RAJASTHAN RAJYA VIDYUT UTPADAN NIGAM LIMITED

2x660 MW SUPER-CRITICAL THERMAL POWER STATION

STAGE II, PHASE III AT CHHABRA, DISTRICT BARAN, RAJASTHAN

DETAILED PROJECT REPORT

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PROJECT AT A GLANCE

SL.NO		
1.	Project	2 x 660MW, Super critical Thermal Power Station Stage II, Phase III at Chhabra, District Baran, Rajasthan
2	Location	Chowki Motipura, 24 km south east to Chhabra Town, Baran Dsitrict, Rajasthan. Latitude : 24° 36' N Longitude : 77° 03' E
3.	Accessibility to Site	
	Road access:	24 km from Chhabra Town , 10kms from Agra Mumbai Highway.
	Railway access:	24 km from Chhabra Gagori railway station which is nearest medium size railway station in the West Central railway (between Jaipur & Jabalpur).
	Port access:	
	Airport access:	Jaipur- 520 Kms
4.	Site Features	The power plant is located adjacent to State Highway No. 51- Agra -Mumbai Highway (about 10 km). The SH 51 is also connected to state highway from Kota via Chhabra town. Elevation of the site is 400 m (approx.). FFL of existing Phase I Power house is taken as 396.5 m. Total Area for phase III supercritical 2x660MW plant is 360 Ha
5.	Fuel, Water and Land	

	i) Fuel	
	Main Fuel:	Washed coal with average GCV of 4000Kcal/Kg
	Annual coal requirement:	5.65 Million Tons (with 85 %PLF)
	Auxiliary fuel:	Heavy fuel oil(HFO)/Light diesel oil(LDO)
	Coal transportation to site:	Coal is proposed to be transported by rail wagons to the plant.
	Fuel oil(HFO/LDO) Transportation to site:	By road tankers / rail tank tankers if railway siding is laid.
	ii) Water	
	Raw water:	Lhasi Dam, Andheri Dam & Parwan Dam
	iii)Land Availability:	Adequate land available.
6.	Main plant & Auxiliary systems	
	Unit size:	2X660MW
	Unit type:	Supercritical unit
	Throttle steam conditions:	242 bar (a),565ºC/593ºC reheat
	Condenser cooling water system:	Natural Draft Cooling Tower for each unit
	Coal handling	Coal handling system would consist of wagon tipplers,

	system:	Crushing and screening equipments, Stacker Reclaimers etc inside plant. Two streams of belt conveyors feed coal in to the bunkers near steam generators from both sides through travelling trippers.
	Ash disposal:	Dry fly ash disposal is by trucks for utilisation. Bottom ash is collected and disposed to ash disposal area by wet slurry system with provision for water recovery from ash pond. Provision to be made for disposal of fly ash also to ash disposal area through wet slurry system during emergency.
7.	Power Evacuation:	By 400kV Double circuit lines to Dahra Pooling Station located 130 KMS away from this plant by Quad Moose conductors. Power evacuation will also be done through 2 Nos. interconnectors proposed between Phase –III and Phase II 400kV Switchyards of the Chhabra Plant.
8.	Environmental Aspects;	One multi flue stacks of 275 m height. ESP to limit dust emission to 50 mg/ Nm^3 .with one field out of service.
9.	Project Schedule:	1st unit synchronization in 42 months and COD by 45 months followed by second unit COD by 48months.
10.	Project capital Cost & Tariff	
	Capital cost:	Rs 6.00 Cr/MW
	Tariff (levellised)	**Rs 3.09/Kwh**

CHAPTER – I
INTRODUCTION

1. The development of the power sector in the country since independence has been predominantly through the State Electricity Boards. In order to meet the growing demand for electricity and for rapid economic development of Rajasthan state, the Government of Rajasthan has assessed requirement of about 4500MW additional generating capacity to be added by the end of 2011-12. After considering availability of additional generation capacity of about 3000MW from the state and central sector projects, the state government has taken a policy decision to promote investment for generation of power to meet the balance requirement.

   With the rapid industrialisation, successful rural electrification and large-scale use of electricity for the irrigation purpose, the demand for electricity has registered a significant growth. Also, it is expected that the on-going liberalisation of the country's economic policy would accelerate the industrial growth, which would further increase the demand for power. Although several new power projects have been identified with a view to bridge the gap between the demand and availability, only a few could be taken up for implementation due to financial and other constraints. This would result in large shortfall in the availability of both power by 1998MW in the state of Rajasthan as of 2013-2014. The present demand for electrical power continues to grow and will continue to outstrip the available and planned generation capacity leading to chronic shortage of available power and energy in the future years.

2. Rajasthan Rajya Vidyut Utpadan Nigam Limited (RRVUNL) is setting up a 2 X 660MW coal based thermal power plant at Chhabra, Baran Dist. Rajasthan.

3. RRVUNL have availed the services of TCE Consulting Engineers Ltd. (TCE) Bangalore for preparing a Detailed Project Report for the proposed 2 x 660 MW supercritical thermal power plant (STPP) project.

4. This report highlights the details of the existing site, availability of fuel and water, evacuation of power, features of the main plant equipment including sea water supply and cooling water systems, fuel supply systems, electrical systems, environmental aspects, estimates of project cost, cost of energy generation, schedule for project implementation.

CHAPTER II

EXECUTIVE SUMMARY

2.0 PURPOSE

2.0.1 The purpose of this report is to present the feasibility, technical and project cost details of the proposed 2 x 660 MW capacity coal fired supercritical thermal power station at Chhabra, Baran Dist., Rajasthan.

2.0.2 This project report highlights the features of the selected site, fuel and water requirements, technical features of the main plant equipment, Plant Mechanical – electrical - instrumentation and control systems, raw water system, coal and ash handling systems, evacuation of power, environmental aspects, estimates of project cost, Project implementation schedule etc. of the proposed thermal power project.

2.1 SCOPE

2.1.0 The scope of this report covers the following:

a) Project Justification : Review of the planned generation capacity vis-a-vis power and energy requirements of Rajasthan State, Northern Grid and establish the need for augmentation of the installed generation capacity

b) Study of the selected site for the installation of a 2 x 660 MW coal-based STPP, soil conditions, accessibility by rail and road, water for other requirements, power evacuation , transport of fuel required for the plant, space availability for ash disposal and general environmental aspects

c) Preparation of plant layout.

d) Brief details of the major aspects of the proposed plant, general design philosophy and salient technical specifications of the following major equipment/systems for the proposed 2 x 660MW units installation:

i. Steam generator and auxiliary systems
ii. Turbine generator and auxiliary systems
iii. Water systems

iv. Coal storage and handling system
v. Ash handling system including ash disposal system
vi. Fuel oil handling and storage system
vii. Other mechanical balance of plant systems
viii. Electrical systems
ix. Power evacuation arrangement
x. Instrumentation and control systems
xi. Civil and structural works

e) Environmental aspects

f) Project cost estimates and tariff

2.2 CONCLUSIONS

2.2.0 Need for Additional Power Plant

2.2.0.1 Based on the details of load forecast and assessment of generation capacity duly taking into account the realistic planned additions to the grid and the states share from the power plants in the Central Sector, it is anticipated that the Rajasthan State would experience a deficit in generation capacity of 1998 MW by the year 2013-2014. Further, the deficit is expected to increase substantially in the subsequent years. Hence, installation of 2 x 660 MW STPP near Chhabra town, Rajasthan State is justified. Installation of these units with a total capacity of 1320 MW would help to mitigate this deficit.

2.2.0.2 The proposed 2 x 660 MW Stage II, Phase III project is an extension of Phase I and II with adequate area as shown in the Plot Plan which shows the layout of main plant including power house, steam generators, transformer yard, switch yard, coal and ash handling plant, cooling towers, other major balance of plant equipment/facilities and green belt.

The land for this project is being acquired side of the Phase II of the power project and totally encumbrance-free. However, site activities are in progress for the on going projects of 2 x 250 MW Phase I and II.

2.2.0.3 The main features of the site are as follows

a) **Location**

The Chhabra TPS site is situated in Chowki Motipura which is about 24 km south east to Chhabra town in Baran district. It is situated at a longitude of 77°03' E and

latitude of 24°36'N. Inter state boundary of Madhya Pradesh is approximately 10 km from the power plant site..

b) **Site features**

The site is generally plain with minimum undulations and is mostly Single crop agricultural. The area around the proposed project site is thinly populated. There is no forest land. There are no temples, archeologically important monument or any sensitive flora/fauna. The elevation of site level is approx. 398m above MSL.

Geo-technical investigations reports of phase-1 & phase-2 of stage -I are available. Geo-technical investigations are required to be carried out for Stage- II area. Based on Geo-technical investigations report of Stage I, the top soil is black cotton soil with expansive in nature for 1-2.5 m followed by fractured rock very severe to moderate for 2.0 m - 5.5 m depth and black basalt rock moderate to strong beyond 5.5m

c) **Access to Site**

The site is easily accessible by road and rail. Site is located 24 kms southeast to Chhabra town. The Gagori railway station which is nearest medium size railway station in the West Central railway (between Jaipur & Jabalpur). The nearest airport is Jaipur which is about 520 km from the site. All the heavy equipment for the power plant are expected to be received at site via road / through rail.

d) **Land Availability**

Total land area of about 2802 Bighas (2361 Bigha Private land + 441 Bigha Govt. land) is in the process of being acquired by the side of the existing power project (phase II) which is adequate for the proposed power plant including the coal stockyard and green belt. 213 Ha of land is considered for 2 X 660 MW Plant. However, site activities are in progress for the on going projects of 2 x 250 MW Phase I and II.

e) **Fuel**

Coal would be the load carrying Fuel and beneficiated (washed) coal would be used. The annual coal requirement for 2 x 660 MW units is estimated to be about 5.65 million tones/year of washed coal having an average calorific value of 4000 kCal/kg and plant would operate at a plant load factor (PLF) of 85 %.

The secondary fuel would be HFO as per IS 1593 and the start up oil would be LDO as per IS 1460-1995.

f) **Main Plant Equipment**

The power plant would comprise of 2x660 MW units and would adopt supercritical technology. For the 660 MW unit the rated inlet steam conditions for steam turbine would be 242 bar (a) steam pressure at 565°C and the reheat steam temperature would be 593°C. The steam turbine would be a four cylinder tandem - compound machine, driving a turbo-generator at 3000 rpm to generate 693 MW output at 0.85 power factor at the generator terminals. The MCR evaporation of the steam generator would be 2200 t/ hr of superheated steam at 251 bar(a) pressure and 568°C temperature. The steam temperature at reheater outlet would be 596°C. The steam generators would be designed as semi- outdoor equipment while the turbine generator sets with all auxiliary and feed cycle equipment would be located indoors. The parameters indicated above are preliminary and subject to confirmation by the selected main equipment suppliers.

g) **Coal Supply Arrangement & Coal Handling system**

The requirement of about 5.65 million tonnes / year of washed coal would be met through washed coal from captive block to be allocated in Chattisgarh/MP or from SECL /NCL. Washed coal with average GCV of 4000Kcal/Kg is envisaged by rail wagons. Required equipments like Wagon tipplers, Crushers, Screens– stacker reclaimers and set of belt conveyors along with Crusher house, Junction towers etc. would be installed to supply coal to coal bunkers of 2x 660 MW Units through travelling trippers.

The coal handling system would comprise of two streams of equipments and conveyors both operating simultaneously and each stream capable of handling coal at the rate of 1000 TPH. Hence the total capacity of the coal handling system

is 2000TPH

h) Ash Handling System

The system proposed for bottom ash removal would be wet slurry system with Jet pumps. Bottom ash is further pumped to the ash disposal area in lean slurry form with provisions for recovery of water from the ash pond. The fly ash removal system would be pressure pneumatic system with provision for dry disposal by trucks for utilisation. It is assumed that up to 80% of the Fly ash generated would be utilised and provision is made to dispose off the remaining 20% fly ash in slurry form to ash pond along with 100% bottom ash.

i) Water

The total water allocated for Phase III is 1570 MCFT per year (1,21,832 m^3/day). The allotted water would be met from Lhasi Irrigation Project (300 mcft), Andheri Irrigation Project (500 mcft) and Parwan Major Irrigation Project (770 mcft) as per letter Reference no. CEWR/TA (W) / 1482 dated 11-08-2009 from The Chief Engineer, Water Resources Department, Jaipur, Govt. of Rajasthan.

Condenser Cooling and Make-up Water

The source of water for the thermal power station would be Lhasi, Andheri and Parwan Irrigation projects which is located at about a aerial distance of 25 – 60 km from the power plant. The total requirement of raw water make-up is of the order of 1485 mcft /year for the 1320 MW power plant capacity. An allocation of 1570 mcft has considered due to evaporation losses in the canal and desilting pond and pipe losses which are located outside of plant boundary,. Raw water is proposed to be pumped from the above irrigation projects to a raw water pond (buffer to cater for 15 days storage for 1320 MW).

For the condenser cooling, closed circuit re-circulation system with filtered water make-up using natural draft cooling towers (NDCT) has been proposed. The make up water for the cooling towers would be drawn from the filtered water sump and gets discharged into the common CW forebay. From the CW pump house the cooling water would be pumped to the condenser through individual MS conduits. The discharge would be led to the cooling tower through similar MS conduits.

Raw water required for other services viz. DM plant will be drawn from a clarified water tank. Water required for cooling water make up for air-conditioning &

ventilation system and plant potable water system, service water shall be drawn from filtered water sump / overhead tank. Water required for coal and ash handling systems, fire protection system, etc. will be taken from cooling tower blow down tank.

Feed cycle makeup and cooling water for steam generator and turbine generator auxiliaries would be met from the DM plant output.

j) Nil

k) **Power Evacuation**

Refer Chapter –VI (Power Evacuation) for details.

l) **Environmental Aspects**

It is proposed to use washed coal with low sulphur content and hence the SO_2 emission would be minimal. The steam generators would be provided with low NOx burners resulting in lower emission of oxides of Nitrogen from the steam generator.

A RCC chimney with multi-flue 275 meters high are proposed to be provided for effective dispersion of SO_2, NO_X and SPM. Further space provision would be made for future installation of FGD units if required. Type of FGD would be either limestone based or sea water based or chemical based system.

m) **Electrostatic Precipitators**

The steam generators would be provided with electrostatic precipitators to limit the particulate matter in the flue gas to 50 mg / N m^3 as per the present guidelines of Central Pollution Control Board and State Pollution Control Board.

Environmental clearance for the proposed project from MOEF and from State Pollution Control Board is already under process. Rapid environmental impact assessment (REIA) and comprehensive environmental impact assessment (CEIA) studies have to be completed and reports submitted to MOEF and also to State Pollution Control Board for their clearances. Detailed project report has to be prepared for submitting the same for various clearances.

Adequate provisions are proposed for neutralising the effluents from the water treatment plant. Effluents from the entire power plant are proposed to be treated and reused in the power plant to minimise the make-up water requirement.

Effective ash management plan for utilization of fly ash would be planned and implemented to ensure proper disposal and use of generated fly ash. The ash utilization would be progressively increased to achieve 100 %.

All the measures would be taken to limit the noise levels within the permissible limits in the premises and at the plant boundary.

Provision would be made for the green belt within the premises.

No villages are directly affected by this project; hence rehabilitation and resettlement issues are expected to be bare minimum.

In view of the above measures no significant impact on environment is expected due to the installation of proposed power project.

n) **Project Cost and Tariff**

Total capital cost including the interest during construction for the proposed 2 x 660MW project is estimated to be Rs.7920.00Crores (Rs. 6.00Crores / MW)

Based on CERC norm of turbine heat rate of 1850 kCal / kWh and boiler efficiency depending on washed coal of 4000 GCV, the gross station heat rate works out to 2280 Kcal/Kwh. The cost per kWh works out to Rs. 2.98 for the first year of operation when all the units are stabilized at a PLF of 85%. The levellised tariff works out to be Rs. 3.09 per kWh considering cost of coal as Rs 2000 per ton and an escalation of coal cost at 4% per year.

o) **Project Schedule**

The project is expected to achieve the commercial operation date for the first unit by 42 months and second unit by 45 months from the effective date.

p) **Recommendations**

To ensure timely completion of the proposed project, it is recommended that early action on the following activities be initiated by RRVUNL:

i. Discussions with Rajasthan electricity board regarding evacuation of power from the proposed power plant and initiation of power purchase agreement (PPA) / tariff based agreement (merchant co), for sale of power and Identification of prospective bulk buyers

ii. Clearance from concerned authorities for coal and developing/engaging coal washing facility for washing of coal, Initiation of discussions with railway authorities for unloading and transportation of coal up to site.

iii. Route survey for raw water pipe line from Lhasi, Andheri and Parwan irrigation projects to power plant. Water analysis from all the three sources.

iv. Approval of civil aviation authority for installing 275 m high chimney

v. Preparation of EIA reports for environmental clearance from state and central ministry.

vi. Discussions with prospective Indian Financial Institutions, Foreign Financial Institutions, external commercial borrowing agencies, Indian commercial banks and reputed main plant equipment suppliers for loans.

vii. RRVUNL to identify suitable buyers for ash generated from the power plant.

viii. To conduct detailed topographic survey of the identified land and the land in the vicinity so as to firm up actual coordinates and extent of land to initiate acquisition

ix. To carry out detailed soil and geo-technical investigations to ascertain load bearing capacity.

x. Arranging for Electric grid System study.

CHAPTER III

NEED & JUSTIFICATION FOR THE PROJECT

1. INSTALLED AND PLANNED GENERATION CAPACITY IN THE STATE OF RAJASTHAN

India is fast developing country requiring the more and more power to sustain & improve the growth rate. As on 31.07.2009 the installed generation capacity in India is 1 51 074 MW having a peak demand of 1 07 945 MW & peak met is 94 380 MW as per CEA report JULY 2009. The State of Rajasthan is part of the Northern Region Electricity Grid. As on 31.03.2009 the installed generation capacity in Northern Region is 39 004 MW. Northern Region having a peak demand of 35 745 MW & peak met is 29 990MW as per JULY 2009. Approximately there is short fall of 16.1% in JULY 2009. As on JULY 2009 the installed generation capacity in Rajasthan state is 7019.50 MW (As published in website of Rajasthan rajya vidyut prasaran nigam ltd as on 27.08. 2009).

2. .DEMAND FOR ELECTRICAL POWER

Demand for electrical power in the state of Rajasthan has been increasing due to rapid industrialization and large scale use of electricity for irrigation, domestic and commercial purposes. This has resulted in large shortfall in the average availability of both power (4200 MW) and energy (16500 MU) in Rajasthan in the year 2008-2009. In spite of the steps taken by Rajasthan Rajya Vidyut Uthpadhana Nigama Ltd (RRVUNL) and Independent Power Producers (IPPs) to set-up new power plants, the demand for power exceeds the availability.

Table–3.1 presents the peak power demand and the energy requirement of Rajasthan from the year 2007-2008 to the year 2011-2012 as projected in 17th Electric Power Survey Report.

Table - 3.1

Peak Power Demand and Energy Requirement in the state of Rajasthan

Sl no.	Year	Projected Peak Power Demand (MW)	Projected Energy Requirement (MKWh)
1	2008-2009	6923	39890

2	2009-2010	7408	42697
3	2010-2011	7927	45701
4	2011-2012	8482	48916
5	2012-2013	9057*	52331*
6	2013-2014	9657*	55946*

* The projected figures based on previous years values differences.

3.1 INSTALLED GENERATING CAPACITY

The installed capacity and availability of power in the state of Rajasthan from various sources for the years 2008-2009 is taken from data furnished by RRVUNL & CEA as follows:

Table - 3.2

Installed Generation Capacity in MW for the State of Rajasthan as on 31-03-2009

Sl. No.	Name of Power Project	Capacity in MW
a)	**RRVUNL**	
1.	Thermal	
	Suratgarh TPS	1500.00
	KotaTPS	1240.00
	Ramagarh Gas PS	113.50
	Giral Lignite TPS	250.00
	Dholpur CCPP	330.00
	Chhabra super TPS	250.00
	Total (Thermal)	**3683.50**
2.	Hydro	
	Mahi Hydel	140.00
	MHM schemes	23.85
	Rana Pratap Sagar hydel PS	86.00
	Jawahar Sagar hydel PS	49.50
	Gandhi sagar hydel PS	57.50
	Others	0.00
	Total Hydel	**356.85**
	Total (RRVUNL)	**4040.35**

b)	IPPs	**696.00**
c)	**Share from Central Sector**	
	SINGRAULI (NTPC)	300.00
	RIHAND-I(NTPC)	95.00
	RIHAND-II(NTPC)	100.00
	UNCHAHAR-I(NTPC)	20.00
	UNCHAHAR-II(NTPC)	38.00
	ANTA (NTPC)	83.00
	AURAIYA(NTPC)	61.00
	DADRI(NTPC)	77.00
	UNCHAHAR-III(NTPC)	23.00
	NAPS	44.00
	RAPS #3&4	125.00
	NAPTHPA-JHAKRI	112.00
	TEHRI-I	75.00
	DULHASTI	42.50
	DHAULIGANGA	27.00
	CHAMERA-II	20.10
	SALAL	21.00
	TANAKPUR	11.00
	CHAM-I	106.00
	URI	43.00
	KAHALGAON U#6&7	49.00
	OTHERS(EXCESS ENTITLEMENTS)	247.40
	Total (Central)	**1720.00**
g)	**Total (State + Private + Central)**	**6456.35**
h)	Total Installed Capacity (MW) (Refer note 1)	**6456.35**
i)	Peak Power Availability (MW) (Refer note 4)	**4842.30**
j)	Energy Availability (MKWh) (refer note 3)	**36460.00**

k)	Peak Power Demand (MW) (refer note-2)	**6923.00**
l)	Energy Demand (MKWh) (refer note-2)	**39890.00**
m)	(-)Deficit / (+) Surplus of Power (MW)	**- 2080.70**
n)	(-)Deficit / (+) Surplus of Energy (MKWh)	**- 3430.00**

Notes : 1. Total installed capacity is obtained from RRVUNL website www.srldc.org.

2 The Peak Power Demand and Energy Demand are obtained from "17th Electric Power Survey of India - CEA".

3 Energy Availability Data is obtained from "CEA Monthly POWER SCENARIO REPORT FOR APRIL 2009".

4 Peak Power Availability is calculated as 75% of overall installed capacity.

4. PLANNED GENERATION CAPACITY IN THE STATE OF RAJASTHAN:

Projects under execution and the projects under planning for the period of 2009-2010 to 2013-2014 are shown in Table –3.3

Table - 3.3

List of Projects under Implementation / Planning in the state of RAJASTHAN

SL.NO	Name Of Power Project	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
a)	**RRVUNL**					
1.	CHABRA TPS-I, U#2	250				
2.	KALISINDH U#1&U#2		600	600		
3.	CHABRA TPS-II			500		
4.	RAMAGARH EXTN			160		
5.	GIRAL STAGE-II				125	
6.						

b)	**PRIVATE SECTOR**					
1.	JALIPA LIGNITE		1080			
2.						
c)	**CENTRAL - SECTOR**					
1.	BARSINGSAR TPS	250*				
2.	RAPP U 5&6	88*				
3.	PARBATI ST-II			88*		
4.	PARBATI ST-III		58*			
5.	CHAMERA-III		27*			
6.	SEWA ST-II	13*				
7.	URI-II		26.10*			
8.	KOLDAM		88*			
9.	LOHARI NAGPALA			66*		
10.	TAPOVAN V GARH			58*		
11.	RAMPUR			46*		
12.	KOTESHWAR		34*			
13.	BARH ST-I			150*		
14.	SUBHANSIRI LOWE			88*		
15.	KAMENG			27*		
d)	**Total Planned Capacity under installation. (MW)**	**601**	**1913.1**	**1783**	**125**	
e)	**Total Planned Capacity available from 2009 to 2014. (MW)**			**4422.10**		
f)	**Available capacity upto 2014. (MW)**			**10878.45**		

* The STATE share is indicated from installed capacity AS PER CEA REPORT JULY-2009.

5. AVAILABILITY OF POWER

The Power Survey of India recognized that while computing the available peak power from the installed capacity, the following factors need to be considered:

a) Planned outage due to maintenance

b) Forced outage

c) Spinning reserve

d) Auxiliary power consumption

e) Partial non availability due to poor quality of indigenous coal, non availability of gas, uncertain irrigation releases resulting in uncertainty of hydro generation at peak hours, loss of active power due to high reactive demand of units.

Considering the peak power availability and energy availability from the existing plants, projections have been made for the peak power availability and energy availability for the future based on the mix in development of hydro and thermal power plants. The peak power demand and deficit are shown in Table 3.4.

Table - 3.4

Deficit in Installed Capacity for the State of Rajasthan.

Sl No	**Details**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**
1	Projected Installed Capacity (MW)	7057.35	8970.45	10753.45	10878.45	10878.45
2	Peak Power Availability (MW)	5293.00	6727.84	8065.00	8158.84	8158.84
3	Peak Power Demand (MW)	7408.00	7927.00	8482.00	9057.00	9657.00
4	Power Deficit (MW)	**(-)2115.00**	**(-)1200.00**	**(-)417.00**	**(-)898.00**	**(-)1498.00**
5	**Installed Capacity required to offset the deficit (MW)**	**2820.00**	**1600.00**	**556.00**	**1198.00**	**1998.00**

Note : 1. The Projected Installed Capacity is taken from Table – 3.3

2. The Peak Power Demand is taken from Table –3.1

3. Peak Power Availability is calculated as 75% of overall installed capacity.

6. Need for Augmentation of Generation Capacity

Table 3.4 above; indicate the installed capacity, peak power available and energy available from the various projects approved and ongoing in Rajasthan state and additional share from Central Sector Projects.

It is noted from Table 3.2 that the deficit in peak power demand was 2080.70 MW in the year 2008-2009. Considering the load growth and the installation of the new plants, from Table 3.4 it is expected that the power deficit experienced by Rajasthan State during the year 2013-2014 by which time the proposed plant is expected to be commissioned is 1498 MW. Additional generating capacity to meet this deficit will be 1998 MW.

Considering this scenario, any delay in the implementation of power projects, due to any reasons such as lack of clearances, financial constraints, etc., will result in much larger deficit in subsequent years. Hence the installation of the proposed 2 X 660 MW TPP project is justified from Peak demand as well as Energy point of view.

CHAPTER - IV

SITE SELECTION AND FEATURES

The proposed power station is extension of 1000 MW power plant of which 2 x 250 MW (Phase II) is being installed now.. Thus, with addition of the proposed units the total station capacity would be 2320 MW. The proposed power plant would be 2 x 660 MW with adequate area as shown in the Plot Plan which shows the layout of main plant including power house, steam generators, transformer yard, switch yard, coal and ash handling plant, cooling towers, other major balance of plant equipment/facilities and green belt..

