PRE-FEASIBILITY REPORT

FOR

**CAPACITY EXPANSION OF
INTEGRATED IRON & STEEL PLANT
FROM 3.0 MTPA TO 5.5 MTPA**

AT

**VILLAGE THELKOLOI, POST LAPANGA, TEHSIL
RENGALI, DISTRICT SAMBALPUR, ODISHA**

OF

Bhushan
POWER & STEEL

APRIL 2015

M. N. DASTUR & COMPANY (P) LTD
CONSULTING ENGINEERS
KOLKATA

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SUMMARY

1. Bhushan Power & Steel Limited (BPSL) is operating an integrated steel plant at Rengali, district Sambalpur of Odisha. The existing plant capacity is 3.0 million ton per year (MTPA) of carbon and alloy steels. Considering the ever increasing demand of steel in infrastructure, manufacturing industries and export market, BPSL now intends to expand the plant capacity to 5.5 MTPA through integrated route of steel production. The enhance capacity of 2.5 MTPA would produce value added products of International standard catering to market demand. This expansion of 2.5 MTPA additional steel, would be largely dependent on the existing infrastructure of the plant. The new facilities proposed under this expansion program would be installed in the area adjacent to its existing plant facilities.

2. After expansion, the plant would produce saleable rolled flat products consisting of hot rolled (HR) coils, CR coil/sheets, galvalume and galvanised coils, colour coated sheets, pipes & tubes and bright bars & rods as listed below:

Hot Rolled Coils	..	29,000
Cold rolled cum annealed coils/sheets	..	500,000
Galvalume coils	..	300,000
Colour coated coils	..	250,000
Galvanised coils	..	250,000
Pipe & tube products	..	600,000
Bright bars & rods	..	300,000
Precision Tubes	..	200,000

Summary (Cont'd)

3. Based on the BF-BOF process route following major plant facilities has been envisaged for the proposed expansion plan.

Sinter plant	..	1 x 450 sqm
Blast furnace	..	1 X 2,015 cum
Coke Oven	..	8 ovens (Modification of existing coke oven from 47 to 55 ovens in one block)
Calcining Plant	..	2 x 600 tpd
Steelmaking	..	BOF - 2 x 250 ton LF - 2 x 250 ton (twin), RH degasser - 2 x 250 ton
Casting and Rolling	..	Thin Slab Casting & Rolling (TSCR)
	..	Bloom Caster
	..	Pipe & Tube Mill
	..	Cold rolling mill
	..	Heavy Rod/Bar & Bright Bar Mill
Captive Power Plant	..	1 x 150 MW

4. Bhushan Power and Steel Limited (BPSL) is located at Rengali of Sambalpur district in the State of Odisha, between latitudes 21° 44' N to 21° 46' N and longitudes 84° 01' E to 84° 03' E and 204 m above mean sea level (MSL). The Rourkela - Jharsuguda - Sambalpur road state highway No. 10 passes on the west of the existing plant site. The nearest railway station is Lapanga on Jharsuguda - Sambalpur line.

5. Requirement of some of the major raw materials considered for the production viz. coking coal, PCI coal and SMS grade limestone would be met through import. Iron ore fines & lump, BF grade limestone, dolomite and quartzite would be procured from indigenous sources. Wagon tipplers/truck tipplers are envisaged for unloading of the raw materials and

mechanised systems are considered for storage and distribution of various raw materials.

6. Requirement of fuel, power and other utilities viz. plant and instrument grade compressed air, steam, industrial gases (oxygen, nitrogen & argon), chilled water would be fulfilled through installation of new facilities/augmentation of existing facilities. Blast furnace gas and LD gas would be available as by-product gases inside the plant for various process needs and heating applications of the plant, besides being a source of power generation. Total make-up water requirement for the plant after full implementation would be about 1,775 cu m per hour, which would be drawn from the backwater of Hirakud Reservoir. A new raw water reservoir of 2.43 lakh cu m capacity has been considered to cater to the additional needs of the expansion.

7. The requirement of power for the expansion would be 1,521 Million KWh, which would be met partly through captive power generation from coal fired power plant. In addition power would also be generated from TRT of blast furnace.

8. The plant is already equipped with all necessary pollution control measures required for the production of 3.0 MTPA crude steel. However, in view of augmentation of aforementioned plant facilities, there would be additional pollution load, for which adequate mitigation measures would be adopted to keep the pollution load within the stipulated norms.

9. It is envisaged that the project would be completed within 36 months from the 'Go-Ahead date'.

10. The estimate of capital cost includes plant cost, preoperative expense, working capital margin and interest during construction. The plant cost comprises the costs of plant & equipment (as erected) together with the cost of pollution control, design, engineering, consultancy & administration during construction and contingency. The capital cost is estimated to be Rs. 9,090 crore approximately. About 7 - 9 per cent of the total plant cost has been kept for environment management measures.

1 - INTRODUCTION

Background

Bhushan Power & Steel Limited (BPSL) is a leading manufacturer of flat and long products and has state-of-the-art plants at Chandigarh, Derabassi, Kolkata and Odisha in India. These plants manufacture value added products covering entire steel value chain since inception from Coal Mining to manufacturing Pig Iron, DRI, Billets, HR Coils, CR Coils, Carbon and Special Alloy Steel Wire Rods and various specialist grades conforming to IS and international standards. BPSL's end-to-end portfolio has enabled it to offer extensive range of products at superior quality consistently surpassing customers' specifications. In addition to export thrust, BPSL also caters to the domestic steel requirements of fast-growing sectors like automotive, white goods, construction/infrastructure, furniture, fasteners, telecommunication, power etc.

BPSL operates an integrated steel plant at Rengali, District Sambalpur, Odisha. The steel products of BPSL cater to the premier segment of end users. At present, the capacity of the plant is being expanded from 3.0 million tons per annum (MTPA) to 5.5 MTPA. The major existing facilities comprise coal washery, iron ore beneficiation plant, pellet plant, sponge iron kilns, coke ovens, sinter plant, blast furnace, steel melt shop, rolling mills, finishing lines, pipe ant tube plant and power plant. The enhance capacity of 2.5 MTPA would produce value added products of International standard catering to market demand. This expansion of 2.5 MTPA additional steel, totalling the plant capacity to 5.5 MTPA, would bank largely on the existing infrastructure of the plant. The new facilities proposed under this expansion program would be installed in the area adjacent to its existing plant facilities.

BPSL vide letter No. MCM/OR/KOL/RKG/RNY/9569 dated 09.06.2014, requested M. N. Dastur & Company (P) Ltd (DASTUR) for preparation of a Feasibility Report for the proposed expansion Project of BPSL.

Structure of the Report

The Pre-Feasibility Report is presented in eight (8) chapters, for the proposed expansion of integrated iron & steel plant to 5.5 MTPA capacity. Following this introduction, product-mix and plant configuration is highlighted in Chapter-2. The plant location and layout is discussed in Chapter-3. Chapter-4 deals with the raw materials requirement for the proposed expansion. The major plant facilities are described in Chapter-5. The environmental pollution mitigation measures are discussed in Chapter-6. Chapter-7 indicates the implementation schedule. The order of magnitude estimates of capital cost is presented in Chapter-8.

Acknowledgment

Consulting Engineers gratefully acknowledge the co-operation and assistance extended by BPSL during the preparation of this Report.

2 - PRODUCT-MIX AND PLANT CONFIGURATION

Product-mix

The proposed plant would be based on flat products and after full implementation the plant would produce saleable rolled flat products consisting of HR & CR coil/sheets, galvalume and galvanised coils, colour coated sheets, pipes & tubes and bright bars & rods. The product-mix adopted for the purpose of this Pre-Feasibility Report is presented in Table 2-1 below:

TABLE 2-1 - PRODUCT-MIX

Sl. No.	Product		Capacity (tpa)
1.	Hot rolled coils	..	29,000
2.	Cold rolled cum annealed coils/sheets	..	500,000
3.	Galvalume coils	..	300,000
4.	Colour coated coils	..	250,000
5.	Galvanised coils	..	250,000
6.	Pipe & tube products	..	600,000
7.	Bright bars & rods	..	300,000
8.	Precision tubes	..	200,000

Plant Configuration

Based on the BF-BOF process route following plant facilities has been envisaged for the proposed expansion plan.

i)	Sinter plant	..	1 x 450 sqm
ii)	Blast furnace	..	2,015 cum (useful volume)
ii)	Coke Oven	..	8 ovens (Modification of existing coke oven from 47 to 55 ovens in one block)
iv)	Calcining	..	2 x 600 tpd
v)	Steelmaking	..	BOF - 2 x 250 ton LF - 2 x 250 ton(twin), RH degasser - 2 x 250 ton
vi)	Casting and Rolling	..	Thin Slab Casting & Rolling (TSCR)
		..	Bloom Caster
		..	Pipe & Tube Mill
		..	Cold rolling mill
		..	Heavy Rod/Bar & Bright Bar Mill

The plant material flow sheet for the proposed process route is given in drawing 11325-2-0001.

3 - PLANT LOCATION AND SITE FEATURES

This Chapter presents the information on plant location, climatic conditions, sources of water and power, road and rail linkage for the proposed expansion of the existing plant of Bhushan Power & Steel Limited.

Plant Location

Bhushan Power and Steel Limited (BPSL) is located at village Thelkoloi, Post Lapanga, Block - Rengali of Sambalpur district in the State of Odisha. The site is between latitudes 21° 44' N to 21° 46' N and longitudes 84° 01' E to 84° 03' E and 204 m above mean sea level (MSL). The plant site is about 16 km from Jharsuguda and about 45 km from Sambalpur. The Rourkela - Jharsuguda - Sambalpur road state highway No. 10 passes on the west of the existing plant site. The nearest railway station is Lapanga on Jharsuguda - Sambalpur line. The seaport Paradip is about 400 km from plant site. The nearest airport is Bhubaneswar. The location of the proposed plant site is presented in Figure 1.

Climatic Conditions

The climatic conditions pertaining to the plant site are as indicated below:

Latitude	..	21^{0} 45′ N
Longitude	..	84^{0} 03′ E
Maximum of mean daily temp.	..	49.8^{0}C
Minimum of mean daily temp.	..	12^{0}C
Relative humidity maximum	..	87%
Relative humidity minimum	..	21%
Relative humidity average	..	54%
Annual rainfall	..	1,461 mm
Mean wind speed	..	4.7 km/hr

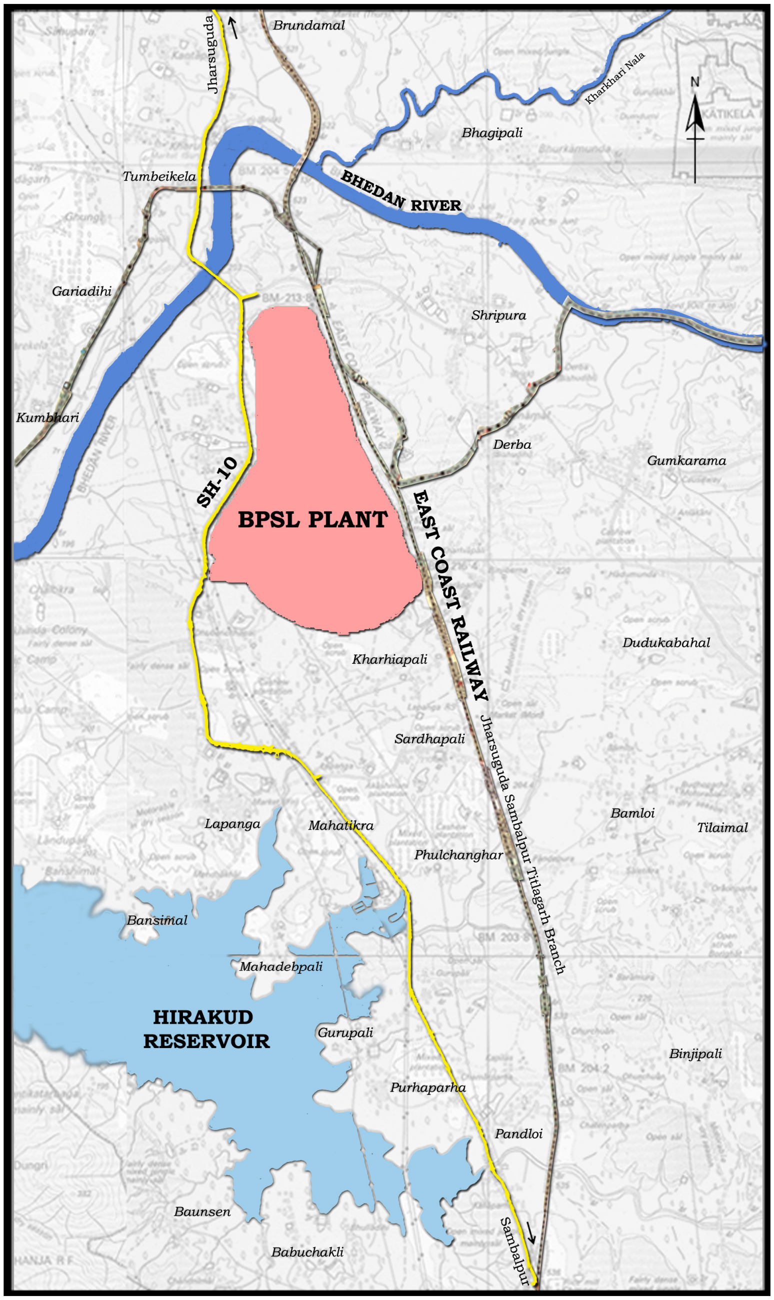


Fig. 3-1 - Site Location Map

Availability of Infrastructure

The availability of major infrastructure like water, power and transport linkages of the plant site are discussed below:

Availability of Water

The total requirement of make up water for the proposed 2.5 MTPA expansion project is around 1,775 cu m/hr, i.e. 9.4 MGD approximately.

The existing plant is drawing water from the back water of Hirakud Reservoir located at a distance of about 11 km from the plant site and the water is perennially available. In addition to the existing raw water reservoirs, one new reservoir of capacity 2.43 lakh cu m is proposed to be constructed to cater the requirement for the proposed units under the expansion project.

Availability of Power

The total power generation at present from the existing CPPs is about 506 MW, which caters to the plant's requirement. Additional power is drawn from Odisha State Electricity Board from their Budhipada substation located at a distance of about 15 km from plant site.

Under the expansion plan, around 150 MW electricity would be produced additionally from coal based Power plant and approx 7.5 MW from TRT.

Road and Rail Linkages

Rourkela - Jharsuguda - Sambalpur road state highway No. SH-10 passes adjacent to the plant boundary on its west. All the approach roads of the existing plant are connected to SH-10.

The Jharsuguda - Sambalpur - Koraput - Raigara railway line of East Coast Railway is passing adjacent to the plant boundary on its east. The plant railway network is connected to the above railway line near Lapanga railway station at a distance of about 8 km from the plant site.

