BHUSHAN LIMITED

THE MODIFICATION –CUM– EXPANSION OF EXISTING INTREGRATED STEEL PLANT AT RENGALI (ORISSA) TO 2.2 MTPA

ENVIRONMENT IMPACT ASSESSMENT (EIA)
&
ENVIRONMENT MANAGEMENT PLAN (EMP)

MECON LIMITED
RANCHI – 834002
INDIA

CONTENTS

1.0 INTRODUCTION

1.1 GENERAL

Iron is perhaps the most important metal to the mankind and its principal alloy, **steel**, is widely used for domestic, agricultural, industrial and defense purposes. Per capita steel consumption is a major indicator of economic status of any country. The growth of the steel industry significantly contributes to economic growth as it generates employment both directly and also due to development of downstream industries.

Industrial process is invariably involving the conversion of raw materials and resources into semi finished and / or finished products. During this process, residues in the form of wastes will be formed. If the residues are not recycled/ re-utilised they become waste and have to be discharged into environment as pollutants. The degree to which the pollutants affect the physical environment depends upon their quantitative and qualitative characteristics as well as the receiving media. However, any industrial development process is accompanied by some environmental problems. Proper planning at the conceptual stages can minimize many of these problems. Once an industry is commissioned it becomes difficult and expensive to retrofit pollution control equipment, as such incorporation of the same at conceptual stage it self is the best alternative.

Setting up of an industry has both positive and negative impacts on the environment. The negative impacts include environmental degradation and adverse socio economic changes. It is the responsibility of scientist and environmentalist to document the likely impacts so that they can be identified and attempts can be made to minimise the effects due to negative impacts and maximise benefits due to the positive impacts. In this regards Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) has been considered as one of the most important documents for utilisation by all the concerned to understand the environmental implications due to the proposed development activity and take decisions in the best interest of the Environment.

1.2 PROPOSED EXPANSION OF 1.2 Mtpy PLANT

M/S Bhushan Limited (BL), is a leading company of Bhushan group of companies and is establishing the most modern, technology efficient and eco-friendly integrated steel plant at Rengali, Dist Sambalpur, Orissa. BL is now intends to augment their hot metal production capacity from 1.2 MTPA to 2.2 MTPA in phases. In second phase, BL will augment their hot metal production capacity by installing the following additional facilities:

- One blast furnaces of capacity 1008 m3 instead of 2x350 m3 earlier proposed,
- One sinter plant of capacity 105 m2

- One 2.0 Mtpy pellet plant
- Two additional DR kiln of 170000 tpy capacity
- Alloy furnaces (4x16 MVA)
- Two no single strand Continuous Thin slab casters
- Two no. Tunnel furnaces based on BF gas mixed with LPG/Propane
- One additional coal washery of 3.5 Mtpy in place of 1.0Mtpy earlier proposed.
- Two no non-recovery type coke oven battery of 0.45 Mtpy each to meet the coke requirement of steel plant.
- Lime and Dolo kiln to meet the flux requirement.
- 3x110 MW CFBC power plants to utilize the second product of coal washery in addition to existing AFBC boilers.

To supplement the auxiliary demands one 400 tpd Oxygen plant and augmentation of raw material handling facilities is envisaged.

In pursuance of Government of India Policy, under 'The Environment (Protection) Act 1986' and Orissa State Pollution Control Board (OSPCB), the proposed project will require clearance from environmental angle. Bhushan Limited entrusted MECON LIMITED (MECON) to prepare an Environmental Impact Assessment and Environmental Management Plan (EIA/EMP) report for their proposed plant at Thelkoloi, Rengali in Orissa. The present report, an EIA/EMP report is prepared based on monitored data for one season covering three months (summer season). The present report is prepared in accordance with the guideline of MOE&F & OSPCB.

For carrying out the Environmental Impact Assessment (EIA) study, the area falling within 7 km radius of project site at Rengali area has been considered for generation of base line data with respect to present air quality, water quality, noise level, soil quality, ecology, socio-economic and meteorology etc. The site studies were carried-out during summer season in March 2005 to June 2005.

1.3 PLANT LOCATION

The plant is located 16 km from Jharsuguda and 45 km from Sambalpur. The plant is located between latitude 21°44' to 21°46' N and longitudes 84°01' to 84°03' E at Rengali block of Sambalpur district of Orissa. Nearest Railway station is Lapanga on SouthEastern railway and nearest port is Paradeep which is more than 400 km away.

Orissa Industrial Infrastructure Development Corporation (IDCO) had earlier acquired the land measuring 1300 acres and transferred to Bhushan Limited to set up 1.2 Mtpy integrated steel plant which is now being expanding to 2.2 Mtpy level.

1.4 CLIMATE

Maximum temperature in the area is 47.8°C in May and minimum temperature 12°C in December. As per local IMD station at Jharsuguda, the average annual rainfall is 1460.9 mm, and most of it is during the monsoon season, which lasts from June ends to September. The relative humidity varies from 21 to 87%. The prevailing wind direction is SW and, N, NE while mean wind speed is around 5.3 and 5.6 m/s in December and January respectively.

1.5 OBJECTIVE OF EIA AND EMP REPORT

The aim of this EIA study report is to take stock of the prevailing quality of environment, to assess the impacts of modification-cum-expansion of integrated steel plant on environment and to build appropriate environmental control measures to minimise adverse impacts and to maximise beneficial impacts. The following major objectives have been considered:

- Assess the existing status of environment.
- Assess the impacts due to the proposed expansion.
- Suggest pollution control and ameliorative measures.
- Prepare an action plan for implementation of suggested ameliorative measures.
- Suggest a monitoring programme to assess the efficacy of the various adopted environmental control measures.
- Assess financial considerations for environmental control plans during expansion.

1.6 BASIC DATA AND FIELD STUDIES

This report has been prepared on the basis of environmental data generated in and around the integrated steel plant site during the Summer Season in the month of March 2005 to June 2005. The data regarding meteorological conditions, air quality, water quality, noise levels, soil quality, ecology and socio-economic environment were generated in the study area falling within 7.0 km radius with the existing plant as center.

An in-depth analysis of the baseline environmental data generated by actual field monitoring and collected from various secondary sources has been carried out for identifying and predicting the probable environmental impacts due to the modification-cum-expansion of existing plant. Reasonable assumptions have been made, wherever data is found lacking. Based on the findings a suitable environmental management plan has also been suggested.

1.7 SCOPE OF THE REPORT

This report contains various information's on the existing environmental attributes including air, water, noise, solid waste, soil quality, ecology and socio-economic patterns etc. This report evaluates and predicts the impact of the modification-cum-expansion of plant activities on the environment. It also cover the various remedial measures considered by plant management like air pollution control systems, complete recycling of process cooling water, green belt development plans and reuse of solid waste and other environmental management system which are useful for control of environmental degradation due to the steel plant. A detailed coverage of the emission sources, emission control equipment, background air quality levels, predicted air quality levels, meteorological measurements, dispersion model and all other aspects of pollution have been provided in this report.

The report includes:

Project Profile
Screening of impacts
Present Environmental Status
Prediction of Environmental Impacts
Environmental Management Plan(EMP)
Disaster Management Plan(DMP)
EMP Implementation and Monitoring.
Organisation and Manpower
Cost considerations

2.2 ACKNOWLEDGMENT

MECON wishes to place on record its deep appreciation for the trust reposed in MECON by BHUSAN LIMITED (BL) for the EIA/EMP study and also for the active interest and the help extended by the concerned officials of BL. The Co-operation extended by the officials of various State and Central Government agencies is also gratefully acknowledged.

2.0 PROJECT PROFILE

GENERAL

M/s Bhushan Limited is proposing to modify/expand the existing 1.2 Mtpy integrated steel plant to 2.2 Mtpy level at Rengali near Jharsuguda in Orissa. The existing steel plant is based on the Directly Reduced Iron (DRI), Blast Furnace - Electric Arc Furnace (EAF),– Continuous casting – rolling mill route with captive power plant for production of about 2,200,000 tpy of finished steel products.

NEED OF THE EXPANSION

Bhushan Steel has the capacity to consume around 1.8 million tonnes HR steel products per year at their own plants to produce CR, Galvanizing and other steel products. The present steel scenario is also favorable to scale of economy of integrated steel plant, and Bhushan Steel is in advantageous position to go for backward integration with a hot rolled plant upto a capacity of 1.8 million tonnes per year plus 0.4 MT long product. Presently HR coils are procured indigenously as well as imported from foreign countries.

Bhushan Limited has initiated several steps as part of their backward integration and developing economy of scale in production and this is one such step to modify/expand the existing 1.2 Mtpy integrated steel plant into 2.2 Mtpy level to bring economy of scale.

PLANT SITE

The site was earlier selected based on comparative parameters considered during establishing the 1.2 Mtpy plant. The proposed modification-cum-expansion will take place at the existing site of Rengali.

The comparative statement for site selection at the 1.2 Mtpy stage showing different locations of Orissa are furnished below:

Comparison of Salient Features of the Sites in Orissa

Comparable factors	Rengali	Bamra	Nayagarh	Dhamra
Topography	Partly flat & partly undulating	Fairly flat	Fairly flat	Totally flat
Soil condition	Firm and stable. Suitable for open foundation.	Firm and stable. Suitable for open foundation.	Firm and stable. Suitable for open foundation.	Soft soil pilling will be required.
Water supply	From Hirakud Reservoir at a distance of 15 km.	Adequate water from nearest Sapal river not available.	From river Baltarani at a distance of 3 km.	From river Baltarani at a distance of 15 km.

Power supply	From Budipadar grid sub-station at about 14 km. distance	Budipadar 50 Km.	From Joda grid sub-station at a distance of 21 km.	Very far from the site.
Rail facility	Will be served by Lapanga railway station at a distance of about 2 km.	Will be served by Bamra railway station at a distance of about 3 km.	Will be Served from Nayagarh railway station on Baspani-Daitari railway line (Proposed)	60 Km. Rail line from Bhadrak to site proposed.
Road facility	L&T road SH-10 adjacent to site,	State highway SH-10 at a distance of 16 km.	State highway will have to be strengthened and widened about 12 km.	Jamjhari Dhamra road (Defence road) at a distance of 3 km.
Nearest town	Jharsuguda 13 km. Sambalpur 32 km.	Rourkela (Panposh) 70 km. Jharsuguda 58 km.	Bhadrak 80 km.	Balasore 105 km. Bhadrak 77 km.
Land availability and cost (cost per acre)	Yes 0.5 Lakh	Yes 0.55 Lakh	Inadequate land	Land is adequate but back water filling
Requirement of reservoir	Not	Yes	Yes	Yes
Nearest port	Paradeep	Paradeep	Paradeep	Paradeep

Site survey team analysed that the site at Rengali was the best site as per the availability of Water, Power, Coal, infrastructure facilities and raw materials particularly coal.

Coal is one of the major raw materials for steel and power generation and is available within 50-60 Kms of Rengali site. This was one of the major factors for deciding this site.

2.1 PLANT LOCATION

The site is located between latitude 21°44’ to 21°46’ N and longitudes 84°01’ to 84°03’ E at Rengali block of Sambalpur district of Orissa. The location of the plant is shown in Drg. No. MEC/Q633/11/S2/01. The land measuring 1300 acres had been acquired by Bhushan Limited to set up integrated steel plant. The above unit is located at village Thelkoli, block Rengali, Dist. Sambalpur (Orissa). The plant is situated on Jharsuguda -

Sambalpur link road SH 10, where all the desired infrastructure facilities needed for steel plant is available. The proposed 2.2 Mtpy expansion shall be taken-up within the existing plant premises, as such no additional procurement of land is required other than for ash/waste dump.

2.2 EXISTING PLANT AND FACILITIES

The integrated steel plant is being highly capital intensive. So, it was planned to implement the project in two phases. The major technological & auxiliary units of the 1.2 Mtpy steel plants for which NOC was granted were as follows:

Step-I

i) 1.0 Mtpy Coal washery
ii) 4 x 170,000 tpy DR plant
iii) 1 x 350 m^3 Blast Furnace
iv) 2 x 40 MW Power Plant (approx. 40 MW from kilns hot gases + 40 MW from 1 x 75tph & 1x150 tph AFBC boiler)
iv) Matching Raw Materials Preparation Plant (RMPP)
v) 2 x 35 t Electric Arc Furnace + 4 x 15 t Induction Furnace
vi) 1 x 35 t Ladle Furnace
vii) 2 x 2 – strand Billet Caster
viii) 330,000 tpy (approx) Bar Mill
ix) Required services and auxiliary facilities

The overall implementation schedule of this step was end of 2004.

Step – II

At this stage, the following production units were planned to be added:

i) 1.0 Mtpy Coal Washery
ii) 4 x 170,000 tpy DR Plant
iii) 1 x 350 m^3 Blast Furnace
iv) 1 x 60 MW Power Plant
v) Matching RMPP
vi) 2 x 100/ 130 t Electric Arc Furnace
vii) 1 x 100/ 130 t Ladle Furnace
viii) 900,000 tpy Compact Strip Caster shop
x) Required services facilities

The total plant was expected to be completed by 2005 – 06.

2.3 PROPOSED MODIFICATION-CUM-EXPANSION OF PLANT

Bhushan Limited is now intends to augment their hot metal production capacity from 1.2 Mtpy to 2.2 Mtpy in phases. During expansion, BL will augment their hot metal production capacity from 1.2 Mtpy to 2.2 Mtpy by installing the following additional facilities:

- One blast furnaces of capacity 1008 m3 instead of 2x350 m3 earlier proposed,
- One sinter plant of capacity 105 m^2
- Two additional DR kiln of 170000 tpy capacity
- Alloy furnaces (4x16 MVA) to produce 0.85 tpy alloy steel.
- Two no single strand Continuous Thin Slab Casters
- Two no. Tunnel furnaces based on BF gas mixed with LPG/Propane
- One additional coal washery of 3.5 Mtpy in place of 1.0Mtpy earlier proposed in step-II.
- Two non-recovery type coke oven battery of 0.45 Mtpy each to meet the coke requirement of steel plant
- Lime and Dolo kiln to meet the flux requirement.
- 3x110 MW CFBC power plant to utilize the second product of coal washery in addition to existing AFBC boilers.

To supplement the auxiliary demands one 400 tpd Oxygen plant and augmentation of raw material handling facilities is envisaged

2.4 ULTIMATE PLANT CONFIGURATION AT 2.2 MTPY STAGE

The ultimate plant facilities after the modification-cum-expansion shall be as follows:

Sl. No.	DESCRIPTION	UNITS IN 1.2 MTPY STAGE(NOC GRANTED)	ULTIMATE PLANT CONFIGURATION AT 2.2 MTPY STAGE
1.	Pellet plant	-	2.0 Mtpy pellet plant
2.	Direct Reduction Iron (DRI)	8 kilns x 170000tpy	10 kilns x 170,000 tpy
3.	Sinter Plant	-	1x105 m2
4.	Blast Furnace	2X350 M3	1 x 1008 m^3
5.	Coal Washery	2X1.0 Mtpy	1.0 +3.5 Mtpy
6.	Power Plant	1 x 40 +1x60 MW AFBC & WHRB based power plant	1 x 40+1x60 +3x110 MW AFBC; CFBC &WHRB based power plant

7.	Raw materials Preparation Plant (RMPP)	Matching the production facilities	Matching the production facilities
8.	Steel making and Casting unit	• 2x35+2x100 t EAF & • 1x35+1x100t LF • 8x15 Induction Furnace • 2X2 – Strand Billet Caster	• 4 x 90 t Electric Arc Furnace (EAF) • 4 x 15 t Induction Furnace (IF) • 4 x 90+2x15 t Ladle Furnace (LF) • 4x16 MVA alloy smelter • 1 x 2+1x4 Strand Billet Caster
9.	CSP Plant	• 0.9 Mtpy Compact Strip Caster	• 2 no. Single Strand Continuous Thin Slab Casters 1.8 Mtpy
10.	Rolling Mill (HSM)	• 0.3Mtpy Bar Mill	• 1.8 Mtpy 6 Strands HSM • 0.1Mtpy Bar Mill
11.	Coke Oven Plant	-	• 2x0.45 Mtpy non recovery type Coke Oven Batteries
12.	Lime & Dolo Plant	-	• 400000tpy lime kiln • 100000tpy dolo kiln
13.	Oxygen Plant	-	• 400 tpd Oxygen Plant

The Material Flow Sheet corresponding to the ultimate stage of implementation of the project is given in the Annexure: 2.1 and the major facilities of the respective production units with their technical parameters have been detailed in the following paragraphs.

2.4.1 Pallet Plant

Bhushan Limited is installing a pellet plant to utilise fines generated from mines in the order of 60-70 %. The capacity of the plant will be 2.0 Mtpy. The pellet made will be suitable for use in the DRI unit as well as in Blast Furnace. The plant will produce both Blast furnace grade and Directly Reduction grade pellets. The pellet plant consists of the following areas:

- Material receiving
- Grinding
- Feed preparation
- Balling
- Indurating
- Product handling
- Pollution control

The material receiving area will have storage facilities for lime stone, bentonite, coal etc. Iron ore fines are received from raw material handling yard. The feed ore is dried in rotary kiln dryers and ground in two compartment ball mills to pelletising fineness. Dry grinding was chosen because it permits processing of vide varieties of ore. The ball mill will operate in open circuit and will grind the ore to minus 270 mesh fineness. Bentonite, coke and lime stone will be supplied and ground separately in a bowl mill and pneumatically transferred to the additive feed bins ahead of the mixers.

Feed preparation consists of wetting the ground ore in a high intensity horizontal paddle mixer. The ground ore and additive are metered to the mixer and are wetted with dust collection slurry to balling moisture. The mixer blends in the water and the additives thoroughly producing a uniform, well-mixed feed to the balling disc. The mixed material has moisture content of about 8%.

Balling is done on 7500 mm diameter discs. The product is called green balls and has diameter of 9-16 mm. The off size pellets are screened by roller conveyor ahead of indurating machine and recycle back to the discs.

Pellet indurating takes place on a 4000 mm wide and 464 m2 grate area indurating machine. It consists of an endless chain of pellets, which carry the pellets. The indurating machine is fed continuously from roller conveyor by a wide belt conveyor, which lays down the green pellet across full length of machine on a protective hearth layer. The pellets pass through five heat zones namely updraft drying, downdraft drying, preheating, indurating and cooling.

In the updraft and down draft drying zones, the moisture is removed from the green pellets and their temperature is raised. The heat for the updaft drying zone is supplied from the second cooling zone. Bled gas from the firing (indurating) zone is used for downdraft drying. The pellets are the preheated and led to the firing zone. The firing zone uses coke breeze as fuel and temperature rises to about 1300 C. the fired pellets are then cooled in the cooling zone. The process of cooling is updraft to quickly lower the temperature of the grate components and to recuperate the heat of the pellets at the highest possible temperature in the first cooling zone and heated air is directly supplied to indurating zone. The finished pellets are stacked in a stockpile and reclaimed using front end loader.

2.4.2 Direct Reduction (DR) plant

The Direct Reduction (DR) plant shall comprise of ten rotary kilns and related accessories including waste heat power generating units with the final phase of implementation.

The major plant facilities for the sponge iron plant envisaged are as follows:

- Day bins
- Rotary kiln and cooler
- Central control room
- Product processing and product storage
- Off – gas system including waste heat power generation

There shall be one day bin building for each set of two kilns. The day bin building shall have separate bins for meeting the raw material requirement of two kilns. These bins will have the storage of about one day's requirement of screened iron ore feed (5-20mm) and feed coal (0-20mm). Dolomite/limestone shall also be separately stored in the respective day bins. Injections coal (0-4mm & 4-20mm) and iron ore fines (1-5 mm) shall be stored in separate bins in Kiln –cooler transfer building.

Rotary kilns each of 4.8m dia and 80.0m length shall be installed for reduction of iron ore into sponge iron using non-coking coal as reductant. Each kiln will be lined with abrasion resistant refractory bricks and castables throughout its length with dams at feed end and discharge end.

The kiln feed from the charging end will consist of sized iron ore (5-20mm), non-coking coal (0-20mm) and limestone/dolomite (1-4mm). Air will be supplied to the kiln through 8 nos. of shell mounted air fans. A part of the required coal (0-4mm & 4-20 mm) shall be thrown from kiln discharge end. The slinger coal will be withdrawn from the bins and pneumatically injected into the kiln. In the kiln, the iron ore will be dried and heated to the reduction temperature of 1,000 – 1,050 °C. The iron oxide of the ore will be reduced to metallic iron by carbon monoxide generated in the kiln from coal. The heat required for the reduction process will also be supplied by the combustion of coal.

The reduced material from the kiln will be cooled indirectly in a rotary cooler by an external water spray. Each kiln will be provided with one rotary cooler. Bypass arrangement will be provided at the discharge end of the cooler for emergency discharge of materials. The cooled product will be conveyed to the product processing building by a system of belt conveyors. The cooling water will be collected in the trough below the cooler and sent to the cooling tower for cooling. The cooled water will be re-circulated.

There shall be one product-processing unit for two kilns. The product containing sponge iron, un-burnt coal, char and spent lime, from the cooler discharge end of the two kilns will be discharged to a set of common conveyors and sent to the product processing building. In case of emergency such as break-down in downstream facilities, production of off grade etc., the product will be sent to an intermediate bin of approx. 470 t capacity. Each kiln shall be provided with separate intermediate bin. Provision will also be there to by pass the intermediate bin and stock-pile the product on the ground. In the product processing building, the product will first be screened in a double deck screen having 3mm and 20mm screens. +20mm material shall be dumped as rejects. The screened product i.e. +3-20mm and –3mm fraction shall separately be subjected to magnetic separation. Sponge iron fines (-3mm) shall be suitably stored in the fines bunker provided near the product processing building, whereas lump sponge iron (3-20mm) shall be stored in bunkers in product storage building from where it shall be taken to steel making shop intermediate hopper as per requirement by a set of conveyors. Char generated shall initially be collected in a char bin. From the char bin, char shall be taken by conveyor to a crushing cum secondary magnetic separation unit where char shall be passed through crusher to crush it to 100 % -6 mm size and then subjected to magnetic separation to separate out any trapped magnetic iron fines. Char free from iron particles shall be then conveyed to AFBC power plant through conveyor for its utilisation for power generation.

Hot waste gases leave the rotary kiln at about 800 - 850 °C through kiln feed end housing, dust settling chamber and come to after burning chamber (ABC) where combustibles are burnt completely by supplying excess air. The gases at about 950 – 1,000 °C will then be led to a waste heat boiler to generate steam for waste heat power generation. The gas will then be cleaned in Electro-static precipitator (ESP) before letting them out into the atmosphere through ID fan and stack. Fine dust collected below DSC, Waste heat boiler and ESP shall be suitable disposed off to ash pond area within the plant boundary.

2.4.3 Sinter Plant

BL has proposed to put up blast furnaces with 1008 m^3 useful volume. To reduce the consumption of coke in the blast furnace, it is proposed to have a sintering plant and about 80% sinter in the blast furnace.

The requirement of burden sinter has been estimated to be 1.088 Mt/yr. To meet this requirement, it is planned to produce 1.106 Mtpy of BF sinter considering the fines generated in transporting sinter from the sinter plant to the blast furnace plant. This production will be achieved on a sintering machine of 105 m^2 area.

For achieving the stipulated production capacity, following operating parameters have been envisaged for the sintering plants.

Sintering area	105 m^2
Sintering machine productivity	1.33 $t/m^2.h$
Number of working days	330 per year
Coke breeze in sinter mix	70 kg/t of sinter
Moisture in the sinter mix	7.0%
Sinter fines recirculated	25%

2.4.4 Blast Furnace

It is proposed to augment production of hot metal by installing one blast furnace with 1008 m^3 useful volume along with auxiliary facilities. The furnace will produce 0.8 Mtpy of hot metal. Coke will be supplied from a non-recovery type coke ovens battery complex proposed to be setup by BL. The blast furnace will be provided with coal dust injection facility to reduce the requirement of coke. It will also be supplied with humidified and oxygen enriched air blast.

The technological parameters of blast furnace operation will be as follows.

Parameters	1008 m^3 BF
Useful volume, m^3	1008
Production, tpy	800000
Fuel rate, kg/t	600
Coke rate, kg/t	480
PC injection rate	120
Hot blast temp degree C	1100-1150
Slag rate, kg/t	300
BF gas generated, Nm^3/h	180000
No. of taps per day	8 - 10
Consumption of dry raw materials, tpy	
Iron ore lumps	272000
Iron ore sinter	1088000
Coke (25 - 75 mm)	420000
Coal	96000

While iron ore will be in the size rang of 10 - 30 mm, fluxes will be 10 - 50 mm sized. The size of coke will be in the range of 25 -75 mm. A small quantity of coke in the range of 6 - 30 mm will be used in blast furnace to reduce consumption of prime coke.

