PUNJAB STATE POWER CORPORATION LIMITED
Regd. Office: PSEB Head Office, The Mall Patiala-147001
Office of the: Chief Engineer
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Corporate Identity No:U40109PB2010SGC033813 Website: www.pspcl.in

Global Expression of Interest

FOR

Disposal of Unit- I & II, Guru Gobind Singh Super Thermal Plant (GGSSTP) Ropar, Punjab

Chief Engineer
GGSSTP, P.O Ghanauli, Rupnagar-140113(Punjab),
Ph-01881-274238, Fax No.01881-274232
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Global Expression of Interest (EOI)

1) Background

Guru Gobind Singh Super Thermal Power Plant(GGSSTP) , Rupnagar (Punjab) is a unit of Punjab State Power Corporation Ltd (PSPCL) and is situated near village Ghanauli on Chandigarh-Manali highway.The power plant is one of the coal based power plants of PSPCL having an installed capacity of 1260 MW i.e. six units of 210 MW each. The unit I & II were commissioned during the year 1984 and 1985 respectively and another 4 units were subsequently added.

2) Introduction

Major Equipments in Unit I and II were replaced /upgraded / renovated in last decade under need based R&M schemes. Due to changed power scenario in Punjab with addition of supercritical thermal units, GGSSTP units has run less as compared to their capacity in recent years. Accordingly, on the basis of CEA guidelines and as per Govt of Punjab notification dated 21-12-2017 , ,PSPCL has decided to permanently shut down its two units (unit-1 to 2) at GGSSTP,Ropar . However ,both units are technically fit for power generation.

3) EXPRESSION OF INTEREST (EOI)

PSPCL invites Expression of Interest (EOI) to identify the interested parties (both Indian and international) for means & modes for disposal of 2 units of stage –I as under :

i **Parties who are interested to dismantle the plant and install it at some other place of their interest for future generation**

ii **Parties interested in acquiring individual equipments as per their requirements.**

4) BRIEF DESCRIPTION OF THE UNITS IS AS UNDER.

Description	Unit 1	Unit II
Capacity	210 MW	210 MW
Year of Commisioning	1984	1985
Boiler	Drum and internals, furnace wall system, Superheater:-, Reheater , Economizer, circulation system: firing equipment & wind box	Drum and internals, furnace wall system, Superheater:-, Reheater , Economizer, circulation system: firing equipment & wind box
Turbine	BHEL Make , Reheat , condensing reaction ,Three cylinder , Three shaft,	BHEL Make , Reheat , condensing reaction , Three cylinder , Three shaft,
Coal mills	Pressurized type(BHEL Make). Type : XRP/803	Pressurized type(BHEL Make). Type : XRP/803 f
Generator	Type THW-210-2 Hydrogen Cooled, BHEL make 247 MVA, 15.75 kV, 9050 A at 0.85 lag, 50 Hz, 3 phase, double star two pole generators.	Type THW-210-2 Hydrogen Cooled, BHEL make 247 MVA, 15.75 kV, 9050 A at 0.85 lag, 50 Hz, 3 phase, double star two pole generators
Control System	DCS System : microprocessor based ABB makes Symphony System	DCS System : microprocessor based ABB makes Symphony System

Please refer Annexure-1 for detailed performance parameters of GGSSTP unit-I to II .
Please refer Annexure-2 for detailed Technical specification of Unit-I & II.
This EOI and its Annexure can be downloaded from our https://www.pspcl.in/tenders/Expression-of-interest

5) GENERAL TERMS & CONDITIONS

I) If required, interested parties may visit the site on any working day with prior approval of PSPCL. Interested parties are requested to submit their detailed proposal in response to this EOI.

II) Proposal must carry at least following information;

i) Nature of Business, Details of Business Entity/Group

ii) Operational and Financial Details of Business Entity/Group

iii) Previous experience of similar nature of job, if any

iv) Proposed method of utilization of these units by dismantling these units and install it at some ther place.

v) Assumptions made in the above proposal

vi) Expected time line for carrying out the complete activity

vii) Intended purpose/use of the purchase of these units

ix)Critical/Vital issues which needs to be addressed by PSPCL before awarding the contract.

x) Details about the authorized personnel to communicate for this proposal

xi) List of the documents attached with proposal

Each page of the document submitted shall be duly authenticated by the applicant. The language of submission of application shall be in English.

III) All Expression of Interest documents, upon submission by any applicant to this EOI shall become the property of PSPCL. PSPCL is not liable for any cost or compensation in relation to the consideration of this EOI.

IV) All information contained in this, Expression of Interest (EOI) subsequently provided / clarified are in good interest and faith. This is not an agreement and is not an offer or invitation to enter into an agreement of any kind with any party.

V) Interested parties should conduct its own investigation and analysis & should check the accuracy, reliability and completeness of the information in this Expression of Interest. Applicants should make their own independent investigation in relation to any additional information that may be required. PSPCL may invite bidders conference on suitable date if required.

VI) Based on the response to this EOI, PSPCL may float NIT for Request for Proposal (RfP) to shortlist the eligible parties, which can participate for Request for Quotation (RfQ). However, PSPCL may, at its absolute discretion either modify or abandon any part or whole of the document and /or process, without giving prior notice to any or all the applicant.

VII) EOI shall be submitted in hard copy at the address given below. EOI received through Fax/E-mail etc. shall not be accepted.

VIII) PSPCL will not be responsible for any cost or expenses incurred by the bidder in connection with preparation or delivery of EOI.

6) PSPCL reserves the right to call the bidder for presentation and may visit the sites of the bidder. The bidder shall have no objection whatsoever in this regard and shall facilitate PSPCL to obtain the same.

7) PSPCL shall not be responsible for any cost or expenses incurred by the bidder for visiting its office for presentation.

8) SUBMISSION OF EOI

Interested parties may furnish their "Expression of Interest" with all the necessary details & documents in hard as well in soft form (CD) in a sealed cover envelope super-scribing : **EOI: Disposal of Unit- I & II, Guru Gobind Singh Super Thermal Plant (GGSSTP) Ropar, Punjab** along with the covering letter duly signed by an authorized representative by 15:00 Hrs dated _____in the office of;

Dy Chief Engineer
Mechanical Mtc Circle –I
GGSSTP ,PO Ghaunali 140113
Punjab , India
Email : se-mm1-ggsstp@pspcl.in

9) In case of any clarification regarding EOI, following is the contact person:
Er Ravi Kumar Wadhwa Dy CE/Mech Mtc Circle-I Mob: 96461-07236
Email: se-mm1-ggsstp@pspcl.in:

Annexure-1

Detailed performance parameters of unit-I to II (YEARLY DATA FROM 2011 TO UPTO DEC 2018)

Year	Unit	GEN MUs	PLF %	AUX MUs	SP.COAL Kg./ Kwh	SP.OIL ml/ Kwh	HEAT RATE (Kcal/ Kwh)	THERMAL EFFICENCY %
2011-12	**1**	1597.82	86.61	807.46	0.65	0.46	2563.75	33.54
	2	1572.33	85.23					
2012-13	**1**	1288.20	70.03	767.23	0.63	0.47	2537.77	33.89
	2	1679.79	91.31					
2013-14	**1**	1228.19	66.76	675.68	0.63	1.24	2575.31	33.39
	2	1264.29	68.73					
2014-15	**1**	938.65	51.02	490.71	0.71	0.93	2681.64	32.07
	2	918.66	49.94					
2015-16	**1**	696.45	37.76	358.30	0.69	1.11	2847.16	30.21
	2	885.06	47.98					
2016-17	**1**	404.01	21.96	268.21	0.67	1.49	2801.90	30.69
	2	400.62	21.78					
2017-18 Upto Dec-18	**1**	144.09	10.40	206.05	0.65	1.77	2684.44	32.04
	2	272.96	19.69					

Annexure-2
Detailed Technical specification of Unit-I & II

1 TURBINE AREA
1.1 TG

1.	**KWU TURBINE & AUX**		
	1.1	NOMINAL RATING	210 MW
	1.2	TYPE	3-Cylinder Reheat condensing reaction turbine.
	1.3	HP TURBINE	Single flow turbine with 25-reaction Stages [BARREL TYPE]
	1.4	IP TURBINE	Double flow with 2x20 stages
	1.5	LP TURBIE	Double flow with 2x8 stages
	1.6	Number of Extractions	6
	1.7	Number of ESV's, IV's HPCV's,IPCV's,LPBP's	2 each
2	**BHEL GENERATOR**		
	2.1	TYPE	THW-210-2
	2.2	MAKE	BHEL
	2.3	HYDROGEN PRESSURE	3.5 kg/cm^2
	2.4	RATED SPEED	3000RPM
	2.5	RATED KVA	247000
3	**SEAL OIL SYSTEM**		
	3.1	TYPE OF SHAFT SEAL	RING TYPE
	3.2	SEAL OIL FLOW	38.5 Ltr. Per minute per seal
	3.3	RING RELIEF OIL PRESSURE	0.5 kg/cm^2 more than seal oil pressure
3	**CONDENSER**		
	4.1	TYPE	Surface type, single shell in two path with two independent CW inlet/ outlet.
	4.2	AREA	9655m^2 (stage-I),
	4.3	NUMBER OF TUBES	19208(stage I)
	4.4.	TUBE SIZE	25.4X1.245 mm
	4.5.	CW FLOW	24000 m^2/hr (stage I
4	**GLAND STEAM CONDENSER**		
	5.1	Max. flow	505.726 T/hr.
	5.2	No. of tubes	313
	5.3	Tube size	ϕ 19 X 1mm
	5.4	Tube material	Stainless Steel
	5.5	Shell OD	570 mm
	5.6	Overall length of shell	2.538 m
6	**DRAIN COOLER**		
	6.1	No.	One per unit
	6.2	Type	Surface type horizontally mounted
	6.3	Operating pressure (shell side)	0.18 kg/cm^2
		(tube side)	20.1 kg/cm^2
	6.4	Tube surface area	35 m^2
	6.5	Material of tubes	Admiralty brass
	6.6	No. of tubes	501 straight tubes