Plant Layout

A preliminary plant general layout has been developed giving due consideration to the land configuration and logistics of receipt and dispatch materials. The major considerations which have influenced the development of the plant general layout are described below:

- The disposition of main production units have been made in such a way that it ensures smooth and unidirectional flow of materials through the process line,
- Optimization of movement from the raw material storage to the finished product,
- Space availability as well as the location of units from operational point of view,
- Logistics for receipt of raw materials despatch of product and in-plant transportation,
- The rail linkage to the existing plant and the need to handle block rakes with independent unloading and loading operations as per railways stipulations,
- Minimum hindrance to existing plant operation during construction,
- Locating manufacturing units at a distance of 500 m from highway,

Disposition of major facilities

Based on the above considerations, conceptual block layout indicating space for the plant production units including major auxiliary facilities has been shown in drawing 11325-3-0001. In general the major product units have been laid out in east to west direction. Some of the salient features of the conceptual layouts are given below:

In-plant transportation: Rail/road transportation would be used for receipt of iron ore, coal and limestone as well as a major share of product dispatch. Road transportation would be used for receipt of miscellaneous raw materials, ferro-alloys, refractories, spares, consumables and waste materials. Conveyors and rail transport would be used for all in-plant material movement.

It is envisaged that around 80% of the additional incoming material for the expansion would be transported by rail transport and the balance would be transported by road. Four (4) Nos. of weighbridge have been considered for the incoming as well as outgoing product by road transportation.

Considering the quantity of saleable steel, provision has been kept for despatch of products by rail. It is proposed to transfer the steel products from the rolling mills by road to a railway loading platform in the proposed railway yard. The product would be loaded on to the wagon by mobile cranes. The other outbound materials would be directly dispatched from the respective storage areas by road.

The railway yard would be linked to East Coast Railway's main line through the existing take off. Full length tracks would be provided in the pre-tippling and post-tippling areas. Since, adequate space is not available beyond the tippler to hold a full rake, a shifter has been proposed for each tippler to shift the empty wagons to a parallel track after tippling. An in-motion rail weigh bridge has been considered for weighing of all outgoing product trains.

4 - RAW MATERIALS

This chapter discusses the annual requirement of major raw materials and indicates their probable source of procurement, size and quality, for meeting the production requirements planned for various units.

Requirement of Major Raw Materials

The annual requirement of major raw materials for the expansion project is given in Table 4-1.

TABLE 4-1 - REQUIREMENT OF MAJOR RAW MATERIALS

Raw materials	Mode of Receipt	Gross quantity Annual, tpa	Daily average, tpd
Power Plant			
Non coking coal	By Rail (WT)	1,123,200	3,077
Coke Oven			
Prime coking coal	By Rail (WT)	48,700	133
Semi-soft coking coal	By Rail (WT)	73,000	200
Calcining plant			
Lime stone	By Rail (WT)	426,764	1,293
Dolomite	By Road	91,305	277
Sinter Plant			
Iron ore fines	By Rail (WT)	4,461,054	13,518
Dolomite	By Road	133,382	404
Lime stone	By Rail (WT)	84,965	257
Quartz fines	By Road	16,137	49
Blast furnace			
Iron ore lump	By Road	440,044	1,257
Quartzite	By Road	53,156	152
PCI coal	By Rail (WT)	271,882	777
BOF			
Iron ore lump	By Road	50,393	168

Moisture, handling and screening losses considered for various raw materials for estimating the gross quantities are given in Table 4-2.

TABLE 4-2 - MOISTURE, HANDLING AND SCREEN LOSSES FOR MAJOR RAW MATERIALS

Consuming unit	Raw materials	Losses considered		
		Moisture %	Handling %	Screening %
Sinter Plant	Iron ore fines	10.00	3.00	0.00
	Limestone	2.00	2.00	4.00
	Dolomite	2.00	2.00	4.00
Coke Oven	Prime coking coal	9.00	1.00	0.00
	Semi soft coking coal	9.00	1.00	0.00
	Soft coking coal	9.00	1.00	0.00
Blast Furnace	Iron ore	10.00	3.00	0.00
	Limestone	2.00	2.00	4.00
	Quartzite	10.00	2.00	0.00
	Coal PCI	10.00	2.00	0.00
	BF Coke	5.00	1.00	0.00
Calcining Plant	Limestone	2.00	2.00	4.00
	Dolomite	2.00	2.00	4.00
BOF	Iron ore	10.00	3.00	0.00

Iron Ore Fines

The analysis of the iron ore fines considered for this project is as follows:

Products	Fe (%)	SiO_2 (%)	Al_2O_3 (%)	Size
Iron ore fines	63.07	2.65	2.04	(-)10 mm, (-)100 mesh (max. 15 %)

Iron ore in the form of lump for use in blast furnace and BOF would be met through purchase. A typical analysis of such iron ore considered for the expansion project is as follows:

Fe (%)	SiO_2 (%)	Al_2O_3 (%)
63.83	1.76	1.85

Coal for injection: Coal with low volatile matter and ash content around ten (10) per cent would be used for pulverized coal injection (PCI) in blast furnace. As such coal is not available in India, the same would be met through imports. The possible sources are Australia and Indonesia. The quality of Australian PCI coal on dry basis is presented below:

Ash %	**VM** %	**FC** %	**S** %
10.82	15.85	78.33	0.55

Australian PCI coal is having low volatile matter and high fixed carbon. Accordingly, for quality reasons, PCI coal may be sourced from Australia.

Coking Coal: It is envisaged that the entire requirement of hard, semi-soft and soft coking coal with low ash content for the proposed integrated steel plant would be met through imports. The possible sources are Australia, China, South Africa, Mozambique, etc. All imported coal would be procured in the size of (-)50 mm. The typical quality of different varieties of coking coal on dry basis is presented below:

Parameters	**Hard coking coal**	**Semi-soft coking coal**
Ash, %	8 to 9	8 to 9
VM, %	20 to 21	24 to 26
Ro	1.15 to 1.20	0.95 to 1.0
CSN	7 to 8	5 to 6

Limestone

BF grade limestone would be used in the blast furnace, while the SMS grade limestone would be used in calcining plant. The total requirement of limestone would be procured from out side with a size range of (+) 40 to (-) 90 mm. A typical chemical composition of limestone considered for the project is as given below:

SiO_2	Al_2O_3	CaO	MgO
0.99%	0.52%	52.27%	1.98%

Dolomite

It is envisaged that the entire requirement of dolomite for use in lime calcining plant would be met from Baradwar region. The typical analysis of Karnataka dolomite is as follows:

CaO %	MgO %	SiO_2 %	Al_2O_3 %	LOI %
30.80	19.12	0.86	0.29	46.05

Quartzite

It is proposed to use quartzite in the blast furnace. It is suggested to procure quartzite from local sources in the size of (+) 10 to (-) 40 mm. A typical analysis of quartzite is as follows:

SiO_2 %	Al_2O_3 %
96.92	0.92

Coal for power plant

A typical analysis of coal to be used in power plant is given below:

Ash, %	VM, %	FC, %	Moisture, %
53.4	22.4	24.20	10.5

5 - MAJOR PLANT FACILITIES

This Chapter describes the major plant facilities envisaged for the project.

Raw Material Handling System

This chapter describes facilities provided for receipt of raw materials, unloading, storage, stockpiling, reclamation and subsequent distribution of the various raw materials to the different consuming units.

Receipt and Unloading of Raw Materials: One (1) No. wagon tippler has been considered for unloading coal and two (2) Nos. truck tipplers have been considered for unloading limestone and lump iron ore respectively for the proposed expansion.

The coking coal and PCI coal would be imported through Paradip port (400 km) and brought to the plant by railway wagons. The average daily quantity of coking coal to be handled about 333 ton.

The iron ore fines would be brought from Bansapni by railway wagons or trucks. The average daily quantity of iron ore fines to be handled would be about 11,651 ton. The iron ore lump would be brought from the same location by truck. Average daily quantity of iron ore lump to be handled about 661 ton. Iron ore lump would be unloaded in the yard by truck tippler.

Part of Limestone would be imported and brought to the plant by railway wagons from the nearest port at Paradip and balance limestone and dolomite would be brought to the plant by road and unloaded in the yard by truck tippler. The average daily quantity of limestone is to be handled about 1,374 ton and that of the dolomite is 236 ton.

The non-coking coal for power plant would be brought from Ib Valley by railway wagons. The average daily quantity of non coking coal to be handled about 3,077 ton.

Major incoming raw materials for the expansion, their mode of receipt, annual and daily quantities required for the steel plant are given in Table 5-1 below.

TABLE 5-1- RECEIPT AND MODE OF TRANSPORT OF MAJOR RAW MATERIALS

Raw materials	Mode of Receipt	Gross quantity Annual, tpa	Gross quantity Daily average, tpd
Power Plant			
- Non coking coal	By Rail (WT)	1,123,200	3,077
Coke Oven			
- Prime coking coal	By Rail (WT)	48,700	133
- Semi-soft coking coal	By Rail (WT)	73,000	200
Lime Calcining Plant			
- Lime stone	By Rail (WT)	453,500	1,374
- Dolomite	By Road	78,000	236
Sinter Plant			
- Iron ore fines	By Rail (WT)	3,844,400	11,651
- Dolomite	By Road	319,700	969
- Lime stone	By Rail (WT)	263,500	798
- Quartz fines	By Road	30,200	92
- Purchased coke breeze	By Road	142,000	430
Blast Furnace			
- Iron ore lump	By Road	183,900	525
- Quartzite	By Road	48,000	137
- PCI coal	By Rail (WT)	239,800	685
BOF			
- Iron ore lump	By Road	40,800	136
- Ferro alloy	By Road	28,300	94
LF			
- Fluorspar	By Road	4,100	14
- Ferro alloy	By Road	12,100	40
- Electrode	By Road	800	3
RH			
- Ferro alloy	By Road	5,500	18

NOTE:

1. The daily average quantities have been derived considering the following days of working for the process plants:

    i) Power Plant - 365
    ii) Coke oven - 365
    iii) Sinter plant - 330
    iv) Blast furnace - 350
    v) Steelmelt shop - 300
    vi) Lime calcining plant - 330

The total quantity and mode of transportation of coal required for expansion to 5.5 MTPA is indicated in Table 5-2 and quantities in-plant generated material to be handled is given in Table 5-3 on the next page.

TABLE 5-2 - RECEIPT AND MODE OF TRANSPORTATION OF COAL

Raw materials	Mode of receipt	Gross Quantity	
		Annual, tpa	Daily Average, tpd
Coking coal			
- Semi-soft	Rail	73,000	200
- Prime	Rail	48,700	133
Non-coking Coal			
- Power Plant	Rail	1,123,200	3,077
- PCI coal for BF	Rail	239,800	657

NOTE:

1. As brought to plant including moisture and handling losses, 365 working days have been considered per year to arrive at average daily receipt quantities.

2. Peak factors of 50 per cent and 33 per cent have been considered for imported and indigenous materials respectively.

TABLE 5-3 - QUANTITIES OF IN-PLANT GENERATED MATERIALS TO BE HANDLED

Materials	Quantity (1) tons/yr	Movement particulars
Product sinter	4,800,000	-
Sinter to proposed BF stock house	2,160,100	From existing transfer point to BF stock house by conveyor
Total charge sinter	4,320,000	-
Pellet to proposed Blast Furnace	259,000	From existing transfer point to BF stock house by conveyor
Gross coke	1,091,700	From coke oven to coke crushing screening building by conveyor
Hard & nut coke to proposed BF stock house	614,200	From coke crushing screening building to BF stock house by conveyor
Charge coke to proposed Blast Furnace	601,200	-
Coke Breeze	107,100	From coke crushing screening building and BF stock house to sinter plant by road.
Calcined Lime	145,000	From Lime calcining plant to SMS by conveyor
Lime Fines	63,000	From Lime calcining plant to SP by road
Calcined Dolo	30,600	From Lime calcining plant to SMS by conveyor
Dolo Fines	4,300	From Lime calcining plant to SP by road

NOTES:
(1) The in-plant generated materials are indicated on net & dry basis.

Storage and Stockpiles of Raw Materials: All the raw materials except coking coal, power plant coal and PCI coal would be brought to the plant by road - either by dumpers or trucks of capacity of about 20 tons. The above materials would be unloaded in respective stockpiles built up in the storage yard.

Coking coal, steam coal, PCI coal, iron ore fines and imported limestone would be received in plant site by railway wagons. One (1) wagon tippler has been envisaged for handling the rakes of coking coal, power plant coal and PCI coal.

Coking coal and steam coal, unloaded in wagon tippler, would be conveyed by belt conveyor and stored in respective stockpiles by two (2) Nos. separate rail mounted single boom stacker cum reclaimer working with its yard conveyor. Separate stock piles would be built up in the storage yard for two grades of coking coal, i.e. semi soft and prime grade. PCI coal would be conveyed by belt conveyor and stored in separate covered storage by travelling tripper.

Iron ore lump and flux materials, the limestone, after unloading in two (2) Nos. separate truck tipplers, would be conveyed by belt conveyor and stored in separate stockpiles by travelling trippers. Other flux material, dolomite would be stored in stockpile by dump trucks.

Handling System for Sinter Plant: Receipt, storage and handling of sinter plant feed materials, i.e. iron ore fines, limestone, dolomite and other additives like mill scale; flue dust return sinter etc would be through conveying system considered in 3 MTPA capacity stage.

Sinter received from existing sinter conveyor would be conveyed to the proposed new sinter storage building and from there it would be further transported to proposed blast furnace by conveyor.

Handling System of Coal for Coke Oven Plant and Power Plant: Semi-soft and prime grade coking coals would be reclaimed by stacker cum reclaimer and conveyed to coal blending bunkers through conveyor system.

The above grades of coal would be withdrawn by weigh feeders from coal blending bunkers proportionately and then that would be despatched to coal tower of coke oven plant after crushing.

Power plant coal would be reclaimed by stacker cum reclaimer and conveyed to proposed power plant through conveying system.

Coke handling system: From wharf conveyor, coke would be transported to the coke crushing & screening building by conveyor system. In coke crushing & screening building, screens would separate hard & nut coke and coke fines and would be stored in their respective storage bunkers.

From coke crushing screening building, hard and nut coke would be transported to proposed BF stock house by a series of conveyor system. Coke can also be transferred to emergency coke storage yard through a conveyor & fixed tripper system. Similarly, coke fines would be transported towards proposed sinter plant.

Handling System for Calcining Plant: SMS grade lime stone/raw dolomite would be reclaimed from the respective stockpile at storage yard by pay loaders and conveyed to the storage bins of calcining plant.

Lime/burnt dolomite handling system: Calcined lime/dolomite (SMS grade) would be transported to BOF shop through conveying system. Lime/dolomite fines would be transported to the proposed sinter plant by road.

Handling System for Blast Furnace: Product pellet received from existing pellet conveyor would be transported to proposed BF stock house by a series of conveyor system.

Lump iron ore and quartzite would be reclaimed from the respective stockpile at storage yard by pay loaders and conveyed to the BF stock house by a series of conveyor system.

PCI coal would be reclaimed from the covered storage at storage yard by pay loaders and conveyed to the BF stock house by a series of conveyor system.