2.4.5 Coal Washery

Coal Washery with annual throughput of about 4.5 Mt/yr shall be set up to meet the clean coal requirement of ten kilns of the proposed DR plant. The requirement of clean coal shall be as follows:

1.		Ash Content	:	27.5 %
2.		Moisture	:	7.0 %
3.		Total DRI requirement	:	1695000 t/ yr
4.		Size fraction requirement, %		
	a)	0 – 20 mm	:	65
	b)	4 – 20 mm	:	15
	c)	0 – 4 mm	:	20
5.		Raw coal requirement	:	4879350 t/ yr

The average analysis of raw coal has been assumed as given below:

Ash Content	:	45 %
Inherent moisture	:	5 %
Yield of clean coal	:	50 %
Ash content of middling	:	56 %

Middling shall be crushed to (–) 6.0 mm size and shall be sent to the proposed power plant.

As the moisture content of the clean coal and middling will be higher than the required moisture of 7%, facilities shall be provided for air-drying. Further, facilities shall be provided in such a manner that the washery can produce clean coal as per the required size fractions.

The washery shall be provided with two – product Batac Jig of 175 t/hr capacity as the main beneficiation equipment. Before feeding, the incoming raw coal shall be deslimed at 0.5 mm size, which shall be recovered and fed to the middling fraction. The separation of 20 – 4 mm and 4 – 0 mm shall be done at the de-watering screen as per requirement. Separate centrifuges shall be provided for de-watering of (–) 20 mm and (–) 4 mm fractions.

The water treatment section shall comprise an overhead thickener and vacuum filter for recovery and de-watering of (–) 0.5 mm fraction.

A tailing pond shall be provided for emergency measure. The settled water from the pond shall be pumped back to the thickener.

The washery shall be provided with process control facilities. The plant shall be operated from the control room. Adequate number of EOT cranes and electric telphers shall be provided to facilitate maintenance of the equipment.

2.4.6 Captive Power plant

A captive Power Plant is being installed to meet the power requirement of the plant including category – I load by utilising waste solid fuels and gaseous fuel being generated in various units. Power plant shall have the following units:

2 x 40 +3x110 MW Turbo – Generator set (TG)
1 x 75 +1x150 tph Atmospheric Fluidised Bed Boiler (AFBC)
3x350 tph Circulatory Fludised Bed Boiler (CFBC)
10 x 51 tph Waste Heat Recovery Boiler (WHRB)

The high-pressure steam generated in the boilers shall be utilised in TG set to generate electric power, which shall be connected to plant distribution system. AFBC shall use waste product like Char from DR kiln and washery rejects from Coal Washery as fuel for firing in the furnace. The waste flue gas from DR kiln shall be used in WHRB to generate steam through heat recovery. The flue gases after utilisation in both types of boilers shall be cleaned in Electrostatic Precipitator and then released to atmosphere through chimney. The ash generated through bottom hoppers shall be collected in silos by dense phase pneumatic system and subsequently discharged to ash dump area.

2.4.7 Coke Oven Battery Complex

BL shall set up two non-recovery coke oven battery of 0.45 Mtpy capacity. Non-recovery coke oven operates under negative pressure and as such the emission of gas is completely eliminated. The common flue system ensures practically complete combustion of all volatile hydrocarbons, leaving a clean hot gas. There is no by-product recovery, hence no phenolic effluent is generated.

The non-recovery coke oven battery complex broadly consists of the following units:

1. Compacting station
2. Coal charge car
3. Coke oven battery

4. Pushing car
5. Hot coke car
6. Quenching tower
7. Coal Crusher
8. Coke cutter
9. Conveying of coal & Coke into & out of plant

The production programme of the proposed Coke Ovens complex is given below:

Production programme of Coke Oven plant

Sl. NO.	Product	Annual Quantity (tpy)
1	Gross Coke	877500
2	Coke breeze (dry)	77420

Technological parameters Coke ovens

The major technological parameters of the coke ovens are given below

No. of Ovens	2x96
Dimension in meter	13.34x3.596x2.758
Dry coal Charge per Oven	45.00 T
Carbonization Time	66 Hrs
Moisture content of the coal charge	7%
GAS Generation per hour	2,27,000 NM3/hr.

2.4.8 Lime Calcination Plants

BF and DR grade soft burnt lime and calcined dolomite of size 10 - 50 mm are required as flux. The lime plant with 400000tpy capacity is envisaged.

The technological parameters of shaft kiln are as follows.

i)	Rated capacity for limestone calcination	-	300 tpd
ii)	Maximum output	-	360 tpd
iii)	Kiln feed size, mm	-	30 - 70
iv)	Calcination temp., °C	-	1,100 - 1,150
v)	Specific consumption of fuel	-	950 kcal/kg

2.4.9 Ferro Alloy Plant

Ferromanganese is produced by smelting manganese ore, quartzite, iron ore(s), dolomite, lime stone, (fluxes) and coke and coal (reductants) in submerged arc furnaces. The raw materials are fed by front end loaders to dump hoppers and conveyors to be crushed and screened. Measured quantities of raw materials are fed into the furnaces by gravity. Alloy tapped from the furnaces is fed to casting machines or to metal bays for layer casting. The slag is poured into ladles and transported to a slag dump station where it is cast and processed. Furnace off gases is scrubbed to remove particulate material and condensate.

2.4.10 Raw Material Preparation Plant (RMPP)

The raw material preparation plant shall deal with the receipt, storage and handling of raw materials required for DR plant, Blast Furnace and coal washery. RMPP shall initially meet the requirement of four DR kilns including coal washery with space provision to accommodate raw materials for another six DR kilns and 4.5 Mtpy capacity coal washery. Similarly it shall meet the requirement of one blast furnace of 1008 m3 capacity.

For DR plant, 15 days storage has been kept for the iron ore/pallets and 10 days for non-coking coal, whereas for blast furnace, one month storage shall be kept for the coke and 15 days for the BF grade iron ore. Fluxes for DR and blast furnace shall have storage of one month.

Bulk of the raw materials shall be received within the plant boundary by rail for which one wagon tippler shall be provided with space provision to install another wagon tippler. A separate provision of truck hopper has also been kept to unload materials coming by truck on to the respective iron ore, coal or coke hopper directly. For stacking and reclaiming of raw materials, separate stacker and reclaimer of adequate capacity shall be provided for DR plant and blast furnaces.

The iron ore required for DR kilns shall be procured as Sized (5-20 mm) or ROM (-150 mm). When sized iron ore is procured, only screening shall be done in the iron ore circuit bypassing the crusher circuit, while for ROM ore, it shall be crushed to -20 mm size. In both the cases, iron ore shall be screened into three fractions of -1 mm, +1-5 mm and 5-20 mm size iron ore. While -1 mm shall be dumped elsewhere by trucks, the other two fractions shall be utilised in the kilns.

The non-coking coal shall be received as -200 mm size and shall be crushed and screened to -20 mm size in primary and secondary crushing circuits before feeding to coal washery. The clean coal from the coal washery shall be stored and suitably conveyed to

the DR kiln day bins through a set of conveyors as per requirement. The middling, on the other hand, shall be crushed within the washery to -6 mm and shall be separately stored before sending to the captive power plant as per the requirement.

2.4.11 Steel making facilities

The entire quantity of DRI produced in the kilns shall be used for production of steel in the steelmaking shop, which will comprise Electric Arc Furnaces (EAF) and Induction Furnaces (IF).

Steel produced in the primary furnaces shall be refined by passing through Ladle Furnaces, of which 4x90 t capacity unit will be installed.

The casting facility shall comprise two billet casters having a total capacity of about 300,000 t/yr. Billet casters shall be of radial type having about 6 m radius. Billets of size 130 x 130 mm shall be produced in the billet casters. Both the billet casters shall be installed in phase-I, and two single – strand Thin Slab Caster have been planned to be installed in phase – II.

The main parameters of steelmaking and casting facilities shall be as follows:

Sl. No.	Parameter		Value
1.	Primary steelmaking furnace	:	Induction Furnace : 4 x 15 t Electric Arc Furnace : 4 x 90 t & Ladle Furnace: 4x90t
2.	Tap – to – Tap Time	:	Induction Furnaces : 120 min Electric Arc Furnaces : 92 min
3.	Rating of furnaces	:	Induction Furnaces : 3 MW Electric Arc Furnaces : 18 / 75 MVA
4.	Availability of furnaces	:	320 days/ yr
5.	Rating of Ladle Furnaces	:	20 MVA for 90t
6.	Casting time of Billet Casters	:	46 min for EAF heats, 40 min for IF heats
7.	Size of cast billets	:	130 x 130 mm x mm
8.	Yield of cast billets	:	96.5 %
9.	Casting time of Strip Caster	:	46 min
10.	Casting speed of Strip Caster	:	5.5 (max) m/ min
11.	Size of slab	:	50 mm x 900 – 1560 mm
12.	Yield of thin slabs	:	97.5 %
13.	Availability of casters	:	320 days/ yr

2.4.12 Rolling facilities

Rolling facilities shall comprise a Bar Mill in Phase – I and an additional Hot Strip Mill in phase – II. The main technical features of the rolling facilities are as follows:

Bar Mill

The main technical details of the proposed mill is given below:

Type	:	Continuous mill
Mill capacity	:	100,000 tpy
Input billet size	:	130 mm x 130 mm x 12,000 m
Product range		
Rebar / plain round	:	10 mm to 40 mm
Steel grade		
Plain round	:	Carbon construction steel, Alloy construction steel, spring steel, commercial quality grade, free cutting steel etc.
Rebars	:	As per IS:1786
Annual operating days	:	320 days
Net rolling hours	:	5500 hr
Mill Yield	:	96%

One side charging and side discharging type re-heating furnace have been envisaged to reheat input billet to rolling temperature.

The furnace will have the following technological parameters:

Type	:	Walking hearth type
Nominal capacity	:	85 t/h
Working regime	:	3 shifts operations daily
Input size	:	130 x 130 x 12,000 mm
Annual requirement	:	364,600 t / yr
Charging temperature	:	Room temperature

2.4.13 Hot Strip Mill (HSM)

The proposed hot strip mill shall comprise 4 no tunnel – type furnace for heating and soaking of slabs after de-scaling in a rotary descaler. The tunnel furnace shall be designed to hold upto four slabs of nominal length. After heating in the furnace, the slabs shall be fed to the finishing mill area.

The finishing mill area shall comprise the entry side guides, five nos. of 4 – Hi stands, emergency guillotine shear and descaling system. After being rolled in the finishing mill, the material shall pass through the run – out table, equipped with water wall cooling by laminar flow cooling system, to the downcoiler. The downcoiler shall be fully hydraulic with associated hydraulic side guides and hydraulic pinch rolls located at the end of the run – out table.

Finally, the coil handling system shall consist of walking beam coil conveyors, coil strapping machine, coil weighing and marking unit.

The product specifications of the hot strip mill shall be as follows:

1. Slab size : 40 – 50 mm thk x 800 – 1350 mm wide
2. Strip size : 1.5 – 12.5 mm thk x 800 – 1350 mm wide
3. Coil size : 760 – 1900 mm OD
4. Coil weight : 24.3 t (max)

2.5 REQUIREMENT AND SOURCE OF RAW MATERIALS

The annual requirement of major raw materials is indicated below at 2.2 Mtpy stage:

Sl. No.	Material	Requirement in t/yr (net & dry)		Source	Mode of Transport
		Size (mm)	Qty (tpy)		
1.	Iron Ore lump (DR grade)	-150	700000	Banspani	Rail
2.	Iron Ore lump (BF grade)	8-30	136000	Banspani	Rail
3.	Iron Ore fines	0-5	3120600	Banspani/In-house generation	Rail
4.	Non – coking coal (ROM)	-250	4879350	Ib valley	Rail / Road
5.	Coking Coal	21-80	1170400	Imported/ib valley	Rail/Road
6.	Dolomite (DR grade)	-6	50250	Baradwar	Rail
7.	Dolomite (BF grade)	0-80	48000	Baradwar	Rail
8.	Limestone (BF grade)	0-80	202000	Imported	Rail / Road
9.	Quartzite	10-50	33870	Local	Road
10.	Pulverized Coal	-	96000	Imported	Rail

2.6 END PRODUCTS AND THEIR USAGE

The quantity and end use of different products are indicated below:

Sl. No.	Products	Quantity in tpy	Remarks
1.	DRI	1675000	- Used in steelmaking - Can be sold if surplus at any stage
2.	Cast Billets	295000	- Used for production of bars and rods - May be sold if surplus at any stage as per requirement
3.	Bars and Rods	100,000	Sold in market by Rail/ Road
4.	HR coils	1,800,000	Sold/ to be used in other plants of Bhushan Ltd.
5.	Cold Pigs	83190	Partly used in plant And sold
6.	Middling of Coal Washery	2439675	Used in captive Power Plant
7.	Coal Char from DR plant	472500	Used in captive Power Plant
9.	Granulated Slag	264000	Sold to Cement Plants
10.	Steelmaking slag	225,400	Dump yard/sold for road making
11.	Return Scrap	95250	Recycled in SMS
12.	Ash from Power Plant	1554578	To be sold/dump

2.7 WATER SUPPLY FACILITIES

The main source of raw water for the integrated steel plant will be the backwaters of Hirakud dam. Water will be pumped from the intake pump house to the raw water reservoir inside the plant through pipeline of approximate length 12 km. The raw water reservoir shall have a storage capacity of 7 days' requirement of the plant. The raw water shall be treated through Settler, Clarifier/ Demineralisation (DM) unit / Softening plant before addition to the system as make – up. The treated water shall be mainly used for the purpose of cooling, steam generation and waste water for dust suppression in different production units of the plant. Apart from this, small quantity of water shall also be used for fire fighting, drinking and sanitary uses. Make-up water requirement for the plant is indicated in the table.

WATER REQUIREMENT

		Circulating Water		Make up Water	
Sr. NO.	Consumer	Soft water	Industrial Water	Soft water/DM water	Industrial Water
		m3/hr	m3/hr	m3/hr	m3/hr
	Phase-I				
1.	4X170000tpy DR Plant		3272		206
2.	1x40MW Power Plant-				
	a) Condenser + Aux.Cooler	8000		170	
	b)DM Water for Boilers			10	
	c)Losses in water treatment				8
3.	1x60MW Power Plant-				
	a) Condenser + Aux.Cooler	12450		275	
	b)DM Water for Boilers			16	
	c)Losses in water treatment				13
4.	2x90t EAF+2x90tLF + 4x15t IF 1x4 strand Billet Caster 1x2 Strand Billet Caster				
	a)Soft water closed cooling	1980	-	20	-
	b)Indirect PHE cooling	-	3000	-	90
	c)Direct Cooling	-	996	-	70
	d)Losses in water treatment				1
5.	1x2 Strand Billet Caster				
	a)Soft water closed cooling	360	-	2	-
	b)Indirect PHE cooling	-	360	-	9
	c)Direct Cooling	-	240	-	20
	d)PF back washing	-	-	-	2
	d)Losses in water treatment	-	-	-	0.5
6.	0.1 mtpy Bar Mill				
	a)Direct Cooling	-	1170	-	66
	b) PF back washing	-	-	-	8
	c) Indirect cooling		700		18
7.	Compressed Air Station		500		15
8.	Laboratory				1.5
9.	Raw Material P{reparation Plant				50
10.	Coal Washery				33.5
11.	Misc.(Horticulture, fire fighting, road spray etc.)	-	-	-	10
12.	Common Facilities				

	Drinking water for quarters				20
	Plant Drinking Needs				2
	Losses in raw water reservoir				10
	Treatment and transit losses				110
	Phase-II				
1.	1x1008 m3 Blast Furnace	-			
	a)BF blower and Motor cooling		5700		280
	b)BF-GCP+ETP of GCP	-		-	
	c)SGP				
	c) PCM	-		-	
2.	6x170000 tpy DR plant		4908	-	309
3.	Sinter Plant		290		98
4.	3x110 MW Power Plant				
	a) Condenser + Aux.Cooler	27000		610	
	b)DM Water for Boilers			75	
	c)Losses in water treatment				75
5.	2x90t EAF + 2x90t LF				
	a)Soft water closed cooling	3500		30	
	b)Indirect PHE Cooling		3500		108
	c)Losses in treatment				1
6.	Compact Strip Caster				
	a)Soft water closed cooling	700		10	-
	b)Indirect PHE Cooling		1400		42
	c)Closed machine cooling		400		12
	d)Direct cooling		800		56
	e)PF backwashing				10
	f)Losses in treatment				2
7.	Hot Strip Mill				
	a)Indirect Cooling		990		30
	b)Laminar & Strip spraying		4400		35
	c)Descaling+Roll cooling		5214		260
	d)PF backwashing				49
8.	Tunnel Furnace		850		27
9.	Oxygen Plant		180		50
10.	Compressed air station		500		15
11.	Coal Washery(1x3.5 Mtpy)	-		-	
12.	Coke Ovens		200		35
13.	Pellet plant				
	a)Clean water cycle		215		15
	b)Contaminated water cycle		1185		110

14.	Horticulture, fire fighting, cleaning & road spray etc.				20
	COMMON FACILITIES				
1	Drinking Water for Quarters	-	-	-	60
2	Plant Drinking needs	-	-	-	5
3	Losses in Raw Water Reservoir	-	-	-	40
4	Treatment and Transit loses	-	-	-	160
	Make-up			**1218**	**2667.5**
	Requirement of Raw Water				**3885.5**

2.8 FUEL FACILITIES

Mainly coal, LDO, and LSHS shall meet the fuel requirement of the proposed steel plant. The non – coking coal from the Ib valley shall be brought in by rail / road and stored in RMP. Washed coal will be utilised in DR kilns while middling and rejects will be used in AFBC/CFBC boilers for generating steam. HSD/ LSHS shall be used for initial heating of AFBC/CFBC boilers, kilns and billets casters. BF gas along with LPG/Propane will be used as heating fuel in tunnel furnace and lime dolo kin while coke oven gas shall be used in coke oven.

2.9 ELECTRIC POWER

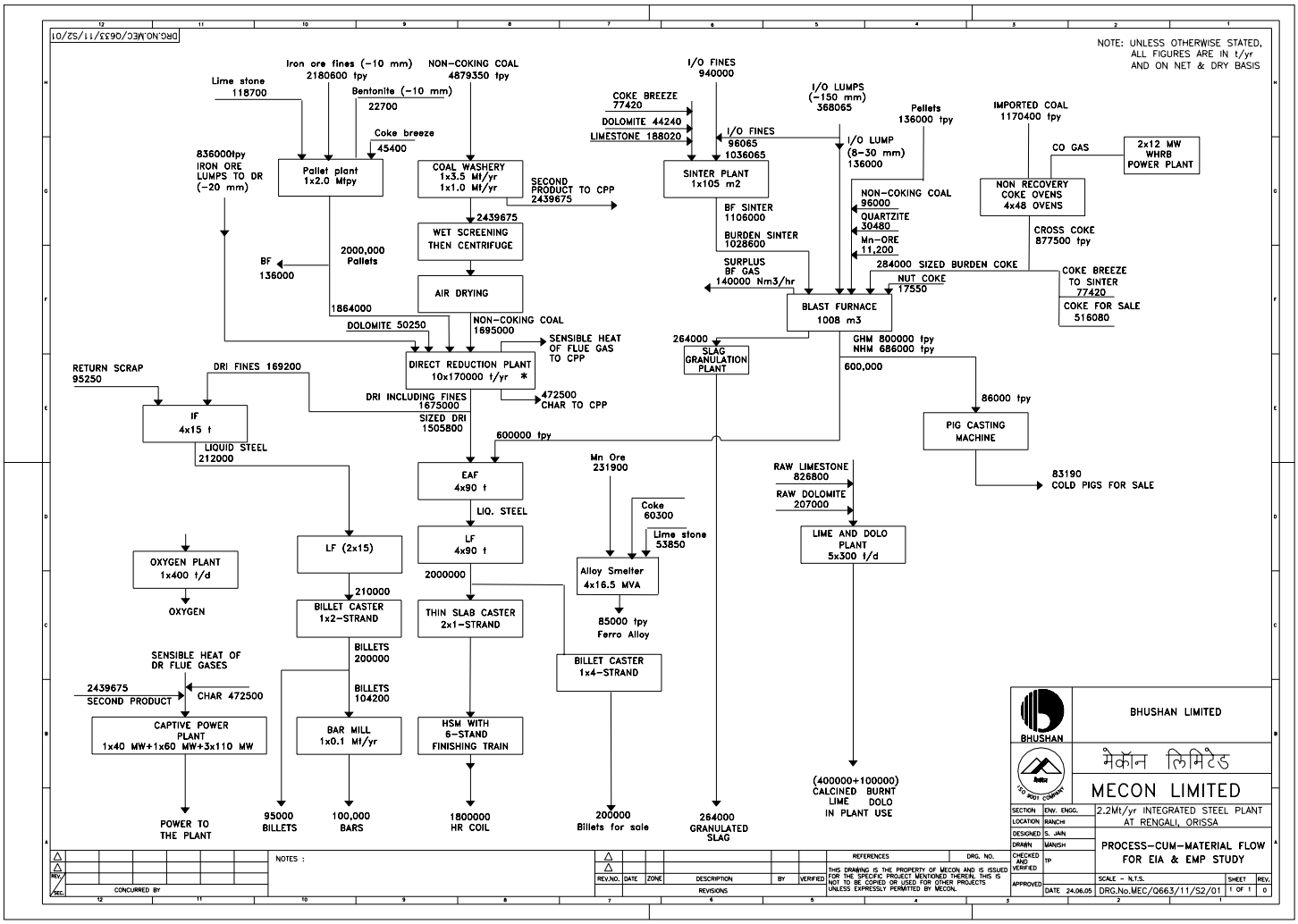
The total requirement of electric power for the proposed plant shall be 320 MVA (max) However, in consideration of the fact that all the units will not be operated simultaneously, the estimated plant load will be 280 MVA (max). This requirement of power shall be met initially from the grid while later on captive Power Plant of 430 MW will cater to power requirement of plant and the surplus power shall be sold to the grid.

2.10 MANPOWER

The proposed plant shall employ about 1500 persons during operation excluding the security staff. During construction, a maximum of 3500 persons shall be employed.

2.11 TOWNSHIP

A small township along with all necessary social amenities has been envisaged to provide residential accommodation of about 250 nos. of officers and staff required for the proposed plant. Sewage from the township shall be treated in a sewage treatment plant and the treated water shall be used for greenbelt development.


DRG.NO.MEC/0633/11/S2/01
NOTE: UNLESS OTHERWISE STATED, ALL FIGURES ARE IN t/yr AND ON NET & DRY BASIS
Lime stone 118700
Iron ore fines (-10 mm) 2180600 tpy
Bentonite (-10 mm) 22700
Coke breeze 45400
NON-COKING COAL 4879350 tpy
836000tpy IRON ORE LUMPS TO DR (-20 mm)
Pallet plant 1x2.0 Mtpy
COAL WASHERY 1x3.5 Mt/yr 1x1.0 Mt/yr
SECOND PRODUCT TO CPP 2439675
2439675
WET SCREENING THEN CENTRIFUGE
AIR DRYING
BF 136000
2000,000 Pallets
1864000
DOLOMITE 50250
NON-COKING COAL 1695000
SENSIBLE HEAT OF FLUE GAS TO CPP
DIRECT REDUCTION PLANT 10x170000 t/yr *
472500 CHAR TO CPP
RETURN SCRAP 95250
DRI FINES 169200
DRI INCLUDING FINES 1675000
SIZED DRI 1505800
IF 4x15 t
LIQUID STEEL 212000
600000 tpy
EAF 4x90 t
LIQ. STEEL
LF 4x90 t
2000000
LF (2x15)
210000
BILLET CASTER 1x2-STRAND
THIN SLAB CASTER 2x1-STRAND
BILLETS 200000
BILLETS 104200
BAR MILL 1x0.1 Mt/yr
HSM WITH 6-STAND FINISHING TRAIN
OXYGEN PLANT 1x400 t/d
OXYGEN
SENSIBLE HEAT OF DR FLUE GASES
2439675 SECOND PRODUCT
CHAR 472500
CAPTIVE POWER PLANT 1x40 MW+1x60 MW+3x110 MW
POWER TO THE PLANT
95000 BILLETS
100,000 BARS
1800000 HR COIL
I/O FINES 940000
COKE BREEZE 77420
DOLOMITE 44240
LIMESTONE 188020
I/O FINES 96065 1036065
I/O LUMPS (-150 mm) 368065
I/O LUMP (8-30 mm) 136000
Pellets 136000 tpy
SINTER PLANT 1x105 m2
BF SINTER 1106000
BURDEN SINTER 1028600
SURPLUS BF GAS 140000 Nm3/hr
NON-COKING COAL 96000
QUARTZITE 30480
Mn-ORE 11,200
284000 SIZED BURDEN COKE
NUT COKE 17550
BLAST FURNACE 1008 m3
264000
SLAG GRANULATION PLANT
264000 GRANULATED SLAG
IMPORTED COAL 1170400 tpy
CO GAS
2x12 MW WHRB POWER PLANT
NON RECOVERY COKE OVENS 4x48 OVENS
CROSS COKE 877500 tpy
COKE BREEZE TO SINTER 77420
COKE FOR SALE 516080
GHM 800000 tpy NHM 686000 tpy
600,000
86000 tpy
PIG CASTING MACHINE
83190 COLD PIGS FOR SALE
Mn Ore 231900
Coke 60300
Lime stone 53850
Alloy Smelter 4x16.5 MVA
85000 tpy Ferro Alloy
BILLET CASTER 1x4-STRAND
200000 Billets for sale
RAW LIMESTONE 826800
RAW DOLOMITE 207000
LIME AND DOLO PLANT 5x300 t/d
(400000+100000) CALCINED BURNT LIME DOLO IN PLANT USE
BHUSHAN LIMITED
मेकॉन लिमिटेड
MECON LIMITED
2.2Mt/yr INTEGRATED STEEL PLANT AT RENGALI, ORISSA
PROCESS-CUM-MATERIAL FLOW FOR EIA & EMP STUDY
DRG.No.MEC/Q663/11/S2/01
NOTES :
CONCURRED BY
REVISIONS
REFERENCES
THIS DRAWING IS THE PROPERTY OF MECON AND IS ISSUED FOR THE SPECIFIC PROJECT MENTIONED THEREIN. THIS IS NOT TO BE COPIED OR USED FOR OTHER PROJECTS UNLESS EXPRESSLY PERMITTED BY MECON.

