JINDAL STEEL & POWER LTD.

RAPID ENVIRONMENTAL IMPACT ASSESSMENT
AND
ENVIRONMENTAL MANAGEMENT PLAN
FOR
2 x 150 MW MIDDLING AND COAL FINE BASED THERMAL POWER PLANT
AT
DONGAMAHUA VILLAGE, RAIGARH DISTRICT, (C.G.) CHHATTISGARH

FEBRUARY, 2007

Prepared by:

MIN MEC CONSULTANCY PVT. LTD.
A-121, Paryavaran Complex, IGNOU Road, New Delhi – 110 030
Ph : 29534777, 29532236, 29535891 ; Fax: +91-11-29532568
Email :min_mec@vsnl.com; Web site : http://www.minmec.co.in

Estb. 1983

An ISO 9001:2000 approved company

JINDAL STEEL & POWER LTD.

RAPID ENVIRONMENTAL IMPACT ASSESSMENT
AND
ENVIRONMENTAL MANAGEMENT PLAN
FOR
2 X 150 MW MIDDLING AND COAL FINE BASED THERMAL POWER PLANT
AT
DONGAMAHUA VILLAGE, RAIGARH DISTRICT CHHATTISGARH

ISSUE 01 REV.0 JULY 2006
ISSUE 01 REV.1 FEBRUARY 2007

Prepared by:

MIN MEC CONSULTANCY PVT. LTD.
A-121, Paryavaran Complex, IGNOU Road, New Delhi – 110 030
Ph : 29534777, 29532236, 29535891 ; Fax: +91-11-29532568
Email :min_mec@vsnl.com; Web site : http://www.minmec.co.in

Estb. 1983

An ISO 9001:2000 approved company

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

ABBREVIATION

AMSL	Above Mean Sea Level
℃	Degree Centigrade
CSEB	Chhattisgarh State Electricity Board
CW System	Cooling water System
CPCB	Central Pollution Control Board
DM	Demineralization Plant
dB	Decibels
EIA	Environmental Impact Assessment
EII	Environmental Impact Index
ESP	Electrostatic Precipitator
ED	Executive Director
EMD	Environmental Management Division
E	East
FGD	Flue gas Desulphurisation
GLC	Ground Level Concentration
HFO	Heavy Fuel Oil
IDCT	Induced draft cooling tower
IMD	India Meteorological Department
IS	Indian standard
JSPL	Jindal Steel & Power Ltd.
JPL	Jindal Power Ltd.
KW	Kilowatt
KWH	Kilo watt hour
KM	Kilo metre
LDO	Light Diesel Oil
MT	Million Tonne
MTPA	Million Tonne Per Annum
MW	Mega watt
MWH	Mega watt Hour
MVA	Mega Volt Amphere
MOEF	Ministry of Environment & Forests
MOU	Memorandum of Understanding
MPN	Maximum Probable Number
M^3 / cum	Cubic Metre
N	North
NOx	Oxides of Nitrogen
P.H.E	Public Hearing Enquiry
PIV	Parameter Impact Value
REIA	Rapid Environmental Impact Assessment
RPM	Respirable Particulate Matter
RF	Reserve Forest
RPII	Relative Parameters Importance Index
SH	State Highway
SPM	Suspended Particulate Matter
Sq. Km	Square Kilometre
TG	Turbine Generator
TPP	Thermal Power Plant
TPS	Thermal Power Station
TPI	Tilted Plate Interceptor
WEII	Weighted Environment Impact Index

CHAPTER 1

INTRODUCTION

This Rapid Environmental Impact Assessment (REIA) and Environmental Management Plan (EMP) has been prepared for 2X150 MW (Total 300 MW) Thermal Power Plant to be set up at village Dongamahua, Tehsil Gharghoda, District Raigarh of Chhattisgarh by Jindal Steel & Power Ltd. (JSPL). The primary fuel will be coal middling and fines with a daily consumption of approximately 312TPH. It is envisaged to set up the thermal power plant over around 56 acres land. Area for raw water reservoir has been provided. Ash dyke will not be provided since ash will be dumped while backfilling in the abandoned portion of Gare IV/1 coal mine. The estimated investment in the project will be approximately Rs. 1050 crores.

1.1 INTRODUCTION

The power demand and supply analysis of the 15th Electricity Survey of India covering 10th & 11th plan period revealed that the State of Chhattisgarh faces considerable deficit in the total availability versus the demand in supply of power. As per estimates of CSEB with rapid industrialization of the state, the average power demand is expected to grow at the rate of 15% per annum upto 2007-08 and thereafter at the rate of 10%. The demand-supply gap from the year 2007-08 (assuming that Seepat power comes on schedule) will be around 200 MW going upto around 500 MW in the year 2011-12.

JSPL is operating an open cast mine, Gare IV/1, along with a crushing screening and washing plant. In the process of coal washing large amount of coal middlings and fines are generated. To effectively utilize the coal middling and fines, a power plant of 2 X 150 MW capacity is proposed at the same location. This will result in savings in the cost of middlings and fines transportation and enhance solid waste utilisation as well as ash disposal since the ash is proposed to be filled back in the abandoned portion of coal mine. The power generated from the power plant will be transmitted to JSPL's existing steel plant in Raigarh through its own dedicated transmission network.

1.2 BRIEF PROJECT OUTLINE

The project will consist of two units of 150 MW having a total capacity of 300 MW. A plot plan showing the plant features has been presented in Fig 2.1. The primary fuel for the Plant will be coal middling and fines generated during washing at Gare IV/1 coal mine located in village Nagarmuda, Janjgir, Tapranga, Dongamahua and Dhaurabhata, at a road distance of about 50 km from Raigarh.

Considering the overall generating capacity of the 2 X 150 MW power plant, the coal middling and fines requirement at full capacity would be around 312 TPH. For 24 hours 330 working days, the total coal middling and fines consumption in a year would be 2.445 million tonnes.

1.3 REASONS FOR PREPARING ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT PLAN

The purpose of preparing environmental impact assessment and management plan for the proposed 2 X 150 MW thermal power project near village Dongamahua in Raigarh district of Chhattisgarh, is to seek clearance on environmental aspects from the Ministry of Environment and Forest in line with the Environmental Impact Assessment Notification, 1994.

The plan is to assess the current environmental scenario of the area and then based on the activities and processes in the proposed thermal power plant, to carry out Environmental Impact Assessment. It will identify and address the impacts, where they are adverse in nature, design mitigative measures to manage such impacts in a manner to conserve the environment and ecology of the area. The EIA/EMP is based on the data generated during the summer season.

1.4 OBJECTIVE OF ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT PLAN

The main objectives of the environmental impact assessment and management plan are listed below :

- To establish the present environmental scenario.
- To anticipate the impacts of proposed construction and operation of the power plant operations on the environment.
- To suggest preventive and mitigative measures to minimise adverse impacts and to maximise beneficial impacts.
- To suggest a monitoring programme to evaluate the effectiveness of mitigative measures.
- To suggest the formation of a core group responsible for implementation of environmental control and protective measures and monitoring of such implementation and a feedback mechanism enabling to make mid course corrections.
- To prepare a capital cost estimate and annual recurring cost for Environmental Management Plan.

1.5 SCOPE AND METHODOLOGY FOR EIA

This report addresses the environmental aspects of construction and operation of the proposed 2 X 150 MW Thermal Power Project in District Raigarh. The project area is referred to as ‘core zone’ and the area with in 10 km of its periphery referred to us ‘buffer zone’ The core zone and the

buffer zone together are called as 'study area'. The area falling within a 10 km radius was considered to assess compatibility with normal environmental guidelines.

The study incorporates primary data on meteorology, ambient air quality, water quality, noise and soil generated during the summer 2006 and prediction of ground level concentration of air pollutants through source study and mathematical modeling. Other aspects of environment have been studied such as soil quality, flora, fauna, noise environment and socio economic factors etc. Secondary data was obtained from recognized sources including government agencies.

Any large scale industrial project is expected to cause environmental impacts near the project site during its construction and operation phases. The type and intensity of impacts on various components of the environment vary depending on the nature and size of the project as well as its geographical location. The net impacts from individual project can be quantified through Environmental Impact Assessment studies of various components of environment such as noise, air, water, land, biological and socio-economic. EIA studies form a basis for preparing an Environmental Management Plan (EMP) to protect the environment of the area.

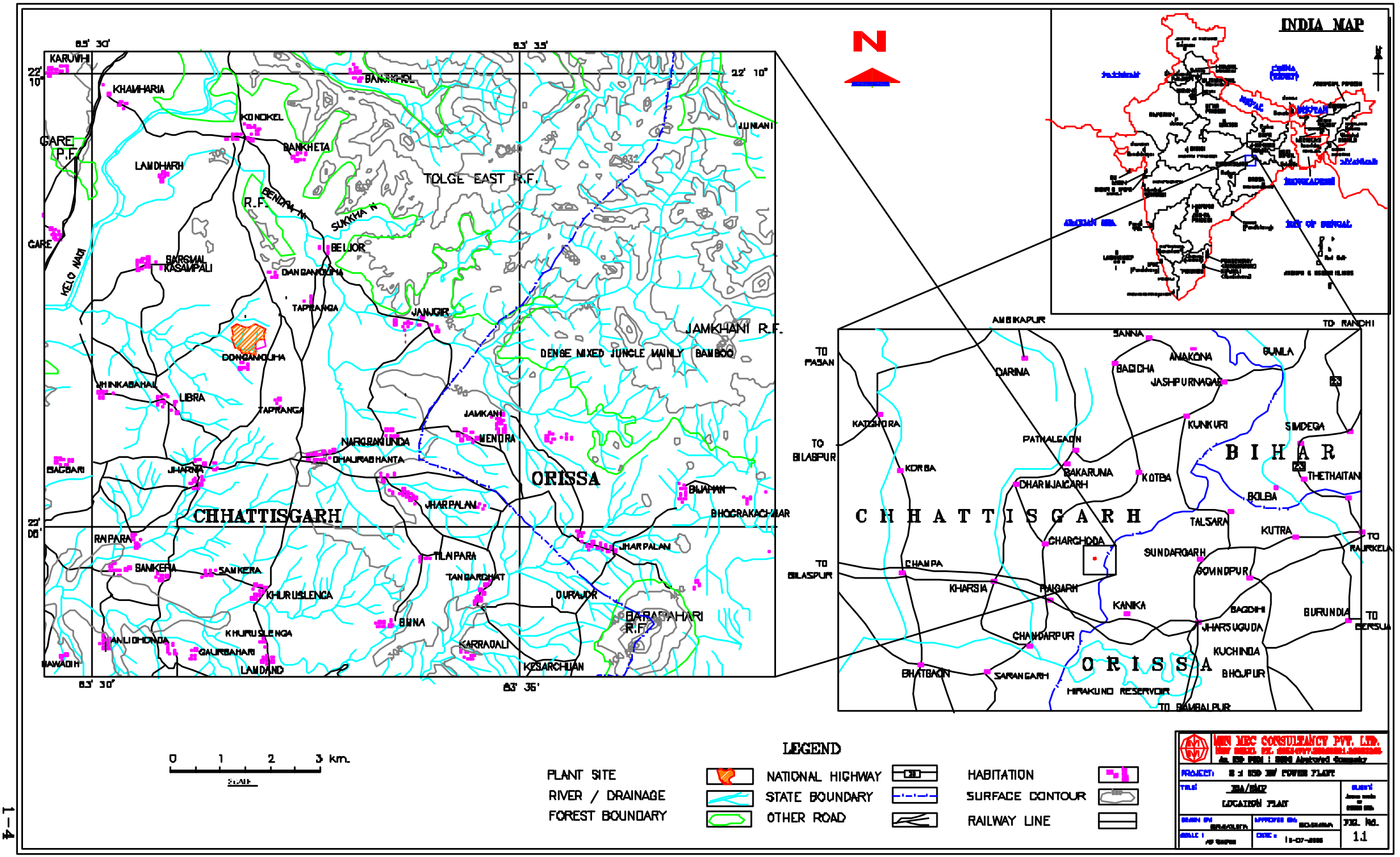
The total EIA studies for a particular project site can be divided into three phases. The first is identification of significant environmental parameters and then assessing the existing (pre-project) status within the impact zone with respect to environmental descriptors. The second phase is prediction of impacts from proposed project on identified environmental parameters based on experience of other projects. The third phase includes the evaluation of total impacts after superimposing the predicted impacts over baseline data. This helps in incorporating proper mitigation measures wherever necessary for preventing deterioration in environmental quality.

In the present case of EIA for this project, an impact zone of 10 km radius around the proposed plant site has been identified as per existing guidelines of MOEF, Govt. of India. The EIA report is based on summer baseline data and the existing environmental scenario around the proposed site. The studies covering all the individual components of environment have been described in detail in subsequent chapters.

1.6 LOCATION AND COMMUNICATION

1.6.1 Location

The proposed power plant is located in village Dongamahua, Garghoda tehsil of Raigarh district in Chhattisgarh state. It is at pit head of Gare IV/1 Coal Block, which is in the south eastern part of Mand Raigarh Coal field. The study area is covered in survey of India Toposheet No. 64 N/8 & 12. The project area is covered in 64 N/12. The location of the proposed project can be seen in Fig.1.1. The coordinates of the proposed 2 X 150 MW power plant.


INDIA MAP
N
83° 30'
83° 35'
22° 10'
22° 05'
KARUWHI
KHAMHARIA
KONDKEL
BANKHOL
JUNIANI
GAREI P.F.
LAMDHARH
BANKHETA
TOLGE EAST R.F.
BENDRA N
SUKKHA N
R.F.
GARE
KELO NADI
BARSWAL KASAMPALI
BELJOR
DANGANKOLIHA
TAPRANGA
JANJGIR
JAMKHANI R.F.
DENSE MIXED JUNGLE MAINLY BAMBOO
DONGANKOLIHA
JHINKABAHAL
LIBRA
TAPRANGA
JAMKANI
MENDRA
NARGRANKUNDA
DHALURABHANTA
BAGBARI
JHARNA
ORISSA
BHAPHAN
JHARPALAN
BHOGRAKACHHAR
CHHATTISGARH
RAIPARA
JHARPALAN
TILAIPARA
BANKERIA
SAMKERA
TANGARGHAT
KHURUSLENGA
DURAJOR
BARRAMAHARI R.F.
BUNA
KHURUSLENGA
ANLIDHONDA
GAURSAHARI
KARRADALI
BAWADIH
LAMDAND
KESARCHUAN
AMBIKAPUR
TO RANCHI
TO PASAN
SANNA
ANAKONA
GUNLA
CHIRIMA
BADICHA
JASHPURNAGAR
KATGHORA
KUNKURI
SIMDEGA
TO BILASPUR
PATHALGAON
KORBA
BAKARUMA
KOTBA
BIHAR
DHARMJAICARH
THETHAITAN
BOLBA
CHHATTISGARH
TALSARA
KUTRA
CHARGHODA
TO RAURKELA
SUNDARGARH
TO BILASPUR
CHAMPA
GOVINDPUR
KHARSIA
RAIGARH
KANIKA
BAGDIHI
BURUNDIA
TO BERSUA
JHARSUGUDA
CHANDARPUR
KUCHINDA
ORISSA
BHATBARI
SARANGARH
BHOJPUR
HIRAKUND RESERVOIR
TO SAMBALPUR
0 1 2 3 km.
SCALE
LEGEND
PLANT SITE
RIVER / DRAINAGE
FOREST BOUNDARY
NATIONAL HIGHWAY
STATE BOUNDARY
OTHER ROAD
HABITATION
SURFACE CONTOUR
RAILWAY LINE
MN NEC CONSULTANCY PVT. LTD.
PROJECT:
TITLE: LOCATION PLAN
DRAWN BY:
APPROVED BY:
DATE:
DWG. NO. 1.1

Latitude 22°06'53" to 22°07'06"
Longitude 83°31'45" to 83°32'11"

1.6.2 Communication

Road link : The proposed power plant is accessible by all weather road from the district head quarter Raigarh which is located at a distance of 50 km. To approach the plant, Raigarh Ambikapur State Highway takes a bifurcation to the east at 22 km milestone at Punji Patra. The distance from site to State Highway is about 30 kms.

Rail link: The nearest Railway station is Raigarh on broad gauge main line via Nagpur which is about 50 km from the mine.

Air link: The nearest airport is at Raipur which is about 250 km towards south west from the project site.

1.7 CHOICE OF LOCATION

JSPL is operating an open cast coal mine along with a crushing, screening and washing plant. In the process of coal washing, large amount of coal middlings and fines are generated. To effectively utilize the coal middlings and fines, a power plant of 2 x 150 MW capacity is proposed at the same location in order to save the cost of raw material transportation, to enhance the utilization of middling and fines which is otherwise a solid waste as well as for easier ash disposal since the ash is proposed to be filled back in the abandoned portion of Gare IV/1 mine.

1.8 CHOICE OF TECHNOLOGY

The CFBC technology has been selected for the proposed power plant due to the following reasons:

1. Considering the high ash content in the coal middlings, pulverized fuel fired boilers cannot be installed as high ash will constantly require oil support for flame stabilization and a lot of maintenance in coal feeding and milling system
2. AFBC boilers can be installed for high ash content coal, however, due to capacity limitation, AFBC boilers have also been ruled out.

CHAPTER 2

PROJECT DESCRIPTION

2.1 PROJECT SITE

The proposed plant will be located in village Dongamahua, Tehsil Garghoda, District Raigarh of Chhattisgarh. The detailed location and communication of the project with respect to nearest road, rail and air link is already discussed under para 1.6 of Chapter 1.

The elevation at the power plant site varies in the vicinity of 280 m above mean sea level (amsl). The land is generally flat. The land required for the project will be approximately 56 acres. Land for raw water reservoir has been provided while ash dyke will not be there as ash will be dumped in abandoned portion of the coal mine. Since the land has been acquired from the village, it is either agricultural or wasteland. No displacement of population has occurred due to this acquisition. The proposed plant layout can be seen in Fig 2.1.

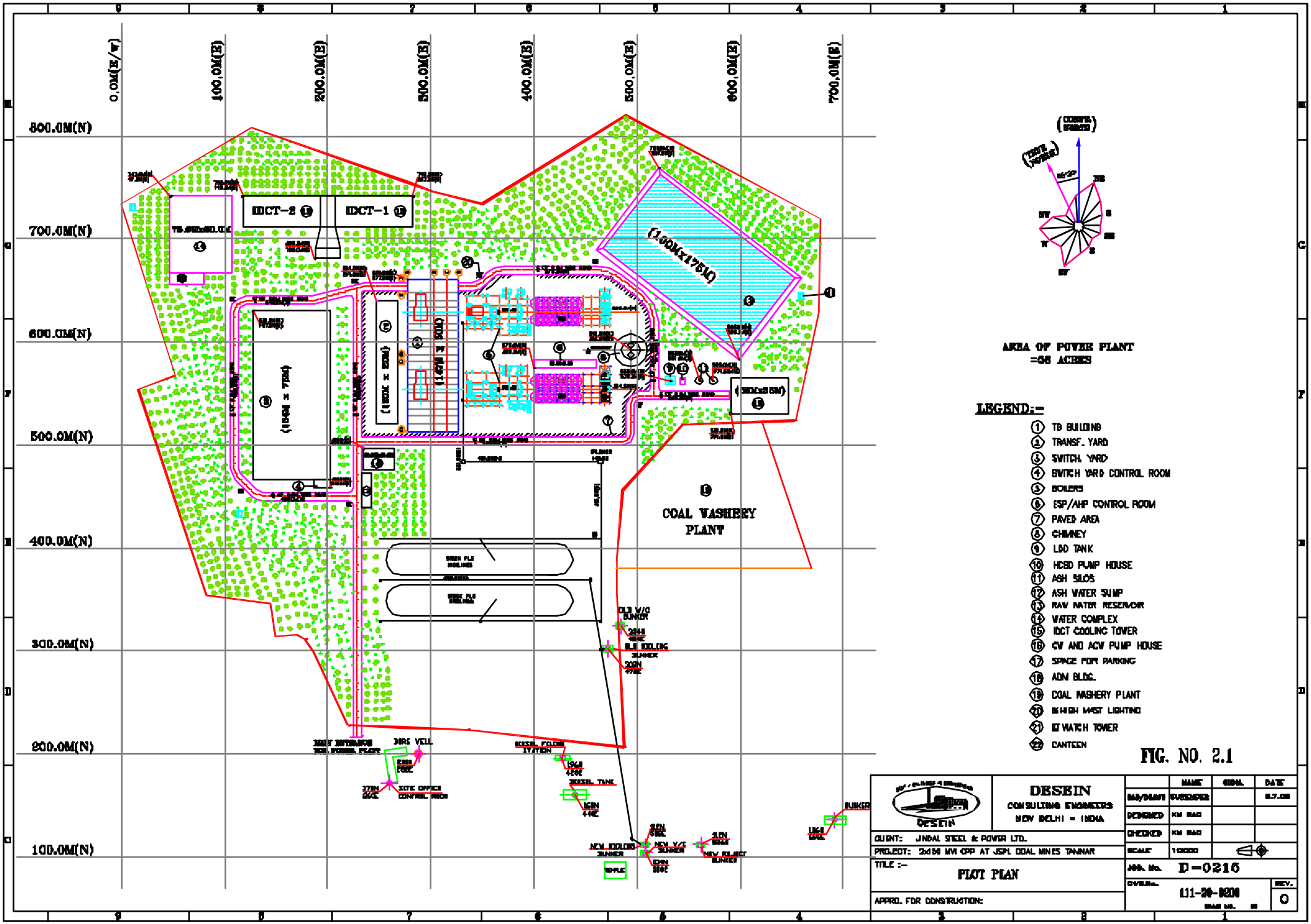
2.2 PROCESS DESCRIPTION

In a middling and coal fines based thermal power station, the heat of combustion is first converted into mechanical and then to electrical energy. The main units of a thermal power plant are steam generator, steam turbine and electrical generator. Steam generator is a combination of heating surfaces in which super-heated steam is generated at high pressure and temperature by utilising the heat liberated from combustion of fuel (middling and coal fines). The steam so generated is fed into a turbine, which converts the thermal energy of steam into mechanical energy and drives the generator for producing electricity. Exhaust steam from the turbine is condensed by means of a condenser. Thus, the water evaporated in the boiler is conserved in a closed cycle. To meet the minor water shortfall of the cycle, due to leakages, blowdown and popping of safety valves, a small quantity of demineralised water is continuously fed into the condenser Hotwell.

The condenser cooling is normally achieved by means of water in a closed cycle. The condenser cooling water is cooled by means of evaporative cooling towers.

The condensate of exhaust steam is heated by steam extracted from the turbine at several stages for improving thermal efficiency of the cycle. The fuel is supplied into the boiler furnace together with the combustion air.

The products of combustion are cooled to a relatively low temperature and exhausted from the boiler through a stack or chimney into the atmosphere after cleaning. In case of a solid fuel (middling and coal fines), ash is



AREA OF POWER PLANT
=56 ACRES

LEGEND:-

1. TB BUILDING
2. TRANSF. YARD
3. SWITCH YARD
4. SWITCH YARD CONTROL ROOM
5. BOILERS
6. ESP/AHP CONTROL ROOM
7. PAVED AREA
8. CHIMNEY
9. LSD TANK
10. HCSD PUMP HOUSE
11. ASH SILOS
12. ASH WATER SUMP
13. RAW WATER RESERVOIR
14. WATER COMPLEX
15. IDCT COOLING TOWER
16. CW AND ACW PUMP HOUSE
17. SPACE FOR PARKING
18. ADM BLDG.
19. COAL WASHERY PLANT
20. 36 HIGH MAST LIGHTING
21. DT WATCH TOWER
22. CANTEEN

FIG. NO. 2.1

DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA		NAME	SIGN.	DATE
	DRAWN	SURENDER		8.7.08
	DESIGNED	KM RAO		
	CHECKED	KM RAO		
	SCALE	1:2000		
CLIENT: JINDAL STEEL & POWER LTD.				
PROJECT: 2x50 MW CPP AT JSPL COAL MINES TAMNAR				
TITLE :- PLOT PLAN		Job. No. D-0215		
APPRO. FOR CONSTRUCTION:		DWG. No. 111-20-0200		REV. 0

2-2

disposed off to ash silo from the boiler furnace bottom by means of dry disposal system.

The fly ash is arrested in Electrostatic Precipitators and disposed off in such a manner that it can be utilised in dry form to the maximum extent possible and unutilised fly ash is disposed to the abandoned portion of coal mine.

The electrical energy generated is sent to JSPL's Steel Plant at Raigarh through a transmission and distribution network after being stepped up to suitable voltage.

2.3 FACILITY PROPOSED

It is proposed to install 2 X 150 MW power station.

Major auxiliaries of a power plant are discussed in brief in subsequent paragraphs below.

2.3.1 Steam Generators and Accessories

The steam generators will be designed for firing coal middling and coal fines. Each of them will be radiant, reheat, natural circulation, single drum, balanced draft, semi-outdoor unit rated to deliver approximately 490 t/h of superheated steam at 137 bar pressure and 540°±5°C temperature when supplied with feed water at a temperature of 246°C at the economiser inlet.

The complete furnace section will be of welded wall type, arranged as a gas and pressure tight envelope. The air and flue gas system will comprise 2X60% axial type forced draft fans with silencers, 2X60% - radial type induced draft fans and 2X60% axial type primary air fans with silencers.

Ash Handling System/Solid Waste Management

The coal used in the proposed plant will contain 58% ash. About 20-25% of ash would be collected at bottom as coarse ash and the balance 75-80% would be collected as fly ash.

The bottom and coarse ash from each boiler will be collected in dry form along with fly ash from the ESP hopper and will be transported to fly ash silos. In the initial years of operations, efforts will be made to ensure maximum utilization of fly ash in dry form for commercial use such as brick making, manufacturing of pozolona cement, manufacturing of aggregates etc. Unutilised fly ash shall be converted into high concentration slurry and shall be transported to abandoned portion of coal mines.

Chimney / Stack

One number, Bi- Flue stack for 2 X 150 MW. The detail of the stack is given Table 2.1

TABLE 2.1
DETAIL OF STACK

Stack	
Number of stacks (Chimneys)	I for 2 X 150 MW
Height of the stack	220 m
Number of flues in each stack	2
Internal diameter of each flue	3.75 m
Flue gas exit volume	265.8 m^3/s
Flue gas temperature	132 ℃
Flue exit velocity	25 m/s
Emissions from one flue (to be doubled for stack)	
SO_2 emission from each flue	1558.8 kg/hr
NO_x emission from each flue	255.6 kg/hr
Particulate matter emission from each flue	32.25 kg/hr
CO	149.16 kg/hr

Condensers Cooling Water System

The proposed plant will have recirculating type cooling water system with wet evaporative cooling tower of capacity 40,000 m^3/hr.

Water Reservoir

Water reservoir of 100 m X 175 m has been provided on the north eastern corner of the site. The raw water reservoir will store water for supply to the plant as well as harvested rainwater. The water will used at various locations in the plant after suitable treatment. To fulfill the water requirement of the plant, a 100% recycling and reuse system has been designed.

Water Treatment System

It comprises of clarifloculator filtration and demineralization (DM) plant to meet the water requirements of the plant and the colony. The clarified water shall be used for cooling tower make up and for supply to filtration plant. The filtered water will be supplied to DM plant. The DM water from the DM plant will be stored in two tanks, from where it will be pumped into condenser Hotwell. The service water required for the plant would be partly supplied by the blowdown from the CW system.

Coal handling and Transportation

Middlings and coal fines will be transported via conveyors. Middlings and fines will be stored in bunkers.

2.4 RAW MATERIAL QUALITY

Coal middling and fines generated from coal washing plant will be used as primary fuel obtained from the washery of GareIV/1 coal block. The coal

available in the block has weighted average GCV of 2200-2700 Kcal/ Kg, ash content between 50-58% and moisture content 10-14%. The coal analysis is summarized in Table 2.2.

TABLE 2.2
MIXED FUEL ANALYSIS (MIDDLING AND COAL FINES)
A. PROXIMATE ANALYSIS (% BY WEIGHT)

S.NO.	DESCRIPTION	DESIGN FUEL	RANGE OF FUEL
1.	Total Moisture (%)	12	10 – 14
2.	Ash (%)	54	50 – 58
3.	Volatile Matter (%)	14	13 – 20
4.	Fixed Carbon	18	15 – 21
5.	Calorific value (Kcal/Kg)	2300	2200 – 2700

B. ULIMATE ANALYSIS (% BY WEIGHT)

S.NO.	DESCRIPTION	DESIGN	RANGE
1.	Moisture(%)	12	10 – 14
2.	Ash (%)	54	50 – 58
3.	Carbon (%)	24	23 – 28
4.	Hydrogen (%)	2.3	2.3 – 3.0
5.	Nitrogen (%)	0.7	0.7 – 0.95
6.	Sulphur (%)	0.5	0.4 – 0.6
7.	Oxygen (by diff) (%)	6.5	4.5 – 6.0

C. ASH ANALYSIS

S.NO.	DESCRIPTION	DESIGN	RANGE
1.	SiO_2	%	58 to 62
2.	Al_2O_3	%	23 to 26
3.	Fe_2O_3	%	7 to 10
4.	SO_3	%	0.15 to 0.4
5.	P_2O_5	%	Traces
6.	Cao	%	3-5
7.	MgO	%	1.5-3
8.	Mn	%	0.02-0.04
9.	TiO_2	%	0.15-0.19
10.	Alkalis & Undetermined	%	Remaining

ASH FUSION TEMPERATURE AT OXIDIZING MEDIA

1	Initial deformation temperature	1210 °C
2.	Hemi spherical temperature	1320 °C
3.	Flow temperature	1350 °C

AT REDUCING MEDIA

1.	Initial deformation temperature	1050 °C

Secondary fuel will be LDO. The oil will be transported by tanker to plant site. The Light Diesel Oil (LDO) analysis is given in Table 2.3.

TABLE 2.3
LIGHT DIESEL OIL (LDO) ANALYSIS

SPECIFICATION	IS: 1460,1995
Acidity (inorganic)	-
Ash content by weight (maximum)	0.02%
Kinematic viscocity	2.5 to 15.7 CST at 40°
Total sulphur by weight (maximum)	1.8%
Flash point (minimum), (pensky martens, closed)	66℃
Pour point maximum	15℃ for winter, 21℃ for summer
Sediment by weight (maximum)	0.10%
Water content by volume (maximum)	0.25%
Carbon residue (rams bottom) by weight (maximum)	1.5%

Remarks

Winter – November to February both months inclusive.

For sulphur content IP-336 (XRF method) may also be followed excise specifications :

1) Smoke point less than 10 mm
2) RCR minimum should be 0.25% by weight minimum
3) As dark as or darker than 0.04 normal iodine solution when tested by colour comparison test
4) Posseses a viscosity of 100 secs. or by Redwood Viscometer at 37.8℃.

2.5 FIRE PROTECTION SYSTEM

An elaborate fire protection arrangement is planned for this plant. A multitude of system will be provided to combat various types of fire in the different areas of plant. The different systems to be provided are:

1. Outdoor fire hydrant system
2. Deluge sprinkler system
3. Portable fire extinguisher
4. Fire Detection and alarm system for central control room

Stand pipe system and fire hydrant is to be provided. Fixed foam system using fluoro protein low expansion foam will be provided for the fuel oil storage tank.

2.6 VENTILATION AND AIR CONDITIONING SYSTEM

In order to maintain suitable space conditions as required for personnel comfort as well as equipment protection, properly designed ventilation and air conditioning system shall be provided in various areas of the plant. All air conditioned space shall be designed for 22°C ± 1% and maximum 60% RH indoor condition.

2.7 MANPOWER

The total manpower required at plant during operation stage will be 200 persons of which skilled will be 50 and unskilled will be 150 persons.

Contractual labour and staff will be hired for several jobs in and around the plant and raw water reservoir, which will be overseen by JSPL's Engineers and Supervisors.

The number of working days in a year will be 330 days with three shift operation of 8 hours each.

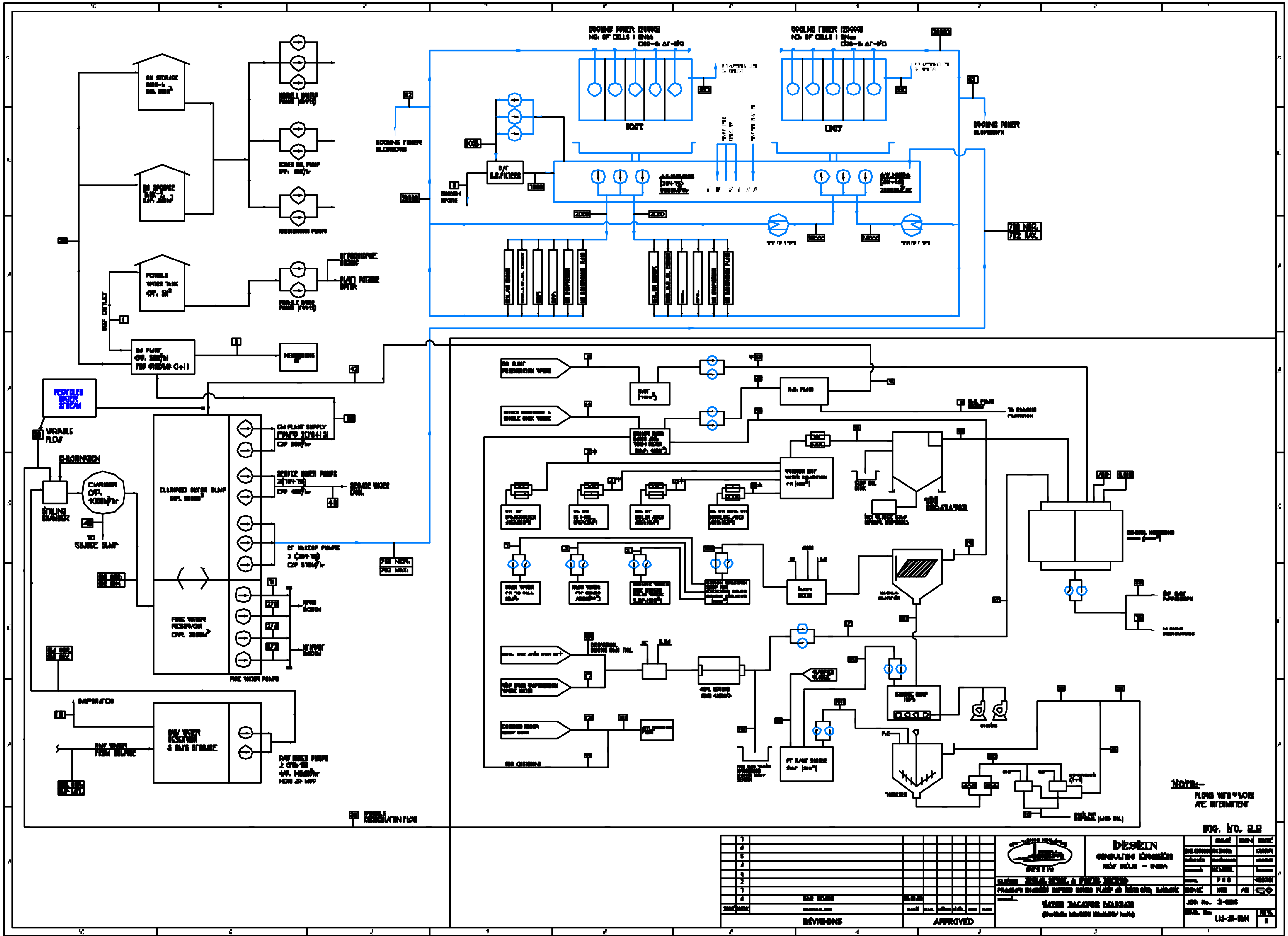
2.8 WATER REQUIREMENT

The water consumption of the plant will be 942m^3/hr. Since recirculation and reuse of water is proposed, the total fresh water consumption can be reduced from 942m^3/hr to 864 m^3/hr after the operation of the treatment and recirculation system. The water consumption in various parts of the plant is given in Table 2.4.

TABLE 2.4
PROPOSED WATER CONSUMPTION

Sl. No.	Usage	Water Consumption (m^3/hr)
1	Via DM plant	
	(a) Potable water	1
	(b) Regeneration, boiler fill & Hotwell makeup	50
	(c) Neutralizing pit	9
2	Service water	40
3	Cooling water make–up	792
4	Evaporation from water reservoir	10
5	Clarifier Sludge	40
	Total	**942**

The maximum water requirement of the proposed power plant is 942m^3/hr. To fulfill this requirement, 36m^3/hr water will be recycled from wastewater treatment plant, 42m^3/hr water will be recycled from Boiler Blow-down, and 864m^3/hr water will be fresh water. Total 78m^3/hr of treated water will be recycled in the plant. The water balance diagram along with the treatment system can be seen in Fig 2.2.


RECYCLED WATER STREAM
VARIABLE FLOW
CHLORINATION
STILLING CHAMBER
CLARIFIER
TO SLUDGE SUMP
CLARIFIED WATER SUMP
FIRE WATER RESERVOIR
FIRE WATER PUMPS
SERVICE WATER PUMPS
RAW WATER RESERVOIR
RAW WATER PUMPS
RAW WATER FROM BARRAGE
EVAPORATION
DESEIN
CONSULTING ENGINEERS
NEW DELHI - INDIA
WATER BALANCE DIAGRAM
REVISIONS
APPROVED

CHAPTER 3

PRESENT ENVIRONMENTAL SCENARIO

3.1 GENERAL

For the purpose of assessing impacts of any development project, the baseline status of environmental factors in the project area and its surroundings is to be established. The project area or core zone in this case forms area of land acquired and includes the area covered by the proposed facilities. The 10 km radius around the proposed project including the project area forms the study area i.e. the anticipated area of impact. The study area in this case falls within Raigarh district of Chhattisgarh.

3.2 SOURCE OF ENVIRONMENTAL DATA

The information of micrometeorological data, ambient air quality, water quality, noise level, soil quality, flora, fauna and socio economic descriptions are drawn from the data monitored and collected by M/s Min Mec Consultancy Pvt. Ltd. and Min Mec R&D Laboratory, New Delhi. Long term meteorological data recorded at the nearest India Meteorological Department (IMD) located at Raigarh was collected while micrometeorology was collected at site. Apart from these, data have been obtained from Census Hand book, Revenue Records, Statistical Department, Soil Survey and Land Use Organisation, Forest Department, P.H.E Department, P&E Department, Ground Water Board etc.

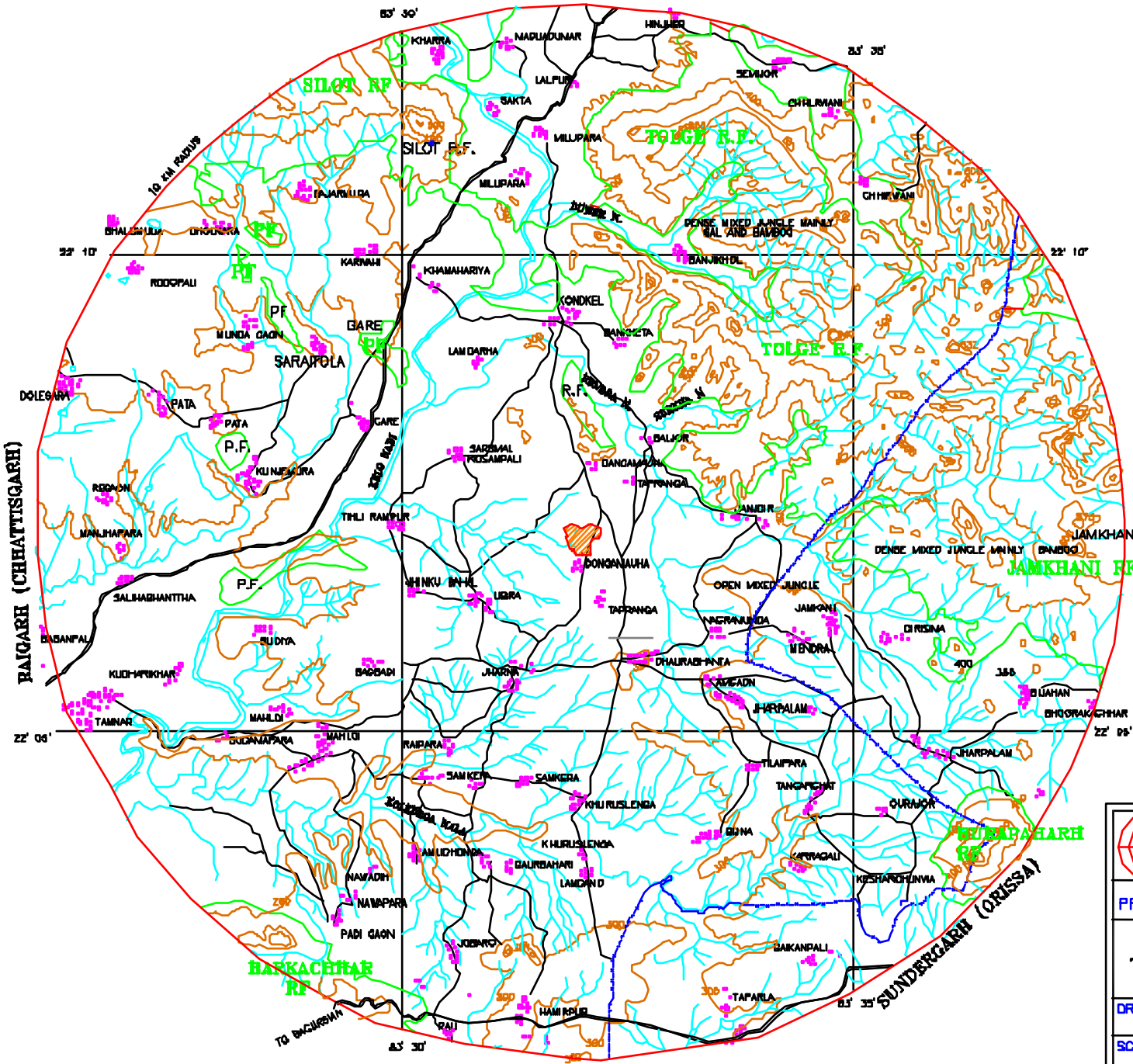
3.3 TOPOGRAPHY & DRAINAGE

3.3.1 Topography

The study area in general is uneven and ground is undulating. The north eastern quadrant is full of weathered rocks in the shape of small hillocks. The elevation within the study area ranges between 260 m and 640 m. The elevation at the plant site is approximately 280 m above mean sea level (amsl). The general gradient is westerly i.e. towards Kelo river. The whole study area can be broadly divided into three sub regions:-

1. North western to eastern region- upper elevation thick forest track.
2. Middle western to southeastern region- agriculture track.
3. South westerly region- small elevation degraded forest track.

The topography and drainage of the study area is shown in Fig 3.1.



MIN MEC CONSULTANCY PVT LTD NEW DELHI PHONE : 26534777,26536861,26532936		
PROJECT: 2 X 150 MW POWER PLANT		
EIA/EMP TOPOGRAPHICAL & DRAINAGE PLAN		CLIENT: JINDAL STEEL & POWER LTD.
DRAWN BY: B.R.MATLOTIA	APPROVED BY: B.D.SHARMA	FIG.NO. 3.1
SCALE : AS SHOWN	DATE: 13-07-2008	

3.3.2 Drainage

Drainage of study area is controlled by Kelo river with tributaries like Bendra nala, Dumer nala, Koledega nala, Chini nala, etc.. The drainage pattern of the study area is dendritic. Kelo river is flowing west of the plant site at a distance of about 3.5 km. Bendra nala is a tributary of Kelo which passes NW of the proposed plant site. Pajhar nadi is another perennial surface water body in the western side of the study area flowing from north to south direction. It joins Kelo river at about 1 km from the buffer boundary. There are some small seasonal nalas for drainage of rainwater. From Fig 3.1, it can be observed that primary 1st level drainage streams originate from the project site. No nala/ seasonal stream is passing through the site.

3.4 CLIMATE AND LONG TERM METEOROLOGY

3.4.1 Climate

The climate of the study area is of subtropical type, and is characterised by an oppressive hot summer, a mild winter and well distributed rainfall during the south western monsoon season.