Iron Ore Handling System for Steelmelt Shop: Lump iron ore would be reclaimed from the respective stockpile at storage yard by pay loaders and conveyed to SMS by a series of conveyor system.

Coke Ovens

Design Basis: By-product recovery type stamp charge (SC) coke ovens (COB-2) of 5.5 m height, currently under implementation for steel plant expansion up to 3 MTPA stage, will cater to one 2,015 cu m blast furnace (BF-2) and the proposed new blast furnace of 2,015 cu m. The capacity of this coke oven plant, with 47 Nos. of ovens in two (2) blocks, will be enhanced by installation of 55 Nos. of ovens in the second block. Total gross coke production from the coke oven considering additional eight (8) Nos. batteries will be around 1,091,700 tpa on dry basis.

Charge coke requirement for the proposed new blast furnace of 2,015 cum useful volume will be about 601,200 tpa. This will be met partly from COB-2 and the rest through purchase.

Requirement of coke for the proposed plant, on dry basis is given below in Table 5-4.

TABLE 5-4 - COKE REQUIREMENT

Gross coke production, tpa	1,091,700
Charge coke requirement in BF-2, tpa	605,100
Charge coke requirement in new BF, tpa	601,200
Coke breeze requirement in sinter plant, tpa	280,800
Excess (+)/shortfall (-)of coke, tpa	
- Hard & Nut coke	(-)211.500
- Coke breeze	(-)142,800

Shortfall of charge coke (hard + nut) of about 211,500 tpa, will be met through purchase of about 235,000 tpa gross coke (on dry basis). Shortfall of coke breeze of about 142,800 tpa for 450 sq m sinter plant will be met through purchase.

Sinter Plant

One sinter machine of 450 sq m would be installed under the proposed expansion to produce 4,800,000 tpa product sinter which would cater to a new blast furnace of 2,015 cu m capacity and the existing blast furnace of 2,015 cu m capacity.

Design Basis: The design basis considered for sinter plant is given in Table 5-5 below.

TABLE 5-5 - DESIGN BASIS OF SINTER PLANT

Product sinter, tpa	..	4,800,000
Product sinter to existing 2,015 cu m blast furnace, tpa	..	2,159,900
Charge sinter to new 2,015 cu m blast furnace, tpa	..	2,160,100
Screening at BF stock house, %	..	15
Operating days/year	..	330
Daily product sinter, tpd	..	14,540
No. of strand	..	1
Approx. suction area, sq m	..	450
Product sinter size, mm	..	5-50
Temperature of sinter at cooler discharge, ^{o}C	..	100

Raw Materials: The typical analyses of input raw materials (dry basis) for sinter production are given in Table 5-6.

TABLE 5-6 - TYPICAL ANALYSES OF RAW MATERIALS FOR SINTER PRODUCTION

	Fe %	SiO_2 %	Al_2O_3 %	CaO %	MgO %	LOI %
Iron ore fines ..	63.07	2.65	2.04	-	-	2.24
Limestone ..	0.196	0.99	0.52	52.27	1.98	42.34
Coke breeze ..	1.74	6.62	4.00	0.80	0.45	85.00
Lime ..	-	3.00	2.50	83.00	3.20	4.00
Dolomite ..	-	3.00	2.00	30.0	21.0	41.0

Sinter Quality: The expected chemical analysis of sinter is as follows:

Fe, %	-	56.96
Al_2O_3, %	-	2.16
MgO, %	-	1.87
CaO/SiO_2, %	-	1.85

Physical and metallurgical properties of sinter would be as follows:

ISO tumbler index (+6.3 mm)	..	76% (min)
Reducibility index	..	65% (min)
RDI (-3.15 mm)	..	28% (max)
Sinter size range	..	5-50 mm
Sinter mean size	..	18 mm

Consumption of Input Materials: The annual input material consumption for production of 4,800,000 tpa product sinter is given in Table 5-7 below.

TABLE 5-7 - CONSUMPTION OF INPUT MATERIALS

Materials		Annual consumption, tpa
Iron ore fines	..	3,844,800
Limestone	..	263,500
Dolomite	..	319,700
Calcined lime	..	63,000
Coke breeze	..	280,800
Mill scale	..	14,600
Quartz fines	..	80,200

NOTE:

(1) Quantities are approximate net input for sinter plant on dry basis.

The raw materials, viz., iron ore fines, flux, coke breeze, calcined lime and mill scale would be fed to the bins in the proportioning section of sinter plant and would be proportioned through weigh feeders provided below the proportioning bins.

Grain size of input materials: The grain size of input materials would be as follows:

Iron ore fines	..	0-10 mm with 15-20%-100 mesh
Limestone	..	0-3 mm
Dolomite	..	0-3 mm
Calcined lime	..	0-1 mm
Coke breeze/anthracite	..	0-3 mm
Mill scale	..	0-3 mm

Plant Facilities: The following major units/facilities have been envisaged for sinter plant:

- Proportioning and sinter machine building
- Mixing and nodulising building
- Sinter cooler
- Cascade chute and double roll crusher building
- Sinter screening building
- Waste gas dedusting system
- Plant dedusting system
- Cranes and hoists
- Sinter emergency storage bin

Blast Furnace

One new blast furnace of 2,015 cu m would be installed under expansion to 5.5 MTPA. Annual hot metal production capacity of blast furnace would be 1,575,200 tpa.

Design Basis: The blast furnace would incorporate all the modern technological features. The design basis of blast furnace is given in Table 5-8 on the next page.

TABLE 5-8 - DESIGN BASIS OF BLAST FURNACE

Hot metal production, TPA	..	1,575,200
Daily production capacity, t HM/day (avg)	..	4,500
No. of furnaces	..	1
Useful volume, cu m (approx)	..	2015
Operating days	..	350
Productivity, t/(useful volume)/day (approx.)	..	2.27
Burden:	..	
Sinter, %	..	75
Pellet, %	..	10
Ore, %	..	15
Coke rate (including nut), Kg/thm	..	378
Coal rate, Kg/thm	..	150
Slag rate, Kg/thm	..	300
Coke ash, %	..	12.5

Raw Materials: The major raw materials for new blast furnace comprise sinter, pellet, additives and coke. Pulverized coal would be injected through tuyeres as auxiliary fuel in the blast furnace. The typical analysis of raw materials envisaged is given in Table 5-9.

TABLE 5-9 - TYPICAL RAW MATERIALS ANALYSIS (dry basis)

		Fe	SiO_2	Al_2O_3	CaO	MgO
		%	%	%	%	%
Pellet	..	65.00	2.50	1.75	0.40	-
Quartzite	..	0.50	96.00	0.92	-	-

		Ash	Moisture	CSR
		%	%	%
Coke	..	12.5	6.0 (max)	63 (min)
Coal for PCI application				
Ash, % (dry basis)	..	10-12		
Fixed carbon, %	..	70		

Consumption of Input Materials: The requirement of annual input materials on dry and net basis is given in Table 5-10 on the next page.

TABLE 5-10- ANNUAL REQUIREMENT OF RAW MATERIALS

Material		Annual Requirement[1], tpa
Charge sinter	..	2,160,100
Charge pellet	..	259,000
Charge Coke	..	601,200
PCI coal	..	239,800
Quartzite	..	48,000

NOTE:
(1) Quantities are on net and dry basis.

Hot Metal Quality: The expected hot metal analysis is given below:

Si, %	..	0.6 - 0.8
S, %	..	0.045 (max)
P, %	..	0.10

Major Facilities: The plant comprises following facilities:

- BF proper
- Tuyere platform and cast house
- Slag granulation plant
- Hot blast stoves (top fired)
- Gas cleaning plant
- TRT (top gas recovery turbine)
- Stock house and charging system
- Hot metal handling system
- Cranes and hoists
- Coal dust injection system
- Pig casting machine and ladle repair shop
- Stock house & cast house de-dusting system
- Air blowing system
- Plant electrics
- Instrumentation, automation and control system
- Communication system
- Water system
- Utility system
- Fire fighting system
- Air-conditioning and ventilation system

Steelmelt Shop

Facilities and process route of steel making have been envisaged taking into consideration the production of liquid steel of equivalent quantity for 2.2 MTPA hot rolled coils production.

Design Basis

Production Plan: The production of liquid steel as envisaged based on the requirement of about 2.2 MTPA hot rolled (HR) coils to be produced from thin slab casting and rolling unit is as follows:

Liquid steel	..	2,255,000
HR coils	..	2,200,000

Additionally around 300,000 TPA of blooms would be produced through one 2 strand Bloom Caster for production of Bright Bars & Heavy rods.

The grade-wise production of hot rolled coil products and equivalent quantity of liquid steel are indicated below:

Steel grades	HR coils, tpa	Liquid steel, tpa
Re-rolling grades	70,000	72,400
Cold forming grades	230,000	239,500
Dual phase steel	70,000	72,000
Boiler quality steel	70,000	72,000
Steel for tubes and pipes	600,000	615,100
Structural steel for general engineering purpose	171,000	174,000
Micro alloyed steel for automotive application	135,000	136,000
Deep drawing quality steel (IF steel)	135,000	136,000
Weathering steel	71,000	73,500
Medium carbon steel	330,000	338,500
Electrical steel	176,000	179,000
API grades	71,000	73,500
Steel for pressure vessel	71,000	73,500
Total	**2,200,000**	**2,255,000**

Depending on the quantity and quality of steel to be produced, one (2) Nos. 250 ton capacity BOF, one (2) Nos. 250 ton capacity twin station ladle furnace (LF) and one (2) Nos. 250 RH degasser have been envisaged for steel making and secondary refining. Two (2) Nos. of single strand thin slab casters are envisaged to cast the liquid steel in thin slab casting and rolling (TSCR) process for production of hot rolled coils (HR coils). One (1) Nos. of 2 strand Bloom Caster is envisaged for production of Bright bar & heavy rods.

Major Facilities

Pre-treatment Facilities

Hot Metal Desulphurisation Plant (HMDP): The sulphur content in hot metal is 0.045 per cent (max). In order to meet the requirement of low sulphur content in steel, desulphurisation of hot metal has been envisaged prior to feeding into steel making furnaces. Hot metal would be desulphurised by deep injection of a combination of desulphurising reagents (calcium carbide and magnesium) in charging ladle by injection lances. Provision for mono-injection (CaC_2) and co-injection (CaC_2 + Mg) as well as deslagging would be provided.

Steel Making Facilities

Basic Oxygen Furnace: The liquid steel would be produced about 2,255,000 tons through basic oxygen furnace (BOF) route. For achieving the desired annual production, it is proposed to install two (2) 250 ton capacity BOFs. The technical parameter of the BOF is presented below.

Production of liquid steel (tons/annum)	..	2,255,000
BOF operating days/year	..	300
No. of installed BOF	..	2
Tap to tap time, min.	..	40

Ladle Furnace: For the purpose of secondary metallurgy, two (2) Nos. twin station ladle furnace (LF) of 250-ton capacity with 40 MVA transformer is envisaged for further treatment of liquid steel including homogenization of chemistry and to raise temperature of liquid steel before casting.

The LF would also function as a holding unit for facilitating sequence casting of heats in the caster.

Number of unit	..	Twin station type with arc heating and inert gas stirring
Heating rate	..	4-5ºC/min.
Furnace cover (roof)	..	Water cooled lift and lower type

RH Degasser: Two (2) Nos. of 250 ton capacity RH degasser unit are envisaged for installation. The salient features of RH unit are as follows:

Vessel refractory heating system	..	Multipurpose lance to be used for heating and blowing
Micro alloy addition system	..	Mechanised addition of micro alloy under vacuum

The ladle would be brought to the treatment position on a self-propelled car. The vacuum vessel system would have vessel lifting system, hot off-take, cooler and would be connected with vacuum pump system. A ferro-alloy addition system would be provided for addition and trimming alloy under vacuum. The unit would be equipped with temperature and sampling device, vessel exchange and maintenance equipment, vessel heating system etc. Provision for oxygen blowing facility would be kept.

The RH degasser unit would be designed to achieve the following final gas content in steel depending on the initial values:

Hydrogen	< 1.5 ppm
Nitrogen	< 30 ppm
Oxygen	< 20 ppm

Endless Strip production (ESP) plant:

Design parameters: The design parameters of the thin slab caster of ESP are indicated below:

No. of ESP envisaged	..	1
No. of strand for casting	..	1
Type of machine	..	Curved type
Thin slab thickness, mm	..	110-80
Thin slab width, mm	..	850-1880
Casting speed, m/min	..	7 (max)
Ladle handling	..	Ladle turret
Tundish handling	..	Tundish car
Dummy bar	..	Rigid type
Withdrawal & straightening unit	..	Pinch rolls
Type of slab cutting	..	Pendulum type mechanical shear
Machine working, days/yr	..	300

Bloom caster:

Design parameters: The design parameters of the billet cum bloom caster are indicated below:

No. of strands	..	6
Type of machine	..	Curved type
Casting radius	..	12 m
Sizes of semis, mm	..	160x160-320x400
Cutting length, mm	..	4-12
Reference casting speed, m/min	..	3.2 (160x160 mm) 1.6 (200x200 mm) 1.2 (240x280 mm)
Ladle handling	..	Ladle turret
Tundish handling	..	Tundish car
Dummy bar	..	Rigid type
Type of semis cutting	..	Torch cutting
Mould level control	..	Automatic
Machine working, days/yr	..	320

Bright Bar & Heavy Rod Mill : One 0.3 MTPA Bright Bar & Heavy Rod Mill with coil drawing line and centerless grinding line is envisaged for production of bright bars and heavy rods.

Calcining Plant

The annual net requirements of calcined lime and burnt dolomite for steelmaking are 145,000 tons and 30,600 tons respectively. The size range of calcined products to be used in SMS would be 10 to 60 mm. The calcined products would be screened before dispatch to the steel melt shop and the undersize lime fines would be sent to the sinter plant. In order to meet the requirement of lime fines for the sinter plant, it is required to produce 63,000 tpa calcined lime.

Considering additional requirement of sinter plant, handling and screening losses as well as fluctuation in the specific consumptions of calcined lime and burnt dolomite, the daily peak production requirement is estimated as 650 tons for calcined lime and 135 tons for burnt dolomite based on 330 days working annually. The installation of a separate dolomite kiln for the above production would make non uniform kiln size with respect to the existing kilns operating at BPSL.

In view of the above and considering the requirement for the present operating units, it is proposed to install two (2) Nos. each of 600 tpd capacity vertical shaft kilns for the production of calcined lime and burnt dolomite in separate campaign.

The calcining plant would comprise of raw materials storage and handling, kilns with kiln feed buildings, calcined products handling and storage facilities. Various utilities, such as fuel, electric power, water, compressed air etc, would be made available to the plant. Mixed gas (BF+CO) having calorific value of 2,200 Kcal/N cu m would be used as fuel.

The plant would be provided with kiln waste gas cleaning system and dedusting system for the calcined materials handling facilities.

Rolling Mills

The envisaged product-mix and the rolling mill facilities detailed out in this section.

Product-mix: The size-wise and grade-wise product-mix envisaged is given in Table 5-11 on the next page.