3.0 SCREENING OF IMPACT

3.1 INTRODUCTION

The first step in environmental impact assessment is to list all the potentially significant environmental impacts. These are then examined critically and the major impacts (both negative and positive) are analysed in detail for the EIA.

The existing plant is a green field project, which had been planned out considering low specific consumption of raw materials and energy and minimum impact on the environment. In order to ensure comprehensiveness, the various aspects considered in listing of impact during modification-cum-expansion of the plant are:

- Investigation of project components.
- Investigation of project phases.
- Investigation of Impact generating activities.
- Investigation of types of impacts.

There are various techniques available for listing of impact. These include checklists, matrices, networks and cause effect diagrams etc.

3.2 LISTING MATRIX

The possible environmental attributes that may be affected by industrial activities are:

- Air
- Water
- Noise
- Soil / land
- Ecology
- Infrastructure
- Socio-economics.

The various activities which could have significant impact during modification-cum-expansion of existing plant have been classified under following groups.

- Existing Operations.
- Future Activities

The matrix thus identifies and lists the environmental attributes likely to be affected and the responsible activities. After listing the potential environmental aspects, the impacts, whether beneficial or adverse, have been analysed in the Chapter on Prediction of Impacts

3.2.1 Construction

In this case, the location of the existing plant is in villages Thelkoloi, Dubenchapar and Khadiapalli of Rengali Tehsil Dist. Sambalpur (Orissa). Existing plant site is generally plain with minor undulation. The existing plant is well connected to state high way SH10 and nearby railway station Lapanga on SE railway. Therefore, construction for infrastructure does not require and hence does not affect the environment in any way.

The major construction will involve excavation and fabrication work. It will have marginal impacts on air, water, and noise quality. Socio-economic pattern may be marginally affected due to generation of employment. However, these impacts will be for a short duration only.

3.2.2 Operation

The existing plant is partly commissioned. Once existing plant fully commissioned the operations of plant may affect the quality of air, water, noise and soil/ land due to emissions, waste disposal, vehicle/automobile movement etc.

The generation of fugitive and process dust, heat and noise may have negative impact on health and safety. Marginal impacts are anticipated on water, soil. Although this impacts will be restricted to within or near the plant premises. The employment generated for the operation will have positive socio-economic impact.

3.2.3 Future Activities

The future impacts are secondary impacts due to setting up of the plant, which shall give rise to further industrial and associated developments. This will have a positive impact on socio-economic structure. The transport activities in the area shall also get a boost.

3.3 SCREENING OF IMPACTS

This is an attempt to identify and list all possible aspects which could generate significant impact due to various phases of the modification-cum-expansion on different environmental attributes has been made. Some of these impacts are insignificant and don't warrant further analysis. Thus objective is to identify and list only the significant impacts which shall require detailed analysis to the extent of decision-making purposes. The major construction activities will be of short duration and will have very few lasting impacts. The operation and future activities will have major impacts, which shall be analysed in detail in the subsequent chapters.

4.0 PRESENT ENVIRONMENTAL STATUS

4.1 INTRODUCTION

Industrial activities are a major cause of pollution. In order, to mitigate any adverse effect on the environment/ ecosystem due to industrial activities, proper environmental planning and implementation are essential. EIA is the most important aspect of overall environmental management strategy. EIA needs a datum on which the prediction can be done. Therefore, comprehensive baseline data covering various aspects of the existing environment is necessary. Accordingly baseline environmental data generation was carried out covering Meteorology, Ambient Air Quality, Noise Levels, Water Quality, Soil, Ecology and Socio-economic Environment. Besides additional data/information regarding water availability, ecology, demographic pattern and socio-economic conditions were collected from various central and state government agencies.

4.2 METEOROLOGY

Meteorological conditions govern the dispersion (and hence dilution) of air pollutants. Hence meteorological studies form an integral part of environmental impact assessment studies.

In order to get some idea about the baseline meteorological conditions to select the locations of the ambient air quality monitoring stations, information published by Indian Meteorological Department (IMD) was used. The nearest IMD observatory to existing integrated steel plant is at Jharsuguda about 15 km north of the project site.

At Jharsuguda, during the Daytime the predominant wind direction annually is NE (prevailing 24% of the time) followed by N (17%) and SW (12.0 %). While the calm values is 12%. Annually the predominant wind directions during Night time are NW (16%), W (16%), S (14%) and followed by calm (21%). Combined wind direction during the both day time and night time is NE (prevailing 16% of the time) followed by SW (14%), S (11.5 %), W (11.5%) and N (11%). While the calm values is 16.5 %. The area's temperature during the year varies from 47.3^{o}C to 7.5^{o}C. The area's average annual rainfall is 1460.9 mm most of it occurs during the monsoon.

To monitor site specific micro–meteorological data, a meteorological station was set up within steel plant site at the guest house.

At the meteorological station, Wind Speed & Direction, Temperature, Relative Humidity and Cloud Cover were recorded at hourly intervals throughout the monitoring period (March - 2005 to May - 2005. Total Rainfall for the entire monitoring period was also recorded. The summarised meteorological data is given in Table 4.1.

Table 4.1: Summarised Meteorological Data at Panchet

Months	Wind Speed (km/hr)		Temperature (^{o}C)		Relative Humidity (%)		Rainfall		Cloud Cover (Oktas)
	Max.	Min.	Max.	Min.	Max.	Min.	Max (mm)	No. of Rainy Days	
March -2005	25.1	Calm	38.5	21.5	96	20	Nil	Nil	0-6
April-2005	31.3	Calm	41.5	22.0	98	10	2.0	2	0-8
May - 2005	30.9	Calm	44.5	19.5	95	8.5	5	3	0-8

Wind frequency distribution during day-time, night-time and combined day and night at the plant site is given as Table 4.2 for the period March - 2005 to May – 2005 (summer season). The Wind Rose diagrams for summer season are given as Fig. 4–1

From Table 4.2 it was observed that during the Day, the predominant wind directions were SSW (prevailing for 19.23% of the time), SW (13.48%), S (8.79%), WSW (8.43%) and SSE (6.1%). Calm conditions prevailed for 5.99% of the time. The wind velocity was mostly between 1.6 to 7.2 km/hr (39.2% of the time).

During the night, the predominant wind directions were SSW (17.57%), S (8.80%) and SSE (7.62). Calm conditions prevailed for 16.25% of the time. The wind velocity was mostly between 1.6 – 7.2 km/hr (51.12% of the time).

Overall, the predominant wind directions for March 2005 – May 2005 were SSW (prevailing for 18.35% of the time), SW (9.7%), S (8.75) and SSE (6.86%). Calm conditions prevailed for 11.09 % of the time. The wind velocity was mostly between 1.6 to 7.2 km/hr (45.19% of the time).

Table 4.2

A: Wind Frequency Distribution (%) at Project site During Summer Season (Day) from

March 2005 – May 2005

Wind Direction	Wind Speed Ranges (m/s)					Sum
	0.44 – 2.0	2.0 – 3.0	3.0 – 5.0	5.0 – 6.0	>6.0	
N	1.64	0.82	0.59	0.11	0.00	3.16
NNE	1.76	0.70	0.00	0.00	0.00	2.46
NE	2.70	0.35	0.12	0.00	0.00	3.17
ENE	2.35	0.70	0.12	0.00	0.00	3.17
E	2.70	0.70	0.12	0.00	0.00	3.52
ESE	1.29	0.35	0.23	0.00	0.00	1.87
SE	1.88	1.29	1.53	0.00	0.00	4.70
SSE	3.29	0.94	1.64	0.23	0.00	6.10
S	2.23	2.70	3.64	0.00	0.22	8.79
SSW	4.69	4.23	8.92	1.06	0.33	19.23
SW	4.58	2.58	5.28	0.82	0.22	13.48
WSW	2.58	1.76	3.40	0.47	0.22	8.43
W	2.11	0.70	1.41	0.47	0.00	4.69
WNW	1.64	0.94	1.88	0.23	0.00	4.69
NW	2.46	0.94	0.82	0.11	0.00	4.33
NNW	1.29	0.47	0.11	0.11	0.00	1.98
Sum (%)	39.20	20.07	29.93	3.64	1.17	94.01
Calm (Wind Speed <0.44 m/s or <1.6 km/hr) = 5.99%						

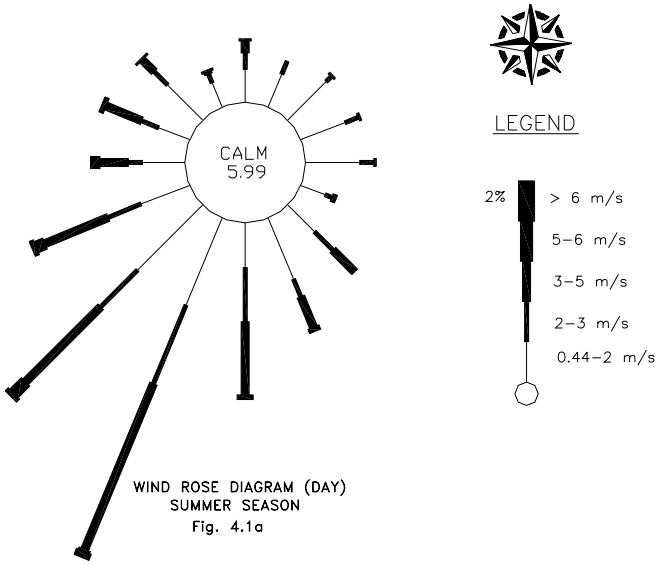
B: Wind Frequency Distribution (%) at Project Site during Summer Season (Night) from March 2005 – May 2005

Wind Direction	Wind Speed Ranges (m/s)					Sum
	0.44 – 2.0	2.0 – 3.0	3.0 – 5.0	5.0 – 6.0	>6.0	
N	2.93	0.47	0.23	0.00	0.00	3.63
NNE	2.70	0.70	0.11	0.00	0.00	3.51
NE	2.70	0.94	0.82	0.00	0.11	4.67
ENE	4.11	1.41	0.94	0.00	0.00	6.46
E	3.64	1.41	0.59	0.00	0.00	5.64
ESE	2.46	1.29	1.17	0.11	0.00	5.03
SE	2.70	0.47	0.70	0.00	0.11	3.98
SSE	3.87	1.88	1.17	0.23	0.47	7.62
S	4.93	2.70	1.17	0.00	0.00	8.80
SSW	10.09	3.99	3.17	0.11	0.11	17.57
SW	2.82	1.41	0.94	0.00	0.11	5.37
WSW	2.00	0.23	0.94	0.00	0.00	3.27
W	1.17	0.47	0.59	0.00	0.00	2.23
WNW	2.11	0.47	0.23	0.00	0.00	2.81
NW	1.41	0.35	0.00	0.00	0.00	1.76

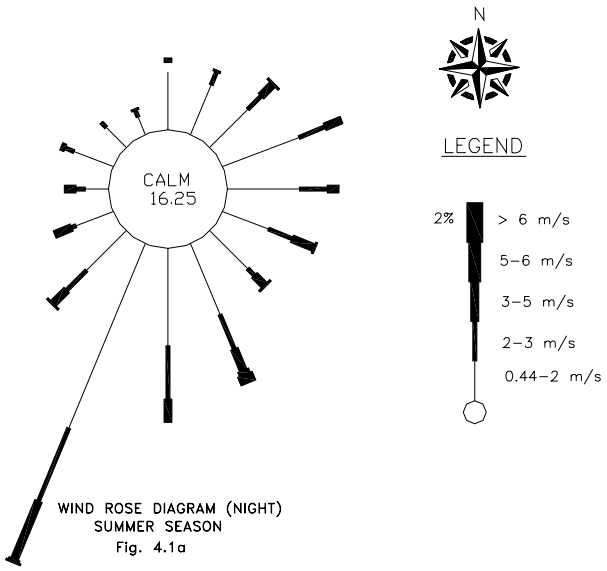
NNW	0.94	0.35	0.11	0.00	0.00	1.40
Sum (%)	51.12	18.54	12.68	0.47	0.94	83.75
Calm (Wind Speed <0.44 m/s or <1.6 km/hr) = 16.25%						

C: Wind Frequency Distribution (%) at Project Site during Summer Season (Overall) from March 2005 – May 2005

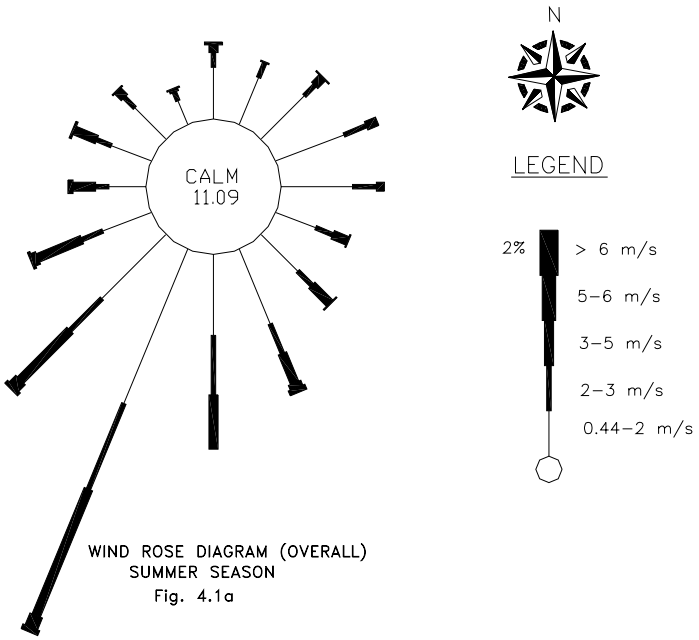
Wind Direction	Wind Speed Ranges (m/s)					Sum
	0.44 – 2.0	2.0 – 3.0	3.0 – 5.0	5.0 – 6.0	>6.0	
N	2.29	0.65	0.41	0.00	0.06	3.41
NNE	2.23	0.70	0.06	0.00	0.00	2.99
NE	2.70	0.65	0.47	0.00	0.06	3.88
ENE	3.23	1.06	0.53	0.00	0.00	4.82
E	3.17	1.06	0.35	0.00	0.00	4.58
ESE	1.88	0.82	0.70	0.06	0.00	3.46
SE	2.29	0.88	1.12	0.00	0.06	4.35
SSE	3.58	1.41	1.41	0.23	0.23	6.86
S	3.58	2.64	2.41	0.00	0.12	8.75
SSW	7.39	4.11	6.05	0.57	0.23	18.35
SW	4.00	2.00	3.11	0.41	0.18	9.70
WSW	2.29	1.00	2.11	0.23	0.12	5.75
W	1.64	0.59	1.00	0.23	0.00	3.46
WNW	1.88	0.70	1.06	0.12	0.00	3.76
NW	1.94	0.65	0.41	0.06	0.00	3.06
NNW	1.12	0.41	0.12	0.06	0.00	1.73
Sum (%)	45.19	19.31	21.30	2.05	1.06	88.91
Calm (Wind Speed <0.44 m/s or <1.6 km/hr) = 11.09 %						



WIND ROSE DIAGRAM (DAY)
Fig. 4-1 (Sheet 1 of 3)



WIND ROSE DIAGRAM (NIGHT)
Fig. 4-1 (Sheet 2 of 3)



WIND ROSE DIAGRAM (OVERALL)
Fig. 4-1 (Sheet 3 of 3)

4.3 AMBIENT AIR QUALITY

In order to evaluate the resultant air quality around the integrated steel plant, it is necessary to determine the existing air quality in terms of Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur–di–oxide (SO_2), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO) and Dust Fall. Accordingly these parameters were monitored at selected Ambient Air Quality (AAQ) monitoring stations.

For locating the ambient air quality (AAQ) monitoring stations, the evaluation area may be considered a circle of radius 50 times the maximum stack height. Since the maximum stack height for the proposed project is 120 m, the evaluation area is a circle of radius 6.0 km.

The main objective of baseline data generation is to assess the future scenario of the surrounding environment by superimposing the predicted pollution levels on the existing pollution levels. Thus it will be possible to identify the location where maximum concentration of pollutants are likely to occur due to emissions from the proposed plant. The location of AAQ stations were finalised with the help of screening models, which were run with actual, source inventory and meteorological data.

The AAQ stations were located in the upwind and downwind direction of the proposed steel plant and by considering the following additional points:

1. Location of AAQ stations within 7.0 km radius around the integrated steel plant.
2. Approachability to and habitation near the monitoring stations.
3. Location of other industries within 7.0 km radius around the proposed plant.

The locations of AAQ stations are given in Table 4.3.

Table 4.3: List of AAQ Monitoring Stations.

Location	Distance & Direction from Project Site	Station No.	Remarks
Landupalli Village	6.0 km, SW	A1	Continuous
Lapanga Village	4.5 km, S	A2	Continuous
Bamloi Village	7.0 km, SE	A3	Continuous
Gumkarma Village	4.6 km, E	A4	Continuous
Sirpura Village	2.5 km, NE	A5	Continuous
Gurupalli Village	7.5 km, S	A6	Selective
Brundamal Village	5.5 km, N	A7	Selective
Patrapalli Village	6.5 km, W	A8	Selective
Kurebaga Village	7.0 km, NNE	A9	Selective
Kandagarh Village	4.2 km, NW	A10	Selective

As such some sponge Iron plants are also existing in NW direction of the steel plant in the study area. The ambient air monitoring locations were selected in surrounding villages considering the existing and proposed expansion of the steel plant, which can have an impact on the receptor in study area considering the existing wind frequencies.

As per the CPCB guidelines on methods of monitoring & analysis, the 10 (ten) AAQ monitoring stations were selected. Five of the above stations were continuous monitoring stations and five were selective monitoring stations. These stations are marked in Drg. No. MEC/Q176/11/S2/G/01.

During the monitoring period, 24 hourly samples were collected twice a week for SPM, RPM, SO_2 and NO_x whereas the CO was estimated by taking one hour sample. The methodology for sampling and analysis is given in Table 4.4.

Table 4.4: Methodology of Sampling and Analysis for AAQ Monitoring

Parameter	Instrument/Apparatus Used	Methodology	Reference
SPM	High Volume Air Sampler (HVAS) / Respirable Dust Sampler (RDS)	Gravimetry	CPCB Notification of 11-04-94
RPM	Respirable Dust Sampler	Gravimetry	CPCB Notification of 11-04-94
SO_2	HVAS with Impinger Tube, Spectro–photometer	Improved West & Gaeke Method	CPCB Notification of 11-04-94
NO_x	HVAS with Impinger Tube, Spectro–photometer	Jacob & Hochheiser Modified (Sodium Arsenite) Method	CPCB Notification of 11-04-94
CO	Gas Chromatograph	Chromatography	CPCB Notification of 11-04-94

The summarised AAQ results are given in Table 4.5. The results have been compared with Central Pollution Control Board (CPCB) norms, which are given in Table 4.6.

Table 4.5 : Summarised Results of AAQ Monitoring

Parameters		Results ($\mu g/m^3$)									
		Landupalli Village (A1)	Lapanga Village (A2)	Bamloi Village (A3)	Gumkarma Village (A4)	Sirpura Village (A5)	Gurupalli Village (A6)	Brundamal Village (A7)	Patrapalli Village (A8)	Kurebaga Village (A9)	Kandagarh Village (A10)
SPM	Max.	189	207	186	215	195	187	201	186	186	209
	Min.	53	57	102	74	84	146	140	130	141	108
	Avg.	139	159	156	147	152	144	159	167	153	153
RPM	Max.	92	104	112	96	120	87	105	89	92	121
	Min.	31	25	58	62	47	54	63	72	67	81
	Avg.	60	61	95	65	70	67	83	78	79	94
SO_2	Max.	BDL	BDL	14	18	BDL	BDL	BDL	19	BDL	BDL
	Min.	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Avg.	BDL	BDL	10	11	BDL	BDL	BDL	12	BDL	BDL
NO_x	Max.	26	15	23	27	18	18	16	29	26	19
	Min.	BDL	BDL	BDL	BDL	BDL	13	BDL	18	10	11
	Avg.	16	11	11	15	11	15	12	22	17	15
CO	Max.	1954	3758	1584	1609	2458	2511	2038	2136	1125	1789
	Min.	937	1845	1251	1125	1258	1985	1787	1268	815	1215
	Avg.	1458	2899	1402	1410	1741	2289	1954	1626	969	1513
Detection Limits of SO_2 and NO_X are 10 $\mu g/m^{m3}$											

Table 4.6: AAQ Norms Prescribed by CPCB

Parameters	NORMS (All values in $\mu g/m^3$)		
	Industrial Areas	Residential, rural & other Areas	Sensitive Areas
SPM(24 hr. Avg.)	500	200	100
RPM(24hr.Avg)	150	100	75
SO_2(24hr.Avg)	120	80	30
NO_X (24hr.Avg)	120	80	30
CO (1hr. Avg)	10000	4000	2000

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

A1 station was located in Landupalli village area about 6.0 km SW side of existing steel plant. This village is covered with village forest in North and eastern side, whereas Hirakud reservoir is located in South and Western side. All the values of SPM, RPM, SO_2, NO_X and CO are found well within the norms for residential, rural & other areas.

A2 station was located in Lapanga village 4.5 km in S side of existing steel plant. This village is adjacent to NH-10. The average values for SPM, RPM, SO_2, NO_X and CO are well within the norm for residential, rural & other areas.

A3 station was situated at Bamloi village 7.0 km SE of the project site. The average values for SPM, RPM,SO_2, NO_X and CO are well within the norms for Residential, rural & other Areas.

A4 station was located at Gumkarma. The station is about 4.6 km E of the existing plant site. The average values for SPM, RPM SO_2, NO_X and CO is within the norm for Residential, rural & other Areas.

A5 station was located in Sirpura village and is 2.5 km NE of the plant site and is in NE direction of project site. This village is adjacent to project site. The average values of SPM, RPM, SO_2, NO_X and CO are well within the norms.

A6 station was installed in Gurupalli village at about 7.5 km in S direction of project site. The station is located around10 km N direction of Rengali town. This station is situated in the eastern bank of Hirakud reservoir whereas the eastern side of village is covered with agricultural field. All values of SPM, RPM, SO_2, NO_X and CO are within the norms for residential, rural & other Areas.

A7 station was located 5.5 km N of plant site in Brundamal village. This village is in South direction of Jharsuguda town and Jharsuguda – Sambalpur rail track is also crossing from

adjacent to this village. The average values of SPM, RPM, SO_2, NO_X and CO were found well within the norms for residential, rural & other Areas.

A8 station was fixed in Patrapalli village i.e., 6.5 km W of existing plant site. This location is almost covered with the forest and adjacent to confluence of IB river with Hirakud reservoir. The average values of SPM, RPM, SO_2, NO_X and CO are found well within the norms for residential, rural & other Areas.

A9 station was in Kurebaga village 7.0 km NNE of project site. This village is located adjacent to reserved forest and also covered with village forest. All values of SPM, RPM, SO_2, NO_X and CO are found well within the norms for residential, rural & other Areas.

A10 station is located at Kandagarh village, which is situated 6 km in NW direction of the project site. This village is surrounded with village forest and agricultural field. Besides this there two sponge iron plants are also located nearby area.

4.4 DUST FALL

Dust fall measurement were made at 5 locations and are given below. The results shown that dust fall rate is very low over the area and it is within the strict German norms of 0.65 gm/m^2 /day as 98 percentile value.