The year may be divided into four seasons. The summer season lasts from March to the middle of June, and the period from June to September is the south west monsoon season. October and November constitute the post monsoon season and the winter season is from December to February. The nearest meteorological station of IMD, for which climatological normal data are available, is at Raigarh. A summary of climatological normal data for Raigarh (Source : Climatological Tables, 1951-1980, Indian Meteorological Department Publication, page 625) is as follows:

a) The air temperature varies from a minimum of 8.1°C to a maximum of 46.1°C. Maximum and minimum recorded temperatures are 48.3°C (on 08 May 1973) and 6.4°C (on 22 January 1963) respectively. The average daily mean maximum temperature was observed as 33.6^{0}C and minimum as 21.3^{0}C over the 30 year period.

b) Relative humidity in the morning varies from 38% during April to 86% during August and the same in the evening varies from 20% during April to 78% during August.

c) Annual total rainfall is reported as 1602.3 mm. The south western monsoon accounts for 89.5% of total rainfall. On an average, there are 69.4 rainy days during the year.

d) Mean monthly wind speed varies from 2.9 kmph during December to 6.7 kmph during June. North eastern winds are more frequent during most of the year except during monsoon season, when south western winds prevail.

3.4.2 Long term meteorology

Meteorological data for Raigarh station for the period 1994-2003 have been collected from IMD and are appended in the form of Annexures as follows:

Monthly average minimum and maximum temperatures	Annexure - I
Monthly total rainfall	Annexure - II
Monthly average relative humidity	Annexure - III

Wind rose diagrams for the period 1976 to 1991 have also been included as Fig 3.4 and Fig 3.5. The data in respect of various parameters are discussed briefly in the following paragraphs:

Temperature

The monthly average of daily maximum and minimum temperatures for the period 1994 to 2003 have been furnished in Table 3.1 and visualised through line graph in Fig 3.2.

TABLE 3.1
AVERAGE MONTHLY MAX. & MIN. TEMPERATURE FROM 1994-2003

Months	Temperature ℃	
	Maximum	Minimum
January	27.74	12.41
February	29.74	15.69
March	35.53	19.73
April	39.57	24.85
May	41.73	27.52
June	36.66	27.01
July	31.62	25.08
August	31.40	24.96
September	31.93	24.41
October	32.14	22.05
November	30.93	17.80
December	28.13	12.81
Mean	**33.09**	**21.19**

On the basis of data available from IMD, the annual mean of minimum temperature ranges from 19.76℃ in 2000 to 22.54℃ in 2003. The annual mean of maximum temperature ranges from 32.14℃ in 1998 to 34.18℃ in 2003. However, the monthly mean values of minimum temperatures were observed in the range from 12.41℃ in January to 27.52℃ in May, and the same of maximum temperatures in the range from 27.74℃ in January to 41.73℃ in May.

FIG 3.2 : MONTHLY AVG. MAX. & MIN. TEMPERATURE (℃)
IMD STATION, RAIGARH (1994-2003)

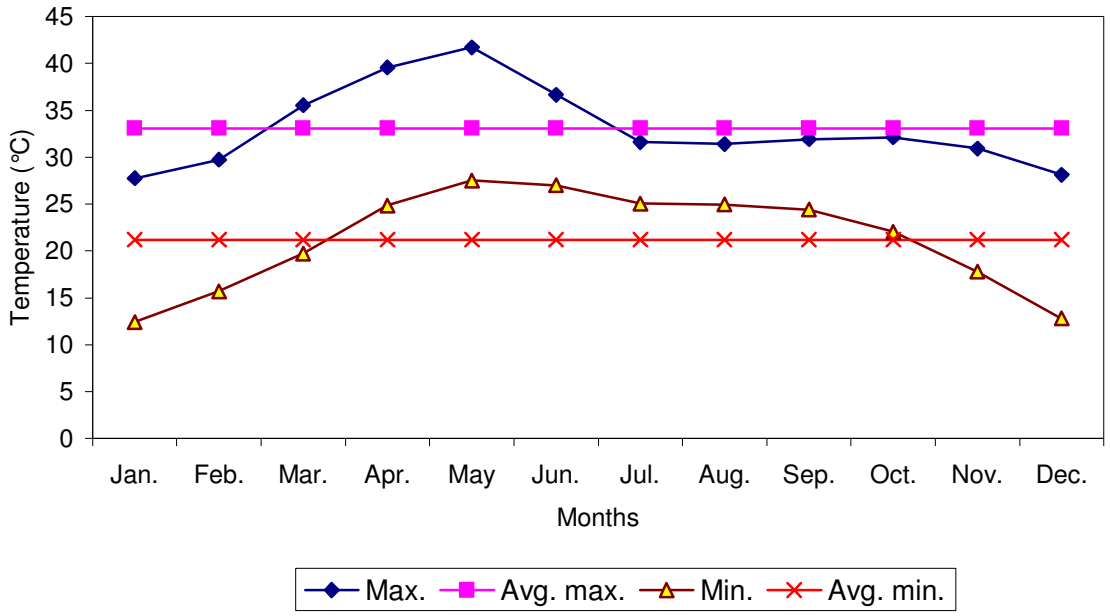
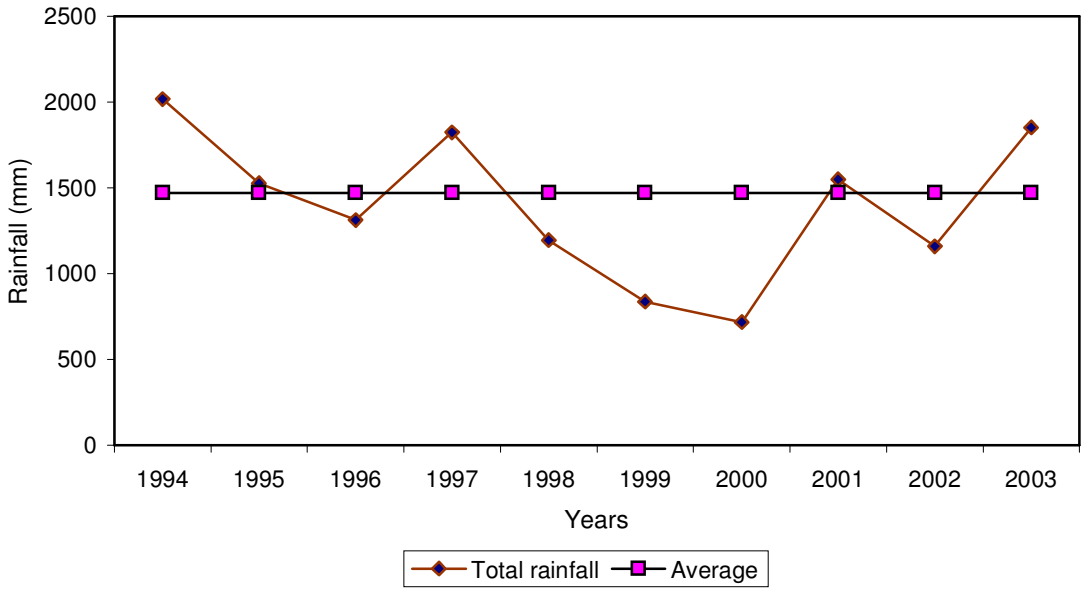


FIG 3.3 : ANNUAL TOTAL RAINFALL (mm)
IMD STATION, RAIGARH (1994-2003)



Rainfall

The annual total rainfall is given in Table 3.2 and line graph is shown in Fig 3.3.

TABLE 3.2
ANNUAL RAINFALL RECORDED AT IMD STATION RAIGARH (1994-2003)

YEAR	RAINFALL(mm)
1994	2017.9
1995	1527.6
1996	1312.7
1997	1825.3
1998	1196.6
1999	836.8
2000	718.0
2001	1550.1
2002	1161.0
2003	1852.4
Average	**1471.6**

The rainfall does not show any cyclic occurrences and shows wide and erratic variations, ranging from as low as 718.0 mm in 2000 to 2017.90 mm in 1994. The average annual rainfall for the period 1994 to 2003 was 1471.6 mm, which is below the climatological normal rainfall of 1602.3 mm. The monsoon season is spread over the months from June to September.

Wind flow pattern

The wind speed and direction for the 15 years period between 1976-91 have been studied through the windrose diagrams supplied by IMD, Pune, presented in Fig 3.4 and Fig 3.5 for 8.30 hrs and 17.30 hrs respectively. An observation of the morning windrose shows that the predominant wind direction is from NE during winter season (October to March) and SW during summer and monsoon seasons.

As per the evening windrose, the predominant wind direction is from NE between October and January, NW between February and May and SW between June and September. The general wind speed ranges form 1 to 5 km/hr throughout the year during both the times. However, winds in the speed ranges 6-11 kmph and 12-19 kmph also occur.

Humidity

The average daily relative humidity data, obtained from IMD station Raigarh is given in Table 3.3 and line graph is shown in Fig. 3.6.

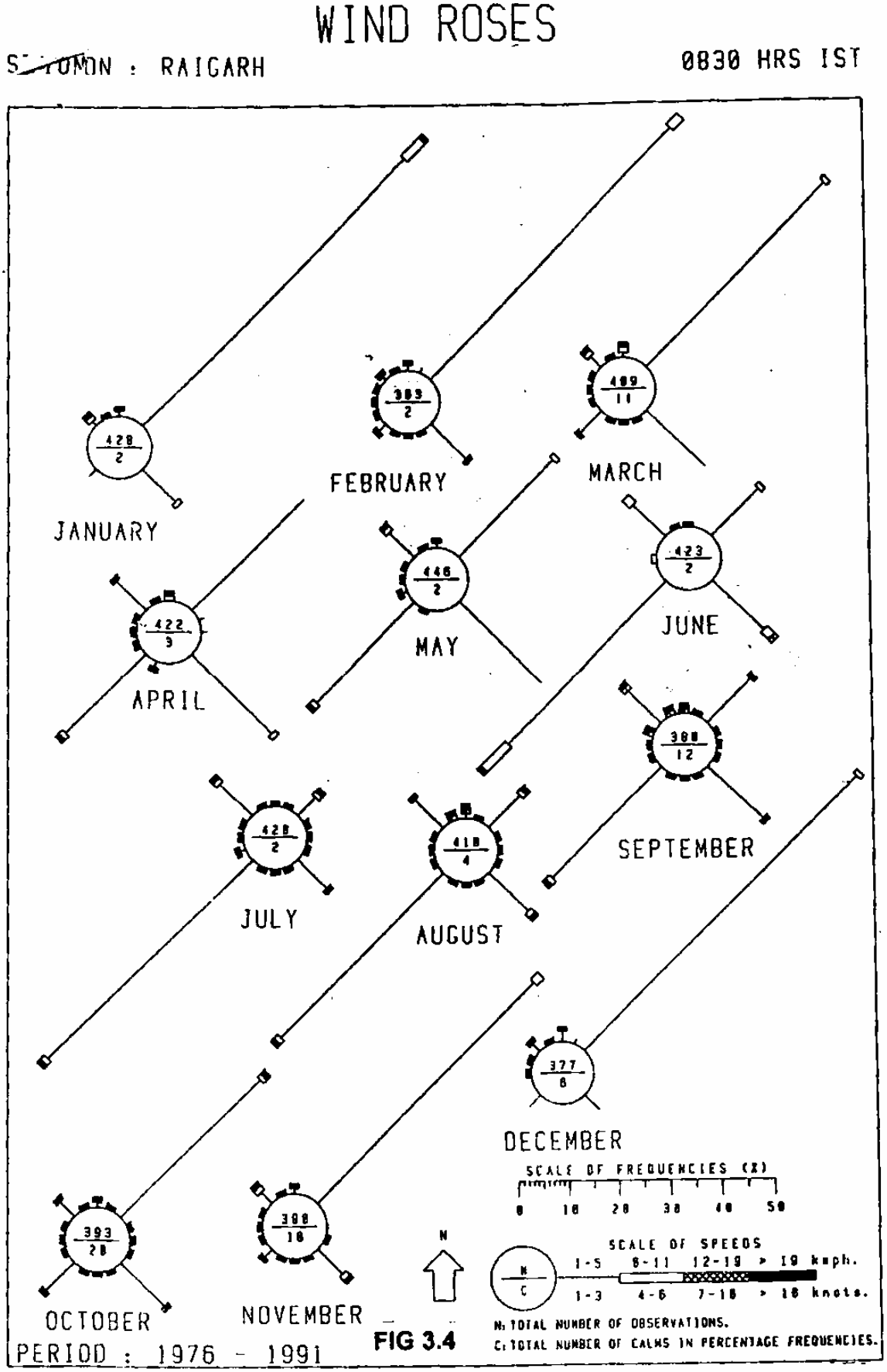

WIND ROSES
STATION : RAIGARH
0830 HRS IST
JANUARY
428
2
FEBRUARY
389
2
MARCH
489
11
APRIL
422
3
MAY
446
2
JUNE
423
2
JULY
428
2
AUGUST
418
4
SEPTEMBER
388
12
OCTOBER
393
28
NOVEMBER
388
16
DECEMBER
377
8
N
SCALE OF FREQUENCIES (%)
0 10 20 30 40 50
SCALE OF SPEEDS
N
C
1-5 6-11 12-19 > 19 kmph.
1-3 4-6 7-10 > 10 knots.
N: TOTAL NUMBER OF OBSERVATIONS.
C: TOTAL NUMBER OF CALMS IN PERCENTAGE FREQUENCIES.
PERIOD : 1976 - 1991

FIG 3.4

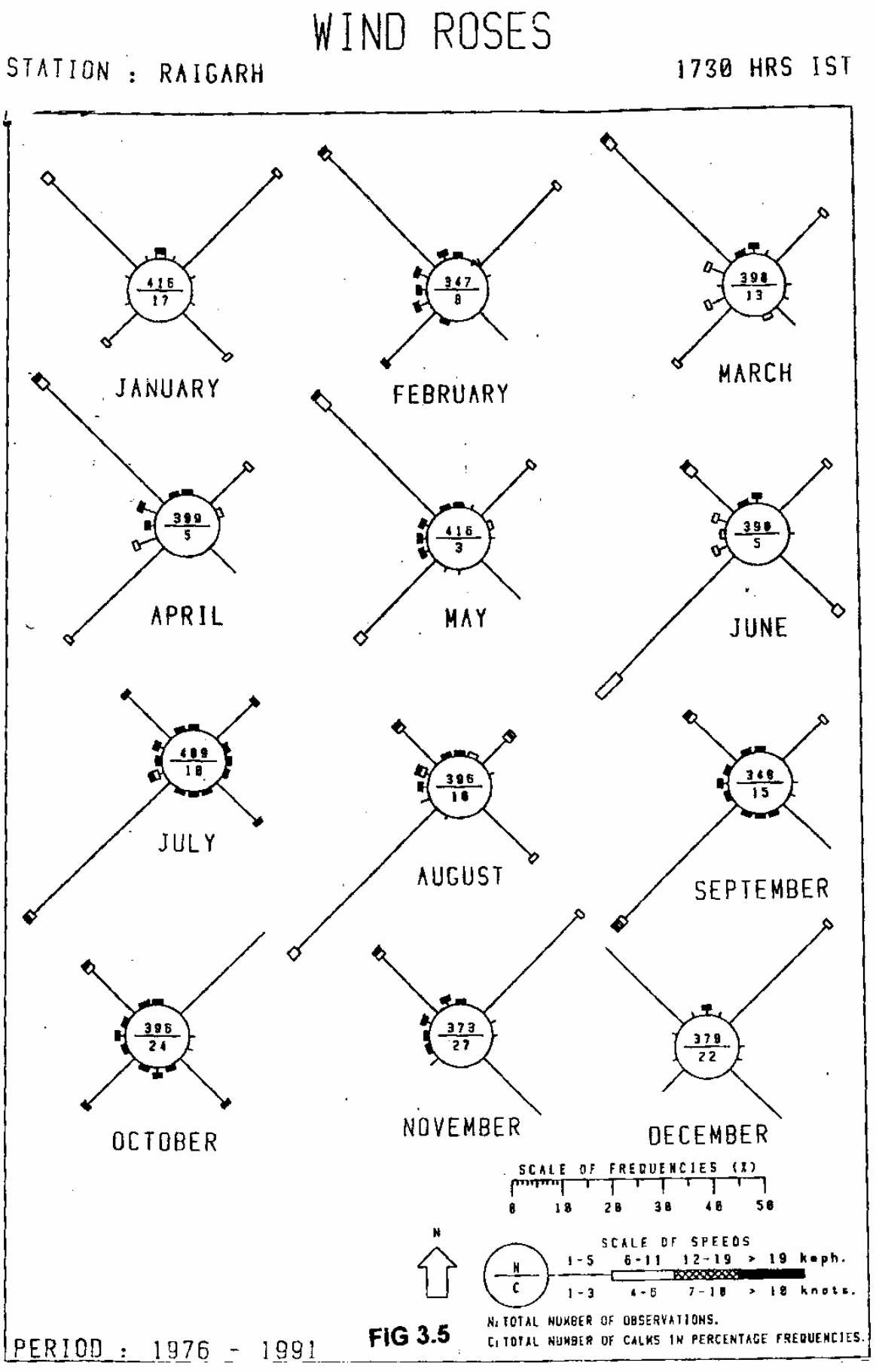
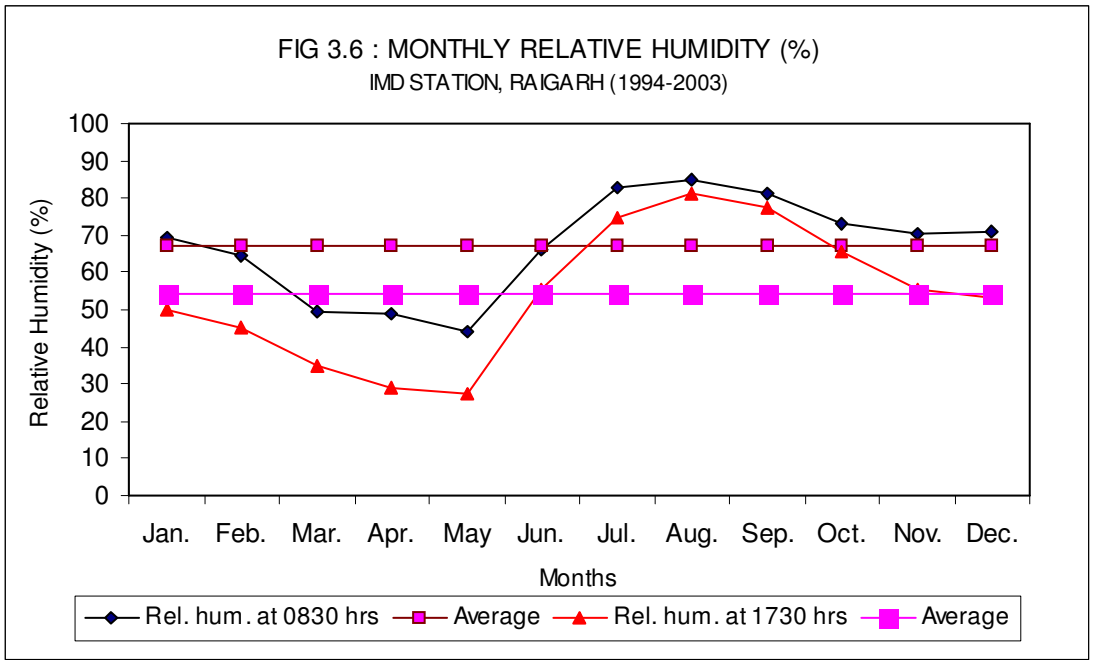

WIND ROSES
STATION : RAIGARH
1730 HRS IST
416
17
JANUARY
347
8
FEBRUARY
398
13
MARCH
399
5
APRIL
416
3
MAY
398
5
JUNE
409
18
JULY
396
16
AUGUST
348
15
SEPTEMBER
396
24
OCTOBER
373
27
NOVEMBER
378
22
DECEMBER
SCALE OF FREQUENCIES (%)
0 10 20 30 40 50
N
N
C
SCALE OF SPEEDS
1-5 6-11 12-19 > 19 kmph.
1-3 4-6 7-10 > 10 knots.
N: TOTAL NUMBER OF OBSERVATIONS.
C: TOTAL NUMBER OF CALMS IN PERCENTAGE FREQUENCIES.
PERIOD : 1976 - 1991

FIG 3.5

TABLE 3.3
MONTHLY AVG. RELATIVE HUMIDITY AT RAIGARH (1994-2003)

Months	Relative Humidity (%)	
	At 8:30 hrs	At 17:30 hrs
January	69	50
February	65	45
March	50	35
April	49	29
May	44	27
June	66	55
July	83	75
August	85	81
September	81	77
October	73	66
November	70	55
December	71	53
Mean	**67**	**54**



It is seen from the above that relative humidity is higher during the period of SW monsoon and lower during other months.

3.5 MICRO-METEOROLOGICAL SURVEY

Micro-meteorological survey was undertaken for monitoring wind speed, wind direction, ambient air temperature and relative humidity during March to May 2006. The meteorological station was set up at the plant site, the location which can be seen in Fig 3.7. The daily average of the micro-meteorological monitored data is given in Annexure IV and summarised in Table 3.4.

LEGEND

- PLANT SITE
- DISTRICT BOUNDARY
- FOREST BOUNDARY
- MOTORABLE ROAD IN DRY SEASON
- JEEPABLE ROAD IN DRY SEASON
- RIVER / DRAINAGE
- HABITATIONS
- SURFACE CONTOUR

SAMPLING STATIONS

- CORE ZONE AIR SAMPLING STATIONS
- BUFFER ZONE AIR SAMPLING STATIONS
- SURFACE WATER SAMPLING STATIONS
- GROUND WATER SAMPLING STATIONS
- NOISE MONITORING STATIONS
- SOIL SAMPLING STATIONS
- TRAFFIC MONITORING STATIONS
- MICRO METEOROLOGICAL
- PHYTO-SOCIOLAGICAL MONITORING STATIONS

MIN MEC CONSULTANCY PVT LTD
NEW DELHI
PHONE : 26534777,26536801,26532256

PROJECT: 2 x 150 MW POWER PLANT

RAPID EIA/EMP

LOCATION OF SAMPLING STATIONS

CLIENT: JINDAL STEEL & POWER LTD.

DRAWN BY: B.R.MATLOTIA

APPROVED BY: B.D.SHARMA

SCALE : AS SHOWN

DATE: 13-07-2006

FIG.NO. 3.7

TABLE 3.4
SUMMARY OF MONITORED MICRO METEOROLOGY

Particulars	Maximum	Minimum	Average
Temperature (°C)	44.5	15.6	28.96
Relative humidity	75.7	12.0	33.34
Wind speed (km/hr)	23.62	Calm	5.84
Predominant wind direction	NE (16.01 % Readings)		

Wind speed

Wind speed plays a dominant role in the dispersion of air pollutants. The wind speeds were found in the range between zero and 23.62 kmph, with the average value of 5.84 kmph. Winds were found usually below 15 kmph.

Wind direction and windrose diagram

This is also one of the important parameters in the dispersion of air pollutants since it determines the direction of transport of pollutants. Frequency of occurrence of winds from different wind directions under different wind speed ranges, also called wind rose pattern, have been computed from the hourly average values recorded continuously during the three months of summer season.

The 16 directional wind frequency table data for day and night hours as well as the 24 hour period have been presented in Table 3.5 (day, night and composite for 24 hrs). Based on the data, wind rose diagrams for the three periods have been prepared and presented as Fig 3.8.

TABLE 3.5
WIND FREQUENCY TABLE OF DATA MONITORED (1 MAR-31 MAY '06)

Direction from	Percent frequency (wind speed in km/hr)							
	Calm	1.8-5	5-10	10-15	15-20	>20	Total	Ex.Calm
DAY TIME (06 hrs to 17 hrs)								
E	0.55	3.09	1.73	0.09	0.00	0.00	5.46	4.91
ENE	0.64	5.64	2.64	0.27	0.00	0.00	9.19	8.55
NE	0.73	13.27	9.45	0.64	0.00	0.00	24.09	23.36
NNE	0.27	4.45	3.73	0.36	0.00	0.00	8.81	8.54
N	0.64	0.55	0.18	0.00	0.00	0.00	1.37	0.73
NNW	0.73	0.00	0.36	0.00	0.09	0.00	1.18	0.45
NW	1.09	0.45	0.55	0.00	0.00	0.00	2.09	1.00
WNW	0.36	0.09	0.18	0.00	0.09	0.18	0.90	0.54
W	0.82	0.18	0.36	0.00	0.00	0.00	1.36	0.54
WSW	0.27	2.00	1.82	0.45	0.00	0.00	4.54	4.27
SW	0.09	6.09	4.00	0.82	0.00	0.00	11.00	10.91
SSW	0.18	2.09	1.55	0.00	0.09	0.00	3.91	3.73
S	0.73	1.55	0.91	0.27	0.00	0.00	3.46	2.73
SSE	0.55	2.09	1.45	0.09	0.00	0.00	4.18	3.63
SE	0.09	6.45	4.18	0.45	0.00	0.00	11.17	11.08
ESE	0.82	3.45	2.64	0.36	0.00	0.00	7.27	6.45
TOTAL	8.56	51.44	35.73	3.80	0.27	0.18	99.98	91.42

Direction from	Percent frequency (wind speed in km/hr)							
	Calm	1.8-5	5-10	10-15	15-20	>20	Total	Ex.Calm
	NIGHT TIME (18 hrs to 05 hrs)							
E	0.64	0.55	0.82	0.18	0.00	0.00	2.19	1.55
ENE	0.73	0.37	0.64	0.18	0.00	0.00	1.92	1.19
NE	0.73	2.93	3.30	0.82	0.09	0.00	7.87	7.14
NNE	0.55	1.19	1.74	0.73	0.00	0.00	4.21	3.66
N	0.73	1.92	3.21	0.46	0.00	0.00	6.32	5.59
NNW	0.73	2.56	3.57	0.73	0.09	0.00	7.68	6.95
NW	0.73	3.48	6.87	1.28	0.27	0.00	12.63	11.90
WNW	0.73	2.20	3.66	0.92	0.00	0.00	7.51	6.78
W	0.55	0.73	3.02	2.38	0.00	0.09	6.77	6.22
WSW	0.55	0.73	2.84	1.92	0.09	0.00	6.13	5.58
SW	0.46	3.11	6.23	3.21	0.00	0.00	13.01	12.55
SSW	1.19	1.65	2.56	0.82	0.00	0.00	6.22	5.03
S	0.92	1.65	2.29	1.37	0.09	0.00	6.32	5.40
SSE	0.64	0.37	1.28	0.46	0.09	0.00	2.84	2.20
SE	0.64	1.83	2.29	0.64	0.00	0.00	5.40	4.76
ESE	0.82	0.37	1.65	0.09	0.00	0.00	2.93	2.11
TOTAL	11.34	25.64	45.97	16.19	0.72	0.09	99.95	88.61
	COMPOSITE (Day + Night)							
E	0.59	1.82	1.28	0.14	0.00	0.00	3.83	3.24
ENE	0.68	3.01	1.64	0.23	0.00	0.00	5.56	4.88
NE	0.73	8.12	6.39	0.73	0.05	0.00	16.02	15.29
NNE	0.41	2.83	2.74	0.55	0.00	0.00	6.53	6.12
N	0.68	1.23	1.69	0.23	0.00	0.00	3.83	3.15
NNW	0.73	1.28	1.96	0.36	0.09	0.00	4.42	3.69
NW	0.91	1.96	3.70	0.64	0.14	0.00	7.35	6.44
WNW	0.55	1.14	1.92	0.46	0.05	0.09	4.21	3.66
W	0.68	0.46	1.69	1.19	0.00	0.05	4.07	3.39
WSW	0.41	1.37	2.33	1.19	0.05	0.00	5.35	4.94
SW	0.27	4.61	5.11	2.01	0.00	0.00	12.00	11.73
SSW	0.68	1.87	2.05	0.41	0.05	0.00	5.06	4.38
S	0.82	1.60	1.60	0.82	0.05	0.00	4.89	4.07
SSE	0.59	1.23	1.37	0.27	0.05	0.00	3.51	2.92
SE	0.36	4.15	3.24	0.55	0.00	0.00	8.30	7.94
ESE	0.82	1.92	2.14	0.23	0.00	0.00	5.11	4.29
TOTAL	9.91	38.60	40.85	10.01	0.53	0.14	100.04	90.13

Note : Calm is cut off at wind speed <1.8 km/hr as per CPCB

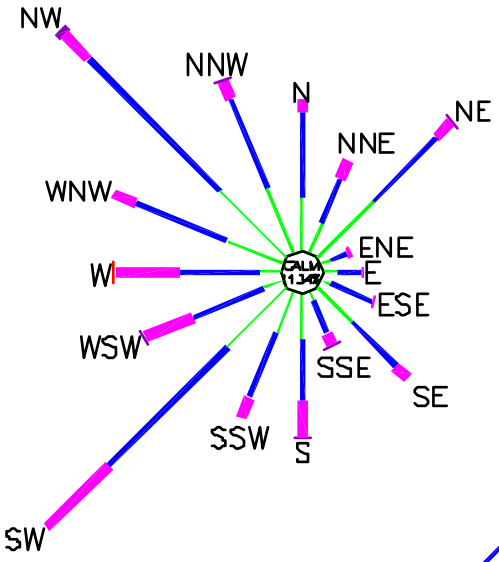
3.6 AMBIENT AIR QUALITY

3.6.1 Ambient Air Quality

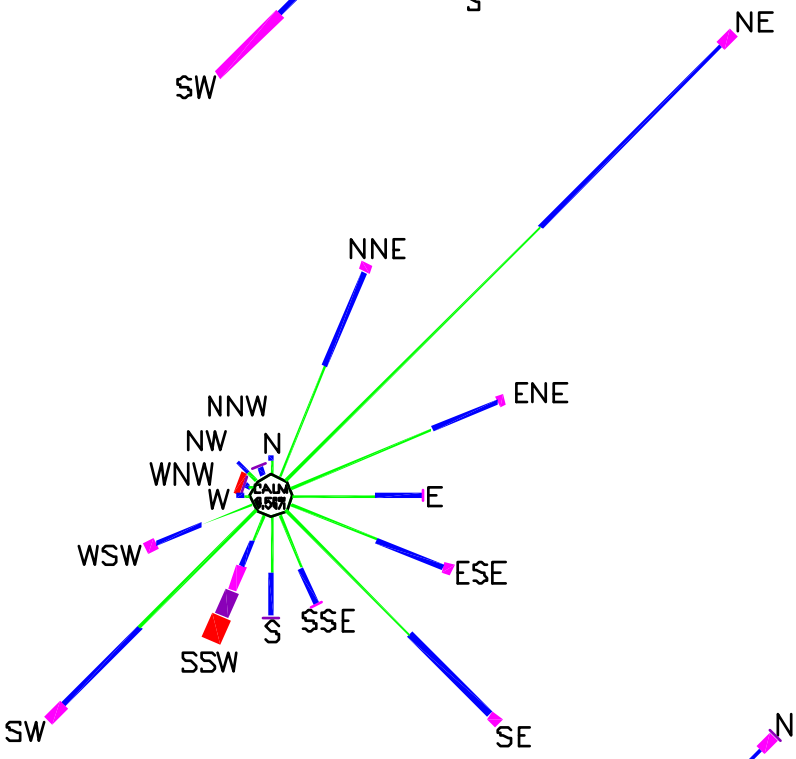
The air sampling stations were established in and around the core and buffer zone to study the present ambient air quality. The ambient air quality monitoring was conducted at five stations during summer season using Respirable Dust Sampler. The sampling station locations are given in Table 3.6 and same marked in Fig 3.7.

WINDROSE DIAGRAM OF DATA MONITORED

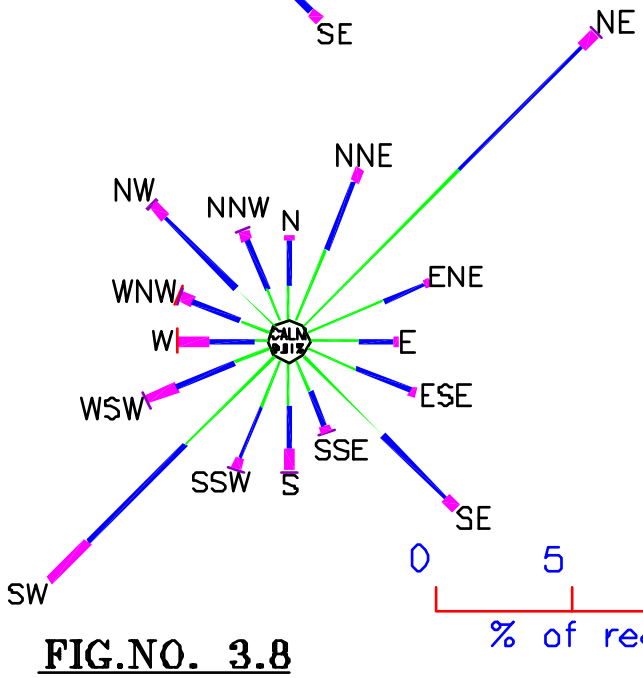
2 x 150 MW POWER PLANT(01-03-2006 TO 31-05-2006)



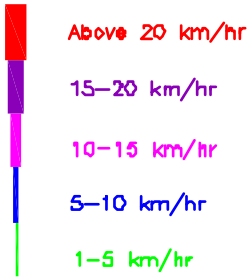
DAY



NIGHT



WIND SPEED



COMPOSITE

FIG.NO. 3.8

TABLE 3.6
LOCATION OF AIR SAMPLING STATIONS

S.No.	Location	Location Code	Distance, Direction
1	Core Zone	CA1	0 km
2	Baljor village	BA1	1.80 km, NNE
3	Sarasmal Kosampali village	BA2	2.6 km, NW
4	Libra village	BA3	2.2 km, SW
5	Nagramuda village	BA4	2.6 km, SE

3.6.2 Sampling Schedule & Parameters

The study was conducted in summer season with frequency of twice a week at each site. 24 hourly samples were collected from each station. These samples were analysed in laboratory by the methods specified in National Ambient Air Quality Standards by Min Mec R&D Laboratory, New Delhi. The following air pollution parameters are being sampled continuously during the sampling periods.

1. Respirable Particulate Matter
2. Suspended Particulate Matter
3. Sulpher Dioxide (SO_2)
4. Oxides of Nitrogen (NOx)
5. Carbon Monoxide (Grab sampling)

3.6.3 Methodology

Respirable Particulate Matter (RPM)

The sampling of ambient air was performed with Respirable Dust Sampler (Make: Envirotech Instruments, New Delhi), which is primarily a High Volume Sampler fitted with a cyclone separator for pre-separation of particles larger than 10 microns diameter. Air exiting from the separator is drawn at a measured rate through the separator followed by a pre-weighed glass fibre (GF) sheet of 20 cm x 25 cm sizes (Whatman, EPM-2000). The RPM concentrations are determined gravimetrically from the average airflow rate, sampling period and the mass of particulate matter collected over the GF filter surface.

Suspended Particulate Matter (SPM)

Sampling for SPM was also performed with the sampler used for RPM sampling. The coarser particles (NRPM) collected in the cyclone separator are transferred quantitatively on a petri dish and evaluated gravimetrically. The sum of masses of coarser (NRPM) and respirable particles (RPM) gives the mass of SPM collected during sampling. The SPM concentrations are computed from the total mass of SPM and total volume of air sampled.

Sulphur dioxide

The sampling of ambient air for evaluating SO_2 concentrations was performed with a Multigas Sampler, using the vacuum created by the Respirable Dust Sampler for drawing the air samples through the impingers. Air is drawn at a measured and controlled rate of 400 to 500 ml/min through a solution of sodium tetrachloromercurate.

After completion of the sampling, the used absorbing reagent is treated with dilute solutions of sulfamic acid, formaldehyde and para rosaniline hydrochloride. The absorbance of the intensely coloured para rosaniline methyl sulphonic acid is measured and the amount of SO_2 in the sample was computed from graphs prepared with standard solutions. The ambient SO_2 concentrations were computed from the amount of SO_2 collected and the volume of air sampled.

Oxides of Nitrogen

The sampling of ambient air for evaluating oxides of nitrogen concentrations was performed with a Multigas Sampler, using the vacuum created by the Respirable Dust Sampler for drawing the air samples through the impingers. Air is drawn at a measured and controlled rate of about 200 ml/minute through an orifice-tipped impinger containing solutions of sodium hydroxide and sodium arsenite. After completion of the sampling, an aliquot of the used absorbing solution was treated with solutions of H_2O_2, sulphanilamide and NEDA. The nitrite ion present in the impinger was calculated from the absorbance of the resulting solution and from the graphs prepared with standard solutions. The ambient NOx concentrations were computed from the total nitrite ion present in the impingers, overall efficiency of the impinger and the procedure, and the volume of air sampled.

Carbon Monoxide

Sampling and evaluation of ambient CO levels was performed by the detector tube technique. Summary of the testing procedures is presented in Table 3.7.

TABLE 3.7
PROCEDURE FOR DETERMINING VARIOUS AIR QUALITY PARAMETERS

Parameters	Testing Procedure
SPM	Gravimetric method using high volume air samplers IS : 5182 (Part IV) 1973
NO_X	Absorption in dil. NaOH and then estimated colorimetrically with sulphanilamide and N(I-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (IS:5182 1975, Part VI)
SO_2	Absorption in Sodium Tetra Chloro-mercurate followed by Colorimetric estimation using P-Rosaniline hydro-chloride and Formaldehyde (IS : 5182 Part. II. 1969)
RPM	Respirable particulate matter sampler
CO	By MSA tube

3.6.4 Air Quality Standards & Observation

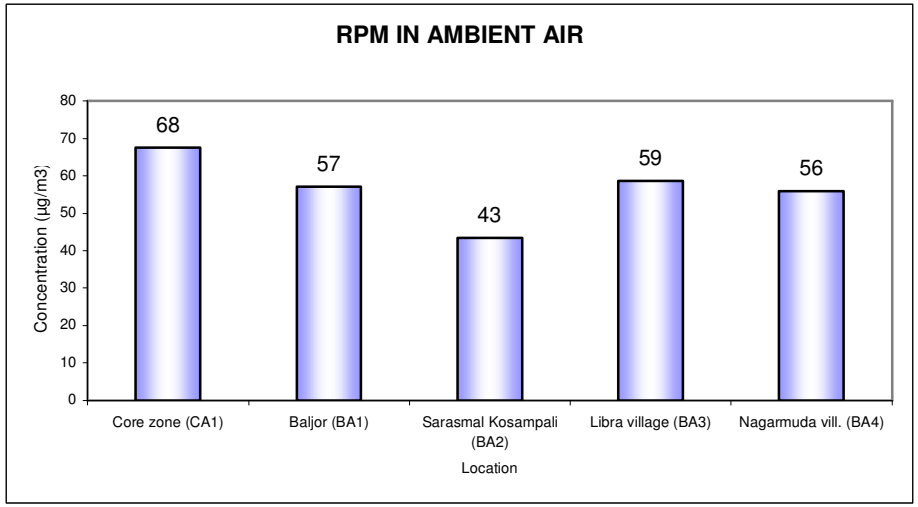
The national ambient air quality standards as per Environment (Protection) Rules, 1996 is presented in Annexure V.

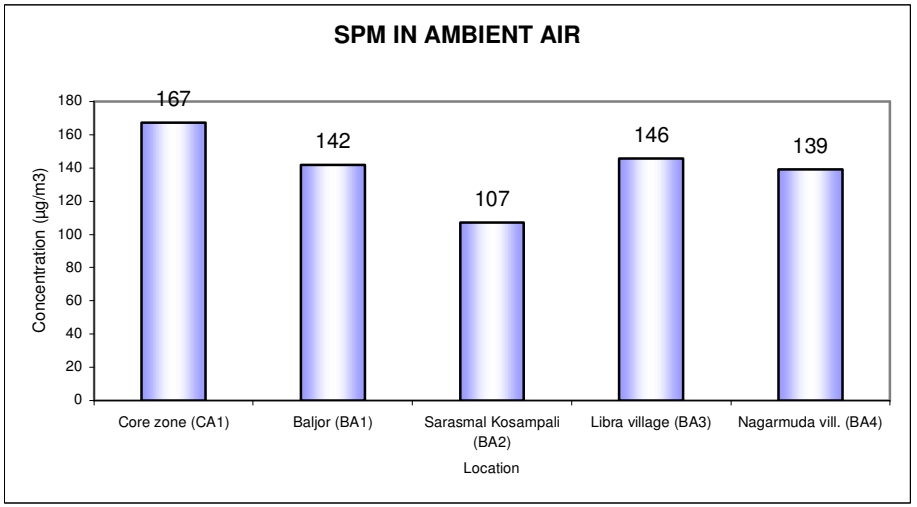
The summarized results of air quality studies are given in Table 3.8 and details are given in Annexure VI.

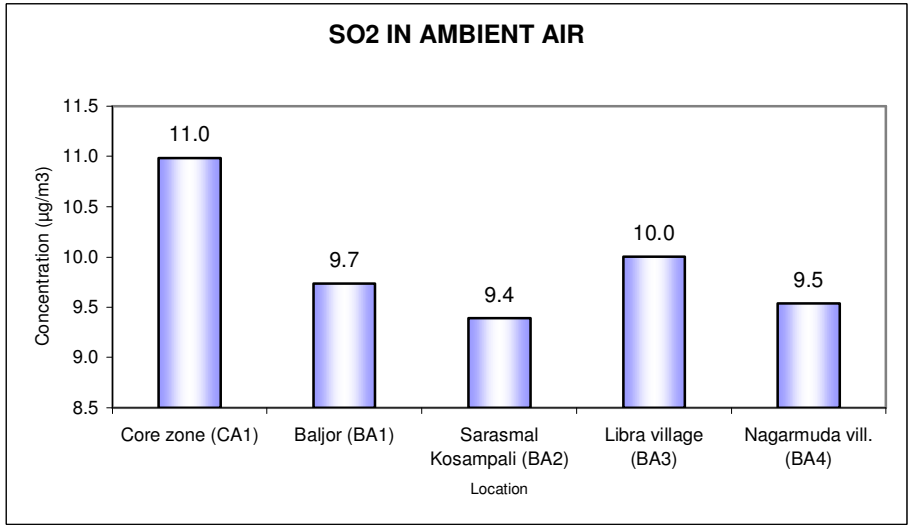
TABLE 3.8
SUMMARY OF AMBIENT AIR QUALITY TEST RESULTS (µg/m^3)

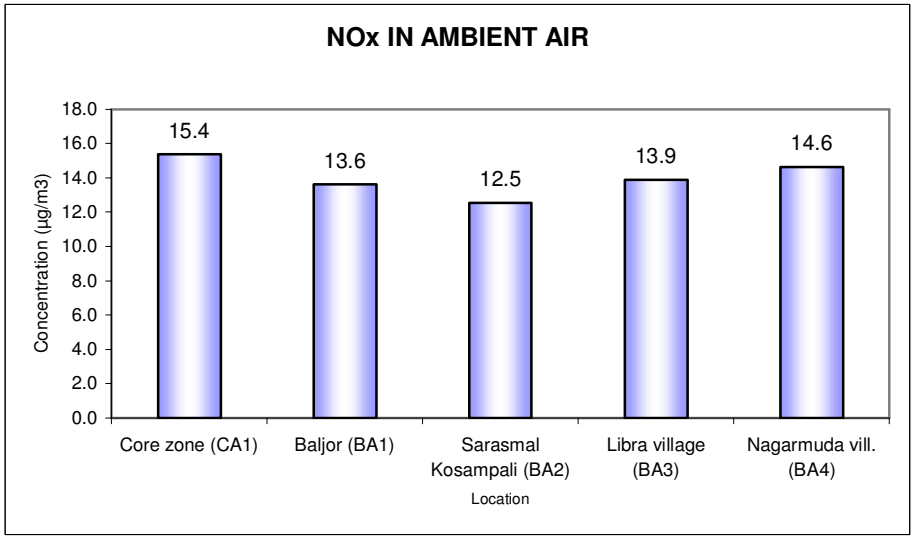
Air Quality Parameters	Location	Max.	Min.	Avg.	98%tile
RPM	Core Zone (CA1)	74	61	68	74
	Baljor village (BA1)	68	45	57	68
	Sarasmal Kosampali vil. (BA2)	59	28	43	59
	Libra village(BA3)	68	49	59	67
	Nagramuda village (BA4)	64	49	56	64
SPM	Core Zone (CA1)	184	151	167	183
	Baljor village (BA1)	168	113	142	168
	Sarasmal Kosampali vil. (BA2)	147	71	107	146
	Libra village(BA3)	168	121	146	167
	Nagramuda village (BA4)	159	121	139	159
SO_2	Core Zone (CA1)	14.0	8.4	11.0	13.7
	Baljor village (BA1)	12.7	7.0	9.7	12.7
	Sarasmal Kosampali vil. (BA2)	11.9	6.4	9.4	11.8
	Libra village(BA3)	12.8	7.1	10.0	12.7
	Nagramuda village (BA4)	12.9	7.2	9.5	12.8
NOx	Core Zone (CA1)	17.9	12.2	15.4	17.9
	Baljor village (BA1)	16.9	11.4	13.6	16.9
	Sarasmal Kosampali vil. (BA2)	15.9	10.4	12.5	15.6
	Libra village(BA3)	17.0	11.5	13.9	16.6
	Nagramuda village (BA4)	17.0	11.2	14.6	17.0

FIG 3.9 : GRAPHICAL REPRESENTATION OF AIR QUALITY MONITORING RESULTS









3.7 WATER ENVIRONMENT

3.7.1 Surface Water

Core zone

A number of small streamlets drain the terrain in vivid direction giving a subdendritic drainage pattern. However, a few more impersistent seasonal nalas / water channels exist within the project area.

