02 EXECUTIVE SUMMARY

02.01 Introduction

NMDC Ltd., a Govt. of India Enterprise, is involved in the exploration of wide range of minerals including iron ore, copper, rock phosphate, limestone, dolomite, gypsum, bentonite, magnesite, diamond, tin, tungsten, graphite, beach sands, etc.

India's single largest iron ore producer and exporter, presently producing about 30 Mt/yr of iron ore from three (3) fully mechanised mines viz., Bailadila deposit - 14/11C, Bailadila Deposit-5, 10/11A (Chhattisgarh) and Donimalai Iron Ore Mines (Karnataka).

NMDC Ltd. is consistent profit making and dividend paying company to the Government of India. The performance of the company for the year 2007-08 indicates that it has produced iron ore including lump and fines was of the order of about 30.0 Mt. It has made profit of Rs 32,509 million in the financial year 2007-08 and corresponding net profit in the previous years was 23,202 million. So far, they have accumulated huge cash surplus / reserve.

The Bailadila iron ore range has the world's best grade of hard lumpy ore having more than 66% iron content, free from sulphur and other deleterious material and the best physical properties needed for steelmaking.

The demand for steel will continue to grow in the years to come and this in turn would call for increased demand for iron ore. NMDC is gearing itself to meet the expected increase in demand by opening up new mines – Deposit-11B in Bailadila sector and Kumaraswamy in Donimalai sector and this would add in allowing the production capability to reach around 33 Mt/yr.

NMDC Ltd., being a consistently profit earning company from the main business of iron ore mining to cater to domestic iron and steel industries as well as export of the same, have decided to further consolidate their profit by value addition from virgin iron ore to steel product. Considering the potential of steel requirement in the country as already indicated earlier as well as export potential of the finished products in open economy, M/s NMDC Ltd. have planned to set up an integrated steel plant of about 3.0 Mt/yr at Nagarnar, in the district of Bastar in Chhattisgarh where they have already got land under their possession.

02.02 Market analysis and product-mix

Iron and steel is crucial to the development of any modern economy and is considered to be the backbone of the human civilization. The level of per capita consumption of steel is treated as one of the important indicators of socio-economic development and living standard of the people in an economy. All major industrial economies are characterized by the existence of a strong steel industry and the growth of many of these economies has been largely shaped by the strength of their steel industries in their various stages of development.

In view of faster growth in economy and growing steel market, M/s NMDC Ltd. envisages to install 3.0 Mt/yr integrated steel plant at Nagranar, Chhattisgarh, to produce pig iron and hot rolled products for sale in the open market. In order to assess demand and availability of the same, it was thought prudent to examine the present market scenario and its future prospects as deliberated in the following paragraphs.

Considering that the proposed plant will be commissioned in 48 months from now with 12 months pre project activities and 36 months for plant to be commissioned from the date of placement of order of major technological packages, the demand/ availability scenario of various steel product for terminal year 2011-12 & 2016-17 has been assessed.

Demand analysis of pig iron

Pig iron is the basic raw material for most of the engineering products and construction industry. Pig iron is categorized into two major types e.g. basic grade iron used for steel making and foundry grade iron used for making iron castings. Pig iron is also used as a scrap substitute in the charge-mix of electric arc furnaces (EAFs). The integrated steel plants of the country use basic grade pig iron in liquid form for steel making.
In view of the export opportunity in Asian and other countries as well as past export performance, an export provision of 15% of projected domestic demand is assumed as export demand. The projected domestic demand and demand with exports provision thus, estimated are furnished in table 02.01.

Table-02.01

Projected demand for pig iron
(Domestic as well as with export)

(In '000 tonnes)

Year	Demand	
	Domestic	With export
2011-12	6900	7940
2016-17	10140	11660

Availability

The capacity of the existing secondary producers of pig iron is furnished in table 02.02.

Table-02.02

List of secondary producers with their capacities

Sl. No.	Producers	Capacity, t/yr
1	Southern Iron & Steel Co. Ltd., Tamilnadu	
2	Kirloskar Ferrous Industries Ltd., Karnataka	245,000
3	Kalyani Ferrous India Ltd., Karnataka	240,000
4	Satvahana Ispat Ltd.	240,000
5	Unimetal Ispat Ltd., Karnataka	210,000
6	Midwest Iron & Steel Ltd., AP	150,000
7	Lanco Industries Ltd., AP	175,000
8	Sesa Industries Ltd., Goa	150,000
9	Usha Ispat Limited, Reddi, Maharashtra	250,000
10	Tata Metaliks Limited, West Bengal	650,000
11	Electro Steel Castings Ltd., West Bengal	235,000
12	Kajaria Iron Castings Limited, West Bengal	120,000
13	Kalinga Iron Works, Orissa	140,000
14	Jaysawal Nicco Ltd., Chhattisgarh	378,000
15	Apparent, Goa	175,000
16	Kudremukh Iron and Steel Co.(KISCO, Karnataka)	227,000
17	Neelachal Ispat Nigam Ltd. (NINL), Orissa	1,099,000
18	Others	1,500,000
	Total	**6,184,000**

Presently, total installed capacity of pig iron from secondary sector is assessed as about 6.2 Mt. Out of the above, Neelachal Ispat Nigam Ltd. (NINL) whose pig iron production capacity is around 1.0 Mt is going ahead with forward integration by installing steel making & rolling facilities by 2011-12. Under the circumstances, the availability of pig iron from NINL will be reduced by 1.0 Mt/yr by 2011-12 & onwards. Capacity utilization of secondary producers of pig iron was about 66% during 2006-07.

For projecting the future availability of pig iron, capacity utilization of 75% and 80% have been assumed for the terminal years 2011-12 and 2016-17 respectively. Based on this assumption, availability of pig iron from secondary sector, is worked out as furnished in table 02.03. Further, the availability of pig iron from integrated steel plant of SAIL and RINL are arrived at from various documents/ publications related to their expansion programmes, and are also furnished in table 02.03.

Table-02.03

Projected availability of pig iron

(In '000 tonnes)

Year	Availability		
	Primary producers	Secondary producers	Total
2011-12	1770	4640	6410
2016-17	1770	4950	6720

Resultant gaps/surpluses

Based on the demand and availability as indicated in preceding paragraphs, the gaps/surpluses for pig iron has been worked out as furnished in table 02.04.

Table-02.04

Demand, availability and gaps/surpluses for pig iron

(In '000 tonnes)

Year	Demand		Availability	Gaps/surpluses	
	Domestic	With exports		Without export	With Export
2011-12	6900	7940	6410	(-)490	(-)1530
2016-17	10140	11660	6720	(-)3420	(-)4940

Demand analysis for HR plates and HR coils/ sheets/ skelps

Apparent consumption of HR plates during 1980-81 was about 0.8 million tonnes which has increased to about 4.2 million tonnes by 2006-07. Imports of HR plates has been in the range of 75,000 tonnes to 1,000,000 tonnes during the past ten years whereas exports of HR plates during the same period has been ranging between 107,000 tonnes to 377,000 tonnes.

Apparent consumption of HR coils/sheets/skelps increased from about 1.1 Mt to 13 Mt. Though, there was gradual increase in apparent consumption during the period 1980-81 to 1993-94, it has increased steadily during 1993-94 to 2006-07.

Imports of HR coils/sheets are reported in the range of 361,000 tonnes to 1,559,000 tonnes during the past ten years whereas exports have increased from 97,000 tonnes in 1994-95 to 1,570,000 tonnes by 2006-07.

Demand with export thus, worked out is depicted in table 02.05.

Table-02.05

Projected demand for HR plates, HR coils/ sheets

(Domestic as well as with export)

('000 tonnes)

Year	HR plates		HR coils/ sheets/ skelps	
	Domestic	With export	Domestic	With export
2011-12	7620	8760	21200	24380
2016-17	12270	14110	31100	35770

Availability of HR plates/coils/sheets/skelps

At present, there are only four major plate mills in the country, viz. 3600 mm plate mill at BSP, 3100 mm plate mill at Rourkela steel plant (RSP), 4500 mm plate mill at Welspum Gujarat Ltd. and 3500 mm plate mill at JSPL. Plate mills are also under installation by M/s Essar Steel Ltd.

Future availability of HR plates in the country works out to about 9.7 Mt and HR coils/sheets/skelps as about 16.9 Mt by 2011-12. The same during 2016-17 works out to about 9.7 Mt and 17.6 Mt respectively.