DUST FALL

Location	RESULTS, gm/m^2 /day
Landupalli Village	0.1684
Lapanga Village	0.1955
Bamloi Village	0.2289
Gumkarma Village	0.1864
Sirpura Village	0.2567
TA LUFT (1986): 0.65 gm/m^2 /day	

4.5 NOISE

In order to have an idea of the present background noise level of the project site, a detailed measurement of noise level was carried out at 7 locations. Precision integrated sound level meter (type 2221 of Bruel & Kjaer of Denmark) was used. The measurements were carried out for 24 hours. Hourly readings were recorded by the operating the instrument for 10–20 minutes in each hour at one hour intervals in which leq (A) have been measured.

The results of ambient noise monitoring are given in Table 4.7. The results have been compared with MOE&F norms given in Table 4.8.

Table 4.7: Results of Noise Monitoring

Sl.No.	Stn. Location	Results					
		Day (0600-2200 hrs)			Night(2200-0600 hrs)		
		Max.	Min.	Avg.	Max.	Min.	Avg.
N-1	Plant Site, Near guest House	58.5	46.4	53.5	46.3	41.1	44.1
N-2	Landupalli Village	52.7	41.1	48.2	43.5	38.1	41.8
N-3	Lapanga Village	54.8	47.4	52.9	43.4	39.9	42.5
N-4	Bomloi Village	53.1	41.4	48.7	41.0	38.5	40.7
N-5	Gumkarma Village	54.4	42.0	50.2	42.7	38.0	40.5
N-6	Sirpura Village	54.9	41.8	48.9	42.9	38.1	40.8
All values in dB(A)							

Table 4.8: Ambient Air Quality Norms in Respect of Noise

Type of Area	Day (0600-2200 hrs)	Night (2200-0600 hrs)
Industrial Area.	75	70
Commercial Area.	65	55
Residential Area.	55	45
Silence zone .	50	40
All values in dB (A)		

In absence of industrial and commercial area, all the noise monitoring stations were selected in residential area and existing plant site. In plant site area (N1) construction work was in progress. Other noise monitoring stations i.e., N2, N3, N4, N5 and N6 were located in completely residential areas.

At all the residential areas the noise levels were found under the norms during Day time as well as at Night. In existing plant site area noise monitoring station (N1), some values were exceeding the norms may be due to the construction activity as well as the civil work were in progress. However the average value of noise level was measured well within under the norms. At other locations, no specific source of noise was available except the village road where the traffic load was very little.

4.6 WATER ENVIRONMENT

In order to study the existing water quality within the study area, samples of water were collected from the following eight (8) locations as given in Table 4.9 the same are also marked in drawing.

Table 4.9: Location of Water Monitoring Station

Sl. No.	Stn. No.	Location	Type
1	SW1	Bhedan River, near Kerala tiles bridge	Surface Water(Down stream of Jharsuguda township)
2	SW2	IB River after confluence of Bhedan River, near Rampur Ghat	Surface Water
3	SW3	Hirakud Reservoir (Intake point), near Landupalli Village	Surface Water (Raw Water)
4	GW1	Bore-well, Near plant site	Ground Water (Project Site)
5	GW2	Tube-well, Waste Dump Site, Rengali	Ground Water
6	GW3	Tube-well, Gumkarma Village	Ground Water (Up-gradient of Project site)
7	GW4	Tube-well, Landupalli Village	Ground Water (Down-gradient of project site)
8	GW5	Tube-well, Kurebaga Village	Ground Water (Up-gradient of project site)

4.6.1 Surface Water Quality

In order to determine the quality of the surface water prevailing in and around the project site, water samples were collected from the above locations as given in above table. One sample of water was also collected from Hirakud reservoir intake point of the project, from the same location from where raw water drawl is made for the plant.

Grab samples from surface water sources were collected once during the summer season. The results of surface water analysis are given in Tables 4.10. The collected surface water sample was analysed for physical, chemical and bacteriological characteristics. The analysis results of this surface water were compared with the surface water quality criteria as per Central Pollution Control Board (CPCB). It has been observed from the analysis results that the surface water samples quality is found to be well within the norms specified by CPCB for surface water under Class C, D and E norms of surface water quality criteria.

Table 4.10: Results of Surface Water Analysis

Date of Sampling: 20.03.2005

Sl. no.	CHARACTERISTICS	Results		
		SW-1	SW-2	SW-3
1.	Colour, Hazen units, Max.	< 5	< 5	< 5
2.	Turbidity, NTU, Max.	6	5	6
3.	pH Value	6.9	7.0	7.1
4.	Electrical Conductivity, µmhos/cm	182	179	134
5.	Dissolved Oxygen (as O_2), mg/l	6.6	6.8	6.5
6.	BOD, 5 days at 20° C, mg/l	1.6	1.8	1.8
7.	Total Hardness (as $CaCO_3$), mg/l, Max.	80	72	60
8.	Iron (as Fe), mg/l, Max.	0.281	0.534	0.229
9.	Chloride (as Cl), mg/l, Max.	13	14	11
10.	Fluoride (as F) mg/L, Max.	0.144	0.221	0.335
11.	Dissolved Solids mg/l, Max.	155	148	115
12.	Calcium (as Ca), mg/l, Max.	17.6	19.2	14.4
13.	Magnesium (as Mg), mg/L, Max.	8.7	5.8	5.8
14.	Copper (Cu), mg/l, Max.	<0.01	<0.01	<0.01
15	Manganese (as Mn), mg/l, Max.	0.034	0.041	0.024
16.	Sulphate (as SO_4), mg/l, Max.	2.0	7	10
17.	Nitrate (as NO_3), mg/l, Max.	2.33	1.25	0.84
18.	Phenolic Compounds (as C_6H_5OH),	< 0.001	< 0.001	< 0.001
19.	Mercury (as Hg), mg/l, Max.	< 0.0005	< 0.0005	< 0.0005

20.	Cadmium (as Cd), mg/l, Max.	< 0.005	< 0.005	< 0.005
21.	Selenium (as Se), mg/l, Max.	< 0.005	< 0.005	< 0.005
22.	Arsenic (as As), mg/l, Max.	< 0.03	< 0.03	< 0.03
23.	Cyanide (as CN), mg/l, Max.	< 0.01	< 0.01	< 0.01
24.	Lead (as Pb), mg/l, Max.	< 0.05	< 0.05	< 0.05
25.	Zinc (as Zn), mg/l, Max.	0.0199	0.0287	0.0278
26.	Anionic detergent (as MBAS) mg/l, Max.	< 0.1	< 0.1	< 0.1
27.	Chromium (as Cr6 +), mg/l, Max.	< 0.01	< 0.01	< 0.01
28.	Mineral oil mg/l, Max.	< 0.1	< 0.1	< 0.1
29.	Alkalinity (as $CaCO_3$) mg/l, Max.	90	90	65
30.	Aluminium (as A1) mg/l, Max.	< 0.01	< 0.01	< 0.01
31.	Free ammonia	<0.01	<0.01	<0.01
32.	Sodium Absorption ratcio (SAR)	0.85	1.04	0.834
33.	Boron, mg/l, Max.	< 0.1	< 0.1	< 0.1
34.	Coliform organisms, MPN/100ml	1700	2200	700

Water Quality Criteria as per Central Pollution Control Board is as follows:

Parameters	Class A	Class B	Class C	Class D	Class E
1. pH	6.5–8.5	6.5–8.5	6.0-9.0	6.5–8.5	6.5–8.5
2. Dissolved oxygen (as O_2), mg/l, min	6	5	4	4	-
3. BOD, 5 days at 20° C, max	2	3	3	-	-
4. Total coliform organism, MPN/100 ml, max	50	500	5000	-	-
5. Free ammonia (as N), mg/l, max	-	-	-	1.2	-
6. Electrical conductivity, µmhos/cm, max	-	-	-	-	2250
7. Sodium absorption ratio, max.	-	-	-	-	26
8. Boron (as B), mg/l, max.	-	-	-	-	2

Class A: Drinking water source without conventional treatment but after disinfection
Class B: Outdoor bathing (organised)
Class C: Drinking water source after conventional treatment and after disinfection
Class D Propagation of Wild life and Fisheries
Class E: Irrigation, Industrial Cooling, and Controlled Waste Disposal
Below E: Not meeting A, B, C, D & E Criteria

4.6.2 Ground Water Quality

In order to determine the quality of the ground water in the study area, samples were collected from 5 locations, Up-gradient and Down-gradient of the project site.

Samples were collected once during the monitoring season. The results of analysis are given in Table 4.11. In absence of any specific norms for Ground Water Quality, the results have been compared with the standards specified in the IS 10500-1991 (Drinking Water-Specification).

Table 4.11: Results of Ground Water Analysis

DATE OF SAMPLING : 19.03.2005 to 23.03.2005

Sl. No.	Characteristics	*Requirement (desirable limits)	Permissible limits	Results				
				GW-1	GW-2	GW-3	GW-4	GW-5
Essential Characteristics								
1.	Colour, Hazen Units, Max.	5	25	<5	<5	<5	<5	<5
2.	Odour	Unobjectionable	-	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
3.	Taste	Agreeable	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4.	Turbidity, NTU, Max.	5	10	4	5	4	4	3
5.	pH	6.5 to 8.5	No Relaxation	7.1	6.3	6.6	7.1	6.6
6.	Total Hardness (as $CaCO_3$), mg/l, Max.	300	600	124	88	124	156	244
7.	Iron (as Fe), mg/l, Max.	0.3	1.0	0.293	0.261	0.229	0.255	0.225
8.	Chloride (as Cl), mg/l, Max.	250	1000	21	32	51	21	105
9.	Residual Free Chlorine, mg/l Min.	0.2	-	-	-	-	-	-
10.	Fluoride (as F) mg/L, Max.	1.0	1.5	1.02	0.185	0.118	0.817	0.264
Desirable Characteristics :								
11.	Dissolved Solids mg/l, Max.	500	2000	293	196	251	370	585
12.	Calcium (as Ca), mg/l, Max.	75	200	27.2	22.4	27.2	35.3	61.0
13.	Magnesium (as Mg), mg/l, Max.	30	100	13.6	7.8	13.6	16.5	22.4
14.	Copper (Cu), mg/l, Max.	0.05	1.5	<0.01	<0.01	<0.01	<0.01	<0.01
15	Manganese (as Mn), mg/l, Max.	0.1	0.3	0.038	0.035	0.019	0.022	0.055
16.	Sulphate (as SO_4), mg/l, Max.	200	400	11	3	5	10	1
17.	Nitrate (as No_3), mg/l, Max.	45	100	0.27	19.7	67.8	0.51	71
18.	Phenolic Compounds (as C_6	0.001	0.002	<0.001	<0.00	<0.001	<0.001	<0.00

Sl. No.	Characteristics	*Requirement (desirable limits)	Permissible limits	Results				
				GW-1	GW-2	GW-3	GW-4	GW-5
19.	Mercury (as Hg), mg/l, Max.	0.001	No relaxation	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
20.	Cadmium (as Cd), mg/l, Max.	0.01	No relaxation	<0.005	<0.005	<0.005	<0.005	<0.005
21.	Selenium (as Se), mg/l, Max.	0.01	No relaxation	<0.005	<0.005	<0.005	<0.005	<0.005
22.	Arsenic (as As), mg/l, Max.	0.05	No relaxation	<0.03	<0.03	<0.03	<0.03	<0.03
23.	Cyanide (as CN), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
24.	Lead (as Pb), mg/l, Max.	0.05	No relaxation	<0.05	<0.05	<0.05	<0.05	<0.05
25.	Zinc (as Zn), mg/l, Max.	5.0	15	0.554	0.887	0.504	0.338	0.224
26.	Anionic detergent (as MBAS) mg/l, Max.	0.2	1.0	<0.1	<0.1	<0.1	<0.1	<0.1
27.	Chromium (as Cr6 +), mg/l, Max.	0.05	No relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
28.	Mineral oil mg/l, Max.	0.01	0.03	<0.1	<0.1	<0.1	<0.1	<0.1
29.	Alkalinity (as $CaCO_3$) mg/l, Max.	200	600	180	70	30	250	30
30.	Aluminium (as A1) mg/l, Max.	0.03	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
31.	Boron, mg/l, Max.	1.0	5	<0.01	<0.01	<0.01	<0.01	<0.01

IS 10500 (1991) : Norms for drinking water.

It can be seen from the analysis results that all the parameters of the ground water are well within the desirable limits of drinking water excepts pH, Total dissolved solids (TDS), nitrate and alkalinity. In study area, all the ground water pH was measured slightly acidic. However, all the sample pH was found well within the desirable range of pH (6.5 – 8.5) except at GW2 (Waste Dumpsite, Rengali). At GW2, pH was measured lower than the low limit. In all the locations, TDS was found under the desirable limit, except at GW5 (Kurebaga village) where it was slightly exceeding the desirable limits. Nitrate was exceeding the desirable limit at GW3 (Gumkarma village) and GW5 (Kurebaga village), whereas the alkalinity at GW4 (Landupalli). However, these parameters (TDS, Nitrate and Alkalinity) are to be found under the permissible limits in the absence of alternate source of drinking water as per IS : 10500-1991 (Drinking water specification.)

4.7 SOIL

In order to have an idea about the soil quality in and around the project area, samples of topsoil were collected once from the five locations viz.

1. Landupalli Village(S1)
2. Gumkarma Village (S2)
3. Patrapalli Village (S3)
4. Thelkoli Village, Plant site (S4)
5. Sirpura Village (S5).

The results of analysis are given in Tables 4.12, 4.13, 4.14, 4.15 and 4.16.

Table 4.12: Physical Properties of Soil Samples

Characteristics	Results				
	S1	S2	S3	S4	S5
Colour	Whitish Brown	Blackish Brown	Reddish Brown	Reddish Brown	Blackish Brown
Texture	Sandy Loam	Loam	Sandy Loam	Sandy Loam	Sandy Loam
Bulk Density (gm/cc)	1.34	1.32	1.44	1.41	1.33
Water Holding Capacity (%)	29.06	34.2	35.51	34.45	33.44

Table 4.13: Chemical Properties of Soil Samples

Characteristics	Results				
	S1	S2	S3	S4	S5
Type of Land	Agricul -tural	Agricul- tural	Agricul- tural	In-side plant	Agricul -tural
PH	5.6	5.7	6.0	5.0	5.1
Electrical Conductivity (µs/cm)	41.2	39.7	31.5	27.4	37.9

Soil pH plays a very important role in the availability of nutrients. The composition of the soil microbial community is also dependent on the soil pH. In the study area the soil samples had low pH.

Electrical conductivity is a measure of the concentration of soluble salts and ionic activity. Salt concentration is directly proportional to the osmotic pressure, which governs the process of osmosis in the soil – plant system. In the tested soil samples, S1 and S5 had slightly high electrical conductivity in comparison to S2, S3 and S4. Results of pH, Conductivity of the tested soil samples are given in Table 4.13.

Table 4.14: Available Major Nutrients in Soil

Nutrients and Ratings	Results				
	S1	S2	S3	S4	S5
Organic Carbon (%) and Rating	0.61 Medium	1.138 High	0.251 Low	0.381 Low	0.98 High
Organic Matter (%)	1.45	2.40	0.80	1.04	2.11
Available Nitrogen (kg/ha) and Rating	345 Medium	413 Medium	195 Low	220 Low	391 Medium
Available Phosphorus (kg/ha) and Rating	28 High	31 High	22 Medium	25 Medium	35 High
Available Potassium (kg/ha) and Rating	151 Medium	216 Medium	148 Medium	158 Medium	189 Medium
Ratings Based on: Organic Carbon : <0.50 – Low; 0.50 to 0.75 – Medium; >0.75 – High Available Nitrogen : <280 – Low; 280 to 560 – Medium; >560 – High Available Phosphorus : <10 – Low; 10 to 25 – Medium; >25 – High Available Potassium : <120 – Low; 120 to 280 – Medium; >280 – High					

Organic Carbon, Nitrogen and Phosphorus are limiting nutrients, especially Phosphorus. In the tested soil samples, availability of phosphorus was high in S1, S2 and S5 whereas in S3 and S4 it was found in medium concentration. These indicate that the fertility of the soil in the project site area is low in respect to other location. Nitrogen and organic carbon are low in the soil of the project area indicating that these areas have low fertility. Low Organic Carbon and Low Available Nitrogen in case of S4 soil also indicates low fertility of the proposed project site soil.

Table 4.15: Available Micronutrients

Micro Nutrient	Results (in mg/kg)				
	S1	S2	S3	S4	S5
Iron	141.3	41.5	26.8	61.3	121.8
Copper	1.62	1.46	1.85	1.11	2.9
Zinc	1.8	2.8	0.98	0.97	1.8
Manganese	9.71	11.8	9.3	22.8	24.7

Soil micro–nutrients also play an important role in the growth and development of plants. Soil micro–nutrient analysis can be employed as a diagnostic tool for predicting the possibility of deficiency of a nutrient and the profitability of its application. For this it is necessary to fix the critical limits. The critical limit of a micro–nutrient is that content of extractable nutrient at or below which plantation practised on it will produce a positive response to its application. The critical limits of copper, zinc and iron are 0.20 – 0.66 mg/kg, 0.50 – 0.65 mg/kg and 4.5 – 6.0 mg/kg, respectively. Results of available micronutrient in the tested soil samples are given in table 4.15. It can be seen that in all the soil samples micronutrient levels are fairly high. Copper and Iron is high in all the tested soil samples. Since in study area, results indicate that the level of Zn is just above the critical limits and it is available in moderate concentration may be helpful in plant growth. However it must be noted that very high concentrations of one or more micro–nutrients may be detrimental to plant growth and soil fertility may be adversely affected.

Table 4.16: Exchangeable Cations in Soil Samples

Cations	Results				
	S1	S2	S3	S4	S5
Calcium (meq/100 gm)	2.50 (39%)	5.7 (58%)	4.20 (46%)	2.36 (49%)	2.54 (42%)
Magnesium (meq/100 gm)	2.62 (41%)	2.30 (24%)	3.58 (39%)	1.26 (26%)	1.88 (31%)
Sodium (meq/100 gm)	0.24 (4%)	0..57 (6%)	0.32 (4%)	0.27 (6%)	0.35 (6%)
Potassium (meq/100 gm)	1.01 (16%)	1.21 (12%)	1.05 (11%)	0.92 (19%)	1.29 (21%)
Total Bases (meq/100 gm)	6.37	9.78	9.15	4.81	6.06
Values within bracket represent % of respective cation of the total cations.					

The results of exchangeable cation in tested soil of study area are presented in table 4.16. The results indicate that calcium and magnesium constitute the major part of the exchangeable cations in all the soils, whereas the sodium and potassium constitutes only a minor proportion.

4.8 ECOLOGICAL FEATURES

The study area is sparsely populated and the nearest population centers Jharsuguda town and Sambalpur town are located at a distance of 16 km and 45 km respectively from the project site. The study area consists of a terrestrial area and an aquatic area.

4.8.1 Terrestrial Ecology

The list of plants commonly found in the area is given in Table 4.17.Table 4.17: List of Plants Commonly Found in the Study Area

Sl. No.	Common Name	Scientific Name
1	Sal	Shorea robusta
2	Mahua	Madhuca indica
3	Tendu	Diospyros melanoxylon
4	Bat	Ficus bengalensis
5	Ashattha	F. religiosa
6	Dumar	F. hispida
7	Neem	Azadirachta indica
8	Kusum	Schleichera trijuga
9	Aam	Mangifera indica
10	Kathal	Artocarpus heterophylla
11	Arjun	Terminalia arjuna
12	Harra	T. chebula
13	Asan	T. tomentosa
14	Gamhar	Gmelina arborea
15	Bija	Pterocarpus marsupium
16	Sisoo	Dalbergia sisoo
17	Karan	Adina cordifolia
18		Cleisanthus spp.
19	Papra	Gardenia spp.
20	Harshringar (Sheuli)	Nyctanthes arbotristis
21	Kachnar	Bauhinia spp.
22	Dhaura	Woodfordia fruticosa
23	Tal	Borassus flabellifer
24	Khajur	Phoenix spp.
25	Jam	Syzigium cumini
26	Ber, Kul	Zizyphus spp.
27	Palash	Butea frondosa

Forest Land:

There is no reserve forest within 7.0 km of existing plant site. However, there are several reserve forests beyond 7 km of the project site. These include Kurebaga R.F (12 km NE) Ghichamura R.F. (16 km SE or E), Rampur R.F. (11.0 km WNW), Katikela R.F. (11 km NE) and Patrapali R.F. (9.0 km West).

The forests fall broadly within subgroup Tropical Dry Deciduous Forest and Dry Mixed Deciduous Forests. The forest crop varies from compartment to compartment with density varying from 0.4 to 0.7. Bamboo occurs in abundance and can be found all over the area. It occurs mainly as under-story with some pure patches. Sal occurs at foothills in moister pockets in valleys and in small isolated patches. Natural regeneration of tree species is poor, whereas that of bamboo is adequate, which leads to the conclusion that with concentrated filling the aggressive bamboo growth may replace the tree species completely, particularly over the hill slopes.

The forest of the region will be described as forest falling under project site and forest in the study area. It is difficult to distinguish at the two but for the purpose of the EIA report it is being described separately.

Forest in project site:
The forests in the project site are in small patches dominated by sal with old stands as well as secondary regenerated from cut stumps.

The common species found in these forests are Shorea robusta, Buchanania lanzans, Madhuca indica, Schleichera trijuga. The undergrowth is mostly dominated by Diospyros melanoxylon, Gmelina arborea, Pterocarpus sp. Dalbergia sp.

In the study area Shorea robusta is the most dominant species with co-dominants as Madhuca indica, Dendrocalamus strictus, Gmelina arborea, Pterocarpus marsupium, Dalbergia sisssoo etc.

Agricultural Land:
The principal agricultural crop is paddy. But other crops like pulses, wheat and vegetables are also grown due to availability of irrigation water. The soil characteristic ranges from heavy clay with kankar to loamy to sandy loam.

Waste Land:
At places where soil condition is not proper for plant growth or places where soil is over exploited the land is completely denuded with vegetation except for the wasteland species and weeds. This type of land basically comprises species like: Calotropis spp, Ipomea sp, Mimosa pudica, Lantana sp, Xanthium sp, Cassia sp, Ageratum sp, etc.

Vegetation near Human Habitation:

Near the villages, the vegetation pattern has abruptly changed from that what it is seen in the forest areas. The common species are those which are useful to the human beings. The species commonly found are Mangifera indica, Madhuca indica, Psidium guava, Syzigium jambolana, Tamarindus indica, Pheonix sp, Artocarpus heterophylla etc.

Wild Life:

The project area is bounded by Jharsuguda, titlagarh railway line on the east, state high way No. 10 on the west side and a village road to sripura on the north.

The reserve forests located around the project are:

1. Ghichamora RF - 16.0 km
2. Batramunda RF - 8.0 km
3. Babu Chakulia RF- 7.0 km
4. Kurebagha RF - 12.0 km
5. Rampur RF - 11.0 km
6. Katikela RF - 11.0 km
7. Patrapalli RF - 9.0 km

The nearest wildlife sanctury is Debrigarh wild life sanctury which is located on the other side of Hirakud reservoir and is about 45 km away from the project site. The other wildlife sanctury of the district is Badromar wild life sanctury which is about 50 km away from project site. Hence the project and surrounding area is not contiguous to any wild life habitat. Through no wild life of significance do occurs in this patch, species like jackals, pythone, cobra, yellow monitor, lizzards, hares besides ground birds like quails and patriges can be rarely seen. Other birds which are seen are parakeets, common hyna etc.

Based on actual field verification and interaction with local people and forest staff it is observed that very few of the listed common wild animals and common birds are actually found in the project area. Also because of high anthropogenic pressure due to the highway and consequent development of human and industrial activity it is not been conducive for wildlife to inhabit the area.

The list of wild mammals and reptiles found in the study area are listed in Table 4.18.

Table 4.18: List of Wild Mammals Found in the Study Area

Common Name	Scientific Name	Status (As per Red	Schedule of Wildlife

		Data Book of Indian Animals)	Protection Act in which listed
A. Mammals			
Sloth bear	Melursus ursinus	-	II
Common jungle cat	Felis chans	-	II
Hyaena	Hyaena hyaena	-	III
Civet	Vivera indica	-	II
Common mongoose	Herpestres edwardsii	-	IV
Jackal	Canis aureus	-	II,V
Wild dog	Cuon alpinus	-	II
Fox	Vulpes bengalensis	-	II
Indian Giant Squirrel	Ratufa indica	-	II
Porcupine	Hystrix indica	-	IV
Common hares	Lepas sp.	-	IV
Wild boar	Sus scrofa	-	III
Nilgai	Boselaphus tragocamelus	-	III
Barking deer	Muntiacus muntiacus	-	III
Sambar	Cervus unicolor	-	III
Spotted deer	Axis axis	-	III
Striped Palm Squirrel	Funambulus palmatum	-	IV
Rhesus monkey	Macaca mulata	-	II
B. Reptiles			
Indian Cobra	Naja naja	_	II
Yellow rat Snake	Ptyas mucosus	_	II
Common Krait	Bungarus caeruleus	-	IV
Russel's Viper	Vipera russelii	_	II
Checkered Keelback	Xenochropis piscator	_	II

The spotted deer usually inhabits on the lower slope of the hills and is found in grassy blanks near village sites. Herds of 10-12 are at times seen when rabi crops are on. Sambar occurs in limited numbers in all the forest areas of Barapahr hills and Meghpal. Wild dogs are common in Basiapara-Birsingah block and Bear in Papagga and Goinpuria areas.

