

# Pre-feasibility Report

for

## **Proposed Expansion of Steel Plant in the Existing Plant Area**

at

Village Ikra, Jamuria, Jamuria Industrial Estate,  
District Burdwan, West Bengal

Project Proponent

**Bhagwati Sponge Private Limited**

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## 1 – INTRODUCTION

### Introduction

**M/s. Bhagwati Sponge Private Limited (BSPL)** is well known specially in the eastern India for their manufacturing activities in steel sector. BSPL proposes to expand its existing Steel Plant at village Ikra, Jamuria, Jamuria Industrial Estate, district Burdwan in West Bengal. Considering the future growth potential of steel market at domestic and international level, BSPL has decided to expand the existing steel plant by installation of Sponge Iron Plant, SMS, Rolling Mill, Ferro-alloy plant & Captive Power Plant in the notified Industrial Area.

The unit proposed to be installed with rated capacity per annum along with the existing plant capacity is presented in **Table-1.1 & 1.2**.

**Table 1.1  
Existing Units**

Sl. No.	Existing Unit	Production Capacity	Product
1.	DRI Plant	60,000 TPA (2x100 TPD)	Sponge Iron
2.	Captive power plant (under construction)	12 MW (WHRB-4MW + AFBC-8MW)	Power

**Table 1.2  
Proposed Unit**

Sl. No.	Proposed Unit	Production Capacity	Product
1.	Sponge Iron Kilns (1x200+1x350) TPD	1,65,000 TPA	Sponge Iron
2.	Induction Furnaces - 4x15 T (with matching LRF & CCM)	1,80,000 TPA	Billets
3.	Rolling Mills	2,00,000 TPA	Structural Steel, TMT Bars, Angles, Channels, Wire Rod
4.	Ferro Alloys Plant (2x9 MVA SAFs)	20,460 TPA or	Ferro Manganese
		14,850 TPA or	Silico Manganese

		6,600 TPA or	Ferro Silicon
		24,750 TPA	Pig Iron
5.	Captive Power Plant	18 MW (10 MW WHRB based + 8 MW AFBC based)	Power

The proposed project will be installed on 29.8 acres of the total land area within the existing boundary of the plant.

### Project Highlights

The principal features or highlights of the proposed Project are as follows:

Location	Village Ikra, Jamuria Industrial Estate, Jamuria, District Burdwan in West Bengal. Latitude-23°41'33.10" N & Longitude-87°06'45.18"E.
Land requirement	The proposed project will be installed on 29.8 acres of land, within the existing plant boundary.
Raw water requirement & source	Total make up water will be supplied by Asansol Durgapur development Authority (ADDA) from Ajoy River. As per an initial estimate, water to the tune of 503 cu.m/day will be required for the proposed project.
Power requirement	The estimated power requirement for the proposed expansion project is 54.5 MW, which will be met from the Captive Power Plant and Damodar Valley Corporation (DVC) supply.
Effluent generation & disposal	To be designed as a zero discharge plant. The entire treated waste water, to be recycled for various purposes inside the plant.
Air pollution control	Adequate control measures like installation of ESP, bag filters, dust suppression system and stack of adequate height at relevant point.
Solid Waste Management	<ul style="list-style-type: none"> <li>• Dolochar from DRI plant will be used in AFBC boiler.</li> <li>• Slag from IF furnaces and Slag generated during Silico Manganese production will be used for road construction / land filling/paver block making.</li> <li>• Generated slag from the process of Ferro Manganese will be used in Silico Manganese manufacturing.</li> <li>• No slag will be produced during Ferro Silicon production.</li> <li>• Scrap / Mill scale will be reused in the IF.</li> <li>• Fly ash from CPP will be used in brick making / cement plant.</li> </ul>
Manpower	500 persons

Project cost	Rs. 324 Crores
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### Location of Project Site

The project site is located in the Jamuria Industrial Estate, Jamuria, district Bardhaman, West Bengal. Its graphical coordinates are Latitude 23°41'33.10" N & Longitude 87°06'45.18"E. The Jamuria Industrial Estate Authorities, is a joint venture of Jamuria Municipality and the Asansol Durgapur Development Authority in Burdwan District of West Bengal.

The proposed site area is well developed and has all necessary infrastructure facilities such as motorable road upto the plant site, nearness to rail head, telephone telefax facilities etc. The proposed site is located on the State Highway at a distance of 5 km from the Durgapur Expressway (NH-2). Nearest railway station is Ikra which is around 1.0 km from the project site. NSCBI Airport, Kolkata is about 180 km in south-east direction from project site. Densely populated town Asansol is about 14.0 km in west direction from the project site. District Head Quarters Burdwan is about 92 km in south-east direction from the project site. The project site has good connectivity with sea port of Kolkata and Haldia.