Resultant gaps/surpluses

Based on the demand and availability projections as deliberated in the preceding paragraphs, It may be observed that the country is likely to face shortage of HR plates of about 2.6 Mt without export and with export provision in demand this gap may widen to about 4.6 Mt by 2016-17.

There would be a shortage of HR coils/sheets/skelps to the tune of about 2.9 Mt by 2011-12 and 12.1 Mt by 2016-17. Considering export demand, the gap will increased to 6.0 Mt & 16.7 Mt in 2016-17.

Conclusion

In view of the market scenario deliberated in the above paragraphs, it has been established that there would be a considerable shortage of pig iron and HR plates and HR coils/sheets/strips in future. Therefore, the installation of proposed integrated steel plant for production of these products is justified under the prevailing condition.

Based on the findings of market analysis the suggested product-mix for the proposed steel plant are furnished in table 02.06.

Table 02.06

Product-mix

Sl. No.	**Items**	**Size (Thickness x width), mm x mm**	**Annual production (tonnes)**
A	**Pig iron**		**272,800**
B	**Hot strip mill**		
	HR coils/sheets/plates		
(i)	HR plates	5-10x1030-1650	400,000
	(IS 2062, IS 5986, IS 3039)		
(ii)	HR plates (IS 2002 & IS 2041)	5-10x1030-1650	400,000
(iii)	API - 5L quality plates -upto X 80	6-12x upto 1550	500,000
(iv)	HR sheets (IS 3196)	2-4x1030-1650	200,000
(v)	LPG cylinders (IS:6240)	2.0-3.15x1000-1650	200,000
(vi)	HR coils (IS 10748, IS 1079)	1.6-10 x 900-1650	946,000
(vii)	High carbon steel (1100-1650) and other alloy steel	2.5-11.5	50,000
(viii)	Silicon steel (DIN 46400-3)	1.81-3.5	100,000
(ix)	Automotive steel		
	- 1250-1524	2.5-11.5	50,000
	- 1525-1650	1.8-6.5	50,000
	Total		**2,896,000**

02.03 Technological considerations

The major plant facilities as envisaged for the proposed project and their capacities are indicated in table-02.07.

Table – 02.07

Selected capacities of major technological facilities

Sl. No.	Technological facilities	Configuration
1.	Coke oven plant with CDCP	2 x 67 ovens, 7.0 m tall
2.	Sinter plant	1 x 460 m^2
3.	Blast furnace	1x 4500 m^3
4.	Desulphurisation units	2 x 175 t
5.	Pig casting machine	3 x 1700 t/d
6.	Slag granulation plant	Catering capacity for production of 848,700 t granulated slag
7.	Basic oxygen furnace	2 x 175 t
8.	Ladle furnace	2 x 175 t
10.	RH-OB	1 x 175 t
13.	Thin slab caster coupled with hot strip mill	2 x 1 strand
17.	Hot strip mill with finishing train	6 stands
18.	Oxygen plant	2 x 1000 t/d
19.	Calcination plants - Lime plant - Dolo plant	 2 x 500 t/d 1 x 300 t/d

02.04 Raw materials

The annual gross requirements of various raw materials for the proposed steel plant and their indicative size specification, proposed sources, and mode of transport are indicated in table-02.08.

Table – 02.08

Estimated gross annual requirements of major raw materials

Sl. No.	Raw material	Size, (mm)	Gross annual requirement (t)	Sources	Mode of Transport
1	Iron ore lump	10-40	1,275,100	Bailadila	By rail
2	Iron ore fines	0 – 10	4,200,500	Bailadila	By rail
3	Lime stone fines for sinter plant	<3	292,600	Jagdalpur area / Satna-Maihar	By rail
4	Lime stone (SMS grade)	25-55	584,700	Jaisalmer area / imported	By rail
5	Dolomite fines for sinter plant	< 3	388,600	Jagdalpur area / Baradwar region	By rail / road
6	Dolomite (SMS grade)	25-55	172,700	Belha region	By rail / road
7	Quartzite	10-50	51,300	Local	by road
8	Coking coal	0-50	2,591,200	China / Australia / New Zealand	By rail from Vizag port
9	Non coking coal for CDI	<50	564,000	China / Australia / New Zealand	By rail from Vizag port
10	Purchased DRI	10 – 20	208,100	Indigenous	By road / rail
11	Purchased scrap	-	33,400	Indigenous	By road / rail
12	Fe-Mn	-	1,500	Indigenous	By road /rail
13	Fe-Si	-	7,400	Indigenous	By road /rail
14	Si-Mn	-	30,000	Indigenous	By road / rail
15	Aluminium	-	6,000	Indigenous	By road /rail
16	Fluorspar	-	2,250	Indigenous	By road /rail

02.05 Site selection and recommendation

Three sites have been identified in Bastar and Dantewada districts of Chhattisgarh. The details of location, land availability and infrastructural facilities for each site has been elaborated below.

Dilimilli site

The proposed site is located in Bastar district of Chhattisgarh. The Dilimilli site is at about 27 km in South - West direction from Jagdalpur town. The National Highway No. 16 runs adjacent to the proposed site in its south direction. Dilimili railway station is located at about 2.5 km from the proposed site in its south direction.

About 4,900 acre of land is available at this site. Almost seventy five percent of land belongs to private owners and the rest is government land. Major portion of land is barren. The site is moderately undulated.

The power transmission lines may be drawn from Barasur 220/132 kV substation that is about 50 km in North - West direction from the proposed site.

Two rivers are located near by the proposed site. The indravati river is about 30 km and Sabari is about 40 km from the proposed site. Primarily, the requirement of water can be made available from either Indravati or Sabari river depending on the water availability.

Nagarnar site

The proposed site is located in Bastar district of Chhattisgarh. The Nagarnar site is at about 16 km in North-East direction from Jagdalpur town. The National Highway No. 43 runs about 1 km from the proposed site in its South direction. Amaguda railway station is located at about 5 km from the proposed site in its south direction.
About 995.8 acre of land at this site is under the possession of M/s NMDC. Site leveling for 75% of land has already been completed. Boundary wall

has also been constructed covering the site. Site offices, health centre have been constructed at the site.

There are two substations near the proposed site. The Barasur 220 / 132 kV substation is about 90 km and Jagadalpur 132 kV substation is about 15 km away in the West direction from the proposed site. It is suggested that grid connection at 220 kV substation is required to meet the requirement of power for high capacity air compressor of oxygen plant. Accordingly power transmission lines are proposed to be drawn from Barasur substation.

The requirement of water for the proposed plant can be met from Sabari river. Although the nearest point of Sabari river which enters in Chhattisgarh from Orissa is only 30 Km but the river again enter in the state of Orissa and flows through a considerable distance in Orissa before entering on dantewada district of Chhattisgarh. As withdrawal of water from upstream of Sabari at a distance of 30 Km away require permission from both the state i.e. Orissa and Chhattisgarh . Under this circumstances, it has been envisaged that water will be drawn from Sabari river at a point where it enters Dantewada district which is about 90 Km from plant site.

The Visakhapatnam port is the nearest port and is about 350 km from the proposed plant site.

Gidam site

The proposed site is located in Dantewada district of Chhattisgarh. The Gidam site is at about 70 km in South-West direction from Jagdalpur town and is about 10 km from Dantewada town in North direction. The National Highway No.16 runs about 1 km from the proposed site in its South direction. Gidam railway station is located at about 5 km from the proposed site in its south direction.

About 500 acre of government land is available at this site. Entire land is under the possession of District Trade & Industry Center (DTIC), Dantewada. About 2,500 acre of additional private land, mostly agricultural land, is available around the above land of DTIC, Dantewada. The site is moderately undulated.

The Barasur 220/132 kV substation is the nearest from the proposed site which is about 20 km. The power transmission lines may be drawn from Barasur substation.

Two rivers are located nearby the proposed site. The indravati river is about 20 km and Sabari river is about 90 km from the proposed site. The requirement of water can be made available from either Indravati or Sabari river depending on the water availability. However, river Sabri has been considered as the source of water for the proposed steel plant at Gidam site.

Recommendation

Based on the infrastructure facilities available at various sites as elaborated in the preceding paragraphs, the techno-economic analysis has been carried out, in order to select the techno-economically most appropriate site for setting up the proposed project.

The sites have been analysed with respect to differential capital investment require for infrastructural facilities, differential annual operating cost comprised of raw material assembly cost and finished product dispatch cost up to nearest port (Visakhapatanam).