The common snakes found in the region are Kraits and Cobras.

The main Hirakud Dam lies some 15 to 20 km away from site however backwater lies about 6 to 8 km south and south west of the project site. Many of the duck like bird are seen in main reservoir water far away from project site. The birds found in the area are as follows:

Table 4.19: List of Birds Commonly Found in the Area

Common Name	Scientific Name	Status	Schedule of Wildlife Protection Act in which listed
Paddy Bird	Ardeola grayii	-	IV
Large Indian Parakeet	P. eupatria	-	IV
Rose Ringed Parakeet	P. krameri	-	IV
Brahminy Duck	Tadorna ferrugninea	-	IV
Pochards	Aythya spp	-	IV
Red Wattled Lapwing	Vannelus indicus	-	IV
Crow Pheasant	Centropus sinensis	-	IV
Koel	Eudynamis scolopacea	-	IV
White Breasted kingfisher	Halcyon smyrnansis	-	IV
Small green Bee-eater	Merops orientalis	-	IV
Coot	Fulica atra	-	IV
Jungle Crow	Corvus marorhynchos	-	V
Common Crow	C. splendens	-	V
Hill Mynah	Gracula religiosa	-	IV
Common Mynah	Acridotheres tristis	-	IV
House Sparrow	Passer domesticus	-	-
Golden Backed Woodpecker	Dinopium benghalense	-	IV
Red Vent Bulbul	Pycnonotus cafer	-	IV
Spotted Dove	Streptopelia chinensis	-	IV

Red Jungle Fowl	Gallus gallus	-	IV
Grey Hornbill	Tockus birostris	-	IV
White Backed Vulture	Gyps bengalensis	-	IV
King Vulture	Sarcogyps calvus	-	IV
Spur Fowl	Galloperdix spp	-	IV
Grey Quail	Coturnix coturnix	-	IV
Bush Quail	Peridicala indica	-	IV
Purple Sun-bird	Nectarinia asiatica	-	IV
Bustard Quail	Turnix suscitator	-	IV
Owls		-	IV

4.8.2 AUATIC ECOLOGY

The main water bodies in the area are Ib River, Bhedan River and the Hirakud Reservoir. The Ib River is a tributary of river Mahanadi and joins the Hirakud Reservoir. The Bhedan River is not perennial. The Hirakud Reservoir has been constructed on the Mahanadi River system. The water requirement of the project would be met from the Hirakud Reservoir backwater. The data on ecology of the aquatic ecosystem in the study area is based on literature.

4.8.2.1 PHYTOPLANKTON

A total of 35 species have been recorded from the area. Diatoms dominate the reservoir, whereas filamentous algae of Chlorophyceae and Cyanophyceae dominate the rivers. In general the density, volume and biomass of algae was higher in the reservoir and lower in the rivers.

4.8.2.2 ZOOPLANKTON

A total of 23 species have been recorded in Hirakud dam and adjoining rivers of which Crustaceans are the dominant group. It has been noted that density of zooplankton is higher in the dam than in the rivers.

4.8.2.3 FISHES

The Hirakud Reservoir is the main ecosystem supporting fishes in the area. As per the survey conducted by Job et.at (1955) on the Mahandi River system, before the construction of dam, there were 183 species of fishes, out of which 24 were of economic importance. The most

common species were Labeo calbasu and L. fimbriatus. After the formation of reservoir, fishery underwent considerable changes and the present fish fauna of the reservoir constitute only 42 species which are listed in Table 4.20. As per the survey conducted by George et.al (1973), four species viz. Silonia silondia, Labeo fimbriatus, Catla catla, and Cirrhina mrigala are the commercially important fishes of the reservoir. Maximum abundance of fishes was reported during April-July. The yield was better in the upper region followed by the middle region.

Table 4.20: Fish Fauna of Hirakud Dam

Sl. No.	Name of fish	Local Name
1.	Catla catla	Bakur
2.	Labeo fimbriatus	Pursi/Berag
3.	Labeo calbasu	Kalanchi
4.	Labeo rohita	Rohu
5.	Labeo gonius	Nunia
6.	Labeo bata	Banghen
7.	Cirrhinus mrigala	Mrikali
8.	C. reba	Pohura/Dumala
9.	Barbus tor	Kusra
10.	Puntius sarana	Sarna
11.	Mystus seenghala	Asdi/Singhari
12.	Mystus sor	Katrang
13.	Mystus gulio	Tingra
14.	Silonia silondia	Gaja
15.	Wallago attu	Balia
16.	Pangasius pangasius	Jalang
17.	Rita chrysea	Kukia
18.	Eutropiichthys vacha	Vacha
19.	Bagarius bagarius	Buthia
20.	Notopterus notopterus	Fali
21.	Notopterus chitala	Chital
22.	Gudusia chapra	Phufur
23.	Rohtee cotio	Chilati
24.	Pama pama	Patharmudi
25.	Glossogobius guiris	Gazra
26.	Rhinomugil corsula	Koinga
27.	Xenentodon cancila	Gourchena
28.	Chela sp.	Jedda
29.	Chela bacailla	
30.	Ailea coilfa	Bauspati

31.	Ambassis nama	-
32.	Ambassis sp	Patponia
33.	Puntius sophore	Kutri
34.	Puntius ticto	
35.	Puntius chola	
36.	Puntius dorsalis	Kutri
37.	Mastacembelus armatus	
38.	Mastacembelus pancalus	Bayarri
39.	Channa striatus	
40.	Channa marulius	Soul
41.	Channa punctatus	Khapsi
42.	Ompok bimaculatus	Banju

4.9 SOCIO – ECONOMIC ENVIRONMENT

4.9.1 Introduction

Socio-economic development is closely linked with the growth of industrialisation in a region. Installation of a heavy industry like an integrated steel plant serves this purpose most because various types of industries, mainly the small scale units, grow in the vicinity of the main plant creating something like the "Bubble-effect". Such a development is envisaged at Lapanga as result of installation of the proposed 1.2 Mt integrated steel plant by Bhusan Steel Limited which is expected to be implemented in two phases. The project as such indicates a break in investment, which can have widespread impact on the socio-economy of the area surrounding it, through multiplier and linkage effects. On this backdrop, the present study is directed towards the following objectives:

4.9.2 Objective

i) To assess the impact of the project on agricultural situation;
ii) To examine the impact of the project on pattern of demand;
iii) To assess the in impact of the project on consumption pattern;
iv) To examine the employment and income effects of the project;
v) To explore the possibility of local industrialisation as an offshoot of the project;
vi) To examine the effect of the project on education status of the people in the study area; and
vii) To judge peoples' perception regarding the project.

4.9.3 The Study Area

In the present investigation, the study area is considered as the circle with 10 km with centre at Lapanga, the plant / project site. The entire study area comes under two thesils (districts), viz, Rengali (Sambalpur) and Jharsuga (Jharsuguda). Of the two thesils, Rengali covers about 80% of the study area while the remaining 20% falls in Jharsuguda. The impact assessment of this project has been done on the study area. Table-1 depicts a synoptic view of the basic statistics of the study area. The population of the area is around 38343 with a density of 122 persons per square km.

4.9.4 Analytical Framework

Sampling Design

The study area is divided in to three strata --- (i) within 3-km radius circle centering the project site, (ii) area between 5km-radius circle and 3 km radius circle and (iii) area between 10-km radius circle and 5kms radius circle. A sample of 50 respondents is selected using two-stage stratified random sampling technique. In the first stage villages are selected and in the second stage, the respondents are selected at random. from the selected villages.

Respondents have been interviewed with the structured questionnaire specially designed for this study keeping in view the objectives. Major constituents of the questionnaire are as follows:

1. Cropping pattern
2. Crop productivity
3. Cost of cultivation
4. Net return from crops
5. Household budget
6. Consumption pattern
7. Peoples' perception about the project.

Methodology

The major methods used as tools of analysis in this study are as given below:

1. Regression:

Simple linear regression of the following type in considered
$Yi = a + b X_i + U_i$ (Where, U is the stochastic error term having its usual properties)

The model is fitted to data applying Ordinary Least Square (OLS) to obtain estimated demand and consumption functions.

2. Fitted regression models is used to work out

i) Elasticity of demand with respect to disposable income (e) in case of demand functions

$$e = (dy / dx). (y/x)$$

ii) Marginal propensity to consume (MPC) from consumption function:

$$MPC = dC / Dy$$

3. Frequency distribution of peoples' perception, educational status, land holding etc.

4.9.5 Demographic Pattern of the Study area

Table: 4-21Estimated Population and Occupational Pattern of the Study Area

(in Nos)

Item	up to 3 kms	3 - 5 kms	5 - 10 kms	Total
1. Population Including Total	4950	6286	27107	38343
Male	2504	3179	13710	19393
Female	2446	3107	13397	18950
SC	827	1051	4530	6408
ST	1838	2334	10066	14239
2. Households	900	1143	4929	6971
3. Literate	1725	2190	9444	13359
4. Occupational pattern				
a) Main workers	1103	1401	6043	8548
i) Cultivators	474	602	2598	3675
ii) Agricultural laborers	80	102	440	623
iii) Workers in household industry	74	93	403	570
iv) Other workers	475	603	2602	3680
b) Marginal workers	136	173	746	1056
Total working population	**1239**	**1574**	**6789**	**9604**

Land use pattern of the area is given in Table: 4-22. It is observed that irrigated and un-irrigated area together constitutes 48 % of the total area. Forest cover is about 6.6%.

Table: 4-22:Land use of the study area

Sl.No.	Type of land	Study area	% of total
1	Forest land	20.8	6.6

2	Irrigated	1.2	0.4
3	Un-irrigataed	149.5	47.6
4	Cultivable waste including groves	81.9	26.1
5	Area not available for cultivation	59.8	19.0
6	Others	1.1	0.3
	TOTAL	314.3	100.0

4.9.6 Agricultural situation

Agriculture is a major source from which people of the area derive their income. However, the climatic condition and the quality of soil of the area are not suitable for developed agriculture. Table 4.23 presents the cropping pattern in the study area. From the table it is evident that paddy is the main crop produced. Paddy is grown on about 88% the Gross Cropped Area (GCA). Other than paddy, vegetables are also grown in this area.

Table 4.23: CROPPING PATTERN & CROPPING INTENSITY

SL No	Crop	Area covered in GCA (%)
1	Paddy (Wharf)	87.8
2	Others	12.2
	TOTAL	100.0

Table: 4.24 depicts productivity of crops. The productivity figure for paddy is found to lie much below state averages.

Table: 4.24 CROP PRODUCTIVITY

Sl. No.	Crop	Productivity (Qtl./ac.)
1	Paddy	6.8

Table: 4.25 presents average investment in agriculture, net return and cropping intensity. It is observed that agriculture is still profitable in this area as net return from agriculture is positive (Rs 3172 per acre). One telling fact as observed in the area is that the cropping intensity is quite low (113.9%). This indicates backwardness of agriculture. Scanty rainfall, scarcity of irrigation water and low quality soil permitted them to produce only a few crops

.

Table: 4.25cost of cultivation, net return and cropping intensity

Sl No	Item	Quantity

1	Investment in agriculture (Rs/acre)	1164
2	Net return (Rs/acre)	3172
3	Cropping intensity (%)	113.9

Overall assessment of the agricultural situation of the area reveals that agriculture is still very backward in this area. Constraints of such backwardness as reported by the farmers are scanty rainfall, lack of irrigation water and unproductive soil. In addition to these, scarcity of capital (for investment) is also one of the major constraint. Majority of the farmers opined that unproductive land is the most important among these constraints. Keeping this in mind, it can be concluded that even if some irrigation facilities are provided/extended in this region, agriculture will still continue to be traditional.

Given the persistent nature of backwardness of agriculture, it can reasonably be said that the project is not going to cause significant damage to it. Hence, the project will not have much of adverse impact on the existing agricultural situation of this area. Instead, the industrial project is likely to provide the farmers with supplementary income, which appears to be essential for raising the standard of living of the people of the study area.

5.0 PREDICTION OF IMPACTS

In the screening of impact (Chapter 3), the environmental attributes that may be affected due to the modification-cum-expansion of existing steel plant have been listed. The existing environmental conditions have been described in the Chapter 4. In the present chapter, the impacts of the project on the environment have been predicted. Impacts on various environmental attributes during construction as well as operation have been discussed.

5.1 IMPACTS DURING CONSTRUCTION

5.1.1 Impacts on Ambient Air Quality

During the construction phase, a lot of civil work is being carried out. This leads to a generation of fugitive dust. However the fugitive dust is not expected to spread too far. In addition, water spraying is being undertaken to suppress dust being spread.

Due to construction activities, the impacts on ambient air quality will not be permanent and will cease once the construction is completed after that generation of fugitive dust will reduce drastically.

5.1.2 Impacts on Noise Levels

Noise levels during construction are likely to increase due to increased movement of trucks and other diesel powered material handling equipment. This is unavoidable. Therefore, movement of trucks and machinery will be regulated to only during daytime to reduce the impacts of increased noise.

Since the construction phase will be temporary, the impacts on ambient noise levels will be temporary and cease once the construction is completed.

5.1.3 Impacts on Water

During construction, a lot of debris, mud etc will be generated. During the monsoon season, storm water run-offs will contain large amounts of suspended solids. These will ultimately flow outside the plant boundary through storm water drain and will lead to natural drainage. Efforts is being made to reduce the suspended solids content of storm water run-offs by routing the storm water drains through catch pits. Moreover storm water run-offs will occur only during the monsoon season which lasts for about 2-3 months in the study area. Moreover these impacts will be temporary lasting only for the duration of the construction period.

5.1.4 Impacts on Ecology

The modification cum expansion of existing unit will remain within 1300 acres of land transferred by government of Orissa to Bhushan Limited. The area involved is small and hence the impacts on the study area as a whole will be insignificant.

Water pipeline 12km from backwater of Hirakud intake well to plant site does not cover much area and mostly underground. Impact on ecology will be insignificant, as most of the area is fallow – barren area.

5.1.5 Socio-Economic Impacts

The construction work is under way and generating lot of employment, both direct and indirect, This is affecting the economy of the study area in positive direction.

5.2 IMPACTS DURING OPERATION

Once the steel plant fully commissioned and operational the impacts are anticipated on Ambient Air Quality, Noise Levels, Water, Ecology and Socio-Economic Environment.

5.2.1 Impacts on Ambient Air Quality

The principal impacts on ambient air quality due to operation of the steel plant will be due to emissions from the stacks of the units and emissions of fugitive dust from the iron ore and coal handling areas.

The prediction of Ground level concentrations (GLC) of pollutants emitted from the above stacks has been carried out using ISCST-3 Air Quality Simulation model released by USEPA. This model is basically a Gaussian dispersion model, which considers multiple sources. The model accepts hourly meteorological data records, to define the conditions of plume rise for each source and receptor combination for each hour of input meteorological data sequentially and calculates short term averages upto 24 hours.

The impact has been predicted over a 10 km X 10 km area with centre of the plant as the centre. To obtain greater resolution, the receptors are defined with respect to 16 radial wind directions (N to NNW) and radial distance from centre. GLC have been calculated at every 500 m grid point to have better results.

The emissions have been computed based on the following:

a) Particulate matter (SPM) has been calculated considering emission rate of 100 mg/Nm^3 though norms of SPM for steel plant is 150 mg/Nm^3
b) Sulphur content of the coal has been assumed to be 0.5% as per CPCB guidelines and Sulphur content of the waste heat gas has been assumed to be 0.1% (v/v)as per manufacturer guidelines
c) NO_x emissions from Power Plant have been estimated based on the 75 mg/Nm3 of NO_x is generated per Nm3 of flue of coal burnt.

The layout of proposed steel plant along-with the location of stacks is given in Drg. No. MEC/Q228 /11/14/00/00/18 sheet 1 of 1.

Details of the stacks at the ultimate stage of 2.2 Mtpy and the estimated emissions are given in Table 5.1.

Table: 5.1

STACKS & EMISSION INVENTORY OF BHUSHAN LIMITED RENGALI FOR 2.2 MTPY STAGE

		Stack Co-ordinate (Plant Centre at 10,10)		Stack Height(m)	Stack Dia (m)	Flow Rate (Nm3/hr)	Exit velocity (m/sec)	Temp C	Emission Rate (g/sec)		
		x-co-ord.	y-co-ord.						SPM	SO2	NOx
	De-dusting stack of DRI Kilns 10X150000 tpy										
1	DRI KILN-I&II	9892	10477	35	2.2	250000	20.4	60	6.9	-	-
2	DRI KILN-III&IV	10000	10248	35	2.2	250000	20.4	60	6.9	-	-
3	DRI KILN-V&VI	9820	10608	35	2.2	250000	20.4	60	6.9	-	-
4	DRI KILN-VII &VIII	9645	10923	35	2.2	250000	20.4	60	6.9	-	-
5	DRI KILN-IX&X	9582	11080	35	2.2	250000	20.4	60	6.9	-	-
	Main Process Stack Of Pallet Plant (1X2.0 Mtpy)										
6	PALLET PLANT	10175	9595	100	3.0	300000	14.2	85	8.3	6.13	6.25
	Blast Furnace Complex : 1x1008 m3 BLAST FURNACE; 1X105 M2 SINTER PLANT										
7	BF STOVE STACK	10027	9946	65	2.5	108630	13.9	400	-	1.76	2.22
8	BF GCP DRY GAS CLEANING STACK	10023	9865	30	2.4	180000	13.8	100	5.0	-	-
9	BF-STOCK HOUSE	10112	9865	35	2.4	220000	14.0	35	6.1	-	-
10	SINTER PLANT-CHARGING STACK	10144	9586	60	4.0	570000	17.9	150	15.8	2.4	2.32
11	SINTER PLANT-DISCHARGING STACK	10275	9415	38	3.0	450000	20.9	80	12.5	-	-
12	SINTER PLANT-DEDUSTING STACK	10202	9640	30	2.5	190000	12.7	80	5.3	-	-
	SMS Complex (4x15t IF, 4x90t EAF, 4x90t LF)										
13	IF-FUME EXTRACTION STACK-I	9910	9573	30	1	30000	13.3	100	0.8	-	-
14	EAF+LF FUME EXTRACTION STACK-II	9843	9528	60	3.0	272000	13.4	100	7.6	-	-
15	EAF+LF FUME EXTRACTION STACK-III	9856	9460	60	3.0	272000	13.4	100	7.6	-	-
	Captive Power Plant (1x40+1x60+3x110 MW Power Plant)										
16	WHRB STACK-I	9654	10405	75	2.0	120000	15.1	150	3.3	20.2	
17	WHRB STACK-II	9703	10338	75	2.0	120000	15.1	150	3.3	20.2	
18	WHRB STACK-III	9797	10171	75	2.0	120000	15.1	150	3.3	20.2	
19	WHRB STACK-IV	9820	10112	75	2.0	120000	15.1	150	3.3	20.2	
20	WHRB STACK-V	9640	10459	75	2.0	120000	15.1	150	3.3	20.2	
21	WHRB STACK-VI	9617	10522	75	2.0	120000	15.1	150	3.3	20.2	

22	WHRB STACK-VII	9482	10788	75	2.0	120000	15.1	150	3.3	20.2	
23	WHRB STACK-VIII	9446	10855	75	2.0	120000	15.1	150	3.3	20.2	
24	WHRB STACK-IX	9406	10940	75	2.0	120000	15.1	150	3.3	20.2	
25	WHRB STACK-X	9370	10990	75	2.0	120000	15.1	150	3.3	20.2	
26	AFBC-(75 tph)	9874	10293	75	2.0	143000	17.5	140	4.0	7.2	2.9
27	AFBC-(150tph)	9847	10338	95	2.5	286000	22.4	140	7.9	14.4	5.9
28	CFBC-I(350tph)	9685	10675	120	4.0	660000	14.52	140	18.3	33.3	13.7
29	CFBC-II(350tph)	9649	10734	120	4.0	660000	14.52	140	18.3	33.3	13.7
30	CFBC-III(350tph)	9605	10625	120	4.0	660000	14.52	140	18.3	33.3	13.7
	CSP PLANT										
31	TUNNEL FURNACE-I(ST-1)	9707	10027	60	1.0	10000	6.0	300	-	-	1.0
32	TUNNEL FURNACE-I(ST-2)	9676	10009	60	1.0	3000	2.0	300	-	-	0.3
33	TUNNEL FURNACE-I(ST-3)	9640	9996	60	1.0	3000	2.0	300	-	-	0.3
34	TUNNEL FURNACE-II(ST-1)	9672	10104	60	1.0	10000	6.0	300	-	-	1.0
35	TUNNEL FURNACE-II(ST-2)	9599	10072	60	1.0	3000	2.0	300	-	-	0.3
36	TUNNEL FURNACE-II(ST-3)	9536	10045	60	1.0	3000	2.0	300	-	-	0.3
	RAW MATERIAL PREPARATION PLANT										
37	RMP STACK-I	10234	10383	30	1	50000	18.0	30	1.4	-	-
	LIME & DOLO PLANT										
38	LIME PLANT-KILN1	10135	9303	60	0.8	246200	12.9	125	0.5	0.23	0.92
39	LIME PLANT-KILN2	10157	9258	60	0.8	246200	12.9	125	0.5	0.23	0.92
40	LIME PLANT-KILN3	10185	9238	60	0.8	246200	12.9	125	0.5	0.23	0.92
41	LIME PLANT-KILN4	10205	9208	60	0.8	246200	12.9	125	0.5	0.23	0.92
42	DOLO PLANT-KILN	10235	9195	60	0.8	246200	12.9	125	0.5	0.23	0.92
	COKE OVEN PLANT										
43	COKE OVEN PLANT-STACK1	10414	9595	70	2.5	81535	13.4	350	1.6	2.26	1.81
44	COKE OVEN PLANT-STACK2	10522	9585	70	2.5	81535	13.4	350	1.6	2.26	1.81
45	COKE OVEN PLANT-STACK3	10464	9595	70	2.5	81535	13.4	350	1.6	2.26	1.81
46	COKE OVEN PLANT-STACK4	10464	9565	70	2.5	81535	13.4	350	1.6	2.26	1.81
	FERRO ALLOY PLANT										
47	FERROALLOY 1&2	9977	9496	30	0.3	3226	18.0	150	0.1	-	-
48	FERROALLOY 3&4	9977	9168	30	0.3	3226	18.0	150	0.1	-	-

The meteorological data of the day on which the maximum GLC occurred is shown as Table 5.2. Stability has been computed by Turner's method and mixing height has been obtained from literature. The predicted GLC values have been provided at Table 5.3. In this table the 10 highest GLC values for each pollutant and the place of occurrence are given.

Table 5.2: Meteorological inputs (Summer 2005)

Time (hours)	Wind Direction	Wind speed (m/s)	Temp. (°K)	Stability	Remarks
01.00	247.5	1.024	299.0	6	
02.00	247.5	1.475	299.0	6	
03.00	225.0	2.364	298.0	6	
04.00	225.0	1.887	297.0	6	
05.00	180.0	1.773	297.0	6	
06.00	225.0	2.085	297.5	5	
07.00	225.0	1.618	298.0	4	
08.00	180.0	3.028	301.0	3	
09.00	180.0	0.594	303.0	3	
10.00	202.5	1.632	304.5	2	
11.00	247.5	1.868	306.5	2	
12.00	202.5	2.023	307.5	1	
13.00	347.5	2.199	309.6	1	
14.00	090.0	3.029	309.5	2	
15.00	157.5	1.228	309.0	3	
16.00	157.5	1.167	308.5	3	
17.00	090.0	1.275	308.5	3	
18.00	067.5	0.994	308.5	4	
19.00	045.0	0.524	306.5	5	
20.00	045.0	0.503	304.0	6	
21.00	045.0	1.087	304.0	6	
22.00	180.0	2.057	302.0	6	
23.00	270.0	2.053	302.0	6	
24.00	292.5	4.303	301.0	6	

NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.