Location of the project site is presented in **Figure 1.1**.

### Need for the Project

#### **National**

The development of industrial projects plays a key role in the economic growth of any country. Iron is perhaps the most important metal to the mankind and its principal alloy, steel, is widely used for domestic, agricultural, industrial and defense purposes. Per capita steel consumption is a major indicator of economic status of any country.

The Indian steel industry is poised for faster growth in the decades ahead as the industrial and economic development of the country gains pace. The steel industry has recorded remarkable performance in recent years. The industry is now capable of producing high quality materials of stringent international specification for high-end applications. The 21<sup>st</sup> century is widely perceived to be the century of Asia and India is looked upon as one of the economies with most promising prospects. This is a formidable challenge as well as an opportunity to the Indian corporate sector.

The estimated domestic market growth outlook for finished steel is given in Table - 1.2. The total steel consumption of finished steel has been estimated to touch 60 MT in the year 2012 from the current level of over 31 MT. Even after approximately doubling the production capacity the per capita domestic consumption would continue to be substantially below the world average of 145 Kg. There is good prospect of domestic steel consumption growing at about 6-7% up to the year 2012. The national steel policy has set a target of 60 million tonne of steel production by 2010 and to increase it to a level of 100 million tonne by 2018. BSPL is in position to fulfill its role in the nation's quest for higher growth and development in the new millennium.

Table - 1.2  
Domestic Market Growth Outlook

Growth Trajectory	2006 – 07 (million tonnes)	2011 – 12 (million tonnes)
GDP @ 6.5%	39.5 - 40.7	57.8 - 59.9

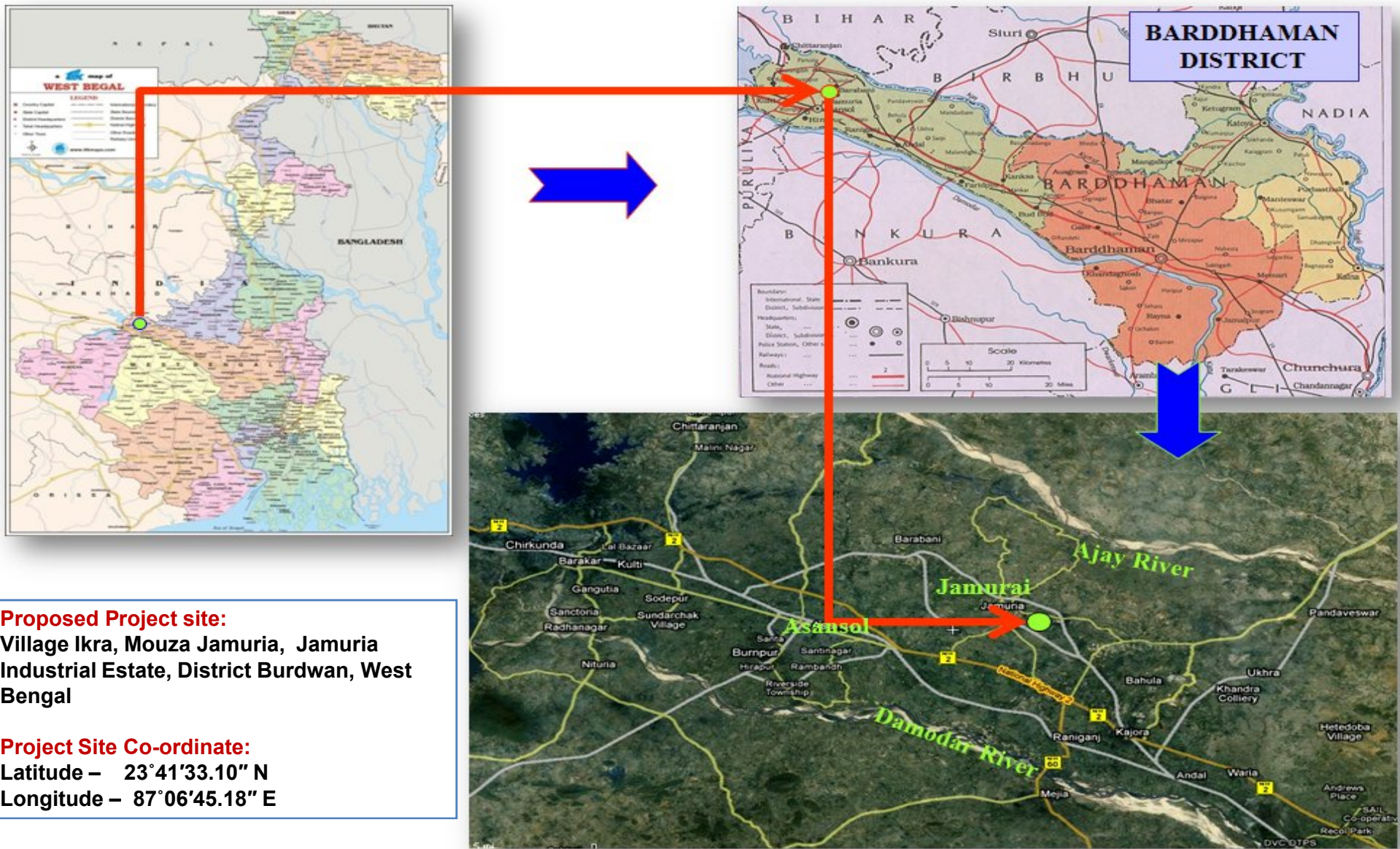
BSPL has drawn up a growth plan with the objective of increasing its market share in Indian steel industry. Keeping all these in mind, BSPL has plan to expand the existing steel plant in a more environment friendly way.