Differential capital investment

While estimating the differential capital investment, the cost required for the following infrastructure facilities for different sites have been considered.

i) Land and site development including soil stabilisation, wherever necessary
ii) External road facilities
iii) External power supply facilities
iv) External water supply facilities
v) Land corridor for water, power, rail, road, etc.
vi) Road Over Bridge (ROB) over national highway
vii) Rehabilitation costs (on a notional basis although realistic estimates can be carried out through a proper R&R Study)

Differential annual operating costs

Assembly cost of raw materials has been estimated based on the procurement of major raw materials viz., Iron ore, coal, limestone, and dolomite, etc. Cost towards services/utilities includes cost towards transportation of water to the respective sites.

The weightages for differential investment in infrastructural facilities and operational costs as discussed in preceding paragraphs for all the three sites are summarised in table 02.09 as follows.

Table-02.09

Sl. No.	Item	Weightages (%)		
		Dilmilli	**Nagarnar**	**Gidam**
1	Differential Infrastructure investment	118	138	100
	Rank	**2**	**3**	**1**
2	Differential annual operating cost	109	100	108
	Rank	**3**	**1**	**2**

Combined techno-economic analysis of sites

Based on the relative positions w.r.t. differential capital investment and the differential annual operating costs as summarised above, combined techno-economic analysis has been worked out based on the life cycle costs using discounted cash flow (DCF) technique in order to ascertain the relative merit positions over longer life span of the project. A discount rate of 12% per annum and operating life of 20 years has been considered for the analysis. The weightage for combined analysis for the three sites are furnished in table 02.10.

Table- 02.10

Sl. No.	Item	Site		
		Dilmilli	**Nagarnar**	**Gidam**
1.	Weightages based on combined analysis	106	100	104
	Rank	**3**	**1**	**2**

The figures presented in table 02.10 indicate that Nagarnar emerges as techno-economically preferred site.

02.06 General layout and transportation

The general layout of the proposed plant has been developed keeping in view the following factors.

- Smooth and uninterrupted flow of materials in accordance with the technological requirements
- Optimum lead for transport of material and for services lines
- Predominant wind direction
- Logistic approach in location of technological units as well as services facilities
- Safety clearances and statutory provisions
- Adequate green belt all around the plant
- Availability and shape of land
- Direction of existing rail ,road, power and water with respect to the proposed site

The salient features of the layout have been indicated in table-02.11.

Table-02.11

Salient features of plant layout

Sl. No.	Item	Feature
1.	Area within plant boundary	995.80acres
	Terraced area	748.0 acres
	Un terraced area	247.80 acres
2.	Length of road	
a.	16.0 m wide	7.0Km
b.	7.0 m wide	8.0Km

Sl. No.	Item	Feature
c.	4.0 m wide	15.0 km
3	Length of railway track	
a.	Amaguda to site	5.0km
b.	Inplant railway tracks	40.0Km
4.	No. of road gates	3 Nos.
5.	No. of railway gate	1 No.
6.	Length of boundary wall	
a.	Existing	13.0 km
b.	Proposed	1.0 Km
7.	No. of watch towers	35 Nos.

The total annual external freight will be approximately **14.69** Mt including **10.40** Mt of incoming materials and **4.28** Mt of outgoing finished products. Table 02.12 indicates the quantity of raw materials to be received and the finished products to be dispatched annually.

Table- 02.12

Transportation of raw materials and finished product

Sl.No.	Material	Quantity, t/yr
A	**Receipt**	
1.	Iron ore lumps	1,275,100
2.	Iron ore fines	4,200,500
3.	Limestone fines	292,600
4.	Dolomite fines	388,600
5.	Non coking coal for CDI	564,000
6.	Coking coal	2,591,200
7.	Lime stone (SMS Grade)	584,700
8.	Dolomite(SMS Grade)	172,700
9.	Quartzite	51,300

Sl.No.	Material	Quantity, t/yr
10.	Purchased scrap	33,400
11.	Fe-Mn	1,500
12.	Fe-Si	7,400
13.	Si-Mn	30,000
14.	Purchased DRI	208,100
15.	Aluminum	6,000
16.	Fluorspar	2,300
	Total receipt (A)	**10,409,400**
B	**Despatch**	
1.	HR coils	2,896,000
2.	Cold Pigs	272,800
3.	Granulated Slag	848,700
4.	Coke	272,200
	Total despatch (B)	**4,289,700**
	Total external freight turnover (A+B)	**14,699,100**

02.07 Receipt, storage and handling of raw materials

Annual gross raw material requirement for 3.0 Mt/yr integrated steel plant will be nearly 10.0 Mt and daily requirement will be nearly 32,000 t.

For unloading and storage of raw materials,3 nos. of wagon tipplers (Rota side type) of capacity 20 tipplings/hr each will be installed which will unload the raw materials. Side arm charger will be installed at each wagon tippling complex for placement of wagons in the tippler building.

Raw materials will be discharged by wagon tippler in hoppers. Belt feeders will receive the material from hopper and convey the same to belt conveyors to be installed below belt feeders.

These belt conveyors will discharge the material to series of belt conveyors. From these conveyors the raw materials will be stored in different beds in raw material storage area. Storage capacity has been kept 7 days for ores and fluxes and 21 days stock for non coking and coking coals due to limited land availability.

9 Nos. of storage beds have been considered, each having effective length of 350 m and width of 30 m (approx.) 4 nos. of bed for coking coal, one no. each for CDI coal and iron ore fines have been provided. Iron ore lump and other fluxes will be stored in 3 beds.

5 Nos. of stacker cum reclaimer (SCR) of 1500 t/hr each have been considered for unloading of raw materials from conveyors to stock bed and for transportation of the same to different shops.

Each junction house and building have been provided with suitable capacity hoisting and handling facilities for maintenance purpose.

Adequate number of hoisting and handling facilities have been considered for various shops.

02.08 Coke oven and by product plant

The battery will be of twin flue, under-jet, regenerative type along with provision of recirculation of a part of waste gas. For the annual production of coke of about 1,762,800 tonnes, two batteries each of 67 ovens have been selected for this project.

The volume of production and consumption of raw materials for the proposed coke oven plant on annual basis has been indicated in the table below.

Volume of production and consumption of raw materials

Sl. No.	Item	Unit	Quantity
1	**Production**		
i)	Gross Coke (dry)	t/yr.	1,762,800
ii)	BF coke (25-80 mm)	t/yr.	1,551,300
iii)	Raw coke oven gas	Nm^3/yr.	732×10^6
2	**Consumption**		
i)	Blend coal Dry (As charged to ovens)	t/yr.	2,289,300
ii)	Mixed gas for heating CV = 1100 kcal/ Nm^3	Nm^3/yr.	1332×10^6

Quality of coking coal and coke

The general quality of imported coal and coke are given in the table 02.13 and 02.14.

Table 02.13

Quality of imported coking coal

Sl. No.	Coal quality parameters	Unit	Value
1.	Size	mm	0 to 50
2.	Crushing fineness	%	80
3.	Ash	%	9.0-9.5
4.	VM	%	24 to 26
5.	Moisture	%	6 to 8
6.	Sulphur	%	0.65 (max)
7.	Phosphorous	%	0.06 (max)
8.	Grey King Coke type	-	G 5 (min)
9.	Crucible Swelling No.	No.	6.5 (min)
10	Mean Max. Reflectance (R0 max)	-	1.15 to 1.30
11	Gieseler fluidity	ddpm	600 min

Table 02.14

Quality of coke *

Quality parameters	Value
Ash, % (max.)	12.0
VM, % (max)	1.0
M10 (max)	7.0
CSR	62

* Quality of coke will depend on coal blend quality

02.08.01 Coke dry cooling plant

2 coke dry cooling plant (CDCP) consisting of four cooling chambers each of 52-56 t/h of coke cooling capacity shall be installed to cool the coke produced in the batteries.

Normally 2 cooling chambers shall be in operation to cool the coke produced from battery, 1 cooling chamber shall be work as hot reserve, while 1 chamber shall be under repair and maintenance.

The technological parameters/ features of coke dry cooling plant will be as indicated in table below.