Buffer Zone

The Kelo Nadi flows in the NE-SW direction at a distance of around 3.5 km from the proposed plant site; Koledega nala flows in EW direction at a distance of approximately 6 km from the project area in the south western part of the buffer zone. Almost all the seasonal nalas surroundings the lease hold area ultimately merge into the Kelo river. Other than these nalas there exist a number of water bodies like rainfed ponds/dugwells and tube wells within the buffer zone.

3.7.2 Ground water

The Ground water in the study area generally occurs within the primary porosity of alluvial material or the Gondwana Sandstone which occur at shallow depth. The occurrence and movement of groundwater is controlled by prevailing geomorphology. The ground water flows generally in south eastern direction as revealed from the study carried out in the region. The depth of water table over the study area varies between 2-10 m below ground. The studies carried out by Central Ground Water Board in the district, reveals that seasonal water table fluctuation in the area varies between 2-4 m. The average seasonal fluctuation works out as 2.8 m. The ground water in deeper aquifer is present in semi-confined to confined conditions. The pumping test results in adjoining area has revealed that the deeper aquifer have got low permeability (0.5 to 1.0 m/day).

3.7.3 Ground Water Resources

The ground water resources for the study area has been worked out on the norms laid down by ground water estimation committee and using the input data collected from secondary sources. The annual replenishable resource were worked out as under.

Monsoon Recharge on Adhoc Norms

Area suitable for recharge	-	328.58 sq km.
Mean Monsoon rainfall	-	1301.9
Rainfall Infiltration factor	-	20%
Monsoon Replenishable Recharge	-	85.55 MCM

Monsoon Recharge on Water Table Fluctuation Method

Area suitable for Recharge	-	328.58 sq km
Seasonal Ground water fluctuation (source CGWB report)	-	2.8 m
Specific Yield	-	5%
Monsoon Recharge	-	46.00 MCM

Annual Ground Water Recharge

As per recommendation of G.E.C., the monsoon recharge estimated by water table fluctuation approach is lesser than recharge estimated by rainfall infiltration method. It should be considered while estimating annual groundwater recharge.

Annual recharge	-	46.00 MCM

3.7.4 Ground Water utilization

There are two main sources of ground water use in the study area (1) Drinking (2) Agriculture. There are several industries and mines coming up in the study area hence the industrial use of groundwater is rising. Monet Ispat Underground coal mine (3 km NW) is under development stage, the water make and use is presently low. Gare IV/1 Coal mine and washery is being operated by JSPL themselves where water consumption is about 0.364 MCM/year. The agriculture in the area is mostly rainfed and only small area receives irrigation. Therefore, to work out actual groundwater utilization the total population and total irrigated area has been considered. The drinking need of rural population has been considered as 70 LPD/capita and irrigational need has been worked out considering Net Irrigational Requirement (N.I.R) of 50 cm/ha. The livestock in the study area totally depend upon surface water. The annual groundwater utilization has been worked out as under:

A. Domestic

Total population	-	84842
Per capita water need	-	70 LPD
Annual Requirement	-	2.167 MCM

B. Irrigation

Total irrigated Area	-	512.80 ha
Irrigational Need	-	0.50 m /ha
Annual Irrigational Need	-	2.564 MCM

C. Total Annual Ground Water Utilisation - 5.095 MCM

Water Balance

Annual Groundwater Recharge	-	46.00 MCM
Annual Groundwater Utilisation	-	5.095 MCM
Balance Groundwater	-	40.905 MCM
Stage of Groundwater development	-	11.07%

3.8 WATER QUALITY

To establish the base line status of water resources in the study area, the physico-chemical characteristics of water samples from important surface water bodies and representative ground water sources were determined. Water quality survey was performed during the summer season of 2006. During the survey, one set of samples was collected from each source and characterized.

3.8.1 Location of Sampling Stations

The location of ground water sample sources is shown in Fig 3.7 and is given in Table 3.9.

TABLE 3.9
LOCATION OF WATER SAMPLING STATIONS

Stations	Source	Location	Distance, Direction
GW1	Bore well	Libra village	2.0 km, SW
GW2	Bore well	Janjgir village	3.0 km, E
GW3	Bore well	Amgaon village	3.4 km, SSE
GW4	Open well	Baljor village	2.0 km, N
GW5	Bore well	Mine colony	1.0 km, S
GW6	Bore well	Tapranga village	1.0 km, NE
GW7	Bore well	Dhaurabhata village	2.4 km, SE
GW8	Bore well	Jharna village	2.6 km, SSW

3.8.2 Methodology

Samples from ground water sources were collected by adopting grab sampling. The sample was filled into a sampling bottle. In case of surface water, sample was collected from a point 12" below the surface.

The physico-chemical quality of water samples were characterised by adopting the relevant parts of IS:3025, "Standard Methods for Water Analysis" and the methods prescribed under IS:10500. Evaluation of parameters like odour, taste, temperature, pH and turbidity were carried out at the sampling stations immediately after collection of samples with the help of Field Analysis Kits (ELICO). For analysis of other parameters, the samples were brought to Min Mec R&D Laboratory, New Delhi, after addition of proper preservatives.

3.8.3 Analytical results

The physico-chemical characteristics of ground water samples are presented in Annexure VII. To facilitate comparison with drinking water standards, Characteristics for Drinking Water as per IS 10500: 1991, has been included in the Annexure VIII.

Salient features of the physico-chemical characteristics of the ground water samples, collected from the eight locations of surrounding villages and colony, are as follows.

- Test characteristics with respect to physical parameters like colour, odour, taste, turbidity and temperature are well within the desirable limits for drinking water.
- The observed pH values ranging between 6.8 to 7.3 are well within the desirable range of 6.5 to 8.5 units.
- Total hardness, as $CaCO_3$ observed in the range between 60 to 128 mg/l, is within the permissible limit of 600 mg/l. Hardness at all locations are within desirable limit of 300 mg/l.
- Iron was observed between 0.14 to 0.88 mg/l, and is within the permissible limit of 1.0 mg/l.
- Chloride concentration was observed ranged between 12 to 28 mg/l, and is within the desirable limit of 250 mg/l.
- Total dissolved solids were observed in the range between 79 to 188 mg/l, which is within desirable limit of 500 mg/l at all locations.
- Concentration of calcium was observed between 11.2 to 28.8 mg/l, which is well within the desirable limit of 75 mg/l at all stations and is well within the permissible limit of 200 mg/l.
- Levels of copper and manganese were observed below their detection limits, i.e., 0.02 mg/l and 0.05 mg/l, and are well within the desirable limits of 0.05 and 0.1 mg/l, respectively.
- The concentration of sulphate was observed between 2.9 to 57.5 mg/l, which is well within the desirable limit of 200 mg/l.
- The concentration of nitrate, as NO_3, was observed between 7.5 to 9.5 mg/l, which is well within the desirable limit of 45 mg/l.
- Fluoride concentration was observed in the range between 0.12 and 0.92 mg/l, which is within the desirable limit of 1.0 mg/l, and well below the permissible limit of 1.5 mg/l.
- Mercury, cadmium, selenium, arsenic, cyanide, lead and chromium were below detection limits of gas chromatography and AAS (as applicable), and within the desirable limits.
- Concentration of zinc was observed in the range 0.02 to 0.27 mg/l, which is well within the desirable limit of 5.0 mg/l.
- Alkalinity was observed between 56 to 136 mg/l, which is within the permissible limit of 600 mg/l.

- Aluminium was below detection limits, i.e., 0.02 mg/l, which is well below the desirable limits of 0.03 mg/l.
- Boron was observed below detection limit, i.e., 0.1 mg/l, which is well within the desirable limit of 1mg/l.

It is, therefore, concluded that the ground water is, more or less, suitable for use as potable water. It is also concluded that, as one moves downwards (north to south) from the mines towards Raigarh, mineralisation of ground water increases.

3.9 NOISE LEVEL AND TRAFFIC DENSITY

3.9.1 Noise level

Measurement of noise level were carried out at seven locations on a round the clock basis. The locations are shown in Fig. 3.7. The obtained values are presented in Annexure IX and summarised in Table 3.10.

TABLE 3.10
AMBIENT NOISE LEVEL IN dB(A)

Location	Noise Level in [Leq. In dB(A)]		Permissible limits	
	Day time	Night time	Day	Night
Tamnar village (BN1)	54.50	48.40	55	45
Tapranga village (BN2)	55.80	48.40	55	45
Janjgir village(BN3)	56.80	48.50	55	45
Gare village (BN4)	58.60	48.50	55	45
Dhaurabhata village (BN5)	56.00	46.80	55	45
Dongamauha village (BN6)	58.80	50.90	55	45
Bilaimunda village (BN7)	61.50	55.30	55	45

During the observation, it was found that noise level in the study are ranged between 46.80 to 61.50 dB(A).

3.9.2 Traffic Density

The power plant is proposed to be set up over approximately 56 acres of area.

A traffic density survey was conducted round the clock on 17-18/04/2006. The survey was conducted at Tamnar to Libra –Dongamauha road. A summary of the traffic density monitored during survey period is given in Table 3.11 and details are given in Annexure X.

TABLE 3.11
TRAFFIC DENSITY

Traffic vehicle	No. of vehicles per day
H.M.V.	651
L.M.V.	270
Two/three wheelers	550
Sub total motorized vehicles	**1471**
Cycles	622
Grand Total	**2093**

3.10 LAND ENVIRONMENT, SOIL, CROPPING PATTERN AND FORESTS

3.10.1 Land Use

a. Core zone

The power plant is proposed to be set up over approximately 56 acres of area. The land had been acquired in the past from the village.

Cadestral map of Core Zone is shown in Fig 3.10.

b. Buffer Zone

Land use pattern of study area i.e. within 10 km radius from proposed plant site has been assessed on the basis of 2001 census data. The number of villages and their areas has been tabulated in Table 3.12.

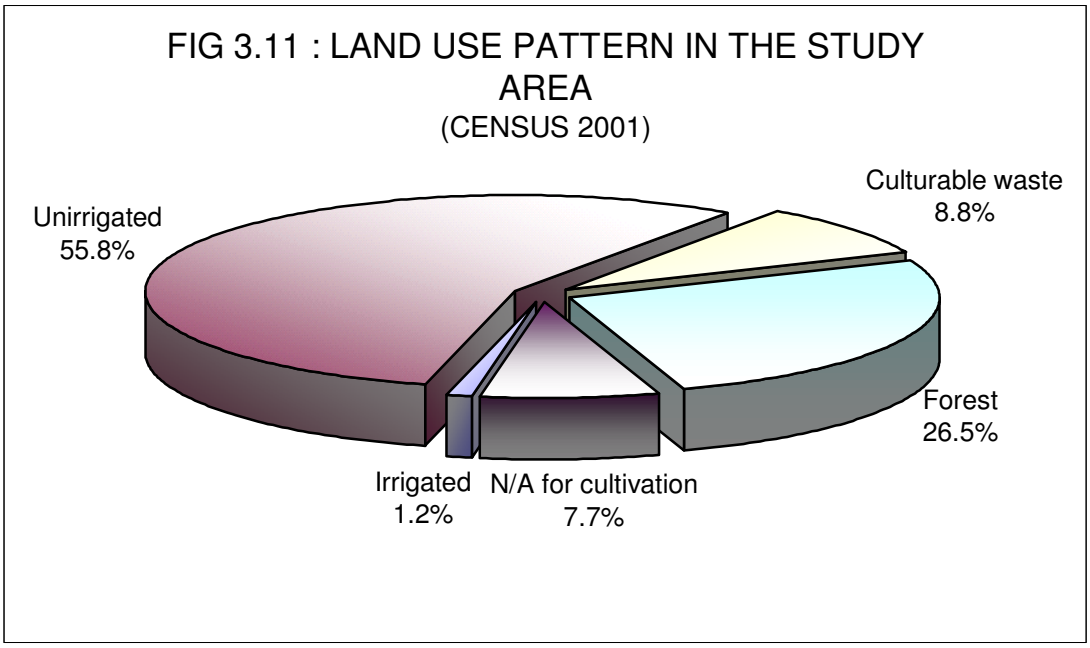
TABLE 3.12
NUMBER OF VILLAGES AND THEIR AREA (HA.) IN STUDY AREA

District	Taluk	No. of villages	Area (ha.)
Sundargarh	Hemgir	24	7473.57
	Lephripara	1	284.05
Raigarh	Lailunga	1	876.00
	Gharghoda	66	23726.00
	Raigarh	2	441.00
Grand Total		**94**	**32800.62**

Detailed break up of land use pattern in study area as per Census 2001 record is given in Annexure XI and summarised in Table 3.13. The land use is depicted by pie diagram in Fig 3.11.

TABLE 3.13
LAND USE DETAILS OF BUFFER ZONE (10 KM RADIUS)

Land Use	Area (ha.)	% of total area
Irrigated agricultural land	512.80	1.24
Unirrigated agricultural land	22999.11	55.82
Culturable waste	3617.75	8.78
Area not available for cultivation	3168.97	7.69
Forest land	10901.56	26.46
Total	**41200.19**	**100.00**



A perusal of above table shows that about 55.82% of the total area is occupied by unirrigated agricultural land while irrigated agricultural land 1.24% out of the total area. The 26.46% is forest land area, area not available for cultivation 7.69% and culturable waste land 8.78%. The land use is depicted by pie diagram.

3.10.2 Soil Quality

To establish the baseline characteristics with respect to soil quality in the study area, survey of soil quality was conducted during summer season of 2006.

Location

Soil samples from the four locations were collected and characterized. Samples of top soil were collected from cultivated agricultural field and non agricultural or barren land.

Methodology

Soil samples from cultivated agricultural fields were collected by digging a pit of 50 cm depth at the appropriate location with the help of a spade and a 'Khurpi'. The excavated soil from each location was mixed thoroughly and about 2 kg of mixed sample was collected by 'Cone & Quartering method'. The sample was packed in a polyethylene bag, sealed and brought to the laboratory.

After drawing sample for moisture content, the remaining samples were air dried for a few days. For chemical characteristics, air-dried samples were ground in an agate mortar with the help of a wooden hammer and passed through a 2-mm (10-mesh) sieve. The coarser materials were rejected and the sieved material was sampled by the standard 'cone and quartering' method.

Characterisation of soil samples was performed by adopting methods prescribed under relevant parts of IS:2720, "Indian Standard Methods of Test for Soils".

Observation

The results of the soil quality analysis are given in Annexure XII and the salient features of the observation is as follows:

1. The soil is mainly Light brown in colour.
2. The quick weathering gensis have produced shallow, loam and sandy soil. The sandy soils are poor in organic contents and have low moisture retaining capacity.
3. The pH soil varies from 6.2-5.7 in agricultural and 7.3 -4.7 in the barren land area.
4. Conductivity of soil samples is normal.

3.10.3 Cropping Pattern

About 57% of the study area belong to the agricultural land category. Rabi and Kharif type of cropping practice is prevailing in the study area. The production of cattle crop is very low in comparison to edible crops during 1997-1998 and 1998-1999. The irrigated area (55-82%) is served by ground water and surface water sources. Paddy is the main vegetable crop while banana and papaya are the main fruits crops grown in the area.

Block wise statistical details of the cropping pattern data as per Agriculture Departments of Raigarh for both Ghargoda and Tamnar Agriculture Block has been collected and summarized in Table 3.14.

TABLE 3.14
CROPPING PATTERN OF TAMNAR BLOCK

Name of crop	Tamnar Block	Gharghora Block	Raigarh District
Wheat	30	41	912
Paddy	21328	40420	241943
Millet	Nil	Nil	21
Maize	12	47	901
Others	136	262	1355
Total area under crops	**21506**	**40770**	**245132**

The details of the Rabi and Kharif cropping pattern are given in Table 3.15.

TABLE 3.15
DETAILS OF RABI AND KHARIF CROPS (Area HECT.)

Crops	Tamnar Block	Gharghora Tehsil	Raighar District
Rabi Crops			
Fooding Crops	25769	4911	270441
Non- fooding crops	1061	2136	11324
Total Rabi Crops	26830	51247	281765
Kharif Crops			
Fooding Crops	925	2107	15088
Non-fooding Crops	581	165	3138
Total Kharif Crops	1006	2272	18226

3.10.4 Forests

In the buffer zone, the reserve/protected/ village forest cover is 109.02 sq. km. i.e. about 26.46% of the total area.

These forests are categorised under group 5 (Tropical Dry Deciduous Forest) as per the Indian forest classification of Champion and Seth. The above mentioned forests is mainly of Sal type, and the soil is derived from the parent rock. Soil is invariably deep sandy loam, brownish in colour and conductive to excellent growth of Sal.

3.11 ECOLOGY

3.11.1 Flora

A plant community may be viewed as a vegetational unit characterised by an essentially constant floristic composition with a uniform appearance. The forest of the study area as per revised classification of Indian forest types belongs to sub groups 5B/c1 (Northern Tropical Dry Deciduous Sal Bearing Forests) and 5B/c2 (Northern Tropical Dry Mixed Deciduous forest)

Within the study area, there are plenty of trees because of good soil, partly flat land and sufficient rainfall. The forest is humid and always full of green grass. Because of the cultivation done by local farmers thinning of forest has been observed. Protected forests are having medium dense vegetation but the Tolge Reserved forest is comparatively denser.

The main species existing in the forest are Sal, Tendu, Mahua, Palas, Neem, etc. A consolidated list of plant species is given in Annexure XIII. The height of the dominant trees ranges from 6 m to 12 m.

Phyto-sociological study

To understand the attribute of communities, a phyto-sociological study of vegetation was conducted in the non-forest area during post monsoon 2003. The sites were selected on the basis of vegetation component and their importance from project view point. At each selected site, random vegetation sampling was done with the help of 10 m X 10 m quadrate size. Presence and absence of species, number of individual species and basal area of each plant species in each quadrate was recorded. Frequencies and densities were calculated following Curtis and Mcintosh (1951) method. Species diversity index was estimated using Shannon-Weiner index (1963).

Shanon Weiner diversity Index was calculated by following formula:

$$\overline{H} = - \Sigma \, Pi \, Log \, Pi$$

Where : $\overline{H}$ = Shanon Weiner diversity index

Pi = ni/N where ni is number or biomass or IVI of individual species and N is the total number or biomass or IVI of all individuals.

In the present study IVI (Importance Value Index) has been taken into consideration for evaluation of diversity index. IVI gives total performance of individual species at particular site. IVI is the total of relative frequency (RF), relative density (RD) and relative dominance (RDO). Since IVI includes many of the attributes at a time, therefore consideration of IVI was preferred on number for evaluation of Shannon-Weiner diversity index. This diversity index includes both richness of species and apportionment of species at any particular site. Higher the value of index, more is the stability of that community. Thus Shannon-Weiner diversity index is an indication of goodness of community.

Phyto-sociological study of tree layer vegetation was conducted at various sites. The parameters such as frequency, density, abundance, relative frequency, relative density, relative dominance and IVI were evaluated for each sampling sites. Shanon-Weiner diversity index was also calculated for each studied stand. Tree flora vegetation analysis results are shown in Tables 3.16 to 3.19.

TABLE 3.16
CHARACTERISTICS OF TREE LAYER VEGETATION AT KONDKEL

Name of species	F	D	AB	RF	RD	RDO	IVI
Shorea robusta	40	1.0	2.50	17.39	22.22	15.85	55.46
Madhuca indica	40	1.3	3.25	17.39	28.89	29.67	75.95
Tectona grandis	10	0.2	2.00	4.35	4.44	0.79	9.58
Bambax malabarium	20	0.2	1.00	8.70	4.44	4.95	18.09
Terminalia tomentosa	30	0.7	2.33	13.04	15.56	11.09	39.69
Azadirachta indica	30	0.4	1.33	13.04	8.89	9.91	31.84
Ficus relegiosa	30	0.3	1.00	13.04	6.67	10.70	30.41
Ficus benghalensis	10	0.1	1.00	4.35	2.22	6.34	12.91
Mangifera indica	20	0.3	1.50	8.70	6.67	10.70	26.06

Diversity Index = 0.88

TABLE 3.17
CHARACTERISTICS OF TREE LAYER VEGETATION AT JANJGIR/ DHAURABHATA

Name of species	F	D	AB	RF	RD	RDO	IVI
Buchanania lanzan	30	0.5	1.67	9.38	10.64	13.00	33.01
Diospyros melanoxylon	30	0.4	1.33	9.38	8.51	3.74	21.63
Terminalia tomentosa	30	0.3	1.00	9.38	6.38	4.39	20.15
Butea monosperma	50	0.7	1.40	15.63	14.89	14.74	45.25
Melia azadirachta	20	0.2	1.00	6.25	4.26	3.33	13.83
Engenia jambolana	20	0.3	1.50	6.25	6.38	9.44	22.07
Cassia fistula	20	0.2	1.00	6.25	4.26	4.21	14.72
Madhuca indica	40	0.8	2.00	12.50	17.02	20.80	50.32
Shorea robusta	30	0.7	2.33	9.38	14.89	8.92	33.18
Ficus religiosa	10	0.1	1.00	3.13	2.13	5.85	11.11
Gmelina arborea	20	0.2	1.00	6.25	4.26	8.78	19.29
Acacia leucoplaea	20	0.3	1.50	6.25	6.38	2.81	15.44

Diversity Index = 1.03

TABLE 3.18
CHARACTERISTICS OF TREE LAYER VEGETATION AT KOSAMPALI

Name of species	F	D	AB	RF	RD	RDO	IVI
Terminalia tomentosa	50	0.8	1.60	15.15	11.11	14.18	40.44
Buchanania lanzan	40	0.8	2.00	12.12	11.11	9.08	32.31
Madhuca indica	80	1.7	2.13	24.24	23.61	24.41	72.26
Diospyros melanoxylon	50	2.0	4.00	15.15	27.78	12.76	55.69
Mangifera indica	30	0.6	2.00	9.09	8.33	20.85	38.27
Shorea robusta	40	0.8	2.00	12.12	11.11	9.08	32.31
Syzygium cumini	30	0.4	1.33	9.09	5.56	7.09	21.74
Ficus religiosa	10	0.1	1.00	3.03	1.39	2.55	6.97

Diversity Index = 0.84

TABLE 3.19
CHARACTERISTICS OF TREE LAYER VEGETATION AT LIBRA

Name of species	F	D	AB	RF	RD	RDO	IVI
Azadirachta indica	10	0.10	1.00	5.56	3.45	0.11	9.11
Ficus religiosa	10	0.10	1.00	5.56	3.45	10.66	19.67
Mangifera indica	40	1.10	2.75	22.22	37.93	42.22	102.37
Madhuca indica	60	1.00	1.67	33.33	34.48	38.38	106.19
Cassia fistula	10	0.10	1.00	5.56	3.45	1.71	10.71
Tamarix aphylla	10	0.10	1.00	5.56	3.45	0.11	9.11
Ailanthus excelsa	10	0.10	1.00	5.56	3.45	1.71	10.71
Diospyros melanoxylon	30	0.30	1.00	16.67	10.34	5.12	32.13

Diversity Index = 0.70

Note : F - Frequency; D - Density; AB - Abundance; RF - Relative Frequency; RD - Relative Density; RDO - Relative Dominance; IVI - Importance Value Index

The result of phytosociological studies shows that “Mahua” and “Sal” are the main dominating species in the study area. The total number. of tree species recorded at various sites varies from 8 to 12. Mahua is showing IVI of 50.30, 75, 72.26 and 106.19 at Kondkel, Dhaurabhanta, Kosumpali and Libra respectively. The observed diversity indices at various sites are 0.88, 1.03, 0.84 and 0.70 at Kondkel, Dhaurabhanta, Kosumpali and Libra respectively.

3.11.2 Fauna

The list of fauna in the core zone and buffer zone is enclosed in Annexure XIV showing the mammals, birds and reptiles found in this area.

The core zone has avifauna such as cattle egret, pigeon, house crow, quail, golden backed wood pecker, cheel and house sparrow. The reptiles found are garden lizard, house lizard, rat snake and blind snake. Mammals such as five striped palm squirrel, mangoose, rat, bat, fox and bandar, which is a Schedule I animal as per Wild Life (Protection) Act, 1972, are found.

The avifauna in the study are comprises 17 species, reptiles 13 species and mammals 13 species. The complete list can be seen in the Annexure XIV. Pea fowl, Rhesus macaque, bear and leopard are the schedule I and animals found in this area.

3.12 SOCIO ECONOMIC CONDITIONS

3.12.1 Demographic profile

There is no habitation within the project area, i.e., the area of land acquired for the project. Hence, no rehabilitation will be required.

In the study area, i.e. the area falling within radius of 10 km from the proposed power plant, there are 94 inhabited revenue villages. Out of the 94 villages, 24 fall under Hemgir tehsil 1 in Lepripara of Sundargarh district of Orissa while 1 under Lailunga tehsil and 66 in Ghargoda tehsil of Raigarh district in Chhattisgarh. Demographic profile of individual villages as per Census 2001. Census records, are presented in Annexure XV. A summary of the same is presented in Table 3.20. Distribution of population & percentage of literates, and the percentage of SC&ST population are presented through pie graphs in Fig 3.12 and 3.13 respectively and tabulated in table 3.21.

TABLE 3.20
DISTRICT AND TEHSIL WISE POPULATION

District	Tehsil	Total Population	Male	Female
Sundarghar	Hemgir	14700	7330	7370
	Lephripara	281	138	143
Raigarh	Lailunga	2582	1298	1284
	Gharghoda	69325	34864	34461
	Raighar	817	404	413
Grand Total		**84842**	**42598**	**42244**

TABLE 3.21
DEMOGRAPHIC DETAILS OF STUDY AREA

Description	Total	% of total population
No. of household	19469	
Schedule cast	8123	9.57
Schedule Tribe	38867	45.81
Total literates	50007	58.94
Male literate	29182	34.40
Female literate	20825	24.55

Salient features of the demographic profile are as follows:

a) There is a slight predominance of males (50.21%) to females (49.79%)
b) Schedule tribes form a significant part of the population, about 45.8% of the total population.
c) Male literacy rate is higher than female literacy rate.
d) Schedule caste population is about 9.57% of total population

3.12.2 Employment and occupation

Employment pattern and occupation are the two main indicators of the economic profile, and the same for the individual villages based on 2001 Census data, are presented in Annexure XVI. Pie diagrams showing employment pattern and occupation is depicted in Fig 3.14 and 3.15. A summary of employment pattern and occupation for the study area is presented in Table 3.22.

FIG 3.12 : LITERACY LEVEL IN THE STUDY AREA
(CENSUS 2001)

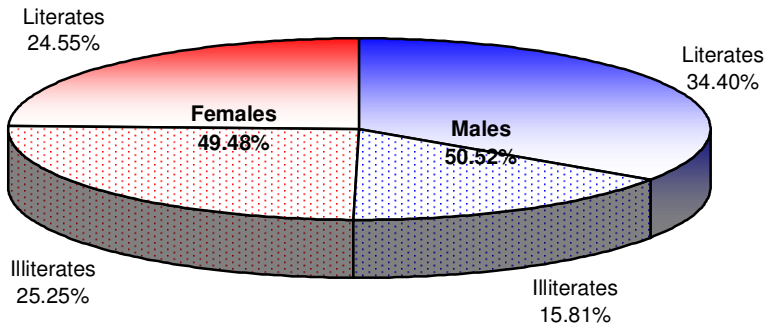


FIG 3.13 : BREAK UP OF SC & ST IN THE STUDY AREA
(CENSUS 2001)

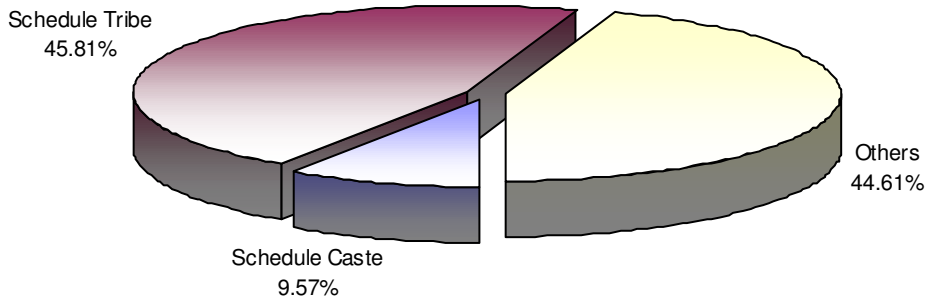


FIG 3.14 : EMPLOYMENT PATTERN IN THE STUDY AREA
(CENSUS 2001)

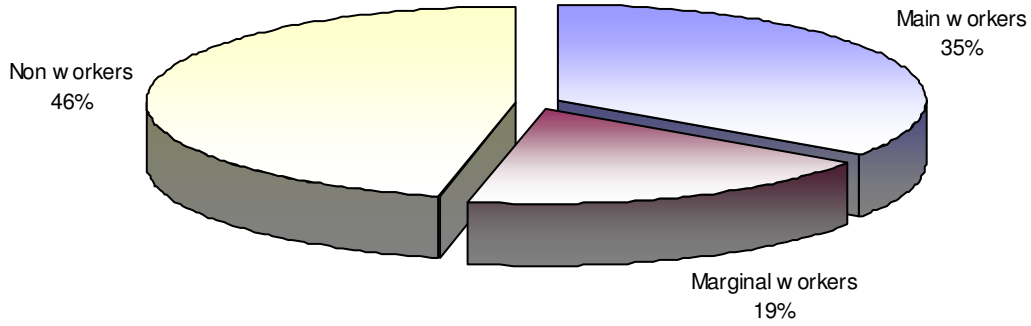


FIG 3.15 : BREAK UP OF MAIN WORKERS IN THE STUDY AREA
(CENSUS 2001)

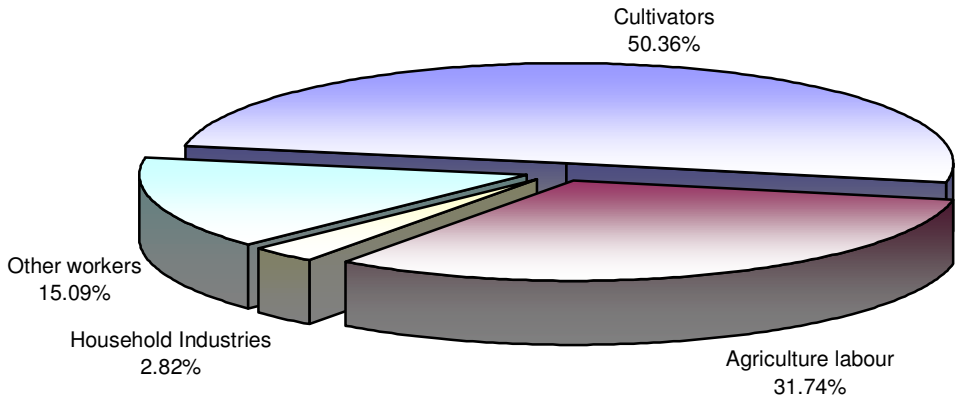


TABLE 3.22
SUMMARY OF EMPLOYMENT AND OCCUPATION IN STUDY AREA

Description	Total	% of total population
Main workers	29488	35
Main workers as % of total workers		65.01
Marginal workers	15868	19
Marginal workers as % of total workers		34.99
Non workers	39486	46.54
Break up of Main workers		
Cultivator	14849	50.36
Agricultural labour	9359	31.74
Household industries	831	2.82
Other workers	4449	15.09
Break up of Marginal workers		
Cultivators	4244	26.75
Agricultural labour	10093	63.61
Household industries	362	2.28
Other workers	1169	7.37

3.12.3 Amenities

Details of amenities available in the individual villages are given in Annexure XVII. A summary of the same is as follows

- Educational facilities in the study area comprise of 106 primary schools, 23 middle schools, 9 secondary schools, 5 senior secondary schools, and 1 adult literacy center.
- For drinking water, hand pump are used in 91 villages, well water in 89 villages, river water in 19 villages, canal water in 2 villages, tank water in 53 villages, tap water in 2 villages, tube well in 17 villages, lake water in only 1 village.
- Census data for power supply shows that from the total villages, 53 villages have power supply for domestic purpose, 7 villages have power for agriculture purpose, 9 villages have power for other purpose and 33 villages have power for all purpose.
- Census data for post and telegraph facilities shows that there are 18 villages have post offices and an equal number have telephone.
- There are 5 pucca approach roads, 85 footpath approaches and 87 mud road approaches to villages in the study area.
- Census data for medical facilities shows that there are 2 allopathic hospitals,1 ayurvedic hospital, 1 allopathic and 2 ayurvedic dispensaries, 2 maternity and child welfare, 1 maternity home, 1 child welfare and health center, 1 primary health center, 16 primary health sub centers, 2 family welfare center, 2 registered private practitioners, 23 community health workers, and 2 other medical centers in the study area.

- Census data for communication shows that there are 26 bus stops in the study area.
- Census data for Banks/credit societies shows that there are 2 commercial and 3 cooperative banks where as there are 4 agricultural credit societies in the study area.

3.13 INDUSTRIES IN STUDY AREA

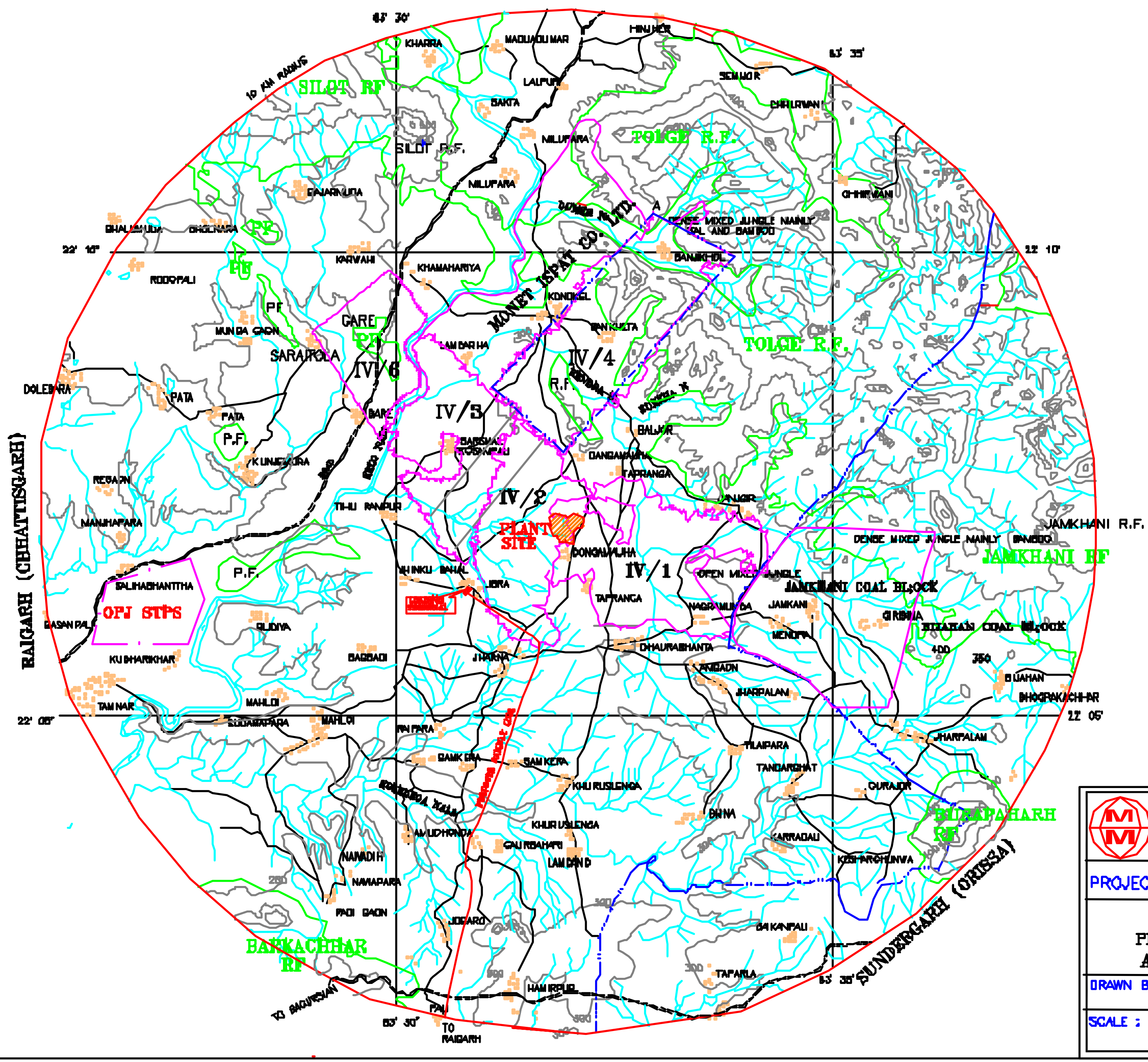
The study area is getting developed from the point of view of industrialisation. Besides the proposed 2 X 150 MW power plant, the following are operating or proposed to operate in the near future.

Sl.	Industry	Status (July 2006)	Distance, km	Direction
1.	4X250 MW O.P. Jindal Super Thermal Power Plant	Under construction. First unit is expected to be commissioned by March '07	7	WSW
2.	Gare IV/1 opencast coal mine	under operation with washery	adjoining	E
3.	Gare IV/2 and IV/3 opencast coal mine	Proposed	Adjoining	W
4.	Gare IV/4 open cast mine	Proposed	1.3	N
5.	Gare IV/5 u/g mine of Monnet	Operational	3	NW
6.	Gare IV/6 o/c & u/g mine	Proposed	3.75	NW
7.	Raigarh to Libra village railway line for coal and ash/slag transportation	Proposed. Not constructed	1.86	S
8.	Jamkhani Coal Block, Bhushan Ltd.	Proposed	3.4	E
9.	Bijahan Coal Block, Bhushan Ltd. and others	Proposed	6.6	ESE

The existing and proposed industries, mines etc can be seen in Fig. 3.16. The state boundary between Chhattisgarh and Orissa passes through the study area. There will be development of coal mines also accruing in the Orrisa portion of the study area such as Jamkhani coal mine, etc.

3.14 PLACES OF TOURISM / HISTORICAL / ARCHAEOLOGICAL IMPORTANCE

There are no places of historical/tourist/religious of archaeological importance in either core zone or study area. There are local places of worship at some villages.



LEGEND

- PLANT SITE
- DISTRICT BOUNDARY
- FOREST BOUNDARY
- MOTORABLE ROAD IN DRY SEASON
- JEEPABLE ROAD IN DRY SEASON
- RIVER / DRAINAGE
- HABITATIONS
- SURFACE CONTOUR
- INDUSTRIES AND MINE

0 1 2 3 4 5 KM

SCALE

MIN MEC CONSULTANCY PVT LTD
NEW DELHI
PHONE : 29564777,29585891,29582256

PROJECT: 2 x 150 MW POWER PLANT

EIA/EMP

PLAN SHOWING INDUSTRIES AND MINE IN STUDY AREA

CLIENT: JINDAL STEEL & POWER LTD.

DRAWN BY: B.R.MATLOTIA	APPROVED BY: B.D.SHARMA	FIG.NO.
SCALE : AS SHOWN	DATE: 13-07-2006	3.16

CHAPTER 4

ENVIRONMENTAL IMPACT ASSESSMENT

4.1 GENERAL ASPECT

4.1.1 Objective and methodology

The basic purpose of the environmental impact assessment is its use as a planning tool so that the environmental considerations are incorporated in initial stages of project planning and the cost of environmental protection measures are treated as an integral component of the total project cost. The EIA is a procedure for bringing out the potential effects of projects on the environmental system and it identifies the possible positive and negative impacts to the environment from the project. The environmental impact assessment methodology involves superimposition of the expected impacts from different activities forming part of proposed project, over the base line environmental status. The superimposition of anticipated impacts on each of the environmental parameters, indicative of the baseline status will enable the impacts on each of the parameters to be objectively assessed. With such an assessment, an impact score will be obtained with implementation of the project without any mitigation measures taken for each of the areas and where adverse impacts are anticipated.

4.1.2 Environmental Parameters

Keeping in mind the environmental baseline scenario as detailed in Chapter 3, it is attempted to assess the likely impact and its extent on various environmental parameters in this Chapter. The important environmental parameter associated with and considered for impact assessment of all developed project can be classified into the following broad categories:

a) Natural physical resources
b) Natural ecological resources
c) Human/economic development resources
d) Quality of life values including aesthetic and cultural values.

In general, the important parameter which are relevant within context are as below:

- Surface water quality
- Air quality
- Seismology/geology
- Noise and vibration environment
- Land use

- Ecological factors
- Socio-economic conditions

4.2 CLIMATE AND METEOROLOGY

4.2.1 Construction Phase

The proposed power plant project will be restricted to different type of activities within core zone covering the land area of about 56 acres. Ash dumping will be done in abandoned portion of coal mine. During the construction phase the activities will be restricted to construction of roads, warehouses buildings, erection of structures, plants and machinery, construction of oil/fuel storage areas etc. Thus, no effect on climate and meteorology of area is expected.

4.2.2 Operation Phase

The only activity, which can be considered in this context is the stack emissions and thermal pollution. The thermal pollution will be restricted to the plant site while these stack emissions will only contribute incremental values of pollutants. The climate is controlled by the pressure depression in the Bay of Bengal and is not anticipated to be affected by local activities under discussion.

4.3 AIR QUALITY

4.3.1 Construction Phase

Sources of air pollution, during the construction phase will be:

1. Vehicle exhausts for transport of materials
2. Dust generation due to excavation work, shifting of construction materials (cement, sand and gravel), vehicle movement on unpaved roads and concrete preparation plant.
3. Exhaust from non-mobile construction equipment like compressors.

Primary impact from these sources on air quality will be high dust generation resulting into increased SPM levels in the surrounding areas. There will be impairment of visibility on certain locations due to dust. Further movement of construction equipment for these operations as well as for transport of material will lead to increased level of SPM, SO_2, NOx and CO in the surrounding areas. Thus, adverse impacts on air quality are envisaged. Certain mitigating measures need to be adopted to reduce the primary impact on air environment to the minimum.

The secondary impacts of air emissions dust as well as other emission will effect the health of the labour force, working in close vicinity. Secondary impacts of air emission could also effect the flora and crops if proper control measures envisaged in management plan are not adopted.

4.3.2 Operation Phase

The air quality impacts of a source or group of sources is evaluated by use of mathematical models. The models simulate relationships between air pollutant emission and the resulting impact on air quality. The inputs to the model include data related to emission and meteorology, all of which can be used for formulation of impact scenario.

The total production capacity of the thermal power plant will be to generate 300 MW of power comprising 2 x 150 MW generating units through use of coal middlings and fines from the washery of the adjacent Gare IV/1 coal mine. The coal middlings and fines transport from the washery to the power plant can be through conveyors or roads, hence fugitive emissions are not anticipated to cause adverse impact on the air quality if proper precautions are taken.