The wind direction concept adopted is as follows:

From South 0 / 360^0

West	90^0
North	180^0
East	270^0

Table 5.3: Predicted Maximum GLCs

Rank	Max. 24 h. Avg. ($\mu g/m^3$) of Pollutants		
	SPM	SO_2	NO_x
1	41.04(14.0,19.5)	40.06(10.5,10.0)	7.09(10.0,11.5)
2	39.24(13.5,18.5)	35.84(9.5,12.0)	7.03(10.5,10.0)
3	38.11(10.0,11.5)	35.49(9.5,12.5)	6.76(11.0,10.0)
4	38.11(13.5,18.0)	34.77(10.5,12.5)	6.64(10.0,11.0)
5	38.10(13.0,17.0)	34.30(10.5,12.0)	6.40(11.0,11.5)
6	37.43(10.0,11.0)	33.68(10.0,11.5)	6.38(10.5,12.5)
7	36.78(10.0,11.5)	32.4(11.0,13.5)	6.33(11.0,9.0)
8	36.48(14.0,19.0)	32.30(9.5,13.0)	6.30(10.0,12.0)
9	35.04(13.0,17.5)	32.10(10.5,12.5)	6.08(11.0,11.5)
10	35.03(12.5,16.0)	31.12(10.0,12.0)	5.98(11.0,11.0)

The average concentrations of SPM, SO_2 and NO_x recorded at the AAQ monitoring station at SirpuraVillage in the North East direction are 152 $\mu g/m^3$; BDL $\mu g/m^3$ and 18 $\mu g/ m^{3,}$ respectively during the summer season. This is the nearest village habitat in the predominant wind direction where the maximum GLC value is obtained. The predicted contribution of different pollutants when added with the background concentration indicated the maximum concentration are 193 ug/m3, 40.0 ug/m3 and 17.0 ug/m3 for SPM, SO2 and NOx respectively against the permissible limit of 500 ug/m3, 120ug/m3, and 120 ug/m3 for industrial area.

During the winter season the monitored background value of AAQ of SPM, SO_2 and NO_x was 160 ug/m^3, 25ug/m^3, and 23 ug/m^3 respectively for Sirpura AAQ station. The predicted contributions of different pollutants from the integrated steel plant, when added with the monitored background levels indicate that the maximum concentrations are 201 ug/m^3, 65.0 ug/m^3 and 30.09.ug/m^3 for SPM, SO_2 and NOx respectively against the permissible limit of 500 ug/m3, 120ug/m3, and 120 ug/m3. The values are within the permissible limit for industrial area. Winter season values were considered because of green field conditions existed during that time.

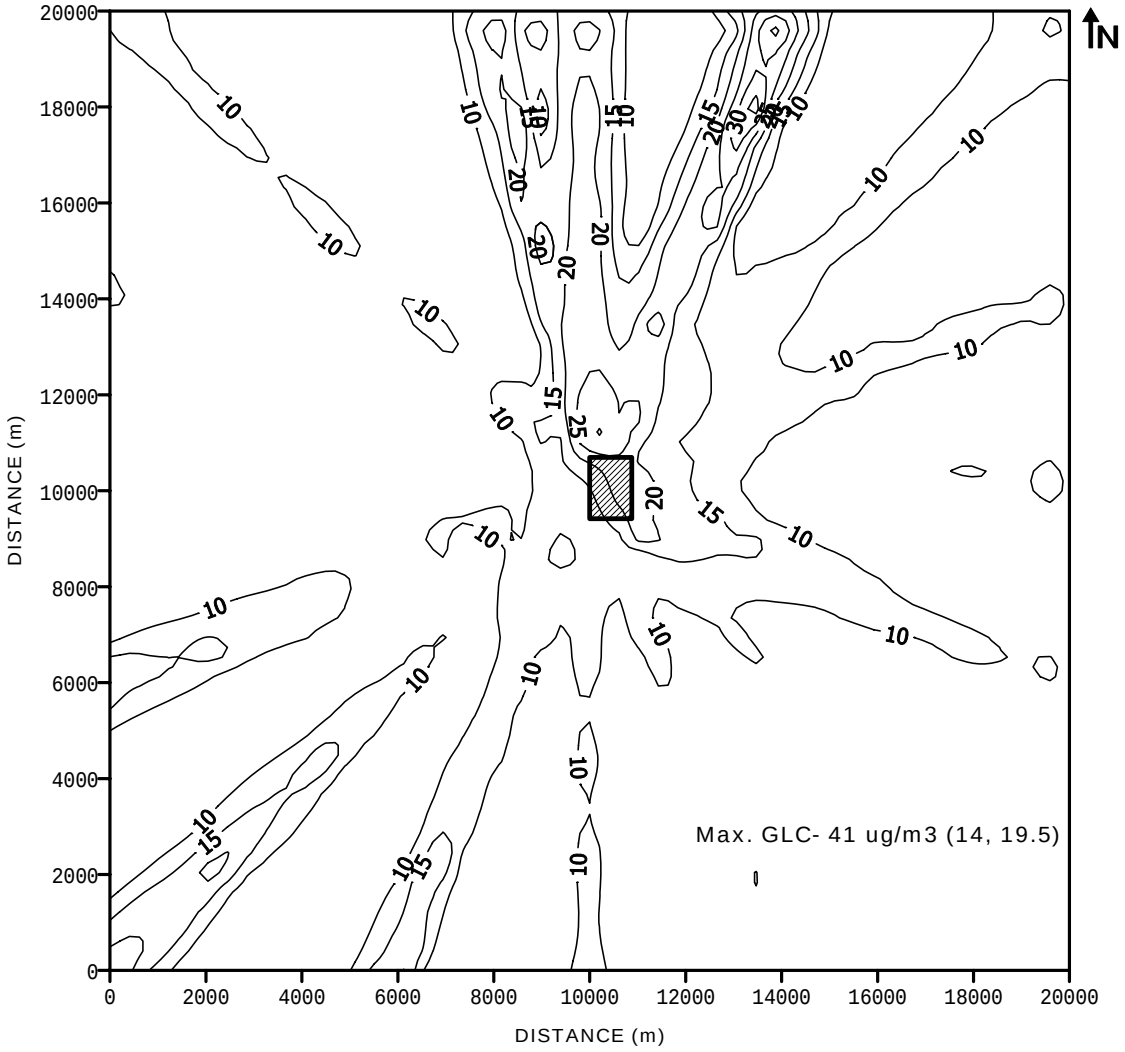
From the results it is observed that the expansion of existing steel plant to 2.2 Mtpy level will not have appreciable impact on the ambient air quality in the area.

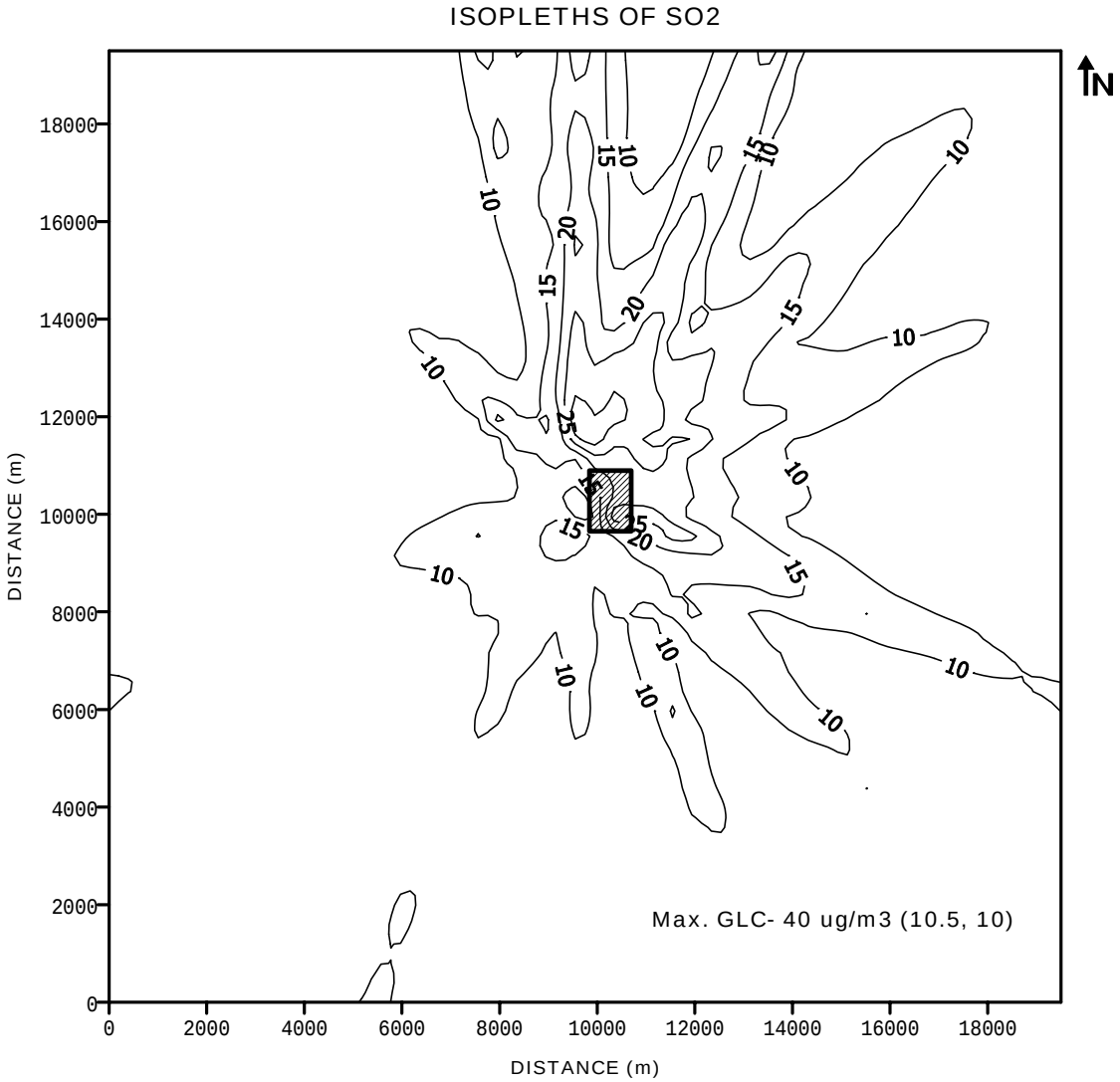
In order to improve the work zone air quality inside the plant premises, the following measures will be taken to prevent escape of dusty air and harmful gases in plant. All the

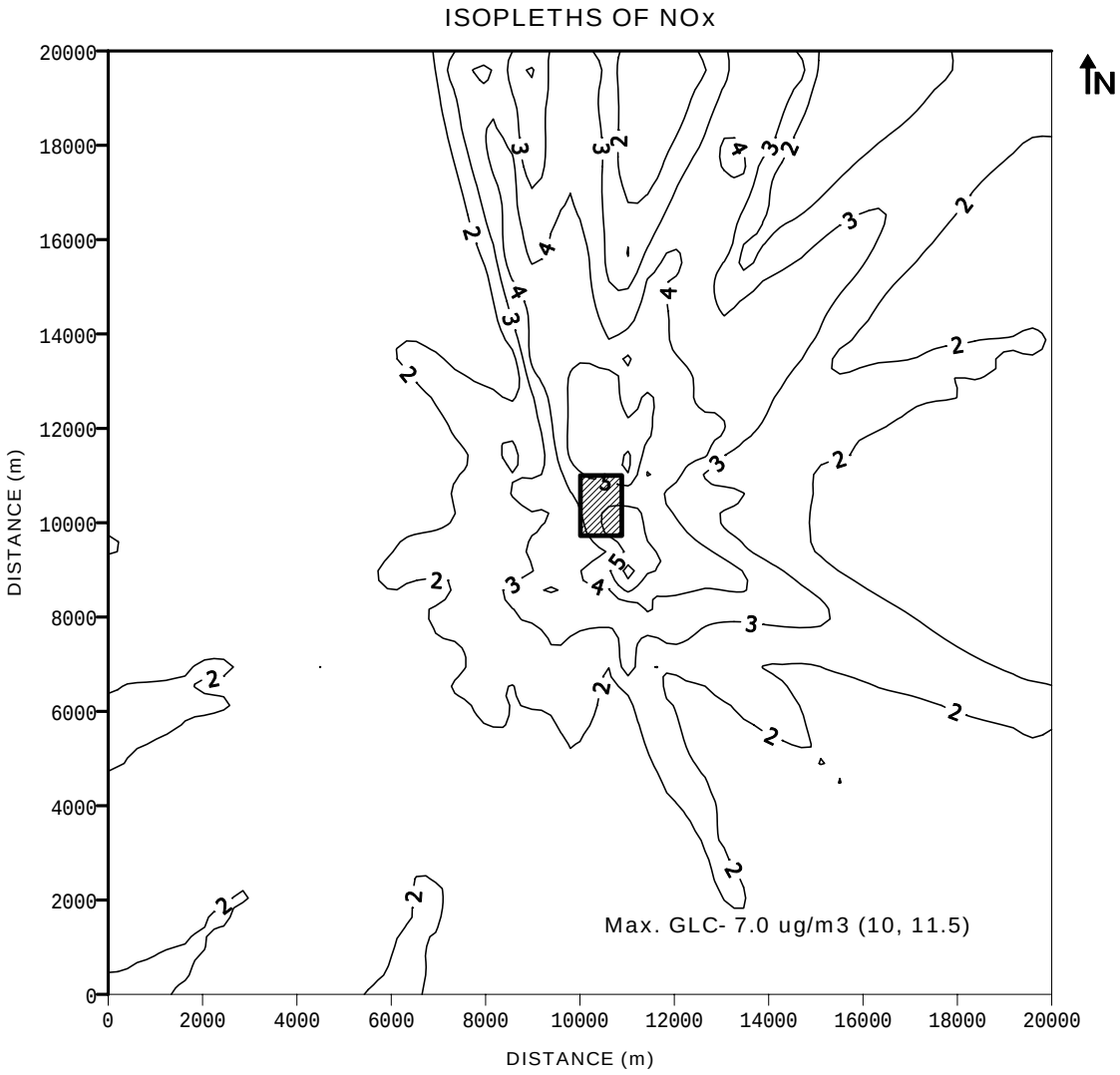
fugitive emissions where de-dusting suction hoods cannot be provided due to physical constraints shall be provided with dust suppression system/water sprinklers.

Habitation centers such as Jharsuguda and Sambalpur are about 16 and 45 km away from plant respectively and the levels of air pollutants expected are much less. Hence no significant impact can be expected.

ISOPLETHS OF SPM




ISOPLETHS OF SO2
N
DISTANCE (m)
DISTANCE (m)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Max. GLC- 40 ug/m3 (10.5, 10)


ISOPLETHS OF NOx
N
DISTANCE (m)
DISTANCE (m)
Max. GLC- 7.0 ug/m3 (10, 11.5)
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000

5.2.2 Impacts on Water

Impacts on Water Resources

The source of water for the proposed steel plant will be the backwater of Hirakud reservoir. The Steel plant authorities have permission for the drawal of 100 cusecs (10080 m^3/h) of water, from Upper Mahanadi Basin (the nodal agency for allotment of water from Hirakud Reservoir). The actual requirements of steel plant will be 3885.5 m^3/h (93252 m^3/day). Drawl of 100 cusecs water from Hirakud reservoir will not affect the availability of water for others, as Dead water storage capacity of Reservoir is 1211.21 million m3 whereas live storage is 4934.53 Million m3.

The integrated steel plant will not draw any ground water nor will do so in future. Thus operation of the steel plant will not affect water availability in the study area.

Impacts on Water Quality

As the plant water system will be designed based on 100% re circulation system thus effective discharge from plant to outside will be zero. Waste water are expected to be generated from different facilities of the proposed plant. The expected quantities and their use are given:

1. Underflow from Thickner of Blast Furnace (Intermittent) : 08.0 m^3/h

2. Boiler Blow Down (net) used for service water : 28.0 m^3/h

3. Blow Down (net) from IF&EAFused for other system : 28.0 m^3/h

The domestic and sanitary wastewater from plant will be treated in septic tank & soak pits.

5.2.2 solid waste

The major solid wastes expected to be generate from the integrated steel plant (2.2 Mtpy level) facilities and its utilisation plan as follows

Table: 5.4Quantity of Solid Waste Generated in the 2.2 mtpy Steel Plant at Rengali, Sambalpur (Orissa)

Sr. No.	Solid Waste Generated from the unit	Nature of Solid Waste	Quantity (tpy)	Probable Re-use
	DRI SECTION:10X150000 t Kilns			
1.	Process Dust	Iron fines & coal fines in the form of solids	38400	To be recycled to the sinter plant
2.	Transfer point dust from bag house	solid dust	230400	To be recycled
3.	Char	Unburned coal particles	472500	100% use in the AFBC/CFBC Boilers
4.	Kiln Accretion and miscellaneous waste	-	30000	Dumped in low lying area
	PELLET PLANT:1x2.0 Mtpy			
5.	Dust from de-dedusting	solids	25200	Will be recycled back
	SMS SECTION : 4X15t IF,4X90t EAF& LF			
6.	Slag (From IF+EAF+LF)	solids	390000	will be used in the land fill
7.	Dust (From IF+EAF+LF)	solid dust	24000	To be recycled to the sinter plant
8.	Muck & Debri(Including Refractory)		48000	To be recycled to the extent possible
9.	Usable Scrap	solids	95250	Recycled in SMS
10.	Ferro Manganese Plant Slag	solids	102000	dumped
	CAPTIVE POWER PLANT :1x75+1x150+3x110 tph AFBC/CFBC boilers			
11.	Dust from hopper of ESP after WHB(All the 10ESP)	Solid dust	422400	Ash pond
12.	Bottom Ash from AFBC &CFBC Boiler	Solid Dust	310916	To ash pond
13.	Fly Ash from AFBC & CFBC Boilers(Boilers ESP)	Solid Dust	1243662	As per fly ash utilization plan
	BLAST FURNACE SECTION: 1X1008 M3			
14.	Dust from GCP	solids	30240	sold
15.	Slag Waste from SGP	solids	264000	sold
16.	Usable scrap	solids	30000	Recycled

	SINTER PLANT: 1x105 m2			
17.	Sinter Dust	solid	6771.6	To be recycled to the extent possible
	CSP & BAR MILLS			
18	CSP Scales	fines	1028	To be recycled to the extent possible
19	CSP muck and Debri		450	To be recycled to the extent possible
20	Bar mill Scales		5250	To be recycled to the extent possible
21	Bar mill muck and Debri		190	To be recycled to the extent possible

Solid waste shall be in the form of following:

- Fines collected from de-dusting system,
- Scales & scraps
- Waste Refractories and Slag and gangue from furnaces
- Mucks and debris etc.

The total dust generated for disposal is indicated in the above table. This can be for pellet making in in-house. The refractories are of non-toxic nature and do not create any problem of contamination and will be dumped in low-lying area. Apart from this scales and skull are generated as solid waste from facilities .Out of which small quantity can be used in the plant itself, while rest are not reusable and shall be sold. Scales and skulls are of ferrous nature and are recyclable. The steel plant shall also generate muck and debris from different shops and it will be sold to interested parties. There will be generation of scrap, which will be recycled in the plant itself in the Induction furnace.

5.2.4 Impacts on Noise Levels

During normal operations of the plant ambient noise levels will increase significantly only close to the turbines/compressor but this will be confined only within plant boundary. However noise levels will increase greatly during bleeding-off of excess steam. But such incidents are rare and will last only for few minutes at a time only. The noise level within the plant boundary is occupational noise levels and confined within shops. The level will be further minimised when the noise reaches the plant boundary and the nearest residential areas beyond the plant boundary, as elaborate green belt development is envisaged for attenuation of noise and fugitive emission.

All the equipment in the steel plant will be designed/operated in such a way that the noise level shall not exceed 85 to 90 dB (A) as per the requirement of OSHA

Standard (Occupational Safety and Health Association).

However, if during operation, the noise level exceeds the OSHA norms then the protective measures given in Environmental Management Plan will be followed.

In addition to it, green belt development around the shops is to be done to minimise propagation of noise to nearby areas.

5.2.5 Impacts on Ecology

Since the change in ambient air quality due to emissions from the steel plant will be small thus the vegetation outside the plant area will not be damaged. As in the acquired area there are village forest, the aim of BL will be to cut minimum number of trees and most of the trees will be maintained. Utmost care will be taken while finalizing the detailed layout of the plant during modification-cum-expansion so that minimum tree is cut. The loss of trees will be otherwise compensated as a part of the aforestation scheme. However this loss in actual term is not a loss because the aforestation will be carried out in other areas already located at Thelkoli, Khadiapalli and Talibara-II. Plantation in these areas will be done through Forest Department of Orissa Govt. Thus the loss of village forest will be the loss of timber only. Bhusan Limited already requested for equivalent of land so that aforestation can be started at the earliest.

Village forest in Thelkoli village are scattered in different places / patches. Most of the village forest of Thelkoli and Dhubenchapar are adjacent to Railway Line will not be cleared.

As plant will have boundary parallel to Railway Line and State Highway, effort will be made to retain the trees already grown in plant boundary so that same trees can form part of Green belt of steel plant also.

A wide green belt will be planted all along the boundary. Green belt will be also planted on both sides of the plant road and all open lawns.

As equivalent trees will be planted as well as Green belt planted in the plant will improve the ecological balance of the area.

5.3 SOCIO-ECONOMIC IMPACTS

5.3.1 Prediction and Impacts

The survey reveals that the respondents spend major portion of their disposable income on food items. However, there has been a growing tendency among the respondents, of higher expenditure allocation on non-food items although their basket of consumption has only few items other than food.

Income elasticity of demand is calculated by fitting demand functions. Table: 5.6 present the results of the regression analysis conducted for fitting the demand functions. It is observed that all the demand functions give uniformly good fits to the data because R2 in all the cases is found to be quite high. Moreover, as indicated by t-test, the relevant parameter of the demand functions is found to be statistically significant at 1-% level. The income elasticity of demand as measured from the fitted functions are 0.63 and 0.93 for food and non-food items respectively. The inelastic demand for food and non-food items indicates their strong necessity of these items. The magnitude of elasticity in case of non-food items is indicating their tendency to shift the demand in favour of non-food items as their income increases.

TABLE: 5.6 DEMAND FUNCTIONS FOR FOOD AND NON-FOOD ITEMS

Form of the fit	Item	Regression parameters		
		ln a	b	R^2
$D_{ij} = a * Y^{b}_{j} * U$	Food	0.690	0.637	0.990
(Where,			(23.1)*	
D_{ij} = Demand for the ith item by	Non-food	-0.108	0.927	0.934
jth respondent.				
Y_j= Disposable income of the jth respondent			(23.1)*	

Figures in ( ) indicate t - values * Significant at 1% level.

Hence, the impact of the project on the pattern of demand can be reasonably predicted as a shift from food to non-food items i.e., a consumer behaviour that may closely follow the Engel law. This is not a bad indication provided they earn considerable income; otherwise, if the shift is a substitution of necessary food requirements then it is not desirable in true socio-economic sense.

5.3.2 Consumption Behaviour

Table: 5.7 present the source-wise distribution of average family consumption. It is observed that the major portion of consumption (65.8%) goes to meet the need for food items while clothing constitute 14.0% and medical expenses 3.9% of the total consumption.

Table: 5.7 Source-Wise Distribution of Family Consumption

Total	Food	Education	Clothing	Medical	Others	Total
Average family consumption (Rs/yr)	31150	845	6650	1835	6880	47360
Percentage Distribution	65.8	1.8	14.0	3.9	14.5	100.0

To investigate the consumption behaviour of the respondents in detail, Marginal Propensity to Consume (MPC) is calculated by fitting the consumption function. The results of the regression analysis performed for fitting the consumption function are presented in Table 5.8. It is observed that the function gave uniformly good fit to data because R^2 is high and parameters are also found to be statistically significant at 1% level. The MPC worked out on the basis of the fitted consumption function is 0.853.

TABLE: 5.8 FITTED CONSUMPTION FUNCTION

Form of the fit	Regression parameters		
	a	b	R^2
$C_j = a + b Y_j + U_j$ Where, Cj = Consumption of the jth respondent Y = Gross income of the jth respondent	1128.9	0.853 (128.7)*	0.990

Figures in ( ) indicate t-values * Significant at 1% level

Effort is taken here to work out the multiplier effect of investment on the people of the study area. The calculations are done using the following model:

Let us consider that the consumption behavior of the respondents closely follow the following type of consumption function:

$$C = a + bY \quad (1)$$

We know that, in equilibrium

$$Y = C + I \quad (2)$$

Where, Y = Gross income,
C = Consumption and
I = Investment

Putting (1) in (2) one gets,

$$Y = a + bY + I$$
$$\Rightarrow \quad Y = (1 / (1-b) * [a + I] \quad (3)$$

Where, $1 / (1-b)$ is the multiplier .

Assuming that consumption behaviour of the people in the study area closely follow this fitted consumption function, one can easily see that existing size of the multiplier is 6.82. Hence, investment on this project and the consequent generation of additional income will have strong multiplier effect in raising average consumption.

The proposed project is going to have positive income effect and consequently, the multiplier effect is expected to lead to an overall increase in average consumption of the people of the study area. Therefore, one can conclude that the impact of the project on consumption behaviour of the local people is likely to be satisfactory and positive.

5.3.3 Employment and Income effect

Direct employment

During the construction period, the project is going to create substantial employment and income. A large portion of these is likely to trickle down to the local people. Besides this, some persons from the study area may get employment on permanent basis for actual operation of the plant in the form of skilled or semi-skilled, or unskilled loabour. Moreover, for regular mining activities local people may get jobs as wage labourer. Thus, substantial amount of employment and income are expected to be generated for the local people.
Hence, it can be ascertained that the project is going to have significant employment and income effects.