TABLE 5-11 - PRODUCT-MIX

Product	Size range, mm
Hot rolled coil	
- Width	900 - 1,550
- Thickness	1.0 - 20.0
Cold rolled and annealed coil	
- Width	900 - 1,550
- Thickness	0.3 - 2.5
Galvanised coil (GI & GA)	
- Width	900 - 1,550
- Thickness	0.18 - 1.25
Galvalume coil	
- Width	900 - 1,550
- Thickness	0.1 - 1.55
Colour coated coil	
- Width	900 - 1,550
- Thickness	0.1 - 1.55
Tube & pipes	
- OD	6 - 219

Based on the product-mix and the production programme, the following rolling mills have been considered.

Thin Slab Casting and Rolling Mill (TSCR): The thin slab casting and rolling mill has been envisaged for a production of around 2.2 million tons of hot rolled coils per year.

Liquid steel from the steel melt shop would be used as input for the thin slab caster of TSCR and the slabs produced from TSCR would have the following specifications:

Slab size		
Thickness, mm	..	50 - 90
Width, mm	..	900 - 1,550
Coil size		
Strip thickness, mm	..	1.0 - 20.0
Strip width, mm	..	900 - 1,550
Coil inner diameter, mm	..	762
Coil outer diameter, mm	..	2,100 (max.)
Coil weight, tons	..	30 (max.)

Liquid steel would be transferred in ladles from steel melt shop to the TSCR, which would comprise the following major facilities:

- Thin slab casters
- Pendulum shears at casters exit
- Roller hearth type tunnel furnace
- Pendulum shear at entry of mill
- De-scaling system
- Roughing mill
- Finishing stands
- Run-out roller table
- Laminar cooling system
- Two nos. down coilers
- Coil conveyor system (with inspection & sampling station, coil strapping, coil weighing and coil marking machine).

However, the line configuration would be finalised after the selection of technology supplier. Apart from the above, the shop would be provided with roll shop, auxiliary and ancillary facilities.

Cold Rolling Mill Complex: Cold rolling mill complex has been envisaged for production of cold rolled annealed, galvanised, galvalume and colour coated coils. The cold rolling mill is envisaged to produce coils for commercial, construction and white goods sector.

In order to cater to the production of cold rolled continuous annealed, galvanised, galvalume and colour coated coils following major processing facilities are envisaged:

- One continuous pickling line with a capacity of 1.57 MTPA along with matching capacity of acid regeneration plant (ARP).

- Two reversing cold rolling mills to produce about 1.5 MTPA of full hard cold rolled coil (FHCR).

- One continuous annealing line (CAL) with a capacity of about 0.7 MTPA.
- One hot dip galvanising line (CGL) to produce GI & GA coils of about 0.3 MTPA.

- One hot dip galvalume line (GALV) to produce galvalume coils of about 0.5 MTPA.

- A part of galvanised and galvalume coil would be process in colour coating lines (2 Nos. of 125,000 tpa each) for production of colour coated coils

- 1 Nos. 0.2 TPA Precision Tubes line

- 2 Nos. automatic packaging line - one No. Each for annealed coils and galvanised/galvalume coils

Continuous Pickling Line (CPL): The design basis for the CPL would be as follows:

Nominal capacity, MTPA	..	about 1.15 MTPA
Pickling medium	..	Hydrochloric acid
Input coil size		
- Strip width, mm	..	900 - 1,350
- Strip thickness, mm	..	2.0 - 6.0
- Coil weight, ton	..	30 (max.)
Output coil size		
- Strip width, mm	..	900 - 1,350
- Strip thickness, mm	..	2.0 - 6.0
- Coil weight, ton	..	30 (max.)

The CPL would have following major process equipment:

- Entry coil conveyor
- Entry coil car
- Pay-off reel
- Welder
- Entry looper
- Scale breaker
- Pickling tanks
- Exit looper
- Side trimmer
- Exit shear
- Tension reel
- Exit coil car
- Exit coil conveyor

Auxiliary facilities would include acid regeneration plant, water system, utility systems, electrics, etc.

Reversing Cold Rolling Mill: Two Nos. reversing cold rolling mill for production of about 1.5 MTPA of FHCR coils have been envisaged for further processing into CAL & CGLs.

Input coil size		
- Input material	..	HR pickled coils
- Strip width, mm	..	900-1,350
- Strip thickness, mm	..	2.0-6.0
- Coil weight, ton	..	30 (max.)
Output coil size		
- Strip width, mm	..	900 - 1,350
- Strip thickness, mm	..	0.12 - 2.5
- Coil weight, ton	..	30 (max.)

Hot Dip Galvanising & Galvalume: One each continuous galvanising line & Galvalume line has been proposed.

The design basis for the CGL & Galv line would be as indicated in Table 5-12.

TABLE 5-12 - DESIGN BASIS OF GALVANISING & GALVALUME LINE

		CGL	GALV
Capacity, '000 tpa	..	300	500
Input coil size			
- Strip width, mm	..	900-1,350	900-1,350
- Strip thickness, mm	..	0.16 -1.2	0.17-1.25
- Coil weight, ton, max	..	25	25
Output coil size			
- Strip width, mm	..	900-1,350	900-1,350
- Strip thickness, mm	..	0.16 -1.2	0.17-1.25
- Coil weight, ton, max	..	25	25

CGL would have GI and GA coating facility.

Continuous Annealing Line (CAL): One CAL of 0.7 MTPA capacity is proposed for construction and commercial grades. The design basis for the CAL would be as follows:

Nominal capacity, MTPA	..	0.7
Input coil size		
- Strip width, mm	..	900-1,350
- Strip thickness, mm	..	0.35-2.5
- Coil weight, ton	..	30 (max.)
Output coil size		
- Strip width, mm	..	900-1,350
- Strip thickness, mm	..	0.35-2.5
- Coil weight, ton	..	30 (max.)

Colour Coating Line (CCL): Two Nos. CCL of 125,000 tpa each for further processing the galvanised and galvalume product has been envisaged to produce colour coated coils.

Coil Packaging Line: Two Nos. fully automated coil packaging lines would be provided, one each for cold rolled continuous annealed and galvanized/galvalume product. The packaging line consist of a number of work stations on a long walking beam on regular intervals to carry out all the distributed strapping, wrapping as required for packaging one after another in a logical sequence.

5 - Major plant facilities (cont'd)

Tube and Pipe Mill

In order to produce 600,000 tpa, the entire range of tubes and pipes, eleven (11) Nos. ERW Pipe plant including three (3) Nos. Galvanising units have been proposed.

Design Basis: The suggested product-mix of BPSL for nominal annual production of 0.6 million tons of ERW Pipe is indicated below:

OD Range		Yearly Production Qty
From	**To**	
mm	mm	MT
6.00	25.00	10,000
20.00	32.00	30,000
9.50	38.10	30,000
13.00	42.40	60,000
15.88	63.50	70,000
15.88	76.20	60,000
15.88	76.20	50,000
15.88	76.20	50,000
33.40	88.90	60,000
31.75	127.00	80,000
88.90	219.00	100,000
	Total	**600,000**

Input Material: Input material would be HR coil and FHCR coil from in house TSCR & cold rolling mill. Input strip width would be 19 mm to 1,500 mm and thickness would be from 0.40 mm to 8.0 mm.

The following facilities are proposed to be installed in ERW Pipe mill.

- Strip Un-coiler
- Pinch roll
- Head and Tail Shear
- Butt Welder
- Accumulator
- Full Leveller
- Edge milling machine
- Forming section
- High Frequency Welding Unit

- Bead trimmers
- On-line seam annealing device
- Water Cooling section
- Sizing equipment
- Ultrasonic testing Unit
- Flying Saw Cutter
- Finishing equipment
- Testing facilities

Captive Power Plant

It is proposed to install a coal based thermal power plant as a part of expansion programme.

Project		Capacity
Coal Based Thermal Power Plant	..	1 X 150 MW

Project envisages installation of 150 MW CPP consisting of pulverized coal fired boilers or circulating fluidized bed combustion boilers, steam turbine generators with associated auxiliaries.

Process Description: The Plant would primarily consists of one (1) No. Pulverized fuel fired Boiler or Circulating fluidized Bed Combustion (CFBC) boilers and one (1) No. steam Turbine Generator with all other equipments and systems.

The power plant would be based on the traditional RANKINE CYCLE which is being used in almost all power plants. It is proposed to have steam parameters of 115 ksca pressure and 540 ± 5^{o}C temperature at boiler outlet. The feed water temperature entering economizer would be 230^{o}C.

Process and Control Mechanism: The steam generator would receive the water from Water Treatment System (DM plant);

which would convert raw water to soft water suitable for the steam generator application. The steam generated would be passed through the Turbine attached to it wherein the steam would rotate the coil of turbine in magnetic field to produce electricity.

This electrical energy would be supplied at step-up transformer; from where, it is transmitted at high voltage to step-down transformer for distribution.

Part of the steam would be used to regenerate the feed water temperature and thereby improve the thermodynamic cycle efficiency. The steam during this process gets cooled and then; it would pass through Water Cooled Condenser.

This condensate so formed would be pumped back with pumps to the deaereator and then to the steam generator. The coal combustion would emit exhaust gases, which would be passed through an Electrostatic Precipitator, which would reduce the emission levels before passing out through the common RCC chimney of suitable height for one (1) No. boiler.

The ash generated from the steam generator would be sent through a high-pressure pneumatic system to transfer ash to a silo.

Fuel Details:

1. Ultimate Analysis of Indian coal

Constituents	Non-coking coal
Moisture	10.50%
Ash	51.50%
Carbon	31.66%
Hydrogen	2.04%
Sulphur	0.56%
Nitrogen	0.61%
Oxygen	3.12%

2. Fuel Consumption Details

Fuel		Quantity
Indian coal (Non-coking coal)	..	1.60 MTPA
LDO	..	50 KL tank
HFO	..	1,000 KL tank

This estimate is based on the use of Indian coal with CV of 3,160 kcal/kg with an average annual station load factor of 90%.

Diesel Oil: Light diesel oil would be used during starting and Heavy Fuel oil would be used for load rising. Furnace oil would be used for stabilization.

Coal Preparation and Firing System for PC Fired Boiler: The coal preparation and firing system would comprise of Bowl mills/Ball mills. The number and capacity of the mills would be so selected that while firing the worst and design coals at BMCR the following spare capacities would be ensured, with ball filling in ratio less than 20% in case of ball mills.

- At least one (1) mill would be spare at 100% TMCR condition (150 MW) while firing the worst coal

- At least two mills would be spare at BMCR while firing the design coal.

Coal from raw coal bunkers would be fed into the mills by gravimetric raw coal feeders, each mill would be provided with independent seal air system consisting of 2 x 100% capacity fans, filters, piping valves and fittings. There would be two axial PA fans or individual PA fans for each mill for transporting the pulverized coal from mills to burners

Fuel Handling System: A suitable coal handling system comprising crusher & screening house and conveying system based on the design data/assumptions furnished below:

Calorific value of coal	..	3,160 kcal/kg
MCR coal requirement for one unit	..	101.5 TPH
Plant operating days	..	328.5 days (90% availability)
Required size of coal at mill	..	25 mm

Ash Handling System: Ash is generated at different zones like furnace bed, air heater ESP and Chimney.

Dense phase pneumatic conveying system is proposed for transporting fly ash to storage silo. From the silo, ash would be withdrawn and transported to suitable dumping areas for disposal or to be sold to Cement Plants. Ash storage silo would be of R.C.C. construction to hold 24 hrs of ash inside the plant.

For bottom ash, suitable collection system either wet or dry would be provided.

The estimated quantity of ash generated in each PC Fired Boiler is given below:

Sl. No.	Ash generation from each boiler		100% Indian coal (Non-coking)
1	Bottom ash, tph	..	11
2	Fly ash, tph	..	42
3	Total Ash generation, tph	..	53

Major System/Equipments of Power Plant: The major equipments of the proposed Power Plant are:

1. Pulverized coal fired Boiler/Circulating fluidized Bed Combustion (CFBC) boilers (1 Nos.) and its associated auxiliaries.

2. Steam Turbine Generator (STG) and its associated auxiliaries

In addition to these two main equipments, the plant would have all necessary auxiliary system such as:

- Coal handling system
- Fuel oil system
- Ash Handling system
- Raw Water Treatment and Storage
- Re-circulating cooling water system
- DM plant
- Fire fighting system
- Ventilation and Air-conditioning Systems
- Plant and Instrument Air System
- Electrical system including power distribution system
- Instrumentation and Control for the complete power plant
- Emergency DG set

Utilities

Fuel System: The by-product gases generated i.e. blast furnace gas and converter (LD) gas would be first utilised as fuel for various heating applications of the steel plant. Balance available gases may be utilised in power plant for steam and power generation.

The major consumers of fuel gas in the steel plant are for blast furnace stove heating, coke ovens under-firing, sinter plant furnace, heating equipment in the steel melt shop, furnaces in the TSCR & mills, lime plant and the boilers. Small quantities of fuel would also be required for the repair shops, laboratories etc.

By-product gas generation: The generation of by-product gases is given in Table 5-13.

TABLE 5-13 - GENERATION OF BY-PRODUCT GASES

	BF-BOF Route	
By-product gas	**Volume** N cu m/hr	**Energy** 10^9 kcal/yr
BF gas	285,515	1,967
LD gas	24,940	296
Total	**367,875**	**4,375**

Availability of By-product Gases for power generation: Surplus by-product gases, which would be available after meeting the plant demands, would be as given in Table 5-14.

TABLE 5-14 - SURPLUS BY-PRODUCT GAS AVAILABILITY

By-product gas		'000 N cu m/hr
BF gas	..	26,415
LD gas	..	4,610

Propane/LPG storage installation: Propane/LPG will be used along with available BF and converter gas from the plant network to meet the fuel requirement in various production units and for cutting operation of the casters.

To meet the above requirement, one (1) No. propane/LPG storage installation with distribution system of suitable capacity has been envisaged.

Process Steam: Process steam required for the plant would be made available through extraction of the steam turbine of the coal fired power plant. Steam network of around 13 kscg and temperature of 220^{o}C has been envisaged within the plant for process steam.

Captive Power Plant: One (1) No. captive power plant of capacity of 150 MW with coal fired boilers has been envisaged to generate the electrical power to meet the total captive demand of the steel plant.

Steam Cycle: High pressure, temperature steam (65 kscg, 485°C) would be generated from various boilers. Bulk of the high pressure steam would be utilised for power generation through condensing turbines.

***Top Recovery Turbines (TRT*):** The TRT has been envisaged to recover energy from the top gas of blast furnace and convert to power.

Air Separation Plant: The industrial gases viz. oxygen, nitrogen and argon are envisaged to be received from the Air Separation Plant.

Oxygen: Oxygen (99.5% purity) would be required in BOF, cutting operation in caster, scrap and other general purpose usage. Low purity oxygen would be required in blast furnace for enrichment purpose.

Nitrogen: Nitrogen (99.9% purity) would be required for gas line purging process purpose and general purpose applications in blast furnace, sinter plant, BOF, TSCR and cold rolling mill etc.

Argon: Argon (99.995% purity) would be required in BOF and ladle furnace.