Process emission in power plant can be considered to be mainly SO_2, NOx and SPM with a considerable proportion being Respirable Particulate Matter. There would be only one stack for the 2 X 150 MW TPS. Stack will comprise two flues. Characteristics of stack is given in table 4.1

TABLE 4.1
CHARACTERISTICS OF STACK AND THEIR EMISSION

S.No.	Details/Particulars	Quantity		
1.	No. of stack	1 for 2* x 150 MW		
2.	Height of the stack	220 m		
3.	No. of flues in each stack	2		
4.	Internal diameter of each flue	3.75 m		
5.	Flue gas exit volume	265.8m^3/s		
6.	Exit flue velocity	25 m/s		
7.	Flue gas temperature	132 ^{0}C		
8.	Pollutants emission from stack	Flue 1	Flue 2	Total
	SO_2 emission (kg/hr)	1560	1560	3120
	NO_x emission (kg/hr)	258	258	516
	Particulate matter emission (kg/hr)	32.25	32.25	64.5
	CO (kg/hr)	149.16	149.16	298.32

Note: Particulate matter has been computed on the basis of 50 mg/Nm^3 at the outlet
**There are 2 Nos. of flues within one stack*

GLC predictions have been performed for the emission source in three predominant directions. The results of modelled incremental GLC's due to stack have been calculated based on hourly average wind speed in each direction and given in Annexure XVIII and summarised below in Table 4.2.

TABLE 4.2
MAXIMUM GLC OF POLLUTANTS OF 2 X 150 MW POWER PLANT IN PREDOMINANT WIND DIRECTION (SW) AT A DISTANCE OF 5 KM FROM STACK (NEAR VILLAGE MAHLOI) WITH 220 M STACK HEIGHT

Pollutant	Concentrations (µg/m^3)
SPM	0.24
SO_2	11.41
NOx	1.89
CO	1.09

The three most predominant wind directions observed during the monitoring period are towards SW, NE and NW directions for 16.0%,12.3% and 8.5% of time respectively during March to May 2006. The GLCs are lesser in subsequent predominant downwind directions.

The above result show that the emission from the plant will increase pollution in the ambient air but it will still be far below the permissible limits.

Impact of loading terminal on air quality

The method proposed for loading middlings from the stock piles to conveyors is via chute from middling ground hoppers. The middling conveyors are completely enclosed. Dust suppression system, consisting of water sprinklers, will be installed on loading and unloading points, in each transfer point and stock piles area. Dust control and Dust extraction system is envisaged in crusher house and boiler bunker area.

Separate stockpile for fines is not envisaged and not required due to dust hazards. Coal from the bunkers is transported to the boiler through drag chain conveying system.

Thus, there will not be any dust emission from the loading and unloading of middlings and fines.

4.4 LAND ENVIRONMENT

i) Core zone area

The total land area requirement is 56 acres for installation of power plant considering the land requirement for raw water reservoir. Ash will be disposed in abandoned portion of coal mine. The construction activities will contribute to the deterioration of environment but this will be for limited time.

ii) Buffer Zone

Land use analyses show predominance of agricultural activities in the study area. Outside the premises, the future activities leading to urbanisation may significantly alter the landscape, but with better management practices adopted improvements can be expected. As all the activities related to the

project will be restricted to core zone, no impact on buffer zone land use is anticipated.

4.5 WATER ENVIRONMENT

4.5.1 Surface Water

During construction phase, rain water flowing through the construction area will carry loose soil, thereby increasing suspended solids of receiving water body. However the impact is temporary and reversible. Appropriate control measures are envisaged in management plan to prevent water pollution in receiving streams.

As a large amount of water is required for the operation of a thermal power plant, which is planed to be sourced from the ground seepage water in adjoining Gare IV/1 mine sump.

The only first order stream passing through the study area of the proposed thermal power plant is Kelo river that flows from 3.5 km West of the project area in North-South direction. All the drains flowing in the study area are tributaries of the Kelo river and all are second order streams. There is no water stream passing through the power plant area except a small drain that starts from the project site and meets the second order drain that connects Kelo river.

The plant is designed on 100% recirculation and reuse of waste water to prevent wastage of water, hence, no waste water discharge or effluent discharge from industrial activities is anticipated. Waste water from DM plant will be neutralised and reused in CHP dust suppression and in plant horticulture via CMB. Water from cooling tower blow down will be used for ash disposal into abandoned portion of mine. Thus there will be no impact on the surface water from the power plant.

4.5.2 Ground Water

In thermal power plants using middlings and coal fines as fuel, the source of ground water pollution usually are leachates reaching sub-soil by infiltration because ash has got to be disposed in slurry form. Even if ash is disposed in dry form, rainfall in the ash disposal area ultimately infiltrates in the ground causing leachate to reach ground water and contaminate it if control measures like laying of impervious layer at bottom is not adopted. During the operation there will not be any direct contact between shallow water table and effluent/ slurries. Hence ground water pollution due to DM plant effluent are not anticipated. Ash pond has not been planned, hence, contamination from it will not be there. Since the project will be utilising mine sump water, depletion of ground water of basin and hydrogeological loss would occur to a minimum extent due to the power plant. The seepage water from the mine which would otherwise have to be disposed in natural drainage after pumping will serve as the water source.

The average seepage of ground water into the mine sump has been estimated at 11200 cum/day or 4.09 MCM per year. At present, the monsoon rainfall accumulation is 0.665 MCM per year. The mine consumes 713 cum/day =0.214 MCM per year) of water while 500 cum/day (0.15 MCM per year) is consumed by the washery. After subtracting this water, insufficient water is available to meet the water requirement of the proposed power plant i.e. 864 cum/hour or 20736 cum/day or 6.84 MCM per year. Only 4.391 MCM per year will be available from the adjacent Gare IV/1 mine sump. In the future, the water availability from the mine sump may increase with the start of operation of the Gare IV/2&3 open cast coal mine on the north west of the proposed plant and adjacent to it, belonging to a sister concern. However, by that time the washery water requirement at Gare IV/1 would also be increasing to 1400 cum/day. At Gare IV/2&3 the daily mine seepage would be 4872 cum/ day (1.78 MCM/yr). Its own consumption would be 1000 cum/day (0.3 MCM) and the consumption of the washery will increase by 900 cum/day (0.27 MCM). Therefore, the water available from the mine would be 1.21 MCM + 0.41 MCM (rainwater)= 1.62 MCM. There would be shortfall of 6.84–(4.391+1.62)= 0.829 MCM, which will have to be met from borewells. The level of ground water development in the study area is only 11.07% which will increase by 1.8% due to withdrawal through bores. The water balance diagram is given in Fig 2.2 at the end of Chapter 2.

4.5.3 Sources of waste water

The major liquid effluent streams from the power plant are given below:
- Cooling tower + boiler blow down
- Water treatment plant wastes
- Demineralisation plant regeneration chemicals
- Backwash of gravity filters/ ion exchange softener

In addition to the above industrial waste water sources, domestic waste water will be generated from the plant as well as the colony.

4.6 NOISE AND VIBRATION

Noise levels were monitored at various sites in and around the proposed plant and these are given in Annexure IX. The noise level during construction will be due to construction machinery, which are of temporary nature, the unpleasant effects of which will be controlled by appropriate mitigation measures. The predominant noise during operation is occupational noise and confined within the plant premises. The noise level near to the sources such as steam generator plant and other operational points will be higher. The noise level at sources like the generator are anticipated to go as high as 95 dB(A). The ambient noise levels are expected to increase above present level if appropriate control measures indicated in management plan are not adopted.

The damage risk criteria as enforced by OSHA and CPCB to reduce hearing loss, stipulates the noise levels up to 90 dB(A) as acceptable limits

for 8 hrs working shift per day. Noise levels will however, exceed the prescribed limits at certain places within core zone. The OSHA damage risk criteria are reproduced in Annexure XIX and the ambient air quality standard in respect of noise is given in Annexure XX.

4.7 ECOLOGICAL IMPACTS

a) During construction

No noticeable impact on land and soil is anticipated during the construction of the plant. Excavation and waste disposal will affect the land and soil within core zone only. During the construction period, only pollutants will be dust from earth moving activities and emission from vehicles etc. There will be impact of these pollutants on vegetation and crops if appropriate control measures are not adopted.

b) During operation

The pollutants emitted from stacks can have adverse impact if control measures are not adopted as narrated in management plan. Bright light and unusual noise during operation activity will shift the activity site of the birds and animals to little away from the location of plant site initially, with the progressive growth of greenery, biological terrestrial environment will improve in due course of time.

Agricultural crops will remain in field maximum for only 3-4 months. Hence it is expected that they will not be affected as the level of pollutants is below the permissible level (as found by dispersion modelling) even for short-term value of 24 hours. The seasonal average will be even lower.

4.8 SOLID WASTE GENERATION

The power plant is being set up to use the solid waste generated from the washer, namely, middlings and fines. The ash content of this mixed fuel will be 50-58%, which will be left after combustion. This will be largest source of solid waste. The quantity of ash generated from the plant is given in Table 4.3.

TABLE 4.3
ANTICIPATED ASH GENERATION

Sl.	Description	Quanitity		
		TPH	TPD	TPA
1	Fly ash	139	3336	11,00,880
2	Bottom ash	34	816	2,69,280

There will be domestic solid waste generated from the plant and colony also which will be predominantly organic and biodegradable in nature and converted into manure using vermin-composting.

4.9 SOCIO-ECONOMIC CONDITIONS

4.9.1 Demography

Most of the work force required for construction and operation of the proposed project will be drawn from the surrounding areas. During the construction phase, no family is expected to migrate from the core zone. Therefore, no impact on demographic profile of the area is foreseen.

The duration of the construction will be 33 months during which an average of 500 workers will be involved in construction, which may occasionally peak to 1000 persons per day also.

4.9.2 Economic Growth

The economic growth of the area in terms of employment generation, consumption behaviour and market-growth are expected outcome of the project. The project has an employment generation impact on skilled manpower. The direct employment potential of the project is estimated as 200 persons, the share of local people in this is expected to be significant. However, indirect employment potential will have major share in the regional, economy, which is expected to be of high order. It is assumed that the generation of indirect employment would be multiple of direct employment. The consumption behaviour is likely to change from food to non-food items. An increase in average consumption is expected. As such, the demand would go up and would put inflationary pressure on essential commodities. The direct beneficiaries in this process would be the local producers.

Therefore the significant positive impact on employment and occupation is envisaged on account of

- Better economic status of the community
- Higher inputs towards infrastructural facilities
- Enhancement of literacy

4.9.3 Social Development

The general social development of the area, at least in restricted sense of the term, is expected due to the improvements in infrastructure and communication system. New facilities will be created to meet growing demand of the population. This will have impact on the current literacy level, primary and middle level education and on existing health facilities. A new awareness generated may have positive impact on the social pattern which, at this stage, is caste and community oriented. The long term implications of this change are definitely progressive.

4.10 PLACES OF RELIGIOUS & HISTORICAL SIGNIFICANCE

No place of religious or historical significance is located within the study area. Only local worship places are existing in some of the villages. Therefore, no adverse impact due to project activity has been envisaged.

4.11 POTENTIAL IMPACT IDENTIFICATION MATRIX WITHOUT MITIGATION MEASURES

4.11.1 Methodology

The identification of environmental impact is based on the base line condition as described in the Chapter 3 and nature of proposed activities as detailed in Chapter 2 and other indirect resultant activities. Different tools or methods are adopted for identification and evaluation of the impacts as follows :

1. Adhoc
2. Overlays
3. Checklists
4. Matrices
5. Networks

Each of above methods has its own merits and limitations. Matrix method is simpler and useful in identifying the severe cause-effect relationship. Since the Leopold Impact Matrix, in general, has the disadvantage of subjective valuation of certain effects, the improved "Modified Matrix" method is adopted, which involves the establishment of cause-effect relationship. Also, it involves assignment of "Parameter Importance Value" (PIV) against each environmental impact parameter. These values are determined by subjective judgement considering the relative importance or significance of individual parameter. After deciding PIV, these values have to be distributed among all the cause-effect relationship which are established between those particular affected environmental parameters and the concerned project activities by means of indices which are called "Relative Parameter Importance Indices" (RPII) such that the sum of all the indices is equal to unity. The value of RPII is decided based on the relative importance of cause-effect relationship and highest important one is given highest RPII value and the next important one is given next higher RPII value.

Another index which is to be determined for each cause effect relationship is called "Environmental Impact Index" (EII). The scale for EII varies from zero to one. The value one is assigned to an impact of highest order and zero is assigned to an impact of negligible magnitude. For adverse impacts, EII carries a negative sign and for beneficial impacts, it carries positive sign. For determining the value of EII, the environmental impact parameters are divided into two categories.

Category "A" incorporates environmental impact parameters whose quality varies linearly with the magnitude of impact as related to the proposed project activities and includes:

- Surface and ground water resources
- Socio-economic aspects
- Land use
- Human settlement

Category "B" incorporates environmental impact parameters whose quality varies logarithmically with the magnitude of impact and includes:

- Surface and ground water quality
- Air quality
- Noise level
- Health
- Flora
- Wildlife

In the latter case, a slight change in impact magnitude will have insignificant change in environmental quality, but as the magnitude increases, the deterioration in quality increases logarithmically. The basis for determination of EII for category A and category B are given in Table 4.4 and 4.5 respectively. After determining EII for each cause-effect relationship the same will be multiplied with RPII to get a "Weighted Environmental Impact Index" (WEII). These values are once again multiplied with PIV and addition of all these values gives the impact score of that particular environmental parameter. The impact score so obtained for all environmental impact parameters is added together to get total impact score. This total impact score is used for interpretation and decision making.

TABLE 4.4
DETERMINATION OF EII FOR CATEGORY "A" PARAMETERS

Sr. No.	IMPACT MAGNITUDE (in %)	EII
1	NO CHANGE	0.00
2	0-4.9% CHANGE	0.05
3	5-14.9% CHANGE	0.10
4	15-24.9% CHANGE	0.20
5	25-34.9% CHANGE	0.30
6	35-44.9% CHANGE	0.40
7	45-54.9% CHANGE	0.50
8	55-64.9% CHANGE	0.60
9	65-74.9% CHANGE	0.70
10	74-84.9% CHANGE	0.80
11	85-94.9% CHANGE	0.90
12	> 95 % CHANGE	1.00

TABLE 4.5
DETERMINATION OF EII FOR CATEGORY "B" PARAMETERS

Sr. No.	IMPACT MAGNITUDE (in %)	EII
1	NO CHANGE	0.00
2	0-4.9% CHANGE	0.02
3	5-14.9% CHANGE	0.05
4	15-24.9% CHANGE	0.10
5	25-34.9% CHANGE	0.15
6	35-44.9% CHANGE	0.25
7	45-54.9% CHANGE	0.50
8	55-64.9% CHANGE	0.75
9	> 65% CHANGE	1.00

4.11.2 Delineation of project activities and environmental parameters activities

The power generation and allied activities which are likely to cause potential impacts on environment are listed as below:

- Power generation operation (including air emissions)
- Disposal of waste (liquid and solid)
- Transportation
- Provision of civic amenities
- Tree plantation programmes.

The likely impacts of these activities and benefits are already discussed under para 4.1 to 4.9.

4.11.3 Parameter importance value for environmental components

The environmental components listed in the earlier section are assigned with PIV so as to convert the environmental impacts into commensurate units, which could be aggregated easily to get the total score of environmental impacts. The parameter importance values are assigned by marking and pair-wise comparison procedure. This procedure involves preparation of a table containing number of columns corresponding to the range of value, which can be assigned a "score of importance" against each impact area. The score of importance is any integer ranging from one to six. The most affected parameter carries a score of six and the least affected parameter carries a score of one.

4.11.4 Importance ranking

This score is made considering the intensity and nature of impact over the impact area identified. The impact areas considered along with their ranking are tabulated in Table 4.6. The weightage for each impact area is calculated by dividing the ranking integer by sum of rankings as done in this table. The total parameter importance value is assumed to be 1000 as per the standard practice. The value of total PIV is distributed among each impact area according to its weightage. The final values computed by this procedure are also tabulated in Table 4.6.

TABLE 4.6
DETERMINATION OF PARAMETER IMPORTANCE VALUE

Sl. No	Impact area	Ranking						Total	Weight-age	PIV
		1	2	3	4	5	6			
1.	Surface water resources	-	-	*	-	-	-	3	3/44	69.77
2.	Ground water resources	-	-	*	-	-	-	3	3/44	46.51
3.	Air quality	-	-	-	*	-	-	4	4/44	93.02
4.	Water quality	-	-	-	*	-	-	4	4/44	93.02
5.	Noise levels	-	*	-	-	-	-	2	2/44	46.51
6.	Health	-	-	*	-	-	-	3	3/44	69.77
7.	Public utilities	-	-	-	*	-	-	4	4/44	93.02

Sl. No	Impact area	Ranking						Total	Weight-age	PIV
		1	2	3	4	5	6			
8.	Economic aspects	-	-	-	*	-	-	4	4/44	93.02
9.	Land use & soil characteristics	-	-	*	-	-	-	3	3/44	69.77
10.	Flora	-	-	-	*	-	-	4	4/44	93.02
11.	Wild life	-	-	*	-	-	-	3	3/44	69.77
12.	Human settlement	-	*	-	-	-	-	2	2/44	46.51
13.	Culture	-	*	-	-	-	-	2	2/44	46.51
14.	Human resettlement	*	-	-	-	-	-	1	1/44	23.26
15.	Thermal	-	*	-	-	-	-	2	2/44	46.51
Total								**44**	**1**	**1000.00**

4.11.5 Weighted environmental impact index (WEII)

It is necessary to establish Relative Parameter Importance Index (RPII) and Environmental Impact Index (EII) in order to arrive at the Weighted Environmental Impact Index (WEII).

4.11.6 Relative parameter importance index (RPII)

The RPII indicates the importance of interaction between the action and environmental components. It is assigned any value between 0 and 1 so that the sum of all the values of RPII under each environmental component is equal to 1. The importance of an interaction is related to the significance or assessment of the consequences, of the anticipated interaction. Assignment of RPII to an interaction is based on the subjective judgement. While deciding RPII, first the RPII values are distributed among adverse and beneficial impacts depending upon their significance. The RPII values so distributed are once again distributed among the respective interactions depending upon their individual significance. The most important interaction under a particular impact area is given the maximum RPII, whereas the lowest important one is given minimum RPII. As the significance increases the RPII also increases.

The RPII values for all the interactions, along with the criteria for deciding the same is presented in Table 4.7

4.11.7 Environmental Impact Index (EII)

The index represents the magnitude of an impact due to the interaction established between an environmental component and a project activity. This impact magnitude is represented by a numerical value, which is determined from Tables 4.4 and 4.5. The environmental components are grouped into two categories viz.: A and B discussed in earlier paragraph. The EII for category A environmental component is determined from Table 4.4 and the same for category B is determined from Table 4.5. The EII are determined for each impact area project activity interaction and are given in Table 4.7 along with the remarks.

TABLE 4.7
POTENTIAL IMPACT IDENTIFICATION IMPACT MATRIX WITHOUT MITIGATION MEASURES

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
1.	Surface water resources	Power generation operations	1	Surface water, if used will reduce flow in streams	Adverse	0.70	High significance compared with impact No. 2	-0.40	40.0	Large amount of water is required for power generation
2.	Surface water resources	Disposal of waste water	2	Disposal of effluent will impart adverse quality to surface water body	Adverse	0.20	Low significance as compared with impact no. 1	-0.40	40.0	During rainy season water may reach the surface water source
3.	Surface water resources	Provision of civic amenities	3	Core group of persons only will be provided with accommodation at site. Others will be staying away from site	Adverse	0.10	This interaction is less significant	-0.20	20.0	Meagre impact since surface water is drawn only for power generation
4.	Ground water resources	Power generation operations	1	Ground water seepage into adjacent mine will be used for operation	Beneficial	0.50	This is as significant as ground water extraction for drinking	0.40	40.0	Seepage water from mine sump would be pumped out and got wasted by disposal into natural stream. The same water is being put to use during operation
5.	Ground water resources	Provision of civic amenities	2	Ground water to be used for drinking purposes	Adverse	0.50	Significant as ground water is used for drinking	0.00	20.0	Ground water is not used for power generation. It is only used for drinking purposes
6.	Air quality	Power generation operations	1	SO2 and NOx will be generated. SPM and ash will be generated	Adverse	0.50	There are activities causing impact on air quality of work phase environment interaction 1 has more importance	-1.00	90.0	It is observed that considerable gases are likely to be generated due to stacks and fugitive emissions

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
7.	Air quality	Transportation	2	Causes dust nuisance as well as gaseous pollution due to vehicular emissions on road transportation	Adverse	0.20	Continuous transportation of raw fuel by truck/dumper raise dust and emission	-0.50	50.0	Significant impact on air quality as transportation of coal middling & fines and fuel oil will be done. However, distance is short. Conveyor use may reduce this further.
8.	Air quality	Vegetative plantation	3	It serves as a natural screen in reducing the SPM concentration	Beneficial	0.10	No vegetation cover	0.00	0.0	In the premitigative stage n0 vegetation is proposed
9.	Air quality	Disposal of solid waste	4	During construction temporary impact due to construction activity. Significant impacts due to ash disposal if in dry form	Adverse	0.20	Less impact as comparison to impact No. 1 & 2.	-1.00	90.0	Large amount of ash will be generated.
10.	Water quality	Provisions of civic amenities	1	Deterioration in ground water quality as domestic waste water is generated	Adverse	0.30	Release of water can affect quality of water bodies	-0.50	45.0	High BOD loading of domestic waste water
11.	Water quality	Power generation operation	2	Impact due to workshop cleaning, cooling tower blow down and clarifier back wash.	Adverse	0.70	This has high significance, hence RPII = 0.7	-1.00	70.0	High quality of solids, oil and grease will be released.
12.	Noise levels	Power generation operations	1	Increase in noise level due to use of various equipment	Adverse	0.50	There are three project activities influencing the noise level in the area. The interaction 1 is comparatively more important. Hence RPII = 0.5	-1.00	80.0	Due to power generation operation noise level will increase, hence impact on both workforce and community.
13.	Noise levels	Transportation	2	Increase in noise levels due to vehicular traffic	Adverse	0.40	This is less significant compared to above	-0.25	40.0	Increase in noise level due to transportation by trucks and dumpers are significant

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
14.	Noise levels	Vegetative plantation	3	It serves as barrier for noise propagation. Thus reducing noise levels	Beneficial	0.10	No vegetation cover	0.00	0.0	No negative plantation in premitigative stage
15.	Health	Power generation operations	1	Deteriorates workers health due to air & noise pollution, accidents & injuries.	Adverse	0.40	Proper importance is given to interaction 1 as the workers are exposed to high levels of noise & air pollutants	-1.00	80.0	The people are exposed to increased noise levels. Possibility of injury is there. Air pollution can adversely effect the health of surrounding people
16.	Health	Transportation	2	Deteriorates health due to air & noise pollution	Adverse	0.30	Since the interaction is significant, RPII=0.3	-0.75	60.0	Low significance. Air and noise pollution due to vehicular activity is less than power plant operation
17.	Health	Provision of civic amenities	3	Affects health through disposal of sewage on open land which causes mosquito nuisance & water borne diseases	Adverse	0.20	RPII=0.2 due to its limited influence	-0.50	50.0	Water borne diseases, mosquito nuisance are likely in absebce of proper mitigation measures
18.	Health	Vegetative plantation	4	Improves the health of inhabitants by acting as a barrier to air & noise pollution, uptake of liquid waste disposed on land and impacts pleasant atmosphere	Beneficial	0.10	No vegetative plantation premitigative stage	0.00	0.0	No vegetative plantation in premitigative stage
19.	Public utilities	Power generation operations	1	Improved public utility services in surrounding villages improves power supply, road network, water supply, sanitation, medical care facilities and communication	Beneficial	0.60	Interaction 1 is more influential than the other interactions. It covers the surrounding villages hence it is given higher RPII value.	0.40	35.0	Major part of facilities shall be prevailed by the project worker

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
20.	Public utilities	Transportation	2	Provides better transportation system to plant area. Improves road network and vehicular movement	Beneficial	0.20	This has less significance than interaction 1	0.10	5.0	Presently road is there due to Gare IV/1 coal mine
21.	Public utilities	Provision of civic amenities	3	Provides water supply, sanitation, power supply, medical facilities and communication in the core area	Beneficial	0.20	Civic amenities are provided to employees of the plant and also to adopted villages	0.10	10.0	Limited to the employees and work force
22.	Economic aspects	Power generation operations	1	Increased employment opportunities both direct and indirect thereby increasing economic status of people	Beneficial	0.80	Interaction 1 has considerable potential in providing employment to substantial people both direct and indirect	0.40	40.0	Indirect and direct employment but availability of power will provide for expansion of economic activities in the area
23.	Economic aspects	Transportation	2	Increased employment opportunities (mostly indirect employment) and thereby increase in the economic status	Beneficial	0.10	Comparatively less influential interaction	0.20	20.0	Marginal significance
24.	Economic aspects	Provision of civic amenities	3	Increased employment both by direct and indirect ways. Employment in commercial services improved economic status of people	Beneficial	0.10	Employment is restricted to limited persons in commercial services. Hence a lower RPII for interaction 1	0.10	10.0	Marginal job opportunities are observed, hence, marginal impact
25.	Land use and soil characteristics	Disposal of solid waste	1	Land degradation due to disposal of solid wastes	Adverse	0.10	Limited solid waste	-0.80	75.0	Large quantities of ash will be generated
26.	Land use and soil characteristics	Civic structure	2	Land use degradation due to erection of civil structures	Adverse	0.40	Civil structures are within plant area	-0.50	45.0	Construction of civil structures will make permanent changes to land surface

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
27.	Land use and soil characteristics	Provision of civic amenities	3	Domestic waste disposal	Adverse	0.20	Disposal of domestic waste is required as colony is envisaged	-0.20	20.0	Quantity of domestic waste is very less
28.	Land use and soil characteristics	Vegetative plantation	4	Beneficial effect on land as it improves aesthetics and provides shelter for wildlife	Beneficial	0.20	No vegetation plantation in premitigative stage	0.00	0.0	No impact
29.	Land use and soil characteristics	Transportation	5	Impact due to settling of air borne dust	Adverse	0.10	This is significant activity	-0.40	40.0	Moderate dust emissions are anticipated
30.	Flora	Power generation operations	1	Impact due to air pollution over larger area	Adverse	0.30	There are four interaction under this impact area. The interaction 1 is assigned RPII value of 0.3 as dust is anticipated during operations	-0.50	50.0	Medium significance since pollutants will be getting displaced to permissible ground level concentration
31.	Flora	Transportation	2	Adverse impact of dust emissions due to vehicular traffic	Adverse	0.10	Dust generation during vehicular movement is considerable	-0.25	40.0	Deposition of dust on leaf will tend to reduce photosynthesis rate. Hence negative impact on yield of agricultural crop could be anticipated.
32.	Flora	Civil structures	3	Deforestation	Adverse	0.40	Normal civil structures are observed, hence, RPII=0.4	-0.05	10.0	Minor impact will be noticed as there is no forest in core zone and minimal vegetation is involved
33.	Flora	Vegetative plantation	4	Creation of vegetative habitat	Beneficial	0.20	Significant impact	0.00	0.0	No vegetative plantation in premitigative stage
34.	Wild life	Power generation operations	1	Affects wild life through air & noise pollution and habitat destruction	Adverse	0.50	Can affect displacement of wild life	-0.50	50.0	Effect due to noise and emissions will be there on flora which in tun can effect the wildlife

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
35.	Wild life	Transportation	2	Adverse effect due to air and noise pollution by vehicular traffic	Adverse	0.40	Considerable importance due to transportation	-0.25	40.0	Secondary impact on fauna by deterioration of flora. Possibility of accidents.
36.	Wild life	Vegetative plantation for wild	3	Habitat to be created	Beneficial	0.10	This interaction has marginal significance	0.00	0.0	No vegetation plantation in premitigative stage.
37.	Human settlement	Power generation operations	1	Increased population density thereby environmental degradation more. Natural resources like fuel wood, water, electricity etc. are required.	Adverse	0.50	Interaction 1 is significant as more No. of persons are in this area. Hence RPII=0.5	-0.30	25.0	Increase in population density in affected area including natural increase in population. This increases stress on natural resources.
38.	Human settlement	Provision of civic amenities	2	Increased employment opportunities in service sector, increase in population density in and around plant	Adverse	0.20	In case of interaction 2, opportunities exist due to residential colonies	-0.30	30.0	Moderate impact will be observed as a new area is being built for employees. Other industries may come up with increased power available
39.	Human settlement	Transportation	3	Increased population puts the strain on existing transport facilities	Adverse	0.30	Transportation is insignificant RPII=0.3	-0.30	25.0	Low significance as marginal increase will take place
40.	Culture	Power generation operations	1	Influx of people of various cultures will have substantial effect on local culture.	Beneficial	1.00	Since there is only one interaction, hence RPII is 1.0	0.10	10.0	Significant impact
41.	Human resettlement	Power generation operations	1	No village will be disturbed	Adverse	1.00	Interaction is significant	0.00	0.0	No impact as no village has to be relocated
42.	Thermal pollution	Power generation	1	On air and surface water body	Adverse	1.00	It is a single impact	-0.10	20.0	Air temperature may rise and water disposal can cause harm to biota in surface water body

Weighted Environmental Impact Index (WEII) :

The WEII is determined by multiplying RPII and EII of corresponding interaction. The values are tabulated in Table 4.8.

TABLE 4.8
IMPACT MATRIX WITHOUT MITIGATION MEASURES

Impact area	WEII (RPII X EII)	PIV	Total (WEII X PIV)
Surface water resources	-0.420	69.77	-26.51
Ground water resources	0.200	46.51	9.30
Air quality	-0.800	93.02	-74.42
Water quality	-0.850	93.02	-79.07
Noise levels	-0.600	46.51	-27.91
Health	-0.725	69.77	-50.58
Public utilities	0.280	93.02	26.05
Economic aspects	0.350	93.02	32.56
Land use and soil characteristics	-0.360	69.77	-25.12
Flora	-0.195	93.02	-18.14
Wild life	-0.350	69.77	-24.42
Human settlement	-0.300	46.51	-13.95
Culture	0.100	46.51	4.65
Human resettlement	0.000	23.26	0.00
Thermal pollution	-0.100	46.51	-4.65
Total		**1000.00**	**-272.21**

4.11.8 Potential Impact identification using Environmental Impact Matrix Without Mitigation Measures

After arriving at WEII and PIV values as described above the environmental impact matrix incorporating all the environmental components and project activities (without control measures for proposed thermal plant), is presented in Table 4.8. It also includes residual impacts of existing plant.

The impact is calculated by multiplying the sum of all WEII's against each environmental component by it's corresponding PIV. Total impact score is calculated by adding all individual impact scores.

The total impact score is assessed by using following relative scale:

upto -200	:	No appreciable impact on environment
-200 to -400	:	Appreciable but reversible impact and appropriate control measures are important.
-400 to -600	:	Significant impact mostly reversible after a short period and mitigation measures are crucial.
-600 to -800	:	Major impact which is mostly irreversible
-800 to -1000	:	Permanent irreversible impact

4.11.9 Summary of impact

The total impact score is –272.21 which indicates appreciable but reversible impact and appropriate control measures are important. The negative impacts are of high degree. Hence proper control measure must be incorporated in context of Environmental Management Plan. It will become more serious and cause hazard if the proposed measures are not implemented.

CHAPTER 5

ENVIRONMENTAL MANAGEMENT PLAN

5.1 GENERAL

The Environmental Management Plan has been developed with a view to bring down the levels of impacts within limits. In each of the areas of impact as assessed in Chapter 4, measures have to be taken to mitigate adverse impacts and where they are beneficial in nature, such impacts are to be enhanced/augmented so that the overall adverse impacts are reduced to as low a level as possible.

The formulation of EMP of coal middlings and fines based Thermal Power Plant (TPP) are based on the following considerations:

1. Proposed project activities as discussed in chapter 2
2. Studies of an environmental impact assessment as derived from base line data/information in Chapter 3
3. Air and water pollution control
4. Control of noise
5. Work zone environmental improvement
6. Biological reclamation and landscaping
7. Occupational hazards and safety
8. Environment management activities
9. Environmental management cost

Careful planning and strategy adopted for the operation of a project is the route to achieve both economic growth as well as environmental protection.

The present environmental management plan for each and every component of environment has been planned to achieve the above-mentioned goal.

Any release of pollutants shall conform to the standards laid down by the regulatory agencies.

Details of environmental management plan are described in the following paragraphs:

5.2 CLIMATE AND METEOROLOGY

As already discussed in Chapter 4, climate is a long term weather regime which can not be affected by small projects. Local air temperature changes will be there due to hot flue gas emissions which may not be felt at ground level due to high stack height and large volume of atmospheric air in which it is getting dispersed. Hence, no additional mitigation measures are being taken.

5.3 AIR POLLUTION CONTROL

The proposed power plant is designed to generate 300 MW power, hence, there is definite possibility of adverse impact on air quality due to stack emission. However, better pollution control equipment with adequate capacity are proposed to be installed to avoid degradation of air environment. Dust particles and gases will be generated during power plant operation. Besides this, coal handling plant and transportation deteriorates the ambient air quality. Following measures are to be taken up to control air pollution during construction and operation stage.

5.3.1 During construction

1. As the site is generally level and clearance will not involve movement of substantial quantity of soil and since the area is not windy and during dry weather condition, the dust created by excavation, leveling and transportation activities will be easily controllable by sprinkling of water.
2. Construction equipment and transport vehicle will be maintained properly to minimize source emissions and spillage. Regular maintenance schedule will be adopted.
3. Pucca road to be constructed.

5.3.2 During operation

During operation, the following measures are to be taken up to control air pollution.

1. Electrostatic precipitators (ESP) with an efficiency of 99.9% will be installed to control the particulate emission so as not to exceed 50 mg/Nm^3, while using middling and fines. Therefore, emission loads of SPM have been computed considering 50 mg/Nm^3 concentration at outlet of ESP.(Refer Annexure XVIII for Dispersion modeling)
2. For dispersal of SO_2, a stack of 220 m height will be constructed as per applicable standards for plant of <500 MW capacity. It has been found that the maximum incremental GLC of SO_2 will be only 11.41 $\mu g/m^3$ at a distance of 5 km measured from the stack of 2 X 150 MW TPS.
3. Stack emission monitoring for SO_2, NOx and particulate matter will be carried out as per frequency mentioned in the consent.

4. Water spraying system will be provided in coal middling and fines yard to suppress dust at suitable location including transfer points, loading and unloading points.
5. Opacity meter will be installed for continuous monitoring of particulate matter
6. Bag filters will be installed at silo for dry ash extraction

The mixed fuel (middling and coal fines) proposed to be used in the proposed plant is expected to contain about 50-58% ash. About 20-25% of the ash would be collected in the furnace hopper as bottom ash and the balance 75-80% would be carried along with the flue gas in the form of fly ash. To limit the concentration of the fly ash fall out, Electrostatic Precipitators (ESP) of about 99.9% efficiency will be installed. The residual fly ash will be dispersed into atmosphere through a stack of 220 m height, to ensure that the ground level concentration of the particulate matter remains within the permissible limit as per requirements of the CPCB. The continuous type particulate and gases (SO_2, NOx and CO) monitors (online analysers) would trigger audio-visual alarm in control room when levels exceed the maximum permissible limit so that controllers can take immediate appropriate action including shutting down the plant, if necessary.

To keep NOx emission to minimum or negligible due to the combustion, temperature being less than 900°C, heat loss through the stack represents only 6 to 10% of the total heat input to the furnace. The quantum of heat, so lost into the atmosphere, is insignificant considering the capacity of the atmosphere as the ultimate heat sink. The high kinetic energy gained by flue gas emanating from the stack, resulting in effective rise of plume will ensure discharge of flue gas at a considerably higher stratum for proper dispersal. A green belt of adequate width and density will be raised all around the plant. Bio monitoring system shall be provided to raise the green belt.

Dust Extraction System

Dust extraction systems have been considered for Junction Towers and all feed points below reclamation hopper. Bag filters will be provided. The exhausted air will be cleaned in bag filters type dust extraction system before being discharged into the atmosphere.

Dust Suppression System

The coal fines and middlings will be transported from the washery to the plant by road/covered conveyor which will prevent the dust from becoming air borne. Sprinklers shall be provided all-around the stock-pile to suppress dust generation. Effective dust suppression/ collection systems will be installed at transfer points.

A Green Belt of three layer system has been envisaged all around the plant. This green belt will help in preventing fugitive dust from spreading beyond the plant boundary.

5.4 LAND USE

The land use after the plant is stabilized and is in operation is given in table 5.1.

TABLE 5.1
LAND USE AFTER PLANT STABILISES ON OPERATION

Sl. No	Particulars	Area (hectares)			
		Total	Built up	Green belt	Other uses
1	Power plant	22.66	10.28	7.47	4.91
	TOTAL	22.66	10.28	7.47	4.91

A Green Belt has been envisaged all around the plant. This green belt will help in preventing fugitive dust from spreading beyond the plant boundary.

The existing colony of the coal mine will be suitably extended for residential purposes.

5.5 WASTE WATER TREATMENT AND MANAGEMENT

The total requirement of water is 942m^3/hr of which 78m^3/hr would be contributed from recirculation and reuse while 864m^3/hr would be fresh water contribution. The effluent generated comprises both the components in industrial and domestic water. The adverse characteristics imparted to effluent are oil/grease, total soluble salt and SS in industrial waste water and BOD loading in respect of domestic waste water. Such water will not be released to the environment without treatment so that these conform to the norms of such releases. Annexure XXI gives the prescribed limits.

5.5.1 Waste water treatment

The domestic effluent from colony and plant will be treated in sewage treatment plant and after treatment water will be used for irrigating green belt and dust suppression system while sludge will be used as manure. The effluent from the industrial activities, after sufficient treatment in oil/grease water separator and sedimentation of SS, will be collected in the central monitoring basin (CMB) and then used for horticulture. To prevent water pollution by oil/grease and sewage waste, following control measures are proposed to be implemented:

- Leak proof containers will be used for storage and transportation of oil.
- Water quality monitoring will be done regularly.

- Workshop effluent will be passed through pit / grease trap and recirculated.

- Analysis of treated waste water will be carried out as per CPCB regulation. The treatment system will be maintained properly.

Waste water generated during the industrial process is recirculated and used thereafter. The details of waste water recirculation and reuse are given below. The flowsheet of the treatment system is given in Fig 2.2 at the end of Chapter 2.

5.5.2 Waste Water Treatment Plant

Domestic waste water from the plant and the colony will be treated in the sewage treatment plant which has been established recently, based on activated sludge process and utilized quantitatively for irrigation of green belt and plantation.

The water treatment plant will be consisting of clariflocculator, filteration unit, gravity filters, filtered water sump, activated carbon filters, and demineralising water treatment plant. This can be seen in Fig 2.2 at the end of Chapter 2.

The proposed plant will have recirculating type cooling water system with wet evaporative cooling towers. The major liquid effluent streams from the power plant are given below:

- Cooling tower + boiler blow down
- Waste water from Water treatment plant
- Demineralisation plant regeneration chemicals
- Backwash of gravity filters/ion exchange softener

The water from the boiler blow down will be recycled to the cooling tower. Cooling tower blow down will be used for dust suppression, ash sluicing and services water.

All the industrial waste water generated will be collected in the Central Monitoring basin (CMB)/ Guard Ponds. Effluents from regeneration in the DM plant will be neutralised and transferred to the CMB. All the unutilised effluents will be collected in the CMB./Guard Ponds.

The other waste streams from the plants will be sent to gravity type plate settlers. The streams from the oil handling area will contain oil due to the spillage, leakage from oil pumps, oil purification plant etc. These streams will be segregated and collected separately in an equalisation tank. The under flow from the oil separator will be led to the plate settler for separation.

The demineralisation process in the DM plant will generate alternatively acidic and alkaline effluent during the regeneration of two types of exchangers. It is expected that dissolved solids will be around 7 times of input concentration. A neutralising basin will be installed with a proper neutralising arrangement. This neutralised effluent will be safely discharged after mixing with other treated effluent stream to abandoned portion of coal mine for back filling.

Floor wash water and stock pile run-off will be taken to settling tank and discharged after settlement to abandoned portion of coal mine for back filling.

Storm water will be used for ground water recharge through rainwater harvesting structures and the extra storm water will discharged separately.

Waste Water Recirculation And Use (2 X 150 MW)

- Decanted ash pond water will be recycled.
- Treated sewage water will be used for irrigating the greenbelt.

Efforts will be made to further utilize waste water for horticulture.

Flow scheme for waste water treatment is shown in Fig 5.1.

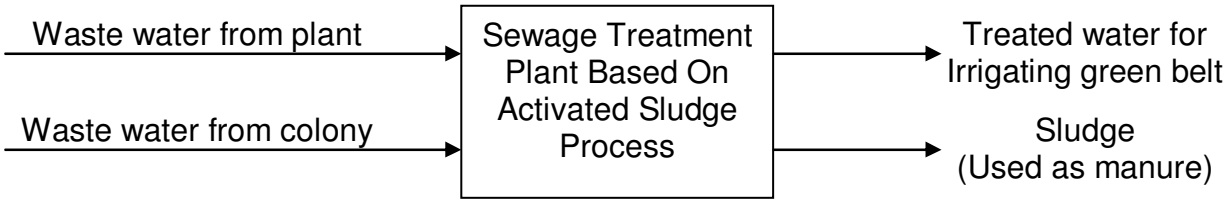


FIG 5.1 : FLOW CHART OF DOMESTIC WASTE WATER TREATMENT FROM COLONY AND PLANT

Rain water falling on the roof tops will be harvested and used for charging of ground water. The rain water falling within the remaining area of the plant will flow into the raw water reservoir, from where it will be utilized in power generation.

5.6 NOISE POLLUTION CONTROL

Proper noise control/suppression shall be provided. The equipments shall be provided with acoustic shields or enclosures to limit the sound level inside the plant.

The proposed green belt will also help to prevent noise generated within the plant from spreading beyond the plant boundary.

The following measures are suggested to be taken up to keep the noise levels with in permissible limits.

1. Provision and maintenance of thick green belt to screen noise
2. Proper maintenance of noise generating machinery including transportation vehicles
3. Provision of air silencers to modulate the noise generated by the machines/equipments
4. Reducing the exposure time of workers to the higher noise levels
5. Proper encasement of noise generating sources will be done to control noise level. Besides, ear muffs/plugs will be provided to the workers in the close vicinity of noise source.
6. Provision has to be made for special vibration dampness and monitoring to prevent propagation of vibration to surrounding areas.
7. All workers working in noise borne area will be regularly subjected to medical check-up for detecting any adverse impact on their TLV of hearing.

5.7 ECOLOGY - PLANTATION PROGRAMME

To reduce the impact of air pollution, it has been proposed to create and maintain a green belt in 7.47 Ha areas in and around the power plant as shown in Fig. 2.1. In order to attenuate noise and air pollution plantation is to be done along the plant boundary, road sides, office building and stretches of open land. The vegetation for air pollution control shall be most needed in the areas where ground level concentrations of pollutants are expected to be higher. A curtain of trees all around the power plant complex will be provided.

Depending upon the local availability, soil and climatic condition, the selection of the suitable species for development of green belt will be made on the following criteria:

1. The plants will be fast growing of local species
2. The plants will be of indigenous nature
3. The plants will be tolerant to site specific conditions
4. With predominant abundance result with proven survival rate.

Selection of Species

The tree species selected for green belt has the following zone-wise characteristics:

Primary zone: This zone will be the nearest one to the emission source, where the ambient pollutant concentration usually would remain higher than in other directions. The trees planted here will have dense spreading canopy. The trees would be close-set with a spacing of 2-3 m between trees. This zone will be along the periphery of the plant. The species

selected are *Butea monosperma* (Palas), *Thevetia neriifolia* (Kahel), *Moringa Oleifera* (Drumstick), *Saraca indica* linn. (Ashoka), *Michelia champaca* Linn. (Champs), *Bauhinia variegata* Linn. (Devakanchana), *Cassia fistula* Linn. (Amaltas) and *Cassia ciamea* Lamk. (Cassia).