Features of coke dry cooling plant (CDCP)

Description	Unit	Value
Temperature of coke charged in the chamber	^{0}C	1050
Temperature of coke after cooling	^{0}C	<200
Temperature of circulating gas before entering cooling chamber	^{0}C	170 – 180
Temperature of circulating gas before waste heat boiler	^{0}C	750 – 800
Thermal efficiency	%	80 – 85

Description	Unit	Value
Pressure of steam generated	ata	66
Temperature of steam generated	^{0}C	500
Generation of steam / boiler	t/h	25
Capacity of one cooling chamber	t/h	52-56
Time of coke cooling in chamber	h	2 – 2.5

02.08.02 By-products plant

The proposed plant will have a capacity to process 83,600 Nm^3/hr of coke oven gas. The by-product plant will be designed for recovery of only essential by-products like ammonia, crude tar and elemental sulphur. In addition to that, naphthalene scrubbing and solar oil regeneration unit will be installed to remove and recover naphthalene from coke oven gas. This regenerated solar oil (stripped off naphthalene) will be reused in the scrubbing unit with addition of make-up fresh solar oil.

Technological parameters

The design of by-product plant is based on the yield figures given in table- 02.15.

Table-02.15

Annual production of by-products

Sl. No.	Item	Unit	Quantity
1.	Coke oven gas	Nm^3/h	83,600
2.	Ammonium sulphate	t/yr	24,090
3.	Crude tar	t/yr	70,080
4.	Sulphur	t/yr	2,452
5.	Naphthalene	t/yr	260

The production figures are subject to variation with change in the characteristics of coal charge and carbonization conditions in the actual operating plant.

02.09 Sinter plant

The proposed sinter plant complex will consist of one sinter machine of 460 m^2 grate area along with associated services facilities. The gross sinter requirement is 4,683,000 t/yr. However, the plant shall be designed at a rated productivity of 1.28 $t/m^2/hr$.

The proposed new sinter plant will have state-of-the-art technology and the basic design and operating parameters as given in table 02.16.

Table-02.16

Design and operating parameter

Sl. No.	Item description	Unit	Value
1	No. of sinter machine x area	No. x m^2	1 x 460
2	Productivity	$t/m^2/h$	1.28
3	Annual sinter production required	t/y	4,683,000
4	Size of finished sinter	mm	5 – 40
5	Annual working regime	d/y	330
6	No. of working hours/ day	h/d	24
7	Gaseous energy consumption for ignition / tonne of gross sinter	kcal/t	15,000
8	Coke breeze consumption/ tonne of gross sinter	kg/ t	70
9	Under-grate suction	mm WC	1650
10	Sinter m/c bed height (including 40 - 50	mm	700

Sl. No.	Item description	Unit	Value
	mm hearth layer)		
11	Cooler type	-----	Circular (deep bed dip rail)
12	Temperature of cooled sinter	deg. C	Below 100
13	Dust content in exhaust gases at stack	mg/ Nm^3	Below 50

02.10 Blast furnace

The blast furnace complex will comprise of one blast furnace of 4,500 m^3 useful volume along with its auxiliaries.

The blast furnace is envisaged to operate with sized iron ore, sinter, coke, coal dust, fluxes and additives.

The hot metal produced will be first sent to desulphurization unit and then charged in BOF. The hot metal (part) will be sent to pig casting machine for cold pigs production as and when SMS is not in a position to accept the hot metal due to some reasons. The liquid slag will be granulated at cast house slag granulation unit. The BF top gas will be cleaned in dust catcher and gas cleaning system, and distributed to the stoves, runner drying and boiler for steam generation for process and turbine requirement. Excess BF gas will be provided to the plant network.

Production programme

The production programme of the proposed blast furnace complex is given below.

Production programme of blast furnace complex

Sl. No.	Product	Annual quantity (t/yr)
1.	Gross hot metal	3,321,200
2.	Granulated slag (dry)	848,700

Operating conditions

The operating parameters of the blast furnace are given below.

No. of operating day/yr	350
No. of shifts/ day	3
No. of hot metal tapping/day	10-16

Technological parameters

The major technological parameters of the blast furnace are given below.

Sl. No.	Parameter	Quantity
1.	No. of blast furnace	1
2.	Useful volume, m^3	4,500
3.	Productivity, $t/d/m^3$ • On useful volume	 2.1
4.	Production, t/d	9,489
5.	Coke rate (dry), kg/thm	360
6.	Slag rate, kg/thm	269
7.	Slag basicity, CaO/SiO_2	1.029
8.	Top pressure, atg (Max.)	3
9.	Hot blast temperature, ^0C	1200
10.	Blast humidity, g/Nm^3	45
11.	Blast volume, Nm^3/thm. (net & dry) 5-6% O_2	865

Sl. No.	Parameter	Quantity
	enrichment	
12.	BF gas generation, Nm^3/thm	1,439

02.11 Steelmelting and continuous casting shop

M/s NMDC Limited intends to set-up an integrated steel plant with state-of-the-art steel melting facilities to produce 3,000,000 t/yr of liquid steel. The production of steel has been envisaged through BOF – LF – RH-OB degasser route.

In order to achieve the liquid steel production of 3,000,000 t/yr, two (2) basic oxygen furnaces of 175 t nominal capacity has been envisaged.

Steelmelting shop

The steelmelting shop will constitute the following major plant facilities

2 x 175t Hot metal desulphurisation (HMD) units
2 x 175 t Basic oxygen furances (BOFs)
2 x 175 t Ladle furnaces (LF), 35 MVA
1 x 175 t RH-OB degasser unit

Brief technological parameters of major steelmelting production units envisaged are given as follows.

02.11.01 Hot metal desulphurisation

The technical/operating parameters of the desulphurisation station are as given in the following table-02.17.

Table-02.17

Technical parameters of the desulphurisation station

Description	Parameters
Type of desulphurisation	Calcium carbide and magnesium based injection system
Amount of hot metal to be treated for desulphurisation	3,006,000 t/yr
Sp. consumption of materials	
-Calcium carbide	2 kg/t of HM
-Magnesium granules	0.75 kg/t of HM
Nominal capacity of hot metal ladle	175 t
Ladle type	Open top
Type of desulphurisation station	Co-injection type
Conveying and injection medium	Dry nitrogen gas
Typical injection rate - for CaC_2 - for Mg	 40 - 50 kg/min 12 - 15 kg/min
Treatment time	12-15 min
Hot metal temperature, ^oC	1,350
Sulphur content in hot metal	
- Before treatment, %	0.05
- After treatment, % (avg.)	0.008

02.11.02 Basic oxygen furnaces (BOFs)

The major technological parameters of basic oxygen furnaces are given in the table-02.18.

Table-02.18

Technological parameters of basic oxygen furnaces

Sl. No.	Item	Unit	Quantity
1.	Liquid steel production	t/yr	3,000,000
2.	No. of converters installed	Nos.	2
3.	No. of converters in operation	Nos.	2
4.	Nominal heat weight	t	175
5.	Tap-to-tap time	min	50
6.	Oxygen blowing rate, • avg. • max	Nm^3/min	 600 750
7.	Specific consumption of oxygen for blowing	Nm^3/t	55
8.	Converter lining life, approx.	Heats	5000
9.	Converter relining time	h	240
10.	No. of heats/d (max.)/ converter	No.	27
11.	Working days of converter per year	No.	320
12.	Metallic yield	%	90.00

02.11.03 Ladle furnace (LF)

Technological parameters of the ladle furnace are given in table-02.19.

Table-02.19

Technological features of ladle furnace

Sl. No.	Parameters	Unit	Value / features
1.	Liquid steel to be treated, max.	t/yr	3,000,000
2.	Heats to be treated per day/ furnace max.	No.	27
3.	Ladle capacity	t	175

Sl. No.	Parameters	Unit	Value / features
4.	Treatment time	min	45
5.	Type of ladle furnace	-	Single station with water-cooled roof
6.	Transformer capacity	MVA	35 (with 20 % overloading)
7.	Heating rate	ºC/min	> 5 deg per minute at top notch
8.	Method of charging additives	-	Mechanized with the system of burners, vibro feeders, weigh hoppers, conveyors
9.	Method of argon purging for bath stirring	-	Porous plug at the ladle bottom
10.	Main functions of ladle furnace	-	➢ Alloying ➢ Heating ➢ Homogenisation of chemical composition and temperature ➢ Desulphurisation ➢ Inclusion morphology control ➢ Holding of liquid steel in case of emergency ➢ Steel cleanliness
11.	Fume collection system and cleaning of off gas	-	Fume chamber above electrode ports, ducting connected to bag house for fume cleaning.
12.	Automation	-	Level – II

02.11.04 RH – OB

The main technological parameters of the RH-OB vacuum degassing unit are given in table 02.20.