### **Regional**

The growth of the steel industry significantly contributes to economic growth of the Nation as well as to the region as it generates employment both directly and also due to development of downstream industries. The infrastructural and other social amenities grow in the region leading to overall development of the region. The proposed project will enhance the overall development of the region.

The proposed project will cover addition of new units and technology. The above will lead to manufacture products at a lower cost and more importantly in a more environment friendly way.

FIGURE-1.1 : Location Map



## 2 – PLANT CAPACITY & PRODUCT MIX

### General

M/s. Bhagwati Sponge Iron Pvt. Ltd., is planning to install the proposed units at its existing Steel Plant at Jamuria Industrial Estate, district Burdwan in West Bengal. There being a large number of integrated steel plants in and around the industrial belt of Durgapur and a mushroom growth of tiny mini steel plants in this area producing alloy steel & carbon steel, the promoters do not envisage any bottleneck in marketing their products locally. However, the ferro-alloys have a strong international demand and export potentialities are also extremely good.

### Product-Mix

The proposed product-mix (either) for the proposed plant is presented in the following table.

<b>Product</b>	<b>Unit</b>	<b>Annual Production (in Tonnes)</b>
Sponge Iron	Sponge Iron Kilns - (1x200+1x350) TPD	1,65,000
Billets	Induction Furnaces - 4x15 T (with matching LRF & CCM)	1,80,000
Rolling Mills Product like Structural Steel, TMT Bars, Angles, Channels, Wire Rod	Rolling Mill	2,00,000
Ferro-Silicon	9 MVA Furnace	6,600
Silico-manganese	9 MVA Furnace	14,850
Ferro-manganese	9 MVA Furnace	20,460

### Capacity, Yield, Efficiency & Major Facilities involved for production

The production capacity of proposed plant depends mainly on kiln/furnace capacity and product-mix and partly on charge mix, process adopted, capacity of auxiliary production facilities, casting facilities employed and other operating parameters. The role of efficient management is also of great importance for achieving the desired production capacity of a plant.

### 3 – MANUFACTURING PROCESS

#### 3.1 MANUFACTURING PROCESS

##### 3.1.1 SPONGE IRON PLANT

**M/s BSPL** is now operating 2 DRI kilns, each of 100 TPD capacity for production of 60,000 TPA sponge iron. The company is now planning to install (1x200 +1x350) TPD DRI Kilns for production of 1,65,000 TPA Sponge Iron. So, the final will be 2,25,000 TPA Sponge Iron.

##### **Manufacturing Process**

The plant uses the coal based process in which pellet is reduced with non-coking type imported coal in a rotary kiln to make sponge iron.

The project activity involves installation of charge pre-heaters to utilise the waste heat energy content of flue gases released during manufacturing process of the sponge iron in rotary kilns. The charge pre-heaters will utilise the sensible heat content of flue gases released at 950°C from the individual kilns to preheat the incoming raw material i.e. pellet and dolomite mixture to around 900°C from ambient temperature of 40°C. The charge pre-heaters are of miniature rotary kiln design to enable adequate mixing of flue gases and raw material mixture for effective heat transfer. Thereafter, the flue gases are released into the atmosphere, complying with the environmental norms. The preheated raw material is then fed to the main rotary kiln for further heating and reduction process to produce sponge iron and hence reduces coal consumption for the same quantity of production. In absence of such project activity, equivalent amount of coal would have been consumed in the main rotary kiln to raise the temperature of the raw material mixture to 900°C. The project activity thus helps in reduction of coal consumption per tonne of sponge iron produced in the sponge iron kilns, thus leading to green house gas (GHG) emission reductions.