Secondary zone: Outer to the former zone, a wide strip of land will be planted with trees which are moderately tolerant to pollutants but are endowed with fast growing, dense foliage and good canopy. The species selected are *Peltophorum pterocarpum* (subabul), *Melia azedarach* (Bakain), *Syzygium cumini* (Jamun), *Terminalia arjuna* (Arjun), *Azadirachta indica* (Neem), *Madhuca indica* (Mahua), *Dalbergia sissoo* (Shisham), *Magnifera indica* (Aam) and *Albizzia lebbeck* (Siris).

Curtain zone: Outer to the middle zone and on the peripheral boundary all along the power plant complex, a wide land strip will be planted with trees which are tall and evergreen in habit. This zone will act as a barrier and as far as possible check the pollutants from going to and contaminating other areas beyond the power plant premises. The spacing from tree to tree will be from 1 to 2 m. The species selected are *Leucaeha leucocephale, Tamarindus indica* (Imli)*, Eucalyptus sp.* (Safeda), *Azadirachta indica* (Neem)*, Albizzia lebek, Albizzia procera Benth* (Safed Siris), *Artocarpus heterophyllus* lank (Kathal) and *Delonix regia* (Gulmohar).

5.8 SOLID WASTE MANAGEMENT

The middlings and coal fines used in the proposed plant will contain 50-58% ash. About 20-25% of ash would be collected as bottom and coarse ash and the balance 75-80% would be collected as fly ash.

The recoverable coal from Gare IV/1 mine is 56.56 Million tonnes (95%) which in terms of volume will come to 37.70 million cum (considering density = 1.5). The total waste generation from the mine will be 178.24 million cum. Thus the total void created by mining will be 37.70 + 178.24 = 215.94 million cum out of which 135.69 million cum will be backfilled by OB. The total volume of void left after backfilling in Gare IV/1 will be about 215.94 -135.69 x 1.15 = 59.89 Million cum.

The power plant will utilise 2.445 MTPA coal middlings containing ash upto 58%. Thus the annual ash generated from the plant will be about 1.37 Million Tonnes. Considering the density of fly ash to be 1.6, this will come to 0.856 million cum. Thus at this rate, the void of Gare IV/1 has the capacity to accommodate the fly ash from this plant upto 59.89/0.896 =66.84 years.

Hence, the void is adequate for accommodating the ash generated from the power plant throughout its life.

The bottom and coarse ash from each boiler will be collected in dry form along with fly ash from the ESP hopper and will be transported to fly ash silos. In the initial years of operations, efforts will be made to ensure maximum utilization of fly ash in dry form for commercial use such as brick

making, manufacturing of pozolona cement, manufacturing of aggregates etc. Unutilised fly ash shall be converted into high concentration slurry and shall be transported to abandoned portion of coal mines.

5.9 SOCIO-ECONOMIC CONDITIONS

5.9.1 Employment

Due to thermal power project there will be development of communication facilities in the area. In the plant area accommodation has been planned for the skilled/ semi-skilled employees and the managerial/ supervisory personnel. The plant site area will be equipped with sufficient infrastructural facilities including drinking water, toilets, sanitation facilities, health center, etc.

During operation, plant will generate a direct employment. The preference will be given for local population for employment in the semi-skilled and unskilled category. Indirect employment is created by the plant for supply of daily domestic goods. More over, permanent supply of electricity in the area will support to improve other type of industries.

5.9.2 Health and Safety Measures

The workers engaged in high pollution generation area will be equipped with appropriate protective equipment. Following measures will be adopted in the plant to keep check on the safety measures and health:

- Inspection and maintenance of pollution control systems regularly
- All safety measures such as provision of safety appliances, imparting training, giving-of safety awards, display of posters with slogans related to safety will be taken
- The workers exposed to noisy sources will be provided with ear muffs/plugs
- Adequate facilities for drinking water and sufficient toilets will be provided for the employees.

5.10 SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN

Proposed mitigation measures for pollution control and environmental management in the thermal power plant are given in Table 5.2.

TABLE 5.2
MITIGATION MEASURES IN THERMAL POWER PLANT

Impact factor	Mitigation measures
Air Emissions	Emission of SPM will be limited to 50 mg/Nm^3 by installing ESP with 99.9% efficiency. There will be one stack of 220 m height comprising two flues for each of the two 150 MW phase for pollutants dispersion. Dust will be suppressed by sprinkling water. Transport of middling and fines from washery to power plant will be by road through covered trucks or covered conveyors and the transfer points will be equipped with dust suppression/ collection systems.

Impact factor	Mitigation measures
Liquid Effluent	Demineraliser regeneration waste will be neutralised. Oil bearing waste water will be routed through an oil water separator. The effluent discharged will have oil & grease concentration less than 10 mg/l. Domestic waste will be treated in a suitable Sewage Treatment plant and used for horticulture and irrigation of green belt in Power Plant Area and in Township. All treated wastewater shall meet applicable standards. Cooling tower blow down will be used for ash disposal and DM Plant regeneration waste water after passing through neutralization pit shall be used for irrigation of green belt and horticulture. Effluent from coal yard will be treated in sedimentation tank.
Noise Emissions	Properly engineered noise deadening encasement of noise generating sources will be done. Plant operators working in high level noise zones will be provided with ear plugs/ muffs. Acoustic system for turbines will be provided.
Thermal Pollution	Since a re-circulating cooling system with cooling tower shall be adopted, no thermal pollution is anticipated.
Solid Waste	Ash generated in the power plant will be backfilled with OB in the voids created by mining in adjacent Gare IV/1 Opencast Mine.
Ecology	A green belt will be developed along the plant boundary, road sides, office building and stretches of open land. The green belt will help in controlling air pollution and in attenuating noise.
Socio-economy	There will be direct and indirect employment opportunities for the local people. Also the plant will provide basic facilities to the nearby villages.

5.11 RESIDUAL IMPACT IDENTIFICATION

5.11.1 Basis

As discussed earlier, the anticipated impact assessment was made using modified Matrix method. The negative score of –272.71 at premitigative stage indicated that the appreciable but reversible impact and control measures are important. This can be done by take care at the planning and engineering stage to incorporate environmental protection measures in the process of power generation. Control measures have been proposed for mitigating the degradation effects and improvement schemes such as afforestation programme around the plant. To predict the resultant effect at post mitigation stage, modified Matrix method is used as explained in the following paragraphs.

5.11.2 Environmental Impact Matrix With Protection Measures

Components such as PIV, RPII, EII, WEII and sum of the above are arrived at and same are shown in Tables 5.3 and 5.4. It is seen that the total score which was originally –272.25 without mitigation has improved to –32.45, after mitigation, as shown in Table 5.4.

TABLE 5.3
POTENTIAL IMPACT IDENTIFICATION IMPACT MATRIX WITH MITIGATION MEASURES

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
1.	Surface water resources	Power generation operations	1	Surface water will not be used to the water requirement	Adverse	0.70	High significance	0	0	No water will be used for power generation, hence, no impact
2.	Surface water resources	Disposal of waste water	2	During rainy season waste water may reach to surface water body	Adverse	0.20	Low significance then interaction No. I	0	0	No impact since this is a zero discharge plant
3.	Surface water resources	Provisions of civic amenities	3	Drinking water is to be provided for domestic use and plantation programme	Adverse	0.10	Interaction 3 is negligible	0	0	No impact since surface water might be rarely used for drinking purpose. Quantity will be small.
4.	Ground water resources	Power generation operations	1	Ground water seepage into adjacent mine will be used for operation.	Beneficial	0.50	This is as significant as ground water extraction for drinking	0.40	40.0	Seepage water from mine sump would be pumped out and got wasted by disposal into natural stream. The same water is being put to use during operation
5.	Ground water resources	Provision of civic amenities	2	Ground water to be used for drinking purposes	Adverse	0.50	Significant as ground water is used for drinking	0.00	20.0	Ground water is not used for power generation. It is only used for drinking purposes
6.	Air quality	Power generation operations	1	Dust & gases are produced High SPM is observed during these operations.	Adverse	0.50	There are four activities causing impact on air quality of work environ-interaction "1" has more impacts	-0.50	50.0	Pollutants will be controlled by installing ESP of 99.9% efficiency dust suppression system
7.	Air quality	Transportation	2	Causes dust nuisance as well as gaseous pollution due to vehicular emissions on road transportation of equipment.	Adverse	0.20		-0.15	30.0	Regular maintenance of vehicles
8.	Air quality	Vegetative plantation	3	It serves as a natural screen in reducing the SPM concentration.	Beneficial	0.20	Extensive plantation has been envisaged	0.25	35.0	Vegetation will help in reducing air pollution

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
9.	Air quality	Disposal of solid waste	4	Increase in SPM level	Adverse	0.10	Insignificant solid waste is to be disposed off.	-0.25	35.0	Ash will be disposed of in slurry form having less impact on air quality
10.	Water quality	Provisions of civic amenities	1	Deterioration in surface/ ground water quality as domestic waste water is disposed on open fields	Adverse	0.30	This has low significance, hence RPII = 0.3	-0.15	30.0	Domestic effluent will be treated in STP and then used for irrigating crops
11.	Water quality	Power generation operation	2	Impact due to workshop cleaning, cooling tower blow down and clarifier back wash and in for ash disposal system.	Adverse	0.70	This has high significance, hence RPII = 0.7	-0.05	5.0	This will be a zero discharge plant and colony
12.	Noise levels	Power generation operations	1	Increase in noise level due to use of various equipment	Adverse	0.50	There are three project activities influencing the noise level in the area. The interaction 1 is comparatively more important.	-0.50	45.0	The impact will be reduced by controlling the noise at source and maintaining and greasing the machinery, providing ear muffs to the workers using air silencers
13.	Noise levels	Transportation	2	Increase in noise levels due to vehicular traffic for transport of equipment	Adverse	0.30	This is more significant compared to above as the noise will be all along the road route transporting equipment.	-0.25	35.0	Increase in noise level and traffic density on road due to transport by trucks. Noise will be reduced by maintaining the vehicle and their silencers regularly, by thick green belt. Use of only conveyors may eliminate this impact
14.	Noise levels	Vegetative plantation	3	It serves as barrier for Noise propagation. Thus reducing noise levels.	Beneficial	0.20	it is not main influential activity	0.15	25.0	Plantation proposed will reduce noise level considerably

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
15.	Health	Power generation operations	1	Deteriorates workers health due to air & noise pollution, accidents & injuries.	Adverse	0.30	Proper importance is given to interaction 1 as the workers are exposed to high levels of noise & air pollutants.	-0.50	50.0	The provision of appropriate stack height will reduce health risk. Noise will be controlled at source and protective gear provided to workers, provision of ear muffs and regular medical check-up, reduces exposure time to noise
16.	Health	Transportation	2	Deteriorates health due to air & noise pollution	Adverse	0.30	Since the interaction is significant, RPII =0.3.	-0.15	30.0	Regular maintenance of vehicles
17.	Health	Provision of civic amenities	3	Affects health through disposal of sewage on open land which causes mosquito nuisance, water borne diseases	Adverse	0.20	RPII=0.2 due to its limited influence	-0.05	5.0	Water from amenities will be treated biologically before being used in horticulture. Nothing will be released into the environment. Medical facilities will be provided
18.	Health	Vegetative plantation	4	Improves the health of inhabitants by acting as a barrier to air & noise pollution uptake of liquid waste disposed on land and imparts pleasant atmosphere.	Beneficial	0.20	RPII=0.2 due to its limited influence	0.10	20.0	Extensive vegetation proposed will reduce adverse impact on health
19.	Public utilities	Power generation operations	1	Improved public utility Services in surrounding villages improves power supply, road network, water supply, sanitation, medical care facilities and communication.	Beneficial	0.60	Interaction 1 is more influential than the other interactions. It covers the surrounding villages hence it is given higher RPII value.	0.40	40.0	Improvement in power supply is significant, increase in employment opportunities
20.	Public utilities	Transportation	2	Provides better transportation system to plant area. Improves road network and vehicular movement	Beneficial	0.20	Interaction 1 is more influential than the other interactions. It covers the surrounding villages hence it is given higher RPII value.	0.10	10.0	Access roads will be made to the project area and maintenance and repair will be done regularly

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
21.	Public utilities	Provision of civic amenities	3	Provides water supply, sanitation, power supply, medical facilities and communication in the core area.	Beneficial	0.20	This has nominal impact.	0.10	10.0	Improve employment and status of people
22.	Economic aspects	Power generation operations	1	Increased employment opportunities both direct and indirect thereby increasing economic status of people.	Beneficial	0.80	Civic amenities are provided to employees of the plant and also to adopted villages	0.40	40.0	Direct and indirect employment but availability of power will provide for expansion of economic activities in the area and widening the scope of industrial establishment
23.	Economic aspects	Transportation	2	Increased employment opportunities (mostly indirect employment) and thereby increase in the economic status.	Beneficial	0.10	Interaction 1 has considerable potential in providing employment to people, both direct and indirect.	0.20	20.0	Marginal significance
24.	Economic aspects	Provision of civic amenities	3	Increased employment both by direct & indirect ways. Employment in commercial services, improved economic status of people.	Beneficial	0.10	Most influential interaction	0.10	10.0	Marginal job opportunities are anticipated, hence marginal impact
25.	Land use and soil characteristics	Disposal of solid waste	1	Land degradation due to disposal of solid wastes	Adverse	0.10	Limited solid waste.	-0.60	60.0	Ash will be disposed off and stored in the abandoned portion of coal mines with proper pollution control measures
26.	Land use and soil characteristics	Civic structure	2	Land use degradation due to erection of civil structures	Adverse	0.40	Civil structures are within plant area	-0.50	45.0	Construction of civil structures will make permanent changes to land surface
27.	Land use and soil characteristics	Provision of civic amenities	3	Domestic waste disposal	Adverse	0.20	Disposal of domestic waste is required as colony is envisaged	-0.10	10.0	Biodegradable waste will be composted. Recyclable material will be sold to vendors.

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
28.	Land use and soil characteristics	Vegetative plantation	4	It improves aesthetics & provides shelter for wildlife	Beneficial	0.20	Quite Infuential Activity	0.20	15.0	Will improve fertility of soil and aesthetics of land
29.	Land use and soil characteristics	Transportation	5	Impact due to settling of air borne dust and vehicle exhaust	Adverse	0.10	This is a significant activity	-0.40	35.0	Coal / fuel is to be transported by trucks / dumpers
30.	Flora	Power generation operations	1	Impact due to air pollution	Adverse	0.30	There are four interaction under this impact area. The interaction 1 is assigned RPII value of 0.3 as dust is anticipated during operations	-0.15	30.0	Medium significance since pollutants will be getting displaced to permissible ground level concentration. Use of ESPs and pollution control equipment will be there
31.	Flora	Transportation	2	Adverse impact of dust emissions due to vehicular traffic	Adverse	0.10	Dust generation during vehicular movement is considerable due to long routes.	-0.10	20.0	Maintenance of vehicles and paving of roads will reduce air borne dust causing harm to plants. Use of closed conveyor will minimize this further.
32.	Flora	Civil structures	3	Habitat destruction	Adverse	0.40	Normal civil structures are observed hence RPII of 0.1.	-0.05	5.0	Adequate plantation will be done to reduce the impact
33.	Flora	Vegetative plantation	4	Creation of vegetative habitat	Beneficial	0.20	Quite influential activity.	0.10	20.0	Reduced transmission of pollutants
34.	Wild life	Power generation operations	1	Affects wild life through air & noise pollution and habitat destruction	Adverse	0.40	Can affect displacement of wildlife.	-0.25	35.0	Wild animals may shift from study area as operational activity of plant affect wildlife
35.	Wild life	Transportation	2	Adverse effect due to air and noise pollution by vehicular traffic and road side accidents	Adverse	0.20	Considerable importance since vehicular traffic will be a significant contributor.	-0.15	30.0	Low significance as wild life is well acquainted with such activity in the road area. Proper precautions will also be taken to prevent accidents
36.	Wild life	Vegetative plantation for wild	3	Habitat to be created which will be suitable for wildlife	Beneficial	0.40	Quite influential activity but lesser significance	0.10	20.0	Positive impact as the vegetation is proposed around the plant

Sl. No.	Environment Components	Project Activities	Interaction No.	Impacts	Adverse/ Beneficial	RPII values	Remark for RPII	EII Index	EII (%)	Remark for EII
37.	Human settlement	Power generation operations	1	Increased population density thereby environmental degradation since more increase in population Natural resources like fuel wood, water, electricity etc. are required.	Adverse	0.50	Interaction 1 is significant as more no of persons are in this area. Hence RPII=0.5	-0.30	25.0	Power generation will improve the industrial potential of the area
38.	Human settlement	Provision of civic amenities	2	Increased employment opportunities in service sector, increase in population density in and around plant.	Adverse	0.20	In case of interaction 2, opportunities exist due to residential colonies.	-0.30	30.0	Moderate impact
39.	Human settlement	Transportation	3	This helps in transportation of people, reducing stress on local settlement.	Adverse	0.30	Impact is less significant	-0.30	25.0	Increase in traffic density will improve human crowd
40.	Culture	Power generation operations	1	Influx of people of various cultures will have substantial effect on local culture.	Beneficial	1.00	Since the effect is great. it is given higher RPII of 1.0	0.10	10.0	Create awareness about local and outside cultures
41.	Human resettlement	Power generation operations	1	No resettlement needed.	Adverse	1.00	Interaction is significant	0.00	0.0	No impact as no village has to relocated
42.	Thermal Pollution	Power generation operations	1	On air and surface water body	Adverse	1.00	It is a single interaction	-0.05	10.0	Proper cooling ponds, cooling towers, etc. will be provided. Zero discharge, hence, no surface water body will be thermally polluted.

This indicates that this project does not have appreciable adverse impact on environment with mitigative measures taken. In such cases, the mitigation measures have very high importance and with strict adherence to EMP with regular monitoring is advised for protection of ecology and to maintain environmental quality parameters within permissible limits. As is clear from the status, after application of mitigation measures, the impact on environment is negative showing that the proposed project has considerable impact on the environment but it leads to less overall adverse impacts.

TABLE 5.4
IMPACT MATRIX WITH MITIGATION MEASURES

Impact area	WEII (RPII X EII)	PIV	Total (WEII X PIV)
Surface water resources	-0.380	69.77	0
Ground water resources	0.200	46.51	9.30
Air quality	-0.255	93.02	-23.72
Water quality	-0.080	93.02	-7.44
Noise levels	-0.295	46.51	-13.72
Health	-0.185	69.77	-12.91
Public utilities	0.280	93.02	26.05
Economic aspects	0.350	93.02	32.56
Land use and soil characteristics	-0.280	69.77	-19.54
Flora	-0.055	93.02	-5.12
Wild life	-0.090	69.77	-6.28
Human settlement	-0.300	46.51	-13.95
Culture	0.100	46.51	4.65
Human resettlement	0.000	23.26	0.00
Thermal pollution	-0.050	46.51	-2.33
Total		**1000.00**	**-32.45**

CHAPTER 6

ENVIRONMENTAL CONTROL AND MONITORING ORGANISATION

6.1 INTRODUCTION

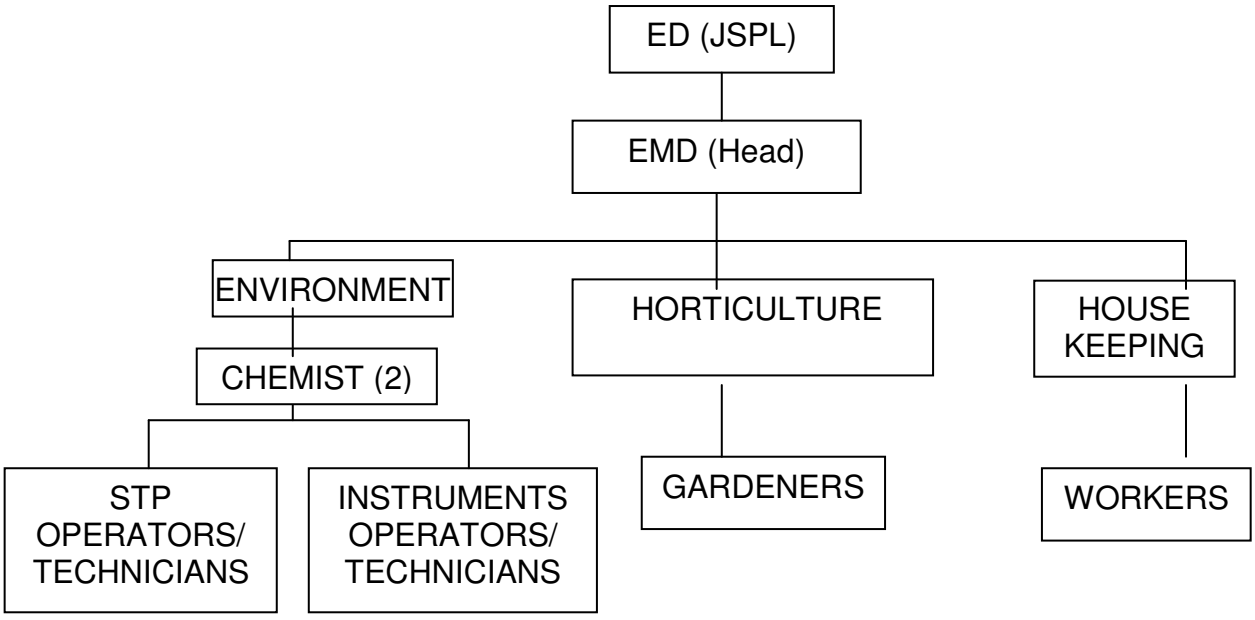
Success of any environmental management programme depends upon the efficiency of the organisational set up responsible for implementation of the programme. Regular monitoring of various environmental parameters is also necessary to evaluate the effectiveness of the management programme so that necessary corrective measures can be taken in case there are some drawbacks in the proposed programme.

Since environmental quality parameters at work zone are important for maintaining safety, the monitoring work forms part of safety measures also.

6.2 PROPOSED SET-UP

A full fledged Environment Management Department (EMD) exists with multidisciplinary team of professionals, technical staffs and all necessary infrastructures, headed by Sr. Dy. GM-EMD. This team will be also responsible for all environment management activities including environmental monitoring, developing greenbelt, ensuring good housekeeping, ensuring statutory compliance as well as creating environmentally aware work forces for proposed Thermal Power Plant. The organizational chart of Environment Management Department is shown in Fig 6.1

FIG 6.1 ORGANISATIONAL CHART FOR ENVIRONMENTAL MANAGEMENT IN PROPOSED POWER PLANT



The said team will be responsible for:

i. Compliance of environmental statutory requirements

ii. Environmental monitoring as per requirement

iii. Submitting returns and compliance status to MoEF, CPCB, CECB, etc.

iv. Green belt management

v. Housekeeping

vi. Other environmental parameters to be monitored and analysed as per requirement

The laboratory will be suitably equipped for sampling/testing for various environmental pollutants.

6.3 MONITORING SCHEDULE AND PARAMETERS

To evaluate the effectiveness of environmental management programme, regular monitoring of the important environmental parameters will be taken up. The schedule, duration and parameters will be as per the consent conditions of No Objection Certificate issued by the State Pollution Control Board for 100% compliance.

6.3.1 Air quality

Ambient air quality will be monitored for SO_2, NOx, SPM and CO. The instruments like high volume air samplers and respirable dust samplers would be used for this purpose. These parameters will be monitored as mentioned in Table 6.1.

6.3.2 Water quality

Water of discharges and surrounding water bodies will be analysed as per norms of the pollution control board.

6.3.3 Noise monitoring

Noise level will be monitored in working environment, main noise producing sources, over the boundary and around the plant.

6.3.4 Green belt and afforested areas

Continuous vigil and monitoring of green belt will be done for its performance and survival rate. The plantation will be properly guarded by watch and ward personnel. Provision will be made for fertilizers application and watering on schedule.

6.3.5 Socio-economics

Gravity modeling (traffic density) studies will be done with the objective to know about the interaction of nearby situated towns. Central Place Hierarchization studies (studies related to change in amenities/services etc.) would be conducted to know about the socio-economic status of the villages along with the above mentioned studies at every five year interval.

6.4 BUDGETARY PROVISION FOR ENVIRONMENTAL MANAGEMENT

A. Capital cost estimated for EMP

Adequate budgetary provision have been made by the Company for execution of Environmental Management Plan. Table 6.1 and 6.2 give overall investment on the environmental safeguards and recurring expenditure for successful monitoring and implementation of control measures.

TABLE 6.1
APPROX. CAPITAL INVESTMENT FOR ENVIRONMENTAL PROTECTION

Sl. No.	Particulars	No.	Cost (lakh Rs.)
I.	**AIR POLLUTION CONTROL**		
1	Electrostatic precipitator	2	6000.00
2	Chimney (twin flue)	1	2500.00
3	Dust collector- Bag filters	2	800.00
4	Water sprayer (Stationary)	LS	50.00
	Sub Total		**9350.00**
II.	**WATER POLLUTION CONTROL**		
1	Domestic effluent treatment plant	LS	20.00
2	Industrial ETP	LS	100.00
3	Storm water drains	LS	100.00
4	Drains along roads	LS	200.00
5	Water drain culverts	LS	20.00
	Sub Total		**440.00**
III.	**NOISE POLLUTION CONTROL**		
1	Acoustics	LS	20.00
	Sub Total		**20.00**
IV.	**ENV. MONITORING AND MANAGEMENT**		
1	High Volume air Sampler	5	2.50
2	Respirable Dust Samplers	4	3.00
3	Micro-meteorological station (Auto)	1	3.50
4	Laboratory for testing	1	10.00
5	Organic vapour sampler	1	2.00
6	SOx, NOx and SPM meter online analyser	1	100.00
	Sub Total		**121.00**
V.	**RECLAMATION**		**Nil**
VI.	**OCCUPATIONAL HEALTH**		

Sl. No.	Particulars	No.	Cost (lakh Rs.)
1	Fire fighting equipment (Portable)	100	7.00
2	Fire fighting equipment (Fixed)	LS	500.00
3	Fire fighting equipment (Mobile)	LS	40.00
4	Personal protective equipment	LS	5.00
	Sub Total		**552.00**
VII.	**GREEN BELT AND PLANTATION IN PLANT**	7.47 ha	**10**
VIII.	**OTHERS**		
1	Environment related studies	LS	7.00
	Sub Total		**7.00**
	GRAND TOTAL		**10500.00**

Annual cost of monitoring and implementation of control measures is given below:

TABLE 6.3
RECURRING ANNUAL COST FOR ENVIRONMENTAL PROTECTION

Sl. No.	Particulars	Cost (Rs. Lakhs)
1	Air pollution control	1309.97
2	Water pollution control	20.55
3	Noise pollution control	1.67
4	Environmental monitoring and management	11.52
5	Reclamation	0.00
6	Occupational health	33.30
7	Green belt	2.35
8	Others (Environmental studies, expert advice etc.)	0.65
	Interest on capital cost	514.50
	Overheads (3% of Dep., Energy, R&M & Interest)	55.20
	TOTAL	**1949.71**

Assumptions:

- ***The cost of electricity = Rs. 2/unit, diesel = Rs. 40/l, petrol = Rs. 50/l***
- ***Three shift working for 8 hours each***
- ***Debt equity ratio 0.7. Rate of interest = 10%***
- ***Life of plant = 30 years***

The total capital investment on environmental improvement work is envisaged as Rs 10500.00 Lakhs which is 7% of the estimated cost of the project (Rs 1050 crores). The recurring expenditure estimated during the power generation is Rs. 1949.71 lakhs/year.

CHAPTER 7

DISASTER MANAGEMENT PLAN

All types of industries face certain types of hazards which can disrupt normal activities abruptly and lead to disaster like fires, inundation, failure of machinery, explosion to name a few. Middling and coal fines based power plant also pose fire, electrocution and explosion hazards. Disaster management plan is formulated with an aim of taking precautionary step to control the hazard propagation and avert disaster and also to take such action after the disaster, which limits the damage to the minimum.

7.1 TYPE OF DISASTER AT POWER PLANT

Disaster may occur due to following hazards at a thermal power plants.

- Fire
- Explosion
- Oil spillage
- Acid spillage
- Electrocution
- Hazardous waste

In any thermal power plant there are various activities or area which pose substantial threat to the workers and hence hazardous in nature. The potential hazardous areas and the likely accidents with the concerned area has been enlisted below in Table 7.1.

TABLE 7.1
HAZARDOUS AREA WITH CONCERNED ACCIDENTS

S.No.	Hazardous Area	Likely Accident
1.	Boiler Area	Explosion
2.	Oil tanks	Fire and spillage
3.	Turbine room	Explosion
4.	Electrical rooms	Fire and electrocution
5.	Transformer area	Fire and electrocution
6.	Cable tunnel	Fire and electrocution
7.	Storage facilities for coal fines/middling/ fuel	Fire/spillage

7.2 ACCIDENT LEVEL

If there is any disaster in any part of plant/work place due to any reason, the classification of areas which may be affected and nature of accidents can

be made as follows:

1	Level	I	Operator level
2	Level	II	Local community level
3	Level	III	Regional/national level
4	Level	IV	International level

Out of the above, only level-I and level-II class of accidents can be considered applicable for this type of thermal power plant.

Level-I Accidents

Under this level, disaster may happen due to electrocution, fire, explosion, oil spillage and spontaneous ignition of combustible material.

This level has probability of occurrence affecting persons inside the plant. Various hazardous areas which have been mentioned above in para 7.1 as potential hazard areas will be affected during this level of accidents.

Level-II Accidents

Disaster of this level can occur in case of sabotage and complete failure of all automatic control/warning systems, and also if the fuel oil stored in tank and covered by tank bunds leaks out. However, probability of occurrence of this is very low due to adequate security, training and education of persons of plant responsible for operating such systems.

7.3 DISASTER PREVENTIVE MEASURE

In order to prevent disaster due to fire, explosion, oil spillage, electrocution and other accidents following preventive measures shall be adopted.

i) Design, manufacture and construction of all plant and machineries building will be as per national and international codes as applicable in specific cases and laid down by statutory authorities.
ii) Provision of adequate access way for movement of equipment and personnel shall be kept.
iii) Minimum two no. of gates for escape during disaster shall be provided.
iv) Water spraying in coal fines/middlings storage area.
v) System of fire hydrants comprising electrical motor division and diesel engine drivers fire pumps with electrical motor driver jokey pump for keeping the fire hydrant system properly pressurized and automatic water sprinkling system for all important transformers.
vi) Fire hydrants with fire hoses in all areas where fire can break.

7.3.1 Site Emergency Control Room

In order to control the disaster more effectively, a Site Emergency Control Room (SECR) shall be established at the plant site. The facilities proposed

to be provided are given in following sections:

- Plant Layout
- Plant Layout with inventories and locations of fuel oil/furnace oil storage tanks, coal storage etc
- Hazard identification chart, maximum number of people working at a time, assembly points etc.
- Population around factory
- Internal telephone connections
- External telephone connections
- Hotline connection to district collector, police control room, fire brigade, hospital etc.
- Public address system
- Torch-lights
- List of dispensaries and registered medical practitioners around factory
- Area map of surrounding village
- Nominal roll of employees
- Note pads and ball pens to record message received and instructions to be passed through runners.
- The blown up copy of Layout plan showing areas where accident has occurred.

7.3.2 Safety Department

Safety department shall be manned by experienced engineers and other supporting staff who shall bring safety consciousness amongst the work force of plant.

The safety department will conduct regular safety awareness courses by organising seminars and training of personnel among the various working levels.

7.4 CONTIGENCY PLAN FOR MANAGEMENT OF EMERGENCY

The emergency organisation shall be headed by emergency leader called Site Main Controller (SMC) who will be plant manager. In his absence senior most person available at plant shall be emergency leader till arrival of plant manager.

Besides the top officials described above, rest of the employees shall be divided into three action teams namely A, B, C, and a Non-action Group D. Action team 'A' will consist of staff of section in which accident has occurred. Action team 'B', will consist of staff of non-affected sections and maintenance department. Action team 'C' will consist of supporting staff i.e. Security supervisor, Ware house Supervisor, Shift Supervisor etc. Group 'D' will consist of people not included in those teams like contractor, labour, security men etc.

Team 'A' comprising staff of affected section will be taking up the action in case of an emergency. Team 'B' will help team 'A' by remaining in their

respective sections ready to comply with specific instructions of SMC. Team 'C' consisting of supporting staff will help team 'A' as required and directed by Team 'B'. Group 'D' will be evacuated to safe region under supervision of Team 'C'.

A multichannel communication network shall connect SECR to control rooms of plant, various shops, other departments of plant, fire station and neighbouring industrial units.

Co-ordination among key personnel and their team has been shown in Fig 7.1.

7.4.1 Outside Organisations Involved in Control of Disaster

In the event of massive spillage of toxic chemicals, fuel oil or occurrence of fire, population inside and outside plant boundaries, vegetation and animal etc. may be affected. In such circumstances secondary fire may also take place. In such an event help shall be taken from outside agencies also. The organisations that shall be involved are as follows:

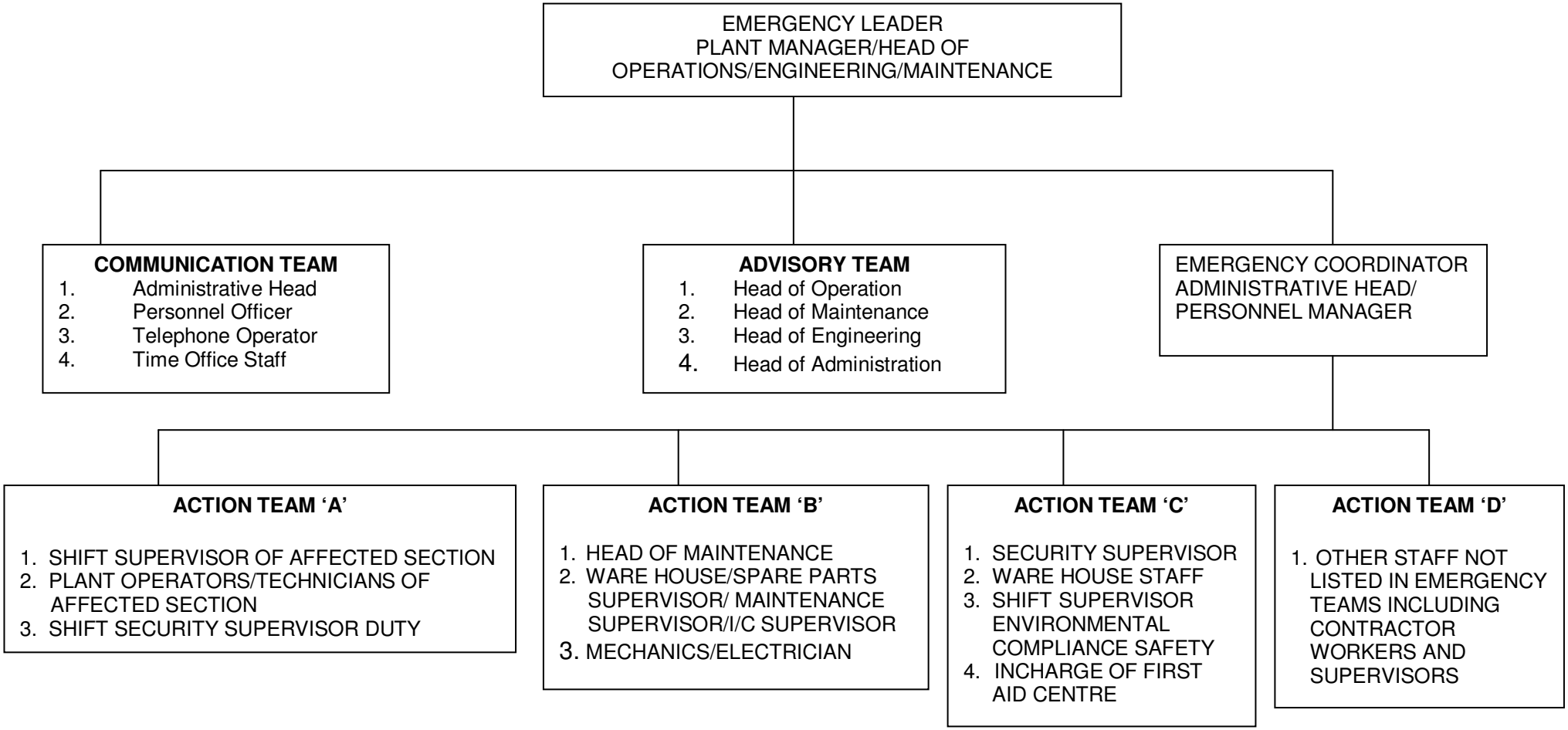
(a) State and Local authorities: District Collector, Revenue Divisional Officer, etc
(b) Factory Inspectorate, Chief Inspector of factories, Joint Chief Inspector of factories, Inspector of factories.
(c) Environmental agencies: Member Secretary of State Pollution Control Boards, District Environmental Engineer
(d) Fire Department: District Fire Officer
(e) Police Department: District Superintendent of Police, SHOS of nearby Police Stations
(f) Public Health Department:
    - District Medical Officer
    - Residential medical officers of PHCs in a radius of 3 km around plant site
(g) Local Community Resources
    - Regional Transport Officer
    - Divisional Engineer Telephones

The outside organisations shall directly interact with district magistrate who in consultation with SMC shall direct to interact with plant authorities to control the emergencies.

7.4.2 Hazard Emergency Control Procedure

The onset of emergency will in all probability, commence with a major fire or explosion the following activities will immediately take place to interpret and take control of emergency.

FIG 7.1 : GENERAL COORDINATION AMONG ON SITE EMERGENCY TEAM MEMBERS



1. Staff member on duty will go to nearest fire alarm call point and trigger off the fire alarm.
2. On site fire crew led by fire man will arrive at the site of incident with fire foam tenders and necessary equipments.
3. Site Main Controller will arrive at SECR, from where he will receive information continuously from incident controller and give decisions and direction to the incident controller, plant control room, emergency security controllers and to the site medical officer to take care of casualties.

Site Main Controller will be directing and deciding a wide range of following desperate issues. In particular SMC has to decide and direct.

- Whether incident controller requires reinforcement of manpower and facilities
- Whether plant is to be shut down or more importantly kept running.
- Whether staff in different locations are to remain indoor or to be evacuated and assembled at designated collection center.
- Whether missing staff members are to be searched or rescued.
- Whether off-site emergency plan to be activated and a message to that effect is to be sent to district headquarter.

When the incident has eventually been brought under control as declared by the Incident Controller, the SMC shall send two members of his advisory team as inspectors to incident site for:

- an assessment of total damage and prevailing conditions with particular attention to possibility of re-escalation of emergency which might, for the time being, be under control.
- Inspection of other parts of site which might have been affected by impact of incident.
- Inspection of personnel collection and roll call centers to check if all persons on duty have been accounted for.
- Inspection of all control rooms of plant to assess and record the status of respective plants and any residual action deemed necessary.

Post emergency, the inspectors will return to SECR with their observations and report of finding and will submit the same to SMC.

7.5 MISCELLANEOUS PREVENTIVE MEASURES

7.5.1 Alarm System to be followed during Disaster

On receiving the message of disaster from Site Main Controller, fire station control room attendant will sound Siren I, wailing type, for 5 minutes. Incident controller will arrange to broadcast disaster message through public address system.

On receiving the message of “Emergency Over” from Incident Controller,

the fire station control room attendant will give All "Clear Signal" by sounding alarm straight for two minutes.

The features of alarm system will be explained to one and all to avoid panic or misunderstanding during disaster.

7.5.2 Actions to be taken on hearing the warning signal

On receiving the disaster message, following actions will be taken:

- All the members of advisory committee, personnel manager, security controller, etc. shall reach the SECR.
- The process unit persons will remain ready in their respective units for crash shutdown on the instruction from SECR.
- The persons from other sections will report to their respective officer.
- Residents of township will remain alert.

7.5.3 Safety Devices/Equipments

In order to make the services more effective, the workers and rescue team will be provided with the safety equipments and items like gas mask respirators, fire entry suits, fire blankets, rubber shoes or industrial shoes, rubber glove, ladders, ropes, petromax lamp torches etc.

7.5.4 Fire Extinguisher

The different type of fire extinguishers have been proposed at strategic locations in the plant and given in Table 7.2.

TABLE 7.2
DIFFERENT FIRE EXTINGUISHERS AT DIFFERENT SITES

Name of Site	Type of Fire Extinguishers
Generator area	CO_2 Type, Foam Type, Dry Chemical Powder
Cable galleries	CO_2 & Foam type, Dry chemical powder
High voltage panel	CO_2 & Foam type, Dry chemical powder
Control rooms	CO_2 & Foam type, Dry chemical powder
MCC rooms	CO_2 & Foam type, Dry chemical powder
Pump Houses	CO_2 & Foam type, Dry chemical powder
Fuel tank area	CO_2, Foam type, Dry chemical powder sand basket
Guest houses and offices	Dry chemical powder, foam type
Godowns	Foam type
Crusher house	CO_2, Dry chemical powder, foam type

7.5.5 Fire Protection and Safety Measures

In order to prevent disaster due to fire, explosion, oil spillage, electroduction and other accidents, following preventive measures shall be adopted:

Design, manufacture and construction of all plant and machineries building will be as per national and international codes as applicable in specific cases and laid down by statutory authorities

Provision of adequate access way for movement of equipment and personnel shall be kept.

Minimum two no. of gates for escape during disaster, shall be provided.

Water spraying in coal storage area.

System of fire hydrants comprising electrical motor division and diesel engine drivers fire pumps with electrical motor driver jokey pump for keeping the fire hydrant system properly pressurized and automatic water sprinkling system for all important transformers.

Fire hydrants with fire hoses in all areas where fire can break.

ANNEXURES

MONTH WISE AVERAGE MINIMUM TEMPERATURE (℃) AT IMD STATION RAIGARH

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG.
1994	14.00	16.40	20.80	25.50	28.90	26.70	24.80	24.90	24.50	22.40	17.80	12.90	**21.63**
1995	12.80	16.40	20.70	24.50	27.20	28.70	25.30	25.30	24.90	21.50	15.90	13.20	**21.37**
1996		15.40	19.70		28.50	26.50	24.70	25.90	24.90	21.50	22.90	12.30	**22.23**
1997	12.50	14.50	20.70	23.50	26.50	27.20	25.30	24.70	23.70	21.60	20.00	14.50	**21.23**
1998	11.50	14.30	14.30	25.80	28.00	27.70	25.40	25.70	25.20	22.60	18.90	12.30	**20.98**
1999	11.20	17.60	20.40	22.80	26.70			24.50	24.40	21.60	14.40		**20.40**
2000	12.30				26.20			25.00	24.30	23.20	16.50	10.80	**19.76**
2001	11.40	13.50	20.70	25.30	27.60		24.30	24.90	24.70	22.60			**21.67**
2002	13.50	16.00	20.40	25.50	27.10	25.30	25.80	24.50	24.20	21.50	16.00	13.70	**21.13**
2003	12.50	17.10	19.90	25.90	28.50	27.00	25.00	24.20	23.30	22.00			**22.54**
AVG.	**12.41**	**15.69**	**19.73**	**24.85**	**27.52**	**27.01**	**25.08**	**24.96**	**24.41**	**22.05**	**17.80**	**12.81**	**21.19**

MONTH WISE AVERAGE MAXIMUM TEMPERATURE (℃) AT IMD STATION RAIGARH

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG.
1994	28.90	29.50	37.60	38.40	42.50	35.10	30.90	30.40	31.70	32.00	29.30	28.00	**32.86**
1995	25.40	30.20	33.80	39.30	39.60	40.00	31.80	31.60	32.90	32.30	29.40	28.10	**32.87**
1996		30.70	36.10		45.70	35.70	32.50	30.50	34.50	32.60	32.00	28.40	**33.87**
1997	26.60	31.00	36.40	36.70	41.60	37.10	30.50	31.10	30.00	32.10	30.90	26.40	**32.53**
1998	25.70	23.30	32.80	38.30	41.60	38.60	30.80	32.40	32.10	32.30	29.90	27.90	**32.14**
1999	27.80	29.70	36.80	40.30	38.10			31.50	30.40	30.70	31.40		**32.97**
2000	29.60	29.00		43.30	40.70	35.00	32.00	31.90	32.00	35.50	33.50	29.20	**33.79**
2001	28.60	33.10	35.50	38.60	42.80	34.40	28.60	32.50	33.20	29.60		27.30	**33.11**
2002	28.40	30.80	36.00	40.40	42.10	35.00	34.70	30.80	31.90	33.20	31.00	29.70	**33.67**
2003	28.70	30.10	34.80	40.80	42.60	39.00	32.80	31.30	30.60	31.10			**34.18**
AVG.	**27.74**	**29.74**	**35.53**	**39.57**	**41.73**	**36.66**	**31.62**	**31.40**	**31.93**	**32.14**	**30.93**	**28.13**	**33.09**

Source : India Meteorological Department, Nagpur (Regional office)

ANNEXURE : I .