6.7	Tube size		ϕ 16 X 1mm		
7	**L.P. HEATERS**				
			LPH3	**LPH2**	**LPH1**
7.1	Nos. off		1	1	1
7.2	Type	Surface type vertically mounted, with tube bundles removable.			
7.3	Operating pressure				
	Shell side (kg/cm^2)		2.2545	0.8072	0.2050
	Tube side (kg/cm^2)		19.963	19.963	19.963
7.4	Tube surface area(M^2)		400	400	225
7.5	No. of water passes		4	4	4
7.6	Tube dia& thickness		ϕ 16 x 1	ϕ 16 x 1	ϕ 16 x 1
7.7	Material of tubes		Admirality brass	Admirality brass	Admirality brass
7.8	Overall length of heater (M)		6.5	6.5	6.5
7.9	Shell O.D. (mm)		1338	1338	1224
7.10	No.of tubes		1150	1150	930

8.	**HP HEATERS**	**HPH-5**	**HPH-6**	
8.1	OPERATING PRESSURE (SHELL) (kg/cm^2)	105.78		35.87
8.2	TUBE SIDE PRESSURE (kg/cm^2)	190		190
8.3.	STEAM TEMPRATURE (ºC)	432.4		336.9
8.4.	FEED WATER I/L TEMPRATURE (ºC)	163.2		196.9
8.5.	TUBE MATERIAL	Special quality mild steel		
8.6.	SHELL SIDE	Boiler quality mild steel		
8.7.	DRY WEIGHT OF HEATER	24 T	33.3 T	
8.8.	OPERATING WEIGHT	26 T	35.3 T	

9.	**DEAERATOR**	**One in each unit**
9.1	DEAERATOR SHELL SIDE ID	24000 mm
9.2	DEAERATOR OVERALL LENGTH	4900 mm
9.3	DESIGN TEMPRATURE	200 ºC
9.4	DESIGN PRESSURE	7.4 kg/cm^2

10.	**FEED WATER STORAGE TANK**	**One in each unit**
10.1	TYPE	Perforated
10.2	DESIGN PRESSURE	7.5 kg/cm^2
10.3	TANK ID	3500 mm
10.4	OVERALL LENGTH	13900 mm(stage I)
10.5	CAPACITY	90 m3 (Stage-I)

11.	**VENT CONDENSER**	**One in each unit**
11.1	TYPE	Surface external vent condenser
11.2	DESGIN PRESSURE SHELL	7.4 kg/cm^2
	TUBE	8.0 kg/cm^2
11.3	DESIGN TEMPRATURE SHELL	200 ºC
	TUBE	165 ºC
11.4	OVERALL LENGTH	5440mm
11.5	SHELL ID	1100 mm
11.6	SURFACE AREA	200 m^2

12.	**VALVES INVOLVED IN SYSTEM**	**Hand Operated, Gate valves, Globe valves, Safety valves, NRV's, Butterfly valves etc.**

SIZES OF VALVES:-

12.1	ABOVE 100MM SIZE	95 Nos./ unit (approximately)
12.2	100 MM & BELOW SIZE	410 Nos./ unit (approximately)

13. PIPE LINES

13.1	PIPE DIA	12 MM TO 1600 MM
	THICKNESS	2MM TO 56 MM
13.2.	MATERIAL	Steel, Carbon steel, Alloy steel Stainless Steel etc.
13.3	TEMPRATURE	Upto 545 ºC

14 GOVERING AND LPBP RACK

15 STATOR WATER SYSTEM OF GENERATOR

16 GLAND SEAL STEAM AND LEAK OFF VALES I NO EACH

17 CRH NRVs AND MS/HRH STRAINSERS 2 NO EACH

18 LUB OIL SYSTEM OF TUBEINE

MOT, COOLERS (2 NOS) AOP(2 NOS) EOP (I NO)
JOP AC(1NO), JOP DC(1 NO) OVE (2N0), GBEF (2 EACH)
CENTRIFUFE MAB 206 (1 NO)

19 HPBP SYSTEM – ARS 100 (2 NOS) ANS SPARY VALES ALONF WITH ACTUATORS

1.2 TG PUMPS

1. BOILER FEED PUMP STAGE – I — 06 No.

Type	200KHI Barrel Type
Make	B.H.E.L
Delivery Capacity	395 T/Hr.
Feed Water Temp.	163° C
Head Developed	2095 Meter
Speed	4500 Rpm

2. BOOSTER PUMP STAGE – I — 6No.

Type	FA1B56 WEIR
Make	B.H.E.L
Flow rate	489 m^3/Hr
Differential head	98.5 m^3/Hr
Speed	1485 Rpm

3. HYDRAULIC COUPLING STAGE – I — 06 No.

Type	R 17 K
Make	Voith
Oil tank capacity	850 Ltrs.

4. CONDENSATE EXTRACTION PUMP STAGE – I — 04 No.

Type	EN5J 40D-30A WEIR
Make	B.H.E.L
No. of stages	5
Rated output	625 T/Hr
Differential pressure	19.8 Kg/cm^2
Speed	1490 Rpm

5. CW PUMPS STAGE – I — 08 No.

Type	BHMA 77 single stage, self-water lubrication
Make	KIRLOSKAR BROS. LTD.
Motor (KW)	275
Capacity	8800 m^3/Hr

	Bowl head	7.2 meters	
	Speed (Full Load)	494 Rpm	
6.	BACW PUMP STAGE – I		06 No.
	Type	6 UP 4	
	Make	KIRLOSKAR	
	Flow	525 m^3/Hr	
	Discharge head	55 meters	
	Pump input (KW)	106.26	
7.	VACUUM PUMPS STAGE – I,		4 No.
	Type	AT 2004 E	
	Make	NASH	
	Stages	Two	
	Speed	495 Rpm	
8.	PRIMING PUMPS STAGE – I,		02 No.
	Type	CL 202	
	Make	NASH	
	Stage	One	
	Speed	1460 Rpm	
9.	SERVICE WATER PUMPS STAGE – I		02 No.
	Type	SV 42/25	
	Make	KIRLOSKAR	
	Capacity	650 m^3/Hr	
	Pump input (KW)	118.76	
10.	VERTICAL SUMP PUMP STAGE – I		2 No.
	Type	100 VCL	
	Make	MAX FLOW	
	Flow	100 T	
	Discharge head	20 m	
	Pump input (KW)	15	
11.	VERTICAL SUMP PUMPS STAGE – I		8 No.
	Type	65 VCL	
	Make	MAX FLOW	
	Flow	60 T	
	Discharge head	15 m	
	Pump input (KW)	4	
12.	HORIZONTAL SUMP PUMPS STAGE- I		08 No.
	Type	DB 32/16	
	Make	KIRLOSKAR	
	Flow	5 l/s	
	Head	35.6 m	
	Pump input (KW)	3.06	
	Size	32x50 mm	
	Speed	2900 rpm	
13.	PHOSPHATE DOZING PUMPS STAGE – I		04 No.
	Type	PR – 35	
	Make	V.K.PUMPS	
	Flow	65 L/Hr	
	Discharge head	200 Kg. /cm²	
	Pump input (KW)	1.5	
14	HYDRAZINE DOZING PUMP STAGE – I		03 No.
	Type	PR – 15	
	Make	V.K.PUMPS	

Flow	50 L/Hr	
Discharge head	50 kg/cm^2	
Pump input (KW)	0.55	
15 H_2 COOLER BOOSTER PUMP STAGE – I		04 No.
Type	10 UP 1M	
Make	KIRLOSKAR	
Total head	20 m	
Size	300X250 mm	
Rate of flow	145.84 L/S	
Speed	1470 Rpm	
Pump input (KW)	35.3	
16 TURBINE LUBE OIL COOLER BOOSTER PUMPS STAGE – I		04 No.
Type	10 UP 1M	
Make	KIRLOSKAR	
Total head	15 m	
Size	300X250 mm	
Rate of flow	173.6 L/S	
Speed	1470 Rpm	
Pump input (KW)	31.52	
17 APH WASH PUMPS STAGE – I		02 No.
Type	KPD 80/20	
Make	KIRLOSKAR	
Capacity	120 T/Hr	
Power input (KW)	37	
18 RAW WATER PUMPS STAGE – I		03 No.
Type	KPD 65/20	
Make	KIRLOSKAR	
Capacity	75 T/Hr	
Power input (KW)	18.5	
19. HOT WELL MAKEUP PUMP STAGE-I		04 No.
Type	KPD 50/16	
Make	KIRLOSKAR	
Capacity	60 T/H	
Speed	2900 RPM	
20. STATOR WATER PUMP		4 No.
Type	CPK-CM-50-200	
Make	KSB Pumps	
Capacity	39.6 T/H	
Head	35 m	
Speed	2900 RPM	
Input	9 KW	
21. BOILER FILL PUMPS STAGE-I		02 No.
Type	KPD 65/32	
Make	KIRLOSKAR	
Capacity	100 T/H	
Speed	2900 rpm	
22. SERVICE WATER BOOSTER PUMPS STAGE-I		01 No.
Type	KPD 40/16	
Make	KIRLOSKAR	
Capacity	20 T/Hr	
Total head	35M	
Speed	2850 rpm	

23. . PIPING AND VALVES

1.3 Mech Aux

I. D.M. PLANT STAGE-I

Capacity: Two Streams each 66.7 T/Hr (Average) 133.5T/Hr (Max.)