Table – 02.20

Major technological parameters of RH-OB degassing unit

Sl. No.	Item	Unit	Value / feature
1.	Type of degasser unit		Fixed treatment station vessel
2.	Heat weight	t	175
3.	Circulation speed	t/min	120
4.	Hydrogen level in steel - before treatment - after treatment	ppm	5-10 <1.5
5.	Min. vacuum level achievable	Torr	0.1
6.	Pump down time (1013 mbar to 0.5 mbar)	min	4 min
7.	No. of working days/yr.	No.	320
8.	Treatment time	mins.	20-25
9.	Heats to be treated / day	Nos.	30 (max.)
10.	Preheating temperature of degassing vessel	°C	1400-1500

02.11.05 Continuous casting shop

It is proposed to install a continuous casting shop for casting the entire quantity of liquid steel produced in BOF shop. The liquid steel will be cast through two thin slabs casters with hot strip finishing mill. The shop will be equipped with state-of-the-art high productivity continuous casting machines and auxiliary facilities for production of 2,896,000 t HR coils per year.

The technological parameters of thin slab caster are given in table 02.21.

Table – 02.21

Technological parameters of thin slab caster

Sl. No.	Parameter	Unit	Value / feature
1.	No. of machine x strands	No	2 x 1-strand
2.	Type of machine	-	Vertical solid bending
3.	Bending radius	m	3.25
4.	Thin slab thickness	mm	55-75
5.	Maximum thin slab width	mm	1650
6.	Type of mould	-	0-frame (new)
7.	Nominal mould width	mm	900 – 1,650
8.	Mould length	min	1,000 (approx.)
9.	No. of segments	No.	3 – 4
10.	Average casting speed	m/min.	5.5
11.	Ladle capacity	t	175
12.	Ladle holding	-	Ladle turret
13.	Tundish capacity	t	30 – 35
14.	Dummy bar system	-	Rigid with vertical insertion and withdrawal from bottom
15.	Thin slab cutting	-	Pendulum shear
16.	Casting time	min.	50
17.	Heats in sequence	No.	12
18.	Operating days/year	No.	320
19.	Steel grades	-	Commercial and special steel grades

The layout for steelmaking and casting facilities is shown in drg. No. MEC/Q6N9/11/03/01 in chapter 12.

02.12 Hot strip mill finishing train with tunnel furnace

The rolling mill equipment will primarily comprise of two nos. of tunnel type temperature equalising-cum-holding furnaces, one pendulum type slab and cobble shear, one high pressure descaling station, required no. of mill stands, run out roller table equipped with laminar type strip cooling system, two sub-floor coilers, coil handling and inspection facilities, coil storage yard, auxiliary facilities, roll shop equipment, electrics and automation.

Technological parameters

The broad technological parameters of the hot strip mill are given in table-02.22.

Table- 02.22

Technological parameters of hot strip mill

Sl No.	Item	Unit	Parameter
1.	Capacity – HR coil	t/yr	2,896,000
2.	Steel grades		Low and medium carbon and alloys steel
3.	Input material		
	Type		Continuously cast thin slabs
	Thickness	mm	55 – 75
	Width	mm	900 – 1650
	Thin slab temp. at furnace exit		1150^0 C (Max.) 980^0 C (Min.)
	Weight	t	35 max
3.	Finished product		
	Type	-	HR coil
	Strip thickness	mm	1.2 – 12.7 (Future 16 mm)
	Width	mm	900 – 1650

Sl No.	Item	Unit	Parameter
	Maximum strip speed		18 m/s (for the whole regrinding range of work rolls)
	Specific coil weight	Kg/mm	20 max
	Coil ID	mm	850
	Coil OD	mm	2300
4.	Major equipment data		
	Temperature equalising furnace (2 Nos.)	Two zone furnace with heating and holding sections	
	Furnace dimension approx.:		
	Length	m	240 (Approx)
	Descaling system:		
	Type	-	High pressure water descaler
	Spray header	No.	4
	Mill stands (4 Hi configuration)	No.	6
	Strip cooling system		
	Type	-	Laminar / water wall
5.	Special features:		
	- Hydraulic AGC for gauge control		
	- Work roll shifting for control of strip shape and profile using profiled rolls		
	- Work roll bending		
	- Hydraulic looper		
	- Roll gap lubrication		
	- High power interstand cooling		
	- Automatic quick work roll changing with side shifter device on all stands to improve mill availability		

Sl No.	Item	Unit	Parameter
	- Laminar strip cooling system at the run out table with edge masking for control of metallurgical properties and improving cold strip flatness - Automatic surface inspection		
	- Heavy duty down coiler with hydraulic operated wrapper rolls with automatic step control for adjustment during head and tail end coiling to reduce coil mark.		
	- On-line automatic strapping devices for circumferential and radial strapping of HR coils.		

Temperature equalising furnace

The Temperature equalizing furnace (or tunnel furnace) is roller hearth type, recuperative tunnel type furnace, which serves both to heat up the thin slab to uniform rolling temperature and convey it from the caster exit to the rolling mill. The technological parameters of tunnel furnace are as follows.

Technical parameters for each tunnel furnace

1.	Type of furnace	Roller hearth type tunnel furnace with swivel.
2.	Nominal throughput	200 tph for each furnace
3.	Furnace length	246 m
4.	Outside width including gear box	4500 mm approx.
5.	Pass line	+915 mm
6.	Pass line to refractory floor	1500 mm approx.
7.	Pass line to foundation floor	4500 mm approx.
8.	No. of rollers	206 (including two idle roller)
9.	Roller speed	2.8 to 60 m/ min
10.	Slab inlet temperature	Emergency: 840 – 855 deg C Normal: 855 – 1050 deg C
11.	Slab outlet temp	1150 ^{O}C + 10 ^{O}C (depending on steel grades)

02.13 Steam and power and blowing station

The process involved in iron making through high top pressure BF route generate considerable quantities of useful BF gas at a higher pressure. The pressure energy content of the BF gas can effectively be utilized to generate steam for various needs and electrical power. In the proposed blast furnace approx. 570,000 Nm^3/h of BF gas will be generated. A portion of this BF gas will be utilized for generation of steam to fulfill the requirements of the steam turbine driven turbo blowers and process steam of the blast furnace complex. The available pressure energy will be utilized to generate electrical power through top pressure recovery turbine. The following facilities have been envisaged.

1. Power and blowing station
   a. Mixed gas fired boilers.
   b. Steam turbine driven turbo blowers
   c. Steam turbo generators
2. Top pressure recovery turbine
3. Centralised compressed air station
4. DG station

Based on the above, following facilities have been envisaged for power and blowing station.

▪ Mixed gas fired boilers and auxiliaries	-	2x250t/h
▪ Steam turbine driven turbo blowers	-	3x50% (2W+ 1SB)
▪ Steam turbo generator set	-	3x30MW
▪ Deaerator	-	2 Nos.

- Boiler feed pumps (for each unit) - 3 Nos.(2W +1SB)

The technical/operating parameters of major equipment for the turbo blower station are given in table 02.23.

Table-02.23

Technological / operating parameters of major items

Sl. No	Equipment	Unit	Parameters
1.	2 x 250 t/h mixed gas fired boiler	.	
	- Steam pressure at super heater outlet	Kgf / cm^2 (abs)	62
	- Steam temperature at super heater outlet.	°C	485
	- Max steaming capacity (each)	t/h	250
2	3x30MW steam turbo generator		
	- Inlet steam pressure	Kgf / cm^2 (abs)	62
	- Inlet steam temperature	°C	485
	- MCR capacity each	MW	30
	- Generator voltage -	kV	11
3.	Extraction steam parameters -Pressure -Temperature	 Kgf / cm^2 °C	 10 250
4.	3x50% steam turbine driven turbo blowers		
	- Max flow of air at 5.3 kgf / cm^2 (g)	Nm^3 /min	3625
	- Normal flow of air at 4.3 kgf / cm^2 (g)	Nm^3 /min	3025

02.14 Steam balance

The steam balance of the turbo blower station is given in table 02.24.