SITE FEATURES

3. Site Location

The Chhabra TPS site is situated in Chowki Motipura which is about 24 KM south east to Chhabra town in Baran district. It is situated at a longitude of 77°03' E and latitude of 24°36'N. Inter state boundary of Madhya Pradesh is approximately 10 KM from the power plant site. (Refer Exhibit 001: Location map of Project site and Exhibit -002: Plot Plan).

Nearest town	:	Chhabra Town (24 km from site)
Nearest railway station	:	Chhabra Gogri Town
Nearest airport	:	Jaipur (520 km from site)
Road access	:	Interconnected to Agra – Bombay Highway(10kms)
Type of soil	:	Black Cotton
Present use of the land	:	Construction activities for ongoing Phase II consisting of 2 x 250 MW units
Source of water	:	Lhasi Irrigation project

		Andheri Irrigation project Parwan Irrigation project
Quantity of water available for the proposed plant	:	1570 MCFT/yr

4. Details of Site and Characteristics of Land

An area of about 213 hectares identified for the proposed project is adequate for 2 X 660MW plant capacity.

The site is generally plain with minimum undulations and is mostly Single crop agricultural. The area around the proposed project site is thinly populated.. There is no forest land. There are no temples, archeologically important monument or any sensitive flora/fauna. The elevation of site level is approx. 400m above MSL.

AVAILABILITY OF WATER

5. The source of raw water for the proposed station would be from three water sources, namely Lhasi, Andheri and Parwan Irrigation projects which is situated 20 – 60 km away from the site. Independent intake pump houses and pipe lines to be laid from all the three sources to the power plant reservoir pond.

Details of the conveying pipeline from all the above three sources shall be worked out during detail engineering when route survey and other related inputs are available. (Refer Exhibit 004A: For Tentative river water system scheme)

The total water allocated for stage II, Phase III is 1570 MCFT per year (1,21,832 m^3/day). The allotted water would be met from Lhasi Irrigation Project (300 mcft), Andheri Irrigation Project (500 mcft) and Parwan Major Irrigation Project (770 mcft) as per letter Reference no. CEWR/TA (W) / 1482 dated 11-08-2009 from The Chief Engineer, Water Resources Department, Rajasthan, Jaipur.

FUEL SOURCE AND TRANSPORTATION

6. RRVUNL is in the process of acquiring the coal block of adequate capacity for the coal requirement of Chhabra super critical units. Coal washeries would be developed or engaged to wash the coal so that the ash percentage would come down to 34% and GCV improves up to 4000 – 4500 Kcals/Kg. approximate rough coal analysis is shown in appendix – 3.

8. Auxiliary liquid fuels, viz. LDO & HFO would be required for start-up and flame stabilization at lower load. The LDO and HFO unloading and storage facilities would be proposed with sufficient storage capacity.

POWER EVACUATION

9. As per the RVPN's Board of director's 167th held on 24-07-2009 for Power evacuation is proposed by 400kV Double circuit lines to Dahra Pooling Station located 130 KMS away from this plant by Quad Moose conductors. Power evacuation will also be done through 2 Nos. interconnectors between this Phase –III and Phase II Switchyards of the Chhabra Plant. The approval of Power evacuation system has been issued by RVPN vide letter no. 595 dt. 4.08.09.

ENVIRONMENTAL ASPECTS

10. Selection of environmentally acceptable site for a thermal power station is the guided by the following guidelines of Ministry of Environment & Forest (MoEF):

a. Location of thermal power plants should be avoided within 25 km of the outer periphery of the following :-
   (i) Metropolitan cities
   (ii) National Parks and wildlife sanctuaries
   (iii) Ecologically sensitive areas like tropical forests. Biosphere reserves. National parks & sanctuaries, important lakes and coastal areas rich in coral formations.

b. The site (i.e chimney) should not fall within the approach funnel of the runway of the nearest airport

c. The site should be at least 500 m away from the flood plain of Riverine system.

d. The site should be at least 500 m away from the highways.

e. Location of the TPS should be avoided in the vicinity (say 10 Km) of places of archaeological, historical, cultural, religious or tourist importance, and defense installations.

f. The TPS should be surrounded by an exclusion zone with respect to the predominant wind direction. Residential/ Commercial development should be regulated in the exclusion zone on the basis of strict land zoning.

g. No forest or prime agriculture land should be utilized for setting up of TPS and ash disposal

11. The site has all the infrastructural requirements for the proposed power plant. Also, all necessary pollution control measures are being proposed for the power plant. It is therefore, considered that this site is suitable for installation of the proposed power plant expansion units.

CHAPTER –V

FUEL AND WATER REQUIREMENTS

5.0 FUEL

5.0.1 TYPE OF FUEL

The steam generator would be designed for coal firing. LDO would be used for light up and initial warm up of units, and heavy fuel oil (HFO) during start-up and flame stabilisation at low loads

5.0.2 SOURCE OF FUEL AND QUALITY

The requirement of about 5.65 million tonnes / year of washed coal would be met through washed coal from captive block to be allocated in Chattisgarh/MP or from SECL /NCL. Washed coal with average GCV of 4000Kcal/Kg is envisaged.
LDO as per IS: 1460 for light up and HFO to IS: 1593 for warm up and flame stabilisation during low loads would be made available from nearby HPCL/ BPCL/IOC outlets.

5.0.3 ANNUAL COAL REQUIREMENT

The annual consumption of coal for the proposed power plant is estimated at 5.65 million tonnes considering an average GCV of 4000 kCal / Kg with an annual plant load factor (PLF) of 85%. For tariff calculation 85% PLF is considered.

5.0.4 TRANSPORTATION OF COAL TO SITE

The coal would be received by rail wagons and stored in the plant. The existing rail link would be extended and a new marshalling yard would be provided to cater to the additional coal rakes for the proposed 2x660 units. A series of belt conveyors, wagon tipplers, crushers, screens, stacker reclaimers - Junction towers, crusher houses etc. would be installed to supply coal to coal bunkers of 2x660 MW bunkers through traveling

trippers.

The coal handling system would be capable of handling coal at the rate of 2000 TPH.

5.0.5 FUEL OIL REQUIREMENT AND TRANSPORT TO SITE

During normal operation, the fuel oil requirement is expected to be about 32 m^3/ day and annual requirement is estimated to be about 9400 m^3, considering CERC norms of 1ml/KWH. HFO and LDO for the power plant would be transported to plant site by road tankers.

5.1.0 WATER

5.1.1 Cooling water re-circulation system with raw water make up employing natural draught cooling tower (NDCT) is proposed for condenser cooling system. The CW water under circulation would about 85000 m^3/ hour per unit. Auxiliary cooling water for SG & TG auxiliaries would be closed circuit with passivated DM water.

5.1.2 The total water allocated for Stage II, Phase III is 1570 MCFT per year (1,21,832 m^3/day). The allotted water would be met from Lhasi Irrigation Project (300 mcft), Andheri Irrigation Project (500 mcft) and Parwan Major Irrigation Project (770 mcft) as per letter Reference no. CEWR/TA (W) / 1482 dated 11-08-2009 from The Chief Engineer, Water Resources Department, Rajasthan, Jaipur

CHAPTER –VI

6.0 POWER EVACUATION

6.0.1 As per the RVPN's Board of director's 167th meeting held on 24-07-2009, the Power evacuation is proposed by 400kV Double circuit lines to Dahra Pooling Station located 130 KMS away from this plant by Quad Moose conductors.

6.0.2 Power evacuation will also be done through 2 Nos. interconnectors between Phase –III and Phase II 400kV Switchyards of the Chhabra Plant as discussed with RRVUNL during the site visit on 14-8-2009.

6.0.3 The proposed 2 X 660 MW Power plant will be provided with a 400 kV Switchyard working on one and half breaker scheme having facility to connect 2 Nos 400 kV Lines for the purpose of Power evacuation.

The approval of Power evacuation system has been issued by RVPN vide letter no. 595 dt. 4.08.09.

CHAPTER –VII

MECHANICAL SYSTEMS

7.0 MAIN PLANT EQUIPMENT AND SYSTEMS

7.0.1 PLANT CAPACITY

7.0.1.1 RRVUNL has planned installation of 1320 MW (2x660 MW) capacity coal based supercritical thermal power station at Chhabra, Baran Dist. Rajasthan.

7.0.2 SELECTION CRITERIA OF TECHNOLOGY AND UNIT SIZE

7.0.2.1 Two (2) units each of 660 MW have been considered for the project.

The Committee appointed by CEA to recommend the next higher unit rating in India, in its report of November – 2003, has recommended to adopt units of 660-1000 MW size in the country. While arriving at the recommendation, the Committee has examined among other factors, the important aspects of grid reliability to withstand outage of unit of large capacity, future grid inter connections, increase in plant efficiency and reduction in the installation cost of large size power plants, established reliability of large size units world-wide and environment benefits.

For the proposed plant, the unit would be of supercritical type. Supercritical pressure (throttle pressure above 221 bar(a)) steam cycle primarily would enhance power generation efficiency of the unit appreciably compared to a subcritical cycle pressure cycle. Although supercritical technology is a recent introduction in the country more than 500 supercritical units of varying sizes upto about 1000MW and parameters have so far been installed in the world over in the last 50 years. The supercritical units have been found to be cost effective in terms of life cycle cost and reliability.

7.0.2.2 The generally adopted supercritical pressure (turbine throttle pressure) is 242.2 bar(a). For the purposes of the present report following proven options of throttle steam and reheat steam parameters for the 660 MW units have been considered to prepare heat balances and to compute turbine cycle heat rates.

242.2 bar(a), 565°C/593°C

(Computed turbine cycle heat rate: 1853kCal/kWh)

The option of 242.2 bar (a), 565°C/593°C having the lower turbine cycle heat rate has been chosen for 660MW units of the proposed power project. The relevant turbine cycle heat balance is presented in Exhibit No. 003.

7.0.3 STEAM GENERATOR AND ACCESSORIES

7.0.3.1 The steam generator (SG) would be once through type and would be designed for firing 100% Indian washed coal of 4000 KCal/Kg GCV. The SG would be radiant; two pass design, single reheat, balanced draft, dry bottom and semi outdoor type. The capacity would be 2 % more than the VWO flow requirement of Steam turbine.

7.0.3.2 The water wall would be spiral wound plain tubes with vertical tubes over the spiral water walls or vertical riffled tubes type.

7.0.3.3 Indicative design parameters for the steam generator for the 660MW unit would be as below.

Parameters for the Steam Generator

a.	Superheater outlet pressure	255 bar(a)
b.	Superheater outlet temperature	568°C
c.	Superheater outlet flow	2200 TPH
d.	Re-heater outlet pressure	63 bar(a)
e.	Re-heater outlet temperature	596°C
f.	Feed water inlet temperature to economizer	294°C

7.0.3.4	The steam generator would have a fuel burning system of corner fired or front and rear wall mounted type. The furnace would be appropriately sized to avoid slagging in the water wall section, pendant/platen super heaters and re-heaters and in the heat transfer surfaces in convection pass.
7.0.3.5	The coal burners would be of proven advanced design to reduce NO_X production and the furnace would also be provided with over fire air ports to further reduce NO_X production.
7.0.3.6	The SG would be provided with circulation system comprising steam separators to remove water moisture from the evaporator outlet and to recirculate the water into economizer inlet, for use during startup. The SG and steam turbine generator (STG) would be designed for sliding pressure operation, which would increase turbine cycle efficiency and reduce boiler feed pump power consumption. The load range for sliding pressure operation would be from about 35% STG maximum continuous rating (STG MCR) to 90% STG MCR.
7.0.3.7	The SG would consist of water cooled furnace, radiant and convection superheaters, reheaters, economizer, regenerative air heater, steam coil air preheaters. Smart soot blower system would be provided with soot blowers located at strategic locations for cleaning the slagged and fouled heat transfer surfaces during operation.
7.0.3.8	The SG would be provided with the required vertical spindle medium speed coal mills, which would be located in the boiler front or between the boiler and the ESPor side mill arrangement. The milling system would be designed such that one(1) mill would be spare with unit operating at SG MCR capacity firing design coal and all six mills operating at SG MCR capacity firing worst coal (N+2 concept- ie. N no. of mills at TGMCR condition with 2 mills as spare). The coal mills would be provided with dynamic classifiers to control the fineness of the ground coal thereby to control the unburnt carbon losses. The coal mills would be provided with gravimetric coal feeders.
7.0.3.9	Sampling arrangement at mill outlet would be provided for the purpose of establishing the average gross calorific value of coal as well as coal fineness. The coal mills would be provided with steam blanketing system for the purpose of fire protection.
7.0.3.10	The SG would be designed to handle and burn HFO as secondary fuel upto about 22.5% SG MCR for start up and for flame stabilization during low load operation or during mill change overs. For unit light up and warm –up purposes, LDO system having 7.5 % SGMCR firing capability would be used with air atomization.
7.0.3.11	The SG would be provided with fuel oil pressuring units and fuel oil heating equipment along with high- energy electric arc ignitors to ignite the fuel oil guns.
7.0.3.12	The draft plant would comprise primary air fans, forced draft fans and induced draft fans.

	The primary and forced draft fans would be of axial blade pitch controlled axial type. The induced draft fans would be axial blade pitch controlled axial type or speed controlled (VFD) centrifugal type, which would reduce power consumption during power plant operation at TGMCR and part load operations.
7.0.3.13	Electrostatic precipitators (ESP) would be provided for the collection of fly ash. The ESP would be provided with microprocessor control system to optimize and for minimum electric power consumption. The ESP would be so designed that for worst coal firing an outlet dust concentration of 50 mg/Nm^3 as stipulated by State/Central Pollution Control Boards, would be achieved.

7.0.4 STEAM TURBINE GENERATOR AND ACCESSORIES AND CYCLE EQUIPMENT

7.0.4.1 Steam Turbine Generator

The steam turbine generator (STG) would be rated for 660 MW maximum continuous output at generator terminals, with throttle steam condition of 242.4bar(a) at 565°C/593°C reheat,0.1 bar(a) condenser back pressure with 1% make up. The STG output at valve wide-open (VWO) condition would be about 693 MW, which is 5% above the maximum continuous rating of 660MW to enable increased output required during low frequency operation and drop in efficiencies over years of operation.

The steam turbine would be a four cylinder, reheat extraction and condensing turbine.

The turbine generator would be complete with all accessories such as protection system, lube and control oil system, seal oil system, jacking oil system, seal steam system, turbine drain system, electro-hydraulic control system, automatic turbine run up system, on-line automatic turbine test system and turbine supervisory instrumentation. A continuous bypass (20% capacity) method of lube oil purification is proposed to be adopted for purification of lubricating oil.

The turbine generator would also have all necessary indicating and control devices to permit the unit to be placed on turning gear, rolled, accelerated and synchronized automatically from the control room. Other accessories of the turbine generator would include an external oil purification unit with transfer pumps and clean and dirty oil storage tanks of adequate capacity.

7.0.4.2 **PLANT CYCLE**

The condensing plant would comprise two condensers, one each for the two LP turbines. Each condenser would be of two pass design of single shell construction. The condenser would be suitable for use of sea water for condenser cooling and proposed to be provided with titanium tubes rolled into titanium clad carbon steel tube and welded sheets.2x100% capacity vacuum pumps would be provided to create vacuum in each condenser during start-up and to remove the non-condensable gases liberated during normal operation. The vacuum pump coolers are also proposed to be provided with Titanium tubes.

The regenerative cycle would consist of four low pressure heaters, a variable pressure Deaerator, three high pressure heaters, drain coolers and one gland steam condenser.
Under normal operating conditions, drains from the high pressure heater would be cascaded to the next lower pressure heater and finally to the deaerator. Drains from the low-pressure heaters would be cascaded successively to the next lower pressure heater and finally to the condenser hot well or pumped forward to the condensate line. Heaters would be provided with drain level controllers to maintain the drain level automatically throughout the range of operation of the heaters. The system would consist of split-range control valves to take the drain to a lower pressure heater or to the condenser through a flash box under exigent conditions.

7.0.4.3 **Bypass system**

The STG unit would be provided with a 60% TGMCR HP-LP bypass system.

a) To prevent a steam-generator trip in the event of a full export load throw-off and to maintain the unit in operation at house load
b) To prevent a steam-generator trip following a turbine trip and enable quick restart of the turbine generator set
c) To minimise warm restart duration of the unit after a trip
d) To conserve condensate during start up
e) To facilitate quick load changes in both directions without affecting the steam generator operation during start-ups

7.0.4.4 **Condensate Pumps**

The condensate from the condensate hotwell would be pumped by 3x50% capacity condensate pumps; two working and one stand by to the deaerator through the gland steam condenser, drain cooler and low-pressure heaters. The pumps would be vertical, cannister type, and multistage centrifugal pumps driven by AC motors.

7.0.4.5 **Boiler Feed Pumps**

Feed water would be pumped from deaerator to the steam generator through high-pressure heaters by means of 2x50% capacity steam turbine driven boiler feed pumps. A 50 % duty AC motor driven boiler feed pump would be provided to facilitate start-up of the unit and this pumping unit would have variable speed hydraulic coupling. The boiler feed pumps would be horizontal, multistage, centrifugal pumps of barrel type.

7.0.4.6 **Low Pressure Heaters**

The low pressure (LP) heaters would be of shell and tube with stainless steel U-tubes (seamless/welded) welded with their ends rolled in carbon steel tube sheets. The LP heaters would be provided with condensing zones and also with drain cooling zones.

7.0.4.7 **Deaerator**

The deaerating feed water heater would be a direct contact, variable pressure type heater with spray-tray type or spray type of deaeration arrangement. The feed water storage tank would have a storage capacity adequate to feed the steam generator for 6 minutes when operating at SG MCR conditions.

7.0.4.8 **High Pressure Heaters**

The high-pressure (HP) heaters would be of shell and tube with stainless steel U-tubes (seamless/welded) welded with their ends rolled in carbon steel tube sheets. The HP heaters would be provided with de-superheating zones and a drain cooling zones in addition to condensing zones.

7.0.4.9 **Gland Steam Condenser**

A surface type gland steam condenser would be used to condense the gland steam exhausted from turbine glands. The gland steam condenser would be of single-pass type with the main condensate flowing through the tubes to condense the steam. Exhausters would be provided to evacuate the air from the shell side and maintain the shell at the required negative pressure.

7.0.4.10 Condensate Polishing Unit

In order to maintain high purity of the feed water, a 100% capacity condensate polishing unit (CPU) is envisaged in the condensate system.

7.0.4.11 Chemical Dosing System

AVT (All volatile treatment) and oxygenated treatment is considered.

Ammonia dosing system would be provided to ensure chemical conditioning of the condensate/feed water for controlling the alkalinity. The ammonia solution would be injected into the condensate at the condensate extraction pump discharge. The low-pressure ammonia dosing system would comprise solution preparation-cum metering tanks with motorized agitators, two positive displacement type-dosing pumps, piping, valves, instruments and local control panel. Each dosing pump would be sized to cater to the 100 % dosing requirement of each of the 660 MW units.

To reduce iron pick up from the boiler, during normal operation of the plant, oxygenated treatment is also proposed. Under this treatment gaseous oxygen would be injected at CPU outlet and suction of feed water and maintain about 150 - 250ppm. Feed water pH is maintained in the range of 7.0-8.5.

7.0.4.12 Fuel Oil system

The annual requirement would be about 9400 m^3 based on consumption of 1ml/kWh (CERC guidelines) of power generation and 85 % PLF. The daily consumption of HFO would be about 35 tonnes.

HFO would be supplied by rail tankers from the nearest source and decanted to decanting pump house near railway track . HFO would pumped to oil dyke area to the two HFO tanks Two tanks each of capacity 3000KL are proposed which are adequate to meet the normal

requirement including peak requirements during commissioning and trial operation of units.
The HFO tanks would be fitted with steam heated floor coil heaters for initial heating and to supply fuel oil at the required temperature to the inlet of pumping and heating units. All HFO lines shall be heat traced and insulated.
The HFO decanting system would comprise 2x100% capacity pumps and decanting header with six flexible connections.
LDO system would be designed for unit light up and initial warm up purposes and a LDO storage capacity of 500 m^3 has been considered.
The LDO decanting system would comprise 2x100% capacity pumps and decanting header with six flexible connections.

7.0.5 WATER SYSTEMS

1.0 The scheme and material balance of water systems for the proposed 2 x 660 MW units is shown in Exhibit- 004. The water would be used for condenser cooling, cooling of SG and TG auxiliaries and various other requirements like SG makeup, service and potable water, fire protection system etc. The water systems consist of various sub-systems listed below and described in the subsequent paragraphs of this chapter.

a) Raw water supply and storage system

b) Condenser cooling water (CW) system

c) Auxiliary cooling water (ACW) system

d) Water treatment (WT) system

e) Service & potable water system

f) Fire protection system

g) Effluent disposal system

h) Chemical laboratory equipment

2.0 **RAW WATER SUPPLY AND STORAGE SYSTEM**

2.0.1 The total water allocated for Phase III is 1570 MCFT per year 1,21,832m^3/day). The allotted water would be met from Lhasi Irrigation Project (300 mcft), Andheri Irrigation Project (500 mcft) and Parwan Major Irrigation Project (770 mcft) as per

letter Reference no. CEWR/TA (W) / 1482 dated 11-08-2009 from The Chief Engineer, Water Resources Department, Rajasthan, Jaipur. All the above three water sources are situated at a an aerial distance of about 20-60 km from the power plant. The total requirement of raw water make-up is of the order of 1482 mcft /year based on 100% bottom ash and 20% fly ash through wet slurry system. Balance 80% of fly ash disposal would be dry system for the 1320 MW power plant capacity. An allocation of 1570 mcft has considered due to evaporation losses in the canal and desilting pond and pipe losses which are located outside of plant boundary.

2.0.2 Raw water is proposed to be pumped from the each source water pump house/ canal to a raw water pond (buffer to cater for 15 days storage) within the power plant.

2.0.3 Though the source of water is at an aerial distance of 20-60 km from the power plant, the requirement of laying the pipe line along the highway for maintenance purpose renders the route length of about 20-60 km.

3 x 50% capacity river water pumps shall be provided in the each intake pump house. Details of the configuration of pumps and conveying pipeline from all the above three sources shall be worked out during detail engineering when route survey and associated hydraulic studies etc. are available.

2.0.4 Power requirement for the river water pumps shall be provided from the power plant at suitable voltage.

3.0 PLANT WATER REQUIREMENT

The total plant water requirement is summarized in Table – 7.1

2.1 RAW WATER TREATMENT

2.1.1 Since the river water is expected to have high turbidity / suspended solids during monsoon and the quality of influent water required for the various systems in the plant is clarified cum filtered water (with turbidity and suspended solids less than 2

ppm), it is proposed to provide clariflocculator type clarifier along with rapid gravity filters, for CW make up and plant service. Another solids contact type clarifier is proposed to exclusively cater to the DM plant. This clarifier will take care of any colloidal silica presence, which cannot be removed by ion exchange units in the water treatment (WT) plant.

2.1.2 The basis for water treatment shall be as per the design raw water analysis.

2.1.3 The filtered water from the main plant clarifier and rapid gravity filters will be stored in a filtered water sump of four(4) hours storage, which will be in two (2) compartments. The storage sump caters to the requirement of CW make up, plant and colony potable water and miscellaneous plant service. The sump shall be underground with top covered of RCC construction.

2.1.4 The clarified water from the DM plant clarifier will be stored in DM plant clarified water storage tank (above ground, top covered of RCC construction) of ten(10) hours storage.

2.2 FILTERED WATER PUMP HOUSE

2.2.1 The following pumps will be located adjacent to the filtered water sump under a top covered enclosure.

i). WT plants supply pumps (taking suction from DM clarified water tank)

ii). Filter backwash pumps (taking suction from filtered water sump)

iii). Filtered water pumps for plant (taking suction from filtered water sump)

iv). Filtered water pumps for colony (taking suction from filtered water sump)

v). CW make up pumps (taking suction from filtered water sump)

2.2.2 A chemical house shall be located close to the pre-treatment plant which shall store chemicals required for minimum 15 days operation. The chemicals include, alum, poly electrolyte, ferric chloride, sodium hypochlorite, etc.. Chemical preparation cum dosing tanks, dosing pumps, safety and handling equipments shall be provided in the chemical house.

2.3 PLANT WATER REQUIREMENT

The total plant water requirement is summarised in Table 7.1 below:

TABLE-7.1

PLANT WATER REQUIREMENT

Sl No	Item	Estimated Quantity			Quality
		M^3/hr	M^3/day (without ash water recovery)	M^3/day (with ash water recovery)	
1.0	CW make up for condenser and other auxiliaries	3258	84672	84672	Filtered Water
2.0	Main Clarifier blow down	-	4556	4556	Sludge
2.1	DM clarifier blow down	-	100	100	Sludge
3.0	Service Water for plant & HVAC makeup	-	754	754	Clarified water
4.0	Plant & Colony potable water	-	530	530	Filtered water
5.0	DM water for SG makeup, ACW makeup	68	1632	1632	DM water
6.0	DM plant regeneration	-	182	182	Waste water
7.0	Filter backwash	-	1902	1902	Waste water
8.0	Plant reservoir evaporation loss	-	3375	3375	River water
9.0	Additional raw water required for wet slurry system	-	17488	13488	River water

10.0	**Total raw water requirement (Item 1 + Item 9)**	**-**	**115191**	**111191**	**River water**

3.0 **CONDENSER COOLING WATER (CW) SYSTEM**

3.1 Recirculation type cooling system with cooling tower is proposed for CW system using Natural draught cooling tower (NDCT).

3.2 **Cooling Water (CW) Pumps**

3.2.1 3x33.33% capacity CW pumps, each of capacity 28333 m^3/hr are proposed for each unit and 1 no. common standby for both the units. Vertical turbine pumps of self lubricated type with cast iron casing, stainless steel (SS 410) shaft and stainless steel (SS 304) impeller are proposed. These pumps will be connected to a common CW fore bay. The CW pumps will be located in the CW pump house. An EOT crane will be provided in the pump house for handling the pumps and motors.

3.2.3 **Cooling Towers**

It is proposed to install One (1) no. natural draft-cooling tower for each unit of capacity 85000 m^3/hr. The cooling water would be collected in a basin. The cooling tower would be designed for a cooling range of 10^0C and an approach of 5 ^{0}C. The design wet bulb temperature would be 27 ^{0}C. The design hot and cold water temperatures of the cooling towers would be 42^0C and 32^0C respectively. Tower construction would be of RCC material with PVC splash fills.

3.2.4 **RC Channels**

CW flow from the cooling tower basin is proposed to be conveyed by gravity to the common CW forebay of RC rectangular open channels. The channels are designed to resist maximum level fluctuations expected under transient flow condition.