1. Pressure Vessels.

a) Contact Tank 2 Nos. Nos. (Each dia. 2.6 M, Height 2.8M) 73T/Hr (Average)
b) Strong acid cation 2 Nos. (Each dia.2.0M, Height 2.9M) 66.7T/Hr (Average) 133.5T/Hr (Max.)
c) Strong Base Anion 2 Nos. (Each dia. 2.4 M, Height 3.2M) 66.7T/Hr (Average) 133.5T/Hr (Max.)
d) Mixed Bed 2 Nos. (Each dia. 1.6M, Height 2.0M), 66.7 T/Hr (Average) 133.5T/Hr (Max.)

2. Atmospheric Tanks

a) Degasser water storage tank 2 Nos. (Each dia. 6.0M, Height 4.0M) Capacity
b) Degasser tower. 2 Nos. (Each dia 1.6 M, Height 3.5M)
c) Acid/Alkali/Phosphate /Alum / Polyelectrolyte/Lime preparation/ Measuring/Dilution tanks. 06 Nos.
d) Gate/Globe/diaphragm. Valves of Various sizes 100 Nos.(approx)
e) MSR/PVC.lines of various sizes. 300 Mtrs.(approx)

3. PUMPS

a. Degassed Water Pumps Qty: 1 no. Flow 75 m^3/hr Model: KPD 65/20 Head: 45 MWC
   Make: Kirloskar
   Model : KPD 65/20
b. DM transfer Pumps : Qty: 3 nos. Flow: 55 m^3/hr Model: CHP-3X2-7 Head: 24 MWC
   Make: Akay
c. Neutralise pit pumps : Qty: 2 nos. Flow: 150 m^3/hr Head: 15 MWC
d. Stator Water Pumps : Qty: 2 nos Flow: 20 m^3/hr Head: 50 MWC Make/Model: Sulzer 40-200
e. Alkali transfer pumps :Qty: 2 nos :Flow: 15 m^3/hr Head: 15 MWC Make: AntiCO

4. BLOWERS

a. Degasser air blower : Qty: 4 nos Flow: 2210 m^3/hr Head: 100 mmWC

II. INSTRUMENT AND SERVICE AIR COMPRESSORS, AIR DRIERS

No .of instrument air compressors. 6
No. of service air compressors. 3

a. Technical specifications of IAC & SAC

1.	Make.	K.G.Khosla Compressor Ltd.
2.	Type.	2HA 2QT Khosla Crepelle, Horizental Balanced opposed, Non-lubricated Air Compressor.
3.	Speed.	690 RPM.
4.	Application.	Air
5.	Free air delivery cap.	1054 m^3/hr.
6.	Pressure.	8.4 Kg./cm^2.
7.	Piston Action.	Double.
8.	No. of stages.	2 Nos.
9.	No. of cylinders.	2 Nos.
10.	No. of cylinder/stage.	1 No.
11.	Type of cylinder.	Horizontal.
12.	Cylinder lubrication.	(Non-lubricated).

13.	Cylinder Bore.	HP 1x210mm dia., HP 1x350mm dia.
14.	Efficiency.	Approx. (84%)
15.	Piston stroke.	150 mm.
16.	Power reqd.	140 HP

Alongwith accessories such as safety valves moisture traps, suction filters, inter and After coolers Air receivers, decompression system, isolating valves and lines of air and cooling water.

b. AIR DRIERS

STAGE-I

No. of driers.	2
Type.	Blow hot.
Model.	KEH 500
Cap.	14.16 m^3/min.
Pressure.	8 Kg./cm^2.
Dessicant	Silica gel 800 kg. Each along with mono blocks blower one no. each.

c. AIR RECEIVERS

Unit-I

Instrument air receivers	2 Nos.
Capacity	5 M^3
Max. Working pressure	8.1 Kg. /cm^2
Hydraulic test pressure	15.2 Kg. /cm^2

Unit-II

Instrument air receivers	2 Nos.
Service air receiver	2 Nos
Capacity.	5 M^3
Maximum working pressure.	8.1 Kg, /cm^2.
Hydraulic test pressure,	15.2 Kg, /cm^2

III. REFRIGERATION & AC SYSTEM

1. **Central AC Plants stage-I**
   a. **AC plant ESP unit 1 & 2** Capacity: 2 X 22 TR Number: 02 nos.
   Compressor Make: ACCEL Compressor model: SMC-6 X65
   No. of AHU: 2 each Location : ESP Panel rooms unit-1& unit 2
   b. **AC plant UCB stage-1** Capacity: 2 X 90 TR Compressor Make: ACCEL
   Compressor model: SMC-8X100 No. of AHU: 2 Location : 21 m PRDS floor
2. **AIR WASHER SYSTEM stage-I**
   No. of blowers: 04 nos (02 at each unit) Make: ACCO Type : LLD Capacity: 1,60,000 m^3/hr Rotation: clockwise
3. **Hydrogen Driers**
   Make: M/s. Jindal Electronics Nos.: 02 (01 at each unit) Model: JEL3TG40
   Type: Refrigerated type Flow rate: 40 m^3/hr Compressor: 1.5 TR, 3 ph
   Ref gas: R-22 Location: 10.5 mtr Turbine side
4. **AC Booster pumps**
   Make: Beacon Weir No. of pumps: 02 Model: 4L3 Location: 0 mtr turbine side
5. **Ductable split AC system, Excitation rooms unit 1 & 2**
   Rating: 6X7.5 TR Nos: 06 (03 at each unit) Compressor rating: 3.75 TR (12 nos)
   Make: LG Model: LBUH0750QC Refrigerant: R-22 Cooling Type: Air cooled
   Voltage/Frequency: 380-415 V/3 ph-50Hz

IV. DG SETS

Diesel Engine stage-I3 Nos Make. Kirloskar Cummins Type. VTA-1710.G

Capacity 614 HP at 1500 RPM

2 BOILER AREA :

2.1 RM CELL –1

1. **BOWL MILLS:STG-I**
   - 1.1 TYPE OF MILL : Pressurized type(supplied by BHEL).
   - 1.2 Size : XRP/803 for Stage-1.
   - 1.3 Capacity : 39.7 Tons/hr.
   - 1.4 No. of Mills/Boiler : 6
   - 1.5 Rating of drive motor : 980 RPM for Stage-1,
   - 1.6 Type of coupling : Geared coupling for Stage-1 Hi Torque Bibby resilient Coupling for Stage-1
2. **RAW COAL FEEDERS** : Gravimetric for unit no. 1 and Type-Volumetric rotary feeders (pressurized) for unit no. 2
   - 2.1 No. of feeder/Boiler: : Six, one for each mill
   - 2.2 Feeder capacity : 39.7 T/Hrs.
   - 2.3 Feeder Drive : Microprocessor based at unit 1, PIV gear in unit-2
3. **Mill Reject System** : In Stage –1 Unit-1 & 2 separate belt conveyor system has been provided for carrying reject coal from mill reject spout to reject stack for each unit.

   Stage-1 **:**

   No. of steel idlers : 345
   No. of intermediate Pulleys. : 10
   Return steel rollers : 36

   CONVEYOR-I DRIVE UNIT :

   Motor capacity (conveyor-I) 2.2 KW/3 H.P.
   R.P.M. : 1400
   Gear Box make : SFSM(ELECON)

   CONVEYOR –II DRIVE UNIT:

   Motor capacity : 2.2KW/3 HP
   R.P.M. : 1400
   Gear box make : A 337(RADICON)
   Gear box ratio : 50.1

4. **COAL PIPING:**

   4.1 Pulverized fuel piping, 4 nos. from each pulveriser to burner nozzle, fabricated from 12.5mm thick steel piping. The pipes are connected with Victaulic coupling to facilitate free expansion of furnace.

   4.2 For larger radius bends of pulverized piping, basalt /certain wear resistant material is used.

   4.3 The pulverized fuel piping is fitted with orifices for equalizing of velocity of all the 4 corners of furnace.

   4.4 Coal pipes are supported at many places by hangers etc.

2.2 RM Cell -2

1. **INDUCED DRAFT FAN:**

1.1	Type/Size of fan	:	Axial impulse fan AN 25e6
1.2	No.of fans/ Boiler	:	Three(3)
1.3	Air capacity handled	:	230m³/Sec.
1.4	Discharge Head	:	225mm WC.
1.5	Type of Control	:	Inlet guide vane control.
1.6	Type of coupling of Fan with motor.	:	Pin type flexible coupling.
1.7	Drive motor rating	:	1300 KW.
1.8	Speed of fan	:	990 RPM

2. **FORCED DRAFT FAN**

2.1 Type/Size of fan Single stage axial reaction fan AP-I-18/11.
2.2 No. of fans/Boiler : Two
2.3 Air capacity/fan handled : 105.3 M³ /Sec.
2.4 Discharge head : 520mm WC
2.5 Type of coupling : Regiflex coupling
2.6 Type of control Variable pitch blade controlled by Servo motor.
2.7 Drive motor rating : 750 KW.
2.8 Speed of fan : 1480 RPM.