Facilities Proposed: Air separation plant of capacity 1,250 tpd would be required to meet the above demand of oxygen, nitrogen and argon. Besides the oxygen plant would have adequate liquid generation and storage capacity so as to supply 72 hours of oxygen, nitrogen and argon in the event of stoppage of operation of the air separation plant.

Buffer vessels and pressure reducing stations for Oxygen, Nitrogen and Argon would be provided to cater to the various peak requirements of the process.

Other Utilities

Plant and Instrument Air System: Plant grade compressed air for general service purpose usage like pneumatic conveying, bag filter pulsing and dry instrument grade compressed air for the operation of pneumatic devices for instruments and controls, pneumatic tools etc. would be required in each of the production shops and other ancillaries.

Requirement of plant grade compressed air and balance requirement for dry instrument grade compressed air would be met from one centralised compressed air station with requisite numbers of centrifugal compressors and dryers along with required nos. air receivers. The pressure of the available compressed air would be around 7-8 kscg.

The pressure of the available dry instrument grade compressed air would be around 5-7 kscg.

Air Pollution, Ventilation and Air Conditioning

Air Pollution Control Systems: The scheme proposed for prevention of air pollution is as follows:

- Collection of fumes from mixer, deslagging station and argon rinsing station and discharging them to the atmosphere through stacks after cleaning.
- Removal of dust generated during various operations by local exhaust systems.

Ventilation Systems: The ventilation systems proposed to achieve desired conditions in different areas are as follows:

- Switchgear rooms, cable tunnel, cable basement, oil and hydraulic cellars: Mechanical ventilation system using fan-filter units for supply and exhaust fans.
- Compressor Building, transformer rooms: mechanical ventilation system using exhaust fans.
- Production building: natural ventilation by roof monitors as necessary.

Natural ventilation arrangement would be adopted in most of the production buildings.

Air Conditioning Systems: The air-conditioning systems are proposed to be designed to maintain the following condition in the spaces serviced:

25 ± 2°C dry bulb temperature and 55 ± 5% relative humidity for control rooms, control pulpits, computer rooms, PLC rooms, laboratory etc.

To meet the above requirement, chilled water based air conditioning are envisaged throughout the plant.

Chilled Water Plants: Vapour compression type chilled water plant of adequate capacity is envisaged to satisfy the air conditioning and ventilation needs of various units. Chilled water inlet and outlet temperature would be maintained at 16 °C and 7°C respectively. Ring mains for both supply and return pipelines would be suitably provided around the shops.

Overhead Yard Pipework: The Steel plant would have a piping network for distribution of the air separation plant products, fuel gases, various utility services, steam, water, compressed air and dry compressed air etc. The yard portion of the pipework for all services (except water) would be laid on towers and trestles with a clear height of 7 m above finished ground level (FGL). Shop internal pipework would generally be routed in multiple rows through building columns taking support from buildings and girders.

Fire Protection System: The Fire Extinguishers proposed are indicated below:

Premises to be covered	Type of Fire Extinguishers
All premises	First aid fire extinguishers of dry powder, carbon dioxide and foam type, fire buckets

High and medium velocity Water Sprinkler System has also been envisaged for the above project.

A list of major equipment required for plant utility system is given below:

Sl. No.	Description	Quantity
1.	Air Separation Plant of capacity 1,250 TPD for meeting the requirements of Oxygen, Nitrogen and Argon along with requisite numbers of oxygen, nitrogen and argon buffer vessels with pressure reducing stations.	1 unit
2.	Compressed air system	1 unit
3.	Gas Mixing Stations	1 unit
4.	LD Gas Export System with ESP & Boosters	1 unit
5.	LD Gas Holder	1 unit
6.	BF Gas Holder	1 unit
7.	LD Gas flare Stack	1 unit
8.	Propane / LPG Storage Installation	1 unit
9.	DE System	lot
10.	Chilled Water Plants	3 units
11.	Air conditioning System	lot
12.	Ventilation System	lot
13.	HVWS / MVWS System	lot

14.	Portable fire extinguisher	lot
15.	SCADA system	lot
16.	Coal fired power plant with boilers, turbo generators & auxiliaries	2 units
17.	Top Recovery Turbine	1 set
18.	Yard and shop pipework for all utility services viz., blast furnace gas, converter gas, LPG, steam, oxygen, nitrogen, argon, plant air, dry instrument grade air, chilled water etc.	1 set

Power Distribution System

This section presents the estimated power requirements, characteristics of plant loads, source of power and power distribution philosophy for proposed expansion.

Plant Power Requirements: The estimated power requirements for the proposed plant are indicated below:

Annual Energy Consumption, million kWh	...	1,521
15-min. maximum demand:		
- in MW	..	236
- in MVA (0.9 p.f.)	..	262
1-min. peak demand, MVA	..	287

Characteristics of Plant Loads: The major consumers of power for the proposed plant will impose a more or less steady load on the power system.

The LF and main drives of multi-strand reversing cold rolling mills, will be fluctuating power consumers and will impose harmonics in the power system.

In order to mitigate the effect of harmonics, reactive power compensation equipment with power factor improvement capacitor banks arranged in harmonic filter circuits will be provided. The plant overall power factor will be maintained in the range of 0.9.

Source of Power: The power requirement of the proposed plant will generally be met from the following captive power sources

i) One (1) No. captive power plant, having capacity of 150 MW with coal fired boilers.

ii) Power generation from TRT of Blast Furnace will be about 7.5 MW.

In addition to the above there will be grid connectivity through existing 220 kV MRSS over a 220 kV inter-connection.

Power Distribution Philosophy: A new 220 kV Main Receiving & Step down Substation (NEW MRSS) will be established in the proposed area for the expansion project.

The existing 220 kV MRSS will be extended with addition of new 220 kV feeder bays for establishing inter connectivity with NEW MRSS. However, the receiving point of grid connectivity will remain at exiting 220 kV MRSS.

The power distribution system will be so developed that the power generated from coal fired CPP and power generated from TRT will be utilized for feeding plant loads. If required, power would be drawn from the grid power supply. The start-up power for CPPs will be arranged from 220 kV MRSS over suitable power distribution arrangement.

The plant primary distribution will be at 33 kV as this is the suitable voltage for feeding bulk power to the load block step-down substations (LBSS), mill main drives, blast furnace blower motors, connectivity with captive power plants etc. Moreover, 33 kV voltage is considered to be the most economical voltage from view point of transmittal of power to ladle furnaces as well as for design of furnace transformers

The plant secondary distribution will be at 6.6 kV as this is the most suitable voltage for distribution of power to various plant units over load block distribution substation (LBDS). 6.6 kV is also considered to be a suitable voltage for feeding power to motors rated above 200 kW.

415-240 V will be adopted for low voltage power distribution over load centre substations (LCSS) as well as utilisation voltage within various plant units.

Process Automation (Level 2) and Supervisory

Computer System: Process automation (Level 2) systems have been envisaged to achieve higher productivity with better quality in a planned and well co-ordinated manner, by using state-of-the-art equipment and facilities. Level 2 automation systems would be considered for major plant units e.g. Blast furnace, BOF, LF, RH, thin slab caster rolling, cold rolling mill and pipe & tube mill.

The process automation systems would perform various model based technological functions to maximize productivity/yield and improve quality as well as optimize consumptions, besides handling of PDI, preventive maintenance functions, fault logging and generation of reports.

The process automation system would be based on client-server architecture and would comprise of PC based application/ database servers and HMI client stations connected on industry-standard Ethernet network with TCP/IP communication protocol.

The following automation systems have also been considered:

Yard Automation System: Yard automation systems are proposed to track finished and semi-finished products in the respective yards(X, Y co-ordinate).

Supervisory Control and Data Acquisition Systems (SCADA): SCADA systems have been envisaged for monitoring and control of production and distribution/consumption of the different utilities, water systems as well as for the electric power systems in the plant.

Laboratory Automation System: Laboratory automation systems would also be considered in the different laboratories as required having interface with the various laboratory instruments for tracking of samples, generation of test reports etc. having provision for manual entry of test results.

IT Infrastructure: Proposed network for IT infrastructure would provide intranet/internet facility for all kind of business related data.

Plant Communication System

The communication facilities for reliable and quick communication amongst various units inside and outside the plant as envisaged for the project are as follows:

Internal Communication System:

- Plant telephone system (Telephone Exchange and associated cable network) for providing telephone connection in all plant units and office buildings.
- Loudspeaker intercommunication (LSIC) system for point to point quick communication and group calling/paging at various shops.
- Closed circuit television (CCTV) system for viewing and monitoring critical operating areas in different shops from respective control rooms.
- Wireless communication system for communication between EOT cranes/Moving machine, control room/shop floor personnel and also for operation & maintenance personnel.

External Communication Facility: Direct communication facilities like trunk lines, FAX lines, Mobile telephone connections from external service providers, are proposed for providing communication facilities beyond the plant battery limit.

Fire Detection and Alarm System

Intelligent addressable microprocessor based Fire Detection and Alarm (FDA) system is envisaged in each plant unit in order to have an early detection and location details in case of possible fire outbreak in the plant premises. All the FDA systems would be monitored from central fire station of the Plant.

Water System

Water is required in the steel plant mainly for equipment cooling. In addition, it is used for process purpose, steam generation, drinking and sanitation purposes of working personnel in the plant, office etc and also for fire fighting and other miscellaneous purposes. This chapter describes the various water systems required for proposed expansion to 5.5 MTPA of BPSL integrated steel plant.

Water requirement: On study of the various recirculating systems, supporting facilities and the corresponding flow figures, it is estimated that the make-up water requirement for proposed expansion of BPSL plant would be around 1,775 cu m per hr and the total make up water requirement for the BPSL plant after expansion would be around 4,525 cu m per hour. Estimated break-up of make-up water quantities is given in Table 5-15.

TABLE 5-15 - MAKE-UP WATER REQUIREMENT

Sl. No.	Facilities	Make-up water requirement cu m/hr
A.	**Water requirement for the existing unit**	**2,750**
B.	**Water requirement for expansion to 5.5 MTPA:**	
1.	Sinter Plant	10
2.	Blast furnace	160

3.	Calcining plant	25
4.	SMS	130
5.	Caster	130
6.	Bloom Caster	75
7.	Heavy Bar/Rod & Bright Bar Mill	65
8.	Pipe & Tube Mill	25
9.	Cold Rolling Mill	175
10.	Oxygen Plant	75
11.	Captive Power Plant	750
12.	DM water for Process Steam	40
13.	Chilled Water Plant	85
14.	Dust Suppression in RMHS	10
15.	Drinking Water for phase-VII	5
16.	Losses in raw water reservoir	15
	Sub-total	**1,775**
C.	**TOTAL**	**4,525**

Note: Blowdown water generated from various circuits shall be treated in the effluent treatment plant and the treated water shall be reused in different units.

Source of Water: The source of water to BPSL plant is backwater of Hirakud reservoir, flowing at a distance of about 11 km from plant site. An intake well system has already been installed by BPSL which supplies raw water to the steel plant on continuous basis.

External Water System: Presently two (2) group of vertical pump have been provided in the intake pump house to supply raw water to plant. The raw water from the river is pumped to the plant through existing parallel raw water pipe line (One DN 1,000 and one DN 600). Total pumping capacity installed in the intake well is 3,900 cu m per hour which is not adequate for supplying the make up water requirement for the expansion. New pump sets with additionally 3,000 cu m per hour pumping capacity is proposed to be installed in the intake pump house to supply make up water requirement for the expansion. It is considered that the pumps at the intake pump house will operate not more than 16 hours a day. The existing raw water intake pipes will be utilized for conveying the additional water requirement for the expansion.

Plant water system

Raw water storage and treatment: Presently the raw water from the river is stored in existing raw water storage reservoir (Reservoir-I & Reservoir-II) located inside plant. The water storage capacity of Reservoir-I is 1.34 lakhs cu m and Reservoir-II is 2.0 lakhs cu m with a total capacity of 3.34 lakh cu m which can cater to the raw water needs of the total plant for about 5 days at 3.0 MTPA stage, in case of any eventualities in the upstream intake system.

In view of the above a new raw water reservoir of capacity 2.5 lakh cu m is proposed to be installed for the expansion to 5.5 MTPA which can cater the total plant water needs for more than 5 days, in case of any maintenance required in the upstream. The raw water reservoir capacity is selected with consideration that the plant upto 3.0 MTPA stage is running smoothly with 5 days storage.

Presently the treatment of the raw water is carried out in the existing raw water treatment plant having three (3) streams. Each stream consists of cascade aerator, flash mixing & flocculation unit and plate settler. The total capacity of raw water treatment plant is 7,465 cu m per hour which is adequate for proposed expansion to 5.5 MTPA. In view of the same no further raw water treatment facilities are envisaged.

The treated water from RWTP is presently stored in existing make up water storage tank having an aggregate capacity of 7,250 cu m. A new make up water storage tank of capacity 5,000 cu m is proposed to be installed for expansion to 5.5 MTPA. For further distribution of the treated make up water to various recirculating system new make up water distribution network has to be provided.

Make-up Water System: A total of around 1,775 cu m per hour make up water have been estimated for the units under expansion of 5.5 MTPA. Out of 1,775 cu m per hour, 1,585 cu m per hour is for make up to ICW and DCW circuits of different process, 15 cu m for losses in reservoir, 20 cu m per hour for soft water generation and 155 cu m per hour for DM water. A completely new make up water distribution network has to be provided for the units under expansion to 5.5 MTPA.

Soft Make-up Water: The existing softening plants have an aggregate capacity to produce soft water at a rate of 1,460 cu m per hour and have adequate spare capacity. The soft water requirement for expansion to 5.5 MTPA is around 20 cu m. In view of the same no further softening plant is envisaged. The soft make up water requirement of around 20 cu m per hour for expansion to 5.5 MTPA would be made available from the existing softening plants.

Demineralised Water: The existing DM plant is having a total capacity of 110 cu m per hour and there is no spare capacity available. Total DM water requirement for expansion to 5.5 MTPA would be around 155 cu m per hour out of which 30 cu m for Captive Power Plant, 40 cu m per hour for process steam and 85 cu m per hour for CRM. In view of the above two (2) Nos. DM plant each of having 100 cu m per hour each is proposed to be installed. One is in Power Plant area and the other one in CRM area.

Drinking Water System: The existing drinking water treatment plants have an aggregate capacity of 85 cu m/hr which is having spare capacity. The drinking water after treatment is stored in an existing drinking water overhead tank having 80 cu m capacity with a staging height of 47 m. The drinking water to the existing plant is distributed through existing drinking water distribution network running through out the plant.

A new drinking water overhead tank of 40 cu m minimum capacity with a staging height of 50 m is envisaged for the plant personnel working under the proposed expansion. The overhead tank has to be installed suitably considering the disposition of new units under the proposed expansion. A new drinking water network would be considered for distribution of drinking water for the new facilities.

Recirculating Cooling Water Systems: In order to conserve water to the maximum possible extent, independent recirculating cooling water systems with cooling towers, pump houses and treatment units wherever required, have been proposed for the units under the proposed expansion. The treated make up water for the new units would be supplied from the new make up water distribution network. In certain contaminated circuits make-up water would be fed from blow-down of non-contaminated circuit to conserve water consumption.