3.2.5 **CW Forebay and Pumphouse**

CW flow is proposed to be discharged from the open channel to a common forebay and pump house. The forebay is designed to ensure equidistribution of flow to the CW pumps as well as to limit the entrance velocity at the CW pump house. The top level of the forebay walls is fixed on the basis of maximum upsurge expected in the

forebay when all the CW pumps trip under normal water level condition. The sump level of the pump house is fixed so as to ensure adequate submergence to the CW pumps.

3.2.6 CW Inlet and Outlet Conduits

From the CW pump house, the CW discharge for each unit is proposed to be conveyed to the respective condensers located in the station building, through CW inlet conduits. These conduits are of mild steel with about 4000 mm internal and buried throughout. Suitable treatment for corrosion protection shall be provided on the CW pipes. The hot water from the condensers will be conveyed back to the cooling towers through CW outlet conduits of mild steel with similar size as the inlet.

3.2.7 Valves and Specialties

Motor operated butterfly valves will be provided at the discharge of the CW pumps and the condenser inlet / outlet piping to facilitate isolation and control. Expansion joints are proposed in the CW pump discharge lines and condenser inlet and outlet lines to take care of any misalignment, thermal expansion, etc., and to facilitate erection and maintenance. The CW pumps and their discharge valves would be suitably interlocked to result in a co-ordinated operation.

3.3 CW BLOWDOWN AND MAKE-UP WATER REQUIREMENTS

3.3.1 Make-up water requirement of CW system is obtained as the sum of drift and evaporation losses from the cooling tower and blow down from the CW system (by way of water drained from the hot water conduit of the CW system). In order to conserve water, the blow down would be utilised to meet the water requirement of the fire protection systems, ash handling system and coal handling system. Table-IX.2 indicates the CW blow down / make-up water requirements, for the cooling water system.

3.3.2 The analysis of raw water (make up water) is presented in Appendix-2. Based on MOEF letter ref. no. J-13012/14/2009-IA-11(T) dated 17-07-2009 a cycle of concentration (COC) of 5 would be adopted for CW system. The CW blow down will

be done from the condenser outlet conduits (hot side). The blow down water from the condenser outlet will be connected to blow down tank for further distribution for coal and ash handling water requirements. Extra water required for ash handling system based on 100% bottom ash and 20% fly ash wet slurry system directly pumped from plant raw water storage reservoir. Blow down water tank shall be used for fire fighting system also considering 3000 cu.m of water as dead storage.

3.3.3 To prevent scaling arising due to the operation of CW system with a higher COC, chemical dosing system with scale inhibitor / dispersant is envisaged. In order to prevent /minimise growth of algae in the CW system, Chlorine dosing system is envisaged.

TABLE - 7.2

CW SYSTEM MAKE-UP REQUIREMENTS

Sl. No.	Item	Quantity (M^3/day)
1.	Cooling Tower (Evaporation + Drift Losses)	34080 x 2 towers = 68160
2.*	Condenser CW System Blow down*	8256 x 2 towers = 16512*
3.	CW Make-up requirement (item 1 + item 2)	68160+ 16512 = 84672
4.	Concentration Ratio 'C' (item 3 / item 2)	5
* Blowdown water will be led to a Blowdown storage tank which will contain the minimum reserve storage for fire protection system. A pump house consisting of fire fighting pumps (as per TAC), pumps for coal handling system, ash handling system and plant service shall be provided beside the tank. The tank shall be suitably sized to cater to the requirement of fire fighting, coal, ash handling systems and plant service water.		

4.0 **CW Make-Up System**

Filtered water from the filtered water sump will be pumped to the CW forebay by 3x50% capacity pumps for CW makeup system.

4.1 **CW System Chlorination**

In order to prevent / minimise the growth of algae in the cooling water system, chlorine dosing is proposed. Provision will be made for shock dosing and continuous dosing. However, the continuous dosing rate would be adjusted during operation phase to meet the chlorine demand. It is proposed to use latest technology like Electro-chlorination type for chlorine dosing system.

4.2 **Side Stream Filtration**

Since filtered water is being provided as CW make up, Side Stream Filtration is not envisaged.

5.0 **AUXILIARY COOLING WATER (ACW) SYSTEM**

5.1 Passivated DM water shall be used to cool all the SG and TG auxiliaries, by means of the following:-

a) 2x100% SG DM cooling water pumps (for each unit)
b) 2x100% capacity Plate Heat Exchangers for SG Auxiliaries (for each unit)
c) 3x50% TG DM cooling water pumps (for each unit)
d) 3x50% capacity Plate Heat Exchangers for TG Auxiliaries (for each unit)

5.2 A common overhead tank (for each unit) of 10 m^3 capacity, consisting of passivated DM water shall be provided on the suction side of the SG & TG DM cooling water pumps.

5.3 Secondary cooling water shall be supplied by auxiliary cooling water pumps(2x50% pumps for each unit with 1x50% common standby) located in the CW pump house, to cool the passivated DM water through plate type heat exchangers. ACW pumps shall be of vertical turbine type.

5.4 Auxiliary Cooling water shall be provided for the following:

(i) Vacuum pump coolers
(ii) Air Compressors for Ash Handling System
(iii) Air Compressors for Plant
(iv) Turbine Oil Coolers

5.5 DM Cooling Water shall be provided on the primary side of Plate Heat Exchangers for the following :

SG auxiliaries consisting of,

(i) ID Fan coolers
(ii) PA Fan coolers
(iii) FD Fan coolers
(iv) Mill coolers
(v) Air Preheater coolers
(vi) Boiler access doors
(vii) Sample coolers

TG auxiliaries consisting of,

(i) SWAS coolers
(ii) BFP coolers
(iii) CEP coolers
(iv) Hydrogen coolers
(v) Exciter air coolers
(vi) Seal oil coolers

6.0 WATER TREATMENT PLANT

The water treatment plant broadly consists of DM pre-treatment plant, filtration and DM plant.

6.1 The DM pre-treatment consists of:

i). Chlorination system in the form of sodium hypochlorite to destroy organic matter and algae.

ii). Alum dosing system for the purpose of coagulation.

6.2 The filtration plant consists of vertical dual media filters, each of suitable capacity, to remove turbidity and suspended solids. The dual media filters will be of mild steel construction with five- (5) mil thick epoxy painted internally. Filter media will be Graded quartz sand and anthracite or granular activated carbon with supporting bed. Two (2) nos., 100% capacity filter air blowers will be used for loosening filter bed before filter back washing. Back washing of filters will be done by means of gravity flow from filtered water storage tank. Part of the filtered water will be stored in filtered water storage tank of suitable capacity which will be located on the roof of water treatment plant building. Water will be supplied to the filtration plant by means of 3x50% capacity WT plant supply. The material of construction of these pumps will be in cast iron casing, bronze impeller and stainless steel (410) shaft. The WT plant supply pumps will take suction from the DM plant clarified water storage tank.

6.3 **Dechlorination Equipment**

Activated carbon filters will be used for dechlorination. These filters will also remove any organic grease, oil etc. present in the water. The filters will be of MS construction with 5 mm epoxy painting internally.

6.4 **DM Plant**

The DM plant will meet the requirements of steam generator (SG) feed water make up, and ACW system make-up and designed for a total output of 1632 m^3/day of DM water based on SG feed water make up at 1.5% MCR for each unit. It is proposed to provide Two (2) working streams of 2 x 60% capacity DM plant. Each stream will be designed for an output of 50 m^3/hr with 18 hours productive run time. Each stream of the DM plant will consist of the following:

(a) **Cation Unit**

Filtered and dechlorinated water will pass through the cation units. The cation unit will be designed to limit the sodium slip within 1.0 ppm as $CaCO_3$.

(b) **Degasser System**

The effluent from SAC units will then pass through a forced draft degasser tower (2x50% capacity) to limit the CO_2 to 5 ppm as CO_2. For the degasser tower two (2) nos., 100% capacity degasser air blowers will be provided. The degassed water will be stored in a common degassed water storage tank. Three (3) nos., (2 working + 1 standby) degassed water transfer pumps will be provided for transferring the degassed water to the anion units. The degassed water storage tank will be of mild steel construction with five- (5) mm-thick rubber lining. The materials of construction of degassed water transfer pumps will be SS.

(c) **Anion Units**

The degassed water transfer pumps will pump degassed water through Weak based anion units (WBA) and strong base anion (SBA) unit. SBA unit will be designed to restrict the silica slip within 0.1 ppm as SiO_2 and conductivity < 6 micromho/cm.

(d) **Mixed Bed (MB) unit**

The final polishing of DM water will be done in MB unit. The MB unit will be designed to limit the silica less than 0.02 ppm, as SiO_2 and conductivity will be restricted to 0.1 micro mho/cm at 25^0C.

All the above Ion Exchange units will be of mild steel construction with five (5) mm thick rubber lining internally and 3 mil thick chlorinated rubber painting externally and all associated piping / valves of Ion Exchange Units will be either rubber lined or SS. DM water from the mixed bed units will be led to Three(3) nos., DM water storage tanks, each of capacity 1300m^3. The DM water from the DM plant storage tanks will be pumped to condensate storage tank by 2x100% DM water transfer pumps.

(e) **Regeneration System**

33% hydrochloric and 48% sodium hydroxide will be used as regenerants for the purpose of regeneration of cation and anion resins respectively. The equipment of regeneration system will comprise bulk acid and alkali storage

tanks, acid / alkali transfer pumps, acid / alkali solution preparation and measuring tanks, ejectors and all associated piping / valves, etc. one (1) no., each bulk acid and alkali storage tanks will be provided to meet the requirement of both streams. Each of the tanks will be sized to hold 15 tonnes of respective chemical.

(f) **Neutralising System**

The acidic and alkaline effluents from DM plant and CPU regeneration will be led to the neutralising pit. The pit will be in two equal compartments. Acid or alkali will be added to the neutralising pit depending on nature of effluents from DM plant. Two (2) nos., pumps, (1 working + 1 standby) to handle effluents of both units with SS 316 material of construction are proposed to dispose the neutralised effluents into the ash pond. The neutralising pit shall be lined with acid/alkali resistant tiles.

(g) **Mode of Operation of DM Plant / Filtration Plant**

The complete mode of operation of DM plant and filtration plant will be semi-automatic for which a PLC based control system will be provided.

7.0 SERVICE AND POTABLE WATER SYSTEMS

7.1 Water required for plant washing and gardening will be provided from the blow down tank and CMB. Water required for air conditioning and ventilation system make-up will be taken from the service water overhead tank (located on TG building in Deaerator bay).

7.2 Requirements of plant potable water system would be met by the filtered water overhead tank (located on TG building Deaerator bay) of 50 cu.m capacity. Distribution of potable water to various consumer points in the plant would be by gravity / pumps based on layout conditions.

7.3 Requirements of colony potable water system would be met by 3x60% colony potable water pumps, which will pump potable water from the filtered water sump to the colony. Further distribution of potable water to various consumer points in colony would be by gravity / pumping as per layout conditions.

8.0 FIRE PROTECTION SYSTEM

8.1 This system will consist of the following sub-systems:

(a) Hydrant system covering all areas of the plant.

(b) High velocity water spray (HVWS) system for the protection of generator transformers, turbine oil tanks, lube oil system equipment, unit auxiliary transformers

(c) Automatic deluge (medium velocity water spray) system for the protection of cable galleries

8.2 The system would be designed to conform generally to the rules and regulations of the Tariff Advisory Committee (TAC). Two(2) nos., motor-driven and two (2) nos., diesel engine-driven pumps would be provided for the hydrant and spray system. Two 2x100 % capacity jockey pumps of horizontal, centrifugal type, would be provided to keep the system pressurised. All the above pumps would be located in the blowdown pump house. The blowdown storage tank would have a minimum reserve storage of 3000 m^3 of water for the fire protection system in line with the regulations of the TAC.

9.0 CHEMICAL LABORATORY EQUIPMENT

A separate chemical laboratory to enable testing of fuel, water, flue gas, etc. as required for normal operation of the power plant would be setup.

10.0 **EFFLUENT DISPOSAL SYSTEM**

10.1 The sources of plant effluent are mainly:

a) C.W. system blowdown
b) Effluent from WT plant (Pre treatment, DM plant)
c) Coal pile area run off water
d) Ash water recovery
e) Plant drains
f) Sludge from various clarifiers / tube settlers
g) Oily wastes from transformer yard drains
h) Oily wastes from fuel oil unloading and tank farm areas
i) Plant and Colony sewage

10.2 C.W system blowdown should be utilised for meeting the requirement of ash handling system (such as 100% bottom ash and 20% fly ash wet disposal, fly ash conditioning, refractory cooling, etc), Coal handling system (dust suppression) and fire protection system. Additional water required for ash handling system would be directly taken from the ash handling pumps which is located at raw water reservoir..

10.4 Water treatment plant effluent comprises mainly of DM regeneration waste. These effluents shall be pumped to the blow down tank

10.5 The drains from the coal handling area run-off shall be led to a settling tank. Coal particles shall settle down in the settling tank and the clear water from the shall overflow / be pumped to blowdown tank after suitable treatment.

10.6 Plant drains from SG/TG area shall be led to a sump which shall also collect oily wastes from transformer area and fuel oil farm area. These oily effluents shall be further treated in an oil water separator for removal of oil traces. The clear water shall be led to the blowdown tank the dirty oil shall be disposed off in drums separately.

10.7 Clarifier sludge and filter backwash system shall undergo a complete solid waste management. The influents will include sludge from main and DM clarifiers, filter backwash wastes, effluent treatment plant wastes, etc. Separated solids after thickener / centrifuge / filter press mechanisms shall be disposed off manually.

10.8 The excess effluent from blowdown tank should be utilised as far as possible for horticulture, service water, etc.

10.9 A common sewage treatment plant shall be provided to handle and treat the sewage from plant and colony for suitable reuse

7.0.6 COAL HANDLING SYSTEM

GENERAL

This chapter covers the provisions for the coal handling system for the proposed power plant.

It covers proposed facilities for receipt of coal by wagons, unloading, crushing, screening, stacking and reclaiming and conveying to the steam generator (SG) bunkers.

DESIGN CRITERIA AND ASSUMPTIONS

The design criteria for coal receipt by wagons, unloading from wagons, stacking, reclaiming, screening, crushing and conveying is based on the following functional requirements and assumptions:

Coal required for each unit at maximum continuous rating (MCR) condition based on washed coal having a gross calorific value of 4000 kCal/kg is 380 TPH.

The maximum lump size of the coal received at power plant will be -400 mm.

Two stage Crushing of coal is considered as the maximum lump size of coal received at site is -400 mm.

A coal stockyard for stacking of coal required for a minimum period 30 days has been considered.

The coal handling system shall normally operate for 14 hours per day. The wagon unloading system shall operate for 20 hours per day. However, the complete coal handling system shall be designed for 24 hours continuous operation.

Provision would be kept for feeding of coal received by wagons directly into the coal bunkers if required.

COAL UNLOADING SYSTEM

In order to have better redundancy, coal handling system is split in to two parts (2X 50%) Each part of the coal handling system would be provided with two Nos wagon tipplers, Crushers, screens and one No. stacker reclaimer along with a series of belt conveyors which would feed the coal to the bunkers in boiler area. Both parts of the coal handling system would be operating simultaneously and independently, while one part of the coal handling system would feed unit 5 from one side the other part would feed the unit 6 from other end. It would be possible to feed either of the units 5 or 6 from both streams of coal handling system.

SYSTEM CAPACITY

Four streams of conveyors 2 W+2S (4x50%) and four streams (4x 50%) of crushers and screens 2W+ 2S shall be provided along with four wagon tipplers for the coal handling system from wagon unloading area to the coal stock yard with two stacker cum reclaimers (2X50%) with a rated capacity of 1000TPH. However, the rated capacity of stacker cum reclaimer shall be 1000 TPH while stacking and average reclaiming capacity shall be 1000 TPH. Separate

conveyors from each of the stock yard would carry coal to the coal bunkers of either units and feed the bunkers through travelling tripper arrangement.

SYSTEM DESCRIPTION

The system description furnished below is to be read with reference to Plot plan Exhibit-002 and Coal Handling System (CHS) flow diagram Exhibit-005.

COAL CONVEYING FROM WAGON UNLOADING TO STOCK YARD

Coal of -400mm size received by rail in BOX-N / BOBR wagons would be unloaded into wagon tippler hopper. Coal handling system would have two streams each stream operating independently. Each stream of coal handling system would be provided with two Nos wagon tipplers for unloading coal from wagons. Coal shall be extracted from wagon tippler hopper by apron feeder for onward conveying to the Primary crusher house (CH). Where the (-) 400 mm coal is reduced to -125mm size. Primary crushed coal of -125mm is conveyed to secondary crusher house where the -20mm coal is screened out and (+) 20 mm coal would be fed to the secondary crushers for crushing the same to (-) 20 mm. The crushed coal of (-) 20 mm size shall be conveyed to coal stockyard and stacked using a reversible bucket wheel type stacker cum reclaimer. Stock piles shall have a minimum capacity of 30 days storage. There shall be two such systems operating simultaneously. Each wagon tippler would also be provided with one No JCB with rock arm arrangement for breaking large size lumps received if any. A separate coal testing laboratory with facilities for sample preparation , testing and storage of reference samples would be provided at the wagon tippler area for third party testing of incoming coal.

RECLAIMING, AND BUNKER FEEDING.

Coal would be reclaimed from the respective stock piles and conveyed to coal bunkers at boiler area through a series of conveyors and fed into the bunkers through travelling tripper arrangement.

SALIENT FEATURES OF THE SYSTEM

Belt Conveyors

All conveyors would be provided with Nylon-Nylon belting with fire retardant (FR) grade covers

of 5mm thickness at top and 3 mm thickness at bottom. The belt width would be 1200 mm with a troughing angle of 35^0. The belt speed would be about 2.75 m / sec.

Conveyor Galleries

All above-ground conveyors would be provided with enclosed galleries with sheeting on side and top. Seal plates at required locations like road & building crossings, etc. will be provided.

Wagon Tipplers

Four Nos. Wagon tipplers along with side arm chargers, Apron feeders and dribble conveyors etc, would be provided to facilitate un loading of coal from the wagons.

Primary Crushers

Each stream of coal handling system would be provided with two primary crushers (1W+1S) of rotary breaker type. These Crushers would have the capacity to reduce coal from (-) 400 mm to (-) 125 mm size at 1000TPH.

Secondary Crushers

Each stream of coal handling system would be provided with two secondary crushers (1W+1S) of Ring granulator type. These Crushers would have the capacity to reduce coal from (-) 125 mm to (-) 20 mm size at 1000TPH.

Screens

There would be four (4) screens(two operating in each stream), Screens would be of triangular / eccentric disc type with a capacity of 1000 TPH each. This type of screen is quite effective for screening sticky coal.

Crusher House

All the floors and roof of the crusher house would be of RCC and side walls would be brick construction. A partition wall would be provided in the crusher house in between operating and standby crusher to reduce the dust nuisance and also to enable maintenance of the standby crusher while the other crusher is operating. Crushers would be mounted on a separate RCC deck supported on springs to isolate vibrations in the crusher house.

Junction Towers

All junction towers would be of structural steel with Rcc floors and roof. Side cladding would

be provided with corrugated GI / colour coated sheets.

Feeding of Coal to Bunkers and Bunker Ventilation System

Coal would be fed to the bunkers from conveyors through motorised travelling trippers. The coal bunkers are of circular type and the openings on the top would be covered with bunker sealing belt to avoid dust nuisance. The bunkers would be adequately ventilated so as to keep the bunkers free from accumulation of volatile gases, thereby eliminating fire hazard and also avoiding dust nuisance in the tripper floor. The ventilated air would be passed through bag filters before being let out into atmosphere.

Stacker-cum- Reclaimer

Two (2) Nos. travelling and slewing type stacker-cum-reclaimer will be provided for stacking and reclaiming of coal in the stock yard. The stacking capacity would be 1000 t/hr and the average reclaiming capacity will be 1000 TPH. The coal would be stacked on both sides of the trunk conveyor.

Metering of Coal

Adequate number of electronic belt scales would be provided on conveyors at appropriate places to monitor the inflow of coal quantity into the plant and the coal feed to the bunkers. Additionally one in motion wagon weighing system would also be provided to monitor the incoming coal.

Tramp Iron Detection and Removal

Tramp iron and other magnetic materials would be removed by means of in-line magnetic separators provided on the head pulleys of conveyors leading to the crusher house and on the Conveyor taking feed from reclaimer. Metal detectors would be provided on other conveyors at appropriate locations to detect non-magnetic metal pieces and heavy iron pieces that may be present in the coal being conveyed.

Dust Control

Dry fog type dust suppression system would be provided at all transfer points in the junction towers. Plain water type dust suppression system would also be provided all around the stockpile to suppress the dust generated and to keep dust nuisance to the minimum. The bunker ventilation system would be provided with dry type bag filters to trap the dust generated while loading coal into bunkers and to vent out dust free gases/air. Dry type DE system would

be provided in primary and secondary Crusher house to minimise the dust nuisance.

Fire Protection

Fire hydrants would be provided at all, junction towers, crusher house, bunker gallery and along the overhead conveyors. Fire hydrants would also be placed along the periphery of the coal stock pile for fire fighting.

Coal Yard Drainage

Around the coal stock yard, drainage channels would be constructed to take all the effluent from the coal stock yard (sprinkling water, rain / leach water) which would be ultimately led to a sump. A sump pump would be provided to pump the leach water to the guard pond.

Controls

Operation of the complete coal handling system, except travelling trippers on bunkers, stacker-cum-reclaimer would be monitored from the coal handling control room. Travelling trippers, stacker-cum-reclaimer would be controlled locally. The control and protection system would be microprocessor based with redundant CPU and colour monitor. Telemetered integrated readings would be provided for accounting of coal consumed by the SG units. Also, annunciation would be provided in the unit control room to indicate low level of each bunker.

7.0.7 ASH HANDLING SYSTEM

GENERAL

The following would be the design criteria for the proposed ash handling system:

Hourly coal firing rate at MCR condition per unit (worst coal)	380 TPH
Ash content in coal (worst coal)considered for the design of ash handling system	32 %
Distribution of total ash produced as	
Bottom ash	20 %
Fly ash	80 %
Volume occupied by one tonne of ash in storage area	1 m^3

PLF 85%

The system proposed for bottom ash removal would be water impounded hopper with jet pumping upto common slurry sump and further disposal of bottom ash in slurry form up to the ash disposal area by slurry pumps and associated piping. Fly ash removal system would be pressure pneumatic system with dry disposal by trucks for utilisation.
The water required for refractory cooling, slurry formation, fly ash dust conditioners and dust suppression in the ash disposal area would be met from CW blow down. However, service water would be used for jacket cooling of air compressors, silo / ESP aeration blowers cooling and slurry pump sealing etc.

Bottom ash handling system (Refer Exhibit – 006A: Flow Diagram)

A maximum of 20% of the total ash produced by each steam generator would be collected in the water impounded, refractory lined furnace hopper as bottom ash. The bottom ash hopper would have a capacity to store about eight (8) hours collection of bottom ash. Two heavy duty clinker grinders and a jet pump would be mounted at each of the hopper outlets to crush the ash clinkers to (-) 25mm size and convey the same to the slurry sump. Out of the four clinker grinders, two clinker grinders would be operating, leaving the other set of two clinker grinders as stand by.

Bottom ash is proposed to be evacuated once in eight hours of one shift. The capacity of bottom ash handling system will be 180 TPH (90 TPH / Jet Pump). Thus, bottom ash will be evacuated from one unit in about 1.5 hours time.

Duly ground Bottom ash will be pumped to ash slurry sump by jet pumps each of 90 TPH ash conveying capacity. From the slurry sump, bottom ash slurry will be pumped to ash disposal area by slurry pumps.

Fly ash handling system (Refer Exhibit – 006B: Flow Diagram)

The fly ash handling system shall be either vacuum-cum-pressure type or pressure-cum-pressure type. The fly ash collected in the ESP hoppers, air preheater hoppers, economizer hoppers and stack hoppers shall be evacuated pneumatically. Manual evacuation facility in addition to pneumatic evacuation shall be provided for fly ash collected in first two rows of

ESP hoppers and stack hopper.

The system capacity for the fly ash evacuation shall be based on evacuating the FA generated in 8 hours in about 6 hours. The capacity of the individual lines and grouping of the various ash hopper shall be based on the standard vacuum pump capacity / conveying capacity.

Pressure-Pressure type system (Dense phase pneumatic type)

Fly ash evacuation from fly ash hoppers and conveyance up to Intermediate Storage Hoppers (ISH):

In this system, Fly ash collected in the ESP hoppers, air pre-heater hoppers and economizer hoppers shall be evacuated pneumatically. Air compressors of suitable capacity shall be installed for conveying fly ash from ash hoppers to ISH.

Clearance of ash from hoppers connected to common fly ash header shall be done one after other. Shifting of ash clearance cycle from one hopper to the next will be automatic. The ash collected in each fly ash hopper shall be conveyed to ISH.

Fly ash conveying from ISH to Fly Ash Storage Silos:

From ISH, dry fly ash shall be conveyed to the storage silos by pressure pneumatic system. Below the ISH, there shall be two transmitters (one operating and one standby normally) for pneumatic conveying system. Two fly ash storage silos shall be provided for each unit. The capacity of the intermediate storage hoppers shall be minimum 200 T each. Provision would also be provided to send fly ash from intermediate storage (Buffer) hoppers to Ash slurry sump in slurry form during emergency.

Vacuum-cum-Pressure type system

In this system, the vacuum shall be created using vacuum pumps. The total ash removal system shall be divided into number of parallel paths depending on the total system capacity and standard vacuum pump capacity. In each path, clearance of ash from hoppers connected to common fly ash header shall be done one after another. Shifting of ash clearance cycle from one hopper to the next will be automatic and based on vacuum level. In either of the systems, the fly ash collected in each fly ash hopper shall be conveyed to intermediate storage

(Buffer) hoppers.

There shall be two (2) intermediate storage (Buffer) hoppers and they shall be provided with bag filters. From intermediate storage hoppers, dry fly ash shall be conveyed to the storage silos located out side the plant boundary by pressure pneumatic system. Below each intermediate storage hopper, there shall be two transmitters (both operating) for pneumatic conveying system. The capacity of the intermediate storage hoppers shall be minimum 200 T each. Provision would also be provided to send fly ash from intermediate storage (Buffer) hoppers to Ash slurry sump in slurry form during emergency.

The fly ash evacuation and conveying system up to silo shall be based on 6 hours of operation in a shift of 8 hrs. Two FA storage silos shall be provided, one for each unit. A vent filter shall be mounted on each silo and intermediate hopper to reduce the environmental pollution.