Table-02.24

A. Steam generation		
SL. No.	**Description**	**HP steam, t/h**
1.	2 nos. mixed gas fired boiler	500
2.	HP steam from CDCP	100
	Total steam generation (max)	600 (Max)
B. Steam consumption		
SL. No.	Description	HP steam, t/h
1.	Steam turbine driven turbo blower	160(max) & 122 (normal)
2.	Steam turbo generator	378
3.	Steam for CDCP	10
4.	Process steam & auxiliary steam	52
	Total steam consumption	600 t/h

DG station

Standby power supply source is necessary to run the blast furnace. In case of failure of power supply from the sub station, emergency loads of blast furnace complex will be met from DG station .To meet the emergency power requirement, 2x5 MW DG sets have been envisaged. The DG sets will be operated by LDO / furnace oil.

02.15 Oxygen plant

Demand of oxygen

Oxygen will be required for oxygen enrichment in the blast furnace, blowing in the BOF, heating of BOF lining, secondary refining in RH – OB and for general purpose use in various units of the steel plant . The estimated requirement of oxygen for various units is approx. 51,200 Nm^3/hr.

Demand of nitrogen

Nitrogen will be mainly required as carrier gas in de-sulphurisation unit, slag splashing in BOF, stirring in BOF, cold dust injection system, bell less top equipment for blast furnace, purging in GCP of BOF and also for occasional purging of fuel gas pipelines and equipment. The estimated requirement of nitrogen for various units is approx. 17,500 Nm^3/hr.

Demand of argon

Argon will be required for shrouding in the tundish and mould in the continuous casting plant, stirring in BOF and ladle. Argon will also be required for laboratory purpose. Average requirement of argon has been envisaged for shrouding in the continuous casting shop is 110 Nm^3/hr at 16 Bar(g) and in SMS shop is 700 Nm^3/hr at 16 Bar(g) for combined blowing, ladle furnace and RH-OB.

In order to meet the above requirement of oxygen, nitrogen and argon, 2(two) air separation units each of 1000 t/d capacity will be installed.

02.16 Lime and dolomite plant

The lime and dolomite plant will comprise of 2 Nos. vertical lime shaft kiln of capacity 500 t/d each and 1 no. vertical dolomite shaft kiln of capacity 300 t/d to meet the requirement of soft lime and calcined dolomite for steelmaking process.

Production capacity

The lime and dolomite plant will have the following production capacity as given below.

Sl. No.	Item	Quantity (t/yr)
1.	Lime of size 10-55mm for SMS and LF	186,000
2.	Undersize lime for sinter plant and desulphurization unit	114,300
3.	Calcined dolomite of size 10-55mm for SMS	66,000
4.	Undersize dolo for mise. use	11,600

Technological parameters

i) No. of lime kiln	-	2 Nos.
ii) Kiln capacity	-	500 tpd
iii) No. of dolomite kiln	-	1 No.
iv) Kiln capacity	-	300 tpd
v) Kiln feed size, mm	-	25-55
vi) Calcination temp. °C	-	1050-1150
vii) Specific consumption of fuel	-	920 Kcal/kg of burnt lime and dolomite
viii) Working schedule of the plant (3 shift /day)	-	330 days /yr

02.17 Repair and maintenance facilities

In order to ensure continuous operation of various plant and equipment of the proposed steel plant, a central machine shop and fabrication shop with adequate facilities has been envisaged which will help to maintain the various equipment in smooth running condition. The state-of the-art repair and maintenance facilities on the growth shop pattern have been considered for the proposed project. Apart from above, area repair shops in different units for day-to-day maintenance have been envisaged.

The repair facilities will mainly comprise the following shops/units

- Central machine shop
- Mould and roller segment rebuilding shop
- Maintenance garage
- Loco and wagon conditioning shop

02.18 Electrics

The estimated power requirement of the proposed integrated steel plant at Nagarnar is as follows.

Maximum demand (MVA)	264 (251 MW)
Average annual energy consumption (in MU)	1542

Source of power supply

Power requirement for the proposed plant shall be met from the 220 kV Barasur grid substation of CSEB located approximately 90 km away from the plant site.

Power distribution scheme

The power from the utility grid at 220kV level shall be received at MRS through double circuit transmission lines.

To meet the plant power requirement, the following power distribution system at MRS is envisaged.

3 Nos of 220/33 kV, 100/120 MVA power transformers with 33 kV, 3 section switchboards are proposed for hot strip mill.

4 Nos. of 220/33 kV, 100/120 MVA power transformers with 33kV, 4 section switchboards are proposed for balance plant loads.

For oxygen plant, one no. 33kV feeder from 220/33 kV, 100/120MVA power transformer and the feeder from section-4 of 33 kV switchboard at MRS.

At power and blowing station, power produced through 3 x 30 MW, steam driven turbo generators and 1x12 MW TRT is synchronized and connected at MRS 33kV level through 2 Nos. of 33kV feeders.

The downstream power distribution network for the proposed steel plant comprises 6.6 kV substations (fed by 33/6.6 kV transformers of appropriate rating) and 6.6/0.415 kV distribution substations, located at various load centres appropriately selected to meet the requirements of loads operating at 6.6 kV and 415V respectively. The 6.6 kV substations shall be fed from 33 kV switchboards of MRS.

Emergency power requirement (Category-I) shall be met from 2 x 5 MW DG sets at 6.6kV located at power and blowing station and shall be fed to 6.6kV sections of various plants.

02.19 Compressed air facilities

The centralised compressed air station consisting of compressors and air drying plants shall provide dry compressed air required for industrial purpose as well as for instruments of different consumers of plant. The compressors and air drying plants shall be located inside a centralised compressed air station building.

Design basis

The compressed air requirement is estimated as follows.

a. Industrial quality at 6- 8 kgf /cm^2 (g) : 337 Nm^3/min

b. Instrument quality at 6-8 Kgf/cm^2 (g) : 216 Nm^3/min

02.20 Fuel and gas facilities

Fuel gas

In order to use and supply various fuel gases generated in the steel plant to the different consuming units, an interplant pipeline network has been planned. The network will comprise of pipelines for blast furnace gas, coke oven gas, mixed gas (BF gas and CO gas) and basic oxygen furnace (BOF) gas. The estimated generations of blast furnace gas, coke oven gas and BOF Gas are 532.54 Gcal/hr, 359.60 Gcal/hr and 59.77 Gcal/hr respectively.

The estimated generations of blast furnace gas, coke oven gas and BOF gas in Nm^3/hr are 568953, 83627 and 33203 respectively.

Part of the blast furnace gas generation will be supplied for CDI Plant, pressure equalizing and other minor consumers e.g. LRS, cast house etc. within BF complex.

Part of the CO gas generation will be supplied in BOF Shop and CCM shop for ladle heating and tundish heating respectively.

Mixed gas (mixture of blast furnace gas and coke oven gas) will be supplied to coke oven battery under firing, stoves heating, sinter plant, tunnel furnaces of hot strip mill and lime and dolomite plant.

An hourly fuel gas balance is indicated in table 02.25

Table 02.25

Hourly fuel gas balance

Sl No	Name of shop/ unit	Product	Annual output/ input	Annual hours of operation	Sp. yeild/ consumption		Calorific value of gas	Hourly fuel gas supply/ consumption (gcal /hrs or million kcal/hrs)			
			(x 1000T)		(Nm 3/t)	(Gcal/t)	kcal/Nm^3	Total	BF gas	C.O. gas	BOF gas
	01 Generation										
1	Blast furnace	Hot metal	3321.20	8400	1439	1.347	936	532.54	532.54	0.00	0.00
2	Coke oven & by-product	Dry coal (Input)	2289.30	8760	320	1.376	4300	359.60	0.00	359.60	0.00
3	BOF	Liq. steel	3000.00	7680	85	0.153	1800	59.77	0.00	0.00	59.77
	Total generation							**951.91**	**532.54**	**359.60**	**59.77**
	Consumption										
1	Blast furnace plant										
	a) Stoves heating with mixed (BF &CO) gas CV @ 1150										
	i) BF gas	Hot Metal	3321.20	8400	336.890	0.315	936	124.68	124.68	0.00	0.00
	ii) Coke oven gas	Hot Metal	3321.20	8400	23.270	0.100	4300	39.56	0.00	39.56	0.00

(Cont…..Table 02.25)