3. **PRIMARY AIR FAN**

3.1 Type / Size of each fan : Radial single suction back ward Curved blades NDV-22 TIEF STACK.
3.2 Air capacity /fan : 70m³ /Sec.
3.3 Discharge Head : 1210mm WC
3.4 No.of fans/Boiler : Two(2)
3.5 Type of control : Inlet damper control.
3.6 Type of Coupling : Hydraulic coupling(Type voith DTP-650).
3.7 Drive motor rating : 1250 KW
3.8 Speed of fan : 1480 RPM

4. **SEAL AIR FAN**

4.1 Type of fan	:	NDM-6 motor mounted centrifugal fan Vertical discharge.
4.2 No.of fans / Boiler	:	Two nos. for stg-I
4.3 Capacity	:	4.25m³ /Sec.
4.4 Total head developed	:	508 WC.
4.5 Speed of fan & motor	:	2880 RPM.
4.6 Motor rating	:	37 KW.

5. **ELECTROSTATIC PRECIPITATOR**

5.1 Type : 2-FAA-7x32-11190-2 in Stg-I
5.2 No. of ESP/Boiler : 1
5.3 No. of gas path/Boiler : 4
5.4 No. of electrical fields in series : 7 in direction of gas flow.
5.5 Total no. of electrical fields. : 28
5.6 Total no. of collecting rapping : 28 in Stg-1,
Gear box.

5.7 Height of collecting electrodes. : 9 mtr.in Stg-I

5.8 Specific collecting areas : 168.06 m^3 /m^3 /Sec. in stg-I

6. DUCTING & DAMPERS/GATES:

6.1 Hot and Cold air dampers and gates of all bowl mills.

6.2 Primary air dampers : 12 nos. Stg-I

6.3 Secondary air dampers. : 04 nos. Stg-I.

6.4 Flue gas dampers. : 36 nos.Stg.-I.

2.3 BM-I

Boiler : The steam generator is a radiant reheat, natural circulation, single drum, and semi outdoor type unit, designed for firing coal as the principal fuel.

1. DRUM: - The steam drum includes the following:

LOCATION	NUMBER	INSIDE DIAMETER
Upper front	One(1)	1778 mm

The drum is of fusion welded construction fabricated from carbon steel plates and equipped with two (2) number 406 mm diameter manholes.

1.1 DRUMInternals: Necessary internals complete for limiting the solids carry over in the steam leaving the drum has been provided.

1.2 Drum connections: Necessary welding inlet and outlet connections required for valves and accessories have been provided.

1.3 Drum supports:- The necessary drum supports have been provided.

2. FURNACE WALL SYSTEM:- The furnace wall system includes the following:

2.1 HEADERS:- The inlet and outlet headers complete with necessary inlet and outlet connections to receive the connecting piping and element tubing.

2.2 TUBES

LOCATION	NUMBER	O.D.(MM)	TYPE OF CONSTRUCTION
Front wall	181	63.5	Fusion welded
Rear wall	181	63.5	Fusion welded Side
wall(per side)	130	63.5	Fusion welded
Extended side wall(per side)	26	63.5	Fin welded
Approximate Volume		5200 M3	
Approximate furnace effective projected radiant. Surface		2100M2	
Furnace width mm		13868	
Furnace depth mm		10592	

The furnace wall system is fabricated from seamless carbon steel tube of SA 210 Gr. A material. The fusion welded walls has been made of tube OD 63.5 kept at 76.2mm pitch.

2.3 DOWN TAKE PIPES(DOWN COMERS):- Six (6) numbers of unheated down take pipes of out side diameter 406mm.

The complete supply and riser piping required for the circulation system.

2.4 SUPPORTS:- Necessary supports material to support the elements/header from the roof structure complete.

3. SUPERHEATER:-The super heater system equipment includes the following:

3.1 **HEADERS**: The headers super heater sections complete with necessary inlet and outlet connections to receive the connecting tubes/piping and element tubing.

3.2 **STEAM COOLED WALLS**

LOCATION	NUMBER	O.D(MM)	TYPEOF CONSTRUCTION
Furnace roof	120	51.0	Peg finned
Back pass	121	51.0	Fin welded Back
pass front	135	51.0	-do-
Back pass rear	121	51.0	-do- Back
pass (perside)	66	51.0	-do- Back
pass extended(perside)	17	51.0	-do-

The steam cooled walls have been fabricated from carbon steel.

3.3 SUPERHEATER SECTION

Description	Rear Horizontal LTSH	Rear Pendant	Platen Pendant	Finish Pendant
Number of assemblies	120	120	29	89
Number of element/assembly	4	4	7	2
Tube O.D.(mm)	44.5	44.5	51.0	51.0
Transverse pitch (mm)(Across gas path)	114	114	457	152
Longitudinal pitch (mm)(Along gas path)	95	102	60	114
MATERIAL				
Assemblies consist of Elements fabricated from tubing in required quantities	Carbon chrome carbon moly & steel chrome	Chrome moly &Austentitic stainless steel		Chrome moly & steel Aust. stainless steel.

APPROXIMATE TOTAL HEATING SURFACE: 8200 M2

3.4 **PIPING**: - Necessary piping to connect the various stage of the super heaters(carbon steel piping for the low temperature section and chrome moly for high temperature section). All further main steam piping from finish super heaters outlet header to turbine.

3.5 **SUPPORTS:**- Necessary supporting materials to support the various steam cooled wall section and various stages of super heater elements, headers and connected piping complete.

3.6 **DESUPERHEATERS FOR SUPERHEATERS**:- The De-Super heater for super heater includes the following:

Two(2) numbers spray type de-super heaters, located in the steam piping leaving the rear pendant spaced section outlet header is for controlling steam temperature of super heater finish pendant spaced section to 540oc from 60% MCR to 100% of Boiler, All necessary spray water piping, valves and fittings.

4. REHEATERS

4.1 HEADERS:-The inlet and outlet headers of the re heater section with necessary inlet and outlet connections to receive the connecting piping and element tubing.

DETAILS OF REHEATER SECTION(PLATENISED)

Description	**Front pendant**	**Finish pendant**
No of assemblies.	59	59
No. of elements/assembly	6	6
Tube O.D. (mm)	63.5	54
Transverse pitch (mm)(A cross gas path)	228.6	228.6
Longitudinal pitch (mm) (along gas path)	73	63.5

APPROXIMATE TOTAL HEATING SURFACE:- 2600 M2 (Circumferential)

4.2 ELEMENT FRONT PENDANT SECTION:_- Assemblies consisting of elements fabricated from tubing of carbon moly and chromemoly steel in quantities has required.

4.2.1 PIPING:- Necessary piping to re heater from turbine and all further piping from the finish pendant section outlet header to turbine.

4.2.2 FINISH PENDANT SECTION: Assemblies consisting of elements fabricated from tubing of chrome moly and austenitic stainless steel in quantities as required.

4.3 SUPPORTS:- Necessary supporting materials to supp9ort the re heater elements and header.

4.4 DESUPERHEATER FOR REHEATER**:** The De-super heater for re heater includes the following.

Two (2) Numbers spray type emergency de-super heater located in the cold reheat steam piping is for use during any abnormal or emergency condition for controlling the reheat steam temperature at re heater outlet to 540oc.

All necessary spray water piping, valves and fittings.

5. **ECONOMISER:-**The economiser system includes the following:

5.1 HEADERS:- Headers complete with necessary inlet and outlet connection to receive the connecting piping element tubing.

5.2 ELEMENTS

Type	Plain tube seamless continuous loop
Tube spacing(mm)	
Vertical	130
Horizontal	95
Tube arrangement	Horizontal in line
No .of assemblies	145
No. of elements/Assembly	One
Direction of gas flow	down
Direction of water flow	up
Tube material	carbon steel
Size of tube O.D mm	*44.5*
Heating surface (M2)	5200 Approx.

The tubes are horizontally arranged such that the tubes of each assembly are in line in relation to the tubes of adjacent assemblies.

5.3 PIPING:Piping from feed check valve to the economiser inlet header and from economiser outlet header to the a steam drum .

5.4 SUPPORT: Necessary support material for supporting the elements/headers piping complete.

6. **CIRCULATION SYSTEM:** The circulation system includes the necessary piping, headers and tubing to from a circulation system as described below. Feed water from the economiser is discharged in to the steam drum below the water level where it mixes with re circulated boiler water. The mixed water flown through down take pipes(Down comers) to the lower ring header. The ring header acts as the inlet to the furnace walls. The water flows upwards through the heat absorbing water walls and is partially evaporated into steam. The water steam mixture from the water walls flows back to the steam drum through riser piping.

7. **FIRING EQUIPMENT & WIND BOX :** This include the 4 no. 560 mm wide burner assemblies of compartmented fuel and air nozzle arranged vertically complete with necessary insulation, scanners dampers and fuel connections for installation, near each corner of furnace and wind box compartment provided on both sides of the furnace.

8. **Oil System**

Heavy Oil heating Station including all associated piping valves and fittings.

9. **LUNGSTROM AIR PREHEATER**

No. of air pre heaters/ boiler	Two(2)
Size	27 VI 80
Arrangement	vertical
Height of elements (Total)	2033 mm
Hot layer	24 DU-Open hearth Steel (813 mm)
Intermediate layer	24 DU-open hearth Steel (915mm)
Cold layer	18 NF-carbon steel(305mm)
Approximate heating surface (each)	19,000 Sq. m

\The drive motor (electric) is rated at 11.0 K.W. at 1480 RPM. The compressed air requirement for air motor is 380 MNM3/hr. per air heater at 7 kg/cm2 pressure.

This air is supplied from the station service air system.

10 **SOOT BLOWER SYSTEM**

No. of long retractable soot blower (Model T 30 LE)	24
No of wall blowers(Model RW 5E)	56
No. of rotary swivel arm type for Air heater.	4
Retractable type temperature probe	2

Complete with pressure reducing station, piping, valves, fittings and drains.