Fly Ash Storage Silo and Disposal of Fly Ash from Silo

There shall be four (4) fly ash storage silos for both the units each having a holding capacity of 850 tonnes. Each silo shall be provided with 3 outlets. Two outlets shall cater to unloading into road trucks / tankers through paddle type dust conditioner. One outlet shall be left blank. The silo operating platform shall have a clear height of 6.0 m for easy movement of trucks / road tankers.

Fly Ash Slurry Disposal System(Emergency)

Suitable Jet pumps and wetting heads as required would be provided below the Intermediate storage (Buffer) hoppers for disposing the fly ash to the ash slurry sump from where it would be pumped to ash disposal area along with bottom ash using slurry pumps and associated piping.

MAJOR EQUIPMENT

BOTTOM ASH HOPPER

The bottom ash hopper would be of 'W' type having two (2) outlets (Each outlet will have its standby). Each outlet will be provided with hydraulically operated feed gate. The bottom ash hopper will have a capacity to store eight (8) hours of bottom ash generation. The bottom ash hopper would be of MS welded construction having external supports. A seal trough would be provided around the top periphery of the ash hopper, for furnace sealing and to

prevent ingress of air into the furnace. The hopper would be lined with a monolithic refractory

CLINKER GRINDER

Two (one working and one standby) single roll / double roll type clinker grinders housed in steel enclosure with suitable liners would be provided below each outlet. The grinders would crush the ash clinkers to (-) 25mm size and each grinder would have a capacity of 90 TPH.

Jet Pumps

One jet pump of 90 TPH capacity complete with water piping, valves, etc. would be provided below each clinker grinder for conveying bottom ash to the ash slurry sump.

FLY ASH TRANSMITTER VESSELS

The fly ash transmitters will be designed to operate on the principle of dense phase pressure type pneumatic system. The size of the transmitter vessel below fly ash hoppers will be selected based on evacuation of ash collected in a shift of 8 hours in 6 hours time.

AIR COMPRESSORS

The requirement of compressed air for conveying fly ash from ESP hoppers, APH hoppers, economizer hoppers and stack hopper to fly ash storage silo would be met by oil free screw compressors of suitable capacity with adequately sized air receivers. The requirement of compressed instrument air for instruments, operation of pneumatic valves in the system and bag filter cleaning would be met by the dedicated oil free screw type air compressors with driers, air receivers and all accessories for ash handling system.

ESP Hopper Fluidising Blowers and FA Silo Fluidising Blowers

The requirement of fly ash hopper fluidising air and silo aeration requirement will be met by separate set of air blowers with adequate no of stand by blowers provided.

High Pressure (HP) and Low Pressure (LP) Water Pumps

HP water pumps will be provided to meet the water requirement of jet pumps provided below the bottom ash and fly ash silos of both units. LP water pumps will be provided to meet the water requirement of the refractory cooling, seal trough makeup, bottom ash hopper filling and makeup, clinker grinder sealing and fly ash conditioners. The HP and LP water pumps will be of horizontal centrifugal type.

Ash Water Recovery System

The ash water recovery sump shall have baffles such a way that further settlement of ash takes place and clear water will flow towards ash water recovery Sumps. There shall be two (2) recovery water pumps (1W+1S) and one recovery water pipeline, adequate for the flow rate of ash water recovered from the ash pond.

Ash Disposal Area Development, Ash Disposal and Ash Water Recovery

All around the ash disposal area (about 45 Hectares), ash dyke of 6 m height shall be constructed. The ash dyke will be constructed such a way that if required, the ash dyke height could be increased at a later date to an ultimate height of 11 M. The ash disposal area is provided with LDPE / HDPE membrane so as to see that ground is not contaminated with ash.

AUTOMATIC SEQUENTIAL CONTROLS FOR ASH REMOVAL SYSTEM

To automatically control all the compressors, pumps, valves, etc., in the fly ash handling system, a centralised control panel with micro processor based PLC would be provided in the control room for the ash handling system. The PLC system would provide for continuous cyclic operation of fly ash evacuation system. The opening and closing of the valves below fly ash hoppers would be controlled with the help of level switches provided on the transmitter vessel / fly ash hoppers in various streams. The hopper from which fly ash is being removed would be indicated on the monitor or mimic panel.

The equipment and valves in the bottom ash handling system would be controlled automatically through a separate PLC system provided in boiler area. The status of operation of bottom ash handling system would be available on the monitor or mimic panel in ash handling system control room.

Silo unloading system would be controlled from the local control panel located at silo unloading floor.

FLY ASH UTILISATION

The fly ash is proposed to be evacuated and stored in silos in dry form so that most of it can be utilised / marketed in dry form.

The fly ash generated in thermal power stations has commercial value because of its usage in cement and construction industries. Fly ash generated from the proposed power plant will be commercially utilised in one or more of the following industries, to the extent possible :

Cement industry

Brick industry
Fly ash aggregate making industry
Road making / paving.

MILL REJECT HANDLING SYSTEM

This chapter covers complete mill reject handling system equipments such as conveyors and its accessories, mill reject silo with remote operated discharge gates and remote operated gates for mill reject hoppers.

Single stream conveyors shall be provided for handling mill rejects. The mill reject handling system equipment shall be designed to operate on continuous basis for 24 hours / day and 365 days / year. Rated capacity of all belt conveyors shall be sized to convey rejects from all the twelve mills with a margin of 10% on the rejects generated from all the mills at continuous MCR rating.

The storage silo capacity shall be sized to store 12 hrs mill reject generation from the mills. Motor operated sector gates shall be provided at the outlet of silo. The rejects from silo will be discharged into truck / dumper for further disposal.

7.0.8 **COMPRESSED AIR SYSTEM**

For the requirement of instrument air, the plant shall be provided with Two (2) x 100 % oil free screw compressors for each unit (1working and 1 stand by), each having a capacity of 2000 Nm^3 / hr and a discharge pressure of 8.8 kg / cm^2 (g). Thus, there will be four (4) air compressors to meet instrument air for the plant. For the requirement of service air, three (3) x 100 % screw compressors (2 working and 1 stand by), each having a capacity of 2000 Nm^3 / hr and a discharge pressure of 8.8 kg / cm^2 (g) would be provided for a set of two units. The requirement of the compressed air for the ash handling system would be met through separate dedicated compressors.

The compressed air system would include accessories such as air driers and air receivers. The discharge lines of all the instrument and service air compressors would be headered. Three air driers (two operating and one stand by) and two air receivers of suitable capacity would be provided for instrument air system and two air receivers shall be provided for service air system.

7.0.9 **AIR CONDITIONING SYSTEM**

It is proposed to air-condition the unit control room, electronic cubicle room, shift charge

engineers room, printer room, maintenance engineers room, UPS room, ESP control room, static excitation cubicle room, analyser panel room, coal handling control room, DM plant control room and switchyard control room. Inside design conditions of 24.5 $\pm$ 1.5^{0}C dry bulb temperature and relative humidity not exceeding 60% would be maintained in all air-conditioned areas.

A common chilled water system is envisaged for 2x660 MW for air-conditioning the unit control room / electronic cubicle rooms and ESP control rooms. Each centralised system would consist of three (two working and one standby) water chilling units. The system also consists of chilled water pumps, condenser cooling water pumps, induced draft FRP cooling towers, adequate number of air handling units for circulating the conditioned air through air distribution system to the room.

For air conditioning of all other rooms, packaged air conditioners or room air conditioners of suitable capacity would be provided.

7.0.10 VENTILATION SYSTEM

For the ventilation of the station building, evaporative cooling system (Air washer type) is envisaged. This system consists of air washers, supply air fans, air washer circulating water pumps, centrifugal fans and air distribution system for distributing the supply air inside the station building. The exhaust of hot air out of the station building would be achieved by provision of roof extractors and wall mounted exhaust fans

For ventilation of other buildings, supply air fans or louvers, exhaust air fans, roof extractors or a suitable combination of these complete with louvers, filters, ducting & grilles would be provided.

7.0.11 **HYDROGEN GAS SYSTEM**

Hydrogen gas with a purity of 99.9% (by volume) is required for cooling of the generators. It would be required for the initial filling and continuous make-up during normal operation for maintaining the required purity in the generator. The normal hydrogen gas requirement for two units is about 30 N cu. m / day. This requirement would be met by installation of a H2 generation plant.

7.0.12 CRANES AND HOISTS

Station Building EOT Cranes

Two (2) overhead, cabin operated electric overhead travelling (EOT) crane of 150/40 tonnes capacity, Class M4, for TG building would be installed in the turbine hall of the station building for handling various equipment, except generator stator, during erection and maintenance. The generator stator would be erected by employing temporary erection facilities such as derrick / hydraulic jacks, or strand jack arrangement. One more EOT crane can procured if any future unit is installed.

Miscellaneous Lifting Tackles / Hoists

Manual hoists shall be provided for handling items of 500 kg to 1000 kg and upto a lift of 10.0m. Electric hoist shall be provided for handling components of 1000 kg and above and/or a lift over 10.0m

At the junction tower motor operated flap gates are provided to change the flow direction. The areas / equipment for which the lifting tackles are proposed to be provided are in ware house, all equipment in the station building which are not accessible to station building EOT crane, steam generator area (all fans, gear boxes, mill components, etc.), DM plant (to load the chemicals in to the tanks), coal handling junction towers and ash water/slurry pump house, cooling tower area, ESPs, clarified water pump house, fuel oil pump house, etc.

7.0.13 **WORKSHOP EQUIPMENT**

The power plant would be equipped with a work shop capable of catering to the routine maintenance requirements of the plant, considering the type of jobs likely to be carried out at the workshop.

7.0.14 **CHEMICAL LABORATORY EQUIPMENT**

A chemical laboratory as per the requirement would be provided in the power plant to enable testing of fuel, water, flue gas, etc. as required for normal operation of the power plant and as stipulated by MOEF and Rajasthan state PCB.The laboratory would be equipped with various lab equipments and necessary laboratory glassware, reagent

chemicals and laboratory furniture. A portion of the chemical laboratory housing equipment such as the spectrophotometer would be air-conditioned. Necessary meteorological and environmental equipment would also be provided

7.0.15 **AUXILIARY STEAM BOILER**

In case of supercritical boiler for every cold/warm startup it is required to supply steam to deaerator for heating, other wise it would require a long time for start-ups. As such an auxiliary steam supply boiler is proposed to be installed.

CHAPTER – VIII

ELECTRICAL SYSTEMS

1. GENERATOR

The key one line diagram Exhibit –012 (TCE.5749A-738-AU-3001) describes the plant electrical system. The generator would be rated to deliver 660 MW at 21 kV, 50 Hz, 0.85-power factor, at 3000 rpm. The generator rating shall not be a limiting factor for total power evacuation, and the rating shall be suitable for VWO rating of the Steam turbine. The generator winding would be star connected with the phase and neutral terminals brought out. The generator would deliver rated MVA within permissible limits of voltage and frequency as per IEC 60034. The star point of the generator would be connected to earth through an earthing transformer, the secondary of which would be loaded by a resistance.

1.2 All generator components, rotor winding, stator core, end region flux shield structures and lead box, except the stator winding, are hydrogen cooled. The stator coils, parallel rings, main leads and terminal bushings are cooled directly with water. Hydrogen coolers would be built into the stator frame of the generator and would be sized to ensure at least 2/3 of the rated output when one hydrogen cooler is taken out for maintenance.

1.3 The generator would be provided with brush-less excitation system. Suitable fast acting non-dead band type continuous acting digital type automatic voltage regulator would be provided and mounted in sheet steel clad cubicles. The excitation cubicles would have necessary sections to house the apparatus and accessories required for field flashing and control.

1.4 The generator winding would be provided with Class – F insulation. However, temperature rise would be limited to Class – B.

.2.0 GENERATOR BUS DUCT

.2.1 The terminals of the generator would be connected to the generator transformer through a generator Circuit Breaker (GCB) using Isolated Phase Bus Duct (IPBD) of adequate short circuit withstand capability with suitably rated tap-offs to the unit transformers and station transformer. Neutral of the generator will be connected to the NGR/NGT using isolated phase busduct (IPBD). The bus duct would be natural air cooled and would run partly indoor and partly outdoor.

3.0 GENERATOR TRANSFORMERS

.3.1 The GT would be 3 Nos. 275 MVA single-phase banks for each unit, 2 winding ONAN / ONAF / OFAF cooled and would be provided with off-circuit tap changer. One additional limb (single phase bank) would be procured as spare. The HV side neutral would be solidly earthed. Lightning arrestors would be provided near the generator transformer. The HV terminals of the transformers would be connected to the associated bays in 400 kV switchyard by means of overhead conductor.

The rating and details of the generator transformer are as in Table– below :

Generator Transformers

Sl. No.	Particulars	Rating
1.	Type of cooling	ONAN / ONAF / OFAF
2.	Rating	3x1 Phase 165/220/275 MVA (ONAN/ONAF/OFAF)
3.	No load voltage ratio	21 kV / 420/√3 kV
4.	Vector group	YNd1
5.	Percentage impedance	15%

6.	Type of tap changer	Off circuit
7.	Tap range	+5% to -15% in steps of 1.25%
8.	Impulse voltage withstand (1.2/ 50 micro-sec)	1425 kV peak.
9.	Terminal connection HV side	Suitable for overhead conductor connection
9	LV Side	matching flanges for connection to IPBD.
10	Coolers	3 X 50 %

3.4.0 EVACUATION OF POWER

3.4.1 As per the RVPN's Board of director's 167th meeting held on 24-07-2009 the Power evacuation is proposed by 400kV Double circuit lines to Dahra Pooling Station located 130 KMS away from this plant by Quad Moose conductors. Power evacuation will also be done through 2 Nos. interconnectors between Phase –III and Phase II 400kV Switchyards of the Chhabra Plant as discussed with RRVUNL during the site visit on 14-8-2009.

3.4.2 In order to evacuate the power as mentioned above, the generated power of the proposed 2 X 660 MW Power plant will be stepped up to 400kV using 3 Nos. single phase 21kV/400kV/√3 Generator Transformers.

3.4.4 It is proposed to use bus connected Reactors of 50 MVAR capacity in the 400 KV Switchyard. A detailed electrical network Power System study needs to be carried out for finalizing the details of the 400 kV lines and the reactors.

3.5.0 400 KV SWITCHYARD

3.5.1 One & half breaker scheme is proposed for the 400 kV switchyard. The switchyard equipment i.e., breakers, isolators, lightning arrestors, current transformers and buses would be rated for a short circuit current rating of 40 kA for 3 second to take into account the increases in grid fault level due to addition of generation capacities. The bus bar arrangement shall be 'I' type.

3.5.2 For each of the outgoing lines, 2 sets (Main and Check metering) precision

energy metering would be provided. It is proposed to provide dedicated 2 core CTs and 2 core CVTs of accuracy class 0.2S for tariff metering purpose. The metering panel with Check meters would be located near the tariff CTs / CVTs by RRVUNL such that the length of the metering cable is kept to a minimum to reduce errors in energy recording. Space would be provided adjacent to this metering panel to enable PGCIL/Purchaser to install Main metering for their verification. The metering panel would have ABT (Availability Based Tariff) energy meters with 0.2S accuracy class.

3.6.0 AUXILIARY POWER SUPPLY SYSTEM

3.6.1 The proposed auxiliary power supply system is shown in enclosed key line diagram. Various auxiliaries would be supplied at the following nominal voltages depending upon their ratings and functions:

a. 11000 V, ± 10%, 50 Hz ± 5%, 3 phase, 3 wire, medium resistance grounded AC supply for motors rated more than 1500 kW.

b. 3300 V, ± 10%, 50 Hz ± 5%, 3 phase, 3 wire, medium resistance grounded AC supply for motors rated more than 160KW and up to 1500KW.

c. 415 V, ± 10%, 50 Hz ± 5%, 3 phase, 3 wire, solidly grounded AC supply for motors rated 160 kW and below and other L.T. services.

d. 240 V, ± 10%, 50 Hz ± 5%, 1 phase AC supply for lighting, space heating of motors and panels, single phase motors, etc.

e. 220 V, ungrounded DC supply for protection, control and indication.

f. 110 V, 1 phase, grounded AC supply for AC control circuits of L.T motors.

g. 24 V DC supply for instrumentation and control systems such as closed loop controls, sequence controls, automatic turbine run-up system, protection and interlock system, sequence-of-events recording system and annunciation system.24 V DC will be derived by the from the 230 V AC UPS system by the vendor.

h. 230 V, 1 phase AC uninterruptible power supply for panel-mounted recorders, CRT units, printers, analysers, etc., forming a part of the plant

instrumentation and control system.

3.6.2 The auxiliary system loads would be segregated as unit loads and common station loads. 2 x 50% rated Unit Transformers (UTs) would be provided per unit to cater to the unit loads & 2 x 100% rated station transformers (ST) would cater to entire station loads under normal operating conditions. The start-up power for the auxiliaries would be supplied through generator transformer and unit transformers of Unit-1 / Unit-2. Once the unit is started and the generator picks up rated speed and voltage, the unit would be synchronised with grid supply by closing generator circuit breaker. One Motor driven BFP and two turbine driven BFPs would be provided for each unit. The motor driven BFP would be used as a standby (50%) and also would run during starting of the unit.

3.7.0 **UNIT TRANSFORMERS (UT)**

3.7.1 Two (2), two winding unit transformers would be provided for each unit. These would be 55MVA, rating, 21/11.5 kV, 3 phase, 50 Hz, with ±10% OLTC in steps of 2.5% on the HV side. The transformers would be ONAN/ONAF cooled with a vector group of Dyn11. The LV side would be medium resistance earthed through a resistance to limit the earth-fault current to about 400A.

3.7.2 The unit transformers would supply power to the 11kV unit switchgear as shown in the enclosed key line diagram. As far as possible, the unit loads would be distributed equally on each 11kV unit switch gear so that in case of outage of any one bus, it would still be possible to operate the unit at partial load. It is also considered that the motor driven motor BFP shall be connected to both the unit buses with the forked arrangement to enable the motor driven BFP to be connected to either of the unit buses.

3.8.0 **STATION TRANSFORMERS (ST)**

3.8.1 Two Station Transformers of rating 55 MVA, 21/11.5kV, 3 phase, 50Hz with ±10% OLTC in steps of 2.5% on HV side would be provided to feed the 11 kV station auxiliary load requirement for complete station loads including the Coal and Ash Handling package loads. The transformers would be ONAN/ ONAF cooled with a vector group of Dyn11 .

3.9.0 **UNIT AUXILIARY TRANSFORMERS (UAT)**

3.9.1 Two (2), unit auxiliary transformers would be provided for each unit to feed 3.3kV unit auxiliary motor loads. These would be 10 MVA, 11/3.3 kV, 3 phase, 50 Hz, with ±5 % off-circuit taps in steps of 2.5% on the HV side. The transformers would be ONAN/ONAF cooled with a vector group of Dyn11. The 3.3kV system would be medium resistance earthed through a resistance to limit the earth-fault current to about 400A.

3.10.0 **STATION AUXILIARY TRANSFORMERS(SAT)**

3.10.1 Two (2), Station auxiliary transformers would be provided for feeding 3.3kV Station auxiliary loads. These would be 15 MVA (catering to loads of ash handling system, coal handling system, water system and other common station auxiliaries.), 11/3.6 kV, 3 phase, 50 Hz, with ±5 % off-circuit taps in steps of 2.5% on the HV side. The transformers would be ONAN/ONAF cooled with a vector group of Dyn11. The 3.3kV system would be medium resistance earthed through a resistance to limit the earth-fault current to about 400A.

3.11.0 **SERVICE TRANSFORMERS**

3.11.1 Service Transformers will be provided to step down the voltage to 415 V

to feed the LT Motors and other LT auxiliaries.

Required number of transformers would be provided depending on service / location / segregation of the loads. The service transformers are indicated in the enclosed key one line diagram tentatively. These transformers would be rated maximum at 2500 kVA so that the maximum rating of the LT Breaker does not exceed 4000 A. Transformers will be of 11kV/433V ratio, with a vector group of Dyn11. The neutral of these transformers would be solidly earthed. The transformers would be provided with ± 5% off-circuit taps in steps of 2.5% on the HV side.

All service transformers would be of dry type.

3.12.0 **11000 V & 3300V SWITCHGEAR**

3.12.1 The 11 kV & 3.3kV system would be medium resistance earthed. The switchgear would be rated for symmetrical fault current of 40 kA for 3 second. The 11kV & 3.3kV switchgear would comprise draw-out type Vacuum circuit breakers housed in indoor, metal-enclosed cubicles would cater to all 11kV, 3.3kV motors, 11kV / 3.3 kV & 11kV / 433V transformers. The switchgear would be equipped with control, protection, interlock and metering & communication features as required.

3.12.2 The 3.3 kV system would be medium resistance earthed. The switchgear would be rated for a symmetrical fault current of 40 kA for 3 sec. The 3.3 kV switchgear would comprise draw-out type Vacuum circuit breakers housed in indoor, metal-enclosed cubicles and would cater to 3.3 kV motor loads LT Loads through 3.3 kV / 433V transformers. The switchgear would be equipped with control, protection, interlock and metering features as required. Separate 3.3 kV switchgear would be provided for the coal handling system. Motor feeders of coal handling switchgear would be provided with fuses and vacuum contactors. All other motor feeders would be provided with circuit breakers.

3.12.3 11 kV Switchgear will be provided with Local breaker back up protection on all feeders and incomers.

3.13.0 **415 V SYSTEM**

3.13.1 The 415V, 3 phase, 3 wire power for the 415V auxiliaries would be obtained from 11kV/433V transformers and 3.3kV/433V transformers. The system would be a solidly earthed system. For maximum reliability, duplicate power supplies with auto changeover facility would be provided for the essential power and motor control centres. The 433V switchgear would be of metal enclosed design with a symmetrical short circuit rating of 50 kA for 1 sec.

All power and motor control centres would be compartmentalised and would be of single / double front execution as needed. They would be of fully draw-out design. The circuit breakers would be of air break type.

Motor starting would be direct on line. All LT motors would be controlled by air break, electro-magnetic type contactors provided with ambient temperature compensated, time lagged, hand reset type thermal overload relays, having adjustable setting with built-in single phasing preventor backed up by HRC fuses for protection against short circuits.

3.14.0 **DC SYSTEM**

3.14.1 For arranging the 220V DC supply for the above, the following shall be provided.

a) One 100% rated battery with one 100% rated Float and Boost Charger and DC switchboard for each unit. (i.e. total two sets for 2 units).

b) One 100% rated battery with one 100% rated Float and Boost Charger and DC switchboard for Station load of 2 Units (i.e. total one set for 2 units).

c) One 100% rated Stand by battery with 100%rated standby Float and Boost charger with battery for the unit & station loads of 2 units.

d) One(1) 100% rated spare battery charger set consisting of float

& boost charger which will act as standby to any other charger.

e) One (1) 100% battery with 2 sets of 100% rated float and boost chargers and DC switchboard for catering to the DC loads of 400kV switchyard.

f) Two (2) 100% battery with 2 sets of 100% rated float and boost chargers and DC switchboard for catering to the DC loads of coal handling and ash handling systems.

The batteries would be of Lead acid Plante type complete with battery racks, porcelain insulators, inter-cell and inter-tier connectors. It is preferred to go for Lead acid plante battery bank considering the longer life of the battery. The chargers would be of silicon rectifier type with automatic voltage control and load limiting features.

Float charger will be rated for the following

i) Trickle charging current of the battery

ii) Continuous load on the DC bus with 25% margin

iii) Full load current of the largest DC motor (for 220V DC battery only).

The boost charger unit shall be rated such that the battery can be charged from fully discharged condition within 10 hours.

3.15.0 EMERGENCY POWER SUPPLY

3.15.1 To enable the unit to shutdown safely during complete A.C supply failure in the station, certain important plant auxiliaries would be provided with a reliable A.C power supply through a separate source. For this purpose, one (1) 415V quick starting diesel generator set with automatic mains failure (AMF) would be provided for each unit. The rating of the DG set

would be about 16000kVA (to be confirmed during detail engg). DG set shall be sized to limit the voltage dip at the highest rated motor terminals during starting within acceptable limit. Start will be considered successful if, voltage dip during starting does not fall below 30%.

3.15.2 The diesel generator would feed a separate emergency 415V Emergency switch gear. This switchgear in turn will feed the Normal/Emergency PMCCs of Units 1 and 2. All the essential loads such as the A.C emergency bearing lube oil and seal oil pumps, turning gear motor, battery chargers, emergency lights, and essential instrument power supply feeders would derive power from this Normal/Emergency PMCC.

When the normal A.C supply is healthy, the N/E PMCC would be fed through a tie from the Unit Service Switchgear. When the normal A.C supply fails, the DG set would start automatically and would feed the loads connected to the emergency switchgear. When the normal A.C supply is restored, these essential loads would be manually changed over to the normal power supply.

Each Diesel Generator will be sized to take the load of one unit only. One (1) more DG set is envisaged as a common stand by for both the units.

3.16.0 UN-INTERRUPTIBLE POWER SUPPLY SYSTEM

3.16.1 For panel mounted instruments, CRTs, printers, analysers, recorder, etc., 230 V single phase A.C uninterruptible power supply would be made available. This power supply would be derived from parallel redundant with static bypass un-interruptible power supply system having two (2) sets of converters, inverters & 2 X 100 % battery banks. Also a standby AC supply would be provided as a back up to the inverters, which would be switched on through static switch in case of inverter failure.

3.17.0 GENERATOR AND GENERATOR TRANSFORMER PROTECTION PHILOSOPHY SYSTEMS AND CONTROL

3.17.1 The details of the protection philosophy that would be provided for the Generators, Generator transformers (GT), HT/LT motors etc., are as follows

3.17.2 The selection of the protective scheme would be based mainly on reliability, sensitivity, selectivity and technical merits. All main protections would be of fast acting type in order to isolate the faulty system from the healthy system in the shortest possible time, to minimise damage to the equipment and ensure continuity of power supply, if possible.

3.18.0 Generator & Generator Transformer Protections

3.18.1 Details of Protection provided for the Generator and GT are shown in the Main One line diagram EXHIBIT -013(TCE.5749 A- 738-AU-3002).

Two multifunction numerical Generator protections operating on different principles and housed in generator relay panels (GRP) would be provided for each unit. The panels would be located in the unit control room / Relay room. The protections would be divided into two groups; each group being 100% redundant and on separate DC supply, so that even if one group of protections is not available or under maintenance, the generator is protected by the other group.

Class A, Class B, Class C and Class D protection schemes would be implemented to ensure safety of operating personnel and equipment. Further as GCB scheme is being proposed, Class A trip logic will be further classified in to Class A1 and Class A2.