MONTH WISE TOTAL RAINFALL (mm) AT IMD STATION RAIGARH

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1994	10.2	0.0	0.0	18.4	0.0	524.9	825.5	339.7	277.5	21.7	0.0	0.0	**2017.9**
1995	29.5	23.0	46.4	28.4	22.9	151.7	575.4	322.6	150.8	120.5	56.4	0.0	**1527.6**
1996	18.0	10.5	12.4		2.5	211.2	458.0	459.1	139.9	1.1	0.0	0.0	**1312.7**
1997	4.5	0.0	0.0	285.0	12.1	191.8	378.1	464.7	299.4	1.0	51.5	137.2	**1825.3**
1998	76.4	7.8	22.0	4.7	4.5	118.3	269.0	250.3	392.4	32.4	18.8	0.0	**1196.6**
1999	0.0	0.0	0.0	0.0	90.2			544.5	197.7	4.4	0.0		**836.8**
2000	5.8	17.5	0.0	0.8	0.0	97.1	283.2	196.3	117.3	0.0	0.0	0.0	**718.0**
2001	0.0	0.0	39.7	16.2	35.5	547.7	539.9	221.9	98.1	51.1	0.0	0.0	**1550.1**
2002	13.8	1.2	21.3	24.0	32.0	181.0	154.2	414.0	294.3	25.2	0.0	0.0	**1161.0**
2003	0.0	57.1	4.2	0.0	0.0	201.3	234.6	625.8	609.8	119.6	0.0	0.0	**1852.4**
AVG.	**15.8**	**11.7**	**14.6**	**41.9**	**20.0**	**247.2**	**413.1**	**383.9**	**257.7**	**37.7**	**12.7**	**15.2**	**1471.6**

Source : India Meteorological Department, Nagpur (Regional office)

ANNEXURE : II .

MONTH WISE AVERAGE RELATIVE HUMIDITY (%) AT IMD STATION RAIGARH (0830 HRS)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG.
1994	71	64	52	47	43	74	88	86	83	77	74	73	**69**
1995	73	74	54	43	50	61	83	84	75	73	71	78	**68**
1996	76	79	46		40	65	81	84	78	68	58	62	**67**
1997	71	47	38	98	37	60	84	84	85	69	75	82	**69**
1998	79	71	57	52	47	58	80	83	78	78	77	72	**69**
1999	68	62	37	38	57	60		89	83	70	66		**63**
2000	69	72		41	44	75	84	82	78	66	73	61	**68**
2001	60	48	64	38	45	82	88	85	79	78	72	67	**67**
2002	66	59	40	43	43	73	74	87	83	74	66	71	**65**
2003	61	70	58	41	34	52	83	86	88	80			**65**
AVG.	**69**	**65**	**50**	**49**	**44**	**66**	**83**	**85**	**81**	**73**	**70**	**71**	**67**

Source : India Meteorological Department, Nagpur (Regional office)

MONTH WISE AVERAGE RELATIVE HUMIDITY (%) AT IMD STATION RAIGARH (1730 HRS)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG.
1994	43	34	37	26	20	65	80	80	71	60	51	37	**50**
1995	49	52	35	30	36	40	72	76	70	66	60	71	**55**
1996	61	44	29		28	52	75	85	74	65	49	44	**55**
1997	56	30	27	27	19	57	76	80	80	62	65	73	**54**
1998	64	50	34	34	30	52	75	80	77	73	67	49	**57**
1999	43	47	28	29	42	43		85	84	69	53		**52**
2000	49	67		22	30	73	78	79	79		43		**58**
2001			67	33	28	74	86	82	83			44	**62**
2002	43	34	23	36	21	56	61	82	75	61	53	53	**50**
2003	41	49	35	25	19	42	71	81	81	70			**51**
AVG.	**50**	**45**	**35**	**29**	**27**	**55**	**75**	**81**	**77**	**66**	**55**	**53**	**54**

Source : India Meteorological Department, Nagpur (Regional office)

ANNEXURE : III .

DAILY AVERAGE OF MICRO-METEOROLOGICAL MONITORED DATA
1 MARCH, 2006 TO 28 MAY, 2006

DATE	CALM	<---------- DIRECTION WISE AVERAGE WIND SPEED (km/hr) EXCLUDING CALM ---------->																TEMP.	REL_HUM
	<1.8kmph	E	ENE	NE	NNE	N	NNW	NW	WNW	W	WSW	SW	SSW	S	SSE	SE	ESE	(øC)	(%)
01/03/2006	0.72	0.00	6.72	4.14	7.03	0.00	4.27	8.43	10.35	5.21	9.53	4.33	0.00	0.00	0.00	4.04	0.00	26.18	31.00
02/03/2006	1.15	3.67	3.34	7.45	4.42	8.88	10.36	3.58	14.66	7.79	5.37	8.04	0.00	0.00	0.00	5.12	4.39	21.98	25.00
03/03/2006	1.05	8.24	5.56	4.47	8.11	5.25	2.58	8.64	10.08	7.24	6.18	7.71	0.00	0.00	0.00	0.00	9.82	21.16	19.00
04/03/2006	0.91	4.83	3.73	7.03	5.85	9.71	10.02	11.24	4.30	14.13	5.40	3.19	0.00	0.00	0.00	5.08	4.47	21.35	23.00
05/03/2006	1.28	5.95	2.94	3.26	6.74	3.85	9.99	8.20	8.78	7.31	6.83	7.86	0.00	0.00	0.00	3.10	8.72	21.45	20.00
06/03/2006	0.81	2.38	10.59	7.78	7.94	6.20	15.04	7.90	4.54	3.90	0.00	5.72	0.00	0.00	0.00	3.81	5.07	20.85	20.00
07/03/2006	1.53	9.33	5.32	3.88	3.53	6.95	5.24	8.56	5.41	8.72	8.98	9.45	0.00	0.00	0.00	2.88	8.28	21.81	20.00
08/03/2006	1.50	2.86	6.01	5.16	8.45	13.54	4.48	4.98	0.00	3.64	10.65	6.57	0.00	0.00	0.00	3.05	4.04	20.86	20.00
09/03/2006	1.19	8.59	3.32	8.41	4.11	6.25	9.22	9.73	8.01	7.49	6.05	7.22	0.00	0.00	0.00	2.58	9.19	20.61	25.00
10/03/2006	0.59	0.00	5.26	6.09	9.52	3.05	2.48	7.46	13.96	0.00	2.98	6.90	0.00	0.00	0.00	4.98	0.00	21.10	24.00
11/03/2006	0.72	3.25	2.60	7.17	5.03	6.05	9.94	11.70	8.26	7.66	8.65	3.22	0.00	0.00	0.00	2.02	3.99	21.06	25.00
12/03/2006	1.13	8.24	7.85	3.56	9.63	2.79	0.00	7.36	3.37	13.83	2.92	9.44	0.00	0.00	0.00	0.00	9.70	20.14	21.00
13/03/2006	1.06	3.95	3.20	7.75	5.72	7.92	6.66	9.28	5.72	10.25	5.34	5.86	0.00	0.00	0.00	4.79	5.17	20.40	28.00
14/03/2006	0.79	8.50	3.86	4.09	3.20	0.00	14.86	6.06	4.21	2.87	7.06	9.41	0.00	0.00	0.00	2.85	5.98	21.75	27.00
15/03/2006	1.26	4.06	7.54	7.83	8.28	8.38	9.75	4.60	7.33	8.73	10.35	6.35	0.00	0.00	0.00	5.34	4.54	21.76	19.00
16/03/2006	0.95	9.41	3.26	4.58	4.49	12.08	4.65	5.83	8.35	3.45	5.23	8.26	0.00	0.00	0.00	4.52	10.10	21.71	19.00
17/03/2006	0.54	3.50	6.93	4.93	8.38	10.63	5.85	4.68	11.85	7.24	3.38	7.59	0.00	0.00	0.00	2.57	2.82	21.53	18.00
18/03/2006	0.72	5.99	4.09	9.37	3.21	2.37	5.42	10.31	7.76	8.79	8.67	4.52	0.00	0.00	0.00	3.39	10.14	21.59	19.00
19/03/2006	0.95	0.00	6.28	4.91	7.33	9.15	10.35	7.98	2.19	12.28	2.50	5.76	0.00	0.00	0.00	4.51	0.00	20.36	19.00
20/03/2006	1.05	4.11	3.52	6.29	6.74	3.05	8.69	9.48	10.47	5.94	10.11	4.34	0.00	0.00	0.00	2.68	4.42	21.39	28.00
21/03/2006	0.53	7.77	6.82	5.11	9.02	7.20	13.45	8.02	3.56	4.31	7.55	7.48	0.00	0.00	0.00	0.00	8.64	21.03	20.00
22/03/2006	1.00	2.74	4.60	5.66	3.51	6.74	9.14	3.88	6.04	8.32	12.63	7.65	0.00	0.00	0.00	4.90	4.18	21.85	20.00
23/03/2006	0.73	10.15	2.72	4.71	5.91	10.18	2.38	10.23	6.62	1.91	7.93	8.92	0.00	0.00	0.00	4.93	9.85	22.50	18.00
24/03/2006	0.93	3.20	8.10	7.57	6.76	9.04	8.78	2.43	11.02	10.74	3.58	5.60	0.00	0.00	0.00	3.28	3.16	22.16	21.00
25/03/2006	0.72	5.53	4.41	7.31	5.84	5.61	4.20	8.62	8.83	5.85	8.57	8.13	0.00	0.00	0.00	5.11	9.66	22.15	17.00
26/03/2006	0.83	2.34	5.75	4.73	9.74	5.53	9.71	10.94	4.60	13.13	2.94	3.67	0.00	0.00	0.00	2.93	3.33	21.03	19.00
27/03/2006	0.23	7.30	3.17	5.53	6.52	3.51	7.28	6.77	8.28	7.87	10.46	8.65	0.00	0.00	0.00	4.93	7.74	20.30	21.00
28/03/2006	0.41	0.00	2.65	4.03	8.60	0.00	0.00	6.77	0.00	0.00	0.00	5.12	0.00	0.00	0.00	0.00	0.00	21.36	26.00
29/03/2006	1.19	2.09	3.82	0.00	9.48	8.72	4.94	8.46	8.90	12.51	6.84	8.28	3.56	4.85	2.74	5.15	2.02	31.06	38.00
30/03/2006	1.22	0.00	9.53	5.99	4.24	3.01	7.47	4.95	3.70	6.37	8.58	3.35	8.36	0.00	0.00	4.84	0.00	30.81	35.00
31/03/2006	0.49	4.62	0.00	4.62	0.00	8.66	4.72	8.47	7.01	12.42	7.16	5.72	2.20	5.49	6.78	4.47	3.75	30.23	35.00
01/04/2006	1.37	8.89	3.91	3.78	4.33	2.57	7.93	6.84	2.69	5.60	8.61	10.99	7.08	5.65	3.94	6.94	8.54	30.49	34.00
02/04/2006	0.98	0.00	4.57	4.66	6.78	10.12	0.00	4.82	6.48	10.58	10.29	4.94	3.90	0.00	5.03	5.14	4.75	31.08	35.00
03/04/2006	0.88	3.98	0.00	6.32	4.70	4.67	3.48	9.29	3.63	7.96	5.04	7.11	0.00	2.66	0.00	4.26	0.00	30.95	35.00
04/04/2006	1.32	3.39	8.47	5.37	0.00	6.73	5.94	3.74	9.95	11.41	14.10	8.13	8.80	2.57	8.56	0.00	5.45	30.99	35.00
05/04/2006	1.03	8.31	4.13	4.50	2.48	2.93	3.01	7.93	0.00	0.00	5.97	10.60	4.21	9.14	4.77	5.80	7.42	30.80	35.00
06/04/2006	1.21	0.00	4.80	4.79	6.14	0.00	6.91	4.27	3.62	6.15	11.13	4.41	7.33	0.00	0.00	6.90	0.00	30.57	34.00
07/04/2006	1.03	4.00	0.00	7.81	0.00	9.39	4.43	8.36	9.83	13.16	7.29	7.81	4.58	3.91	2.30	4.19	5.08	30.45	35.00
08/04/2006	0.25	4.17	8.79	3.90	2.92	4.98	8.52	2.63	3.40	5.90	9.94	0.00	8.90	3.51	7.50	6.17	4.85	30.95	35.00
09/04/2006	1.07	6.48	3.34	9.49	3.77	6.11	2.44	8.04	10.37	11.46	4.95	7.01	4.67	0.00	3.38	5.37	5.41	30.91	35.00
10/04/2006	0.29	0.00	0.00	3.95	8.16	4.63	8.56	6.81	2.63	5.29	9.80	7.73	7.23	8.47	0.00	6.16	0.00	30.70	35.00
11/04/2006	1.04	3.12	4.39	8.44	0.00	6.75	0.00	4.93	8.72	13.19	0.00	5.59	4.01	2.99	3.93	4.59	3.46	30.69	35.00
12/04/2006	0.92	3.80	9.52	4.57	3.41	4.30	5.27	8.00	2.44	9.26	5.83	10.78	8.56	3.49	5.73	6.45	3.91	30.88	35.00
13/04/2006	1.02	0.00	2.60	4.71	5.01	7.81	8.59	3.39	9.15	11.97	8.93	6.40	6.37	0.00	2.44	7.55	0.00	31.07	35.00

ANNEXURE : IV

DATE	CALM	<---------- DIRECTION WISE AVERAGE WIND SPEED (km/hr) EXCLUDING CALM ---------->																TEMP.	REL_HUM
	<1.8kmph	E	ENE	NE	NNE	N	NNW	NW	WNW	W	WSW	SW	SSW	S	SSE	SE	ESE	(øC)	(%)
14/04/2006	0.59	8.65	0.00	3.49	6.64	4.55	4.75	8.31	0.00	0.00	10.03	7.25	5.11	10.66	0.00	5.90	10.10	30.50	35.00
15/04/2006	0.70	3.89	2.43	7.97	0.00	0.00	7.67	4.37	2.29	10.16	11.41	6.77	7.21	3.41	2.73	8.81	4.51	30.60	35.00
16/04/2006	0.75	2.11	9.59	0.00	2.81	9.29	3.82	7.51	6.84	13.80	6.21	6.66	5.70	0.00	6.89	3.40	2.57	30.90	35.00
17/04/2006	1.30	0.00	2.75	3.53	5.08	4.32	9.05	5.02	4.94	6.31	8.70	9.00	6.10	4.74	0.00	6.28	0.00	30.40	34.00
18/04/2006	1.22	7.19	0.00	4.73	0.00	6.02	3.90	8.11	9.39	11.12	5.34	4.35	4.03	7.26	4.51	3.62	6.13	30.67	34.00
19/04/2006	1.05	3.07	3.58	7.94	9.29	2.43	6.72	6.79	3.67	10.08	12.32	10.26	5.02	4.21	3.84	9.46	3.83	30.38	35.00
20/04/2006	0.99	0.00	6.37	9.78	2.43	8.38	0.00	4.42	9.60	14.84	2.00	5.03	6.70	0.00	9.81	3.46	0.00	30.30	35.00
21/04/2006	1.22	3.10	0.00	4.18	3.58	2.32	2.59	7.08	2.90	5.87	9.48	10.57	0.00	3.94	0.00	7.70	4.10	30.53	35.00
22/04/2006	0.81	7.16	3.33	5.44	0.00	9.56	8.40	3.44	7.77	13.93	9.27	5.91	3.79	9.87	4.84	0.00	10.50	30.51	35.00
23/04/2006	0.73	4.68	4.63	4.28	6.64	5.74	2.93	8.64	0.00	0.00	6.99	9.13	3.98	4.78	3.69	4.38	4.55	30.90	35.00
24/04/2006	0.68	0.00	8.68	8.38	4.58	0.00	8.55	4.82	2.75	5.59	8.83	4.94	8.29	0.00	0.00	5.97	0.00	30.78	35.00
25/04/2006	1.20	2.56	0.00	3.68	0.00	5.93	3.35	5.93	6.81	13.39	9.38	8.82	3.93	2.83	8.79	5.93	3.54	30.94	35.00
26/04/2006	1.14	6.29	4.01	3.52	4.90	5.60	9.08	4.58	5.15	7.13	10.27	0.00	6.28	8.22	4.68	6.30	7.06	30.82	34.00
27/04/2006	1.15	0.00	3.63	6.76	6.84	7.84	4.23	7.83	7.60	14.27	8.41	5.72	4.19	0.00	2.56	4.72	3.78	30.64	35.00
28/04/2006	0.89	3.90	0.00	7.80	3.08	4.01	8.10	6.18	2.06	8.24	9.12	7.94	5.99	3.09	0.00	6.01	0.00	31.34	35.00
29/04/2006	1.44	3.04	9.98	5.04	0.00	9.68	0.00	4.22	9.03	14.94	0.00	7.13	5.45	3.82	6.04	4.88	3.31	30.76	35.00
30/04/2006	0.99	6.65	2.97	4.71	3.80	3.75	2.70	8.73	3.92	8.00	6.56	11.44	2.34	10.55	3.04	5.68	7.57	31.08	35.00
01/05/2006	0.71	0.00	4.59	4.49	6.97	5.86	6.20	3.41	6.80	11.31	12.44	4.90	6.94	0.00	0.00	4.73	0.00	30.60	35.00
02/05/2006	0.34	4.15	0.00	5.94	0.00	3.97	2.08	7.89	0.00	0.00	7.93	6.40	3.38	5.01	5.50	3.69	3.80	31.01	34.00
03/05/2006	1.40	4.36	5.70	4.45	3.74	0.00	0.00	0.00	4.70	0.00	0.00	0.00	0.00	7.45	0.00	7.28	7.63	30.67	41.00
04/05/2006	0.27	5.54	4.52	2.76	3.22	0.00	0.00	0.00	0.00	0.00	6.93	4.31	0.00	5.14	7.83	6.95	7.96	34.53	44.00
05/05/2006	0.39	4.54	3.45	4.93	4.04	0.00	0.00	0.00	0.00	0.00	0.00	8.38	2.89	5.41	8.43	0.00	7.05	34.93	40.00
06/05/2006	0.15	0.00	6.39	6.40	2.68	4.36	4.53	0.00	0.00	5.09	0.00	7.91	10.31	0.00	6.70	4.30	4.80	35.38	40.00
07/05/2006	0.09	8.80	3.23	5.33	7.54	5.69	0.00	13.80	7.07	6.35	3.46	13.96	6.15	9.17	3.03	6.55	0.00	36.66	40.00
08/05/2006	0.82	0.00	0.00	3.74	3.13	0.00	0.00	0.00	0.00	0.00	10.02	3.92	10.95	7.66	9.18	7.84	4.26	31.90	40.00
09/05/2006	1.40	0.00	8.62	5.88	3.64	3.35	9.82	3.42	0.00	9.92	0.00	11.90	6.80	5.45	6.30	7.77	0.00	34.62	41.00
10/05/2006	0.80	11.76	9.66	0.00	0.00	0.00	3.59	4.25	4.39	0.00	0.00	5.43	14.77	9.73	4.11	3.89	5.21	35.64	45.00
11/05/2006	0.00	4.62	3.29	6.40	5.57	3.58	9.88	8.05	0.00	0.00	3.31	0.00	8.11	6.55	5.15	0.00	5.07	35.80	47.00
12/05/2006	0.62	0.00	6.95	4.24	0.00	0.00	0.00	0.00	9.19	0.00	6.84	9.58	3.98	9.79	5.16	5.25	5.65	34.87	52.00
13/05/2006	1.56	3.67	7.90	5.94	7.64	0.00	5.74	9.51	8.36	3.53	6.85	3.89	4.14	11.99	4.17	11.65	3.55	31.76	51.00
14/05/2006	1.68	0.00	2.35	10.67	4.71	0.00	3.67	6.79	0.00	0.00	3.82	6.13	6.37	2.96	7.94	3.88	6.17	30.28	38.00
15/05/2006	0.88	4.89	0.00	5.57	0.00	0.00	0.00	0.00	0.00	6.04	0.00	3.51	7.80	8.72	13.93	2.65	2.11	32.15	44.00
16/05/2006	0.28	7.39	12.84	0.00	0.00	0.00	0.00	6.44	7.26	0.00	0.00	6.80	10.30	8.10	7.24	6.32	3.48	36.53	41.00
17/05/2006	1.32	0.00	6.16	4.26	6.14	0.00	0.00	0.00	0.00	0.00	5.25	4.18	9.35	10.50	12.74	5.12	4.06	36.50	33.00
18/05/2006	0.13	0.00	4.71	4.49	0.00	0.00	9.03	0.00	0.00	0.00	9.87	4.69	9.90	6.42	8.28	6.91	10.60	37.29	27.00
19/05/2006	0.22	10.02	2.70	6.43	5.45	2.03	0.00	3.84	14.82	7.07	0.00	0.00	7.63	12.68	0.00	5.91	0.00	33.18	32.00
20/05/2006	1.14	0.00	2.49	6.60	8.92	0.00	7.65	0.00	0.00	14.49	2.30	7.84	5.11	9.22	8.50	9.74	5.09	31.69	36.00
21/05/2006	0.00	2.64	7.87	3.88	6.63	5.90	0.00	8.08	5.08	0.00	7.37	3.56	6.65	9.47	7.94	7.01	5.42	29.12	34.00
22/05/2006	0.61	3.98	4.67	6.31	4.38	0.00	7.89	6.37	21.14	12.44	0.00	4.98	5.56	3.85	4.04	0.00	0.00	32.85	45.00
23/05/2006	0.00	5.85	11.56	7.85	0.00	1.81	6.21	0.00	5.06	6.74	0.00	6.12	6.42	5.32	5.36	5.17	5.97	34.30	48.00
24/05/2006	1.03	9.93	3.98	7.65	3.31	0.00	8.10	0.00	7.92	2.21	6.40	6.97	9.91	6.61	4.44	4.18	5.33	35.56	45.00
25/05/2006	0.73	8.46	8.61	3.64	0.00	3.08	0.00	6.44	9.36	8.44	0.00	0.00	0.00	0.00	0.00	8.05	6.18	35.75	43.00
26/05/2006	1.25	4.01	8.30	4.41	12.16	5.69	7.29	0.00	7.19	0.00	6.87	4.38	0.00	4.04	6.27	0.00	2.79	35.24	45.00
27/05/2006	1.40	0.00	0.00	6.84	7.07	7.22	8.51	0.00	7.50	8.25	10.38	0.00	6.92	6.52	9.15	2.48	0.00	35.87	42.00
28/05/2006	1.52	6.68	0.00	2.90	0.00	0.00	5.80	4.46	0.00	7.72	8.09	7.45	0.00	0.00	0.00	5.86	8.47	35.75	42.00
29/05/2006	0.32	0.00	4.60	9.71	3.91	5.91	7.20	8.35	11.58	9.40	3.92	0.00	11.41	7.26	4.95	6.00	0.00	33.23	52.00
30/05/2006	0.00	5.82	14.40	5.24	5.11	0.00	14.38	9.18	0.00	0.00	0.00	6.38	0.00	10.55	0.00	3.55	4.26	32.12	57.00
31/05/2006	0.00	0.00	8.38	7.94	4.36	0.00	0.00	5.75	7.47	0.00	0.00	4.85	0.00	10.38	0.00	3.55	4.14	32.48	57.00

ANNEXURE : IV Contd.

ANNEXURE : V

[1]SCHEDULE VII

(See Rule 3B)

National Ambient Air Quality Standards (NAAQS)

Pollutants	Time-weighted average	Concentration of ambient air (All concentrations are μ g/m^3 except for CO in mg/m^3)			Method of measurement
		Industrial area	Residential, Rural & other areas	Sensitive area	
1	2	3	4	5	6
Sulphur Dioxide (SO_2)	Annual Avg*	80	60	15	- Improved West and Gaeke Method
	24 hours**	120	80	30	- Ultraviolet Fluorescence
Oxides of Nitrogen as NO_x	Annual Avg*	80	60	15	- Jacob & Hochheiser Modified (Na-Arsenite) Method
	24 hours**	120	80	30	- Gas Phase Chemiluminescence
Suspended Particulate Matter (SPM)	Annual Avg* 24 hours**	360 500	140 200	70 100	High Volume Sampling, (Average flow rate not less than 1.1 m^3/ minute)
Respirable Particulate Matter (RPM)	Annual Avg* 24 hours**	120 150	60 100	50 75	Respirable particulate matter sampler
Lead (Pb)	Annual Avg* 24 hours**	1.0 1.5	0.75 1.00	0.50 0.75	AAS Method after sampling using EPM 2000 or equivalent Filter paper
Carbon Monoxide (CO)	8 hour ** 1 hour	5.0 10.0	2.0 4.0	1.0 2.0	Non dispersive infra red Spectroscopy

* Annual Arithmetic mean of minimum: 104 measurements in year taken twice a week 24 hourly 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 two consecutive days.

NOTE:

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

SOURCE : Pollution Control Acts, Rules and Notifications Issued Thereunder, Pollution Control Law Series : PCLS/02/1992 (Fourth Edition) of Central Pollution Control Board, September 2001, pp 381-82

[1] Inserted by Rule 5(b) of the Environment (Protection) Rules, 1996 published by G.S.R. 176(E), dated 2.4.1996

AMBIENT AIR QUALITY TEST RESULTS

2x150 MW MIDDLING & COAL FINE BASED THERMAL POWER PLANT OF JSPL

Sl. No.	Date of sampling	24 hrly concentrations (in µg/m^3)																			
		RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx
	Locations	**Core zone (CA1)**				**Baljor (BA1)**				**Sarasmal Kosampali (BA2)**				**Libra village (BA3)**				**Nagarmuda vill. (BA4)**			
1	02-03/03/2006	65	160	12.2	17.3	68	167	9.9	11.4	33	80	11.9	15.2	49	121	7.3	14.9	58	144	9.7	13.9
2	06-07/03/2006	71	175	11.0	12.2	65	161	12.6	13.7	50	124	7.5	14.8	50	123	8.4	16.1	50	123	7.4	16.5
3	09-10/03/2006	73	181	9.6	17.1	55	137	8.3	14.0	47	114	8.8	12.3	64	159	9.9	12.1	54	133	7.2	12.9
4	12-13/03/2006	63	156	11.5	15.7	50	124	9.2	12.6	42	105	8.3	13.0	65	160	9.5	12.5	64	158	8.3	17.0
5	16-17/03/2006	73	180	9.3	13.3	60	149	12.3	12.1	58	144	7.7	14.9	68	168	9.5	14.8	49	122	12.7	15.7
6	21-22/03/2006	62	154	14.0	14.4	54	136	9.7	12.2	39	95	9.8	10.5	56	138	12.3	13.1	64	158	10.0	16.0
7	25-26/03/2006	65	162	12.0	14.6	60	149	11.1	11.7	38	94	8.9	15.9	53	132	10.7	14.8	60	149	12.9	11.2
8	29-30/03/2006	74	182	8.4	17.2	65	160	12.7	16.0	39	96	6.4	13.3	58	143	10.0	12.5	64	157	9.5	16.5
9	02-03/04/2006	68	170	12.0	17.3	64	159	8.0	16.4	34	84	9.2	10.8	57	143	12.4	12.4	49	121	8.1	16.8
10	06-07/04/2006	66	163	9.7	17.8	59	147	11.7	12.1	32	80	10.0	13.9	49	122	8.2	15.4	50	122	8.5	15.1
11	10-11/04/2006	66	164	12.2	12.7	68	168	11.6	16.9	51	126	11.7	13.8	63	157	11.0	14.8	54	133	11.3	13.8
12	13-14/04/2006	64	158	9.5	13.9	45	113	7.5	13.1	59	147	10.7	14.2	60	148	7.1	12.8	58	143	10.3	16.9
13	17-18/04/2006	65	161	13.3	17.6	61	149	8.5	11.4	28	71	10.8	10.7	61	150	9.3	15.4	50	123	8.5	12.7
14	21-22/04/2006	74	184	8.8	15.8	62	154	7.0	15.6	36	89	7.0	11.9	64	159	12.5	14.5	53	132	7.7	13.5
15	25-26/04/2006	72	180	8.5	14.2	58	143	8.5	11.6	30	73	10.8	10.7	49	122	9.6	17.0	64	159	7.4	14.2
16	29-30/04/2006	61	151	10.7	12.6	47	116	8.3	15.4	46	112	9.7	10.8	65	162	7.2	15.9	51	127	8.6	13.5
17	03-04/05/2006	67	166	11.5	13.5	64	157	8.9	12.2	49	120	6.9	13.7	65	160	10.2	11.8	54	135	10.6	12.2
18	07-08/05/2006	64	160	12.1	15.3	54	134	12.1	16.8	55	136	11.7	12.5	63	156	11.2	15.9	59	145	12.2	14.9
19	11-12/05/2006	63	157	11.0	17.9	49	122	8.7	13.5	38	92	10.2	10.4	57	141	7.6	14.7	61	152	10.1	16.6
20	14-15/05/2006	63	157	11.8	17.4	53	131	10.4	14.7	49	123	9.0	10.8	66	166	12.8	11.5	60	149	11.5	16.2
21	17-18/05/2006	73	180	11.4	14.2	59	146	7.4	11.9	45	111	11.3	10.6	60	149	9.1	12.3	55	137	9.6	16.1
22	20-21/05/2006	68	169	11.4	17.3	56	139	9.2	15.0	36	88	9.3	11.1	60	148	11.5	12.5	56	138	8.7	13.0
23	23-24/05/2006	69	173	12.1	14.3	49	121	11.9	12.4	55	136	10.2	11.0	58	146	11.4	12.2	55	137	9.7	12.1
24	27-28/05/2006	71	174	9.6	15.6	47	117	8.1	14.4	52	128	7.5	13.9	49	122	11.4	13.4	59	144	8.4	14.2
	Minimum	**61**	**151**	**8.4**	**12.2**	**45**	**113**	**7.0**	**11.4**	**28**	**71**	**6.4**	**10.4**	**49**	**121**	**7.1**	**11.5**	**49**	**121**	**7.2**	**11.2**
	Maximum	**74**	**184**	**14.0**	**17.9**	**68**	**168**	**12.7**	**16.9**	**59**	**147**	**11.9**	**15.9**	**68**	**168**	**12.8**	**17.0**	**64**	**159**	**12.9**	**17.0**
	Average	**68**	**167**	**11.0**	**15.4**	**57**	**142**	**9.7**	**13.6**	**43**	**107**	**9.4**	**12.5**	**59**	**146**	**10.0**	**13.9**	**56**	**139**	**9.5**	**14.6**
	98 percentile	**74**	**183**	**13.7**	**17.9**	**68**	**168**	**12.7**	**16.9**	**59**	**146**	**11.8**	**15.6**	**67**	**167**	**12.7**	**16.6**	**64**	**159**	**12.8**	**17.0**

ANNEXURE : VI

WATER TEST RESULT

Sl. No.	Parameters	Desirable Limits	Permissible Limits	*Libra village*	Janjgir village	Amgaon village	Baljor village	Mine colony	Tapranga village	Dhaurabhata village	Jharna village
1.	Colour, Hazen units	5	25	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
2.	Odour	Unobject-ionable	Unobject-ionable	Unobjec-tionable	Unobjec-tionable	Unobjec-tionable	Unobjec-tionable	Unobjec-tionable	Unobjec-tionable	Unobjec-tionable	Unobjec-tionable
3.	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4.	Turbidity, (NTU)	5	10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
5.	pH value	6.5-8.5	6.5-8.5	7.3	6.8	7.0	6.9	6.8	7.2	6.9	7.1
6.	Total hardness as $CaCO_3$, (mg/l)	300	600	104	96	112	120	60	80	128	96
7.	Iron as Fe, (mg/l)	0.3	1.0	0.88	0.27	0.14	0.14	0.45	0.18	0.18	0.56
8.	Chlorides as Cl, (mg/l)	250	1000	12	16	16	28	20	24	20	24
9.	Residual, free chlorine, (mg/l)	0.2	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
10.	Dissolved solids, (mg/l)	500	2000	143	120	165	188	79	128	172	138
11.	Calcium as Ca, (mg/l)	75	200	20.8	19.2	22.4	28.8	11.2	20.8	27.2	19.2
12.	Copper as Cu, (mg/l)	0.05	1.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
13.	Manganese as Mn, (mg/l)	0.1	0.3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
14.	Sulphate as SO_4 ,(mg/l)	200	400	9.5	2.9	4.8	57.5	3.7	6.2	4.3	5.4
15.	Nitrate as NO_3 ,(mg/l)	45	100	8.4	9.2	8.1	7.8	9.5	7.5	8.1	8.7
16.	Fluoride as F, (mg/l)	1.0	1.5	0.18	0.49	0.55	0.22	0.12	0.52	0.92	0.14
17.	Mercury as Hg, (mg/l)	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
18.	Cadmium as Cd, (mg/l)	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
19.	Selenium as Se, (mg/l)	0.01	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
20.	Arsenic as As, (mg/l)	0.05	0.05	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
21.	Lead as Pb, (mg/l)	0.05	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
22.	Zinc as Zn, (mg/l)	5	15	0.02	0.02	0.02	0.09	0.27	0.02	0.02	0.90
23.	Chromium as Cr^{6+}, (mg/l)	0.05	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
24.	Magnesium as Mg, (mg/l)	-	-	12.6	11.6	13.6	11.6	7.7	6.8	14.5	11.6
25.	Alkalinity, (mg/l)	200	600	124	108	134	56	66	96	136	104
26.	Aluminum as A, (mg/l)	0.03	0.2	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
27.	Boron as B (mg/l)	1	5	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
28.	Nickel as Ni, (mg/l)	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
29.	Sodium as Na, (mg/l)	-	-	7.0	6.1	7.2	8.1	6.2	7.5	7.1	6.5
30.	Potassium as K, (mg/l)	-	-	6.3	5.9	7.2	4.5	5.0	5.8	4.6	6.9

ANNEXURE : VII

Table 1 Test Characteristics For Drinking Water

(*Clause* 3.1)

Sl No.	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect Outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Essential Characteristics						
i)	Colour, Hazen units, *Max*	5	Above 5, consumer acceptance decreases	25	3025 (Part 4) : 1983	Extended to 25 only if toxic substances are not suspected, in absence of alternate sources
ii)	Odour	Unobjectionable	—	—	3025 (Part 5) : 1983	a) Test cold and when heated b) Test at several dilutions
iii)	Taste	Agreeable	—	—	3025 (Parts 7 and 8) : 1984	Test to be conducted only after safety has been established
iv)	Turbidity, NTU, *Max*	5	Above 5, consumer acceptance decreases	10	3025 (Part 10) : 1984	—
v)	*p*H value	6·5 to 8·5	Beyond this range the water will affect the mucous membrane and/ or water supply system	No relaxation	3025 (Part 11) : 1984	—
vi)	Total hardness (as $CaCO_3$) mg/l, *Max*	300	Encrustation in water supply structure ane adverse effects on domestic use	600	3025 (Part 21) : 1983	—
vii)	Iron (as Fe) mg/l, *Max*	0·3	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures, and promotes iron bacteria	1·0	32 of 3025 : 1964	—
viii)	Chlorides (as Cl) mg/l, *Max*	250	Beyond this limit, taste, corrosion and palatibility are affected	1 000	3025 (Part 32) : 1988	—
ix)	Residual, free chlorine, mg/l, *Max*	0·2	—	—	3025 (Part 26) : 1986	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be *Min* 0·5 mg/l.
Desirable Characteristics						
x)	Dissolved solids mg/l, *Max*	500	Beyond this palatability decreases and may cause gastro intestinal irritation	2 000	3025 (Part 16) : 1984	—
xi)	Calcium (as Ca) mg/l, *Max*	75	Encrustation in water supply structure and adverse effects on domestic use	200	3025 (Part 40) : 1991	—

Table 1 Test Characteristics for Drinking Water (*Contd*)

Sl No.	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect Outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
xii)	Copper (as Cu) mg/l, *Max*	0·05	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond this	1·5	**36** of 3025 : 1964	—
xiii)	Manganese (as Mn) mg/l, *Max*	0·1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures	0·3	**35** of 3025 : 1964	—
xiv)	Sulphate (as SO_4) mg/l, *Max*	200	Beyond this causes gastro intenstinal irritation when magnesium or sodium are persent	400 (*see* col 7)	3025 (Part 24) : 1986	May be extended up to 400 provided (as Mg) does not exceed 30
xv)	Nitrate (as NO_3) mg/l, *Max*	45	Beyond this methaemoglobinemia takes place	100	3025 (Part 34) : 1988	—
xvi)	Fluoride (as F) mg/l, *Max*	1·0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1·5	**23** of 3025 : 1964	—
xvii)	Phenolic compounds (as C_6H_5OH) mg/l, *Max*	0·001	Beyond this, it may cause objectionable taste and odour	0·002	**54** of 3025 : 1964	—
xviii)	Mercury (as Hg) mg/l, *Max*	0·001	Beyond this, the water becomes toxic	No relaxation	(*see* Note) Mercury ion analyser	To be tested when pollution is suspected
xix)	Cadmium (as Cd), mg/l, *Max*	0·01	Beyond this, the water becomes toxic	No relaxation	(*ses* Note)	To be tested when pollution is suspected
xx)	Selenium (as Se), mg/l, *Max*	0·01	Beyond this, the water becomes toxic	No relaxation	**28** of 3025 : 1964	To be tested when pollution is suspected
xxi)	Arsenic (as As), mg/l, *Max*	0·05	Beyond this, the water becomes toxic	No relaxation	3025 (Part 37) : 1988	To be tested when pollution is suspected
xxii)	Cyanide (as CN), mg/l, *Max*	0·05	Beyond this limit, the water becomes toxic	No relaxation	3025 (Part 27) : 1986	To be tested when pollution is suspected
xxiii)	Lead (as Pb), mg/l, *Max*	0·05	Beyond this limit, the water becomes toxic	No relaxation	(*see* Note)	To be tested when pollution/plumbosolvency is suspected
xxiv)	Zinc (as Zn). mg/l, *Max*	5	Beyond this limit it can cause astringent taste and an opalescence in water	15	**39** of 3025 : 1964	To be tested when pollution is suspected
xxv)	Anionic detergents (as MBAS) mg/l, *Max*	0·2	Beyond this limit it can cause a light froth in water	1·0	Methylene-blue extraction method	To be tested when pollution is suspected
xxvi)	Chromium (as Cr^{6+}) mg/l, *Max*	0·05	May be carcinogenic above this limit	No relaxation	**38** of 3025 : 1964	To be tested when pollution is suspected

(*continued*)

Table 1 Test Characteristics for Drinking Water (*concluded*)

Sl No.	Substance or Characteristic	Requirement (Desirable Limit)	Undesirable Effect Outside the Desirable Limit	Permissible Limit in the Absence of Alternate Source	Methods of Test (Ref to IS)	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
xxvii)	Polynuclear aromatic hydrocarbons (as PAH) g/l, *Max*	—	May be carcinogenic	—	—	—
xxviii)	Mineral oil mg/l, *Max*	0·01	Beyond this limit undesirable taste and odour after chlorination take place	0·03	Gas chromatographic method	To be tested when pollution is suspected
xxix)	Pesticides mg/l, *Max*	Absent	Toxic	0·001	—	—
xxx)	Radioactive materials:				58 of 3025 : 1964	
	a) Alpha emitters Bq/l, *Max*	—	—	0·1	—	—
	b) Beta emitters pci/l, *Max*	—	—	1	—	—
xxxi)	Alkalinity mg/l, *Max*	200	Beyond this limit taste becomes unpleasant	600	13 of 3025 : 1964	—
xxxii)	Aluminium (as Al), mg/l, *Max*	0·03	Cumulative effect is reported to cause dementia	0·2	31 of 3025 : 1964	—
xxxiii)	Boron, mg/l, *Max*	1	—	5	29 of 3025 : 1964	—

NOTE — Atomic absorption spectrophotometric method may be used.

NOISE LEVELS WITHIN THE STUDY AREA [Leq in dB(A)]
2x150 MW MIDDLING AND COAL FINE BASED THERMAL POWER PLANT OF JSPL

Hours	Tamnar (BN1)	Tapranga (BN2)	Janjgir (BN3)	Gare (BN4)	Dhaurabhanta (BN5)	Dongamuha (BN6)	Bilai munda (BN7)
Date of monitoring	**08-09/04/06**	**10-11/04/06**	**13-14/04/06**	**16-17/04/06**	**19-20/04/06**	**22-23/04/06**	**25-26/04/06**
1.00	46.30	48.80	42.40	46.10	44.90	52.60	55.20
2.00	48.40	50.80	49.80	49.50	43.60	48.20	59.60
3.00	50.20	44.50	49.10	52.10	48.30	53.00	52.90
4.00	51.10	48.50	51.00	49.70	45.80	51.90	50.20
5.00	47.40	50.30	52.10	47.30	44.40	53.50	55.00
6.00	45.50	50.50	51.80	52.10	47.70	50.90	54.00
7.00	54.80	46.80	59.30	57.30	60.80	58.90	57.30
8.00	57.60	51.00	54.00	61.80	46.90	57.60	59.60
9.00	58.00	53.70	53.40	60.80	52.30	55.60	57.80
10.00	49.50	60.50	56.40	56.60	54.40	57.90	60.10
11.00	56.50	62.90	61.10	54.60	50.50	56.40	60.20
12.00	50.60	54.00	59.60	53.10	63.50	55.00	58.40
13.00	59.30	59.80	57.50	60.60	49.60	60.90	62.90
14.00	50.30	63.40	62.60	60.60	57.80	56.80	61.30
15.00	53.20	53.60	61.50	57.40	62.20	60.50	60.40
16.00	56.50	67.10	59.00	64.10	57.20	62.40	59.30
17.00	56.10	52.10	58.40	59.40	65.00	60.90	57.80
18.00	52.60	50.90	55.70	58.80	59.40	56.50	67.30
19.00	57.90	64.20	53.20	62.00	48.20	58.80	66.40
20.00	52.80	49.30	52.10	59.10	55.80	58.90	68.20
21.00	52.20	47.50	47.90	52.40	56.90	65.00	65.60
22.00	49.40	45.30	48.20	49.50	51.90	52.40	59.60
23.00	50.80	47.50	44.80	41.70	46.90	46.40	53.30
24.00	46.90	49.60	42.90	48.70	47.60	49.00	58.10
Day time Leq.	**54.50**	**55.80**	**56.80**	**58.60**	**56.00**	**58.80**	**61.50**
Night time Leq.	**48.40**	**48.40**	**48.00**	**48.50**	**46.80**	**50.90**	**55.30**
Average Leq.	**52.20**	**53.00**	**53.50**	**54.80**	**52.60**	**55.80**	**59.20**
Permissible (Day)	**55**	**55**	**55**	**55**	**55**	**55**	**55**
Permissible (Night)	**45**	**45**	**45**	**45**	**45**	**45**	**45**

ANNEXURE : IX

ANNEXURE : XI

LAND USE PATTTERN WITHIN THE STUDY AREA AS PER CENSUS 2001 RECORDS (area in Ha.)