Indirect employment

In the case of indirect employment also, the effect is quite strong and widespread. Besides direct employment, the project is expected to generate substantial indirect employment in other sectors. So far indirect employment is concerned, the effect is very strong and widespread specifically in mining, ancillary industries and transport sectors. In view of the above, it can be justifiably concluded that the present project has tremendous positive employment and income effects.

Overall assessment of the employment and income effects indicates that the project has strong positive direct as well as indirect impact on employment and income generation.

5.3.4 Industrialisation around the steel plants

Steel plants by nature serve as the nuclei for development of ancillary industries in the areas around them. These ancillary units usually have input-output linkages with the steel plants. The demand for spares, assemblies and sub-assemblies by steel plants are generally met through the supply (of these items) from ancillary units located nearly. The ancillary units, in turn, get necessary steel products from the steel plants. In the vicinity of major Indian steel plants e.g. Rourkela Steel Plant, TISCO, Bhilai Steel Plant etc. similar type of units had come up. This brings forth mutual advantages with one acting as complementary to another. The advantages to steel plants as well as ancillary units are listed below :

Advantages to steel plants

i) Assurance of a reliable source of supply of spares and consumables;
ii) Supply on short-delivery schedules enabling maintenance of lower inventory;
iii) Lower freight element in comparison to materials supplied by firm located far away;
iv) Better service facilities

Advantages to ancillary units

i) Availability of ready market;
ii) Freight advantage on steel and other by products produced from the steel plant;
iii) Freight advantage on their own products for sale to the nearby steel plans;
iv) Availability of infrastructure support from the steel plant

Proper utilisation of these mutual advantages is expected to play a catalytic role in the development of the region where the present project is proposed to be implemented.

The ancillary industries that are likely to come up in the vicinity of the steel plant can be grouped into three categories, viz., spares, metal based and chemical based.
These will be complemented by the service units. This indicates that scope is there for industrialisation in the area surrounding the plant. It is important to note that the ancillary units are usually labour-intensive and high-priority industries from social point of view.

The proposed project is expected to foster the process of growth of small-scale industrial economy around the steel plant complemented by the services sector. This is expected to play a major role in the future economic and social development of this area.

5.3.5 Educational status

The existing educational status of members of the sampled households is depicted in Table 5.9. The table revealed that about 44% of total members in the sample are illiterate. This figure includes the non-school going children also. About 15% of the members have education at primary level. Middle school level educated people constitute around 16%. Persons with high school and intermediate level education are observed to be around 13%. The study area has substantial number of highly educated persons (i.e., Graduate, PG and technical).

As reported by the respondents during field survey, their interest towards education has been increasing due to hope of getting employment which may come up especially in the non-agricultural sectors in this region, as an indirect impact of this project. The general awareness towards the importance of education is expected to increase as a result of the new project and hence, it can be said that the project has a strong positive impact on the level of education of the people of the study area.

Table: 5.9 Educational Status of the people of the Study Area

Sl.No	Level of education	No (% in total)
1.	Illiterate*	101 (43.5)
2.	Primary	35 (15.1)
3.	Middle school level	38 (16.4)
4.	High schooling and intermediate	30 (12.9)
5.	Graduation	17 (7.3)
6	P G	5 (2.2)
6	Technical	4 (2.6)
	TOTAL	232 (100.0)

* Includes non-school going children

5.3.6 Peoples' perception

Peoples' perception regarding a project is as important as the impact of the project. So, it is worthwhile to examine what people perceive about the project. To fulfil this objective, an opinion poll was conducted. The results of the poll are analysed and furnished in Table 5.10. It is observed that 80.0% of them have identified the employment opportunity in the plants as the main advantage. This is quite natural because expansion of any steel plant has tremendous employment potential which can fulfil the aspirations of local people of this agriculturally backward area. Opportunities of business development is pointed out by about 23.0% of the respondents. 17.5 % of them have identified higher industrialisation in the area as an advantage. This is of course a very important aspect because with the progress of industrialisation the entire area will be more urbanised.

On disadvantages, about 45% of the respondents have cited pollution as the major factor. Around 45 % of the respondents seems worried about damage to crops due to dust from the plant. The problem related to scarcity of water and displacement of people are pointed out by around 25.0% and 5.0% of the respondents respectively.

TABLE: 5.10 PEOPLES' PERCEPTION

	Perception	Respondents
	ADVANTAGES	
1	Employment	32 (80.0)
2	Business development	9 (22.5)
3	Industrialisation	7 (17.5)
5	Development of the area	5 (12.5)
	DISADVANTAGES	
1	Pollution	18 (45.0)
2	Health damage	3 (7.5)
3	Scarcity of water	10 (25.0)
4	Displacement	2 (5.0)

[Figures in ( ) indicate % in total no. of respondents. Individuals have spelt out more than one advantages / disadvantage]

5.3.7 Conclusion

On the basis of the overall results of the present impact assessment the following conclusions are drawn:

i) The project is not going to cause significant damage to the existing agricultural situation. Instead, it is likely to provide the farmers with supplementary income.

ii) The project is going to have positive impact on pattern of demand, which can be reasonably predicted as a shift from food to non-food items i.e., a consumer behaviour which may closely follow the Engel law. This is not a bad indication provided they earn considerable income; otherwise, if the shift is a substitution of necessary food requirements then it is not desirable in true socio-economic sense.

iii) The project has strong positive impact on average consumption standard of people and also has intensive multiplier effect.

iv) The project has good impact on employment and income generation, both direct as well as indirect.

v) There is a great possibility of industrialisation in the vicinity of the proposed steel plant. This is likely to bring in dramatic changes by transforming this backward area into an industrially developed one.

vi) The project has a strong positive impact on the level of education of the people of the study area.

vii) People of the study area are spontaneous in support of the implementation of the project.

The overall assessment of this impact study leads to the formulation of a self-explanatory model depicted through Figure-1. The model chalks out the major inter-relationships and dependence among certain aspects of the study highlighting impact of the project on the socio economic system. As an impact of installation of the steel plant, a ancillary industrial economy is likely to emerge in the

Surrounding area. The ancillary industrial units are expected to get financial supports from the financial institutions and banks. In this way, an overall development may take place in this area. The process of development will have maximum impact on the lifestyle of the local people. The project and the consequent peripheral industrial economy will generate income to the local and migrating people, which will increase the aggregate demand. This demand will get realised in the market and will finally, lead to the market expansion in the locality of the project. Market expansion supported by expected infrastructural developments e.g. roads, electricity, water supply etc. is expected to foster the economic development in the entire area.

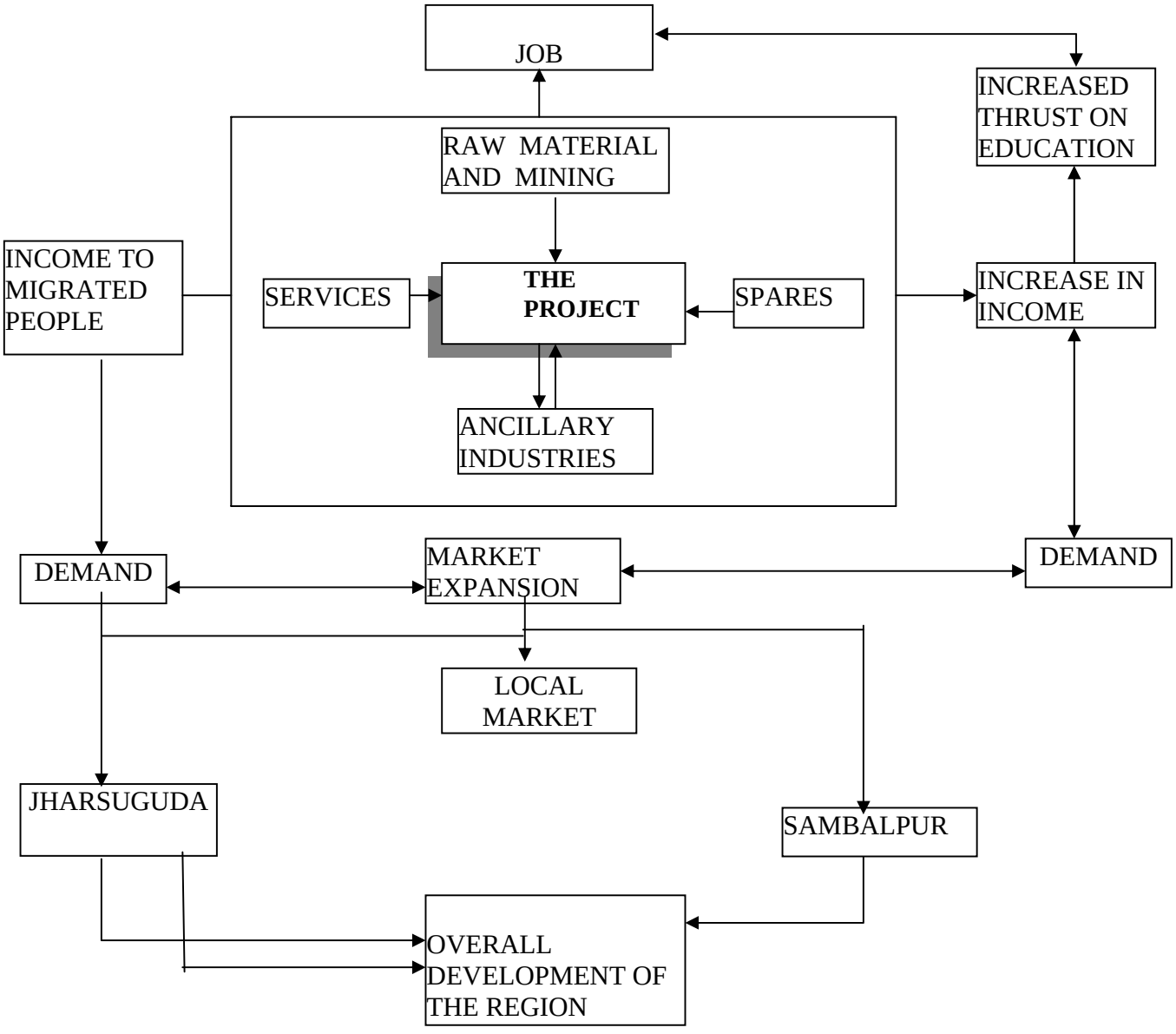


Fig.-1 : SOCIO-ECONMIC IMPACT OF THE PROJECT

6.0 ENVIRONMENTAL MANAGEMENT PLAN

6.1 INTRODUCTION

As discussed in the chapter 5.0 that there will be minimum impact due to modification/construction and operation of the 2.2 Mtpy integrated steel plant at Rengali. The adverse impacts shall be minimized, by adequate provisioning of pollution control measures put into the process and adequate measures undertaken while implementing the plan. A comprehensive Environmental Management Plan (EMP) has been formulated in this context. The EMP has been worked out based on present environmental conditions and environmental impact appraisal. The EMP has been made for formulation, implementation and monitoring of environmental protection measures during and after commissioning of the project taking into consideration the following:

- Mitigation of Adverse impacts by treating significant aspects
- Occupational safety and Health
- Training & environmental awareness facilities

6.2 MITIGATION OF ADVERSE IMPACTS

6.2.1 Air Pollution

In the proposed steel plant the sources of air pollution will be:

- Burning of fuel (coal) in DRI, Pellet plant, Sinter plant, coke ovens and reject and middling of coal washery into AFBC and CFBC boilers of Captive Power Plant
- Air pollution in the form of fumes due to melting of iron scrap and sponge iron in furnaces
- Fugitive dust due to handling of coal and iron ore and other raw materials etc

The major emission due to coal/coke burning in DRI, Pellet plant, Sinter plant, Blast furnace will be Particulate Matter (PM). The hot gases from DRI and coke ovens are taken to waste heat recovery boiler to utilize the waste heat content of gases after which these gases are discharge to atmosphere after cleaning in ESP to reduce the emissions of SPM from the stacks. The ESPs will have an efficiency of 99.8%. This will limit the emission of SPM from each flue to maximum 100 mg/$Nm^{3.}$ as per prevalent norms. ESP will be designed with 80-mg/Nm^3 dust emission.

The low concentration of sulphur in the waste gases will lead to less emissions of $SO_{2.}$ Moreover the stack will be 75 to 120 m high to ensure sufficient dispersion (i.e. dilution) of the pollutants.

The burners will be designed so as to produce less quantities NO_x in AFBC and CFBC boiler of CPP.

To reduce fugitive dust emission due to handling of iron ore, coal, dust extraction and dust suppression systems will be installed at appropriate locations. The Crusher House will be provided dry type dust extraction system with bag filters. Plain water type dust suppression system will be provided at the all around the coal/ raw material stockpiles. The dust extraction systems will consist of suction hoods, fans and bag filter units with all accessories. The dust suppression systems will consist of water sprinkling systems.

The bottom ash generated from AFBC and CFBC Boilers will be taken to the ash pond. To prevent fugitive dust emissions from the exposed bottom ash, a layer of soil will be spread on the ash. In addition a green belt will be developed around the ash pond surroundings to prevent dispersion of fugitive dust to nearby areas.

Following are the list of pollution control equipment provided in the plant.

LIST OF POLLUTION CONTROL EQUIPMENT

	NAME OF THE UNIT	POLLUTION CONTROL SYSTEM
	PELLET PLANT	
1.	Pellet Plant De-dusting	ESP
	DRI KILNS - De-dusting stack of	
2.	DRI KILN-I&II	ESP
3.	DRI KILN-III &IV	ESP
4.	DRI KILN-V&VI	ESP
5.	DRI KILN-VII&VIII	ESP
6.	DRI KILN-IX & X	ESP
	BLAST FURNACE COMPLEX	
7.	BF STOVE STACK	-
8.	BF-DRY GAS CLEANING	BAG HOUSE
9.	BF-STOCK HOUSE	ESP
10.	BF-CAST HOUSE	DRY FOG DUST SUPPRESSION SYSTEM

	SINTER PLANT	
11.	SINTER PLANT-CHARGING STACK	ESP
12.	SINTER PLANT – DISCHARGING STACK	ESP
13.	SINTER PLANT – DEDUSTING STACK	ESP
	SMS Complex (4x15t IF, 4x90t EAF, 4x90t LF)	
14.	IF-FUME EXTRACTION STACK-I	Bag Filter
15.	EAF+LF FUME EXTRACTION STACK-II	ESP
16.	EAF+LF FUME EXTRACTION STACK-III	ESP
	CAPTIVE POWER PLANT	
17.	DRI-WHRB STACK-I	ESP
18.	DRI-WHRB STACK-II	ESP
19.	DRI-WHRB STACK-III	ESP
20.	DRI-WHRB STACK-IV	ESP
21.	DRI-WHRB STACK-V	ESP
22.	DRI-WHRB STACK-VI	ESP
23.	DRI-WHRB STACK-VII	ESP
24.	DRI-WHRB STACK-VIII	ESP
25.	DRI-WHRB STACK-IX	ESP
26.	DRI-WHRB STACK-X	ESP
27.	AFBC(75tph)-I	ESP
28.	AFBC(150tph)-II	ESP
29.	CFBC(350tph)-I	ESP
30.	CFBC(350tph)-II	ESP
31.	CFBC(350tph)- III	ESP
	RAW MATERIAL PREPARATION PLANT	
32.	RMP CRUSHER	Bag Filter
	LIME & DOLO PLANT	
33.	LIME PLANT – KILN1	ESP
35.	LIME PLANT – KILN2	ESP
36.	LIME PLANT – KILN3	ESP
37.	LIME PLANT – KILN4	ESP
38.	DOLO PLANT – KILN5	ESP

	COKE OVEN COMPLEX	
39.	COKE OVEN PLANT STACK1	-
40.	COKE OVEN PLANT STACK2	-
41.	COKE OVEN PLANT STACK3	-
42.	COKE OVEN PLANT STACK4	-
43.	FERRO ALLOY – 1&2	ESP
44.	FERRO ALLOY – 3&4	ESP

7.2.2 Water Pollution Control

Waste Waters are expected to be generated from different facilities of the proposed plant. The expected quantities and their use are given:

1. Boiler Blow Down (net) used for service water : 28.0 m^3/h
2. Underflow from Thickener of Blast Furnace (Intermittent) : 08.0 m^3/h
3. Blow Down (net) from IF & EA F used for other system : 28.0 m^3/h

Underflow/Sludge from Raw Water Clarifier and filter backwash water will be used in coal washery. Cooling tower blow down from condenser cooling system and Auxiliary Cooling system will be reused for service water system.

Acidic/ Alkaline effluents will be generated at the DM Water Plant. These effluents will be properly neutralised and after which it can be reused for plant washing.

In addition the bottom of the ash ponds will be lined with impervious material (e.g. clay) to minimise leaching of ash-pond water to the ground water table. Water will be pumped back to use in bottom ash disposal system.

Water from coal washery will be treated in thickener. Overflow from thickener (clarified water) will be reused in the plant. An oil sewer will collect water from areas where there are possibilities of contamination by oil (transformer yard, fuel & lubricating oil storage areas, and workshop) and the drains from such areas will be routed through an oil-water separator. The clarified water from oil separator will be used to the ash handling system.

All storm water drains from the raw material handling and coal handling areas will be routed through Ash pond.

Suitable drains shall be provided around the stockyard. Water shall be collected into drains around the stockyard, which may contain washed off suspended solids. The water shall be led to the settling tank, which will be provided near to the coal/raw material stockyard. This type effluent from the coal stockyard is anticipated only in monsoon season.

All drains will be taken to a common point and surge pond will be provided. This water will be taken to ash handling system.

The sewage from the plant and canteen waste will be treated in septic tanks and soak pits.

6.2.3 Solid Waste Disposal

The principal solid waste produced by any steel plant is slag, scale and dust.

The dust from dust catcher of DRI unit, pellet dust and dust from SMS section will be recycled to the sinter plant.

Slag from Blast furnace will be granulated and sold to the cement plants for slag cement. SMS slag from IF, EAF and LF will be used in land fill at low-lying areas. Scrap from SMS and other areas will be recycled in the proposed steel plant. Scale and debris from CSP will be recycled to the maximum extent possible in the plant itself.

Fly ash from AFBC and CFBC boiler of captive power plant will be sold to the cement manufacturer and brick manufacturer in the nearby area. The flyash utilization plan is indicated below:

Action Plan For Fly Ash Utilisation

Year of operation	Fly Ash Generation (tpy)	Fly Ash Utilization (tones/year)						% of utilization
		to Cement plant	% of FA	Fly ash brick manufacturer	% FA	Dumping in Ash Pond	% FA	
1	1243662	124366	10	0	0	1119296	90	10
2	1243662	124366	10	124366	10	994930	80	20
3	1243662	186550	15	124366	10	932746	75	25
4	1243662	373099	30	124366	10	746197	60	40
5	1243662	435282	35	186550	15	621831	50	50
6	1243662	559648	45	186550	15	497465	40	60
7	1243662	621831	50	248732	20	373099	30	70
8	1243662	746197	60	248732	20	248732	20	80
9	1243662	808380	65	310915	25	124366	10	90
10	1243662	932746	75	310915	25	0	0	100

Note :

1. The fly ash generation figure is calculated based MCR. The actual fly ash generation could be less due to PLF and type of coal.
2. The actual utilization of fly ash is dependent upon the availability of users which is not entirely in control of Bhushan Limited.

Fly ash can also be used for filling the abandoned mines. BL will be looking after local entrepreneur for establishing fly ash brick manufacturing unit in near by area.

Other solid waste like bottom ash will be dump in a ash pond for which a suitable low-lying area will be acquired for 25 year storage the area requirement for ash pond will alone be 300 acres.

.

6.2.4 Noise Control

In steel plant, crusher area, furnace area, the power generating sets, fans and pumps will be the major sources of noise.

Noise generation levels will be considered while selecting equipment. Equipment should not generate noise more than 85 dB (A) at 1m distance. Wherever required noisy equipment will be placed on vibration isolators or surrounded by baffles covered with noise absorbing material. Personnel working in high noise zones will be issued with personal noise protection equipment (e.g. ear muffs, ear plugs) and their duty hours will be regulated to control noise exposure levels.

6.3 GREEN BELT DEVELOPMENT

Trees are important sinks for air pollutants. Trees absorb noise and by enhancing the green cover, improve the ecology and aesthetics and affect the local micrometeorology. Trees also have major long-term impacts on soil quality and the ground water table. By using suitable plant species, green belts can be developed in strategic zones to provide protection from emitted pollutants and noise.

Plant species suitable for green belts should not only be able to flourish in the area but must also have rapid growth rate, evergreen habit, large crown volume and small / pendulous leaves with smooth surfaces. All these traits are difficult to get in a single species. Therefore a combination of these is sought while selecting trees for green belt.

The green belt should be planted close to the source or to the area to be protected to optimise the attenuation within physical limitations. A total of 300acres area will be developed as green belt or green areas in plant area, Ash pond and nearby areas.

In the steel plant, green belt will be developed in vacant areas, around office buildings, around switchyard and stores, along the side of roads, along the plant's boundaries, in the colony and in the ash pond area. The species, which will be planted, include:

Amaltas (Cassia fistula)
Siris (Albizzia lebbeck)
Neem (Azadirachta indica)
Druping Ashok (Polyalthia longifoila)
Gulmohar (Delonix regia)
Mango (Mangifera indica)
Peepal (Ficus religiosa)
Arjun (Terminalia arjuna)
Jackfruit (Artocarpus heterophylla)
Palash (Butea spp)
Bougainvillea spp.
Ber (Zizyphus spp.)

It is to be noted that only indigenous species will be planted. The species will be selected in consultation with Soil Conservation Department. Mixed plantations will be done keeping optimum spacing between the saplings.

Kitchen waste from plant canteen can be used as manure either after composting or by directly burying the manure at the base of the plants.

6.4 HOUSE KEEPING

Proper house keeping is an essential part of sound environmental management.

It will be rigorously seen that there is no accumulation of wastes, especially combustible wastes (e.g. Oily rags, oil sludge, wood from packing boxes, etc.) inside the plant area. In summer dry grasses & vegetation growing inside the plant area will be cut and removed. All fire fighting equipment and warning devices will be kept in perfect working conditions.

It will be seen that all personnel are aware of the implications of environmental pollution and simple practices to avoid pollution.

6.5 OCCUPATIONAL SAFETY AND HEALTH

Maintenance of occupational safety and health is very closely related to productivity, good employer employee relationships and good relationships among all on board personnel.

The main factors of occupational health in steel plant are dust, heat and noise. Following measures will be undertaken in the installation for occupational safety and health of workers.

- Inspection and maintenance of pollution control systems will be undertaken only after checking that the equipment has been properly shut down or with permission of authorised officer.
- Immediate removal of waste accumulated in working areas.
- Insulation of hot surfaces.
- All safety measures will be strictly implemented. Fire fighting equipment will be tested regularly to ensure their full serviceability. Contingency plans drawn up to deal with accidents will be rehearsed by all personnel.
- Training of employees for use of safety appliances and first aid.
- Regular medical check up of personnel will be carried out.

6.6 POLLUTION MONITORING

The plant's Environmental Management Division may be equipped to monitor meteorology, air quality, noise, water quality, emissions from stacks and solid wastes. External laboratories may be contracted to carry out the required monitoring work for third parties auditing. The frequency of sampling will be as per Central or Orissa State Pollution Control Board guidelines. On line monitoring facilities will be provided for major stack. An Environment Management Division will be constituted to operate and maintain all pollution control systems, organise necessary environmental monitoring and maintain records & details of monitoring.

6.7 TRAINING FACILITIES

To achieve the objective of pollution control it is essential not only to provide latest pollution control and monitoring systems but also provide trained manpower to operate and maintain such systems. So the Environmental Management Division's personnel will be provided with additional specialized training to operate and maintain the equipment to

be deployed on the installation. All personnel will be trained to deal with pollution emergencies also.

7.0 DISASTER MANAGEMENT PLAN:

An Emergency Plan has been formulated to take care of any disaster in the existing integrated steel plant and surrounding areas and is detailed as under:

In order to prevent occurrence of any disaster, the plant will be provided with various safety and disaster control facilities. **Normally, in the steel plant, no major disaster affecting nearby population areas are foreseen.** However, accidents inside the plant affecting workplace in vicinity cannot be ruled out. Work-force inside the plant shall be exposed to various high pressure system pipelines and vessels, acids and chemicals, fuel such as coal and furnace oil and other process equipment which, if not properly operated and maintained, can cause serious accidents affecting life and property in the vicinity of accident site. In addition to these, numerous material handling systems, heavy road transport, high-tension electric lines, level crossings, overhead cranes and various other handling and transport systems always have a chances of accidents.