The philosophy of Class A, B and C tripping is as follows :-

a) Class – A1- Trip GCB and field breaker for faults in the generator, excitation system and bus duct up to GCB.

b) Class – A2- Trip GCB, GT HV side main and middle breaker, UT LV

side breaker, field breaker for faults in GT and bus duct between GCB and GT.

c) Class- B- Turbine trips first and generator circuit breaker and Field Brekaers are tripped on reverse power through class A1 trip relays. This is adopted for mechanical faults in Turbine and minor electrical faults in Generator for which immediate tripping of generator is not required.

d) Class- C- GT HV main and middle breaker trip. This is adopted for faults not cleared by line protection.

e) Class- D- To trip UT LV side breaker on winding/oil temperature very high conditions.

3.18.2 All standard electrical and mechanical protections will be provided for the Generator Transformers. Considering the large rating as well as criticality of the Generator Transformers, Online condition monitoring system is proposed to be provided for the GTs to ensure that the availability of the transformer is high.

3.18.3 For all the other electrical equipments it is proposed to provide fast acting, state of the art, numerical protections using microprocessor based multifunction relays.

Transformers – GT, UT and ST will be provided with redundant numerical protections with redundant CTs.

3.9 Generator and GCB Controls

3.19.1 A hard wired back up panel ie., Generator Control Panel is proposed to be provided and located in the Unit Control room. This will house the GCB, Field Breaker, 400 kV Breakers (middle and bus side) and Isolator controls and Indicating Meters for the Generator and Field parameters. All other HT/LT breakers will be controlled from the DCS.

3.19.2 Generator circuit breaker would be used as the synchronising breaker during start up of the unit.

3.18.3 It shall be possible to operate (close/open/synchronise) the GT bay 400 kV breakers and associated isolators also from the Generator control panel (

GCP).

3.19.4 An Auto Synchroniser will be provided (either in GCP or GRP). Upon initiation from the DCS Auto synchroniser will issue commands to GCB after synchronisng the Generator voltage with grid supply.

3.20.0 **Generator Circuit Breaker and 400 kV Switchyard circuit breaker Protection**

3.20.1 The following protections would be included for all these breakers.

a) Pole discrepancy protection

b) Trip coil supervision relay for each trip coil (98L1 to L6).

c) Anti pumping device for breaker closing (94).

d) Inherent protections built in the circuit breaker such as low SF6 pressure etc.

e) Stuck Breaker (Local Breaker back up) Protection

Details of Protection proposed for the Generator are indicated in Main One line Diagram EXHIBIT-013. (TCE. 5749 A- 738-AU-3002)

3.21.2 Fast and slow bus transfer scheme for 11kV and 3.3kV shall be microprocessor based.

3.21.0 **PROTECTION OF MV AND LV MOTORS**

3.21.1 All important MV and LV motors would be provided with standard electrical and mechanical protections ensuring safe and desirable operation of the motors as intended.

3.21.2 LV Motors rated :

- Up to 50kW shall have MPCB+ contactor (MPCB shall be with adjustable S/C+O/L protection).
- 50kW to 90kW shall have MCCB+ contactor+ bimetallic relay.

- 90Kw to 160kW shall have ACB +motor protection relay(MPR).

3.21.3 Motors rated 90 kW to 160 kW and all MV Motors would be provided with composite motor protection relay covering the following protections. These will be of the numerical type enabling protection, monitoring and measuring motor parameters on a continuous basis to ensure healthiness of the motor over the lifetime of the motor.

a) Phase over current.

b) Phase under current

c) Earth fault/ sensitive earth fault.

d) Thermal over load.

e) Locked rotor, excessive starting time

f) Starts per hour

g) Negative phase Sequence/ un balance

3.22.0 POWER SUPPLY AND LIGHTING CIRCUITS

3.22.1 The power supply feeders would have properly rated HRC fuses for short-circuit protection. Lighting circuits would be protected by miniature circuit breakers.

3.23.0 400 KV SWITCHYARD CONTROL

3.23.1 All breakers would be remotely controlled from SCADA. They can also be locally controlled from Local Control Cabinets kept in the switchyard for testing purpose. Relay panels with Bay Control Unit (BCU) pertaining to 400kV switchyard would be located in the switchyard relay room, which would be kept locked. SCADA terminals will be provided in the switchyard control room for control and monitoring of these breakers. Additional SCADA terminal will be provided in the central control room for the purpose

of monitoring only.

3.23.2 It will be possible to control the middle breaker and its associated isolators as well as the bus side breaker associated with the Generator Transformer breaker either form the Switchyard control room(SCADA or BCU) or from the Central control room(GCP).

3.23.3 One (1) no., 10kVA, 230 V single phase A.C uninterruptible power supply would be made available for SCADA system. The UPS would be parallel redundant with static bypass type having two (2) sets of converters, inverters & 2 X 100 % battery banks.

3.24.0 **CABLING SYSTEM**

3.24.1 Power cables would be selected based on the following minimum criteria:

a) Continuous circuit current rating

b) De-rating factors for ambient temperature and grouping

c) Short circuit rating of the circuit (not applicable for MV/LV fuse protected feeders)

d) Voltage dip under steady state and starting of Motors.

e) Standardisation of cable sizes to reduce inventory

3.24.3 The following types of cables would be used:

a) For 11 kV system

11kV unearthed grade, stranded aluminium conductor, cross linked polyethylene (XLPE) insulated, extruded black PVC inner sheathed, galvanized steel wire armoured for three core or aluminium wire armoured for single core and outer FRLS extruded black PVC sheathed cables conforming to IS : 7098.

b) For 3.3 kV system

3.6kV unearthed grade, stranded aluminium conductor, cross linked polyethylene (XLPE) insulated, extruded black PVC inner sheathed, galvanized steel wire armoured for three core or aluminium wire armoured for single core and outer FRLS extruded black PVC sheathed cables conforming to IS : 7098.

c) For low voltage system

Power cables of 1100V grade, stranded aluminium conductor, cross linked polyethylene (XLPE) insulated, extruded black PVC inner sheathed galvanized steel wire armoured for three cores or Aluminium wire armoured for single core and outer FRLS extruded black PVC sheathed cables conforming to IS : 7098.

d) For control applications

1100 V grade annealed high conductivity stranded copper conductor having 7 strands, PVC insulated, PVC inner sheathed, galvanised steel wire armoured and FRLS extruded black PVC outer sheathed cables conforming to IS: 1554. Conductor cross section would generally be 1.5 sq. mm. CT and PT control circuits would use 2.5 or 4 sq. mm copper conductor cables.

e) For instrumentation applications

1100V grade, stranded high conductivity annealed tinned copper conductor, PVC insulated, flexible, twisted pair / triplets, individually and overall shielded (for low level analog signals) and only overall shielded for digital signals, PVC inner sheathed, steel wire armoured and outer FRLS PVC sheathed cables. Conductor cross section would be 0.5 sq. mm.

3.24.4 Cables would be laid in fabricated steel ladder type or perforated type cable trays in the station and other auxiliary buildings and upper elevations of the steam generator area. Between buildings, the cables would be laid in built-up trenches if the distance is short or on overhead racks if the distance is long. Cables to other plant areas located far off from the station building would be directly buried in soil or carried on overhead racks.

3.25.0 **LIGHTING SYSTEM**

3.25.1 Suitable illumination necessary to facilitate normal operation and maintenance activities and to ensure safety of working personnel would be provided. This would be achieved by artificial lighting using normal,

emergency and DC lighting.

3.25.2 For yard illumination, floodlights would be installed at suitable locations to provide the requisite level of illumination. Pole-mounted high-pressure sodium vapour fixtures would be used for approach roads.

3.25.3 Generally, fluorescent fixtures would be used for indoor illumination. A combination of high pressure sodium vapour and fluorescent fixtures would be used for the turbine building. For steam generator area and pumps area, high-pressure sodium vapour lamp fixture would be provided.

3.25.4 The illumination levels at different places would be maintained as per accepted norms. The lighting system would be designed to ensure uniform illumination

3.25.5 Power distribution from the lighting transformers would be through 415V, 3 phases, 4 wire distribution boards. A suitable number of 3 Phase lighting panels would be located in each area. Power to the lighting panels would be supplied from the 415V, 3 phases, 4-wire distribution.

3.25.6 About 80% of the total light fittings would be connected to the normal 240 V AC lighting supply and the balance 20% to the station emergency bus fed from the DG set in the station building and steam generator areas.

3.25.7 Installite type DC emergency lights are envisaged at strategic points in the power station viz., near entrances, staircases, control rooms, etc. These would be provided with local battery back up for 3 hours, which would be normally off when AC power is available. These would be automatically switched on when the normal / emergency AC supply fails. In critical areas like control room, the DC lighting would be fed from the station DC supply.

3.26.0 SAFETY EARTHING AND LIGHTNING PROTECTION

3.26.1 A safety earthing system comprising buried steel conductor earthing grid would be provided for the 400kV Switchyard and other outlying areas. This would be connected to the earth grids in various buildings. The buried earth grids would be further connected to earthing electrodes. The selection of earth conductor sizes would be based on the maximum fault current

expected at the respective voltage levels..

3.26.2 Lightning protection system comprising roof conductors, vertical air termination and down-comers would be provided for all structures whose calculated risk index requires protection as per applicable standards.

3.27.0 COMMUNICATION SYSTEM

3.27.1 For effective communication in the plant, public address system, Electronic private automatic branch exchange system (EPABX), landlines with ISDN / PSTN facility with the features described below would be provided.

3.28.0 PUBLIC ADDRESS SYSTEM

3.28.1 This system would have paging and party channels comprising handset stations with amplifiers, transmitters, receivers, sound proof booths, and loud speakers. This system would facilitate paging, communication and also private conversation as in conventional telephone.

3.29.0 EPABX System

3.29.1 This system would have adequate number of push button type handset stations, central automatic telephone exchange, etc. The handsets in the control room would be provided with priority service facility to enable them to have immediate access to any handset even if it is already engaged. Interface between the EPABX, PA & walkie-talkie systems would be provided to enable communication between these systems.

3.30.0 LANDLINE TELEPHONES, BROADBAND CONNECTIVITY.

3.30.1 Necessary number of ISDN / PSTN landlines would be provided at strategic locations within the plant boundary. Broadband connectivity would be provided at strategic locations for online access of data from remote station.

3.31.0 **WALKIE-TALKIE SYSTEMS**

3.31.1 Walkie-talkie systems would be provided for mobile communications. These systems would be of particular use during commissioning stage as well as subsequently for convenience during maintenance.

3.31.2 VSAT link would be provided for connectivity as well as remote access to load dispatch centre for control.

3.31.3 OPGW (Optical fibre ground wire) communication link will also be provided to ensure fast communication between Switchyard & LDC.

3.32.0 **FIRE DETECTION / ALARM AND FIRE PROOF SEALING SYSTEM**

3.32.1 Addressable analogue type multi criteria detector based fire detection and alarm system would be provided to facilitate visual and audible fire detection at the incipient stage of fire in strategically important areas of the power station. This system would comprise manual call points located at strategic locations in areas which are normally manned and automatic addressable type multi-criteria detectors located in plant areas, such as control room, switchgear room, battery rooms, etc., to detect fire at an early stage. Linear heat detectors would be provided for the cable gallery and conveyors. Infrared type amber detector would be provided for the conveyor gallery. Fireproof sealing would be provided for all cable penetrations through walls and floors to prevent spreading of fire from one area / floor to another.

3.33.0 **ELEVATORS**

3.33.1 One freight-cum-passenger elevator of adequate capacity and speed of 0.75 m/sec would be provided in each of the steam generator areas to serve major platforms of the steam generators. A common 8 passenger, 1m/sec elevator would be provided for catering to the station building. This elevator would have access to different floors of the station building. One freight-cum-passenger elevator at the service building. One freight-cum-

passenger elevator of adequate capacity and speed of 0.75 m/sec would be provided in the bunker bay for each unit(total 2 nos).

A separate elevator will be provided for each stack to access the top of the stack.

3.34.0 **CATHODIC PROTECTION**

3.34.1 Cathodic protection is proposed to be provided for the underwater structures in CWPH like trash rack, travelling water screen, etc. and water boxes of condenser, heat exchangers, and water boxes of coolers using sea water.

3.35.0 **CONSTRUCTION POWER SUPPLY**

3.35.1 Construction Power shall be made available by RRVUNL at 33 kV.

33/11kV substation, 33/11kV transformer,11kV switchgear , 11kV ring mains, 11kV/433V transformer as required would be provided for catering to the 415 V the construction power.

4.0 **POWER SUPPLY FOR RIVER WATER INTAKE SYSTEM:**

4.1 The approximate power requirement at the three locations of the River water intake are as follows:-

Parwan- 2000kW

Lhasi – 800kW

Andheri-3600 kW

It was intimated to us by RRVUNL during the site visit on 14-8-2009 that the power supply to the pumping stations at the above locations is to be taken from the power plant.

4.2 The approximate lengths of transmission lines from the Chhabra Power plant to the above pumping stations would be as follows:

Chabra- Andheri: 35 KM

Andheri-Lhasi- 15 KM

Lhasi-Parwan- 25 KM

4.3 Two alternative power supply arrangements were studied to cater to the power requirements of the RW system.

Alternative-1: Take 2 nos.11 kV supplies one each from the proposed Station Switchgears – A and B located in Chhabra super critical TPS and step it up to a higher voltage such as 33kV or higher and step it down to 11 kV or 3.3 kV at the pumping station.

Alternative-2: Provide a bay in the 400 kV Switchyard with 2 feeders for this purpose. Step down the voltage from 400 kV to 33kV or appropriate voltage for transmission to the pumping stations. Step down the voltage to 11 kV or 3.3 kV at the pumping station.

4.4 **Alternative -1:** Observations of the study are as follows:

a) In order to keep the voltage dip within 20 % during starting of the RW pump motor, the transmission voltage has to be minimum 132 kV.

b) With this alternative, the Station Transformer capacity needs to be increased by about 7 MVA which is the total power demand of the RW system. The new Station transformer capacity will be about 65 MVA.

c) 65 MVA Transformer would necessitate use of 2 Circuit breakers in parallel since the maximum rating of the 11 kV circuit breaker available is only 4000 A(before de-rating)

d) The cost of this alternative including differential cost of Station Transformers, 132 kV Transmission line, 11/132 kV Transformers, 132 kV Substation and the electrical installations at the 3 pump houses works out approximately 30 Crores.

e) As the contour map for the area between Chhabra and the pump houses is not available, the capacities of the pump considered in the study are approximate and any change in the capacities of the pump will affect the sizing of the Station Transformer.

4.5 **Alternative -2:** Observations of the study are as follows:

a) In order to keep the voltage dip within 20 % during starting of the RW pump motor, the transmission voltage has to be minimum 132 kV.

b) With this alternative an additional bay of 400 kV and 400/132kV Transformer and associated 132 kV Substation needs to be provided.

c) The cost of this alternative including additional 400kV bay, 132 kV Transmission line and the electrical installations at the 3 pump houses works out to approximately 45 Crores.

4.6 Alternative -1 is lesser compared to Alternative-2 by 50%. However in this alternative the amount of loads that can be added in the RW Pump houses or on to the 132 kV system in future is limited by the capacity of the Station Transformer. In Alternative-2 this restriction does not arise.

Considering that we are already utilizing the available water at the 3 river sources and there is no plan to utlise the 132 kV line for other loads alternative -1 is suggested to be implemented.

5.0 ATTACHMENTS:

5.1 Exhibit-012 (TCE.5749A-738-AU-3001) - Key one line diagram)

5.2 Exhibit-013 (TCE.5749A-738-AU-3002) – Main one line diagram.

5.3 Exhibit-014 (TCE.5749A-738-AU-3011)- 400kV switchyard plan and Section.

5.5 Exhibit-015 (TCE.5749A-EL-SK-2001) - Uninterruptable power supply scheme

5.6 Exhibit-016(TCE. 5749A-EL-SK-2002) - Single line diagram for 220V DC.

5.7 Exhibit-017(TCE. 5749A-EL-SK-2003) - Parallel redundant UPS with static bypass to regulated supply.

6.0 INSTRUMENTATION AND CONTROL SYSTEM

6.1 PLANT CONTROL SYSTEM ORGANIZATION

6.1.1 The instrumentation and control (I&C) system for the plant is proposed to be a comprehensive system integrating the functions of plant monitoring, control and protection to facilitate the task of integration, co-ordination and autonomous operation of the plant sub systems/equipment namely Steam Generators (SG), Steam Turbine Generator (STG) and their associated auxiliaries, balance of the plant equipment / systems, plant electrical system, utility plants like coal handling plant, Ash handling plant, DM water plant and compressed air plant, Station common electrical systems.

6.1.2 Certified SIL 3 conforming fail safe type microprocessor based Control System of approved configurations as par standard for BMS & Boiler Protection system is proposed. Separate & independent microprocessor based STG Integral Control system comprising Turbine governing, protection, sequential logic control (ATRS, ATT etc.) system proposed for STG control. BMS & Boiler Protection system for SG & STG Integral control systems will be separate & independent for each unit.

6.1.3 The control requirements of the main power plant comprising SG, STG with associated auxiliaries (except for BMS & Boiler Protection system for SG & STG Integral control systems), and all other balance of plant system/equipment required for functioning of main plant (both unit specific and common systems) like CW / ACW / Miscellaneous water systems, chemical dozing system (both HP& LP), plant electrical system will be implemented in plant Distributed Control System (DCS). Control of plant common system like fuel oil un-loading, handling / storage & forwarding, cooling tower, misc. water systems & Station common electrical system etc. also will be in plant DCS. DCS system for each unit & common systems will be independent yet connected at network level. Except for BMS & Boiler Protection system for SG /STG integral control controls all other controls for the main plant will be implemented in DCS. This will include all other boiler related controls, BOP auxiliaries control & regenerative system controls.

6.1.4 Separate & independent PLC based control systems are envisaged for all other unit specific and plant common system utility and auxiliary plants which are not covered in DCS / BMS & Boiler Protection system for SG & STG Integral control systems.

These include Coal Handling / Ash Handling Plant (both Bottom Ash & Fly Ash Handling system) / Raw Water & Pre-treatment / DM Water Plant / Sea Water Intake System /Switchyard SCADA etc.

6.1.5 All different control systems viz. BMS & Boiler Protection system for SG / STG Integral control systems, PLC controls are interfaced with main plant control system DCS through redundant OPC link with Ethernet based TCP-I/P protocol.

6.1.6 In general no relay based control system is envisaged for any plant system/equipment.

6.2 PLANT OPERATION PHILOSOPHY

6.2.1 OPERATION FROM CENTRAL CONTROL ROOM (CCR)

6.2.1.1 All equipment/system associated with complete power plant plant viz. SG, STG and their associated auxiliaries, auxiliary systems like chemical dozing systems (HP & LP) etc. & plant electrical system of each unit, and plant common systems like fuel oil un-loading, handling / storage & forwarding, CW / ACW / Misc. water systems, Sea Water Intake system, plant common station electrical system, BOP systems like Coal /Ash Handling / DM Plant / Raw Water & Pre-treatment / Effluent Treatment Plant / Switchyard SCADA etc. & other unit specific auxiliary plants will be operated / monitored from CCR. Electrical system will include non-synchronising breakers of 415V, 6.6 kV and 11 kV switch gear. CCR operation includes unit, functional group / drive level control and operation of equipment/system.

6.2.1.2 Switchyard will be primarily operated / monitored from CCR. However, for testing & maintenance purpose, facility of operation/monitoring from Switchyard building is envisaged.

6.2.1.3 CCR operation /monitoring will be carried out mainly through a set of Operator Station (OS) of DCS comprising console type LCD monitors along with the keyboard / mouse / Large video Screens (LVS) mounted on Unit Control Desk (UCD). UCD will also accommodate PA & Telephone sets. UCD will be organized unit wise and for plant common separately in CCR. Emergency trip pushbuttons for Boiler, Turbine and 6.6 kV drives for safe shutdown & DC LOP / DCJOP start push buttons etc. will be provided on UCD. Also, Limited number of Annunciation windows (appx 50) are envisaged in CCR mounted near LVS.

6.2.1.4 When operated from OS/LVS, the operator will be able to call for the various types of

displays for all parameters as required on the screen and carry out all types of operations.

6.2.1.5 DCS OS / LVS monitors will be are supported by different types of peripherals for logs/reports, SER/ alarm / graphic / operator action printing, which are located in the control room

6.2.1.6 A vertical free standing type panel called Unit Control Panel (UCP) organized unit wise would be located in the control room to house the hardware like synchronising switches, selector switches & meters for operation and monitoring of generator circuit breaker and generator field breakers, electrical unit auxiliary and common auxiliary power supply system for manual synchronisation and monitoring purpose

6.2.2 LOCAL OPERATION FROM FIELD

6.2.2.1 In addition to the control room operation / monitoring facility, local emergency stop operation from local pushbuttons (LPB) is envisaged for all motorized drives except for solenoid valves as a testing and maintenance facility. The local pushbuttons for various drives will be hooked up to respective plant control system. The emergency stop facility will be directly connected to SWGR. / MCC & monitoring of the same in control room. For the motorised valve with integral starter would have LPB operation on the actuator itself.

6.2.2.2 In general, for no system/equipment, local control panel based operation and monitoring is envisaged.

6.2.2.3 DCS/PLCs will be provided with following additional facilities and the equipments pertaining to the same will be located in the respective control room (CCR/LCR):

a) Maintenance engineer's equipment (MEE) for DCS/PLC program modification.
b) Historical data storage & retreaval facility in 2 x 100% configuration.
c) Shift in charge Engineer's Monitoring Equipment.

6.3 SALIENT FEATURES OF DISTRIBUTED CONTROL SYSTEM / PLCs.

6.3.1 The distributed control system (DCS) would use the state of the art technique of functional distribution of control and monitoring to reduce the risks associated with failure of any single controlling unit. The DCS has complete control capabilities that include closed loop control, open loop control, computation and interfacing for data

acquisition, graphic displays, logging, annunciation, sequence of events recording, data storage, retrieval, performance calculations and management information system. The system allows for operation from the control desk through LCD monitors. The communication from the control desk operators' interface to the electronic hardware is over a data highway. The system is provided with adequate redundancy at various levels thereby ensuring reliability of the system. The system would be based on open system architecture at the management information system (MIS) level to facilitate interface with third party software. MIS would have interface with both DCS and all PLCs.

6.3.2 The microprocessor based system proposed is functionally distributed with electronic cubicles located in a centralised location and plant operation from the central control room. The operator consoles of the each unit shall be located in a common unit control room and the electronic equipment / cabinets of each unit shall be located in respective electronic equipment rooms positioned on each unit

6.3.3 The DCS/PLCs will have adequate redundancy features. The system is provided with the following redundancy at various levels.

a) Processors, I/O bus, Data bus, Communication bus, power supply
b) I/O module redundancy would be for all control applications- both open loop and closed loop controls.
c) Triple redundant sensors for critical control applications and dual redundancy for less-critical controls.

6.3.4 Number of DCS controllers will be employed to implement all controls in such a way that, no two critical controls are assigned to the same controller. DCS controller grouping philosophy will be based on the principle to ensure minimizing the plant non-availability even in case of failure of any single controller.

6.3.5 To the extent feasible foundation fieldbus technology will be employed for the project.

6.4 CENTRAL CONTROL ROOM

6.4.1 It is proposed to have a common Central control room for both the units with physically separate space demarcated for each unit.

6.5 OTHER I&C SYSTEM FACILITIES / FEATURES

6.5.1 Following special features / facilities are envisaged for I&C system:

a) Sequence Of Events Recording System- Integral with DCS / Control system
b) Conventional hardwired type audio-visual annunciation system with limited number of windows for critical alarms in grouped condition
c) Boiler tube leak detection system for early warning of boiler tube leak condition
d) Furnace Flame monitoring & thermographic analysis system
e) Vibration Monitoring and analysis system of STG/ Turbine driven BFP & Other HT drives / rotating equipment bearings (both DE & NDE end)
f) Performance Analysis, Diagnostic and Optimisation system
g) Smart Transmitter Maintenance Facility
h) Computerised Maintenance Management System
i) Management Information System
j) Steam & Water Analysers
k) Environmental monitoring System Analysers comprising Stack monitoring, Ambient Air Quality & Metereological monitoring systems
l) Plant Security & Surveillance System

6.6 POWER SUPPLY

6.6.1 A redundant uninterrupted power supply (UPS) system is envisaged to cater to 230V AC, single phase, 50 Hz, 2 wire power supply requirements of instrumentation and control systems.. Any other voltages required including control system supply of + 24 VDC would be derived from the 230VAC UPS

6.7 MASTER CLOCK

6.7.1 A stand-alone Master clock system complete with GPS reference time using suitable antenna and receiver with adequate number of slave clocks is envisaged for common time referencing of DCS / PLC & all other programmable control systems.

6.8 TESTING & CALIBRATION INSTRUMENTS WITH I&C LAB

6.8.1 Necessary testing and calibration instruments required for the complete I &C system are envisaged.

6.9 SPARES

6.9.1 Adequate essential spares are envisaged for the complete Instrumentation and Control System.

CHAPTER –IX

CIVIL ENGINEERING ASPECTS

9.1 Plant Layout

The layout of the main plant along with all the auxiliary systems for 2 x 660 MW expansion units is shown in PLOT/ PROPERTY PLAN- Exhibit-002 and 002A. In laying out the various facilities, consideration has been given to the following general principles :

a) Least disturbance to existing habitation and vegetation, if any
b) Flexibility to have future expansion units
c) Predominant wind directions as given by the wind rose are duly taken into account with a view to minimise pollution, fire risk, etc. The plot plan indicates wind rose information also
d) Power evacuation corridor for connection to Rajasthan state grid
e) Raw water intake facilities
f) Railway siding entry point for coal transport
g) Approach road to the power plant from the state highway : SH 51
h) Availability of adequate space for fabrication / construction equipment within the power plant boundary.
i) Availability of adequate space for labour colony during construction stage

9.2 All facilities of the plant are laid out in close proximity to each other to the extent practicable so as to minimise the extent of land required. The layout also facilitates communication of men and movement of materials between the various facilities both during initial construction and also during subsequent operation and maintenance.

9.3 Besides taking into consideration the above aspects, the Plot Plan is made to permit coal receipt by railway wagons. Heavy Fuel Oil (HFO) (which will be used for boiler flame stabilisation) would also be received by rail tankers as in the case of Stage I, of the Project.

9.4 SITE TOPOGRAPHY AND GRADE LEVEL

The site for proposed unit is 213 Hectares and is generally having gentle slope with minimum undulations. The site for proposed project is adjacent to existing units 2x250MW (Phase 1) and 2x250MW (Phase 2) under construction and is mostly Single crop agricultural land. The area around the proposed project site is thinly populated.

The main plant, auxiliary buildings and coal stockyard etc. would be located suitably at levels in line with the existing units.

9.5 STATION BUILDING

9.5.1 General arrangement plans of the station building for the proposed expansion plants are shown in Exhibits – 007 and 008 and sectional view is indicated in Exhibit – 009.The station building would be a non-basement structure with sandwich layout having electrical bay and one common control room for two units. The total length of the building will be about 270m and the width will be about 48m.

