deaerator shall be determined by ASME-D 888. Reference Method A and any recognised modification thereof.

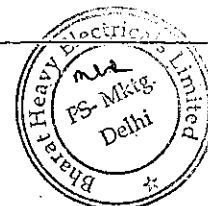
Free carbondioxide content of deaerator effluent shall be measured by APHA method.

5.05.00 Statutory Requirements

All parameters of plant, equipment & facilities which are under jurisdiction of Statutory Authorities, like MOEF, GPCB etc., shall be guaranteed. Conformance to the performance parameters under statutory requirement is mandatory.

5.06.00 Remaining Plant and Equipment

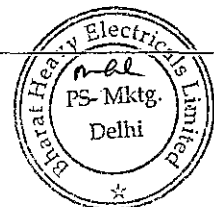
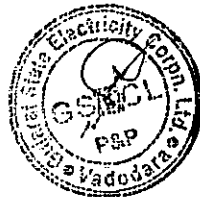
For other equipment, plants and systems, the performance test shall be carried out as per the respective equipment specification and the applicable codes.



VOLUME : IIA

SECTION-VIII

REQUIREMENTS OF SPARES, TOOLS & TACKLE,  
LUBRICANTS/OIL/CONSUMABLES



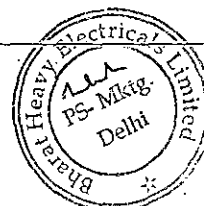
CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	TOOLS AND TACKLE
2.00.00	SPARES
	ANNEXURES
NNEXURE-I	MANDATORY SPARE LIST

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MUKESH K.A. SINGH



DEVELOPMENT CONSULTANTS  
(K9213R-EPC-SPC-001-Vol-IIA-Sec-8.doc)



VOLUME : IIA

SECTION-VIII

REQUIREMENTS OF SPARES, TOOLS & TACKLE,  
LUBRICANTS/OIL/CONSUMABLES

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackles required for the erection, assembly, dis-assembly & maintenance of the equipment. These special tools will also include special material handing equipment, jigs & fixtures for maintenance and calibration/ re-adjustment, checking & measurement aids etc. A list of such tools & tackles shall be submitted by the Bidder along with the offer. Detailed description of each tool/tackles, its function along with the equipment/part for which it is meant for and the price of each tool/tackles shall also be indicated in the offer. These tools & tackles shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

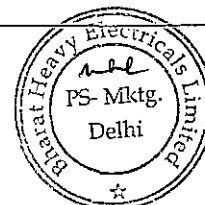
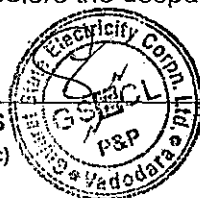
The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with dessicator packs as necessary.

2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be despatched before the despatch of the associated main equipment.



2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30 years after commissioning of the plant.

2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is later. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.

2.02.00 **Recommended Spares**

02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalised after mutual discussion.

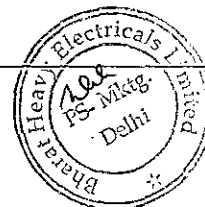
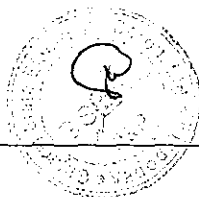
03.00 **Start-up Commissioning Spares**

03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.

03.02 The Contractor shall submit a complete list of all such start-up spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.

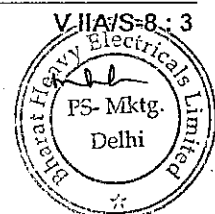
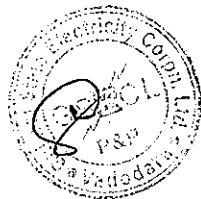
04.00 **Mandatory Spare Parts**

2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.



Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

- 2.04.02 Since the components involved can not be foreseen at the bidding stage, only broad requirements of the Owner in this respect are outlined hereinafter. The Bidder shall include in his proposal, on the basis of these guidelines, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.
- 2.04.03 The mandatory spares should be supplied to the Owner at least one month before the trial run. The despatch programme is subject to approval of the Owner/Consultant after award of contract.
- 2.02.04 Criteria for selection of Quantity of Mandatory Spares :  
For Mandatory Spares refer Annexure-I.
- 2.04.05 Purchaser will have the option to procure any or all of the mandatory spares at his discretion.





**1x800 MW WANAKBORI STPP  
AIR CONDITIONING SYSTEM  
TECHNICAL SPECIFICATION  
(ELECTRICAL PORTION)**

**SPECIFICATION No: PE-TS-408-553-A001**

**VOLUME: II B**

**SECTION : C-3**

**REV. 00**

**SECTION: C-3  
TECHNICAL SPECIFICATION (ELECTRICAL PORTION)**

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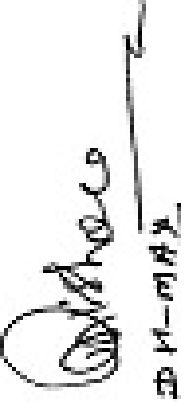
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MUKESH K. SINGH

GUJRAT STATE ELECTRICITY  
CORPORATION LTD.  
1 X 800 MW WANAKBORI TPS

AIR CONDITIONING SYSTEM

TECHNICAL SPECIFICATION  
(ELECTRICAL PORTION)

  
D. M. M. A.

  
S. A. KHAN

  
MUKESH K. SINGH



TITLE :  
**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
VENNtilATION SYSTEM  
WANAKBORI TPS (1X800MW)**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION : **C**

REV NO. : **00** DATE : 23.10.2015

SHEET : 1 OF 3

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D	ELECTRICAL LOAD DATA FORMAT	1
D	CABLE LISTING FORMAT	3

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MUKESH K. SINGH



TITLE :  
**ELECTRICAL EQUIPMENT SPECIFICATION  
FOR  
VENNTILATION SYSTEM  
WANAKBORI TPS (1X800MW)**

SPECIFICATION NO.  
VOLUME NO. : **II-B**  
SECTION : **C**  
REV NO. : **00** DATE : 23.10.2015  
SHEET : 2 OF 3

**1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for Condensate Poilishing Unit
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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

Refer “Electrical Scope between BHEL and Vendor”.

**3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

**3.0 List of enclosures:**

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

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REV: 0 DATE: 23.10.15

**ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**  
**PACKAGE: AIR CONDITIONING SYSTEM**

PROJECT: 1 x 800 MW WANAKBORI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 4 Wire) /240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling ( max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.

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REV: 0 DATE: 23.10.15

**ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**  
**PACKAGE: AIR CONDITIONING SYSTEM**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable (excluding power cables) in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

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

  
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VOLUME : IIF/1

SECTION-II

TECHNICAL SPECIFICATION  
FOR  
A.C. & D.C. MOTORS

## CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS
<b>ATTACHMENT</b>	
ANNEXURE-A	DESIGN DATA

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VOLUME : IIF/1

SECTION-II

TECHNICAL SPECIFICATION  
FOR  
A.C. & D.C. MOTORS

- 1.00.00 **SCOPE**
- 1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.
- 2.00.00 **STANDARDS**
- 2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed :
- IS-325
- IS-12615
- IEC-34
- 3.00.00 **SERVICE CONDITIONS**
- 3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

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4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 All HT & LT motors shall be energy efficient type.

4.01.06 The motor name plate rating shall have at least 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point.

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all HT auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No

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further tolerances are applicable on starting current specified above for HT motors. For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall be 80% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 80% rated voltage at motor terminals.
- 5.02.03
- a) Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.
  - b) Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.
  - c) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 HT pump motors shall be suitable to start with forward rotation.
- 5.02.05 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 Motors for circulating water pumps of large output ratings, located indoor and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.03 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.02.02 For large capacity motors, closed air circuit water cooled (CACW) may be considered for acceptance.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.05.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

*Signature*  
S.A. KHAN  
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