Definition of Disaster

A situation will be called a `Disaster' if it entails any one or more of the following factors:

i) Risks of loss of human lives - ten or more in one single situation.

ii) Loss of property as a consequence of the incident is over Rs.1 crore and/or bears a potential to the above.

iii) A situation which goes beyond the control of the available resource of the plant.

iv) A situation apparently may not have much loss but its long-term severity can affect loss of life, production and property.

The types of possible disaster are given below:

Type of disasters

i) Disaster due to emergencies on account of:

- Fire
- Explosion
- Oil spillage
- Spillage of toxic chemicals
- Electrocution

ii) Disaster due to natural calamity on account of:

- Flood
- Earth quake / cyclone / Storm / Cloud burst / lightning

iii) Disaster due to external factors on account of:

- Food poisoning / water poisoning
- Sabotage

Objectives

Objectives of disaster control/management plan for existing Steel Plant are:

i) To identify type of major disasters which may occur in the plant.

ii) To collect data on type of disasters which has happened already in other steel plants.

iii) An action plan to handle disaster.

IDENTIFICATION OF HAZARDOUS PROCESS/AREA

1. Furnaces area - Explosion
2. Fuel Oil tanks - fire & spillage
3. Turbine Hall – Explosion
4. Boiler Explosion

Electrical premises

1. Electrical Rooms - Fire & Electrocution
2. Transformer area - Fire & Electrocution
3. Cable Tunnel - Fire & Electrocution

Other premises

Storage facilities for coal and fuel oil -Fire/spillage

LEVEL OF ACCIDENT

If there is any disaster in any part of the plant /work place due to any reason the area which may be affected can be classified in the following four classes.

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

There is only level I and II class of accidents can be considered for the steel plant.

Level I

Under this level, disasters may happen due to fire, explosion, oil spillage and spontaneous ignition of inflammable materials.

This level has probability of occurrence affecting persons inside the plant. The various shops, which have been mentioned as potential hazard areas, will be affected during this level of accident.

Level II

In case of sabotage/complete failure of all automatic control/warning systems for example in fuel oil storage area the oil kept in tanks and covered by tank bund may leak out. However, the probability of this is very low due to adequate security and training of persons of the plant operating such system.

DISASTER PREVENTIVE MEASURES

If any disaster takes place it is not easy to control if contingency plans are not available. For effective control of disaster adequate manpower, technical know-how, alertness and internal help are necessary. It always betters to take preventive measures to avoid any disaster. In proposed plant following prevention measures will be taken to prevent disaster.

Plant layout:

i) Design, manufacture and construction of all plant and machinery's and buildings will be as per national and international codes as applicable in specific cases and laid down by statutory authorities.

ii) Provision of adequate access ways for the movement of equipment and personnel are kept.

iii) Minimum two numbers of gates for escape during disaster shall be provided.

iv) Siting of fuel oil storage shall be in protected fenced area inside tank bend.

v) Water spraying in coal storage area.

Fire Fighting

The existing plant is having a well-equipped fire-fighting group for the existing steel plant with 5 Officers, 25 Workers trained in this field. Following fire-fighting equipment shall be in place when the plant fully commissioned:

- Fire Tender 2 No.
- Jeep 4 Nos
- Portable Extinguishers Lot
- Foam generator Lot
- Static tanks Lot

LIST OF FIRE EXTINGUISHERS REQUIRED AT DIFFERENT LOCATIONS

Name of site	Type
Kiln Area	CO_2 Foam type Dry Chemical type
IF & EAF Area	CO_2 Foam type Dry Chemical type
Caster Area	CO_2 Foam type Dry Chemical type
Turbo generator Area	CO_2 Foam type Dry Chemical type
Cable galleries	CO_2 Foam type Dry Chemical type
High voltage pannel	CO_2 Foam type Dry Chemical type
Various control rooms	CO_2 Foam type Dry Chemical type

Various MCC rooms	CO_2 Foam type Dry Chemical type
Various pump houses	CO_2 Foam type Dry Chemical type
Fuel Tank Area	CO_2 Foam type Dry Chemical type Sand Baskets
Guest Houses & offices	Dry Chemical powder type
Godowns	Foam type
Crusher House	CO_2 Foam type Dry Chemical type

However before installing fire station & safety equipment, an experienced fire officer would be appointed who carry out an in-depth study and shall decide about the selection of equipment.

Safety

The existing steel plant when fully commissioned will have a safety department manned by experienced engineers and staff whose main job will be to bring about safety consciousness amongst the work force in the plant. The safety department will conduct regular safety awareness courses by organizing seminars and training of the personnel among the various working levels.

Safety awareness will also be created by the various posters highlighting the safe working practices in different shops, hazards in working area, public places and roads etc. Safety engineers of the plant will conduct regular checks and mock exercises on the safe working of their department and report will be given to departmental head for corrective measures to improve the safety conditions.

Training

A department of training will also be set up to train officers. They will arrange training on safety accident prevention, first aid, hazard control, house keeping and environmental management. Special emphasis with mock drills in disaster control will also be planned.

Communication

During the proposed modification-cum-expansion of steel plant there will be an up-to-date communication facilities with telecommunication and wireless, walkie-talkies, telecommunication and loud speakers in each shop, office and gate to warm workers in case of an accident.

Organization to combat contingency

The contingency plan is prepared from the experiences of accidents that have occurred in various other Steel plants. The contingency plan being a dynamic plan will need periodical reviews and modifications with new experiences. Even with all precautionary measures taken to avoid disaster, disaster may occur. To tackle situations during and after disaster, a well-defined contingency plan is a must. A Disaster Control Room (DCR) will be set up having links with all plant control rooms. An officer will be manning the DCR. On getting information about any accident, the officer will verify from the affected plant control room and inform the Disaster Controller (DC) and/or other co-ordinators immediately.

The responsible officers of Disaster Control Group will assemble in the DCR and formulate control procedures as per the contingency plans. The functions of the various officers of the Disaster Control Group will be as follows:

Functions of Disaster controller

- To declare "Disaster Emergency" after consulting the Sr. officer available and inform Fire Station Control Room to sound the sirens accordingly and arrange to convey the message in public address system

- To report to DCR immediately.

- To receive messages from the communication center.

- To take decisions in consultation with the Commanding Officers of different services and convey them to the disaster point.

- To be responsible for planning and provisions of assistance from township and from local authorities.

- To keep higher authorities informed about the situation.

- The decision of the Disaster Controller on any matter to meet the objective of disaster control plan will be final.

Functions of Officer In-charge:

Disaster Controller will nominate an officer whose functions will be as follows:

- To be responsible for the operation of DCR and for the dispatch of messages.

- To decide on the priority of dispatch of messages.

- To keep liaison with all activities and give up to date and accurate appreciation of the situation.

- To be responsible for the efficient organization of the Disaster Control Room.

Functions of Commanding Officers of various services:

The Commanding Officers of various services are designated Coordinator (services), Coordinator (Operation) and Coordinator (external services). The following are their functions:

- To report to the Control Post immediately on hearing "Disaster Siren".

- To keep Disaster Controller posted with the up-to-date information regarding manpower and material available concerning their respective services.

- To advise Disaster Controller on all matters arising out of disaster.

- To assist Disaster Controller for provision of material and man power concerning his service.

- To convey message to his service teams through communication centre after consulting Disaster Controller.

- To consult between themselves on matters related to more than one service and to decide on the action to be taken.

Casualty services

The Commanding Officer of Casualty Services will be medical officer.

Functions:

- First aid service by first aid parties on the spot.

- Ambulance service for transport of casualties from the spot to township hospital and from township hospital to outside, if required.

Procedure for treatment

On getting a signal from the Disaster Control Room or information on telephone or hearing siren, the Sub-Commanding Officer of the Casualty service will report to hospital and doctor on call duty and first aid personnel will report to Disaster Control Room. The Ambulance with the driver will report to Disaster Control Room. First aid parties will render first aid to casualties at the place of occurrence and those requiring further treatment would be transported to the nearest hospital by ambulance.

In case of extra help from outside or within CMO would contact Co-ordinator (Planning) for help in areas such as:

- Extra medical helps from neighboring hospital or main hospital.
- Evacuating the casualties.
- Essential assistance in first aid.

First Aid

It is necessary to give first aid to the persons injured in disaster. There will be two first aid posts to meet the workload, one post will be near the Disaster Control Room and the other post will be in the township hospital. At each post 3 first aid parties shall be kept in rotating shifts of 8 hours.

Equipment

Each member of the first aid will be provided with the following personnel equipment.

Helmet	-	1 no.
Water bottle	-	1 no.
Torch	-	1 no.
First aid box	-	1 no.

Rescue and repair services

The responsibility of effective working of Rescue and Repair Services are with Co-ordinator (Services) and Sub-Commanding Officers as follows:

Rescue services

- To extricate persons from the debris of collapsed building and save human lives.
- To hand over the dead bodies and injured persons to first aid parties.
- To take immediate steps as may be necessary for the temporary support or demolition of buildings and structures, the collapse of which is likely to endanger life or obstruct traffic.
- To cut of supplies of water, steam & gas, electricity to damaged buildings / structures.

Each rescue party will be provided with the following equipment:

1. Gas mask respirator
2. Fire proximity suits
3. Resuscitators
4. Petromax lamp, Torches
5. Axes/hand saw
6. Fire entry suits
7. Fire blankets
8. Ropes
9. Ladders
10. Rubber glove (Tested up to 25,000 voltage)
11. Blankets
12. Rubber shoes or Industrial shoes.

Repair services

- To take up quick repairs of the damaged machinery.
- To take up repair of damaged building roads and culverts.

- To maintain essential public utility services viz. water, electricity and sewage system.

Fire fighting services

Fire officer will be the Commanding Officer of Fire Fighting Services. Additional strength for fire fighting which is beyond the control of fire station will come from security and maintenance personnel and if required form outside fire stations.

Functions

- To co-ordinate fire fighting activities
- To enforce all regulations for prevention of fire.
- To request neighboring industries and District Authority for rendering services of their fire fighting crew under mutual aid schemes, if necessary.

Traffic control

The free movement of the fire vehicles and ambulance at the scene of fire/emergency is very important and therefore, the security personnel on duty must ensure that all the roads at the scene of fire/emergency are kept clear and free from obstruction. Persons arriving by motor transport at the scene of fire/emergency must not park their vehicles within 100 meters of fire, near fire hydrants, at road junction and at access roads. The ignition key should be left in the vehicles.

Training services

Functions:

- To arrange training of volunteers/employees nominated by Commanding Officers of various services.
- To arrange refresher training courses once in a year.
- To arrange mock drills, twice in a year.
- To make a list of employees trained in various specialized disasters so that they can be easily contacted to handle a particular type of disaster. The person concerned will immediately report to Disaster Control Room.

Faculty

Faculty will be consisted of commanding officers/sub-commanding officers and/or their nominated officers.

Depot and Transport services

Functions:

- Dispatch of vehicle to the place of incident as per orders from the DCR.
- To get back the vehicle as soon as the work is completed.
- General administration of the depot including repair and maintenance of vehicle.
- Storage maintenance and inspection of equipment.
- Maintenance of discipline and moral.
- Ensuring adherence to the depot duties.
- Welfare of personnel in the depot.

Vehicle repair

The Sub-Commanding Officer and his staff will promptly attend to all major repairs of the essential vehicles under his supervision.

For carrying out minor repairs, vehicle repair party will be detained at the depot. The party will be provided with a vehicle for quick movement.

Commanding Officer will evolve a system such that he is apprised of the conditions of the vehicles scheduled at 1500 hrs. daily during peace time. This is required so that the vehicles are available at a short notice.

Fuel

The Commanding Officer will contact Co-ordinator external services for arrangement of fuel for vehicles during fuel crisis and stop supplying fuel to vehicles other than those, which are in use for disaster control.

Supply services

A senior person will head supply service from stores department.

Functions:

- To be responsible for planning, organizing and procuring necessary equipment/materials.
- To be responsible for storage of equipment/materials at accessible location and for quick distribution on demand.
- To obtain the requirement of equipment / materials from Commanding Officers of various services for their respective services.

- To co-ordinate with Commanding Officer of Depot and Transport Services for transports required for distribution of equipment / materials in consultation with DCR.

Salvage service

The salvage services will be under the charge of Committee. This committee will be formed taking one person from stores and one from production.

Functions:

- To salvage properties from debris
- To take care of such properties
- To return the properties to respective shop in-charges.
- To co-ordinate patrolling with the help of, police and security personnel for the safeguard of valuable properties till the same are removed to a safe place.

Welfare services

Management of proposed Steel plant will nominate one person from administration side and he will be the Commanding Officer of welfare services.

Vacant buildings, schools complex and club will be used for housing those rendered homeless. Emergency camps will be set up only in exceptional cases on playing ground. For this purpose necessary material will be brought from nearby market.

Functions:

- To provide shelters to affected persons.
- To arrange enough stock of essential commodities through co-operative society.
- To arrange cooking of food in canteen supply to place where people are given shelters in township. For plant people, food will be supplied within battery area by mobile vans.
- If canteen is affected by disaster, the food will be cooked at school complex and will be served as indicated above.
- To arrange clothing and medicines to affected persons. Doctor(s) will assist for giving medicines.

To arrange drinking water, if supply is disrupted, with the help of District Authorities.

Mobile canteen

One mobile canteen in a motor van/truck will be made available in the plant area. The mobile van will be stationed in Depot.

Co-operative Society

There will be one cooperative society in township, which will be dealing in essential commodities. The District authorities during any emergency will further supplement the resources of this society.

Security services

Chief Security officer will be Commanding Officer, Security Services.

Functions:

- Security services will be primarily responsible for the security of the plant.
- Commandant in consultation with co-ordinator (external service) will keep a close liaison with local police and district authorities.
- To control the vehicular traffic inside the plant.
- To help local police in patrolling the area of plant and outside the battery area, necessary.
- To assist Fire fighting services in fighting fires.
- To assist in transporting injured persons.
- To assist local police in patrolling in township and work out adequate arrangement for protection of property.

One jeep and one motor cycle will always be kept as reserve to cope up with emergency demand and for immediate mobility of security personnel.

Crash shut down of Units

Section head will be the Commanding Officer for Crash Shut down of the units, which are affected and may further aggravate disaster.

Function:

To shut down the unit(s) affected and which may cause further disaster.

Public Relation Service

The Officer-in-Charge of Public Relation Services will look after this job.

Functions

- To consult DC before communication, if required with outside agencies.
- PRO will be the official spokesman for the steel plant with outside agencies.
- PRO will arrange for photography and filming of the whole disaster as photography and filming of such incidents are of immense value for the purpose of investigation, training and education.

.

Contingency Plan

The following contingency plan shall be followed:

Fire and Explosion

- Plant fire fighting is activated.

- Disaster Controller along with Commanding Officers takes overall charge of the situation.

- DC will assess the situation for possible after effects of the fire in the plant and the surrounding areas likely to get affected.

- DC will inform local authorities to send fire tenders, if necessary.

- DC will inform the people of likely affected areas through communication system to leave the area and move to other areas earmarked, if necessary.

- DC will inform co-ordinator, external services to inform the District authorities of the disaster and request them for help.

- To evacuate people from the affected areas outside the plant.

- To control the traffic and law and order.

- To arrange medical aid for the affected people.

- DC will arrange inspection of affected areas to get first hand knowledge of damages occurred.

Alarm System

On receiving the message of `Disaster' from Disaster Controller, fire station control room attendant will sound SIREN WAILING TYPE FOR 5 MINUTES. DC will arrange to broadcast disaster message through Public Address System.

On receiving the message of "Emergency Over" from DC the fire station control room attendant will give All Clear Signal by Sounding Siren straight for two minutes. The features of the alarm system will be explained to one and all to avoid panic or misunderstanding during disaster.

Actions to be taken on hearing the warning signal

On receiving the message of "Disaster" the following actions will be taken.

- All the co-ordinators will report to the Disaster Control Room even if not contacted by the Cell :

- The Commanding Officers and Sub-Commanding Officers will report to the place of accident.

- The Process Unit persons will remain ready in their respective units for crash shut down on the instruction from the co-ordinator.

- The persons from other sections will report to their respective officer.

- The concerned section (Civil, Engineering Services, Mechanical, Project etc.) will take immediate action to remove contractors personnel outside the plant gate.

- The residents of the township will remain alert.

Disaster due to natural calamity and external factors

Most of the measures & processes shall be same as given under in-house disaster except that the disaster controller will contact the state / district authorities for necessary instructions to co-ordinate with them.

Chemicals/Oil spillage

The possibility of large chemical/oil spillage in the final effluent discharged in reservoir is remote. However, DC will arrange to inform the following:

- State Pollution Control Board

- District authorities and request them to arrange patrolling of the area along with security personnel.

- District authorities, to warn people in the affected area against fire/hazard that may occur and against the adverse effect of using water for any purpose.

- Disaster Controller along with Commanding Officers takes overall charge of the situation.

- DC will inform the people of likely affected areas through communication system to leave the area and move to other safe areas earmarked.

- DC will inform co-ordinator, external services to inform the District authorities of the disaster and request them for help.

- To evacuate people from the affected areas outside the plant. -To control the traffic and law and order.

- To arrange medical aid for the affected people.

- DC will arrange inspection of affected areas to get first hand knowledge of damages occurred.

Cloud burst/lightning

Cloud burst/lightning may lead to a situation, which could be minor to major emergency. In such emergency, actions indicated under fire and explosion will be initiated.

Food poisoning

In case of food poisoning in plant canteen the following actions will be taken:

- DC will inform the medical officer of steel plant health center for immediate first aid.

- DC will contact District Authorities and seek their help, if necessary.

- Security Personnel and employees will help in evacuating the affected people to various hospitals.

8.0 EMP IMPLEMENTATION AND MONITORING

Various measures have been suggested in the EMP for mitigation of impacts. These have to be implemented according to the suggestions and monitored regularly to prevent any lapse.

A large part of the sampling and measurement activity will be concerned with long term monitoring aimed at providing an early warning of any undesirable changes or trends in the natural environment that could be associated with the steel plant facilities.

8.1 METEOROLOGY

A meteorological station will be set up at a suitable location to monitor wind speed & direction, air temperature and humidity on a continuous basis. This data will be used to identify the zones where air pollution levels due to release of pollutants will be more than the permissible limits levels.

8.2 EMISSIONS AND AIR QUALITY

Work zone air quality shall be monitored once a month, to assess the levels of particulate matter inside the steel plant complex. To the extent possible, on line monitoring for PM, SO_2, NO_x , CO, and CO_2 for each stack will be provided. 4 no permanent AAQ station will be stationed around the steel plant and monitoring will be conducted twice a week. Emissions from other de-dusting stack will also be monitored once a month. However the frequency of monitoring may be increased if the Orissa State Pollution Control Board desires so.

8.3 DRAINAGE SYSTEM

The effectiveness of the drainage system depends on proper cleaning of all drainage pipes/channels. Regular checking will be done to see that none of the drains are clogged due to accumulation of sludge/sediments etc. The clogged drains will be cleaned as soon as possible, preferably the same day. The catch-pits linked to the storm water drainage system from the coal handling areas will be regularly checked and cleaned to ensure their effectiveness. This checking and cleaning will be rigorous during the monsoon season, especially if rains are forecast.

8.4 WATER QUALITY

Raw water will be monitored daily. Drinking water being supplied inside the plant and the township will be monitored at least once a week. Although there are no effluent discharge outside the plant boundary, however bleed off from system either may be utilized for fire fighting or discharge after proper treatment.

8.5 OCCUPATIONAL HEALTH

Routine medical examination of personnel shall be carried out as a systematic programme.

8.6 LABORATORY FACILITIES

The plant's chemical laboratory may be equipped and manned to carry out the necessary environmental monitoring work. Alternately other reputed laboratories may be contracted for carrying out the necessary environmental monitoring. In case the plant decides to have its own environmental monitoring facilities, the following additional equipment will have to be installed in its chemical laboratory:

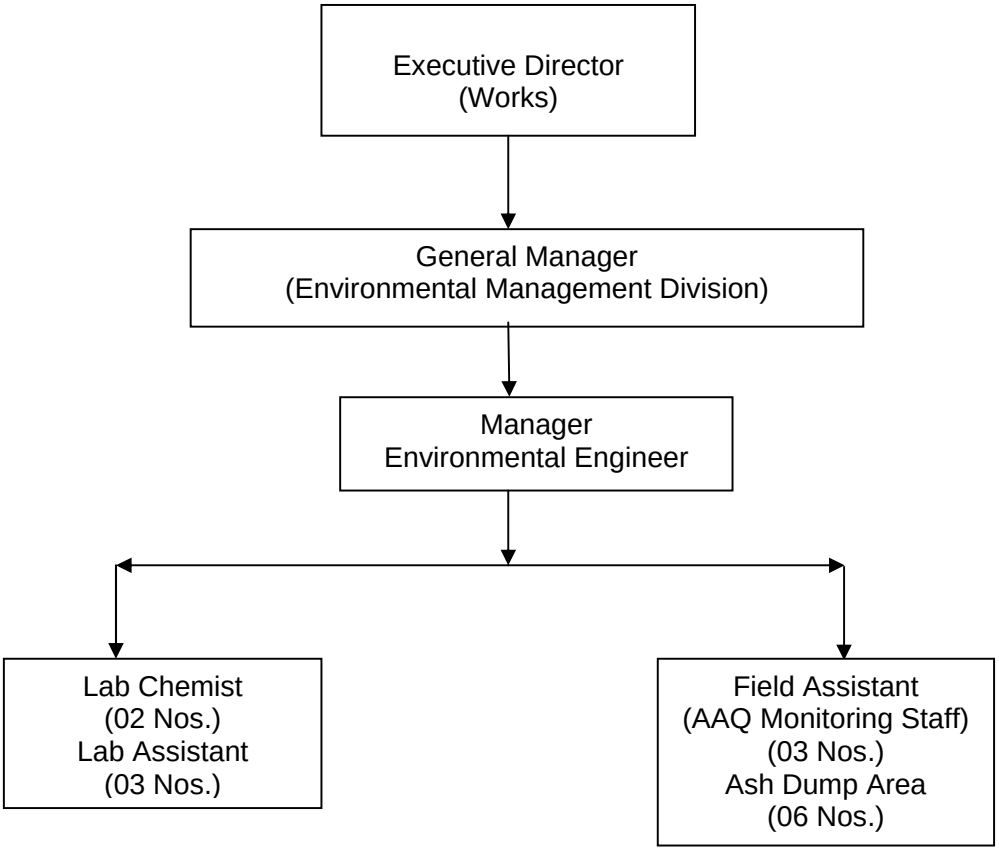
Sl. No.	Instrument / Equipment	Nos.
1	Respirable Dust Samplers	4
2	Stack Monitoring Kit for stack monitoring	1
3	Orsat Apparatus	1
4	Noise Monitor	1
5	Spectrophotometer	1
6	BOD Incubator	1
7	Glass-ware for Microbiological Test of Water	Lot
8	Electronic balance	1
9	Chemicals	1 lot

8.7 UPDATING OF EMP

The periodicity of monitoring will be governed by the directives from statutory authorities and prevailing regulations. The action plan of EMP will be updated every year with respect to the results achieved and to plan activities for the next year.

9.0 ORGANISATION AND MANPOWER

Bhushan Limited (BL) is having Environmental Management Division at plant level as well as at Corporate level for interaction with statutory bodies and managing environmental issues at plant level. Executive Director (works) of Plant operation is the head of the plant level pollution control cell with Environmental Engineer, Chemist, etc. The plant level EMD will be provided with well-equipped laboratory for carrying out analysis of the samples of the water, air etc. Plant EMD will carry out the monitoring of the stack emission, noise level, analysis of the water etc. and keep the regional / local statutory body informed about the status of pollution control with intimation to the Corporate office EMD. Bhushan Limited will arrange professional training for personnel of EMD at plant level. The proper training shall be provided in area of monitoring and continuous analysis of the pollutants, legal requirement and environmental management system.



10.0 COST CONSIDERATIONS

The total project cost including expansion has been estimated to be Rs. 55000.00 Million (Rupees Fifty-five thousands million). The capital cost of environmental control measures is Rs. **4400.00** Million, which includes:

Cost Of Air Pollution Control Systems	:	Rs. 2200.00 million
Cost of Water Pollution Control	:	Rs. 0660.00 million
Cost of Solid Waste Management System (Including cost of dust & ash pond/dump storage with bunds)	:	Rs. 1520.00 million
Green belt development	:	Rs. 0020.00 million

Since Bhushan Limited will be getting necessary environmental monitoring carried out by an external agency, capital cost towards environmental monitoring facilities and occupational health of personnel is not required.

The annual cost of environmental control for the proposed units has been estimated to be Rs. **550.00** Million. The annual environmental control costs include:

Cost of Air Pollution Control	:	Rs. 225.00 million
Cost of Water Pollution Control	:	Rs. 055.00 million
Cost of Solid Waste Management	:	Rs. 165.00 million
Cost of Green Belt Maintenance	:	Rs. 025.00 million
Cost of Environmental Monitoring	:	Rs. 080.00 million
TOTAL	**:**	**Rs. 550.00 million**

LIST OF ANNEXURE