9.5.2 The TG bay would be serviced by three floors - ground floor at 0.0 M level, mezzanine floor at 8.5 M level and operating floor at 18.0 M level. Localised O&M platforms at required levels would be provided. The deaerator would be located at EL 39.00 M in the BC bay. Road access will be provided to the unloading and maintenance bays for unloading TG components and auxiliary equipment.

9.5.3 The superstructure will be of structural steel framing with RCC floor slabs. Brick work side cladding upto 3.0 m above ground level and insulated metal sheet cladding above this level has been considered. The cladding for the electrical bay will be of brick with single sheet cladding from aesthetical point of view. The roof of the TG bay would be permanent metal decking with insitu concrete and screed on top and supported on steel trusses. Building will have crane girder at a suitable elevation to support the E.O.T cranes. Intermediate floors are supported with internal columns around TG foundation.

9.5.4 The turbine-generator pedestal would be of reinforced concrete frame structure and would be isolated from the building foundations and super-structure. Suitable measures shall be taken to isolate the vibration transfer to the TG building. All structures would be designed to cater to applicable wind /seismic forces in the area as per relevant Indian Standards

9.6 STEAM-GENERATOR AREA and BUNKER BAY

The bunker bay would be of structural steel-framed construction, supporting the circular steel bunkers. The bunker bay would have Mill at ground level and floors for the raw coal feeders and for the bunker feeding conveyors provided with trippers. The bunker bay would be located on either side of Boiler (Side mill arrangement) or any other suitable arrangement depending on the manufacturer's standard. Concrete paving would be provided in the steam-generator area and ESP area with necessary drains and trenches. Pipes and cables in this area would, in general, be routed on overhead pipe/ cable racks.

9.7 CHIMNEY

One multi flue RCC chimney common for two units has been envisaged for the proposed expansion thermal power plant. The height of chimney is 275m above grade level, which would meet the requirement of Indian emission regulations. The flues would be of mild steel construction of suitable exit diameter with glass wool insulation. The chimney windshield shall be of RCC construction. Appropriate aviation warning system would be provided for the chimneys as per regulatory requirements.

9.8 RAW WATER SYSTEM / CW SYSTEM

The plant is provided with a circulating cooling water system with Natural Draft Cooling Tower. The source of water for the proposed expansion power plant is from three sources namely Lhasi, Andheri and Parwan dams of Irrigation projects which are located at an aerial distances ranging from 20 – 60 km from the power plant. The dams are yet to be constructed across river Lhasi and Andheri. Whereas dam across the Parwan is in place for irrigation purpose The type of intakes at these locations would be decided during detailed engineering stage. It is proposed to convey the water from rivers to the power plant area through buried MS pipe and stored within the plant in a storage pond. Raw water storage reservoir of 18 Lakh cu.m has been envisaged to cater for 15 days storage. This water will be treated in a clarifier and the treated water will be stored in an RC storage tank. The required make-up water for condenser cooling will be conveyed from the storage tank to the forebay of CW Pump House. The CW system would involve the following:

a) Make- up water intake to draw water required for make-up water requirement .

b) Make-up water pipeline to convey the water from intake to make-up water pump house

c) CW pump house

d) CW pipeline from pump house to condenser, condenser to NDCT

e) CW channels from NDCT towers to pump house

The CW Conduits will be buried MS pipes and sizes of the conduits will be based on the optimisation studies.

9.9 MISCELLANEOUS BUILDINGS / STRUCTURES

Table 9.I below indicated the list of miscellaneous buildings / structures planned in the proposed plant along with the type of construction(Sizes to be decided during detailed engineering stage)

Table 9.1

Major Buildings / Structures

Sl. No.	Building / Structure	Remarks / Type of Construction
1.	ESP control room	Separate ESP control rooms for both units. Structural steel construction with brick walls. Floors and roof shall be of RCC.
2.	Air washer rooms	Two per unit; Each having ground plus one floor. Structural steel construction with brick walls. Floors and roof shall be of RCC.
3.	Ware houses and Workshop	Structural steel columns with bricks for side cladding. Pre-coated galvalume sheet supported on structural steel will be provided for roof.
4.	D.G house	RCC framing with brick cladding.
5.	Hydrogen cylinder shed	Structural steel construction with pre-coated galvalume sheet for roof with 1.8 m high brick dwarf walls for the sides.

6.	CW pump house & MCC room	RCC construction with Brick wall for side cladding.
7.	Clarified water pump house	RCC Structure with cladding in brick walls.
8.	D.M Plant / Control room	Structural steel columns with pre-coated galvalume sheets for roof. Roof is supported on structural steel trusses.MCC room is RCC construction with brick cladding.
9.	Coal handling switch gear cum control room	RCC construction with brick walls.
10.	Switch yard control room	RCC construction with brick walls
11	Admin Building	RCC construction with brick walls
12	Canteen Building	RCC construction with brick walls
13	Service Building	RCC construction with brick walls
14	Fire Station Building	RCC construction. Sides are kept open. Fire office space will be provided with Brick wall cladding.
15	Car / Scooter parking	Structural steel construction with pre-coated galvalume sheet for roof. Sides are kept open.

9.10 **SOIL PROFILE**

Based on Geo-technical investigations report of Stage I, it is observed that top portion consist of about 1 to 1.25m depth black cotton soil followed by fractured rock (very severe to moderate) for 2.0 m - 5.5 m depth and black basalt rock (moderate to strong) beyond 5.5m.

In stage-1 terrace grading have been adopted. For power block area the founding level is considered at 5.5m below graded level of 396.0m where Basalt rock as founding strata with net SBC 50 t/m2 and for other areas founding strata at 3 to 4m below graded level where SBC is 30 to 40t/m2 where fractured rock strata is encountered. For estimation purpose above parameters has been considered

9.11 **FOUNDATIONS**

All heavily loaded foundations are proposed to be taken to Basalt rock level with SBC of 50T/m2. Other structures will be founded in weathered rock with SBC 30T/m2.However detailed Geo technical investigations needs to be carried out during detailed engineering stage to ascertain the soil properties.

In general for cable trenches and drains it is proposed that soils should be excavated to 0.5 m below bottom level of the trench / drain and the black cotton soils should be replaced by CNS layer. The CNS may consist of murrum (non-swelling) or natural soils mixed with lime or fly ash.

9.12 MACHINE FOUNDATIONS

All major machine foundations will be proportioned such that frequency separation is ensured and amplitudes are with in specified limits. These foundations will be suitably isolated from building super structure.

9.13 ROADS ,COMPOUND WALL AND FENCES

9.13.1 The approach road and road to Administrative building would be duel corridor of 10.0m width , other main roads in the power plant will be 7.0m wide and all other Minor roads will be 4.0m wide. All major roads will have 1.5m wide shoulder on either side of the road. on either side of the roads open drains shall be provided. Initially water bound macadam road will be constructed and the surface will be provided with bituminous carpet after all the major construction activities are completed. It is also considered to provide RCC roads in Power Block area.

9.13.2 Boundary wall will be provided around the land acquired for the power plant including colony area. The construction will be of stone masonry. Height of the wall will be 3.0m above the grade level. Coping of 150mm thick in PCC M15 will be provided at top. Over the stone masonry wall, 600mm high anti-climbing device will be provided using eight strands of galvanised barbed wire drawn through the slots in vertical Y shaped fence post made up of galvanised MS angles.

9.13.3 Fencing will be provided around switch yard, transformer yard, auxiliary transformer yard and fuel oil tank farm area. The height of fencing will be 3.0m above the toe wall. The toe wall will be of RCC construction and top of the toe wall will be 200mm above grade level. Fencing shall consists of 2.4m high PVC coated GI chain link fence of 8 gauge with mesh size of 75mm square. Fencing post will be of galvanised MS angle of 75x75x6 size and will be spaced at a maximum spacing of 2.5m center to center with struts made up of galvanised MS angle at every fifth fencing post in addition to those at bends. Over this fencing 600mm high anti-

climbing device consisting of GI barbed wires will be provided.

9.14 DRAINAGE

A network of drains will be provided covering the entire plot. Garland drains will be provided around all buildings to connect to the road side drains. The storm water drains will be connected to the nearest water body / will be suitably integrated with Stage I, storm water system and will be treated suitably and reused for gardening and other purposes. Rainwater harvesting schemes would also, be adopted.

9.15 DESIGN BASIS

Dead and live loads will be considered as per relevant IS codes and standard engineering practices. The basic wind speed of 47 m / s is considered for design of buildings / structures as per IS : 875 : Part III. The power plant is located in Seismic Zone II as per IS : 1893 (IS:2003) and seismic forces will be considered accordingly for the structures / buildings. All designs shall be carried out in SI units and shall be as per relevant IS codes.

9.16 MATERIALS

All civil construction materials used would confirm to relevant IS codes.

9.17 SEWAGE DISPOSAL

A network of sewers with manholes located at all junctions and at a spacing of 50 m will be provided to cover all the buildings in the project. Sewage from various buildings will be led by sewers connecting to the nearest manholes. The collected sewage will be led to a sewage treatment plant.

9.18 LAND SCAPING

Various services / utility areas within the plant area would be suitably graded to different elevations in line with Stage -I. Natural features of the plant site will be retained as far as possible to integrate with the buildings to form a harmonious / pleasant environment. Areas in

front of various buildings and the entrance of power plant will be landscaped with ground cover, plants, trees based on factors like climate, adaptability etc. A green belt of atleast 30% area is proposed to be provided for plant as per guidelines of MOEF. The green belt will consist of native perennial green and fast growing trees. Trees will also be planted around the coal stock pile area and ash disposal area to minimise the dust pollution.

9.19 **COLONY**

The land being acquired for the plant staff housing colony has an area of 40 hectares located close to plant area. These dwellings will be of RCC structures having maximum 2 storeys with Brick / Concrete block Masonry infill walls with all necessary amenities essential for a good housing unit. Quarters of type I and type II shall be individual bungalows and other shall be of Block type. The areas and the type of housing with numbers required are indicated below.

Type	Area in Sq.m	Nos. required
I	200	14
II	160	34
III	110	100
IV	75	274
V	65	200

The colony will be provided with facilities like hospital, shopping complex, school, parks, play grounds, community hall, entertainment centre, etc.

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	CHAPTER - X	
	ENVIRONMENTAL ASPECTS	
10.1	**TYPES OF POLLUTION**	
10.1.1	The technical details and emission parameters mentioned in this chapter refer to proposed 2x660MW STPP at Chhabra, Baran district, Rajasthan state for RRVUNL. This chapter details out the following environmental impact aspects:	
	a)	Air pollution
	b)	Water pollution
	c)	Noise pollution
	d)	Sewage disposal
10.1.2	**AIR POLLUTION**	
10.1.2.1	The air polluting emittants from the power plant are as follows:	
	a)	Dust particulates in flue gas, from chimney
	b)	Sulphur dioxide (SO2) in flue gas
	c)	Nitrogen oxides (NOx) in flue gas
	d)	Coal dust particles while handling of coal
	e)	Dust in the ash disposal area

10.1.2.2	**REGULATIONS FOR LIMITING AIR POLLUTION**		
10.1.2.2.1	Indian Standards		
10.1.2.2.2	As per notification by Ministry of Environment and Forests dated 19 May 1993, the emission limits are as follows:		
	a)	Suspended particulate matter (SPM)emission (dust particulate from fly ash)	50 mg/Nm^3
	b)	Sulphur di-oxide *	-
	c)	Nitrogen oxides	Not specified
	d)	Coal dust particles during Storage/handling of coal	Not specified
	e)	Dust in the ash disposal area	Not specified
10.1.2.2.3	Note : *Sulphur di-oxide emission would be controlled by specifying minimum stack height limit which is as follows :		
	Power Generating Capacity		**Minimum Stack Height**
	500 MW and more		275 m
	200 MW and above to less than 500 MW		220 m
	Less than 200 MW		H = 14 (Q) ^ 0.3 Where H = stack height in M Q = SO_2 emission rate in kg/hr
10.1.2.2.4	As per notification by Central Pollution Control Board dated 11 April 1994, for the ambient air quality, the permitted limits of ground level concentrations of pollutants considering Industrial, Residential, Sensitive areas is furnished in Table- X.1 below :		

Table – X.1

National Ambient Air Quality Standards

Pollutant	**Time Weighted Average**	**Concentration in Ambient Air** $\mu g/m^3$		
		Industrial	Residential,	Sensitive Area

Table – X.1

National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air $\mu g/m^3$		
		Area	Rural & Other areas	
Sulphur Dioxide (SO_2)	Annual Average*	80	60	15
	24 hrs**	120	80	30
Oxides of Nitrogen as NO_2	Annual Average*	80	60	15
	24 hrs**	120	80	30
Suspended Particulate Matter (SPM)	Annual Average*	360	140	70
	24 hrs**	500	200	100
Respirable Particulate matter)(RPM) (size less than 10um)	Annual Average*	120	60	50
	24 hrs**	150	100	75

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week – 24 hours at uniform interval.

** 24 hourly / 8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on the consecutive days.

Notes:

1. National Ambient Air Quality Standard: The levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property
2. Whenever and wherever two consecutive values exceed the limit specified above for the respective category, it would be considered adequate reason to institute regular / continuous monitoring and further investigations

10.1.2.2.5 **Dust Particulates from Fly Ash in Flue Gas**

As per the above norms, the standard for particulate emission applicable to this project is 50 mg / N m^3. The electrostatic precipitators (ESP) proposed to be installed in this project would be designed to limit the emission level of the particulate matter to this limit

10.1.2.2.6 **Sulphur Dioxide (SO2) in Flue Gas**

As per the above norms, the minimum stack height for plants over 500 MW units would be 275m. A twin flue stack for two units of 660MW has been proposed for effective dispersal of SO_2

10.1.2.2.7 **Nitrogen Oxides (NOx) in Flue Gas**

The steam generators would be fitted with advanced low NOx burners and over fire airports to reduce NOx emissions. The NOx emissions would be checked at ground level concentrations (GLC) as per the above indicated Indian Emission Regulations

10.1.2.2.8 **Coal Dust Particles due to Handling of Coal**

10.1.2.2.8.1 Coal dust would be generated generally at the conveyor transfer points, coal unloading area and coal stockpile area. Hence, coal transfer points and coal stockyard would be provided with dust suppression / dust extraction facilities. Further, in order to arrest the coal dust generation, all conveyors would be provided with enclosed galleries. The bottom portion of all the conveyor galleries would be provided with seal plates with in the power plant area and at road crossing

10.1.2.2.8.2 Dust collection system would also be provided in coal bunkers to evacuate dust and

hazardous gases like methane from the coal bunkers. Collected dust would be returned to either the associated belt conveyor or to the coal bunker

10.1.2.2.9 **FLY ASH DUST PARTICLES FROM ASH SILOS AND ASH DISPOSAL AREA**

Two (2) nos. Intermediate surge (buffer) hopper, Four (4) nos. fly ash storage silos, two (2) nos. for each unit located outside the plant boundry, are proposed to be provided. Fly ash evacuated from the ESP/APH/ECO collecting hoppers would be transported in closed pipelines by pneumatic means. At the time of unloading fly ash in to the ISH / silos, some ash laden air would get vented out. However in order to restrict the fly ash dust particles to the limit, a vent filter would be installed on top of each of the fly ash ISH / silos at the vents.

10.1.2.2.10 The following pollution control measures are proposed to be installed for ash disposal:

a) 80% utilization of fly ash in dry form is envisaged. Closed trucks and containers would be used for this purpose, as far as possible
b) To reduce the dust nuisance while unloading the ash into the open trucks from fly ash silos, the fly ash would be conditioned with water spray
c) Water sprinkling system would be provided in the ash disposal area to restrain flying of fine ash due to wind
d) The ash disposal area would be lined with impervious lining to prevent seepage of rain water from the disposal area in to the ground and pollute ground water

10.1.3 **WATER POLLUTION**

The water pollutants applicable for this plant are:

a) Cooling tower blow down water

b) Boiler blow down water

c) Water treatment plant effluent

d) Effluent from ash disposal area

e) Effluent from coal pile area run off

f) Air pre-heater wash water effluent

g) Plant wash down water

h) Floor and equipment drainage effluent

i) Rain water drainage

j) Sewage from various buildings in the plant

10.1.3.1 **REGULATIONS FOR LIMITING WATER POLLUTION: INDIAN STANDARDS**

10.1.3.1.1 Environmental (Protection) Rules 1986 issued by Ministry of Environment and Forests - Schedule-I, stipulates the following limits for effluent disposal:

10.1.3.1.1.1 **Ash pond effluent:**

pH	6.5 to 8.5
Suspended solids	< 100 mg/l
Oil and grease	< 10 mg/l

10.1.3.1.1.2 **Effluent from WT plant** Not Specified

10.1.3.1.1.3 **Steam generator blow down:**

Suspended solids	< 100 mg / l
Oil and grease	< 20 mg / l
Copper (total)	< 1.0 mg / l
Iron (total)	< 1.0 mg / l

10.1.3.1.1.4 **Cooling tower blow down:**

Free available chlorine	< 0.5 mg/l
Zinc	< 1.0 mg/l
Chromium (total)	< 0.2 mg/l
Phosphate	< 5.0 mg/l

10.1.3.1.2 As per the notification issued by the Ministry of Environment and Forests dated 19 May 1993, the Schedule-VI specifies the quality of effluent permitted to be discharged. The qualities of effluents have been specified under the following categories:

a) Inland surface water
b) Public sewage
c) Land for irrigation
d) Marine coastal areas

10.1.3.1.3 For the proposed power plant, the category to be considered would be under inland surface waters. The major effluent limits under category are:

Suspended solids	100 mg / l (max).
pH	5.5 to 9.0
Temperature	Shall not exceed 7^{o}C above the receiving water temperature.
Oil and grease	10 mg / l

10.1.3.1.4 The quantity of effluents would confirm to the limits indicated above and also those limits prescribed by Rajasthan State Pollution Control Board

10.1.3.2 **REUSE OF PLANT EFFLUENETS**

Following paragraphs describe the proposed reuse of plant effluents:

a) **Cooling Tower Blow Down**

The cooling tower blow down water will be used for fire fighting, ash handling purpose and for coal dust suppression purpose.

The cooling tower blow down does not require treatment but relies on minimising the level of pollutants by operating at reduced cycles of concentration to prevent the build up of contaminants and through the proper selection of treatment chemicals which do not introduce additional pollutants such as zinc and chromium.

b) **Boiler Blow Down Water**

The boiler blow down does not require treatment to achieve the limits but relies on

operating at sufficient blow down levels to prevent the build up of contaminants. Also, by operating with proper chemistry in the condensate and feed water systems, copper and iron are not present in significant quantities in the blow down stream. The boiler blow down is also directed to the guard pond.

c) **Water Treatment Plant Effluent**

The effluent from the regeneration of the cation resin units in the water treatment plant (DM Plant) is generally acidic in nature and from the anion resin units are alkaline in nature. The combined waste water from the DM plant would be neutralised in a neutralising pit. The neutralised effluent is expected to have suspended solids less than 5 ppm and pH in the range of 6.5 to 8.5. This would be led to CMB.

d) **Coal Pile Area Run Off**

The coal pile area run off water during monsoon season would be led to a separate pond. Coal particles would settle down in the pond and clear water would be allowed to flow into the CMB.

e) **Effluent From Bottom Ash Handling System**

The drain and overflow water from the bottom ash handling system would be collected at the bottom ash sump where the ash would settle down and clarified ash water overflows to clear well section of the basin. This clear water would be sent to the guard pond.

f) **Plant Wash Down Water**

In the power plant, some specific locations require washing to maintain good plant house keeping and prevent build up of dirt and waste material. The waste water would be led to the bottom ash sump via suitable oil water seperators.

g) **Floor and Equipment Drainage System Effluent**

Means would be provided for collecting and draining water from floors in process areas of the plant and collecting and disposing of water and other liquids from process equipment, discharged fire protection water and oil storage tanks.

In the turbine building, the ground floor slabs would be sloped to drain out floor

drains. The equipment drains are piped directly to the drain system. Drains are collected and directed to sumps outside the buildings from where it would be pumped to the bottom ash sump.

10.1.3.3 **RAIN (STORM) WATER DRAINAGE**

The rain (storm) water removed from the building roofs and yard area grade level surfaces would be directed through the open ditches and culverts to the storm drainage piping. All ditches would be concrete lined and located along the roads. All drainage ditches would be located to provide the shortest practical drainage path while providing efficient drainage for the yard. Grade level would be contoured such that storm water run off is directed on the ground by sheet flow, to well defined drainage paths leading to the ditches.

10.1.3.4 **SEWAGE FROM VARIOUS BUILDINGS IN THE PLANT**

Sewage from various buildings in the power plant area will be conveyed through separate sewage pipes to sewage treatment plant where the sewage will be treated and treated water will be used for gardening / irrigation purpose

10.1.3.5 **MONITORING OF GROUND WATER**

Four bore-wells would be identified inside / outside the plant premises to monitor the ground water quality as per IS: 10500 (1991).

10.1.4 **NOISE POLLUTION**

10.1.4.1 The source of noise in the proposed power plant are:

a) Steam turbine generator
b) Other rotating equipment
c) Combustion induced noises
d) Flow induced noises
e) Steam safety valves

10.1.4.2 **REGULATIONS FOR LIMITING NOISE POLLUTION: INDIAN STANDARDS**

10.1.4.2.1 As per the Environmental (Protection) Rules 1986, the limits in the ambient noise levels are:

Industrial area 75 dB (a) in day time (6 AM to 9 PM)
70 dB (a) in night time (9 PM to 6 AM)

Occupational Safety and Health Administration Standards (OSHA), USA indicate the following permissible noise

Duration per Day (Hours)	**Sound Level (dBA)**
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25	115

10.1.4.2.2 All the equipment in the power plant would be designed / operated to have the noise level not exceeding 85 db (a) measured at a distance of 1.5 m from the equipment. Also, all the measures would be taken to limit the noise levels at the plant boundary within the stipulated limits.

10.1.4.3 **POLLUTION MONITORING AND SURVEILLANCE SYSTEMS**

The emission and gas monitoring systems installed in this Project consist of the following:

a) **Flue Gas O_2 and CO Monitoring** :

These would be measured at the economiser outlet. In addition, O_2 would be monitored at the air pre heater outlet. For this purpose, CO and O_2 monitor probes and analysers would be installed separately.

b) **Stack emissions**:

Flue gas exiting into the atmosphere would be monitored for CO & O_2, NO_x , SO_x and Opacity. Stack emission readings would be sent to the DCS for monitoring. For this purpose, the required probes and associated equipment would be installed. The Opacity sensors would be equipped with a blower to protect the optics from coating by flue gas particles.

c) **Air Monitoring**

Air Monitoring Stations (AMS) would be set up to monitor the air quality in the plant area and the surrounding areas depending upon the requirements of MOEF norms. The parameters being monitored are suspended particulate matter (SPM), respirable particulate matter (RPM), Sulphur di-oxide (SO_2), Nitrogen Oxide (NOx), Carbon monoxide (CO) , Hydro carbons (HC) and Ozone (at one point). The air quality monitoring will be carried out continuously.

d) **Meteorological data**

Arrangements would made to measure meteorological parameters like ambient air temperature, Wind speed and direction, Relative humidity etc at one point in plant area.

10.1.4.4 **GREEN BELT**

In the proposed power plant, for raising plantation adequate saplings would be planted in side the power plant.

10.1.4.5 **IMPACT OF POLLUTION/ENVIRONMENTAL DISTURBANCE**

All necessary pollution control measures to maintain the emission levels of dust particles, sulphur dioxide and nitrogen oxides would be taken and necessary treatment of effluents would be carried out. Hence there would be no adverse impact on either air or water quality in surroundings of the power station site on account of installation of the proposed plant.

10.1.4.6 **ENVIRONMENTAL CLEARANCE**

Environment impact assessment reports would be prepared and submitted to concerned state authorities / MOEF for project environment clearance.

CHAPTER - XI

PROJECT IMPLEMENTATION AND SCHEDULE

11.1 PROJECT SCHEDULE

11.1.1 The project milestone schedule is presented in Exhibit-010. It is envisaged to synchronise the first unit and put into commercial operation in 42 months, reckoned from the date of award of boiler and turbine generator (BTG) contract for the project. The second unit would be put into commercial operation 3 months thereafter. The first synchronisation of each unit would be three months ahead of their commercial operation date (COD).The time between synchronisation and COD would be utilised for the following activities:

11.1.2 Trial operation of steam generator (SG) and turbine generator (TG) including submission of report upon successful completion, for duration of four (4) weeks. Trial operation would include the following major activities.

a) Trial operation of the unit for 72 hours at full load on auto mode.
b) Operation of the unit at various load regimes for sufficient duration on auto
c) Stable operation of unit and notice for performance guarantee (PG) test for SG and TG – 2 weeks
d) Performance guarantee test including shutdown for removal of instruments and unit characteristics tests inclusive of VWO test, house load operation test, ramp rate test, demonstration of cold, warm and hot start-up times – 2 Weeks
e) PG test for balance of plant systems like WT plant, water clarification plant, cooling towers, coal handling etc. – 2 Weeks.
f) Review/approval of PG tests and take over for commercial operation – 2 Weeks.

11.2 TRANSPORTATION / HANDLING OF EQUIPMENT

11.2.1 The power plant is located adjacent to (500 m away) from the State Highway No.

51. The SH 51 is connected to Agra -Bombay Highway (about 10 km). The SH 51 is also connected to state highway from Kota via Chhabra town. For Stage I, Phase I and II of the Project equipment is received from both the above two directions. For Stage II, Phase III also, similar route will be followed.

11.2.2 VOID

11.2.3 The following mode of handling at site is envisaged for heavy equipment at the erection stage:

11.2.3.1 All steam-generator parts would be brought to the SG area and hoisted to the erection points using tower/ boom crane / and other types of lifting devices. Some of the market brands of cranes (specially to lift ceiling girders) are

a) FMC, USA – capacity= 350MT, boomlength = 100M
b) Manitowac, Germany – capacity = ›400MT, boomlength = 132M
c) Potain - capacity = ›400MT, boomlength = 130M

11.2.3.2 The generator stator would be unloaded from the carriers by means of hydraulic jacks in the maintenance bay of the station building. At the time of erection, the stator would be moved to the side of A row on to the erected portal frame and would be lifted by a portal crane or by strand and jack method and moved to its place (Generator foundation) by the portal crane or on rails by suitable method.

11.2.3.3 All equipment in the station building, except the generator stator, would be erected using two (2) nos. 120/40 ton E.O.T. crane installed in the station building. The transport carriers would be brought into the maintenance bay of the station building to facilitate handling by the E.O.T. cranes. Typical weights of major power plant equipment are furnished at Table-XI-1.