Individual Soft water cooling water system has been envisaged for the following units

a) Stave, Hearth, Stack, bosh belly, etc., of Blast Furnace
b) Lance, sub lance cooling of BOF
c) Hood, stack, skirt cooling of BOF
c) Ladle Furnace
d) Machine parts cooling of RH degasser
e) Mould and closed machine of Thin slab caster
f) Mould cooling of bloom caster

Independent non contact type recirculating cooling water (ICW) system has been envisaged for the following units:

a) Sinter Plant
b) TRT and auxiliary unit of Blast Furnace
c) Secondary cooling in heat exchanger for different soft water circuits
d) Lime Calcining Plant
e) General service water for BOF
f) Fume Extraction of Ladle Furnace
g) Reheating furnace of TSCR
h) Machine cooling, motor cooling of mill area of Caster
i) Pipe & tube mill
j) Cold Rolling Mill
k) Heavy Bar/Rod & Bright Bar Mill
l) Condenser cooling of Captive power plant
m) Oxygen Plant

Individual Contact type cooling water (DCW) system has been envisaged for the following units:

a) GCP for Blast Furnace
b) Slag Granulation Plant of Blast Furnace
c) Pig casting machine of Blast Furnace
d) GCP for Converter
e) Slag Quenching of Converter
f) Open machine cooling & Spray Cooling for Thin Slab Caster of TSCR
g) Open machine cooling and spray cooling for Bloom Caster
h) Condenser cooling of RH Degasser
i) Strip process spray cooling for Mill area of TSCR
j) Laminar cooling of Mill area of TSCR
k) Roll cooling of heavy bar/rod & bright bar mill
l) Pipe & Tube Mill

The detail break up of the above recirculating cooling water circuits has been shown in schematic water flow diagram (Drawing Nos. 11325-97A-000-WTS-0001, 0002 & 0003).

Emergency Cooling System: For critical equipment which requires emergency cooling water during power failure, emergency overhead tank (EOHT) with 15 min retention capacity, diesel engine driven pump or combination both has been envisaged to prevent the equipment from damage. Emergency cooling system has been considered for the following units:

a) Soft water closed cooling of Blast Furnace

b) Soft water closed cooling of Caster

c) ICW circuit of Reheating furnace of TSCR

d) Soft water closed cooling of Bloom Caster

e) ICW circuit of reheating furnace of heavy bar/rod & bright bar mill

Fire-fighting Water System: For the new units under expansion to 5.5 MTPA, one (1) new fire water pump house comprising of main fire pumps with stand by diesel pump and jockey pumps, has been envisaged. Fire hydrants with accessories at regular interval on the ring main/network have been envisaged conforming to TAC.

Waste Water Management: Presently there are two (2) Nos. waste water treatment plants (WWTP-1 & WWTP-2) of identical capacity with an aggregate capacity of 1,500 cu m per hour and there are adequate spare capacities at present. However these two (2) Nos. WWTP are located at a distance from the facilities under expansion to 5.5 MTPA. In view of the same a new WWTP is envisaged to be installed for the facilities under the proposed expansion.

Waste water generated from the different areas of the plant under expansion to 5.5 MTPA would be collected in a waste water collection tank, treated to the desired extent with suitable treatment facilities and recycled back to the process, as far as practicable, facilitating adequate reuse of water in the respective recirculating systems and economizing on the make-up water requirement. The treated waste water would be used as a make up to different contaminated water cycle, as well as in some low end application such as dust suppression, existing ash silo etc. However no waste water would be discharged from the plant as the plant is designed with zero liquid discharge (ZLD) concept.

Faecal Sewage Management: Septic tanks have been envisaged for storage of the sewage generated from toilet blocks.

Pollution Control System: In order to combat industrial pollution and to comply with guidelines lay down by the statutory authorities, suitable treatment units to be envisaged to control water pollution in different water system units. Suitable dust suppression system would be provided in all material transfer point, all other dust generating points.

Distribution System: Different type of water would be distributed/circulated through pipelines of generally mild steel construction. The pipe work would comprise all necessary pipes, valves, fittings and all other accessories as required conforming to the relevant standards. For buried pipes necessary corrosion protection would be considered and for road crossing suitable protection would be provided. Air release valves would be provided at all peak points and drain valves would be provided at low points.

Laboratory Facilities: The laboratory would provide the basic facilities for exercising control over the plant processes and the quality assurance of finished products. These facilities primarily relate to the chemical analysis and testing of raw materials, in-process materials and finished products.

Ancillary Facilities

Necessary ancillary facilities, such as administrative building, canteen, car park, cycle & scooter strand, first-aid station etc. would be provided based on the manpower requirement for the plant.

6 - ENVIRONMENTAL POLLUTION MITIGATION MEASURES

The proposed project involving the expansion of Integrated steel plant of BPSL from 3.0 MTPA to 5.5 MTPA crude steel production, comprises of sintering, iron making, steelmaking, casting and rolling etc. have been discussed in the previous chapters. This additional production would generate added wastes in different forms, the recipient of which would be air, water and land environment causing pollution of these environmental elements.

This Chapter accordingly outlines the various mitigation measures in compliance with the prevailing Environment Protection Acts & Rules and amendments thereof taking into consideration of the proposed production facilities envisaged for the expansion.

Review of Pollution Potential

The additional production, due to the expansion, would happen by installation of new production units; namely, Sinter Plant, Coke oven, Blast furnace, LCP, LDs and the mills. The additional off gases would be utilized for in-plant use and power generation. Also power would be generated from BF top gas heat recovery turbine.

Hence, the expansion plan would generate additional amount of particulate dusts, Volatile organic compounds (VOCs), Dioxins, Furans, oxides of sulphur and nitrogen and carbon dioxide to the air environment, in addition to the present pollution level.

Likewise, there would be additional generation of waste water due to enhanced capacities, contaminated with total suspended solids (TSS), BOD, COD, oil and grease etc. which are of major concern from environment perspective.

The land environment may get disturbed due to generation of the excess solid wastes like BF slag, BOF slag, mill scales etc which may call for other secondary environmental problems.

Proposed Mitigation Measures

The plant is already equipped with all necessary APC control measures required for the production of 3.0 MTPA crude steel. However, in view of augmentation of aforementioned plant facilities, there would be additional pollution load, for which adequate mitigation measures as described below have been considered:

Air Pollution Control (APC) Measures

Material Handling Area: There would be fugitive dust emission from the handling and stockpiling of the added raw material, which would be controlled by Dry Fog (DF) system. The raw material handling section is provided with dust suppression (DS) by water sprinkling at open stockyard. All conveyors would be of covered types and leak proof to prevent any emission of dusts during transport of raw materials and products. All closed zone working areas such as raw materials handling zone, conveyor transfer points, dust generation points at screen is provided with multiple dust extraction (DE) systems/dry fogging (DF) at several emission points to control the fugitive dust emissions. DE system shall consist of suction load followed by bay filter, ducts, extraction fans and stack of adequate height.

6 - Environmental Pollution
Control Measures (cont'd)

Coke Ovens: Emission from the coke oven would result from coal charging, coke pushing and coke quenching. Charging emission would be controlled by high pressure liquor aspiration (HPLA) injection for on-main charging system. Pushing emission would be controlled by land based pushing emission control. The raw coke oven gas (COG) would be cleaned by passing through a by-product recovery plant for use as plant clean fuel having H_2S level less than 500 mg/N cu m. These pollution control measures would be maintained and there would be retrofitting as per requirement.

Sinter Plant: In Sinter Plant, the principal air pollution control system is dust extraction (DE) or fume extraction (FE) systems and ESPs with stacks of appropriate heights. Stretching of the capacity of sinter plant would add to the present pollution level, requiring augmentation of present APC equipments.

Blast Furnace: In addition to cleaning of BF gas in gas cleaning plant (GCP), which is a process requirement, dust and fumes emission in stock house and cast house areas would be controlled by dust and fume extraction (DE & FE) systems respectively in all the operating BFs.

Calcining Plant: The emissions arising due the fuel burning in lime calcining plant would be taken through a bag filter to separate out the lime fines. The kilns would be provided with separate DE systems, complete with bag filters and stack of adequate height. For the increased production, one new calcining plant would be be implemented. The same pollution control systems would be adopted for the new Lime plant.

BOF Plant: Besides BOF gas cleaning, steelmaking shop would be provided with secondary fume extraction system. The secondary emissions of the steelmelt shop would be controlled by providing ESP.

Casters: The thin slab caster and bloom caster would be provided with suitable fume extraction system for vapours and particulates arising during cooling of the slabs.

Rolling Mill: The reheating furnaces would be incorporated with low NOx burner, and controlled combustion would take place. Fume extraction (FE) system would be installed in hot strip mill to prevent the formation of oil smog. The flue gas, which is fairly clean, would be vented through a stack of adequate height. These pollution control measures would be carried on and additional APC measures would be adopted as per requirement.

The acid pickling line of PLTCM unit would be fume extraction (FE) system to control the acid fumes generated from the pickling tanks and spray rinse tanks. The system would comprise of extraction ducts, exhaust fans, fume scrubber, scrubber pumps and a vent stack of appropriate height.

The non-annealed cold rolled coils would undergo hot dip galvanization in molten zinc baths in CGL lines followed by chromate passivation. These processes would generate vapours and fumes which would be controlled by fume extraction system.

Water Pollution Control (WPC) Measures: The overall aim of the plant would be to bring down the specific consumption rate of make up water to the extent possible to accommodate lesser fresh water intake from the Hirakud Reservoir. This would be achieved by subjecting the treated wastewater from various units to secondary treatment for making it suitable for recycling to the plants direct make up water circuit.

Five different types of process effluent streams would be generated from the steel plant complex. Type-I effluent would be separately treated in Biological Oxidation and Dephenolisation (BOD) treatment unit. The treated effluent of BOD plant would be taken to the effluent storage reservoir.

Type-II effluent would have to be treated in a separate bay where acidic and alkaline waste streams would be neutralized with separation of floating and emulsified oil; spent acids from pickling line would be regenerated in an Acid Regeneration Plant (ARP) for in-plant recycling. Toxic hexavalent chrome wastewater would be treated separately for conversion of Cr^{+6} to Cr^{+3}.

For Type-III effluent streams, mostly physico-chemical treatment schemes like oil separation, settling, clarification, pH adjustment etc, would be employed.

Type-IV effluent, CT blow downs would be taken to the treated waste water storage reservoir for recycling purpose.

The Type-V effluent, which is plant sanitary wastewater, would be separately treated in a sewage treatment plant before the same is also routed to the treated effluent storage reservoir.

Zero Discharge Concept

In order to have a 'near zero discharge' of the proposed plant, the CT blow down along with all other primary treated wastewater streams with high TDS levels may be further subjected to Reverse Osmosis (RO) treatment to reduce the TDS levels and the residual oil & grease, BOD and COD levels, so that this treated waste water as RO permeate can be added to the plants make up water circuit.

Work Zone Pollution Control Measures

The work zone pollution would be mostly fugitive dust, heat and noise. The fugitive dust emission would be controlled by DS and DE system as described earlier.

All the process vessels would be lined with adequately thick refractory bricks to contain the surface heat emission and in some cases they would be indirectly cooled by water. In addition to this, there would be provision for adequate ventilation of the closed zone work environment.

Noise arising from the mechanical machineries like crushers, screens, compressors, blowers, pumps etc can not be ruled out. Such noise-prone equipment would be installed in a separate housing so as to enhance the noise attenuation. Isolation of the operational staff from the high noise prone zone would be adopted by providing noise proof control room so that they are not exposed to the noise level exceeding the allowable limit.

Solid Waste Generation and Disposal

There would be an additional generation of solid by-products like BF slag, BOF slag, mill scales, caster scrap, refractory debris, flue dusts etc from the proposed expansion project. It is estimated that the proposed expansion would generated around 1 MTPA solid waste comprising mainly of BF & BOF slags, dusts, etc.

TABLE 6-1 - ADDITIONAL SOLID WASTE GENERATION 5.5 MTPA STAGE OVER 3.0 MTPA STAGE

Sl. No.	Solid By-product	Expected additional generation at 5.5 MTPA crude steel stage, TPA
1.	BF slag	495,700
2.	BOF slag	382,500
3.	Dusts and fines	102,000
4.	Mill scales	16,550

Additional BF slag would be required to be granulated before it is sold off. The extra amount of flue dusts and scraps would be recycled to the either Sinter plant or BOF.

Plant Safety

Plant safety measures would be an integral part of the environment protection plan of the proposed plant. Workers' safety would be of highest degree of concern as required by the Factories act-1948 and OSHAS 18001-2007 so as to avoid any personal injury or untoward incident. In-built safety measures of the plant and machinery would be made adequate in order to avoid hazardous events causing damage to the life and property.

Plant Greenbelt and Landscaping

As per the recent regulatory requirement, 33% of the plant area has to be reserved for peripheral greenbelt, gardening and tree plantations. This would not only prevent the fugitive dust emissions but also improve the plant peripheral appearance from aesthetics view point. This would be kept in mind while planning for the expansion facilities.

Design Targets for Environmental Protection

The proposed mitigation measures would be adopted the following design targets:

I. Stack emissions

Particulate matter	:	50 mg/N cu m
SO_2 emission	:	500 mg/N cu m
NOx emission	:	500 mg/N cu m

II. Wastewater discharge

Temperature	:	Ambient
pH	:	5.5 to 9
Total Suspended Solids	:	< 100 mg/l
BOD_3 (27^oC)	:	< 30 mg/l
COD	:	< 250 mg/l

Oil and grease	:	< 10 mg/l
Iron (as Fe)	:	< 3 mg/l

III. Workzone Environment

Exposure to Dusts	:	3 mg/cu m (max) in a closed environment 500 mcg/cu m (max) in an open environment within 20 to 30 m aerial coverage
Exposure to Noise	:	L_{eq} 85 dB(A) for a continuous period of 8 hours exposure

Environmental Monitoring

While design and engineering of the plant, the principal pollution sources like BF, BOF and captive power plant stacks would be provided with on-line monitoring device for routine monitoring of pollutants like TSP, SO_2 and NOx. In addition, conformance to the ambient air and waste water discharge standards would also be monitored.

7 - IMPLEMENTATION SCHEDULE

This chapter deals with the construction aspects of project-overall construction schedule and construction facilities for implementation of the project.

Implementation Schedule

The preliminary overall implementation schedule for the project, indicating the time required to complete the major activities like engineering, construction, procurement of equipment, erection, testing/trial run and commissioning and hook up of the various plant facilities is shown in the form of a bar chart in Fig. 7-1 on the following pages.

It is envisaged that the project will be completed within a period of 36 months from "Go-Ahead date".

The schedule has been developed on the basis of the estimated quantum of work, expected delivery and installation periods of plant and equipment and the need to commission the plant facilities in the shortest possible time. Scheduled commissioning of the plant can only be achieved if construction, delivery and erection periods, as shown in the bar chart, can be met by respective suppliers and contractors.