Hourly fuel gas balance

Sl No	Name of shop/ unit	Product	Annual output/ input	Annual hours of operation	Sp. yeild/ consumption		Calorific value of gas	Hourly fuel gas supply/ consumption (gcal /hrs or million kcal/hrs)			
			(x 1000T)		(Nm 3/t)	(Gcal/t)	kcal/Nm^3	Total	BF gas	C.O. gas	BOF gas
	b) Coal dust injection (BF gas)	Hot Metal	3321.20	8400	65.760	0.062	936	24.34	24.34	0.00	0.00
	c) Pressure equilizing (BF gas)	Hot Metal	3321.20	8400	18.970	0.018	936	7.02	7.02	0.00	0.00
	d) Bleeder losses	Hot Metal	3321.20	8400	37.940	0.036	936	14.04	14.04	0.00	0.00
	e) LRS, cast house, etc.	Hot Metal	3321.20	8400	5.058	0.005	936	1.87	1.87	0.00	0.00
	Sub-total consumed					0.535		211.51	171.94	39.56	0.00
2	Coke oven battery										
	Heating with mixed (BF &CO) gas CV @ 1100										
	i) BF gas	Dry Coal	2289.30	8760	553.450	0.518	936	135.38	135.38	0.00	0.00
	ii) Coke oven gas	Dry Coal	2289.30	8760	28.350	0.122	4300	31.86	0.00	31.86	0.00
	Sub-total consumed					0.640		167.24	135.38	31.86	0.00
3	Sinter plant										
	Heating with mixed (BF & CO) gas CV @ 2000										
	i) BF gas	Sinter	4683.00	7920	5.130	0.005	936	2.84	2.84	0.00	0.00

(Cont…..Table 02.25)

Hourly fuel gas balance

Sl No	Name of shop/ unit	Product	Annual output/ input (x 1000T)	Annual hours of operation	Sp. yeild/ consumption		Calorific value of gas	Hourly fuel gas supply/ consumption (gcal /hrs or million kcal/hrs)			
					(Nm 3/t)	(Gcal/t)	kcal/Nm3	Total	BF gas	C.O. gas	BOF gas
	ii) Coke oven gas	Sinter	4683.00	7920	2.370	0.010	4300	6.03	0.00	6.03	0.00
	Sub-total consumed					0.015		8.86	2.84	6.03	0.00
4	Lime and dolomite plant										
	Lime plant heating with mixed (BF &CO) gas CV @ 2000										
	i) BF gas		300.3	7920	314.500	0.294	936	11.19	11.19	0.00	0.00
	ii) Coke oven gas		300.3	7920	145.500	0.626	4300	23.7	0.00	23.7	0.00
	Dolomite plant heating with mixed (BF &CO) gas CV @ 2000										
	i) BF gas		77.6	7920	314.500	0.294	936	2.89	2.89	0.00	0.00
	ii) Coke oven gas		77.6	7920	145.500	0.626	4300	6.125	0.00	6.125	0.00
	Sub-total consumed					1.840		43.905	14.08	29.825	0.00
5	Steel melting shop										
	a) BOF shop										

Sl No	Name of shop/ unit	Product	Annual output/ input (x 1000T)	Annual hours of operation	Sp. yeild/ consumption		Calorific value of gas	Hourly fuel gas supply/ consumption (gcal /hrs or million kcal/hrs)			
					(Nm 3/t)	(Gcal/t)	kcal/Nm3	Total	BF gas	C.O. gas	BOF gas
	Ladle heating with CO gas CV @ 4300										
	i)Coke oven gas	Liquid Steel	3000.00	7680	6.000	0.026	4300	10.08	0.00	10.08	0.00
	b) CCM shop										
	Tundish heating with CO gas CV @ 4300										
	i) Coke oven gas	Liquid Steel	3000.00	7680	6.000	0.026	4300	10.08	0.00	10.08	0.00
	Sub-total consumed					0.052		20.16	0.00	20.16	0.00
6	Hot strip mill										
	a) Tunnel furnace heating with mixed (BF &CO) gas CV @ 2000										
	i) BF gas	Thin slab	3000.00	7680	68.370	0.064	936	25.00	25.00	0.00	0.00
	ii) Coke oven gas		3000.00	7680	31.630	0.136	4300	53.13	0.00	53.13	0.00
	Sub-total consumed					0.200		78.13	25.00	53.13	0.00
7	Losses										
	a) BF gas – 2%							10.65	10.65	0.00	0.00

Sl No	Name of shop/ unit	Product	Annual output/ input (x 1000T)	Annual hours of operation	Sp. yeild/ consumption		Calorific value of gas	Hourly fuel gas supply/ consumption (gcal /hrs or million kcal/hrs)			
					(Nm 3/t)	(Gcal/t)	kcal/Nm3	Total	BF gas	C.O. gas	BOF gas
	b) CO gas - 1%							3.60	0.00	3.60	0.00
	c) BOF gas - 2%							1.19	0.00	0.00	1.19
	Sub-total consumed							15.44	10.65	3.60	1.19
	Total consumption							545.25	359.88	184.16	1.19
	Total generation							951.91	532.54	359.60	59.77
	Surplus fuel for power generation							407	172.66	175.44	58.58

02.21 Water supply facilities

Steelmaking and casting are heat intensive processes wherein a considerable quantity of cooling water is required for control of metallurgical processes as well as for dissipation of unutilized heat. In order to conserve precious fresh water, water economy has been an underlying criterion for selection of plant and equipment.

Raw water shall be sourced from Sabari river which is around 90 km away from the proposed site, through dedicated water pumping system and rising main.

Raw water received at the plant water reservoir (15 days capacity) will be clarified in the raw water treatment plant for use as makeup and drinking water. Water will be further treated in a DM and soft water plant to meet the plant demand.

The total requirement of raw water from water source is 4130.75m^3/h to meet process make-up water requirement, estimated as 3747 m^3/h. This will be further rationalized during detailed engineering. Water balance diagram is shown in drawing No. MEC/Q6N9/11/40/01 of chapter 21.

02.22 Quality control and laboratory facilities

The proposed integrated steel plant will produce high quality hot rolled coils according to the stipulations of various national and international standards. In order to achieve this objective, efficient and stringent quality assurance measures are to be enforced at every stage of production. Quality assurance can be implemented effectively in the form of analyses and test results which can be provided only by a well-equipped laboratory entrusted with day-to-day quality control at all stages of processing and quality evaluation of finished products.

Planning of laboratories

The following laboratories have been envisaged.

- One coke oven laboratory catering to the testing requirements of coal and coke.
- One raw material sample preparation and physical testing laboratory
- One iron making laboratory catering to the requirements of the sinter plant and blast furnace plant
- One steel making and continuous casting laboratory catering to the requirements of the steel melting shop and continuous casting machine
- One rolling mill laboratory catering to the requirements of the hot strip mill
- One central laboratory which will function as the nerve centre for all the quality control activities being done throughout the plant.

All these laboratories will be located near the respective production units at suitable locations.

02.23 Environmental management

An integrated steel plant is a potential source of environmental pollution. The pollutants in the form of solids, liquids and gases are generated from various technological units and, if let out as such, will have hazardous effects on the environment. Pollution of the environment, not only adversely affects the flora and fauna, but also shortens the life of plant and equipment. This vital aspect, therefore, has been taken into account while planning the plant and equipment and adequate measures have been proposed to limit the emission pollutants within the stipulations of statutory norms. However, before starting the plant, the detailed Environmental Management Plan (EMP) needs to be prepared based on the findings of an Environmental Impact Assessment (EIA) study which will cover monitoring of existing environment at site, assessment of pollution likely to be caused by the proposed plant and its impact on the socio-economic, flora-fauna, demography, land use, etc.

Ventilation and air conditioning

Ventilation and air-conditioning systems are proposed to provide proper working conditions necessary for maintaining environment compatible with human hygienic requirements and to maintain conditions necessary for proper storage of materials and working of plant and equipment. The ventilation and air-conditioning systems generally include one or more items of equipment and accessories such as fans, air filters, air-conditioning units, duct work, pumps, cooling tower, air supply grills, dampers, insulation, instrumentation and controls, electrics, etc.

02.24 Fire fighting facilities

In order to protect the working personnel, equipment and machinery from any damage or loss and to ensure un-interrupted production, adequate safety and fire fighting measures have been considered for the proposed plant. The facilities provided will bear all relevant approvals, as required, from concerned agencies like TAC etc.

02.25 Civil and structural work

Civil work

Civil work comprises all plant units, its auxiliaries, site levelling, roads, drainage, sewerage and all other infrastructure within the plant boundary. General specification / details in respect of type of structures, grade of concrete, materials, etc. for all units have been assumed to be as per BIS stipulation.