Table-XI-1

TYPICAL WEIGHTS OF MAJOR COMPONENTS FOR 660 MW TP PLANT		
Sl. No.	Name of the Equipment	Weight in tonnes
1.	Generator stator	340
2.	Generator Rotor	82
3.	Generator transformer(single phase)	230
4.	LP Turbine rotor	80

5.	HP heater	105
6.	LP heater	30
7.	GSC	5.1
8.	GS exhauster	0.75
9.	Main oil tank	8.5
10.	De aerator and feed water tank	130
11.	Main oil cooler	5.5
12.	Thyristor panel	6.5
13.	Excitation transformer	24.5

11.2.3.4 The generator transformer would be jacked up and unloaded on the railway track provided for transformers close to the foundations and moved to the position by means of the bi-directional rollers provided. Smaller transformers would be skidded into position using winches.

11.3 OPERATION AND MAINTENANCE

11.3.1 To ensure adequate technical competence in operation and maintenance of the power station, the following measures are proposed to be taken:

a) Personnel identified for O&M functions would comprise a cadre of engineers having the required background and experience in commissioning, operation and plant maintenance functions for a coal fired thermal power plant of similar capacity.

b) These O&M personnel would be recruited at an early stage and would be given adequate training at the manufacturer's works, at site, at other similar power stations and/or in training simulators so as to familiarise them with the necessary O&M functions relating to plant and equipment specific to this project.

11.4 PRELIMINARY AND OTHER WORKS

To ensure timely project execution, within the cost envisaged, several project developmental activities are to be completed before the date of award of BTG contract. However, apart from obtaining necessary approvals and clearances, some of the important site-related works such as site enabling works viz. temporary site office, storage sheds, construction water and power supply have to be taken up and

completed early. A separate logistics study to be initiated to study the suitability of roads. for movement of equipment and fuel to site.

CHAPTER – XII

ESTIMATION OF PROJECT COST AND TARIFF

12.1 The cost estimate is based on the identified location of the proposed 2x660MW, super critical power station at Chhabra, Baran District, Rajasthan.

12.2 BASIS OF COST ESTIMATES

The project would be executed by Three EPC packages BTG, BOP and River water system packages and hence the project cost estimate is based on the same. The total project cost estimate includes the cost of land, cost of steam turbine generators and auxiliaries, steam generators and auxiliaries, coal / ash handling systems, water systems, control and instrumentation system, electrical system and other balance of plant required for the power plant, overheads and pre-operative expenses, interest during construction and financing costs**.** The cost of main plant equipment (consisting of boiler and turbine islands) and other systems / structures / equipment / services are estimated from in-house data bank.

12.3 COST OF LAND

The cost of the land for the proposed facilities has been estimated based on a rate of Rs.2.20Lakh per acre.

12.4 CIVIL WORKS

12.4.1 The project cost includes the following:

a A station building and all other plant structures

b Pile foundations for all major structures

c The cost of ash disposal area development

d Non-plant buildings such as gatehouse, warehouse, and site offices and other infrastructures required during the construction period

e Cost of site grading, terracing for areas like SG /TG area, transformer yard, GIS/ open switch yard, cooling tower area, coal handling area and other non-service areas

f Boundary wall and anti climbing fencing for the area proposed to be acquired for the power plant

g A lump sum amount of Rs. 3000 lakhs has been provided for miscellaneous buildings

under civil works

h The cost of external Raw water system three sources and plat raw water system is expected to be 25000 laks, which is included in civil costs.

i Basic issue rates of building materials are considered as follows:

Cement	Rs. 4200 per tonne
Fabricated Reinforcement steel	Rs. 55000 per tonne
Structural steel (Including fabrication & erection)	Rs. 75000 per tone

12.5 **Mechanical and Electrical Works**

12.5.1 While all the mechanical and electrical equipment required for a complete power plant are included, the following are to be noted:

Clarified water for condenser cooling and all other plant applications is proposed to be generated at the plant clarifier systeml

Cost of transmission system beyond Switch yard is not included in the project cost

Cost of spares for mechanical and electrical equipment at 3% of ex-works cost is considered

Coal handling system cost does not include the cost of any captive berth.

Costs of erection, testing and commissioning for all the equipment has been included.

12.5.2 For the indigenous equipment, the following taxes and duties are assumed:

Excise duty (inclusive of educational cess)	-	0%(mega power status)
VAT / Central sales tax against 'C' form	-	3%
Freight and transit insurance	-	3%
Service tax inclusive of educational cess	-	10.3%

12.5.3 No price escalation is considered during execution of the project.

12.6 **INTEREST DURING CONSTRUCTION PERIOD**

Based on debt-equity ratio of 80: 20 and interest rate including financing charges of 12.0% the interest on loan during construction (IDC) has been considered. Since IDC can be capitalised, the overall project outlay includes this amount.

12.7 PROJECT COST

The total project cost including IDC is estimated at Rs.7920 Crores (about Rs.6.00Crores / MW) as indicated in Appendix - 7

12.8 TARIFF

The sale of energy would be through a Power Purchase Agreement with the Rajasthan state power transmission co. or as a merchant co based on tariff based on agreements with other states

Based on CERC norm of turbine heat rate of 1850 Kcal / kWh , the station gross heat rate + 6% (as per CERC) would be 2280 Kcal/Kwr. The cost per kWh works out to Rs. 2.98 for the first year of operation when all the units are stabilized at a PLF of 85%. The levellised tariff works out to be Rs. 3.09 per kWh

CHAPTER – XIII
CLEAN DEVELOPMENT MECHANISM

13.1 OVERVIEW OF KYOTO PROTOCOL

Climate change emerged on the political agenda in the mid-1980s with the increasing scientific evidence of human interference in the global climate system and with growing public concern the environment. Kyoto protocol was signed in 1997 and came into force since 16 February 2005 and protocol commits industrialized countries to reduce their greenhouse gas by 5.2% below 1990'levels in 2008-12.

Individual, qualified emission targets for each industrialized country
Six greenhouse gases covered: CO2, CH4, N2O, HFC.PFC & SF6

The protocol establishes three cooperative mechanisms as given below,

a. Clean Development Mechanism (CDM)
b. Joint Implementation (JI)
c. International Emissions Trading

13.2 CLEAN DEVELOPMENT MECHANISM (CDM)

Clean Development Mechanism (CDM) allows emission reduction projects that assets developing countries in achieving sustainable development and the generated Certified Emission Reductions can be used by the industrialized countries or companies,

PROJECTS ELIGIBLE UNDER CLEAN DEVELOPMENT MECHANISM

Renewable Energy	Hydro, Wind, Solar, Biomass, Bagasse, Geothermal, Tidal
Waste Heat Recovery	Cement, Steel/ Metal, Coke Oven
Waste Management	Waste Water Management, MSW Management, Fuel Pellets,

Transportation	LP NG, BiodieseL MRTS. Pipeline, Railways Shift
Process Change	Petroleum Refineries, Oil & Gas Refineries, Fertilizer CO2 Recovery, Nitrous Oxide (N2O) Destruction, Refrigerant: HFC Abatement, Aluminum: PFC Control
Energy Efficiency	Efficient Generation (Efficient Machinery, T&D Loss Reduction, Thermal / fuel, Steam Saving, Thermal Saving, Process Fly ash in Cement)
	Efficient Utilization (Energy efficiency measures for buildings and | Industries), Efficient Steam Utilization in Process
Industrial Fuel Switch	Fossil Fuel to Natural Gas, LPG, Biomass
LULUCF	Plantation / Forestry, Afforestation. Reforestation

13.3: 2 X 660MW SURATGARH SUPER CRTICAL UNITS-7 & 8 PF FIRED THERMAL POWER PLANT AND CDM

The purpose of the project activity is to set up TPP and the generated power will be exported to state electricity board grid / exported. The project will be located in the existing Suratgarh thermal power project.

The fuel used in the power plant will be washed Indian coal for generating electricity. Since super critical technology is being adopted, the heat rate will be of the order of 2250 kCal / kWh, which is less than a sub critical thermal power project by around 200 kCal/kWh, which leads to less emission to that extent. There will be reduction in the coal consumption also to the tune of 40953 Tonnes per annum, which further saves the precious fossil fuels. As per guidelines issued by CEA based on methodology ACM0013 ver 01, the reduction in CO2 will be 0.941 Tonnes of CO_2 per MWH. For 2 X 660 MW Super Critical Power Plant with 85 % PLF, the reduction in CO_2 will be around 8598852.35 Tonnes/year.

Since the project will use lesser fuel vis-a vis sub critical units of similar capacity, the project is eligible for getting carbon credits under Clean Development of Kyoto Protocol.

Using Clean Development mechanism the amount of CO2 reduced can be monetized under forward contract with CER Buyer
Road Map moving ahead

The proposed project needs to be developed under CDM cycle to monetize the carbon credits from the project. Project will be developed as bilateral CDM project, with CER buyer. RRVUNL will take the responsibility to develop and finance the subject project in CDM cycle.
The CDM cycle involves following steps and these components will be taken care by CER buyer.

13.4 CDM PROJECT CYCLE

Project Development

- Determine emission reductions:

  - Choose project boundary
  - Select project baseline
  - Set crediting period
  - Calculate emissions reductions

- Develop emissions monitoring and verification protocol
- Prepare investment plan and undertake financial analysis

Functional Approval

- Carry out an environmental impact assessment if required
- Obtain stakeholders' comments
- Obtain host country approval

Validation And registration

- Prepare project design document
- Operational entity evaluated and validated project
- Executive board register project

Verification and certification

- Operational entity verifies emissions reduction
- Executive board certifies project and issue CERs

CHAPTER – XIV

CORPORATE SOCIAL RESPONSIBILITY

As per MOEF TOR guidelines the following social activities shall be taken up by the Owner and executed.

a) Action plan for identification of local employable youth for training in skills relevant to the project for eventual employment in the project itself to be formulated and executed.

b) Study on land use pattern in the project area to be carried out including identification of common property resources available for conversion into productive land and action plan for abatement and compensation for damage to agricultural land/ common property land (if any) in the nearby villages, due to the proposed project to be prepared and executed.

c) R&R details along with settlement for homestead oustees which will include details of families (name and size) compensation paid etc. to be prepared. It will be ensured that R& R shall be completed before commissioning of the plant.

d) Detailed socio economic study to be carried out for the study comprising of ten (10) kms from the plant site.

e) CSR component shall be based on need based assessment study to be carried out in the study area. Income generating measures which can help in upliftment of poor sections of the society which is consistent with the traditional skills of the people to be identified. The program can include activities such as development of fodder form, fruit bearing orchids, occasional training etc.. In addition vocational training for individuals shall be imported so that poor section of society can take up self employment and jobs. Separate budget for community development activities and income generating programs to be specified. Financial allocation to be taken up under CSR to be specified.

f) Possibility of adopting nearest three (3) villages will be explored and details of civic amenities such as roads, drinking water, power etc. proposed to be provided at the company's expenses to be identified and executed.

g) Impact of project on local infrastructure of the area such as road network and whether any additional infrastructure would need to be constructed and the agency responsible for the same with time frame to be identified and executed.

h) Details regarding infrastructure facilities such as sanitation, fuel, restroom, medical facilities, safety during construction phase etc. to be provided to the labour force during construction as well as to the casual workers including truck drivers during operation phase to be identified and executed.

CHAPTER – XV

SAFETY AND DISASTER MANAGEMENT

14.0 Safety

14.1 The safety of the Power plant and its associated systems shall at all the time during its construction and post construction period be governed by CEA's draft standard for (Safety requirements for construction, operation and maintenance of electrical plants and electric lines) Regulations, 2008 – DRAFT.

14.2 Rajasthan Electricity Regulatory Commission (RERC)'s safety standard No. RERC/ Secy/ Safety Standards Date: 5th January 2004 will also be followed for all Electrical installations.

14.3 Various contractors engaged by RVUNL for execution for this project shall at all times will comply with RVUNL's Hearth and Safety Policy while performing the works. In addition, the Contract Organisation shall have a written health and safety policy issued by the Chief Executive of the Organisation, appropriate to the scale and nature of the risks involved in the contract works. A copy of the Policy shall be made available to the RVUNL before signing the contract agreement as evidence of CONTRACTOR'S commitment to management of employee's health and safety and compliance to Statutory and regulatory requirements.

14.4 In addition, stipulations made under following Acts and rules/regulations made the reunder, as applicable, shall also be complied with:

(a) The Explosives Act, 1884
(b) The Explosive Substance Act, 1908
(c) The Indian Boilers Act, 1923 and Indian Boiler Regulations, 1950
(d) The Motor Vehicle Act, 1988
(e) The Petroleum Act, 1934
(f) The Public Liability Insurance Act, 1991
(g) The Static and Mobile Pressure Vessel (unfired) Rules, 1981
(h) The Workman's Compensation Act, 1923

(i) The Water (Prevention and Control of Pollution) Act, 1974
(j) The Air (Prevention and Control of Pollution) Act, 1981
(k) The Environment Protection Act, 1986
(l) Battery Management and Handling Rules, 2001
(m) Bio Medical Waste (Management and Handling) Rules, 1998
(n) Chemical Accident (Emergency, planning, preparedness and response) Rules, 1996
(o) Explosive Rules, 1983
(p) Gas Cylinder Rules, 1984
(q) Hazardous Wastes (Management and Handling) Rules 1989
(r) Petroleum Rules, 1976
(s) Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
(t) Ozone Depleting Substances Rules, 2000
(u) Any other rules and regulations in this regard
(v) Any specific approvals, permits, clearances issued by any authority under different statutes

15.0 Disaster Management

15.1 Contract specifications will address the following points in connection with the Disaster management:-

15.2 An Emergency Response (ER) specific to the site which shall be M written and communicated to all employees by the various Contractors.

a. ER shall be reviewed by the CONTRACTOR to review his emergency preparedness and response plans and procedures in particular after occurrence of incidents or emergency operations.

b. CONTRACTOR shall designate an emergency team with their duties during emergencies defined, Including those of the hose Teams, medical personnel, first-aiders and security. CONTRACTOR shall maintain a procedure as to how his emergency organization shall liaise with RVUNL's representatives in ER.

c. The CONTRACTOR will periodically test such emergency procedures by conducting Mock-drills and use the experience for updating the emergency Plan and for training the Employees on the perceived competence needs.

d. The emergency Response Plan of the CONTRACTOR shall be under the control of the Safety Respresentative (SR) of the Contractor who shall be able to co-ordinate with the RVUNL for liasing with Government agencies.

e. The plans will be designed to allow people to work under disaster conditions when normal services such as telephone water, light power, transport and sanitation are not available and first aid and fire fighting facilities are not able to cope up with sudden demand on services.

f. The telephone numbers, of ambulance, Police and Managers, RVUNL's key Executives will be prominently displayed in the identified Emergency Response Centre.

g. The maintenance staff shall be trained in disaster management.. The staff shall be trained in emergency restoration procedures for managing major failures and breakdowns. Equipment such as vehicles, diesel generating sets and fire fighting equipment and Emergency Restoration System for transmission lines shall be kept available at sub-station or at appropriate location for disaster management.

	APPENDIX – 1	
	SITE INFORMATION	
1	Location of Plant	Chowki Motipura, 24 km south east to Chhabra Town, Baran Dsitrict, Rajasthan
2	Latitude and Longitude :	Latitude : 24°36' N
		Longitude : 77°03' E
3	Elevation of TG building above MSL	396 m (APPROX.). FFL of existing Stage I, Phase I Power house is taken as 396.0 m
4	Access to Site	The site is near to the Agra – Bombay Highway- 10kms
		Rail - 24 km from Chhabra Gagori railway station which is nearest medium size railway station in the West Central railway (between Jaipur & Jabalpur).
5	Terrain	level land.
	Climatic Conditions	
6	Temperature	
6.1	Monthly basis	
	a) Dry bulb temperature	
	Mean daily max :	42.0 deg.C (in the month of May)
	Mean daily min. :	10.6 deg.C (in the month of Jan)

6.2	Yearly basis	
	b) Dry bulb temperature	
	daily max	32.3 deg.C
	daily min.	19.6 deg.C
6.3	Highest temperature recorded	46.3 deg.C
6.4	Lowest temperature recorded	(-) 2.2 deg.C
6.5	Design ambient temperature for performance guarantee of Boiler	30 deg C
6.6	Design CW inlet temperature:	32.0^0C
6.7	For electrical system design	50 ^{0}C
7	Relative humidity	
	Range	Varies between 20% and 80%
	Design relative humidity for performance guarantee.	Boiler - 65% NDCT – 45%
8	Rainfall	
	Annual average	900 mm
9	Annual mean wind speed	13.6 km / hr.
	Basic wind speed	Calculations for wind effect shall be in

		accordance with IS:875-1987(Part-3) taking into account the following: a) Basic wind speed = 47 m/sec b) Factor K1 = 1.07 c) Category of terrain = Category 2 d) K3 – as per IS 875
	Wind loading for RCC stack	Shall be considered as per IS: 4998.
10	Seismic Data	As per IS : 1893 latest issue
11	Zone	Zone II
12	Auxiliary Power Supply	Electrical equipment to be supplied against this specification shall be for operation on the following supply system
13	For motors rated above 1500kW	11000V,3phase, 3-wire, 50 Hz non-effectively earthed AC
	For motors rated 160kW : And up to 1500 kW.	3300V,3 phase,3 wire,50 Hz non-effectively earthed AC
	For motors rated 160 kW and below & other LT loads	415V, 3-phase, 3-wire, effectively earthed AC
	DC alarm, control and protections	220V DC, 2-wire, unearthed
	AC control circuits	110V, 1 Phase, 50 Hz, 2 wire, earthed AC supply.
	Uninterrupted power supply	240 V, 1 phase, 50 Hz, 2 wire AC supply
	Space heaters (for motor & panels), Lighting & 1 phase Motor	240V, 1-phase, 2 wire, 50Hz AC system.

	Instrumentation & Control (including solenoid valves)	24V DC Supply This power supply has to be derived by the bidder from 220V AC UPS supply.
14	All devices shall be suitable for continuous operation over the entire range of voltage and frequency indicated below without change in their performance :	
	AC supply : Voltage variation ± 10% Frequency variation ± 5% Combined voltage & Frequency variation: 10%	

APPENDIX – 2

RAW WATER ANALYSIS (DATA NOT AVAILABLE)

Sample – 1: Lhasi Irrigation project

Sample – 2: Andheri Irrigation project

Sample – 3: Parwan Irrigation project

SL. NO.	Constituent	Unit	Sample - 1 Lashi	Sample - 2 Andheri	Sample - 3 Parwan
1.	Color and odor	-			
2.	Oil and grease	mg/l			
3.	BOD				
4.	COD				
5.	Suspended solids	mg/l			
6.	Turbidity	NTU			
7.	Calcium hardness as $CaCO_3$	mg/l			
8.	Magnesium hardness as $CaCO_3$	mg/l			
9.	Sodium + Potassium as Na	mg/l			
10.	Chloride as Cl	mg/l			
11.	Sulphate as SO_4	mg/l			
12.	Sulphide as S	Mg/l			
13.	M-Alkalinity (HCO_3) as $CaCO_3$	mg/l			
14.	P-Alkalinity as $CaCO_3$	mg/l			
15.	Nitrates as NO_3	mg/l			
16.	Nitrites as NO_2	mg/l			

17.	Silica as SiO_2 – Dissolved	mg/l			
18.	Silica as SiO_2 – Colloidal	mg/l			
19.	Iron as Fe-dissolved	mg/l			
20.	Iron as Fe-suspended	mg/l			
21.	Total dissolved solids	mg/l			
22.	Conductivity at 25^0C	μ-mho/cm			
23.	pH at 25^0C	-			
24.	Dissolved Oxygen as O_2	mg/l			

APPENDIX – 3

FUEL ANALYSIS (LATER)

APPENDIX - 4			
BASIC INFORMATION FOR ENVIRONMENTAL APPRAISAL			
GENERAL INFORMATION ABOUT THE PROJECT			
1. Name /Title of the project	:	2 x 660 MW Chhabra Super Critical TPP, Stage – II, District Baran, Rajasthan .	
1. Name and address of the project proponent	:	Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RRVUNL)	
2. Site where proposed plant would be located (Site map, land layout plan to include 25 km radius zone around the site)	:	Chhabra, Baran Dist., Rajasthan. (Please refer site Location Map : Exhibit - 001)	
4.Capacity of the project under consideration	:	2 x 660MW	
5. Whether alternative sites were explored? If so, give details for each site (Maps to be enclosed) :			
		Nil	
6.Land use pattern of the land	:	Mostly private owned plots, all of which are outside any demarcated forestland	
7. Cost of land per acre	:	Rs.220,000/- per acre.	
8.Govt. Land / private land/ others	:	Government land and private land	
9. Topographical features, demographic profile and physiographic.	:	Refer Chapter - IV of the Report (Demographic profile will be covered in EIA report)	
10.Nature of soil	:	Refer Chapter - IV of the Report	
11.Distance from the nearest town/city/major human settlement	:	The Chhabra town is about 24 km from the project site	

12. Population to be displaced	:	Nil (to be established after detailed R/R studies)
13. Distance from water source	:	20 to 60 km from Lhasi, Andheri and Parwan Irrigation projects
14.Area of forest land, if involved	:	NA
15.Distance of forests from the site	:	Not applicable.
16. Give basis for selection of site	:	i) This site is identified as a potential power plant site. ii) Availability of land iii) Availability of water. iv) Least habitation and displacement of habitation
17. Is this an extension? If so indicate capacity of the existing plant	:	YES, 2x 660 MW
18. What is the ultimate capacity?	:	1320 MW
19.Name and address of the consultant, if any.	:	TCE Consulting Engineers Ltd, 73/1, Sheriff Center, St. Mark's Road, Bangalore-560001
20.Details of major industries, thermal power plants, mines, quarries etc. existing within a radius of 25 km of your plant	:	NA
21. What is the total human population of 25 km of the plant site indicate the pattern of population dispersal.	:	Very thinly populated

22. Give a broad description of the site. Attach map showing topographical features	:	Refer Exhibits – 001 and 002
23.Nature of soil	:	Refer Chapters- IV and IX
24.Area of the land proposed to be acquired (Attach layout plan)	:	About 213 Hectares
i) Area required for plant	:	For the complete power plants project i.e. for 2x660 MW The proposed power plant would be constructed in the available land of 213 Ha. Main plant Fuel block and water block } 300 Ha Coal stock yard Cooling tower area Green belt : 120 Ha Ash Dyke: 40 Ha
ii) Ash disposal	:	Located on north eastern side of the proposed Power Plant
iii) Colony (indicate separately for departmental staff, contractors (if any)	:	Separate colony proposed. The operation and maintenance staff are proposed to be accommodated in the colony covering an area of 40 acres.
iv) Transmission corridors and power evacuation system	:	Power evacuation would be through 400 kV Switch Yard
v) Approach road, railway bridges etc. vi) Others	:	Refer Exhibits – 001 and 002. The power plant site is located near to an existing road connecting SH 19A and it is very near NH12 Nil
25.Present use of land	:	Waste upland with / without scrubs

26.Area proposed to be built-up or developed	:	In about 213 Ha of land	
27.Specify site characteristics river basin/estuarine/ coastal/others	:	NA	
28. Is the site situated in the forest area? Give following details:-	:	No	
i) Area	:	Not applicable	
ii)Type of forests	:	Not applicable	
iii) If site is situated nearer to the forests? Give the distance from the site	:	Not applicable	
iv) Give a description of the vegetation within 10 km of your plant site under the following heads:-	:	Area in sq.km	Percent Area
a) Water body	:	Not available.	
b) Non vegetation area	:	Not available.	
c) Degraded vegetation	:	Not available.	
d) Vegetation medium density	:	Not available.	
e) Vegetation high density	:	Not available.	
f) Scrub	:	Not available.	
g) Sea	:	Not available.	
h) River	:	Not Applicable	
i) Other (Built-up residential, Salt pan, Mud flat)		Not available.	
Total	:	Not available.	

v) Give a general description of the fauna, especially wild-life, endangered species, etc., within a radius of 25 km.	:	Refer EIA Study Report by M/s BHEL
vi) Give details of the following features, if they exist, with-in a radius of 25 km of the proposed site? i) Fisheries	:	No
ii) Sanctuary / natural park / Biosphere reserves	:	No
iii) Lakes / ponds / reservoir	:	Nil
iv) Stream / river	:	Nil
v) Estuary / sea	:	Nil
vi) Hill / mountains	:	Nil
vii) Historic / cultural /tourist / archaeological/scenic sites / defense installations	:	Nil
29.Human Settlement Total number of persons proposed to be employed. i) During construction ii) During operation	:	Not applicable Company's Employees / Contractor's Employees / Total 100 / 1000 / 1100 194 / 500 / 694
30. Do you propose to build a township / housing quarters for your employees/contractor's workers?	:	Colony not envisaged for now.
31.Area required for above	:	40 Ha
32.Population to be accommodated	:	Approx. 600 families

33. Distance and direction of township from plant site		Adjacent to Power Plant.
Services provided in township.		
i) Daily consumption of water	:	Yes
ii) Power system	:	Yes
iii) Sewage treatment	:	Yes
iv) Drainage	:	Yes
v) Any other	:	Nil
34.Number of persons to be displaced along with details of their occupation and income	:	Nil
i) Number of persons who do not own property, but, derive their sustenance from the land to be acquired	:	Nil
ii) Details of rehabilitation plan for the oustees	:	Nil
iii) Site where they would be resettled	:	Not Applicable
iv) Compensation to be paid	:	Not Applicable
v)Authority responsible for their resettlement	:	Not Applicable
FUEL		
35. Has fuel linkage been established?	:	To be established
i)Type, quantity and characteristics of fuel used	:	Washed coal - Refer Appendix – 3
ii) Has the linkage been established?	:	To be established

iii)Name of Mine/Block	:	The requirement of about 5.65 million tonnes / year of washed coal would be met through washed coal from captive block to be allocated in Chattisgarh/MP or from SECL /NCL. Washed coal with average GCV of 4000Kcal/Kg is envisaged.
iv) Is it a working mine or yet to be opened?	:	Working mine with source block which are yet to be developed
v) Is the mine situated in the forest area?	:	NA
vi)Please furnish a fuel analysis report from a recognised laboratory (Details to include percentage contents of C, H, N, S and Oxygen (if any) and gross calorific value)	:	Refer Appendix - 3
vii)Indicate the type of fuel firing to be adopted	:	Pulverised coal firing
viii)Air to fuel ratio to be specified	:	8.9:1 to be confirmed during detail engg
WATER		
36.Water use and liquid wastes (provide a detailed water balance diagram)	:	Refer Exhibit- 004
37. What is the source of Water?	:	Lhasi, Andheri and Parwan irrigation projects which are located 20 to 60 km from the site.
38.Lean season flow	:	Not Applicable
39. Give details of the receiving water body.	:	

40.Average daily quantity of Water required for		
i) Cooling tower makeup	:	84672 m^3 / day
ii) Process	:	30519 m^3 / day
iii) Others	:	Refer Exhibit-004
iv) Reuse of water	:	Blow down, clarifier waste water and waste water from other sources would be treated suitable for reuse.
v) Total daily water requirement	:	115191 m^3 / day
41.What type of cooling system is proposed once through/closed	:	Closed loop cooling system with natural draft cooling towers
i) Give temperature difference between inlet and outlet.	:	Temperature rise across condenser is 10°C
ii) Annual temperature profile of the receiving water	:	Normal raw water temperature variation is expected.
42.Quantity and expected characteristics of the waste water discharged per day from the plant	:	No waste water is discharged out of the plant. Hence not applicable
i) Cooling	:	NA
ii) Cooling Tower Blow-down	:	NA
iii) Process	:	NA
iv) Others	:	NA
v) Total	:	(Refer Exhibit – 004)
43. Type of waste water treatment proposed to be adopted.	:	All effluents will undergo a treatment program to qualify Zero Water Discharge.
44.Applicable standards regulations for the Effluents	:	Not applicable
45.Point of final discharge land / sewer / river / lake /bay / estuary / sea	:	Rain water drain will be led to nearby drain.