Completion time of major Plant units:

Coke Oven	..	33 Months
Sinter Plant	..	24 Months
Calcining Plant	..	24 Months
Blast Furnace	..	35 Months
SMS+TSCR	..	36 Months
CRM	..	30 Months
Pipe & tube Mill	..	24 Months
Heavy Bar/Rod & Bright Bar Mill	..	24 Months

7 - Implementation schedule (cont'd)

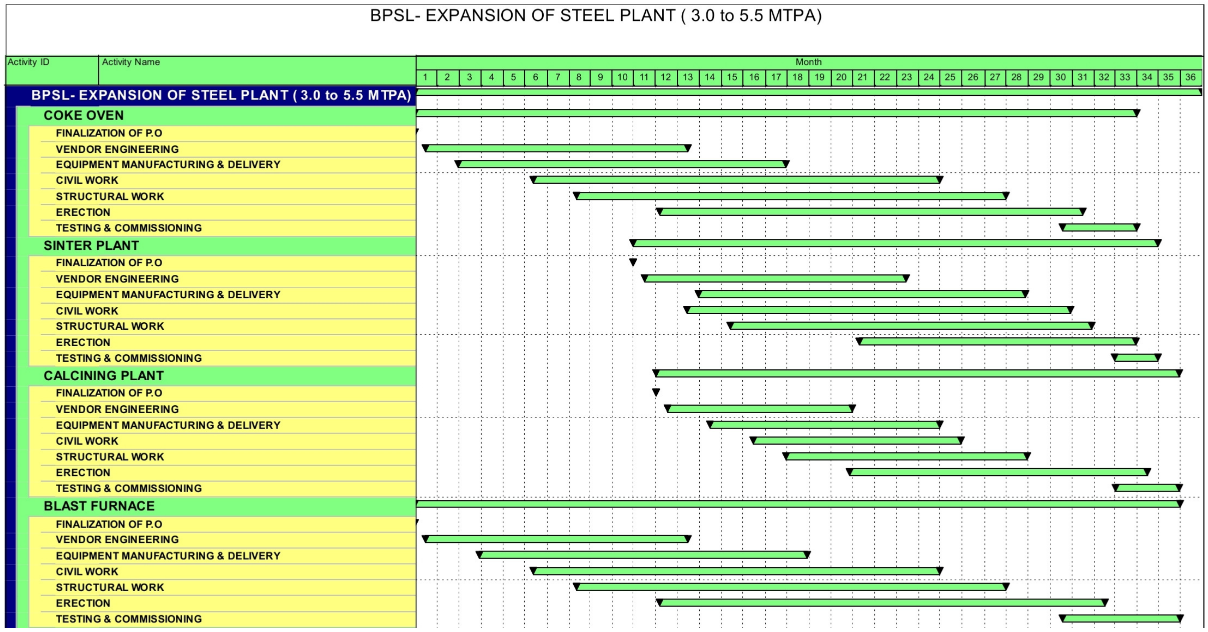


Fig. 7-1 - Implementation Schedule (1 of 3)

7 - Implementation schedule (cont'd)

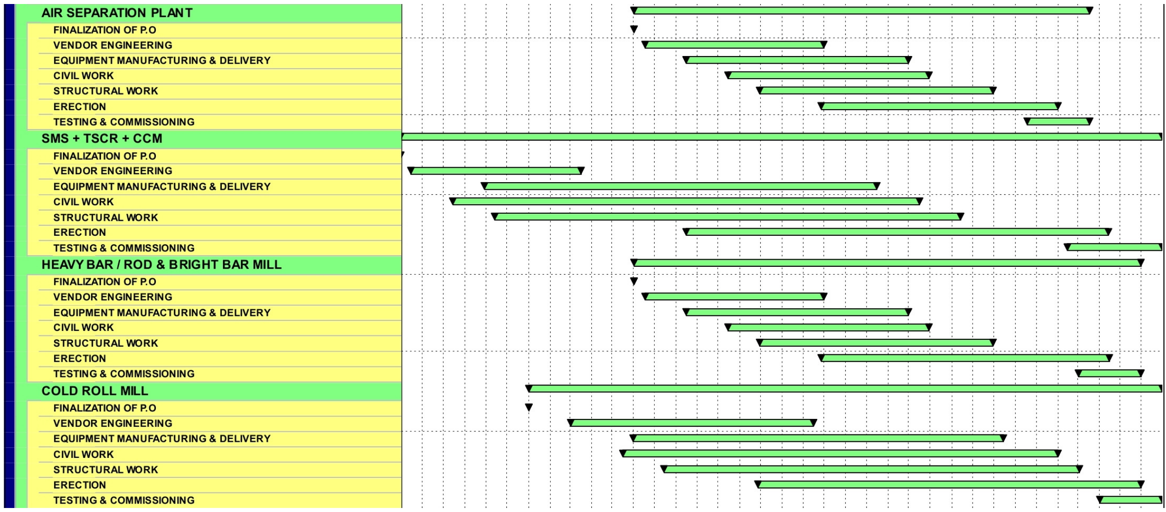


Fig. 7-1 - Implementation Schedule (2 of 3)

7 - Implementation schedule (cont'd)

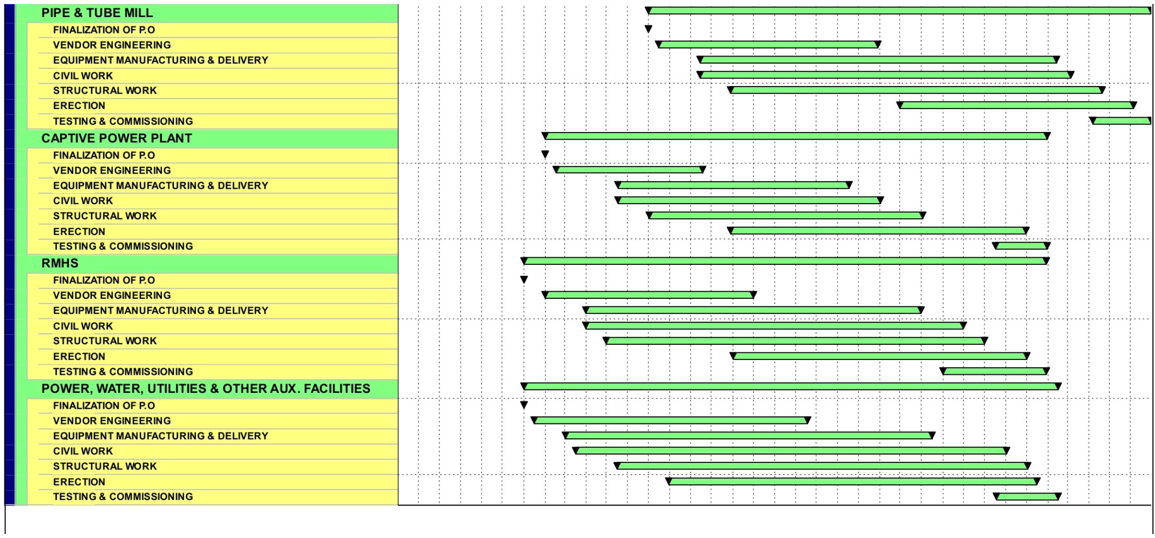


Fig. 7-1 - Implementation Schedule (3 of 3)

8 - PROJECT COST

The order of magnitude estimates of capital cost for this capacity augmentation is presented in this chapter. The cost estimates are based on the data/information available with CONSULTING ENGINEERS for similar projects. The estimates are based on price levels, taxes & duties and exchange rates prevailing during 1^{st} quarter 2015-16.

Capital Cost Estimate

The estimate of capital cost includes plant cost, margin money for working capital and interest during construction. The plant cost comprises the costs of plant & equipment (as erected) together with the cost of pollution control, design, engineering, consultancy & administration during construction and contingency.

Plant and equipment (as erected): It includes cost of plant and equipment and civil and structural. Additionally, taxes, duties, transportation and erection (on normative basis) have been considered to arrive at the cost of plant and equipment (as erected).

Pollution Control Equipment: It includes the cost towards air pollution control, water conservation, energy conservation etc. A provision has been made at 10 per cent of the project cost.

Design, engineering, consultancy, administration during construction (DE & ADC): A provision has been made at 5 per cent on the supply cost of plant and equipment including civil, structural and erection.

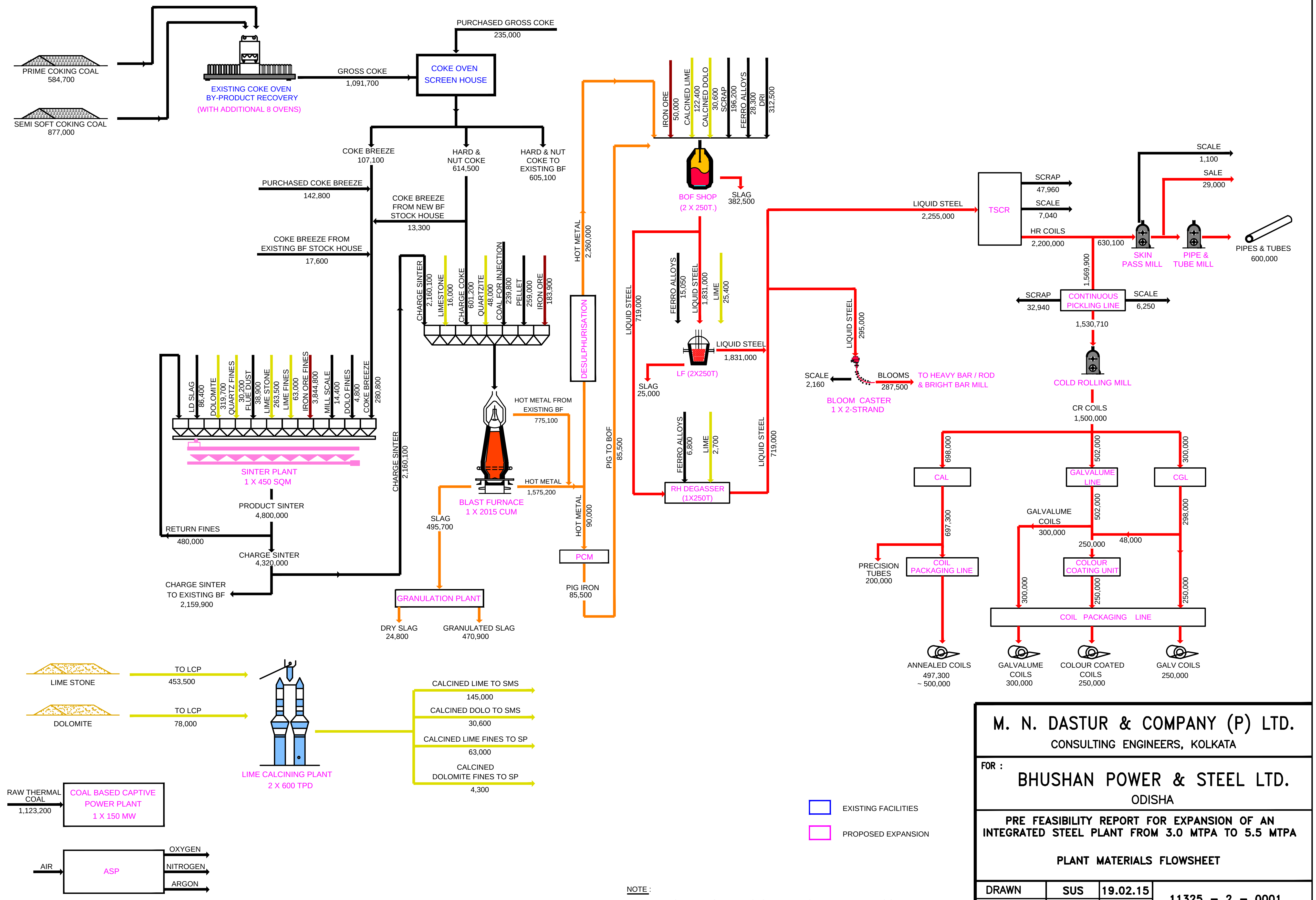
Contingency: A contingency provision has been made at 5 per cent on the plant cost towards unforeseen items. Forward escalation and exchange rate variation are not included in the above provision.

Margin Money for Working Capital: A certain portion of the estimated working capital for the first year of operation has been included in capital cost as margin money for working capital.

Interest during Construction: Interest during construction (IDC) has been calculated based on the following:

- Implementation period of 36 months for the project
- Interest rate at 12 per cent per year

Based on the above, capital cost estimated for the project works out to Rs. 9,090 crore. About 7 - 9 per cent of the total plant cost has been kept for environment management measures.



NOTE :

1. ALL QUANTITIES ARE IN TONS PER YEAR ON NET AND DRY BASIS, UNLESS OTHERWISE SPECIFIED.

M. N. DASTUR & COMPANY (P) LTD.

CONSULTING ENGINEERS, KOLKATA

FOR :

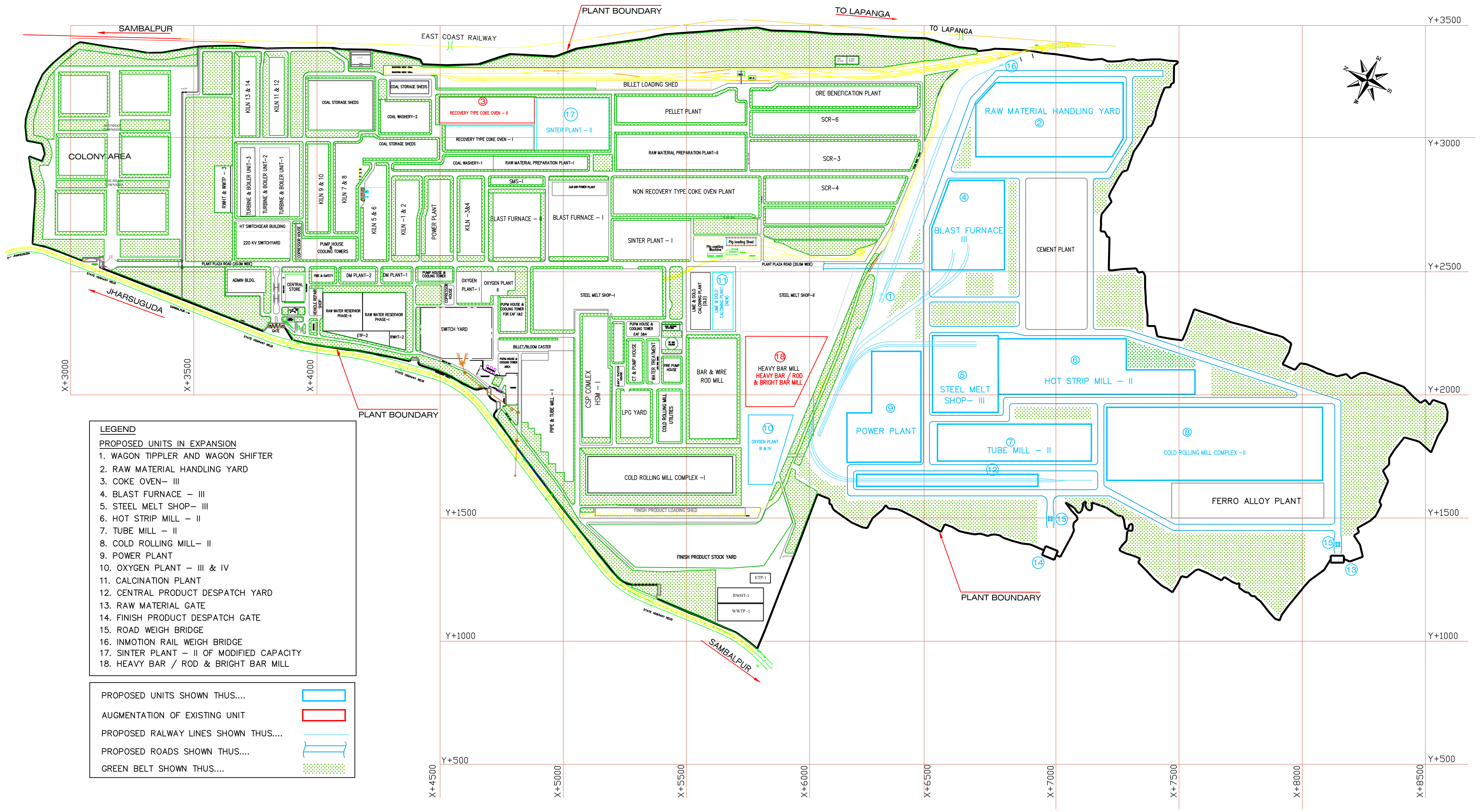
BHUSHAN POWER & STEEL LTD.