11. **AUXILIARY PRDS** There is one Aux PRDS per Boiler. It includes pressure reducing station, spray station and Aux. Header. Steam Station used for tank heating, wagon heating, atomizing station, SCAPH, Gland sealing, Oil preheating station and Dearerator. High pressure piping and valves, Low pressure piping and valves, flange joints and drain valves are included. Its drains are terminated in CBD tank.

12. **SCAPH:** Two No. SCAPHs are provided between FD fans and air pre heater ducts and used to heat secondary air during initial stage to avoid corrosion of cold end heating element of air-pre heater. piping and valves from Aux. Header to IBD tank are included.

13. **CBD TANK**: Test pressure 10.5 kg/cm2
Working pressure. 6 kg/cm2
Temperature 165oc
At unit-I and II it has been provided at RC feeder floor, where as at unit-III & IV it has been provided at Aux. PRDS floor.

14. **IBD TANK**: There is one IBD tank per boiler. All drain valves and piping from the related system are included. Tentative technical parameters are as under:

Test pressure	3.9 kg/cm2
Working pressure	1.0 kg/cm2
Temperature	143oc

15. **STEAM STATION**: There is one station per boiler at firing floor. It include steam lines from Aux. PRDS to this station, all tracing lines, all drain lines up to IBD tank, Atomizing steam lines up to firing system at corners at different elevation. Piping and valves steam trap, NRVs strainers.

16. **F.O. STATION**: There is one fuel oil station per boiler. All piping and valves from oil heating station to firing equipment are included.

17. **L.D.O. STATION**:-There is one LDO station per boiler . All piping and valves up to firing equipment are included.

18. **ATOMISING AIR STATION**:- There is one atomizing air station per boiler. All piping, fittings and valves at firing station up to corner fittings is included.

19. **TANK HEATING,WAGON HEATING,F.O. AND L.D.O. LINES**:- There is one line per stage, piping and valves from LDO pump house to respective stations shown at sr.no.15,16,17,18 and all supporting structures for these piping is included.

20. **H.F.O. PUMPS**: There is one pump house per stage. It includes four HFO pumps. All piping valves, oil trays and other allied equipment is included.

21. **DUCTING AND DAMPERS**:- Flue gas ducting below economiser area up to air pre heater, secondary hot air ducting from air pre heater outlet to wind box is included. Flue gas dampers at inlet of air pre heater and out let dampers on secondary hot air are included.

22. **OTHER IMPORTANT EQUIPMENTS**

DETAIL OF WIND BOX ASSEMBLIES(ITEM NO. 7 FIRING EQUIPMENT) PER BOILER.

22.1	No. of Oil Burners	12 Nos.(3 per corner)
22.2.	No. of coal burners (Coal compartment assemblies)	24 Nos. (6 per corner)
22.3	Inter air compartment	8 Nos. (2 per corner)
22.4	Oil nozzle tip A	8 Nos. (2 per corner)
22.5	Oil nozzle tip B	4 Nos. (1 per corner)
22.6	End air nozzle tip	8 Nos. (2 per corner)
22.7	Igniter guide pipe assembly	12 Nos. (3 per corner)
22.8	Scanner	

TOTAL NUMBER OF VALVES STAGE—I (PER UNIT)

Size	**No. of Valves**
TOTAL NUMBER OF FURNACE VALVES	
10mm	01
15mm	03

25mm	46
40mm	08
50mm	02
65mm	14
100mm	06
3”SH safety valves	01
4”RH safety valves	01
6”RH safety valves	03

TOTAL NUMBER OF DRUM MOUNTING VALVES

65mm	01
40mm	30
25mm	12
10mm	12

3” Safety valve 03

TOTAL NUMBER OF P.R.D.S. VALVES

25mm	76
40mm	15
100mm	02
200mm	01
250mm	02
250mm NRV	01

Safety Valves 03

TOTAL NUMBER OF SOOT BLOWERS

Water wall soot blowers	56 Nos.
Long retractable soot blowers.	24 Nos.
Soot Blower header safety valve.	01 No.

2.4 BM-2

TECHNICAL SPECIFICATION OF WET ASH HANDLING SYSTEM

1. BOTTOM ASH HOPPER

Each unit has two bottom ash hoppers underneath the boiler furnace. Below these hoppers clinker grinder are placed in Unit-I and II. The mixture of water and ash is discharged through the inclined feed gate and into the clinker grinder which crush the clinkers. The crushed clinkers and ash water mixture is discharged continuously in the trench.

1.1 No. of clinker grinders

Unit-I	2 nos
Unit-II	2 nos.

2. FLY ASH SYSTEM

The fly ash is collected in the hoppers as given below:-

2.1 Electrostatic precipitator

Unit-I	56 nos.
Unit-II	56 nos.

2.2 Economizer hoppers

Unit-I	4 nos.
Unit-II	4 nos.

2.3 Stack hopper

Unit -I	1 no.
Unit-II	1 no

2.4 Below each hopper there is 1 no manually operated plate valve, one expansion joint and one flushing apparatus. For regulating ash from ESP hopper to flushing apparatuses, rotary feeders have been provided in Stage-I .

2.5 Rotary feeders

Unit-I 24nos.

Unit-II 24nos.

Dry fly ash from the hoppers is mixed with water and water falls into the sluiceway trenches where it is conveyed to ash slurry sump by water jets pressure.

3. ASH DISPOSAL SYSTEM

The slurry from sumps is pumped out to disposal area approximately 2500 mtr. away by ash slurry pumps through 300mm diameter disposal pipe lines in Stage-I .To transport ash, four series of 2 nos. slurry pumps in each series have been installed for Stage-I. Two series of pumps runs normally and two remains as standby for unit-I and II. The ash slurry sump is a RCC tank with bottom side lined with Cast iron replaceable wear plates/liners.

4. PUMPS

4.1 Low Pressure water pumps:(Unit-I and II 345 M^3/hr at 55 MWC),There are three pumps in each stage one pump is required for each unit and third being standby in each stage.

4.2 Seal water pumps (Unit-I and II 20 M^3 /hr at 110 MWC)

There are three pumps in stage-I one each for two units and third being stand by

4.3 Ash slurry pumps (675M^3/hr at 29.5 MWC unit I and II). There are four series (Total 8 no. ash slurry pumps) one set for each unit of stage-I

4.4 Medium Pressure Pumps (355 M^3/hr at 85 MWC Unit I and II).There are three pumps one for the each of two units and the third is standby. The pumps supply water jets in sluiceway trenches. flushing apparatuses of economizer hoppers and supply of water for flushing of ash disposal lines.

4.5 Sump drain pumps (150 M^3/hr at 10 MWC at 10 MWC for stage-I (2 nos.).

Dry Fly Ash Major equipment of Dry Fly Ash Handling of Stage-1							
Major equipment in Unit#1				Major equipment in Unit#2			Stage-1
Equipment Name	MBPL Make	UCCI Make	APH/DUCT (MBPL)	MBPL Make	UCCI Make	APH/DUCT (MBPL)	Common for Unit#1&#2
Ash Vessels	24	32	4	24	32	4	
Dome V/V Assembly	24	32	4	24	32	4	
Switch V/V assembly	16			16			
Expension Joints	24	32	4	24	32	4	
Pnumatic Plate V/V	48	32	10(Manual)	48	32	10(Manual)	
RVF							1+1(MBPL & UCCI Make)
Buffer Silo (Steel)							1 UCCI (Make)
Pipe Lines	350X2=700 m	350 m		350X2=700 m	350 m		

3 IMC

3.1 ATRS SYSTEM:-

Sr.No	Equipment's	Qty. Installed (For 1 & 2 Units)
1	Pressure Switches	134
2	Limit Switches	218
3	Level Switches	20
4	Flow Switches	04
5	Pressure Transmitters	20
6	Position Transmitters	48
7	Coils	08
8	Solenoid Valves	68
9	Junction Boxes (SUV-13)	26
10	Thermocouples	140
11	RTD PT-100	04
12	Turbovisory Instruments	42
13	Pressure Gauges	80
14	Temperature Gauges	14

CONTROL ROOM EQUIPMENTS/INSTRUMENTS:

Sr.No	Equipment's	Qty. Installed (For 1 & 2 Units)
1	Control Panels with electronic modules	32
2	ATRS Consoles with plugging cables	08
3	Recorders	04
4	TSE	02
5	Lube Oil temperature Controllers	02

3.2 VALVES & ACTUATORS

1. Electrically Actuator Opearted Valves with actuator Limitorque/Rotork/Auma/EMG)

Sr. No	Type/Class	Size	Qty. unit-1	Qty. unit-2
1	Gate valve: Class 150/300/1500/2500/2500SPL	80/150/200/250/300/350/450/650 mm	37	37
2	Globe valve: Class 150/300/1500/2500/2500SPL	80/150/200/250/300/350/450/650 mm	63	63
3	Angle valve: Class 1500/2500	25/50 mm	16	16

2. Manually Hand operated valves

Sr. No.	Type/Class	Size	Qty. unit-1	Qty. unit-2
1	Gate valve: Class 300	250 mm	2	1

3. Gear Box with electrical actuators

Sr. No.	Actuator make/model/gear box model		Qty. unit-1	Qty. unit-2
1	Limitorque /SMC04/ 20/G VGC-8		16	16
2	AUMA/ SA12 B/ AUDCO-F		8	8