46.Mode of final discharge open channel / pipeline / covered drains	:	Not applicable
47.If the liquid effluents are finally discharged to river/pond/lake, the impact on the quality of Water at the nearest human settlement should be mentioned	:	Not applicable
48.Details of the reuse of waste water	:	As indicated in above
AIR EMISSIONS		
49.Please furnish for your Location	:	Refer Plot Plan
50.Wind rose	:	Refer Plot Plan
i) Maximum and Minimum temperature for every month of the year	:	Average max. temp. : 32.3 deg. C Average min. temp. : 19.6 deg. C The coldest temperature recorded is (-)2.2^{0}C The hottest temperature recorded is 46.3^{0}C
ii)Mean wind speed	:	Annual mean wind speed is 13.6 kmph.
iii)Humidity, rainfall	:	The annual average fall : 900 mm. The RH on an average : varies between 20% to 80%.
iv)Mean cloud cover	:	Annual mean cloud cover : Not available
v)Percentage(frequency) occurrence of inversions and heights	:	Later.
vi)Please specify the following:		
vii)Number of stacks	:	1
viii)Number of flues in each stack	:	2
ix)Inter-stack distance	:	NA

x)Stack height	:	275 m
xi)Internal diameter of each flue at the top	:	8m (approx.)
xii)Gas velocity	:	25 m / sec approx. (at exit)
Flue gas characteristics		
i) Volume (through each stack)	:	965 kg/sec
ii) Temperature	:	130 ^{o}C
iii) Density	:	1.3105 kg/Nm^3
iv) Size distribution of particulates	:	During detail engg
v) Gas composition (by Vol.)	:	
CO_2	:	13.62
O_2	:	3.21
SO_2	:	0.08
N_2	:	73.09
H_2O	:	10.00
vi)Heat emission rate of gases from each stack	:	During detail engg.
vii)Emission rate of SO_2, NOx and particulates from each stack in milli gm/m^3	:	SO_2 : 6.4 t/hr NOx : 700 mg / Nm³. Particulates: 50 mg / Nm³. FGD is not required. However, space is provided in the layout.
viii)Back ground pollution levels of SO2, NOx and particulates kg/hr	:	Detailed study has been carried out for EIA / EMP report.

a) What kind of stack emission monitoring is proposed	:	Flue Gas: O_2 & CO monitoring- These are measured at the economizer outlet. For this purpose, O_2 & CO monitor probes & analyzers are installed separately. Stack emissions: Flue gas existing into the atmosphere is monitored for CO_2, NOx, SO_2 and Opacity. Stack emission readings are sent to the DCS for monitoring. For this purpose, dilution probes, associated gas analyzers and support equipment, sample lines and opacity sensor/ transmitters are installed. The opacity sensors equipped with a blower to protect the optics from coating by flue gas particles. The system operation is continuous. Stack gas analysis for SO_2, CO_2 and NO_x is performed by extracting a gas sample from the flowing stream in the stack, filtering to remove particulate droplets, diluting with scrubbed instrument air and conveying the sample to the analyzers.
b) What equipment is proposed to be acquired or used for this purpose	:	Same as above
c) Give details of the air pollution control equipment proposed to be installed.	:	High efficiency electrostatic precipitator to limit particulate emission to 50 mg / Nm^3
d)Give details of the organisation set-up for maintenance of pollution control equipment and level of expertise and authority of person in charge	:	There would be an experienced and qualified chief chemist in charge of analytical measurements and pollution control.
e)Emission rate of particulates and sulphur dioxide to be released when control equipment is :	:	

f)Functioning normally SO_2 Particulates	 : :	 6.4 t/hr 50 mg / Nm^3 (with one field of ESP not functioning)
g)Not functioning SO_2 Particulates	 : :	 Not applicable as the plant would be shut down -
h)What special procedure do you propose to lay down for the air pollution control during the period when emission exceeds prescribed limits for any reason including malfunction of pollution control equipment?	:	Adequate design margins and standby capacity are provided for proposed electrostatic precipitators to forestall such problems
51.Other types of pollution	:	Noise
a)Details of measures to control noise	:	All equipment would be designed / operated to have a total noise level not exceeding 85 to 90 dB (a) measured at a distance of 1.5 m.
b)Details regarding prevention and control of fire and explosion hazards	:	All equipment vulnerable to explosion or fire would be designed to relevant codes & statutory regulations Suitable fire protection system comprise hydrants and spray systems would be provided for fire protection.
TRANSPORTATION OF FUEL:		
52. Proposed mode of transport of coal/ oil/ gas.	:	The requirement of about 5.65 million tonnes / year of washed coal would be met through washed coal from captive block to be allocated in Chattisgarh/MP or from SECL /NCL. Washed coal with average GCV of 4000Kcal/Kg is envisaged. Coal will be transported through rail route to the proposed power plant. Coal movement within the power plant is by belt conveyors.
i)By sea	:	Nil

ii)By Road	:	Fuel oil
iii)By Pipe / Rope ways	:	Nil
iv)By Rail	:	Coal/Fuel oil
v) By Others	:	Nil
Coal and Ash Handling:		
53. What procedure would be adopted for coal handling at the plant site?	:	Coal transported by wagons would be unloaded by wagon tippler. From here the coal is screened, crushed and conveyed by conveyors either to boiler bunkers or stacked in stock piles. When required coal is reclaimed from the coal piles and conveyed to the boiler bunkers. Coal to bunkers would be transported through series of belt conveyors and traveling trippers.
i)Give details of dust suppression / collection equipment for reducing pollution from coal fines and other fugitive emissions from coal handling (wagon tippling, conveyor transfer points, storage, crushing mills, Bunker filling etc.)	:	Dust extraction system at all coal transfer points, bunker ventilation system for coal bunkers and Ventilation system for tunnels are provided. Also dust suppression system in the stock yard is provided.
ii) How do you propose to prevent /treat the run-off from the coal storage/ handling area?	:	Coal pile run off treatment system
iii)What quantity of fly ash and bottom ash would be produced per day	:	Total ash expected: 5100 t/day Fly ash:4080 t / day Bottom ash: 1020 t / day

iv) Indicate the method of collection, transportation and disposal of the ash.	:	Fly ash: Fly ash collected in various hoppers would be pneumatically (pressure) conveyed to the silos. From silos it would be disposed by trucks in dry form for commercial use. Provision is also made to pump the Fly ash in slurry form to ash disposal area during emergency. Bottom ash: would be disposed off in slurry form to ash disposal area.
v) What efforts have been made or you wish to make towards utilisation of fly ash for bricks /cement/ road construction/land fill/soil stabilisation/ other forms of disposal or use.	:	Arrangements would be made with private entrepreneurs for utilising fly ash for commercial purposes
vi) What precautions are proposed to be taken to prevent pollution of water source and ground water from solid waste disposal, especially with regard to coal particles and ash slurry?	:	Ash disposal pond would be completely- lined with impervious liner to prevent ground water pollution
vii) What land area is available for ash disposal? Would it be sufficient for the expected life of the plant?	:	Area has been earmarked on the Northern side of plot plan for ash disposal. Approx. 250 acres of land area is available for ash disposal.
54.0 CONSTRUCTION MATERIALS		
i)Indicate source of supply of stones and location of quarries in the site map with the alignment of the roads to the projects site and its distance from the site	:	It would be sourced from nearby locations.
ii)Source of supply of sand and its distance from the site	:	It would be sourced from nearby locations.

iii)If new roads are built whether their alignment is through agriculture land /forest/ grazing land/human settlement/fallow land	:	No, In plant roads only planned
iv)Mode of transportation of heavy equipment, cement & steel i.e. by road or rail or sea	:	By road /rail route.
v)Name of the nearest rail head where they would be off loaded and its distance from the site	:	Majority of the equipment is expected to be received by road route. The nearest medium size railway station is Chhabra Gagori in the West Central railway (between Jaipur & Jabalpur).
vi)If a new road is to be built from the rail head, the details of land to be acquired should be given	:	NA
OCCUPATIONAL SAFETY AND HEALTH		
55.Health status of workers especially those engaged in the coal handling, ash collection and ash disposal area	:	In coal handling and storage areas suitable dust control /collection equipment are provided to ensure a clean and healthy environment. No problems are envisaged in ash disposal area where wetting of dry ash is envisaged
56. Whether any adverse health effects due to noise were observed among the workers engaged in the turbine, compressor room, crushing mills etc.	:	Noise level would be limited to 85-90 dB (a) in these areas, hence no adverse health problems anticipated. Further, necessary protection gear like ear plug would be provided.

57. If the plant is new, precautionary measures proposed to be taken for safety and health protection of workers may be mentioned	:	Suitable personnel protective equipment would be provided to employees such as, industrial safety helmet, crash helmets, face shield with replacement acrylic vision, zero power goggles, cylindrical type ear plugs, ear muffs, welders equipment for eye and face protection, leather apron, safety belt/line man's safety belt, leather hand gloves etc. Full-fledged hospital facilities would be made available round the clock for attending emergency arising out of accidents, if any.
ENVIRONMENTAL MANAGEMENT		
58. Give details of organizational set-up you propose to have for pollution monitoring and control?	:	Qualified engineer would be in charge of the pollution monitoring and control.
59. What is the level of expertise of the person in charge of pollution control?	:	Qualified engineers will be in charge of the job
60.Briefly outline the proposed environmental monitoring programme, mention No. of observation sites and frequency of observations addressing to the following parameters:	:	
i)Air	:	At three locations, once in a month
ii)Water	:	At one location (effluent discharge point), once in a week
iii)Ground water	:	At two locations, one in a six months
iv)Stack Monitoring	:	Continuous

v) Have you been asked by the Central State Pollution Control Boards to take any special environmental control measures and how do you propose to carry out these Obligations?	:	No
vi)Raising of green belt(Area may be indicated in a map)	:	Green belt shown in the plot plan. Green belt would be developed in and around the power plant.

DETAILS OF EXISTING UNITS

61. If it is an extension, please furnish the following details in respect of the existing units : Later

Existing units and their capacity	**Efficiency of ESP in %**	**Fuel consumption(coal/oil/gas)tons/day**	**Sulphur content in %**	**Stack height in m**	**Heat emission rate in kcal/hr from stack**	**Particulates**	
						SO_2 (PPM (v))	**NO_x**

62. Have there been public complaints or questions in the Parliament or State assembly regarding the Env. Problems posed by the existing Units. If so, give details.	:	Not applicable.

63.Have there been any representation / protests from the Public/voluntary organisations against the setting up of the new units/plant at the Proposed locations if so, give details	:	Not applicable.
64.Economics of Pollution Control	:	The required features are inbuilt in the cost of the purchased equipment for the proposed 2 x 660 MW power plant.
65. What is the total project cost?	:	Rs. 8008.34 Crores.
66.Indicate costs of pollution control under the following heads	:	Capital cost included in the project cost
Capital / Recurring (annual)	:	6.06 Crores (capital cost)
Air	:	Included in above cost
Fly ash control	:	Included in above cost
Sulphur dioxide control	:	Included in above cost
Oxides of Nitrogen control	:	Included in above cost

APPENDIX – 5

PLANT COST ESTIMATES

Sl.No.		Cost in Lakhs
	MECHANICAL WORKS	
3.1	Steam generators (boilers) with all auxiliaries like ID/FD/PA fan systems, electro static precipitators and all auxiliaries, steam turbine generators with all auxiliaries including heaters, de-aerators, turbine oil systems, boiler feed pumps and their auxiliaries, critical piping, H2 & CO2 cylinders, including erection and spares etc.	330500
3.2	Coal handling system: Wagon tipplers, crushers, screens, stacker reclaimers and Series of belt conveyors, travelling trippers , auxiliaries such as coal weighing system, metal detectors, DE & DS system, bunker ventilation system, coal samplers, inline magnetic separators etc.	
	CHS inside plant	20392
	Marshalling yard - 25Kms track x200 Lakhs/Km	5000
3.3	Ash handling plant: including compressors, water system, silo and ESP hopper aeration blowers, ash evacuation valves, pipelines, valves etc.	10000
3.4	Raw water pumps & travelling screens, intake pump house –included in civil works etc.	0
3.5	CW system including pumps (including following) included in civil	0
	Chlorination system	
	RE joints	
	Debris filters	
	OLTCS	
	Butterfly valves	
3.6	Water treatment	

Sl.No.		Cost in Lakhs
	DM plant(Including filtration) RO Plant	1200
3.7	HP / LP piping, valves and fittings etc.	700
3.8	Fuel oil unloading system : including unloading pumps, forwarding pumps, electric heat tracing, steam tracing, floor coil heaters etc.	200
3.9	Air conditioning plants : for main control room, ESP control room, DM plant control room etc.	600
3.10	Ventilation system: for station building, switchgear room, cable vaults, Air washer etc. –included in AC system	0
3.11	Fire protection system	600
3.12	Miscellaneous pumps, auxiliary cooling water system including pumps and valves and service water system including piping, valves and fittings	300
3.13	Chemical lab	100
3.14	Cranes: Station building cranes, other cranes &hoists, etc.	500
3.15	Air compressors and accessories including air receivers, air driers etc.	500
3.16	Instrumentation and control system including control panels, transmitters, local and remote instruments, indicators, controllers, actuators, PLCs, DAS, SWAS, UPS etc.	6000
3.17	Work shop equipment	150
3.18	Emergency D.G sets	150

Sl.No.		Cost in Lakhs
3.19	Total cost for Mechanical works	376892
3.20	Cost of BOP equipment(excluding 3.1- BTG)	46392
3.21	Mechanical Spares cost @ 3% of 3.20 for BOP portion	1392
3.22	Ex works cost of BOP (3.2+3.21)	47784
3.23	Excise duty @0% on Ex-works cost of BOP – because of Mega power status	0.00
3.24	Freight and insurance (3%)	1433.51
3.25	VAT / Central sales tax @ 3%	1433.51
3.26	Erection testing and commissioning (10%)	4639.2
3.27	Service Tax including cess @ 10.3 % of 3.26	477.83
3.28	**Total cost of mechanical works (3.19+3.21+3.22+3.23+3.24+3.25+3.26+3.27)**	**386268**
4	**ELECTRICAL WORKS**	
4.1	Generator transformers	10500
4.2	Station transformers	1300
4.3	Unit transformers and service transformers	1800
4.4	Bus ducts: generator bus ducts, segregated and non segregated phase bus ducts .	3500
4.5	HT switchgear	1800
4.6	LT switch gear(Load centre substation, pdbs) and MCC	4500
4.7	DC system and UPS system	750

Sl.No.		Cost in Lakhs
4.8	Power and control cables and trays	7000
4.9	Control and relay panels	600
4.10	400 KV switch yard equipment including SCADA	14000
4.11	Lighting system	500
4.12	Plant communication system including EPABX, public address system etc.	150
4.13	Earthing and lightning protection including cathodic protection	300
4.14	Fire detection & alarm system including fire proof sealing system	200
4.15	Electrical lab equipment	200
4.16	Elevators	300
4.17	Miscellaneous electrical equipment	200
4.18	Generator circuit breaker	1400
4.19	Cable/Bus duct, and Cable carrier system	6000
4.20	Aviation lighting (NDCT and Chimney)	100
4.21	Power supply to RW pumps	8000
4.22	Security and CCTV	200
4.23	Total cost of electrical equipment	63300
4.24	Electrical spares Cost @ 3% of 4.23	1899

Sl.No.		Cost in Lakhs
4.25	Total electrical equipment cost – Ex works	65199
4.26	Excise duty @0% on Exworks- Because of Mega power status	0.00
4.27	VAT / Central sales tax @ 3 %	1899
4.28	Freight and insurance @ 3%	1955
4.29	Erection testing and commissioning @ 10 % of 4.23	6330
4.30	Service tax @ 10.30 % of 4.29	651.99
4.31	**Total electrical works cost(4.25+4.26+4.27+4.28+4.29+4.30)**	**76035.96**
5	**CIVIL WORKS**	
5.1	Preliminary investigation such as site survey, soil investigations and oceanographic surveying	200
5.2	Land cost(400 Acres @ 2.20 lakhs/acre)	880
5.3	**CIVIL AND STRUCTURAL WORKS**	
5.4	Site improvement works like site clearing, boundary walls, roads and drains (includes site grading for Terracing Main plant, CT area and CHS area)	500
5.5	Coal bunkers / bunker bay structures and foundations	8500
5.6	Station building : structures and all civil works	15000
5.7	Foundations for SG island equipment, misc. structures and pipe and cable racks	5000
5.8	Coal handling system: Civil works and structural works including	0

Sl.No.		Cost in Lakhs
	Single conveyor galleries, junction towers and wind screens for the coal stock yard – included in mechanical	
5.9	Ash handling system structures / houses, fly ash pipe trestles, compressor house, foundations, fly ash silos and bottom ash / mill reject silo, development of ash disposal area and pipe racks upto disposal area.	1000
5.10	Cooling water / circulating water system, pipes, switchgear room, chlorination room / structures, stop logs, screens, channels and all misc, clarified water storage tank, civil works etc.,	6500
5.11	Natural draft cooling tower	15000
5.12	Raw water intake system and plant raw water system and related civil works.	25000
5.13	Multiflue chimney (one no common for two units)	6000
5.14	Miscellaneous buildings such as workshop, warehouse, admin building, canteen, fire station, fuel oil pump house, air washer room, gate and security house, service building, water storage tank, DM plant etc., DG room .	2500
5.15	Fuel handling system	400
5.16	Transformer yard and Switch yard	950
5.17	Colony(developmental works)	1000
5.18	Additional Costs for PILING:	0
5.19	Total cost of civil and structural works	88350

Sl.No.		Cost in Lakhs
6.0	**Sum total of Land, Civil / structural, Mechanical and Electrical Works (The cost is inclusive of packing, forwarding, transportation, insurance, taxes, duties, erection, testing and commissioning)**	**551733.78**

APPENDIX – 6

ABSTRACT OF PROJECT COST

Sl. No	Item	Cost (Rs. Crores)	Cost in % of total works	Cost in % of Total Project Cost
1	**Direct and Indirect Costs**			
1.1	Land, preliminary works and civil / structural works	883.50	11.88%	
1.2	Mechanical Works	3862.68	75.91%	
1.3	Electrical works	760.35	12.21%	
1.4	**Total of direct and indirect costs**	5517.33	100%	69.75%
2	**Physical contingency 3% of total direct and indirect Costs**	165.52		2.10%
3	**Overhead construction costs**			
3.1	Pre-operative expenses	50.00		
3.3	Insurance during construction @ 1% of total direct / indirect costs and contingencies	55.17		
3.4	Finance charges at 1.0 % of the 60 % of 1.4	33.10		
3.5	**Total of overhead construction costs**	138.27		1.75%

4	**Total project cost excluding IDC and margin money (sum of items 1.4+2.0+ 3.5)**	**5821.13**	73.50%
5	**Expected escalation During project execution Period – 10%**	**582.11**	7.35
6	**Interest during construction and loan rising expenses (@12.00 % average)**	**1517**	19.15%
7	**Total project Cost (sum of items 4.0+5.0)**	**7920**	100%
8	**Cost per MW (Rs. Crores)**	**6.00**	

APPENDIX – 7

INPUT DETAILS FOR COST OF GENERATION

SL.NO	ITEM		
1	NO. OF UNITS	:	2
2	CAPACITY OF EACH UNIT (MW)	:	660
3	HEAT RATE (kCal / kWhr) as per CERC-Turbine heat rate	:	1850
3a	HEAT RATE (kCal / kWhr) as per Heat balance for an 660MW unit		1850
3b	STATION GROSS HEAT RATE (kcal / kWhr) CONSIDERED IF ENERGY SALE IS ON TARIFF BASED		2280
4	NO. OF HOURS IN YEAR	:	8760
5	PLANT LOAD FACTOR - PLF (%)	:	85%
6	FUEL OIL CONSUMPTION (ml/kWh)	:	1
7	CALORIFIC VALUE OF FUEL OIL (KCal/Kg)	:	10800
8	CALORIFIC VALUE OF COAL (KCal/Kg)	:	4000
9	COST OF COAL (Rs. PER TON)	:	2000
10	COST OF FUEL OIL (Rs. PER TON)	:	23000
11	AUX. POWER CONSUMPTION	:	7.00%
12	DEBT (% OF TOTAL PROJECT COST)	:	80%
13	EQUITY (% OF TOTAL PROJECT COST)	:	20%
14	INTEREST RATE (%)	:	12.0%
15	RATE OF RETURN (%)	:	15.5%
16	DEPRECIATION (%)	:	3.60%
17	O & M CHARGES Rs.lakhs / MW , as per CERC norms for the year 2007-08	:	10.95
18	NO. OF YEAR OF REPAYMENT OF LOAN	:	10
19	INTEREST RATE ON WORKING CAPITAL (%)	:	12.0%
20	NUMBER OF HOURS OF OPERATION	:	

	DURING FIRST YEAR	:	3358
21	WT. AVG. HEAT RATE DURING FIRST YEAR	:	2500
22	WORKING CAPITAL BORROWING	:	80%
		:	.

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APPENDIX - 8

PHASING OF EXPENDITURE		
YEAR	**EXPENDITURE**	**PERCENTAGE**
	Rs. Crores	**(%)**
I	**1188.0**	**15.00**
II	**1584.0**	**20.00**
III	**2772.0**	**35.00**
IV	**2376.0**	**30.00**
TOTAL	**7920.0**	**100**

APPENDIX- 9

COMPUTATION OF INTEREST DURING CONSTRUCTION

S.NO	PARTICULARS	Zero Date (ZD)	12 months from ZD	24 months from ZD	36 months from ZD	48 months from ZD	TOTAL
A							
1.0	Phasing of Expenditure including IDC						
1.1	Percentage Phasing		15.0	20.0	35.0	30.0	100
1.2	Expenditure (Rs. in cr.)		1180.0	1584.0	2772.0	2376.0	7920.0
2.0	Equity						-
2.1	Equity Percentage (25%)		3.0	4.0	7.0	6.0	20
2.2	Equity Amount (Rs. in cr.)	-	237.6	316.8	554.4	475.2	1584
3.0	Rupee Loan (75%)	-	12.0	16.0	28.0	24.0	80
3.1	Loan Availed (Rs. in cr.)	-	950.4	1267.2	2217.6	1900.8	6336.0
3.2	Interest @ 12.0 % (Rs. in cr.)	-	462.7	415.0	410.9	228.9	1517
4.0	Project Cost without IDC (Rs. in cr.)						6403.25
5.0	Project Cost with IDC (Rs. in cr.)						7920.00
B	INPUT DATA						
	Rupee loan interest rate	0.12					

C NOTES

1. The phasing against loan is inclusive of interest due thereon.

APPENDIX – 10

ESTIMATED COST OF POWER GENERATION

Sl.No.	PARTICULARS	UNITS	
1.0	Installed capacity	MW	1320
2.0	Cost of the project excluding IDC	Rs. In Crores	6403.25
3.0	Cost per MW of installation (item 2.0 / item 1.0)	Rs /MW	4.85
4.0	Interest During Construction (IDC) and other financing charges	Rs. In Crores	1517.00
5.0	Cost of project including IDC and other financing charges.	Rs. In Crores	7920.00
6.0	Cost per MW of installation including IDC and other financing charges (item 5.0 / item 1.0)	Rs in crores. / MW	6.0
7.0	Annual generation @ 85% PLF	MkWh	9828.7
8.0	Annual auxiliary power consumption at 7.0%	MkWh	688
9.0	Net generation per annum (item 7.0 – item 8.0)	MkWh	9140.7
10.0	Annual coal consumption(based on 4000Kcal/Kwh , at MCR condition) for tariff calculation	M Tonnes	5.602
11.0	Annual coal cost at 2000/- per tonne (4% escalation is considered)	Rs. in Crores	1120.47
12.0	Annual fuel oil consumption considering 1.0 m/kWh	KL	9828.72
13.0	Annual fuel oil cost at Rs.23000/- per KL	Rs. in Crores	22.61
14.0	Fixed charges :		
	a) Interest on term loan(ist year)	Rs. in Crores	760.32
	b) O&M charges has been computed for the first year Rs.10.95 lakhs / MW based on CERC norms for the year 2007 – 08. Further escalation at 4% per annum has been considered for the subsequent year of operation(ist year)	Rs. in Crores	144.54

	c) Depreciation (ist year)	Rs. in Crores	285.12
	d) Interest on working capital borrowing	Rs. in Crores	82.86

APPENDIX – 10 (CONT'D)

ESTIMATED COST OF GENERATION

Sl.No.	PARTICULARS	UNITS	
	Return on equity(@ 15.5%)	Rs. in Crores	306.9
	Total fixed charges	Rs. in Crores	1579.14
15.	Total fixed and running charges (item 11.0 + item 13 + item 14.0)	Rs. in Crores	2722.22
16.	Cost per kWh generated (Item 15.0 / item 7.0-Ist year)	Rs. / kWh	2.76
17.	Cost per kWh at the bus (item 15.0 / Item 9.0-1st Year)	Rs. / kWh	2.97
18.	Return on equity at 15.5%	Rs. in Lakhs	306.9
19.	Profit per unit sent out (Item 18.0 / item 9.0)	Rs. / kWh	0.33
20.0	Levilised tariff for 25Years	Rs. / kWh	3.09

Notes:

1 Based on 90% hours of unit availability in an year.
2 Return on equity is considered at 15.5% on the equity portion (20%) including working capital margin money.
3 Cost of generation worked is for units generated after plant stabilisation period.