Town/ village code	Town/village name	Total area	Forest land	Irrigated land	Unirrigated land	Culturable waste land	Area not available for cultivation
District	**Sundargarh**						
Tehsil	**Hemgir**						
00375300	Mendra	195.50	49.51	8.00	107.92	6.62	23.45
00375400	Jamkani	453.30	23.90	4.00	365.48	12.61	47.31
00375500	Jamkani (R.F.)	0.00	0.00	0.00	0.00	0.00	0.00
00375600	Girisima	302.16	25.61	0.00	129.24	1.63	145.68
00376900	Ghogharpali	227.30	11.91	0.00	169.00	3.65	42.74
00377000	Latapani	124.00	26.40	0.00	96.40	0.84	0.36
00377100	Bhograkachhar	466.33	60.61	8.00	381.02	1.37	15.33
00377200	Bijahan	254.29	5.61	6.00	171.60	3.28	67.80
00377300	Jharpalam	474.96	140.89	46.00	258.17	23.53	6.37
00377400	Gaikanpali	223.50	13.42	4.00	197.38	1.25	7.45
00377500	Samarpinda	96.94	10.32	4.00	78.93	1.68	2.01
00377600	Kandadhuda	411.25	245.87	2.80	35.78	4.92	121.88
00377700	Beldhipa	82.76	48.31	0.00	21.32	2.74	10.39
00377800	Chakra	144.62	61.81	0.00	66.16	6.13	10.52
00377900	Bileimunda	302.00	41.29	0.00	217.95	6.55	36.21
00378000	Mundelkhet	393.86	57.68	0.00	322.21	1.25	12.72
00378200	Chhatabar	288.14	85.45	8.00	146.22	6.71	41.76
00380500	Garjanjore	638.00	140.50	0.00	428.20	10.18	59.12
00380700	Luabahal	220.00	11.40	0.00	176.16	11.13	21.31
00380800	Pandiapali	173.06	37.04	0.00	129.02	1.15	5.85
00380900	Pithampur	240.60	95.10	8.00	116.12	2.55	18.83
00381000	Toparia	1411.01	198.92	12.00	922.52	12.98	264.59
00381100	Chandarpur	111.74	19.06	0.00	83.33	0.42	8.93
00381300	Chatakpur	238.25	11.37	4.00	210.63	0.88	11.37
	Sub total	**7473.57**	**1421.98**	**114.80**	**4830.76**	**124.05**	**981.98**
Tehsil	**Lephripara**						
00393800	Bandega	284.05	97.01	0.00	114.35	13.70	58.99
	Sub total	**284.05**	**97.01**	**0.00**	**114.35**	**13.70**	**58.99**
	Total from Sundargarh	**7757.62**	**1518.99**	**114.80**	**4945.11**	**137.75**	**1040.97**
District	**Raigarh**						
Tehsil	**Lailunga**						
00340400	Munda Gaon	876.00	0.00	11.00	779.00	42.00	44.00
	Sub total	**876.00**	**0.00**	**11.00**	**779.00**	**42.00**	**44.00**
Tehsil	**Gharghoda**						
00359600	Uraba	419.00	16.00	10.00	244.00	117.00	32.00
00359700	Hinjher	293.00	60.00	8.00	137.00	67.00	21.00
00359800	Jarhidih	193.00	29.00	2.00	105.00	49.00	8.00
00359900	Lalpur	288.00	0.00	2.00	193.00	55.00	38.00
00360000	Kharra	157.00	31.00	1.00	77.00	31.00	17.00
00360100	Maduadumar	92.00	1.00	3.00	69.00	5.00	14.00
00360200	Banjhikhol	247.00	0.00	17.00	113.00	49.00	68.00
00360300	Semijor	164.00	44.00	3.00	75.00	35.00	7.00
00360400	Chirwani	222.00	0.00	1.00	146.00	54.00	21.00
00360500	Sakta	78.00	0.00	15.00	57.00	2.00	4.00
00360700	Dholnara	344.00	20.00	7.00	245.00	49.00	23.00

LAND USE PATTTERN WITHIN THE STUDY AREA AS PER CENSUS 2001 RECORDS (area in Ha.)

Town/ village code	Town/village name	Total area	Forest land	Irrigated land	Unirrigated land	Culturable waste land	Area not available for cultivation
00360800	Bajarmuda	335.00	2.00	12.00	279.00	18.00	24.00
00360900	Karwahi	316.00	0.00	3.00	235.00	60.00	18.00
00361000	Khamahariya	434.00	77.00	5.00	236.00	71.00	45.00
00361100	Milupara	452.00	39.00	5.00	347.00	11.00	50.00
00361200	Lamdarha	327.00	0.00	2.00	228.00	21.00	76.00
00361300	Kondkel	512.00	4.00	5.00	457.00	16.00	30.00
00361600	Kerakhol	408.00	0.00	0.00	202.00	168.00	38.00
00361700	Chirramuda	459.00	26.00	9.00	229.00	151.00	44.00
00362200	Kolam	291.00	0.00	2.00	203.00	22.00	64.00
00362300	Chitwahi	285.00	0.00	4.00	252.00	15.00	14.00
00362600	Rodopali	443.00	0.00	5.00	315.00	19.00	104.00
00362700	Salihabhanttha	393.00	0.00	6.00	296.00	30.00	61.00
00366400	Nawapara	188.00	0.00	7.00	150.00	15.00	16.00
00366500	Basanpali	441.00	0.00	15.00	282.00	96.00	48.00
00366700	Tamnar	1229.00	0.00	9.00	957.00	176.00	87.00
00366800	Budiya	576.00	0.00	2.00	414.00	131.00	29.00
00366900	Bagbadi	172.00	0.00	1.00	162.00	2.00	7.00
00367000	Kunjemura	442.00	0.00	4.00	324.00	69.00	45.00
00367100	Kosampali	253.00	19.00	5.00	208.00	11.00	10.00
00367200	Gare	413.00	29.00	4.00	316.00	30.00	34.00
00367300	Pata	676.00	0.00	17.00	563.00	50.00	46.00
00367400	Mudagaon	390.00	40.00	5.00	305.00	27.00	13.00
00367500	Saraitola	273.00	0.00	1.00	217.00	37.00	18.00
00367600	Sarasmal	293.00	34.00	19.00	209.00	14.00	17.00
00367700	Tihli Rampur	289.00	0.00	0.00	212.00	40.00	37.00
00367800	Aamgaon	546.00	0.00	6.00	461.00	34.00	45.00
00367900	Janjgir	559.00	79.00	6.00	295.00	129.00	50.00
00368000	Tapranga	354.00	2.00	4.00	257.00	63.00	28.00
00368100	Tangarghat	557.00	0.00	2.00	422.00	87.00	46.00
00368200	Dongamauha	325.00	83.00	3.00	168.00	55.00	16.00
00368300	Telaipara	50.00	0.00	0.00	40.00	8.00	2.00
00368400	Dhaurabhatha	321.00	6.00	5.00	207.00	83.00	20.00
00368500	Nagramuda	293.00	0.00	4.00	207.00	64.00	18.00
00368600	Baljor	273.00	93.00	0.00	115.00	40.00	25.00
00368700	Jhinku Bahal	301.00	0.00	1.00	243.00	43.00	14.00
00368800	Libara	671.00	0.00	3.00	596.00	38.00	34.00
00368900	Jharna	482.00	0.00	2.00	423.00	20.00	37.00
00369100	Samkera	553.00	0.00	5.00	419.00	90.00	39.00
00369200	Gourbahari	454.00	0.00	4.00	382.00	43.00	25.00
00369300	Mahloi	877.00	0.00	10.00	726.00	55.00	86.00
00369400	Deogaon	576.00	46.00	3.00	375.00	96.00	56.00
00369500	Padi Gaon	579.00	8.00	4.00	452.00	77.00	38.00
00369700	Pali	69.00	0.00	0.00	46.00	17.00	6.00
00369800	Jobaro	360.00	2.00	6.00	295.00	37.00	20.00
00369900	Karmagarh	205.00	46.00	4.00	94.00	50.00	11.00
00370000	Kenani Bahra	46.00	22.00	7.00	8.00	2.00	7.00
00370100	Auorajor	193.00	0.00	0.00	104.00	75.00	14.00
00370200	Karra Pali	183.00	0.00	15.00	143.00	6.00	19.00
00370300	Kesharchunwa	212.00	0.00	2.00	170.00	27.00	13.00
00370400	Kusmel	86.00	0.00	5.00	55.00	18.00	8.00
00370500	Khurus Lenga	640.00	0.00	12.00	491.00	83.00	54.00
00370600	Chakabahal	104.00	19.00	8.00	40.00	25.00	12.00
00370800	Barkachar	146.00	2.00	13.00	91.00	26.00	14.00
00370900	Bijana	520.00	0.00	13.00	425.00	42.00	40.00
00371100	Hamirpur	404.00	0.00	10.00	277.00	93.00	24.00
	Sub total	**23726.00**	**879.00**	**373.00**	**17086.00**	**3339.00**	**2049.00**

LAND USE PATTTERN WITHIN THE STUDY AREA AS PER CENSUS 2001 RECORDS (area in Ha.)

Town/ village code	Town/village name	Total area	Forest land	Irrigated land	Unirrigated land	Culturable waste land	Area not available for cultivation
Tehsil	**Raigarh**						
00373700	Hardijhariya	184.00	0.00	10.00	141.00	11.00	22.00
00380900	Chhirwani	257.00	104.00	4.00	48.00	88.00	13.00
	Sub total	**441.00**	**104.00**	**14.00**	**189.00**	**99.00**	**35.00**
	Total from Raigarh	**25043.00**	**983.00**	**398.00**	**18054.00**	**3480.00**	**2128.00**
	Tolge RF	5431.82	5431.82	0.00	0.00	0.00	0.00
	Silot RF	1218.82	1218.82	0.00	0.00	0.00	0.00
	Burapahar RF	89.13	89.13	0.00	0.00	0.00	0.00
	Barkachar RF	1127.29	1127.29	0.00	0.00	0.00	0.00
	Gare PF	47.43	47.43	0.00	0.00	0.00	0.00
	Devgaon PF	90.37	90.37	0.00	0.00	0.00	0.00
	Other RF	166.23	166.23	0.00	0.00	0.00	0.00
	Other PF	228.48	228.48	0.00	0.00	0.00	0.00
	Total RF and PF	**8399.57**	**8399.57**	**0.00**	**0.00**	**0.00**	**0.00**
	GRAND TOTAL	**41200.19**	**10901.56**	**512.80**	**22999.11**	**3617.75**	**3168.97**
	Percentage	**100.00**	**26.46**	**1.24**	**55.82**	**8.78**	**7.69**

Source : Village Directory, Census of India, 2001

ANNEXURE: XII

SOIL TEST RESULT

PROJECT : 2 x 150 MW MIDDLING AND COAL FINES BASED THERMAL POWER PLANT OF JSPL

Sl. No.	Parameters	Unit	Sampling Locations			
			Washery	Proposed power plant	Jharna (Buffer zone)	Baljor (Buffer zone)
1	Colour		Light brown	Light brown	Light brown	Light brown
2	pH value		7.3	4.7	6.2	5.7
3	Temperature	^0C	31.0	31.0	30.5	31.0
4	Type of soil		Sandy loam	Sandy loam	Sandy loam	Sandy loam
5	Moisture	% by mass	2.03	2.57	3.40	1.94
6	Bulk density	gm/cm^3	1.36	1.22	1.30	1.36
7	Conductivity	Micromhos/ cm	315.6	146.2	300.0	41.2
8	Organic matter	% by mass	0.73	0.27	0.58	0.56
9	Chloride as Cl	% by mass	0.018	0.020	0.007	0.005
10	Sulphate as SO_4	% by mass	0.004	0.003	0.004	0.005
11	Calcium carbonate as $CaCO_3$	% by mass	7.5	11.5	14.0	14.5
12	Iron as Fe_2O_3	%by mass	0.003	0.003	0.006	0.006
13	Phosphorus as P_2O_5	%by mass	0.003	0.002	0.002	0.002
14	Nitrate as NO_3 - N	% by mass	0.085	0.020	0.030	0.025
15	Sodium as Na	%by mass	0.423	0.505	0.149	0.076
16	Potassium as K	% by mass	0.014	0.006	0.005	0.003

FLORA IN THE CORE ZONE

Botanical name	English/Hindi name	Family
I. Tree		
Anogeissus latifolia	Dhaura (H)	Combretaceae
Azadirachta indica	Margosa / Neem (E/H)	Meliaceae
Bridelia retusa	Kasai/Kamahi	Euphorbiaceae
Buchanania lanzan	Char (H)	Anacardiaceae
Butea monosperma	Flame of the forest / Palas (E/H)	Fasaceae
Cleistanthus collinus	Karra (H)/Garari	Euphorbiaceae
Cotoneaster acuminata	Riujha (H)/Riu	Rosaceae
Dalbergia sisoo	Sisam/Bija	Papilionaceae
Emblica officinalis	Aonla	Euphorbiaceae
Madhuca indica	Mahua tree / Mahua (E/H)	Sapotaceae
Mangifera indica	Mango / Aam (E/H)	Anacardiaceae
Saccopetalum tomentosaum	Koriya/Kirua/Kari	Annonaceae
Schleichera oleosa	Kosam/Kusum	Sapindaceae
Semecarpus anacardium	Bhelpa/Bhelwan	Anacardiaceae
Shorea robusta	Sahuya (H)	Dipterocarpaceae
Syzygium cumini	Jambolana / Jamun (E/H)	Myrtaceae
Tamarindus indica	Imli (H)	Caesalpiniaceae
Terminalia bellirica	Bahera	Combretaceae
Terminalia chebula	Harra (H)	Combretaceae
Terminalia tomentosa	Saja (H)	Combretaceae
II. Shrubs/Herbs		
Achyranthus aspera	Chirchitta (H)	Amaranthaceae
Calotropis procera	Akund / Madar (E/H)	Asclepiadaceae
Cynodon dactylon	Doob (H)	Graminae
Ziziphus mauritiana	Chinese date / Ber (E/H)	Rhamnaceae

LIST OF PLANT SPECIES PLANTED BY JINDAL STEEL & POWER LTD. WITHIN ADJOINING ML AREA OF GARE IV/1 COAL MINE (AS ON 31.08.2003)

Sl. No.	NAME OF SPECIES
1	Gulmohar
2	Sisam
3	Karanj
4	Kadam
5	Amrood
6	Mango
7	Acacia
8	Amla
9	Neem
10	Khamar
11	Kaju
12	Sitafal
13	Sindur
14	Peltoarm
15	Siris
16	Chakundi
17	Teak
18	Alostasia
19	Banana
20	Nerium
21	Peltoform
22	Bamboo
23	Butea

CONSOLIDATED LIST OF FLORA IN THE STUDY AREA

Botanical name	English/Hindi name	Family
SHRUBS		
Abrus precatorius	Indian liquorice/Ghumchi (E/H)	Fabaceae
Achyranthus aspera	Chirchitta (H)	Amaranthaceae
Calotropis procera	Akund / Madar (E/H)	Asclepiadaceae
Lantana camara	Besharm (H)	Varbenaceae
Ipomea purpurea	Tall morning glory (E)	Convolvulaceae
Mimosa pudica	Mimosa/Chhuimui (E/H)	Mimosaceae
Ocimum basilicum	Sweet basil/ Ban tulsi (E/H)	Labiatae
Peganum harmata	Foreign henna/Harmal (E/H)	Zygophyllaceae
Ziziphus mauritiana	Chinese date / Ber (E/H)	Rhamnaceae
Trees		
Acacia auriculiformis	Australian wattle (E)	Mimosaceae
Acacia farnesiana	Sweet acacia/Gandh babul (E/H)	Mimosaceae
Acacia nilotica	Kiker	Mimosaceae
Aeacia lauco phloea	Safed kikar	Mimosaceae
Aegle marmelos	Bael/Bel (E/H)	Rutaceae
Albizia lebbeck	Koko/Siris (E/H)	Mimosaceae
Annona squamosa	Sugar apple/Sarifa (E/H)	Annonaceae
Anogeissus latifolia	Yon/Dhaura (E/H)	Combretaceae
Anogeissus latifolia	Dhaura (H)	Combretaceae
Antidesma ghaescmbilla	Black current/Ymtao (E/H)	Stilaginaceae
Artocarpus heterophyllus	Jack tree / Kathal (E/H)	Moraceae
Azadirachta indica	Margosa / Neem (E/H)	Meliaceae
Bombax malabaricum	Red silk cotton / Semur (E/H)	Bombacaceae
Bridelia retusa	Kasai/Kamahi	Euphorbiaceae
Buchanania lanzan	Cuddapah almond (E)	Anacardiaceae
Buchanania lanzan	Char (H)	Anacardiaceae
Butea monosperma	Flame of the forest / Palas (E/H)	Fasaceae
Caesalpinia sappan	Sappan wood / Bakam (E/H)	Caesalpiniaceae
Callistemom citrinus	Bottle brush / Lal botal brush (E/H)	Myrtaceae
Carica papaya	Papaya / Papita (E/H)	Caricaceae
Cassia fistula	Golden-shower (E)	Caesal pibiaceae
Cleistanthus collinus	Karra (H)/Garari	Euphorbiaceae
Cotoneaster acuminata	Riujha (H)/Riu	Rosaceae
Dalbergia sisoo	Sisam/Bija	Papilionaceae
Delonix regia	Peacock flower / Gulmohar (E/H)	Caesalpiniaceae
Diospyros melanozylon	Tendu (E/H)	Ebenaceae
Emblica officinalis	Aonla	Euphorbiaceae
Eucalyptus sps.	Eucalyptus / Safeda (E/H)	Myrtaceae
Ficus benghalensis	Banyan / Bargad (E/H)	Moraceae
Ficus glomerata	Cluster fig / Gular (E/H)	Moraceae
Ficus religiosa	Peepal / Pipal (E/H)	Moraceae
Gmelina arborea	Malay bushbeech (E)	Verbenaceae
Jasminum grandiflorum	Jasmin / Chameli (E/H)	Oleaceae
Madhuca indica	Mahua tree / Mahua (E/H)	Sapotaceae

Botanical name	**English/Hindi name**	**Family**
Mangifera indica	Mango / Aam (E/H)	Anacardiaceae
Michelia champaca	Champac / Champa (E/H)	Magnoliaceae
Moringa oleifera	Drumstick tree / Sahinjna (E/H)	Moringaceae
Pongamia pinnata	Pongam / Karanj (E/H)	Papilionaceae
Saccopetalum tomentosaum	Koriya/Kirua/Kari	Annonaceae
Samanea saman	Rain tree / Vilayati siris (E/H)	Mimosaceae
Schleichera oleosa	Kosam/Kusum	Sapindaceae
Scleichera oleosa	Lac tree / Kusum (E/H)	Sapindaceae
Semecarpus anacardium	Bhelpa/Bhelwan	Anacardiaceae
Shorea robusta	Sal (H)	Dipterocarpaceae
Spondias pinnata	Hog plum / Amra (E/H)	Anacardiaceae
Syzygium cumini	Jambolana / Jamun (E/H)	Myrtaceae
Tamarindus indica	Imli (H)	Caesalpiniaceae
Tectona grandis	Teak / Sagwari (E/H)	Verbenaceae
Terminalia bellirica	Castard myrobalan / Bahera (E/H)	Combretaceae
Terminalia bellirica	Bahera	Combretaceae
Terminalia chebula	Cheublic myrobalan / Harara (E/H)	Combretaceae
Terminalia tomentosa	Sajada (H)	Combretaceae
Terminalia tomentosa	Saja (H)	Combretaceae

ANNEXURE : XIV

LIST OF FAUNA IN THE STUDY AREA

Zoological Name	Common name	Reference to Schedule of the Wildlife (Protection) Act, 1972 amended in 1995		
		Schedule	Part	Section
Avifauna				
Acridotheres tristis	Indian Myna	IV	11	45
Bubo bubo	Horned owl	IV	II	48
Bubulcus ibis	Cattle egret	IV	II	66
Columba livia	Pigeon	IV	II	54
Corvus splendens	House crow	V	-	1
Coturnix coturnix	Quail	IV	11	57
Cuculus varius	Common hawk-cuckoo	IV	-	7
Dinopium benghalense	Golden backed wood pecker	IV	II	79
France linus poncerianus	Grey partridge	IV	-	51
Gallus gallus	Red jungle fowl	IV	-	36(A)
Gyps benghalensis	Vulture	IV	11	75
Magalaima asiatica	Blue throated barbet	IV	-	4
Milvus migrans	Cheel	IV	11	24
Passer domesticus	House sparrow	IV	11	78
Pavo cristatus	Pea fowl	I	III	11
Psittacula krameri	Roseringed parakeet	IV	-	50
Streptopelia decaocto	Ring Dove	IV	-	19
Reptiles				
Ahaetulla nasutus	Green whip snake	IV	-	12
Bungarus cacruleus	Common Indian Krait	IV	-	12 vi
Calotes versicolor	Garden lizard	IV	-	12
Echis carinatus	Saw scaled viper	IV	-	12
Eryx johni	Russell's earth boa	IV	III	12
Hemidactylus flaviviridis	House gecko	IV	-	12
Naja naja	Indian cobra, Naga	II	II	11
Oligodon arnensis	Common kukri snake	IV	-	12
Opheophagus hannah	King cobra	IV	II	12
Ptyas mucosus	Rat snake, Dhaman	II	II	19
Typhlina bramina	Blind snake	IV	-	12
Varanus bengalensis	Indian monitor	II	II	15
Vipera russelli	Russells viper	II	II	14

Zoological Name	Common name	Reference to Schedule of the Wildlife (Protection) Act, 1972 amended in 1995		
		Schedule	Part	Section
Mammals				
Axis axix	Spotted deer	III	-	2
Funambulus palmarum	Five striped palm squirrel	IV	-	3A
Herpestes edwardsi	Mongoose	IV	-	6A
Hyaena hyaena	Striped hyena	III	-	12
Hystrix indica	Jhink	IV	-	4E
Macaca Mulatta	Rhesus macaque	I	I	17A
Melursus ursinus	Bear	I	I	31 C
Muntiacus muntjak	Barking deer	III	-	2
Panthera pardus	Leopard	I	I	16(B)
Rattus rattus	Rat	V	-	6
Rousettus leschenaulti	Fulvous fruit bat	V	-	3
Sus scrofa	Wild boar	III	-	19
Vulpes bengalensis	Fox	II	II	1B

FAUNA IN THE CORE ZONE

Zoological name	Common name	Reference to Schedule of the Wildlife (Protection) Act, 1972 amended in 1995		
		Schedule	Part	Section
Avifauna				
Bubulcus ibis	Cattle egret	IV	11	66
Columba livia	Pigeon	IV	11	54
Corvus splendens	House crow	V	-	1
Coturnix coturnix	Quail	IV	11	57
Dinopium benghalense	Golden backed wood pecker	IV	11	79
Milvus migrans	Cheel	IV	11	24
Passer domesticus	House sparrow	IV	11	78
Reptiles				
Calotes versicolor	Garden lizard	IV	-	12
Hemidactylus sps.	House lizard	IV	-	12
Plyas mucosus	Rat snake, Dhaman	II	11	19
Yphlina bramina	Blind snake	IV	-	12
Mammals				
Funambulus palmarum	Five striped palm squirrel	IV	-	3A
Herpetes edwardsi	Mongoose	IV	-	6A
Macaca Mulatta	Bandar	I	I	17A
Rattus rattus	Rat	V	-	6
Rousettus leschenaulti	Fulvous fruit bat	V	-	3
Vulpes bengalensis	Fox	II	II	1B

VILLAGE WISE POPULATION AND LITERACY WITHIN THE STUDY AREA (CENSUS 2001)

Town/ village code	Town/village name	No. of house-holds	Population break-up			Population (0-6 years)			Schedule Caste	Schedule Tribe	Literacy level		
			Total	Male	Female	Total	Male	Female			Total literates	Male literates	Female literates
District	**Sundargarh**												
Tehsil	**Hemgir**												
00375300	Mendra	104	443	233	210	71	41	30	105	196	173	100	73
00375400	Jamkani	142	539	276	263	93	49	44	60	360	195	127	68
00375500	Jamkani (R.F.)	2	7	4	3	0	0	0	0	7	0	0	0
00375600	Girisima	66	321	173	148	67	40	27	14	84	160	97	63
00376900	Ghogharpali	44	152	76	76	27	12	15	0	12	86	52	34
00377000	Latapani	32	104	55	49	14	7	7	0	27	36	25	11
00377100	Bhograkachhar	162	722	353	369	122	63	59	44	334	355	222	133
00377200	Bijahan	63	269	126	143	49	19	30	33	107	75	49	26
00377300	Jharpalam	189	738	365	373	89	44	45	72	296	261	159	102
00377400	Gaikanpali	98	466	249	217	57	34	23	23	99	322	189	133
00377500	Samarpinda	64	245	124	121	45	19	26	33	119	131	86	45
00377600	Kandadhuda	231	1013	492	521	157	82	75	43	327	530	307	223
00377700	Beldhipa	56	263	139	124	47	28	19	69	16	144	83	61
00377800	Chakra	174	709	352	357	98	46	52	21	303	469	264	205
00377900	Bileimunda	236	1073	531	542	158	76	82	58	633	579	319	260
00378000	Mundelkhet	198	951	447	504	181	78	103	84	395	463	262	201
00378200	Chhatabar	251	1069	547	522	147	75	72	188	377	606	377	229
00380500	Garjanjore	332	1322	646	676	154	76	78	179	565	713	418	295
00380700	Luabahal	189	793	384	409	103	43	60	71	82	594	324	270
00380800	Pandiapali	70	292	149	143	38	17	21	40	112	136	80	56
00380900	Pithampur	65	302	148	154	42	20	22	48	235	160	92	68
00381000	Toparia	634	2335	1166	1169	308	158	150	252	604	1407	800	607
00381100	Chandarpur	85	326	173	153	42	23	19	122	8	203	125	78
00381300	Chatakpur	67	246	122	124	36	14	22	15	97	128	76	52
	Sub total	**3554**	**14700**	**7330**	**7370**	**2145**	**1064**	**1081**	**1574**	**5395**	**7926**	**4633**	**3293**
Tehsil	**Lephripara**												
00393800	Bandega	66	281	138	143	48	22	26	15	114	116	72	44
	Sub total	**66**	**281**	**138**	**143**	**48**	**22**	**26**	**15**	**114**	**116**	**72**	**44**
	Total from Sundargarh	**3620**	**14981**	**7468**	**7513**	**2193**	**1086**	**1107**	**1589**	**5509**	**8042**	**4705**	**3337**
District	**Raigarh**												
Tehsil	**Lailunga**												
00340400	Munda Gaon	523	2582	1298	1284	434	234	200	113	1581	1190	666	524
	Sub total	**523**	**2582**	**1298**	**1284**	**434**	**234**	**200**	**113**	**1581**	**1190**	**666**	**524**
Tehsil	**Gharghoda**												
00359600	Uraba	247	1039	526	513	186	94	92	120	741	502	319	183

VILLAGE WISE POPULATION AND LITERACY WITHIN THE STUDY AREA (CENSUS 2001)

Town/ village code	Town/village name	No. of house-holds	Population break-up			Population (0-6 years)			Schedule Caste	Schedule Tribe	Literacy level		
			Total	Male	Female	Total	Male	Female			Total literates	Male literates	Female literates
00359700	Hinjher	89	407	195	212	71	29	42	62	299	222	142	80
00359800	Jarhidih	62	292	156	136	46	23	23	3	203	194	122	72
00359900	Lalpur	83	400	210	190	67	41	26	32	255	296	163	133
00360000	Kharra	64	280	141	139	54	23	31	4	215	200	107	93
00360100	Maduadumar	45	204	98	106	33	12	21	27	15	143	76	67
00360200	Banjhikhol	65	266	133	133	36	16	20	14	236	199	105	94
00360300	Semijor	82	316	155	161	66	35	31	22	200	184	101	83
00360400	Chirwani	52	182	96	86	27	13	14	8	133	114	70	44
00360500	Sakta	73	294	153	141	34	20	14	18	223	232	132	100
00360700	Dholnara	91	408	200	208	71	37	34	17	281	233	142	91
00360800	Bajarmuda	179	800	407	393	121	67	54	74	470	497	289	208
00360900	Karwahi	122	557	288	269	81	41	40	2	269	383	228	155
00361000	Khamahariya	121	531	264	267	75	34	41	62	198	407	219	188
00361100	Milupara	282	1165	573	592	188	97	91	78	784	704	396	308
00361200	Lamdarha	84	325	158	167	56	30	26	12	305	225	120	105
00361300	Kondkel	199	856	423	433	131	73	58	74	563	560	310	250
00361600	Kerakhol	88	351	168	183	55	23	32	71	256	139	93	46
00361700	Chirramuda	145	588	293	295	108	54	54	44	438	332	202	130
00362200	Kolam	103	427	223	204	73	38	35	54	188	258	155	103
00362300	Chitwahi	174	747	363	384	130	66	64	40	515	406	261	145
00362600	Rodopali	158	688	351	337	111	62	49	89	430	445	264	181
00362700	Salihabhanttha	173	764	383	381	122	62	60	58	395	437	258	179
00366400	Nawapara	68	293	142	151	53	22	31	39	215	174	115	59
00366500	Basanpali	216	991	459	532	154	75	79	84	197	638	347	291
00366700	Tamnar	867	3974	1997	1977	594	313	281	158	994	2632	1494	1138
00366800	Budiya	200	960	480	480	142	78	64	27	488	690	370	320
00366900	Bagbadi	90	379	177	202	49	26	23	0	233	285	137	148
00367000	Kunjemura	238	1054	539	515	181	88	93	76	528	585	363	222
00367100	Kosampali	64	279	146	133	43	22	21	16	143	163	106	57
00367200	Gare	150	741	368	373	97	45	52	44	438	476	277	199
00367300	Pata	273	1189	595	594	184	87	97	124	474	685	432	253
00367400	Mudagaon	119	520	245	275	73	35	38	33	339	342	192	150
00367500	Saraitola	112	564	272	292	91	51	40	84	367	360	205	155
00367600	Sarasmal	113	508	260	248	69	37	32	0	415	294	190	104
00367700	Tihli Rampur	107	448	221	227	73	39	34	24	213	330	174	156
00367800	Aamgaon	317	1441	727	714	234	115	119	58	697	909	521	388
00367900	Janjgir	251	1037	509	528	177	86	91	136	617	652	386	266
00368000	Tapranga	142	593	301	292	106	51	55	42	155	398	230	168
00368100	Tangarghat	308	1268	650	618	205	112	93	195	960	773	471	302
00368200	Dongamauha	169	777	590	187	68	35	33	0	231	642	531	111
00368300	Telaipara	9	57	27	30	8	4	4	7	40	43	21	22
00368400	Dhaurabhatha	250	1046	555	491	135	64	71	67	315	763	448	315
00368500	Nagramuda	115	565	290	275	76	40	36	61	148	423	236	187
00368600	Baljor	72	304	146	158	42	24	18	10	261	219	115	104
00368700	Jhinku Bahal	134	599	294	305	78	44	34	66	189	430	234	196
00368800	Libara	276	1181	598	583	145	69	76	98	636	875	500	375

VILLAGE WISE POPULATION AND LITERACY WITHIN THE STUDY AREA (CENSUS 2001)

Town/ village code	Town/village name	No. of house-holds	Population break-up			Population (0-6 years)			Schedule Caste	Schedule Tribe	Literacy level		
			Total	Male	Female	Total	Male	Female			Total literates	Male literates	Female literates
00368900	Jharna	298	1265	616	649	192	95	97	53	745	754	446	308
00369100	Samkera	300	1491	726	765	229	111	118	242	621	1044	576	468
00369200	Gourbahari	235	1075	531	544	154	86	68	353	396	635	374	261
00369300	Mahloi	509	2292	1166	1126	332	183	149	316	1385	1068	693	375
00369400	Deogaon	244	1079	525	554	155	77	78	134	441	624	354	270
00369500	Padi Gaon	334	1412	685	727	228	116	112	251	606	884	493	391
00369700	Pali	38	144	79	65	28	19	9	25	104	82	50	32
00369800	Jobaro	184	775	384	391	123	68	55	46	337	535	293	242
00369900	Karmagarh	81	340	172	168	53	31	22	38	234	246	128	118
00370000	Kenani Bahra	13	66	30	36	11	6	5	0	1	50	23	27
00370100	Auorajor	57	250	131	119	36	22	14	40	197	144	86	58
00370200	Karra Pali	117	545	282	263	81	45	36	39	219	368	217	151
00370300	Kesharchunwa	100	590	287	303	100	54	46	77	464	358	198	160
00370400	Kusmel	43	194	103	91	22	10	12	12	28	125	79	46
00370500	Khurus Lenga	310	1437	722	715	195	95	100	334	643	945	558	387
00370600	Chakabahal	52	222	110	112	41	21	20	11	152	117	67	50
00370800	Barkachar	57	246	127	119	40	22	18	15	125	167	97	70
00370900	Bijana	272	1288	648	640	220	117	103	131	320	901	505	396
00371100	Hamirpur	267	1252	655	597	192	95	97	75	418	801	493	308
	Sub total	**15750**	**69325**	**34864**	**34461**	**10608**	**5423**	**5185**	**6471**	**33240**	**41595**	**24280**	**17315**
Tehsil	**Raigarh**												
00373700	Hardijhariya	113	603	294	309	109	51	58	44	136	371	205	166
00380900	Chhirwani	52	214	110	104	30	20	10	34	96	115	64	51
	Sub total	**165**	**817**	**404**	**413**	**139**	**71**	**68**	**78**	**232**	**486**	**269**	**217**
	Grand total	**19469**	**84842**	**42598**	**42244**	**12892**	**6558**	**6334**	**8123**	**38867**	**50007**	**29182**	**20825**
	Percentage		**100.00**	**50.21**	**49.79**	**15.20**	**7.73**	**7.47**	**9.57**	**45.81**	**58.94**	**34.40**	**24.55**

VILLAGE WISE EMPLOYMENT PATTERN IN THE STUDY AREA (CENSUS 2001)

Town/ village code	Town/village name	Employment pattern											
		Total workers	Main workers					Marginal workers					Non
			Total	Cultivators	Agri. Labours	HH ind.	Others	Total	Cultivators	Agr. Labours	HH ind.	Others	
District	**Sundargarh**												
Tehsil	**Hemgir**												
00375300	Mendra	273	132	60	40	18	14	141	28	103	4	6	170
00375400	Jamkani	334	137	123	7	1	6	197	2	195	0	0	205
00375500	Jamkani (R.F.)	6	1	1	0	0	0	5	0	5	0	0	1
00375600	Girisima	193	89	61	9	0	19	104	60	38	1	5	128
00376900	Ghogharpali	78	44	30	7	0	7	34	0	31	0	3	74
00377000	Latapani	64	37	21	6	0	10	27	0	21	0	6	40
00377100	Bhograkachhar	419	265	128	115	0	22	154	6	134	1	13	303
00377200	Bijahan	194	56	16	6	15	19	138	31	84	4	19	75
00377300	Jharpalam	434	177	71	61	15	30	257	115	122	11	9	304
00377400	Gaikanpali	237	177	100	24	22	31	60	6	49	5	0	229
00377500	Samarpinda	155	79	35	0	1	43	76	3	48	25	0	90
00377600	Kandadhuda	669	296	162	87	2	45	373	152	197	3	21	344
00377700	Beldhipa	159	76	48	9	1	18	83	51	23	0	9	104
00377800	Chakra	405	211	33	85	6	87	194	56	93	13	32	304
00377900	Bileimunda	520	335	92	58	0	185	185	11	87	1	86	553
00378000	Mundelkhet	641	414	199	108	45	62	227	116	57	19	35	310
00378200	Chhatabar	464	261	116	80	5	60	203	53	98	4	48	605
00380500	Garjanjore	780	407	276	97	7	27	373	122	247	0	4	542
00380700	Luabahal	369	223	62	6	4	151	146	11	127	1	7	424
00380800	Pandiapali	169	73	48	19	0	6	96	31	58	0	7	123
00380900	Pithampur	226	93	42	44	2	5	133	65	61	3	4	76
00381000	Toparia	1300	765	554	125	7	79	535	66	458	7	4	1035
00381100	Chandarpur	212	97	46	43	0	8	115	1	114	0	0	114
00381300	Chatakpur	150	72	50	18	0	4	78	22	56	0	0	96
	Sub total	**8451**	**4517**	**2374**	**1054**	**151**	**938**	**3934**	**1008**	**2506**	**102**	**318**	**6249**
Tehsil	**Lephripara**												
00393800	Bandega	176	52	48	3	0	1	124	3	18	0	103	105
	Sub total	**176**	**52**	**48**	**3**	**0**	**1**	**124**	**3**	**18**	**0**	**103**	**105**
	Total from Sundargarh	**8627**	**4569**	**2422**	**1057**	**151**	**939**	**4058**	**1011**	**2524**	**102**	**421**	**6354**
District	**Raigarh**												
Tehsil	**Lailunga**												
00340400	Munda Gaon	1367	1130	630	428	9	63	237	34	196	3	4	1215
	Sub total	**1367**	**1130**	**630**	**428**	**9**	**63**	**237**	**34**	**196**	**3**	**4**	**1215**
Tehsil	**Gharghoda**												
00359600	Uraba	448	396	297	51	9	39	52	1	51	0	0	591

VILLAGE WISE EMPLOYMENT PATTERN IN THE STUDY AREA (CENSUS 2001)

Town/ village code	Town/village name	Employment pattern											
		Total workers	Main workers					Marginal workers					Non
			Total	Cultivators	Agri. Labours	HH ind.	Others	Total	Cultivators	Agr. Labours	HH ind.	Others	
00359700	Hinjher	146	125	86	30	0	9	21	0	21	0	0	261
00359800	Jarhidih	116	103	53	46	0	4	13	0	13	0	0	176
00359900	Lalpur	188	172	132	31	0	9	16	3	12	0	1	212
00360000	Kharra	153	148	59	89	0	0	5	1	4	0	0	127
00360100	Maduadumar	68	33	28	3	0	2	35	0	33	0	2	136
00360200	Banjhikhol	129	47	41	3	0	3	82	1	80	0	1	137
00360300	Semijor	155	98	54	40	3	1	57	4	49	2	2	161
00360400	Chirwani	113	79	45	33	0	1	34	0	33	0	1	69
00360500	Sakta	198	137	6	120	0	11	61	0	60	0	1	96
00360700	Dholnara	242	239	0	232	0	7	3	0	2	0	1	166
00360800	Bajarmuda	458	413	133	258	0	22	45	7	38	0	0	342
00360900	Karwahi	260	186	80	68	0	38	74	23	51	0	0	297
00361000	Khamahariya	266	140	67	53	3	17	126	45	74	6	1	265
00361100	Milupara	498	378	130	171	4	73	120	25	78	1	16	667
00361200	Lamdarha	196	110	108	0	0	2	86	86	0	0	0	129
00361300	Kondkel	502	254	99	92	38	25	248	80	165	3	0	354
00361600	Kerakhol	153	106	99	3	1	3	47	0	46	0	1	198
00361700	Chirramuda	248	213	98	102	5	8	35	5	30	0	0	340
00362200	Kolam	243	187	66	101	2	18	56	39	17	0	0	184
00362300	Chitwahi	405	246	50	138	3	55	159	22	137	0	0	342
00362600	Rodopali	400	304	152	111	14	27	96	19	12	35	30	288
00362700	Salihabhanttha	514	226	132	58	7	29	288	190	79	15	4	250
00366400	Nawapara	171	112	80	26	3	3	59	34	24	1	0	122
00366500	Basanpali	576	266	116	81	44	25	310	75	211	20	4	415
00366700	Tamnar	1409	1109	277	304	26	502	300	118	146	8	28	2565
00366800	Budiya	474	363	155	196	1	11	111	22	85	4	0	486
00366900	Bagbadi	145	123	27	87	0	9	22	3	18	1	0	234
00367000	Kunjemura	541	380	175	136	2	67	161	93	59	1	8	513
00367100	Kosampali	196	119	81	30	0	8	77	68	9	0	0	83
00367200	Gare	448	373	207	108	30	28	75	61	6	8	0	293
00367300	Pata	644	528	242	232	17	37	116	59	54	0	3	545
00367400	Mudagaon	314	246	119	109	2	16	68	21	44	0	3	206
00367500	Saraitola	297	178	129	28	3	18	119	98	20	0	1	267
00367600	Sarasmal	199	197	149	17	21	10	2	1	1	0	0	309
00367700	Tihli Rampur	274	8	0	0	0	8	266	64	202	0	0	174
00367800	Aamgaon	717	618	218	340	4	56	99	36	62	0	1	724
00367900	Janjgir	474	383	215	150	3	15	91	35	48	0	8	563
00368000	Tapranga	294	178	70	28	15	65	116	47	61	5	3	299
00368100	Tangarghat	717	450	235	157	16	42	267	126	132	2	7	551
00368200	Dongamauha	630	518	113	5	5	395	112	0	106	2	4	147
00368300	Telaipara	32	15	14	0	0	1	17	17	0	0	0	25
00368400	Dhaurabhatha	458	401	133	115	28	125	57	10	38	7	2	588
00368500	Nagramuda	315	293	158	84	20	31	22	3	13	3	3	250
00368600	Baljor	183	170	130	26	3	11	13	1	11	1	0	121
00368700	Jhinku Bahal	267	169	96	40	1	32	98	36	62	0	0	332
00368800	Libara	530	472	212	205	9	46	58	14	39	0	5	651

VILLAGE WISE EMPLOYMENT PATTERN IN THE STUDY AREA (CENSUS 2001)

Town/ village code	Town/village name	Employment pattern											
		Total workers	Main workers					Marginal workers					Non
			Total	Cultivators	Agri. Labours	HH ind.	Others	Total	Cultivators	Agr. Labours	HH ind.	Others	
00368900	Jharna	757	416	278	111	7	20	341	39	300	2	0	508
00369100	Samkera	690	486	278	162	7	39	204	14	184	3	3	801
00369200	Gourbahari	487	344	135	186	1	22	143	13	129	1	0	588
00369300	Mahloi	1162	720	463	159	7	91	442	101	316	1	24	1130
00369400	Deogaon	612	101	72	17	2	10	511	75	415	5	16	467
00369500	Padi Gaon	772	496	278	160	13	45	276	87	184	1	4	640
00369700	Pali	69	68	28	35	0	5	1	0	1	0	0	75
00369800	Jobaro	381	378	264	90	0	24	3	0	3	0	0	394
00369900	Karmagarh	207	130	18	100	1	11	77	1	70	0	6	133
00370000	Kenani Bahra	41	30	3	26	0	1	11	1	9	0	1	25
00370100	Auorajor	174	125	123	0	0	2	49	7	41	0	1	76
00370200	Karra Pali	351	181	165	0	10	6	170	18	152	0	0	194
00370300	Kesharchunwa	329	327	225	94	4	4	2	0	2	0	0	261
00370400	Kusmel	100	96	57	22	4	13	4	0	4	0	0	94
00370500	Khurus Lenga	687	547	220	275	23	29	140	64	68	4	4	750
00370600	Chakabahal	143	118	18	55	42	3	25	4	18	3	0	79
00370800	Barkachar	152	121	74	40	2	5	31	27	4	0	0	94
00370900	Bijana	654	559	296	198	22	43	95	55	38	2	0	634
00371100	Hamirpur	545	315	166	42	20	87	230	51	158	5	16	707
	Sub total	**36430**	**24500**	**12305**	**8028**	**676**	**3491**	**11930**	**3235**	**7584**	**260**	**851**	**32895**
Tehsil	**Raigarh**												
00373700	Hardijhariya	336	332	119	196	0	17	4	1	3	0	0	267
00380900	Chhirwani	139	139	51	81	4	3	0	0	0	0	0	75
	Sub total	**475**	**471**	**170**	**277**	**4**	**20**	**4**	**1**	**3**	**0**	**0**	**342**
	Grand total	**45356**	**29488**	**14849**	**9359**	**831**	**4449**	**15868**	**4244**	**10093**	**362**	**1169**	**39486**
	Percentage	**53.46**	**65.01**	**50.36**	**31.74**	**2.82**	**15.09**	**34.99**	**26.75**	**63.61**	**2.28**	**7.37**	**46.54**

VILLAGE WISE AMENITIES IN THE STUDY AREA AS PER CENSUS 2001

CODE	NAME OF VILLAGE	EDUCATION	Medical	DRINKING WATER	POWER SUPPLY	P & T	COMMUN-ICATION	BANKS / SOCIETIES	CULTURAL FACILITY	APPR. TO VILLAGES	INCOME (Rs. Lc)	EXPENCES (Rs. Lc.)
DISTRICT : SUNDARGARH TEHSIL : HEMGIR												
00375300	Mendra	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED,EO	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00375400	Jamkani	P-1	ALH(0-5),MCW(0-5), PHC(0-5)	W,TK,HP	ED	PO(0-5), Ph(0-5)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00375500	Jamkani (R.F.)	P(5-10),M(5-10), C(>10)	ALH(>10),MCW(>10), PHC(>10)	W,TK	NA	PO(5-10), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	FP-1	--	--
00375600	Girisima	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	NA	PH-1	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00376900	Ghogharpali	P-1	ALH(5-10), MCW(5-10),PHC(5-10)	W,HP	ED,EO	PO(5-10), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(5-10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377000	Latapani	P(0-5),M(5-10), C(>10)	ALH(5-10), MCW(5-10),PHC(5-10)	R	NA	PO(5-10), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(5-10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377100	Bhograkachhar	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	NA	PH-1	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377200	Bijahan	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	NA	PO(5-10), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377300	Jharpalam	P-1,M-1	PHS-1	W,TK,HP	ED,EO	PO-1,PH-1	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377400	Gaikanpali	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED,EO	PH-1	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377500	Samarpinda	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED,EO	PH-1	BS-1, RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377600	Kandadhuda	P-1,M-1	PHS-1	W,HP,C	ED,EO	PO(5-10), Ph(0-5)	BS-1, RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377700	Beldhipa	P-1	ALH(0-5),MCW(0-5), PHC(0-5)	W,TK,HP	ED	PO(0-5), Ph(0-5)	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377800	Chakra	P-1	PHS-1	W,HP	ED	PO(0-5), Ph(0-5)	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00377900	Bileimunda	P-1,M-1	ALH-1,MCW-1,CWC-1, FWC-1	W,TK,HP	EA	PO-1,PH-1	BS-1, RS(>10), NW(>10)	COM-1,ACS(0-5), NACS(>10),OCS(>10)	CV(5-10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00378000	Mundelkhet	P-1	ALH(0-5),MCW(0-5), PHC(0-5)	W,HP	ED	PO(0-5), Ph(0-5)	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00378200	Chhatabar	P-1,M-1	ALH(>10),MCW(>10), PHC(>10)	W,HP	ED,EO	PH-1	BS-1, RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(5-10), SPCL(>10), STAU(>10)	PR-1,MR-1, FP-1	--	--
00380500	Garjanjore	P-1	ALH(0-5),MCW(0-5), PHC(0-5)	W,TK,HP	ED	PO-1,PH-1	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(5-10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00380700	Luabahal	P-1,M-1,S-1	PHS-1	W,TK,HP	EA	PH-1	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(5-10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--

CODE	NAME OF VILLAGE	EDUCATION	Medical	DRINKING WATER	POWER SUPPLY	P & T	COMMUN-ICATION	BANKS / SOCIETIES	CULTURAL FACILITY	APPR. TO VILLAGES	INCOME (Rs. Lc)	EXPENCES (Rs. Lc.)
00380800	Pandiapali	P-1	ALH(5-10), MCW(5-10),PHC(5-10)	W,HP	ED	PO(5-10), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00380900	Pithampur	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED,EO	PO(5-10), Ph(0-5)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00381000	Toparia	P-1,M-1,S-1	AYD-1,PHS-1	W,TK,HP	ED	PO-1,PH-1	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	PR-1,MR-1, FP-1	--	--
00381100	Chandarpur	P-1	ALH(>10),MCW(>10), PHC(0-5)	W,HP	ED	PO(0-5), Ph(0-5)	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00381300	Chatakpur	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED,EO	PO(5-10), Ph(0-5)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
TEHSIL : LEPHRIPARA												
00393800	Bandega	P-1	ALH(>10),MCW(>10), PHC(5-10)	W,TK,HP,R	ED	PO(>10), Ph(0-5)	BS(>10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
DISTRICT : RAIGARH												
00340400	Munda Gaon	P-2,M-1	PHS-1,CHW-2	W,HP	EA	PO-1	BS-1, RS(>10), NW(>10)	COM(5-10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1	1230	1000
TEHSIL : GHARGHODA												
00359600	Uraba	P-2,M-1,S-1,SS-1	PHS-1,CHW-1	W,HP	ED	PO-1	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1	45000	40000
00359700	Hinjher	P-1	ALH(>10),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	35000	30000
00359800	Jarhidih	P-1	ALH(>10),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	25000	21000
00359900	Lalpur	P-2	ALH(>10),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	25000	22000
00360000	Kharra	P-1	PHS-1	W,HP,R	ED	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	40000	35000
00360100	Maduadumar	P-1,ALC-1	ALH(>10),MCW(>10), PHC(>10)	W,TW,HP	ED,EAG	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	30000	25000
00360200	Banjhikhol	P-1	ALH(>10),MCW(>10), PHC(>10)	W,HP	NA	PO(5-10), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	FP-1	20000	18000
00360300	Semijor	P-1	ALH(>10),MCW(>10), PHC(5-10)	W,TK,HP	ED,EAG	PH-1	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	25000	20000
00360400	Chirwani	P-1	ALH(>10),MCW(>10), PHC(>10)	W,HP	NA	PO(5-10), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	25000	20000
00360500	Sakta	P-1	ALH(>10),MCW(>10), PHC(5-10)	W,HP,R	EA	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1	--	--
00360700	Dholnara	P-1	ALH(>10),MCW(>10), PHC(0-5)	W,TK,TW,HP	EA	PO(5-10), Ph(>10)	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00360800	Bajarmuda	P-1,M-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,TW,HP	EA	PH-1	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--

ANNEXURE : XVII Contd.