4. Pneumatic operated valve (Fisher/MIL/KOSO/Dresser/ILP etc)

Sr. No.	Size	Qty. unit-1	Qty. unit-2
1	Small (upto 75mm)	80	80
2	Medium (80mm to 150mm)	13	13
3	large (above 150mm)	9	9

5. Local gauges

Sr. No.	Size	Qty. unit-1	Qty. unit-2
1	Pressure Gauge	394	394
2	Temperature Gauge	190	190

3.3 FSSS CONTROL SYSTEM

1. Relay based control panels : 16 x 2 No.
2. SADC control panel (BHEL make) : 01 x 2 No.
3. Flame scanner control panel (BHEL make) : 01 x 2 No.
4. Oil gun Igniter assemblies : 08 x 2 No
5. Flame Scanner assemblies : 20 x 2 No.
6. Console desks : 2X2 No
7. Local Junction Boxes : 117 x 2 No
8. Field Equipment as tabulated below (Combined for Unit #1 & 2)

Sr No.	Equipment Name	Qty
1.	Pressure Switches	16
2.	Solenoid Valves	12
3.	Temperature Switches	3
4.	Temperature Gauges	24
5.	Limit Switches	34
6.	I/P Converter	10
7.	Pneumatic Power Cylinders	30
8.	Air filter regulator	34
9.	Local Controller	6
10.	Local remote switch	24

3.4 INTERLOCK, MEASUREMENT & DCS SYSTEM:-

Name of System: - Balance of Plant (Interlock, Measurement and Annunciation system)

A. DCS System :-

Open Loop/ Closed Loop & Measurement system of microprocessor based ABB makes Symphony System DCS system having integrated facility of DAS and annunciation system of M/s Instrumentation Ltd. Kota.

Microprocessor based system includes various communication network, GPS clock system., Peripherals, LAN switches, Workstation, Servers, engineering station, Archiving station, Historian, Trends, Sequence of events.

DCS System is called Melody and DAS is Maestro having CMC70 processor cards, Window 2000 Professional+sp4 based Engineering and Archiving stations.

DAS is Maestro UX basic software vers. 2.6 C1-sp2 and Maestro UX operating system vers HP-UX 10.20 ACE software installed.

Gravimetric System.

B. UCB instruments:-

Mosaic Tiles, Bar Graph and Digital Indicators, Chartless recorders, Hydrastep for Boiler Drum level, *Peripheral devices* etc.

C. Field instruments:-

I/P convertors, AFR's, Feed Back transmitters, Contact Type Temp. gauges, Transmitter, Pressure/Level Switches, Power Cylinders etc.

3.5 HPBP CONTROL SYSTEM AND ANALYSERS:-

Sr No	Description	Qty.		
		Unit-1	Unit-2	Total
1.	Steam & Water Analysis System (SWAS) consisting of: M/S Yokogawa make Conductivity Analysers, pH Analysers , Dissolved Oxygen Analysers. M/S Thermon make Silica Analyser, Phosphate Analyser, Sodium Analyser. Sample handling System: sentry make Sample Coolers, Solenoid valve with Dry Panel, Wet Panel and other accessories Make Yokogawa India Ltd.	1 SET	1 SET	2 SETS
2.	Continuous Emission Monitoring System consisting of: M/S Siemens make IR based SOx and NOx Analyser M/S Adage Automation Pvt Ltd, Goa Make Sample handling system in shelter, Heat Traced Line and other accessories.	1 set	1 set	2 set
3.	AV-5 based M/S BHEL make HPBypass control system having Control Panel with electronic modules along with field instruments.	1 set	1 set	2 set
4.	H_2/seal Oil and Stator Water Control system consisting of, H2 Purity Analyser , Pressure Transmitters, Conductivity Analysers along with other field instruments	1 set	1 set	2 set
	M/S Yashmun , Mumbai make Annunciation panel for 50 annunciation windows with all the accessories of seal oil system.	1	1	2
	M/S Yashmun , Mumbai make Annunciation panel for 30 annunciation windows with all the accessories for stator water system.	1	1	2

4.0 ELECTRICAL

Generator: 210MW Turbo Generator, 15.75kV, 9050A, pf0.85 lagging, Hydrogen Cooled, Stator-water cooled, Grounding-resistance through transformer. Allied equipment like protection / metering CTs /PTs neutral Grounding transformer Hydrogen pumps, Bus Ducts etc. is also installed.

Transformers Generator Transformer, Excitation Transformer and Unit Auxiliary Transformers are directly connected to Generator.

Rating

GT	250MVA, 15.75kV /230kV, Delta/ Star,
UAT A & B	15MVA, 15.75kV /6.6kV, Delta/ Star
Excitation Transformer	2500KVA,15.75kV/575V, Delta/ Star

Allied equipment like protection / metering CTs /PTs neutral Grounding transformer Bus Ducts etc. is also installed.
List of other Transformers installed in Stage-1 is as per the list attached, Annexure-C.

Excitation System

Excitation Transformer -2500KVA,15.75kV/575V, Delta/ Star
Excitation of the generator is through excitation transformer (rating as detailed above) directly connected to generator. 15.75kV stator voltage is tapped and stepped down to 575V which is then rectified and controlled with the help of latest Digital Voltage regulation system of BHEL make (Max DNA system) and fed to rotor through Slip rings.

Synchronization

210MW generator is synchronized to 220kV grid through SF6 breaker on 220kV side

6.6kV Switchgears In 6.6kV Switchgears, two no. unit buses A &B are fed through Unit Auxiliary Transformers (UATs). All the breakers installed in 6.6kV switchgears are Vacuum Circuit Breakers (VCB) of rating 1250A and 2000A.The feeders for auxiliaries PA Fan (2), ID Fan(3), FD fan(2), BFP(3+1standby), Coal Mills (6+1 spare), CEPs(2) feeder are connected on 6.6kV unit buses. Besides these, transformer feeders like Unit Service Transformer (2), ESP Transformers (1+1 standby) and Ash Handling Transformers (3) CWPH transformers (1+1 standby) and PT panel are also connected on 6.6kV buses.

Total No. of VCBs are

Capacity 1250A 80No.

Capacity 2000A 22No.

Allied equipment like protection / metering CTs /PTs, Bus Ducts and adequate protection relays etc. is also installed.

LT Switchgears

LT switchgear consists of 415V LT buses named
-USSG (Unit Service Switchgear) A & B fed from Unit Service Transformer,
-SSSG (Station Service Switchgears) fed from Station Service Transformer,
- Normal-cum-Emergency Bus fed from unit bus/Emergency transformer/DG sets,
- CWPH LT switchgear fed from CWP transformers,
- FOPH and Water Treatment Plant LT switchgear.
Besides above LT switchgears and MCCs for Boiler Valves, Soot blowers and Turbine Valves are installed. Local control panels for different auxiliaries like PA fan, ID Fan, AOP, JOP, Seal Air Fan etc. are also installed.
All the LT auxiliaries as mentioned in Annexure-D are run through feeder connected to these switchgears. Detail of the modules installed in Stage-1 is as per Annexure-D.
Allied equipment like protection / metering CTs /PTs, Bus Ducts and adequate protection relays etc. is also installed.

HT and LT Motors

As per Annexure-A

DC Backup Supply

It consists of Battery Banks and Chargers and DC DBs. Detail is as under: -

Battery Banks

+24 v – 1200 Ah	-	04 (2 Set for each unit)
+24 v – 1200 Ah	-	04 (2 Set for each unit)
-24 v – 600 Ah	-	04 (2 Set for each unit)
384 v – 250 Ah	-	02 (UPS for unit 1 & 2)
24 v – 1.2 v 135 Ah	-	06 (1A, 1B, 2A, 2B, 3A, 3B)
24 v – 1.2 v 60 Ah	-	02 (A & B)

Battery Charger

220 v, 350A Float and 200A Boost - 04 (Unit 1, 2, common & standby)
24 v, 627A Float and 180A Boost - 04 (2 for each unit 1 & 2)
-24 v, 150A Float and 90A Boost - 04 (2 for each unit 1 & 2)
24 v, 20A Boost Charger (DG SET) - 03 (1A, 2A, 3A)
24 v, 50A Boost Charger (DG SET) - 03 (1B, 2B, 3B)

Electro Static Precipitator (ESP)

ESP is dry type and consists of four paths each having 07 fields (Totaling 28 fields) for ash collection. ESPs are fed through three no. (one standby for unit-1 &2) ESP transformer connected to 6.6kV unit buses. 28Nos. BHEL make/ Hind Rectifier make Rectifier transformers (62.8KVA, 373V/53.18kV) are installed for giving supply to the fields. Tis voltage is suitably rectified and controlled using semi-pulse controllers, model EPIC II of Alstom make.