ODISHA

PRE FEASIBILITY REPORT FOR EXPANSION OF AN INTEGRATED STEEL PLANT FROM 3.0 MTPA TO 5.5 MTPA

PLANT MATERIALS FLOWSHEET

DRAWN	SUS	19.02.15	11325 – 2 – 0001
APPROVED	SKM	19.02.15	



LEGEND

PROPOSED UNITS IN EXPANSION

1. WAGON TIPPLER AND WAGON SHIFTER
2. RAW MATERIAL HANDLING YARD
3. COKE OVEN– III
4. BLAST FURNACE – III
5. STEEL MELT SHOP– III
6. HOT STRIP MILL – II
7. TUBE MILL – II
8. COLD ROLLING MILL– II
9. POWER PLANT
10. OXYGEN PLANT – III & IV
11. CALCINATION PLANT
12. CENTRAL PRODUCT DESPATCH YARD
13. RAW MATERIAL GATE
14. FINISH PRODUCT DESPATCH GATE
15. ROAD WEIGH BRIDGE
16. INMOTION RAIL WEIGH BRIDGE
17. SINTER PLANT – II OF MODIFIED CAPACITY
18. HEAVY BAR / ROD & BRIGHT BAR MILL

PROPOSED UNITS SHOWN THUS....

AUGMENTATION OF EXISTING UNIT

PROPOSED RALWAY LINES SHOWN THUS....

PROPOSED ROADS SHOWN THUS....

GREEN BELT SHOWN THUS....

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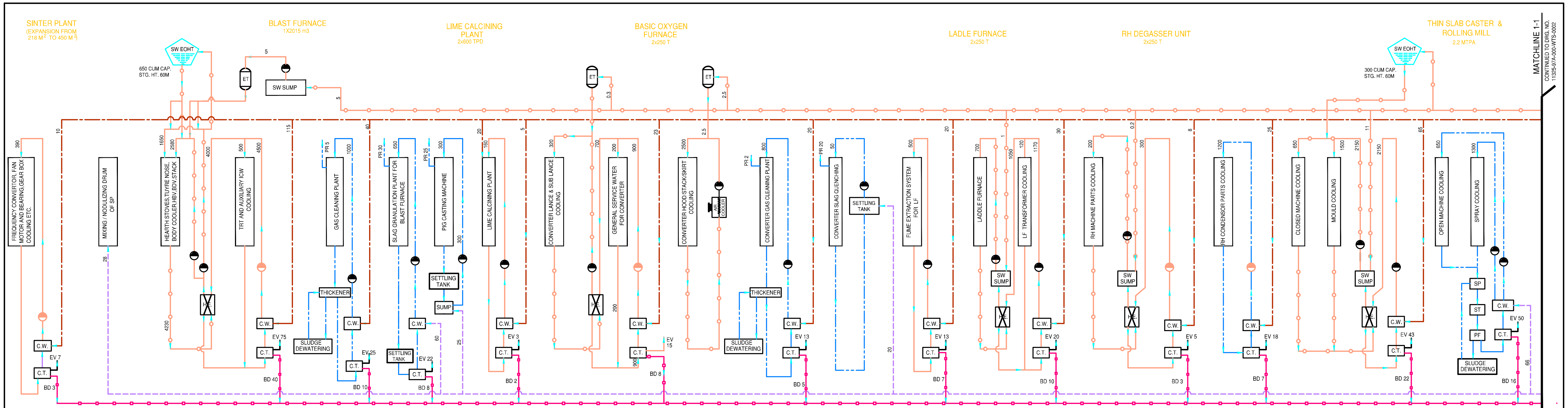
EIA FOR 3MTPA TO 5.5MTPA EXPN. OF INTEGRATED STEEL PLANT AT THELKOLOI, SAMBALPUR, ODISHA

PLANT GENERAL LAYOUT

DRAWN	SUS	20.02.2015	11325–3–0001
APPROVED	SM	20.02.2015	



LEGEND

(symbol)	PUMPING SYSTEM
H.E.	HEAT EXCHANGER
C.T.	COOLING TOWER
C.W.	COLD WELL
OHT	OVER HEAD TANK
ET	EXPANSION TANK
SP	SCALE PIT
ST	SETTLING TANK
PF	PRESSURE FILTER
EV	EVAPORATION LOSS
BD	BLOW DOWN
DMW SUMP	DEMINERALISED WATER SUMP
TWW	TREATED WASTE WATER

(line)	SOFT WATER (SW)
(line)	CONTACT COOLING WATER (DCW)
DW (line)	DRINKING WATER (DW)
(line)	NON CONTACT COOLING WATER (ICW)
(line)	MAKE-UP WATER
(line)	TREATED WASTE WATER MAKE UP
(line)	WASTE WATER
DM (line)	DEMINERALISED WATER
SW SUMP	SOFT WATER SUMP
PR	PROCESS LOSS
EOHT	EMERGENCY OVERHEAD TANK

NOTE:-

1. ALL FLOW FIGURES ARE IN cum / hr.
2. FLOW FIGURES ARE TENTATIVE.
3. '#' INDICATES FIRE WATER FLOW IS OCCASSIONAL, i.e. DURING FIRE BRAKE OUT.

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FOR :
BHUSHAN POWER & STEEL LTD.
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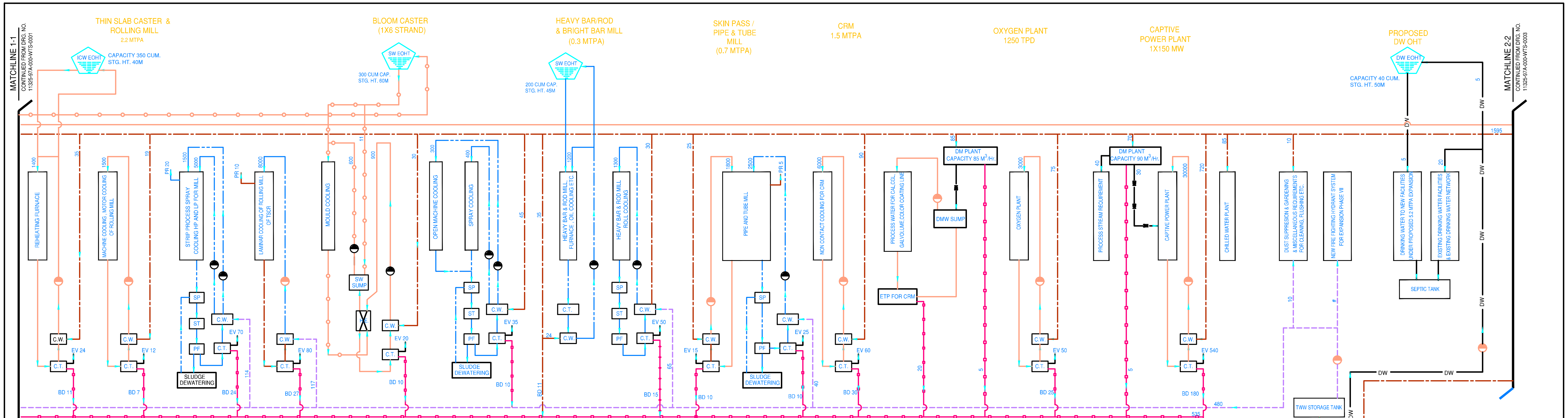
PRE FEASIBILITY REPORT FOR EXPANSION OF AN INTEGRATED STEEL PLANT FROM 3 MTPA TO 5.5 MTPA

SCHEMATIC WATER FLOW DIAGRAM (SHEET 1 OF 3)

DRAWN	CHMU	23.02.2015	11325-97A-000-WTS-0001
APPROVED	SKP	23.02.2015	



LEGEND

	PUMPING SYSTEM
H.E.	HEAT EXCHANGER
C.T.	COOLING TOWER
C.W.	COLD WELL
OHT	OVER HEAD TANK
ET	EXPANSION TANK
SP	SCALE PIT
ST	SETTLING TANK
PF	PRESSURE FILTER
EV	EVAPORATION LOSS
BD	BLOW DOWN
DMW SUMP	DEMINERALISED WATER SUMP
TWW	TREATED WASTE WATER

- SOFT WATER (SW)
- CONTACT COOLING WATER (DCW)
- DRINKING WATER (DW)
- NON CONTACT COOLING WATER (ICW)
- MAKE-UP WATER
- TREATED WASTE WATER MAKE UP
- WASTE WATER
- DM DEMINERALISED WATER

SW SUMP	SOFT WATER SUMP
PR	PROCESS LOSS
EOHT	EMERGENCY OVERHEAD TANK

NOTE:-

1. ALL FLOW FIGURES ARE IN cum / hr.
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3. '#' INDICATES FIRE WATER FLOW IS OCCASSIONAL, i.e. DURING FIRE BRAKE OUT.

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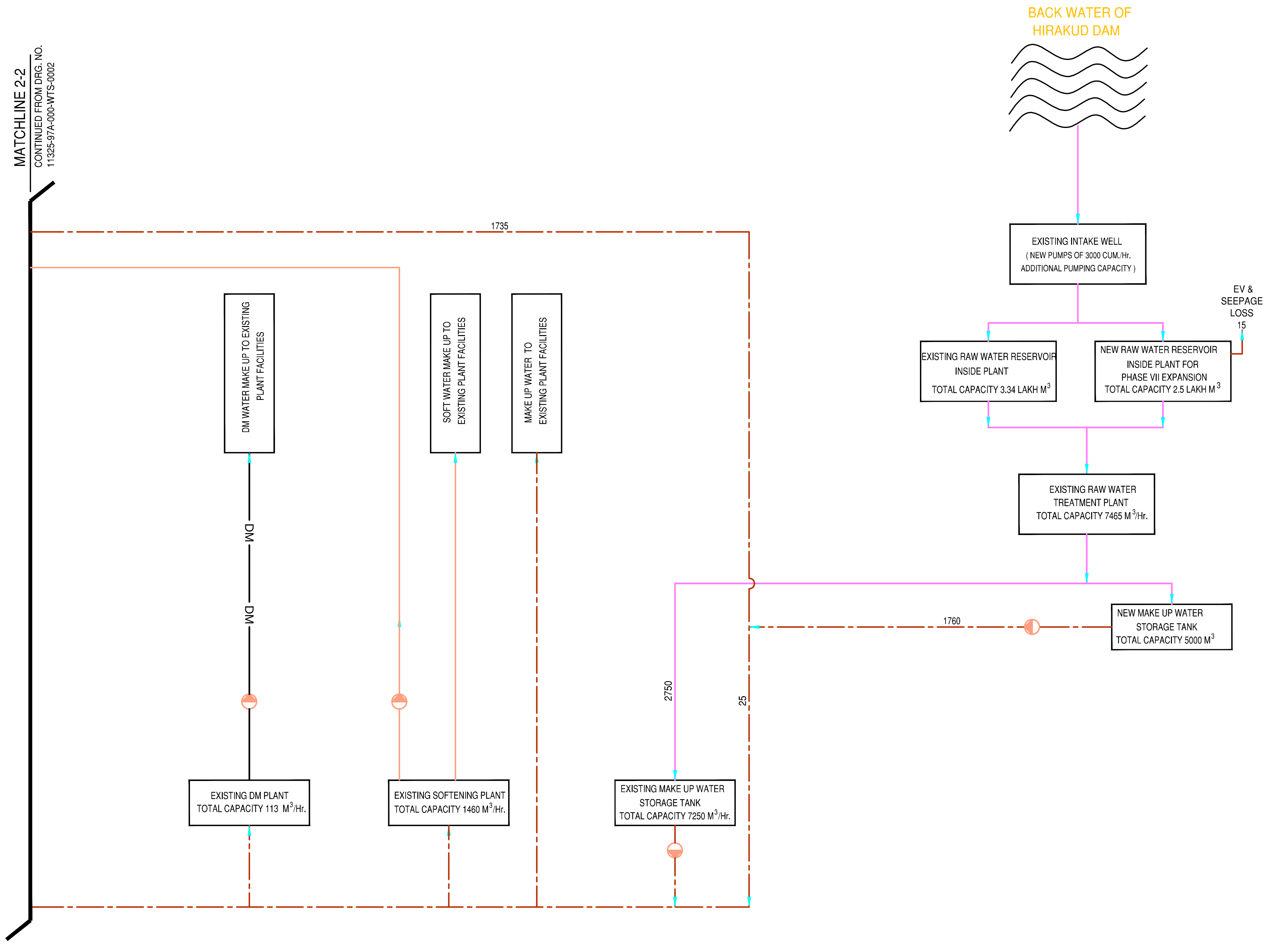
FOR :
BHUSHAN POWER & STEEL LTD.
ODISHA

TECHNO-ECONOMIC FEASIBILITY REPORT FOR EXPANSION OF AN INTEGRATED STEEL PLANT FROM 3 MTPA TO 5.5 MTPA

SCHEMATIC WATER FLOW DIAGRAM (SHEET 2 OF 3)

DRAWN	CHMU	23.02.2015	11325-97A-000-WTS-0002
APPROVED	SKP	23.02.2015	



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FOR : **BHUSHAN POWER & STEEL LTD.** ODISHA			
TECHNO-ECONOMIC FEASIBILITY REPORT FOR EXPANSION OF AN INTEGRATED STEEL PLANT FROM 3 MTPA TO 5.2 MTPA SCHEMATIC WATER FLOW DIAGRAM (SHEET 3 OF 3)			
DRAWN	CHMU	24.02.2015	11325-97A-000-WTS-0003
APPROVED	SKP	24.02.2015	