Steel structures

Structural steelworks will cover all steel structures required in buildings, including crane girders, platforms, walkways, stairs, sheeting, etc., conveyor galleries, junction houses, stacks, blast furnace including furnace proper, four poster, top structures, gas mains, etc., stoves, dust catcher, interplant pipelines and their supporting structures, feed end building, transition and cooler buildings, building for power and blowing station and all other steel structures and sheetings required in different units envisaged for the project.

02.26 Project planning

The implementation schedule for the project, taking into account the facilities proposed and the volume of work involved, is given in drg No. MEC/Q6N9/11/PY/01(R-2) in chapter 21. According to this schedule, the proposed project has been planned to be commissioned in **42 months** time from its zero-date, which has been reckoned as the placement of order for major technological units.

Pre ordering schedule for the project is given as annexure-1, preordering activities is planned to be completed in 19 months.

To facilitate the integrated commissioning of the overall plant **in stipulated time**, mechanical completion of the major units as per proposed schedule has been indicated in the following table.

Unit	Ready for cold test / commissioning in months from "zero-date"
Auxiliaries	**36 - 39**
Coke ovens	**37**
Sinter plant	**37**
Blast furnace	**38**
Oxygen plant	**38**
Lime plant & dolo plant	**38**
SMS (BOF,LF & RH-OB)	**39 - 40**
Thin slab caster coupled with hot strip mill	**40**
Test and trial run	**36 - 41**
Integrated commissioning	**42**

The proposed schedule is considered preliminary at this stage, and may necessitate updating during the detailed planning and implementation stages, based on updated volume of work, the modus operandi for the implementation, etc.

02.27 Manpower planning

In order to operate and maintain the plant facilities, including its technical and general administration needs, the estimated manpower requirement for the integrated complex has been estimated to be 3500.

The above estimate covers the top management, middle and junior level executives and other supporting staff. The estimate, however, does not cover the personnel for township, medical facilities, etc. The category-wise break-up of manpower is indicated in table-02.26.

Table – 02.26

Category wise break-up of manpower

Sl. No.	Category	Requirement
1.	Managerial	113
2.	Executive	300
3.	Skilled	1310
4.	Semi-skilled	891
5.	Un-skilled	821
6.	Clerical	65
	Total	**3500**

02.28 Capital costs

The summary of estimated capital cost of the project is furnished in the table-02.27.

Table-02.27

Abstract of capital cost estimate

(Base date: 4th Quarter, 2008)

(Rs Crore)

Sl. No.	Item description	Value
1.	Land and site development	166.5
2.	Buildings and misc. civil works	1531.2
3.	Plant and machinery including services and auxiliary	9958.7

Sl. No.	Item description	Value
	facilities	
4.	Detailed engineering, consultant's fees, project management, enabling work etc.	1040.5
5.	Know-how fees, expatriate supervision of basic engineering, erection, start-up etc.	19.6
6.	Training Charges	10.9
7.	Misc.fixed assets and offsite facilities	1134.8
8.	External Infrastructure Cost including township	691.00
9.	Preliminary and capital issue expenses	184.0
10.	Pre-operative expenses	260.3
11.	Provision for contingencies	749.9
	Total Fixed Capital Cost excluding IDC	**15747.2**
12.	Interest During Construction (IDC)	2081.8
	Total Fixed Capital Cost including IDC	**17829.0**
13.	CENVAT credit	1048.1
	Total Project Cost (after CENVAT benefit)	**16780.9**
14.	Margin money for working capital	295.2
	Total Project Cost with margin money (after CENVET benefit)	**17076.1**

02.29 Production costs

The details of annual manufacturing expenses (excluding depreciation and interest) at 100% capacity utilization is shown in table-02.28.

Table-02.28

Annual manufacturing expenses (excluding depreciation & interest charges) (At 100% capacity utilisation)

(Rs lakhs)

Sl	Item	Unit	Unit rate	`Annual Values

				Annual Quantity	Annual Cost
A	**Material**				
1	Iron ore lump (BF grade)	t	3000	1237000	37110
2	Iron ore fines	t	1800	4200500	75609
3	Limestone fines for SP	t	700	292600	2048
4	Dolomite fines for SP	t	700	388600	2720
5	Non coking coal for CDI	t	9000	563900	50751
6	Coking coal	t	9000	2591200	233208
7	Limestone (SMS grade)	t	2100	584700	12279
8	Dolomite (SMS grade)	t	1000	172700	1727
9	Quartzite	t	500	51300	257
10	Purchased scrap	t	20500	34100	6991
11	Iron ore lump (SMS grade)	t	3000	38100	1143
12	Fe-Mn	t	65000	1500	975
13	Fe-Si	t	65000	7400	4810
14	Si-Mn	t	73500	30000	22050
15	Purchased DRI	t	15000	208100	31215
16	Aluminium	t	103000	6000	6180
17	Fluorspar	t	12000	2250	270
	Total material cost				**489343**
B	**Cost above material**				
1	Salaries & wages				13539
2	Electrical contract demand charge	kVA	3600	233333	8400
3	Electricity (Purchased)	kWh	3.05	858,457,200	26183
4	Electricity duty on own generation	kWh	0.25	683,542,800	1723
5	Make-up water	cu m	3	34,698,216	1041
6	Consumables, operating supplies & refractories				79350
7	Repair & maintenance				14239
8	Overhead expenses & misc. other expenses				21671
	Total cost above material				**166146**

Sl No	Item	Unit	Unit rate (Rs/Unit)	`Annual Values	
				Annual Quantity	Annual Cost
	Annual manufacturing expenses				**655489**

02.30 Financial appraisal

The salient techno-economic indices are presented in table-02.29.

Table-02.29

Salient techno-economic indices

Sl No	Item	Unit	Value
1	Capital cost of fixed assets incl. IDC	Rs. Crore	17829
2	Annual manufacturing expenses at 100% capacity utilization	Rs Crore	6555
3	Annual net sales realization at 100% capacity utilization	Rs 12379 Crore	12379
4	Cumulative retained profit after tax (10 years of operation)	Rs crores	24734
5	Average retained profit after tax per year	Rs crores	2473
6	Cumulative cash surplus (10 years of operation)	Rs crores	26223
7	Internal rate of return (IRR) based on 20 years of operation including township		
a)	Pre-tax	%	26.1
b)	Post-tax	%	22.3
8	Internal rate of return (IRR) based on 20 years of operation excluding Township		
a)	Pre-tax	%	26.5
b)	Post-tax	%	22.6

6	Debt service coverage ratio (average over 15 years of operation)	Ratio	2.74
7	Pay-back period	Years	5.39
8	Break-even capacity	%	38

Sensitivity analysis

A sensitivity analysis has been carried out to assess the impact of changes in:

- Change in capital cost
- Change in manufacturing expenses
- Change in NSR
- Change in salaries and wages

Sensitivity analysis has been carried out including township and excluding township. The results are summarised in table-02.30.

Table-02.30

Sensitivity analysis

Sl. No.	Sensitivity factor	With township	Without township
		Post-tax IRR, %	Post-tax IRR, %
1	**Base case**	22.3%	22.6%
2	**Sensitivity with respect to change in**		
	capital cost		
	Increase in NSR by 5%	21.4%	21.7%
	Increase in NSR by 10%	20.6%	20.9%
	Decrease in NSR by 5%	23.3%	23.6%
	Decrease in NSR by 10%	24.3%	24.7%
3	**Sensitivity with respect to change in**		
	annual manufacturing expenses		
	Increase in manufacturing expenses by 5%	21.3%	21.6%
	Increase in manufacturing expenses by 10%	20.2%	20.5%

Sl. No.	Sensitivity factor	With township Post-tax IRR, %	Without township Post-tax IRR, %
	Decrease in manufacturing expenses by 5%	23.3%	23.7%
	Decrease in manufacturing expenses by 10%	24.3%	24.7%
4	**Sensitivity with respect to change in**		
	Net Sales Realization (NSR)		
	Increase in capital cost by 5%	24.1%	24.5%
	Increase in capital cost by 10%	25.8%	26.1%
	Decrease in capital cost by 5%	20.4%	20.8%
	Decrease in capital cost by 10%	18.4%	18.7%
5	**Sensitivity with respect to increse in salaries and wages**		
	due to Pay Rivision		
	Increase in salaries and wages by 30%	22.1%	22.5%
	Increase in salaries and wages by 40%	22.1%	22.4%
	Increase in salaries and wages by 50%	22.0%	22.4%