Electrical Protection System

All the recommended protection relays for electrical protection of Generator, Generator Transformer, Unit Auxiliary transformers, Station Transformer are installed in the UCB (unit control board). Numerical Type Generator Protection Relays are installed for 210MW generator and HT motors along with static relays. List of Protections for GT and UATs is as Annexure-B

Annexure-A

Sr. No.	Complete Description Of **415V LT Motors** To Be Dismantled From **Stage-I (Unit1&2)**	Qty.
1.	Air Cond. Compressor 93KW,1485 RPM,Crompton Make	2
2.	Air Cond booster pump 30 KW 1430 RPM NGEF Make	2
3.	AC Scanner Fan 3.7 KW,1480 RPM, Kirloskar Make	2
4.	RC Feeder 2.2 KW ,955 RPM ,Siemen Make	12
5.	Air Pre Heater Guide Brg. 0.55 KW ,1420 RPM , Crompton mk	8
6.	APH Support Brg. 0.75 KW,1400 RPM,GEC Make	6
7.	Soot Boiler 0.56 and 0.5 KW,1425 RPM,NGEF Make	224
8.	Rotary Motor 0.75 KW,1430 RPM ,NGEF Make	48
9.	Hot well Make up pump 11 KW,1400 RPM,Kirloskar Make	4
10	Boiler Fill pump 67 KW ,2960 RPM,Kirloskar Make	2
11	Air Pre Heater Wash Pump 37 KW,2960 RPM ,Kirloskar Make	4
12	FD Fan Lub. Oil Pump 3.7 KW, 1420 RPM, Kirloskar Make	8
13	ID Fan Lub.Oil Pump 0.37 KW,1390 RPM, kirloskar Make	12
14	Pa Fan Lub Oil Pump 1.5 KW, 1435RPM,Kirloskar Make	8
15	Hydro coupling of PA Fan 4.0 KW,1435 RPM,Siemens Make	8
16	Emitting Motor 0.25 KW, 900 RPM,Kirloskar Make	56
17	Collecting Motor 0.25 KW,900 RPM,Kirloskar Make	56
18	Slurry Pump motor 110KW,985 RPM,Kirloskar Make	8
19	M.P Pump 135 KW,1485 RPM.Kirloskar Make	3
20	L.P Pump 76 KW, 1480 RPM, Kirloskar Make	1
21	Vacuum Pump 90 KW, 495 RPM, GEC Make	4
22	Vacuum Pump Recirculation 3.4 KW,2820 RPM,GEC Make	4
23	Air Washer boiler 55 KW, 1480 RPM, Crompton Make	4
24	I.A.C Compressor 103 KW,1485 RPM,NGEF Make	6
25	S.A.C Compressor 103 KW,1485 RPM,NGEF Make	3
26	B.A.C.W Motor 148 KW,985 RPM, Kirloskar Make	8
27	Emulsifier Pump 149 KW, 1480 RPM ,Kirloskar Make	1
28	Fire & Hydrant 135 KW, 1486 RPM, Kirloskar Make	2
29	Service Water Pump 160 KW,1435 RPM, Kirloskar Make	2
30	Seal Air Fan 37 KW, 2955 RPM, kirloskar Make	4
31	APH main drive Pump 11 KW , 1445 RPM, Crompton Make	6
32	Stator Water pump 9.3 KW ,2900 RPM NGEF Make	4
33	Tribune CBP 40 KW ,1475 RPM , Kirloskar Make	4
34	H2 CBP 45 KW 1480 RPM, Kirloskar Make	4
35	Hot End Soot B.C & S.B Boiler 0.18 KW 1350 RPM, Bharat Bijali Make	8
36	HFO Motor 30 KW, 1486 RPM , Bharat Bijali Make	4
37	LDO Pump Motor 11 KW, 2940 RPM ,Bharat Bijali Make	2

38	BFP 's AOP 5.5 KW 1450 RPM, ABB Make	6
39	LM Dozing 0.37 KW 1395 RPM, Crompton Make	4
40	Phosphate 0.37 KW , 1425 RPM, Crompton Make	4
41	Mixing phosphate 1.5 KW, 1395 RPM, Crompton Make	4
42	Clinker Grinding 7.5 KW 1455 RPM NGEF Make	4
43	A.O.P Pump 90 KW, 1480 RPM Siemens Make	4
44	JOP Motor 30 KW, 2940 RPM Kirloskar Make	2
45	H_2SOP AC4.4 KW	
46	OVE (MOT) 0.75 KW , 1450 RPM , Crompton Make	4
47	Station Sum Pump 11 KW, 1400 RPM, GEC Make	2
48	GT Fan 1.2 KW, 700 RPM GEC Make	48
49	D Water Transfer Pump 7.5 KW, 2855 RPM ,Crompton Make	3
50	Degasser Pump 18.5 KW, 2900 RPM, Crompton Make	4
51	D Set Cooling Fan 3.7 KW, 1420 RPM Kirloskar Make	2
52	Service water Booster pump 5.5 KW , 2850 RPM ,Kirloskar Make	2
53	Sump Pump 3.7 KW, 1440 RPM NGEF Make	3
54	Primary DG Set pump 0.37 KW, 1337 RPM ,Crompton Make	3
55	Clarifier Fire Bride 1.5 KW 700 RPM Kirloskar	2
56	Gland Seal Steam 0.25 KW ,1400 RPM Siemens Make	4
57	Jockey Pump 18.5 KW , 2925 RPM, Kirloskar Make	2

Sr. No.	Complete Description Of **220V DC Motors** To Be Dismantled From **Stage-I (Unit1&2)**	Qty.
1	Scanner Fan (DC) 3.7KW,1480 RPM, Kirloskar Make	2
2	EOP (DC) 11 KW 1450 RPM, Siemens Make	2
3	MSSV (DC) 6.9 KW, 1600 RPM ,Limitorque Make	4
4	SOP (DC) 5.5 KW ,1984RPM,KEC Make	2
5	JOP (DC) 30KW,2900 rpm Siemens/Crompton Make	2
Sr. No.	Complete Description Of **6.6 KV HT Motors** To Be Dismantled From **Stage-I (Unit1&2)**	Qty.
1	BFP 4000KW, 1485 RPM,BHEL Make	6
2	CEP 500 KW, 1482 RPM, BHEL Make	4
3	Coal Mill 340 KW, 1485 RPM BHEL Make	12
4	PA Fan 1250 KW, 1493 RPM BHEL Make	4
5	FD Fan 750 KW, 1490 RPM , BHEL Make	4
6	ID Fan 1300 KW, 993 RPM BHEL Make	6
7	CWP House 275 KW, 494 RPM Kirloskar Make	8

Annexure-B

Detail of Protections installed on Generator, Generator Transformer, UATs and HT/LT auxilliaries

Sr. No.	Description of Protection	MAKE	MODEL
GENERATOR PROTECTIONS			
1	**NUMERICAL GENERATOR PROTECTION RELAY** Generator Differential Protection (87G) Reverse Power (32G) Low Forward Power Protection (37G) Stator Earth Fault Protection (64G1) Stator Earth Fault(3rd harmonic) Protection Loss of Excitation (40G) Dead Machine (98G) Negative Phase Sequence (46G) Under/Over Frequency Protection (81G) Overflux Protection (99GT) Back-Up Impedance (21G) Out of Step Protection (78G)	Siemens	Siprotec-7UM622
2	Generator Inter-Turn Differential Protection (87 GI)	English Electric	CAG 34
3	Generator Differential Protection (87 G)	ABB	RADHA
4	Generator Voltage Supervision Relay (27G)	English Electric	VAGM-61
5	Stator Stand-By E/F Protection (64G2)	English Electric	VDG 14
6	Reverse Power (32G1)	C&S	MRP
7	Reverse Power (32G2)	C&S	MRP
GENERATOR TRANSFORMER PROTECTIONS			
1	GT Back Up Overcurrent Protection (51GT)	Easun Reyrolle	TJM-12
2	GT Directional E/F Protection (67N)	Easun Reyrolle	TJM
3	GT Standby E/F Protection (51NGTX)	Easun Reyrolle	TJM-12
4	GT Restricted E/F Protection (64GTR)	ABB	RADHD
5	GT Overall Differential Protection (87GT)	ABB	RADSE
UAT PROTECTIONS			
1	UAT Overcurrent Protection (50/51UAT)	Easun Reyrolle	TJM-11
2	UAT Differential Protection (87UAT)	ABB	RADSE
PROTECTIONS on 6.6 KV AUXILIARIES			
1	UAT Overcurrent Protection(51)	English Electric	CDG 31
2	Aux. Transformer Feeder over current	English Electric	CDG 63
3	Motor Feeder		
4	Motor Protection Relay (49) Earth Fault Protection (50N) Motor Lock Rotor Protection (50L/R) Motor Overload Alrm Relay (50AO/L) Motor Overcurrent Relay(50)	Easun Reyrolle C&S English Electric JYOTI JYOTI English Electric	RHO SEG CTU 15 RMA 421 RMA 420 CAG37

ANNEXURE-C

Detail of Transformers installed in for Stage-1

SR. NO.	DESCRIPTION OF TRANSFORMERS	Make	CAPACITY	INCOMING SUPPLY VOLTAGE	OUTGOING SUPPLY VOLTAGE	TOTAL QTY.
1	Generator Transformers	BHEL	250MVA	15.75KV	230KV	02
2	Station Transformers	NGEF	50MVA	220KV	6.9KV	01
3	Unit Auxiliary Transformers	EMCO	15MVA	15.75KV	6.9KV	04
4	Unit Service Transformers	ECE	2.0MVA	6.6KV	433V	04
5	Station Service Transformers	ECE	2.0MVA	6.6KV	433V	02
6.	Ash Handling Transformers	ECE	1.6MVA	6.6KV	433V	03
7	ESP Transformers	ECE	1.6MVA	6.6KV	433V	06
8	CWPH Transformers	ECE	2.0MVA	6.6KV	433V	03
9	Emergency Transformers	East India T/F & Switchgear(P)Ltd.	500KVA	11KV	433V	02
10	D.M.P. Transformers	ECE	1.6MVA	6.6KV	433V	01
11	FOPH Transformers	ECE	1.6MVA	6.6KV	433V	01
12	SF_6 Breakers installed in 220kV Switchyard, 220kV, 3150A.	CGL	NA			03