CODE	NAME OF VILLAGE	EDUCATION	Medical	DRINKING WATER	POWER SUPPLY	P & T	COMMUN-ICATION	BANKS / SOCIETIES	CULTURAL FACILITY	APPR. TO VILLAGES	INCOME (Rs. Lc)	EXPENCES (Rs. Lc.)
00360900	Karwahi	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,TW,HP	EA	PO(0-5), Ph(>10)	BS(>10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00361000	Khamahariya	P-1	PHS-1,CHW-1	W,TK,TW,HP	EA	PH-1	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00361100	Milupara	P-2,M-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,TW,HP,R	EA	PO-1,PH-1	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00361200	Lamdarha	P-1	ALH(>10),MCW(>10), PHC(>10)	W,HP,R	EA	PO(5-10), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00361300	Kondkel	P-1,M-1	PHS-1,CHW-1	W,TK,HP	EA	PO(5-10), Ph(>10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00361600	Kerakhol	P-1	CHW-1	HP	ED	PO(5-10), Ph(0-5)	BS(>10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1	--	--
00361700	Chirramuda	P-1	CHW-1	W,HP	ED,EAG	PO(0-5), Ph(0-5)	BS(>10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1	--	--
00362200	Kolam	P-1,M-1,S-1,SS-1	CHW-1	W,TK,TW,HP	EA	PO-1	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(5-10), SPCL(5-10), STAU(>10)	MR-1,FP-1	60000	40000
00362300	Chitwahi	P-1	CHW-1	W,TK,HP	EA	PO(0-5), Ph(5-10)	BS-1, RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(5-10), SPCL(5-10), STAU(>10)	MR-1	50000	35000
00362600	Rodopali	P-1	PHS-1,CHW-1	W,TK,TW,HP	EA	PO(0-5), Ph(>10)	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1	50000	50000
00362700	Salihabhanttha	P-2,ALC-1	CHW-1	W,TK,TW,HP	EA	PO(0-5), Ph(0-5)	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(5-10), SPCL(5-10), STAU(>10)	PR-1	95000	85000
00366400	Nawapara	P-1	RMP-1	W,TK,HP,R	EA	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(5-10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00366500	Basanpali	P-1	CHW-1	W,TK,TW,HP,R	EA	PH-1	BS(0-5), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(5-10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00366700	Tamnar	P-4,M-2,S-1,SS-1	ALH-1,AYH-1,ALD-1, AYD-1,MCW-1,MH-1, CWC-1,HC-1,PHC-1, PHS-1,FWC-1	T,W,TK,TW,HP,R,C,L	EA	PO-1	BS-1, RS(>10), NW(>10)	COP-1,ACS-1	CV(>10), SPCL(>10), STAU(>10)	PR-1,MR-1, FP-1	--	--
00366800	Budiya	P-1,ALC-1	ALH(0-5),MCW(0-5), PHC(0-5)	W,TK,HP,R	ED	PO-1	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00366900	Bagbadi	P-1,ALC-1	ALH(5-10), MCW(5-10),PHC(5-10)	W,TK,HP,R	ED	PO(0-5), Ph(>10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00367000	Kunjemura	P-1,M-1,S-1,SS-1	PHS-1,CHW-1	T,W,HP,R	EA	PH-1	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	PR-1,MR-1, FP-1	--	--
00367100	Kosampali	P-1	CHW-1	W,HP	EA	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	FP-1	--	--
00367200	Gare	P-1	RMP-1,CHW-1	W,TW,HP,R	EA	PH-1	BS-1, RS(>10), NW(>10)	COP-1,ACS-1	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00367300	Pata	P-2,ALC-1	CHW-1	W,TK,TW,HP	EA	PH-1	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--

ANNEXURE : XVII Contd.

CODE	NAME OF VILLAGE	EDUCATION	Medical	DRINKING WATER	POWER SUPPLY	P & T	COMMUN-ICATION	BANKS / SOCIETIES	CULTURAL FACILITY	APPR. TO VILLAGES	INCOME (Rs. Lc)	EXPENCES (Rs. Lc.)
00367400	Mudagaon	P-2	ALH(>10),MCW(>10), PHC(>10)	W,HP,R	EA	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00367500	Saraitola	P-1	CHW-1	W,HP	ED	PO-1	BS(0-5), RS(>10), NW(>10)	COP-1,ACS-1	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00367600	Sarasmal	P-1	CHW-1	W,HP	EA	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00367700	Tihli Rampur	P-1	CHW-1	W,HP,R	EA	PO(0-5), Ph(5-10)	BS(0-5), RS(>10), NW(>10)	COM(5-10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00367800	Aamgaon	P-2	ALH(>10),MCW(>10), PHC(>10)	W,TK,TW,HP	EA	PO-1	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00367900	Janjgir	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP,R	EA	PO(0-5), Ph(>10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368000	Tapranga	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,TW,HP	ED,EAG	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368100	Tangarghat	P-1,M-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED,EAG	PO-1	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368200	Dongamauha	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,TW,HP	ED,EAG	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368300	Telaipara	P(0-5),M(0-5), C(>10)	ALH(>10),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(>10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	FP-1	--	--
00368400	Dhaurabhatha	P-1,M-1,S-1,SS-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,TW,HP	EA	PO-1	BS-1, RS(>10), NW(>10)	COM-1,ACS-1	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368500	Nagramuda	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED,EAG	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368600	Baljor	P-1	ALH(>10),MCW(>10), PHC(>10)	W,HP,R	ED	PO(0-5), Ph(>10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	FP-1	--	--
00368700	Jhinku Bahal	P-1	ALH(>10),MCW(5-10), PHC(5-10)	W,TK,HP	ED	PO(0-5), Ph(5-10)	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368800	Libara	P-1,M-1	ALH(>10),MCW(5-10), PHC(>10)	W,TK,R	ED	PO-1	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00368900	Jharna	P-2	ALH(>10),MCW(5-10), PHC(5-10)	W,TK,HP	ED	PO(0-5), Ph(5-10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00369100	Samkera	P-3,M-1	ALH(>10),MCW(>10), PHC(5-10)	W,TK,HP	ED	PO-1	BS(5-10), RS(>10), NW(>10)	COM(>10),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00369200	Gourbahari	P-2	ALH(>10),MCW(5-10), PHC(5-10)	W,TK,HP	ED	PO(0-5), Ph(5-10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	40000	39000
00369300	Mahloi	P-2,M-1,S-1	PHS-1,CHW-1	W,TK,HP,R	EA	PO-1	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00369400	Deogaon	P-1	CHW-1	W,TK,HP	NA	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00369500	Padi Gaon	P-2,M-1	PHS-1,CHW-1,O-2	W,TK,HP	EA	PO-1	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--

ANNEXURE : XVII Contd.

CODE	NAME OF VILLAGE	EDUCATION	Medical	DRINKING WATER	POWER SUPPLY	P & T	COMMUN-ICATION	BANKS / SOCIETIES	CULTURAL FACILITY	APPR. TO VILLAGES	INCOME (Rs. Lc)	EXPENCES (Rs. Lc.)
00369700	Pali	P(0-5),M(0-5), C(>10)	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED	PO(0-5), Ph(>10)	BS-1, RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00369800	Jobaro	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00369900	Karmagarh	P-1	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370000	Kenani Bahra	P(0-5),M(0-5), C(>10)	ALH(>10),MCW(>10), PHC(>10)	W,TK,HP	ED	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370100	Auorajor	P-1	ALH(5-10),MCW(>10), PHC(>10)	HP	ED	PO(0-5), Ph(>10)	BS(0-5), RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1	--	--
00370200	Karra Pali	P-1	ALH(5-10),MCW(>10), PHC(>10)	HP	ED	PO(0-5), Ph(>10)	BS(>10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370300	Kesharchunwa	P-1	ALH(5-10),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(>10)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370400	Kusmel	P(0-5),M(0-5), C(>10)	ALH(0-5),MCW(>10), PHC(>10)	W,HP	EA	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370500	Khurus Lenga	P-2	ALH(0-5),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(>10)	BS-1, RS(>10), NW(>10)	COM(0-5),COP(0-5),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370600	Chakabahal	P-1	ALH(0-5),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370800	Barkachar	P-1	ALH(0-5),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(5-10)	BS(0-5), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00370900	Bijana	P-1,M-1	ALH(0-5),MCW(>10), PHC(>10)	W,HP	ED	PO(0-5), Ph(>10)	BS(5-10), RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
00371100	Hamirpur	P-1,M-1,S-1	PHS-1,CHW-1	W,HP	ED	PO(0-5), Ph(0-5)	BS-1, RS(>10), NW(>10)	COM(5-10), COP(5-10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	--	--
TEHSIL : RAIGARH												
00373700	Hardijhariya	P-1	ALH(>10),MCW(>10), PHC(>10)	HP	EA	PO(0-5), Ph(>10)	BS(>10), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	FP-1	--	--
00380900	Chhirwani	P-1	ALH(>10),MCW(>10), PHC(>10)	W,HP	EA	PO(0-5), Ph(0-5)	BS(0-5), RS(>10), NW(>10)	COM(>10),COP(>10),	CV(>10), SPCL(>10), STAU(>10)	MR-1,FP-1	121536	121536

Source : Village directory, Census of India, 2001

ANNEXURE : XVII Contd.

A B B R I V A T I O N S

1. EDUCATION :							
P	Primary school	M	Middle school	S	Secondary school	SS	Senior secondary school
C	Collage	IS	Industrial school	TS	Training school	ALC	Adult literacy class/centre
O	Other educational facilities						
2. MEDICAL							
ALH	Allopathic hospital	AYH	Ayurvedic hospital	UNH	Unani hospital	HMH	Homeopathic hospital
ALD	Allopathic dispensary	AYD	Ayurvedic dispensary	UND	Unani dispensary	HMD	Homeopathic dispensary
MH	Maternity home	CWC	Child welfare centre	MCW	Maternity and child welfare centre	HC	Health centre
PHC	Primary health centre	PHS	Primary health sub centre	FWC	Family welfare centre	TB	T.B. centre
NH	Nursing home	CHW	Comunity health workers	RMP	Registered private medical practitioners	SMP	Subsidised medical practitioner
O	Other medical facilities						
3. DRINKING WATER							
T	Tap water	W	Well water	TK	Tank water	TW	Tubewell water
HP	Hand pump	R	River water	C	Canal	L	Lake
S	Spring	O	Other drinking water sources				
4. POWER SUPPLY							
ED	Power for Domestic purpose	EAG	Power for Agriculture	EO	Power for Ind./Comm. purpose	EA	Power for all purposes
5. POST AND TELEGRAPH							
PO	Post Office	TO	Telegraph Office	PTO	Post & Tele. Office	PH	Telephone
6. COMMUNICATION							
BS	Bus Stop	RS	Railway Station	NW	Navigable waterways		
7. BANKS / CREDIT SOCIETIES							
COM	Commercial bank	COP	Cooperative bank	NACS	Non agricultural credit societies	ACS	Agricultural credit societies
OCS	Other credit societies						
8. CULTURAL FACILITIES							
CV	Cinema / Video hall	SPCL	Sports club	STAU	Stadium/Auditorium		
9. APPROACH TO VILLAGE							
PR	Pucca road	MR	Mud road	FP	Footpath	NR	Navigable river
NC	Navigable canal	NW	Navigable waterways (other than river & canal)				

TOTAL AMENITIES AVAILABLE IN THESE VILLAGES

1. EDUCATION :							
Primary school	: 106	Middle school	: 23	Secondary school	: 9	Senior secondary schools	: 5
Adult Literacy Centre	: 5						
2. MEDICAL							
Allopathic Hospital	: 2	Ayurvedic hospital	: 1	Allopathc dispensary	: 1	Ayurvedic dispensary	: 2
Metarnity and child welfare	: 2	Maternity home	: 1	Child welfare centre	: 2	Health centre	: 1
Primary health centre	: 1	Primary health sub-centre	: 16	Family welfare centre	: 2	Regd. Pvt. Medi. practiotioner	: 2
Comunity health workers	: 23	Other Medical Centres	: 2				
3. DRINKING WATER :							
Tap Water	: 2	Well water	: 89	Tank Water	: 53	Tube Well Water	: 17
Hand Pump	: 91	River water	: 19	Canal water	: 2	Lake water	: 1
4. POWER SUPPLY :							
Power for Domestic purpose	: 53	Power for Agriculture	: 7	Power for other purpose	: 9	Power for all purposes	: 33
5. POST AND TELEGRAPH :							
Post Office	: 18	Telephone	: 18				
6. COMMUNICATION :							
Bus Stop	: 26						
7. BANKS/CREDIT SOCIETIES :							
Commercial bank	: 2	Cooperative banks	: 3	Agricultural credit society	: 4		
8. APPROACH TO VILLAGE :							
Pucca road	: 5	Mud road	: 87	Footpath	: 85		

Source : Village directory, Census of India, 2001

ANNEXURE : XVII Contd.

ANNEXURE : XVIII

DISPERSION MODEL FOR ANTICIPATING THE GROUND LEVEL CONCENTRATION (GLC'S) OF AIR POLLUTANTS FROM 2x150 MW MIDDLING AND COAL FINE BASED THERMAL POWER PLANT OF JINDAL STEEL & POWER LIMITED

Ground Level Concentration (GLC) of SPM has been calculated for multi-stack dispersion modelling using double Gaussian diffusion equation : IS 8829-1978 and as per 'Assessment of Impact to Air Environment : Guidelines for Conducting Air Quality Modelling' by CPCB, Delhi, (PROBES/70/1997-98).

$$X_{(x,y,z)} = \frac{Q}{2\pi\sigma_y\sigma_z Up} \exp\left(-\frac{1}{2}\frac{(y^2)}{\sigma y^2}\right) \left[\exp\left\{-\frac{1}{2}\frac{(z-he)^2}{\sigma z^2}\right\}\right]+\left[\exp\left\{-\frac{1}{2}\frac{(z+he)^2}{\sigma z^2}\right\}\right]$$

Where :

$X_{(x, y, z)}$	=	Ground level concentration of pollutant in micro g/cum at the point with co-ordinates (x,y,z).
x	=	Down wind distance in m.
y	=	Cross wind distance in m.
z	=	Vertical distance in m.
he	=	Effective stack height in m.
Q	=	Pollutant emission rate in µg/sec.
σ_y	=	Standard deviation of pollutant plume width in cross wind direction in m.
σ_z	=	Standard deviation of pollutant plume width in vertical direction in m.
Up	=	Mean stack top wind speed in m/sec.

BASIC CONDITIONS

Spatial Distribution of the hourly mixing depth applicable to the site as per "Programme objective series (PROBES/88/2002-03)" published by Central Board for the Prevention and Control of Water Pollution, has been adopted for summer season available from 0500 hrs to 1900 hrs whereas the rest data has been taken from CPCB published data for Calcutta.

The source strength of SO_2 from each stack is calculated on the basis of 312 TPH coal consumption containing 0.5% sulphur. Emission of particulate matters will be <50mg/Nm^3 and NOx will be <400 mg/Nm^3 from the stack. The stack details are given in Table 1 and the assumed receptors are given in Table 2. The surrounding area is almost plain. The stability classes are given in Table 3 for the monitored period of summer season, 2006. The 24 hrs average Ground Level Concentrations has been calculated for SPM, SO_2, NOx and CO which are tabulated in Table 4 based on meteorological monitored data of March to May, 2006. The location of receptors assumed in three most predominant wind directions is shown in Fig 1.

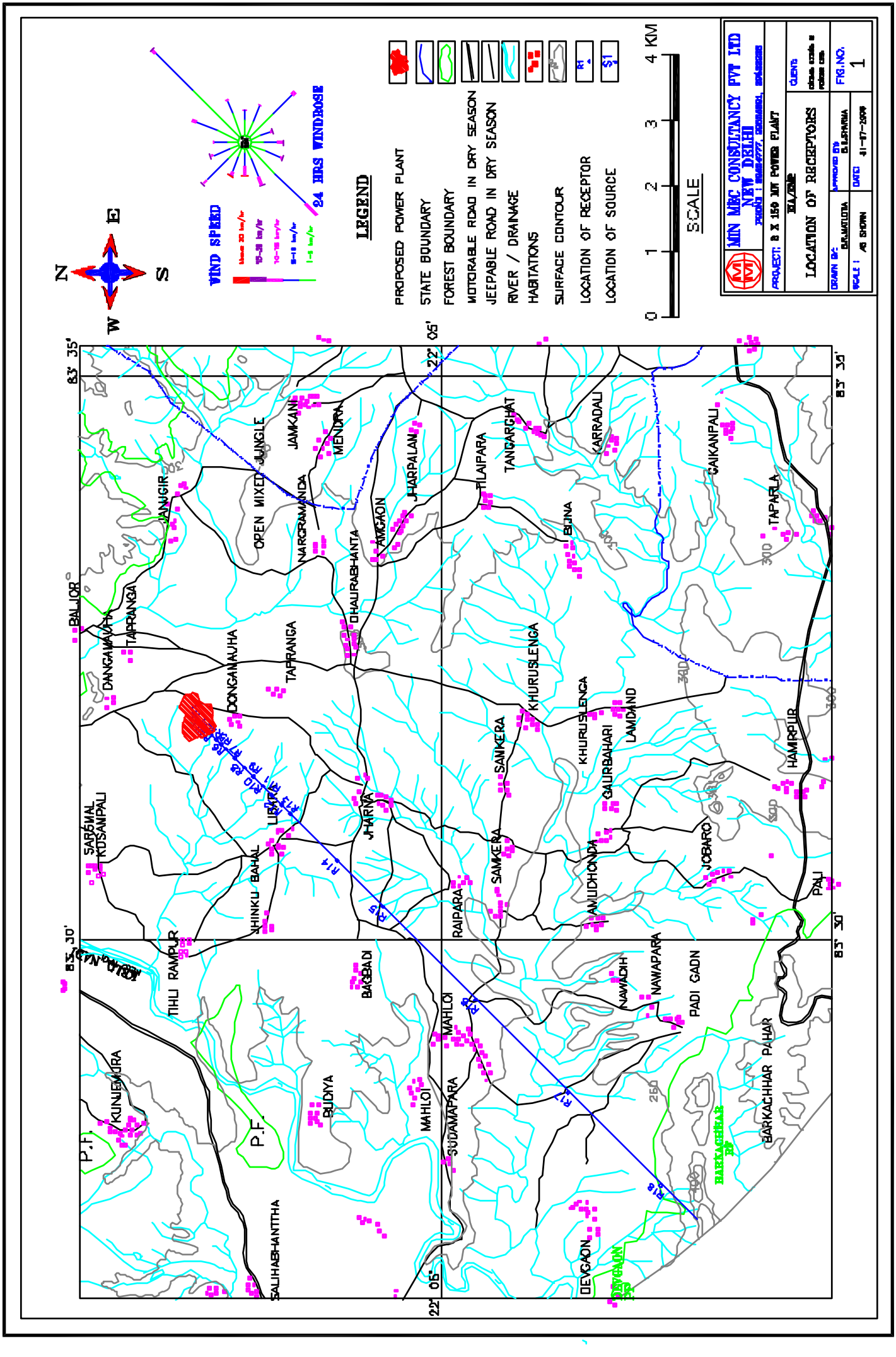

MIN MEC CONSULTANCY PVT LTD
NEW DELHI
PROJECT: 2 X 150 MW POWER PLANT
LOCATION OF RECEPTORS
FIG.NO. 1
DATE 11-12-2009
AS SHOWN
LEGEND
PROPOSED POWER PLANT
STATE BOUNDARY
FOREST BOUNDARY
MOTORABLE ROAD IN DRY SEASON
JEEPABLE ROAD IN DRY SEASON
RIVER / DRAINAGE
HABITATIONS
SURFACE CONTOUR
LOCATION OF RECEPTOR
LOCATION OF SOURCE
SCALE
0 1 2 3 4 KM
24 HRS WINDROSE
WIND SPEED
N
S
E
W
83° 35'
83° 30'
22° 05'
BALJOR
JANJGIR
TAPRANGA
DANGAMAJHA
DONGAMAJHA
SARSIMAL
KOSAMPALI
JHINKU BAHAL
LEMRA
JHARNA
TIHLI RAMPUR
KUNJEMURA
BUDIYA
BAGBADI
MAHLOI
SUDAMAPARA
SALIHABHANTTHA
OPEN MIXED JUNGLE
JAMKANI
NARGRAMANDA
MENDRA
DHAURABHANTA
AMGAON
JHARPALAN
RAIPARA
SANKERA
KHURUSLENGA
LAMDAND
GAURBAHARI
AMUDHONDA
JOBARO
TILAIPARA
TANDARGHAT
KARRADALI
BUNA
GAIKANPALI
TAPARLA
HAMRPUR
PALI
NAWADIH
NAWAPARA
PADI GADN
BARKACHHAR PAHAR
DEVGAON
P.F.
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18

TABLE 1
STACK DATA

Sl. No.	Stack name	Height (m)	Dia (m)	Temp (°C)	Exit gas Vol. (m^3/s)	Pres-sure	Emission rate (μg/s)			
							SPM	SO_2	NOx	CO
1	Stack 1 (Flue 1)	220	3.75	132	265.8	101.325	8958444	433333333	71667560	41433334
2	Stack 1 (Flue 2)	220	3.75	132	265.8	101.325	8958444	433333333	71667560	41433334

TABLE - 2
DESCRIPTION OF ASSUMED RECEPTORS DISTANCE FROM STACK

Receptor name	Distance from stack (m)	Direction (deg.)	Receptor name	Distance from stack (m)	Direction (deg.)	Receptor name	Distance from stack (m)	Direction (deg.)
N-1	500.0	0.0	ESE-4	5000.0	112.5	SW-7	20000.0	225.0
N-2	1000.0	0.0	ESE-5	10000.0	112.5	WSW-1	500.0	247.5
N-3	2000.0	0.0	ESE-6	15000.0	112.5	WSW-2	1000.0	247.5
N-4	5000.0	0.0	ESE-7	20000.0	112.5	WSW-3	2000.0	247.5
N-5	10000.0	0.0	SE-1	500.0	135.0	WSW-4	5000.0	247.5
N-6	15000.0	0.0	SE-2	1000.0	135.0	WSW-5	10000.0	247.5
N-7	20000.0	0.0	SE-3	2000.0	135.0	WSW-6	15000.0	247.5
NNE-1	500.0	22.5	SE-4	5000.0	135.0	WSW-7	20000.0	247.5
NNE-2	1000.0	22.5	SE-5	10000.0	135.0	W-1	500.0	270.0
NNE-3	2000.0	22.5	SE-6	15000.0	135.0	W-2	1000.0	270.0
NNE-4	5000.0	22.5	SE-7	20000.0	135.0	W-3	2000.0	270.0
NNE-5	10000.0	22.5	SSE-1	500.0	157.5	W-4	5000.0	270.0
NNE-6	15000.0	22.5	SSE-2	1000.0	157.5	W-5	10000.0	270.0
NNE-7	20000.0	22.5	SSE-3	2000.0	157.5	W-6	15000.0	270.0
NE-1	500.0	45.0	SSE-4	5000.0	157.5	W-7	20000.0	270.0
NE-2	1000.0	45.0	SSE-5	10000.0	157.5	WNW-1	500.0	292.5
NE-3	2000.0	45.0	SSE-6	15000.0	157.5	WNW-2	1000.0	292.5
NE-4	5000.0	45.0	SSE-7	20000.0	157.5	WNW-3	2000.0	292.5
NE-5	10000.0	45.0	S-1	500.0	180.0	WNW-4	5000.0	292.5
NE-6	15000.0	45.0	S-2	1000.0	180.0	WNW-5	10000.0	292.5
NE-7	20000.0	45.0	S-3	2000.0	180.0	WNW-6	15000.0	292.5
ENE-1	500.0	67.5	S-4	5000.0	180.0	WNW-7	20000.0	292.5
ENE-2	1000.0	67.5	S-5	10000.0	180.0	NW-1	500.0	315.0
ENE-3	2000.0	67.5	S-6	15000.0	180.0	NW-2	1000.0	315.0
ENE-4	5000.0	67.5	S-7	20000.0	180.0	NW-3	2000.0	315.0
ENE-5	10000.0	67.5	SSW-1	500.0	202.5	NW-4	5000.0	315.0
ENE-6	15000.0	67.5	SSW-2	1000.0	202.5	NW-5	10000.0	315.0
ENE-7	20000.0	67.5	SSW-3	2000.0	202.5	NW-6	15000.0	315.0
E-1	500.0	90.0	SSW-4	5000.0	202.5	NW-7	20000.0	315.0
E-2	1000.0	90.0	SSW-5	10000.0	202.5	NNW-1	500.0	337.5
E-3	2000.0	90.0	SSW-6	15000.0	202.5	NNW-2	1000.0	337.5
E-4	5000.0	90.0	SSW-7	20000.0	202.5	NNW-3	2000.0	337.5
E-5	10000.0	90.0	SW-1	500.0	225.0	NNW-4	5000.0	337.5
E-6	15000.0	90.0	SW-2	1000.0	225.0	NNW-5	10000.0	337.5
E-7	20000.0	90.0	SW-3	2000.0	225.0	NNW-6	15000.0	337.5
ESE-1	500.0	112.5	SW-4	5000.0	225.0	NNW-7	20000.0	337.5
ESE-2	1000.0	112.5	SW-5	10000.0	225.0			
ESE-3	2000.0	112.5	SW-6	15000.0	225.0			

TABLE – 3
HOURLY STABILITY FREQUENCY

HOUR	OCCURRENCE OF STABILITY CLASSES (in %) (01/03/2006-31/05/2006)					
	A	B	C	D	E	F
0.00	0.00	0.00	0.00	0.00	17.58	82.42
1.00	0.00	0.00	0.00	0.00	7.69	92.31
2.00	0.00	0.00	0.00	0.00	21.98	78.02
3.00	0.00	0.00	0.00	0.00	2.20	97.80
4.00	0.00	0.00	0.00	0.00	15.38	84.62
5.00	0.00	0.00	0.00	1.10	16.48	82.42
6.00	0.00	70.33	27.47	2.20	0.00	0.00
7.00	0.00	82.42	16.48	1.10	0.00	0.00
8.00	77.17	22.83	0.00	0.00	0.00	0.00
9.00	82.61	17.39	0.00	0.00	0.00	0.00
10.00	97.83	2.17	0.00	0.00	0.00	0.00
11.00	100.00	0.00	0.00	0.00	0.00	0.00
12.00	100.00	0.00	0.00	0.00	0.00	0.00
13.00	100.00	0.00	0.00	0.00	0.00	0.00
14.00	98.91	1.09	0.00	0.00	0.00	0.00
15.00	82.61	17.39	0.00	0.00	0.00	0.00
16.00	69.23	30.77	0.00	0.00	0.00	0.00
17.00	0.00	76.92	23.08	0.00	0.00	0.00
18.00	0.00	72.53	27.47	0.00	0.00	0.00
19.00	0.00	0.00	0.00	0.00	0.00	100.00
20.00	0.00	0.00	0.00	0.00	25.27	74.73
21.00	0.00	0.00	0.00	0.00	3.30	96.70
22.00	0.00	0.00	0.00	0.00	2.20	97.80
23.00	0.00	0.00	0.00	0.00	14.29	85.71
AVG.	**33.90**	**16.38**	**3.92**	**0.18**	**5.25**	**40.37**

TABLE 4
24 HOURS AVERAGE GROUND LEVEL CONCENTRATIONS (µg/m^3) TOWARDS THREE MOST PREDOMINANT DOWN WIND DIRECTIONS

Receptor	Distance (m) From stack	Direction (deg.)	Concentration (01/03/2006 to 31/05/2006)											
			SPM			SO_2			NOx			CO		
			NE (12.3%)	SW (16.0%)	NW (8.5%)	NE (12.3%)	SW (16.0%)	NW (8.5%)	NE (12.3%)	SW (16.0%)	NW (8.5%)	NE (12.3%)	SW (16.0%)	NW (8.5%)
ENE-2	1000.0	67.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE-3	2000.0	67.5	0.01	0.00	0.00	0.29	0.00	0.00	0.05	0.00	0.00	0.03	0.00	0.00
ENE-4	5000.0	67.5	0.01	0.00	0.00	0.25	0.00	0.00	0.04	0.00	0.00	0.02	0.00	0.00
ENE-5	10000.0	67.5	0.00	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
ENE-6	15000.0	67.5	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE-7	20000.0	67.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE-2	1000.0	45.0	0.00	0.00	0.00	0.14	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00
NE-3	2000.0	45.0	0.08	0.00	0.00	4.05	0.00	0.00	0.67	0.00	0.00	0.39	0.00	0.00
NE-4	5000.0	45.0	0.12	0.00	0.00	5.63	0.00	0.00	0.93	0.00	0.00	0.54	0.00	0.00
NE-5	10000.0	45.0	0.07	0.00	0.00	3.38	0.00	0.00	0.56	0.00	0.00	0.32	0.00	0.00
NE-6	15000.0	45.0	0.05	0.00	0.00	2.52	0.00	0.00	0.42	0.00	0.00	0.24	0.00	0.00
NE-7	20000.0	45.0	0.04	0.00	0.00	2.06	0.00	0.00	0.34	0.00	0.00	0.20	0.00	0.00
NNE-2	1000.0	22.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE-3	2000.0	22.5	0.01	0.00	0.00	0.29	0.00	0.00	0.05	0.00	0.00	0.03	0.00	0.00
NNE-4	5000.0	22.5	0.01	0.00	0.00	0.26	0.00	0.00	0.04	0.00	0.00	0.02	0.00	0.00
NNE-5	10000.0	22.5	0.00	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
NNE-6	15000.0	22.5	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE-7	20000.0	22.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW-2	1000.0	337.5	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
NNW-3	2000.0	337.5	0.00	0.00	0.01	0.00	0.00	0.26	0.00	0.00	0.04	0.00	0.00	0.02
NNW-4	5000.0	337.5	0.00	0.00	0.01	0.00	0.00	0.25	0.00	0.00	0.04	0.00	0.00	0.02
NNW-5	10000.0	337.5	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.00	0.01
NNW-6	15000.0	337.5	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
NNW-7	20000.0	337.5	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
NW-2	1000.0	315.0	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.02	0.00	0.00	0.01
NW-3	2000.0	315.0	0.00	0.00	0.08	0.00	0.00	3.66	0.00	0.00	0.61	0.00	0.00	0.35
NW-4	5000.0	315.0	0.00	0.00	0.11	0.00	0.00	5.15	0.00	0.00	0.85	0.00	0.00	0.49

ANNEXURE : XVIII Contd..

Receptor	Distance (m) From stack	Direction (deg.)	Concentration (01/03/2006 to 31/05/2006)											
			SPM			SO_2			NOx			CO		
			NE (12.3%)	SW (16.0%)	NW (8.5%)	NE (12.3%)	SW (16.0%)	NW (8.5%)	NE (12.3%)	SW (16.0%)	NW (8.5%)	NE (12.3%)	SW (16.0%)	NW (8.5%)
NW-5	10000.0	315.0	0.00	0.00	0.06	0.00	0.00	3.00	0.00	0.00	0.50	0.00	0.00	0.29
NW-6	15000.0	315.0	0.00	0.00	0.05	0.00	0.00	2.24	0.00	0.00	0.37	0.00	0.00	0.21
NW-7	20000.0	315.0	0.00	0.00	0.04	0.00	0.00	1.84	0.00	0.00	0.30	0.00	0.00	0.18
SSW-2	1000.0	202.5	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW-3	2000.0	202.5	0.00	0.01	0.00	0.00	0.55	0.00	0.00	0.09	0.00	0.00	0.05	0.00
SSW-4	5000.0	202.5	0.00	0.01	0.00	0.00	0.51	0.00	0.00	0.09	0.00	0.00	0.05	0.00
SSW-5	10000.0	202.5	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.02	0.00	0.00	0.01	0.00
SSW-6	15000.0	202.5	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00
SSW-7	20000.0	202.5	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW-2	1000.0	225.0	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.03	0.00	0.00	0.02	0.00
SW-3	2000.0	225.0	0.00	0.16	0.00	0.00	7.78	0.00	0.00	1.29	0.00	0.00	0.74	0.00
SW-4	5000.0	225.0	0.00	0.24	0.00	0.00	11.41	0.00	0.00	1.89	0.00	0.00	1.09	0.00
SW-5	10000.0	225.0	0.00	0.14	0.00	0.00	6.70	0.00	0.00	1.11	0.00	0.00	0.64	0.00
SW-6	15000.0	225.0	0.00	0.10	0.00	0.00	4.99	0.00	0.00	0.83	0.00	0.00	0.48	0.00
SW-7	20000.0	225.0	0.00	0.08	0.00	0.00	4.08	0.00	0.00	0.67	0.00	0.00	0.39	0.00
WNW-2	1000.0	292.5	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
WNW-3	2000.0	292.5	0.00	0.00	0.01	0.00	0.00	0.26	0.00	0.00	0.04	0.00	0.00	0.02
WNW-4	5000.0	292.5	0.00	0.00	0.01	0.00	0.00	0.25	0.00	0.00	0.04	0.00	0.00	0.02
WNW-5	10000.0	292.5	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.01	0.00	0.00	0.01
WNW-6	15000.0	292.5	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
WNW-7	20000.0	292.5	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
WSW-2	1000.0	247.5	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW-3	2000.0	247.5	0.00	0.01	0.00	0.00	0.56	0.00	0.00	0.09	0.00	0.00	0.05	0.00
WSW-4	5000.0	247.5	0.00	0.01	0.00	0.00	0.52	0.00	0.00	0.09	0.00	0.00	0.05	0.00
WSW-5	10000.0	247.5	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.02	0.00	0.00	0.01	0.00
WSW-6	15000.0	247.5	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00
WSW-7	20000.0	247.5	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note : *The concentrations as calculated on other receptors are Nil.*

CONCLUSIONS

From Table 4, it can be observed that based on meteorological data of March to May 2006, the anticipated 24 hours average GLC's at 5 km from stack 1 will be the maximum and will be as given below :

CALCULATED MAXIMUM GROUND LEVEL CONCENTRATION (µg/m^3)
(AT 5 KM DISTANCE FROM THE STACK TOWARDS SW DIRECTION)

Pollutant	Concentrations (µg/m^3)
SPM	0.24
SO_2	11.41
Nox	1.89
CO	1.09

The three most predominant wind directions observed during the monitoring period are towards SW, NE and NW directions for 16.0%, 12.3% and 8.5% of time respectively during March to May 2006. The GLCs are lesser than the first predominant downwind direction in the second and third predominant downwind directions.

Above results show that the emissions from the plant will increase pollution in the ambient air but it will still be far below the permissible limits.

ANNEXURE : XIX

DAMAGE RISK CRITERIA FOR HEARING LOSS OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA)

MAXIMUM ALLOWABLE DURATION PER DAY, hour	NOISE LEVEL dB(A) (SLOW RESPONSE)
8	90
6	92
4	95
3	97
2	100
1.5	102
1.0	105
0.5	110
0.25 or Less	115

MAXIMUM PERMISSIBLE EXPOSURE TO SOUND UNDER OCCUPATIONAL HEALTH AND SAFETY IN INDIA

SOUND LEVEL, dB(A)	MAXIMUM EXPOSURE HOURS
90	8
93	4
96	2
99	1
102	½
105	¼
108	1/8 or 7.5 min

THE NOISE POLLUTION (REGULATION AND CONTROL) RULES, 2000

SCHEDULE

[See Rule 3(1) and 4(1)]

Ambient Air Quality Standards in respect of Noise

Area Code	Category of Area/Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Note :

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.

2. Night time shall mean from 10.00 p.m. to 6.00 a.m.

[a][3. Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority].

4. Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale 'A' which is relatable to human hearing.

A "decibel" is a unit in which noise is measured.

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

Leq : It is an energy mean of the noise level over a specified period.

SOURCE : Pollution Control Acts, Rules and Notifications Issued Thereunder, Pollution Control Law Series : PCLS/02/1992 (Fourth Edition) of Central Pollution Control Board, September 2001, pp 711

[a] Substituted by Rule 4 of the Noise Pollution (Regulation and Control) (Amendment) Rules, 2000 notified vide S.O. 1046(E), dated 22.11.2000.

The Environment (Protection) Rules, 1986

[1]SCHEDULE I[**]
(See Rule 3)

5 Thermal Power Plant

		Maximum limiting concentration, mg/l (except for pH and temperature)
Condenser cooling waters (once through cooling system)	PH	6.5 – 8.5
	Temperature	Not more than 5°C higher than the intake water temperature
	Free available chlorine	0.5
Boiler blow downs	Suspended solids	100
	Oil and grease	20
	Copper (total)	1.0
	Iron (total)	1.0
Cooling tower blow down	Free available chlorine	0.5
	Zinc	1.0
	Chromium (total)	0.2
	Phosphate	5.0
	Other corrosion inhibiting materials	Limit to be established on case by case basis by Central Board in case of Union Territories and State Board in case of States
Ash pond effluent	PH	6.5 – 8.5
	Suspended solids	100
	Oil and grease	20

SOURCE : Pollution Control Acts, Rules and Notifications Issued There under, Pollution Control Law Series : PCLS/02/1992 (Fourth Edition) of Central Pollution Control Board, September 2001, page 279

[1] The Environment (Protection) Rules, 1986 are referred to as principal rules in all subsequent Notifications beginning with S.O.32(E), dated 16.2.1987 published in the Gazette No. 66, dated 16.2.1987. The Schedule to be principals rules was renumbered as Schedule – I vide S.O.32(E) supra.

[**] Substituted by Rule-2 of the Environment (Protection) Amendment Rules, 1996 notified by G.S.R. 176, dated 2.4.1996. may be read as BOD (3 days at 27°C) wherever BOD 5 days 20°C occurred.

ANNEXURE : XXII

CLARIFICATIONS AS PER THE TOR ISSUED BY THE MINISTRY OF ENVIRONMENT AND FORESTS

Sl. No. as per MoEF	Description as per MoEF	Covered in EIA as per details
I.	Impact of loading terminal shall be included in the EIA report.	Para 4.3.2 (page 4-4)
II.	Impact of the project on first order streams passing through the project site and also on the hydrology of the area.	Fig. 3.1 (page 3.2), Para 4.5.1 & Para 4.5.2 (Page 4-4 and 4-5)
III.	Water requirement to be rechecked and re-confirmed	Para 2.8 (page 2-7), fig 2.2 (page 2-8)
IV.	Details of the measures taken for water conservation shall be provided	Para 5.5.1 (page 5-4) and para 5.5.2 (page 5-5)
V.	Details of water balance taking into account reuse and re-circulation of effluents	Para 2.8 & Table 2.4 (page 2-7), Fig 2.2 (page 2-8)
VI.	Details of greenbelt clearly showing the extent of land under greenbelt, nature of species to be planted and the phasing of plantation.	Fig. 2.1 (Page 2-2), Table 5.1 and Para 5.4 (page 5-4), Para 5.7 (page 5-7)
VII.	Details of void which will be left in the mines after backfilling the OB generated from the mines. Whether the void so left have the capacity to accommodate the ash to be generated from the proposed power plant. Supporting documents and calculations in this regard shall be provided.	Para 5.8 (page 5-8)
VIII.	Environment Management Plan to mitigate the adverse impacts of the project.	Para 5.10 and Table 5.2 (page 5-9)