	Annexure -D	
S.No.	**Complete Description of Material installed at Stage-1(LT Switchgear)**	**Qty.**
A	**415V Unit Service Switchgear (USSG) Unit # 1 & 2**	
1.	Incomer & Bus coupler breakers Cap. 3150Amp Make English Electric	6
2.	ACB Cap. 800Amp Siemens Make	12
3.	Supply Feeder 400Amp	4
4.	Supply Feeder 200Amp	6
5.	Supply Feeder 100Amp	8
6.	Supply Feeder 160Amp	4
7.	Supply Feeder 63Amp	26
8.	Supply Feeder 25Amp	104
9.	Power Module 93.25KW	2
10.	Power Module 90KW	4
11.	Power Module 45KW	6
12.	Power Module 40KW	4
13.	Power Module 30KW	6
14.	Power Module 15KW	6
15.	Power Module 12KW	2
16.	Power Module 9.3KW	2
17.	Power Module 7.5KW	4
18.	Power Module 5KW	6
19.	Power Module 1.5KW	4
20.	Power Module 0.6KW	2
21.	Power Module 0.55KW	4
22.	Transformer 3KVA	8
B	**415V Station Service Switchgear (SSSG) Unit # 1 & 2**	
1.	Incomer & Tie breakers Cap. 3150Amp Make English Electric	4
2.	ACB Cap. 800Amp Siemens Make	5
3.	Supply Feeder 400Amp	9
4.	Supply Feeder 250Amp	6
5.	Supply Feeder 200Amp	6
6.	Supply Feeder 100Amp	6
7.	Supply Feeder 25Amp	95
8.	Power Module 63KW	19
9.	Power Module 55KW	1
10.	Power Module 45KW	1
11.	Power Module 37KW	2
12.	Power Module 30KW	3
13.	Power Module 22.3KW	1
14.	Power Module 15KW	6
15.	Power Module 11.19KW	1
16.	Power Module 11KW	1
17.	Power Module 5KW	6
18.	Power Module 2.24KW	1
19.	Power Module 1.5KW	1
20.	Power Module 0.75KW	3

21.	Power Module 0.37KW	3
22.	Transformer 3KVA	2
23.	Transformer 4KVA	1
24.	Transformer 10KVA	6
25.	Bus P.T 100VA	2
C	**415V DM PlantLT Switchgear Stage I**	
1.	Incomer & Tie breakers Cap. 2500Amp Make English Electric	2
2.	Supply Feeder 63Amp	5
3.	Supply Feeder 25Amp	21
4.	Power Module 18.5KW	5
5.	Power Module 11KW	4
6.	Power Module 7.5KW	3
7.	Power Module 5.5KW	8
8.	Power Module 5KW	2
9.	Power Module 3.7KW	3
10.	Power Module 1.5KW	6
11.	Power Module 1.1KW	1
12.	Power Module 0.37KW	7
13.	Power Module 0.18KW	2
14.	Bus PT 100VA	
D	**415V ESPLT Switchgear Unit # 1 & 2**	
1.	Incomer & Bus Coupler Cap. 2500Amp Make English Electric	8
2.	Supply Feeder 400Amp	10
3.	Supply Feeder 250Amp	62
4.	Supply Feeder 63Amp	16
5.	Supply Feeder 25Amp 3-Phase	30
6.	Supply Feeder 25Amp 1-Phase	28
7.	Bus P.T 100VA	6
8.	Transformer 10 KVA	4
E	**415V FOPHLT Switchgear Stage I**	
1.	Incomer & Bus Coupler Cap. 2500Amp Make English Electric	2
2.	Supply Feeder 63Amp	8
3.	Supply Feeder 25Amp	11
4.	Power Module 45KW	1
5.	Power Module 23KW	10
6.	Power Module 7.5KW	1
7.	Power Module 2.2KW	1
8.	Bus P.T	1
9.	Transformer 100 KVA	1
10.	Transformer 3 KVA	1
F	**415V DG SetLT Switchgear Stage I**	
1.	ACB Cap. 800Amp Make English Electric	8
2.	Supply Feeder 800Amp	2
3.	Supply Feeder 250Amp	1
4.	Supply Feeder 63Amp	5
5.	Supply Feeder 25Amp 1-Phase	14

6.	Bus P.T	2
7.	Transformer 10 KVA	1
G	**415V CWPHLT Switchgear Stage I**	
1.	Incomer & Bus Coupler Cap. 3150Amp Make English Electric	4
2.	ACB 800Amp Siemens Make	11
3.	Supply Feeder 200Amp	3
4.	Supply Feeder 100Amp	1
5.	Supply Feeder 63Amp	6
6.	Supply Feeder 25Amp	38
7.	Power Module 30KW	4
8.	Power Module 22KW	1
9.	Power Module 18.5KW	5
10.	Power Module 15KW	4
11.	Power Module 10KW	3
12.	Power Module 5KW	6
13.	Power Module 3.7KW	1
14.	Power Module 1.1KW	8
15.	Bus P.T	3
16.	Transformer 10 KVA	2
17.	Transformer 3 KVA	4
H	**415V NE BusLT Switchgear Unit # 1 & 2**	
1.	ACB 800Amp Siemens Make	2
2.	Supply Feeder 200Amp	20
3.	Supply Feeder 100Amp	10
4.	Supply Feeder 63Amp	10
5.	Supply Feeder 25Amp	60
6.	Power Module 90KW	2
7.	Power Module 30KW	2
8.	Power Module 11KW	4
9.	Power Module 10KW	2
10.	Power Module 5.5KW	6
11.	Power Module 4.4KW	6
12.	Power Module 3.7KW	4
13.	Power Module 0.75KW	4
14.	Power Module 0.55KW	8
15.	Bus P.T 100VA	2
16.	Transformer 10 KVA	2
17.	Transformer 5 KVA	2
18.	Transformer 3.5 KVA	2
19.	Transformer 3 KVA	2
I	**415V Boiler MCCLT Switchgear Unit # 1 & 2**	
1.	Incomer & Bus Coupler Cap. 800Amp Siemens Make	6
2.	Supply Feeder 250Amp	4
3.	Supply Feeder 200Amp	6
4.	Supply Feeder 63Amp	10
5.	Supply Feeder 25Amp	112

6.	Power Module 45KW	4
7.	Power Module 37KW	4
8.	Power Module 15KW	6
9.	Power Module 11KW	4
10.	Power Module 5KW	4
11.	Power Module 2.2KW	12
12.	Power Module 1.5KW	2
13.	Power Module 0.37KW	4
14.	Power Module 0.2KW	12
15.	Bus P.T 100VA	4
16.	Transformer 10KVA	4
17.	Transformer 2.5KVA	6
J	**415V Boiler Valve MCCLT Switchgear Unit # 1 & 2**	
1.	Supply Feeder 200Amp	4
2.	Supply Feeder 63Amp	8
3.	Supply Feeder 25Amp	16
4.	Power Module 7KW	4
5.	Power Module 3KW	2
6.	Power Module 2KW	16
7.	Power Module 1.5KW	4
8.	Power Module 1KW	4
9.	Power Module 1.2KW	8
10.	Power Module 0.9KW	4
11.	Power Module 0.87KW	2
12.	Power Module 0.82KW	8
13.	Power Module 0.69KW	8
14.	Power Module 0.5KW	6
15.	Power Module 0.4KW	10
16.	Power Module 0.37KW	4
17.	Power Module 0.3KW	24
18.	Power Module 0.2KW	22
19.	Transformer 3KVA	2
K	**415V Turbine Valve MCCLT Switchgear Unit # 1 & 2**	
1.	Supply Feeder 400Amp	4
2.	Supply Feeder 25Amp	28
3.	Power Module 7.5KW	20
4.	Power Module 5KW	2
5.	Power Module 4.4KW	14
6.	Power Module 3.3KW	6
7.	Power Module 1.3KW	50
8.	Power Module 1.1KW	10
9.	Power Module 0.75KW	12
10.	Power Module 0.37KW	56
11.	Power Module 0.23KW	10
12.	Power Module 0.18KW	36
13.	Transformer 10KVA	2

14.	Transformer 3KVA	2
L	**415V Soot Blower MCCLT Switchgear Unit # 1 & 2**	
1.	Supply Feeder 200Amp	2
2.	Supply Feeder 25Amp	20
3.	Power Module 0.56-0.60 KW	120
4.	Power Module 0.57KW	12
5.	Power Module 0.45KW	102
6.	Power Module 0.37KW	12
7.	Transformer 10KVA	2
M	**415V Ash Handling Plant MCCLT Switchgear Unit # 1 & 2**	
1.	Incomer & Bus Coupler Cap. 2500Amp English Electric Make	4
2.	ACB 800Amp Siemens Make	11
3.	Supply Feeder 250Amp	2
4.	Supply Feeder 200Amp	2
5.	Supply Feeder 100Amp	4
6.	Supply Feeder 63Amp	8
7.	Supply Feeder 25Amp	22
8.	Power Module 76KW	2
9.	Power Module 20KW	2
10.	Power Module 15KW	2
11.	Power Module 10KW	2
12.	Power Module 5KW	2
13.	Power Module 2.2KW	6
14.	Power Module 1.1KW	4
15.	Power Module 0.75KW	58
16.	Transformer 10KVA	1
17.	Transformer 5KVA	1
18.	Transformer 4KVA	1
N	**220V DC Board Unit # 1 & 2**	
1.	Supply Feeder 400Amp	6
2.	Supply Feeder 200Amp	3
3.	Supply Feeder 100Amp	6
4.	Supply Feeder 80Amp	2
5.	Supply Feeder 60Amp	35
6.	Supply Feeder 25Amp	50
7.	Power Module 13.6KW	2
8.	Power Module 7.12KW	4
9.	Power Module 0.42KW	26