The raw materials (Pellet, Imported coal and dolomite), in desired quantities and sizes, are fed into the rotary kiln. The rotary kiln is a refractory lined cylindrical vessel on which blowers and air pipes are mounted to provide combustion air to the kiln. The rotary kiln has a downward slope and is mounted on rollers to enable rotation. The angle of inclination, rotational speed, and length of time the charge is exposed to the atmosphere and temperature has important bearings on the quality of the end product. The rotary kiln has three functions as: It is a heat exchanger, Vessel for chemical reaction, Conveyor for solids.

With the rotation of the kiln, the charge moves down the slope and the surface of the material is exposed to heat. The heat exchange takes place via the non-refractory lining of the kiln. The reduction from oxide to metal occurs by gradual removal of oxygen at various temperatures giving rise to various intermediate oxides. Hot sponge iron is discharged from the kiln- discharge end and taken into the rotary cooler. The effluent gas that contains coal volatile, fine carbon particles and sponge iron dust is treated separately in the waste gas handling system. The system consists of:

- (a) Dust settling chamber
- (b) After burner chamber
- (c) Waste heat recovery boiler
- (d) Electrostatic precipitator
- (e) ID fan
- (f) Chimney

#### **Direct Reduced Iron / Sponge Iron Process (DRI)**

The process of reduction takes place inside the rotary kiln, which is mounted on 2 tyres and supported by 4 support rollers. The transverse motion of the kiln is controlled with the help of hydro thruster and thrust rollers. The kiln is rotated at the rate of 0.35 rpm with the help of a girth gear mounted on the kiln and connected with 1 pinion drives, which in turn are coupled with gear boxes and motors.

The direct reduction of iron ore inside the kiln is held due to CO gas, which is generated out of coal at nearly 950°C. Shell air fans are mounted on the kiln, which inject air in controlled manner into the kiln for creating reducing atmosphere. The CO reacts with  $\text{Fe}_2\text{O}_3$  and reduces it to Fe. The kiln is lined with refractory for sustaining the high temperature.

The hot DRI is then cooled by indirect cooling inside a cooler. The rotary cooler is supported on 2 tyres and 4 support rollers. The cooler is rotated at the rate of 0.6 rpm with the help of a girth gear mounted on the cooler and connected with single pinion drive, which is coupled with a gearbox and motor. The water is sprayed on the cooler shell while the sponge iron travels inside the cooler and hence, the material gets cooled at outlet to 150°C while discharged on the product conveyer.

#### **Product Separation**

The sponge iron along with un-burnt coal in the form of char comes out of the cooler. The sponge iron being magnetic is separated out of the char by

passing it through a magnetic separator. The sponge iron and char, recovered separately, are stored in the storage bunkers and discharged through trucks.

#### **Off gas cleaning system**

The off gases moving in counter current of material flow inside the kiln are at a temperature of 1000°C and carry coal dust, which is passed through dust settling chamber and after burning chamber (ABC). Air is added into the ABC for converting CO to CO<sub>2</sub>. The hot flue gas stream is taken to the waste heat recovery boiler for utilization of the sensible heat for making steam. The off gases are then allowed to pass through ESP for removal of dust so that the concentration of dust is limited to below 50 mg/Nm<sup>3</sup> before being discharged from the chimney.

#### **In-plant de-dusting system**

Reverse air bag filter shall be installed for catching the dust from various conveyors, material handling equipments and-product handling equipment. The dust collected from the bag filter shall be conveyed pneumatically to a distant location and discharged on trucks in wet condition.

#### **Raw Materials required for Sponge Iron manufacture**

The main raw materials for sponge iron production are iron ore, coal, and dolomite. The specific consumption and annual requirement of the major raw materials for DRI plant are presented below,

#### **Requirement of Raw Materials for Sponge Iron (Dry & Net)**

S. No.	Raw material	Quantity in TPA
1.	Pellet	2,65,000
2.	Imported Coal	1,23,000
3.	Dolomite	9,000

#### **Preferred Raw Material Characteristics**

The principal burden material used for production of steel making grade DRI in the sponge making process is Pellet, non-coking coal and lime stone/dolomite.

The Pellet should be preferably high in Fe content (>65% Fe) and non-decrepitating type. Coal with a high reactivity and high fusion temperature is preferred. The coal should also be non-coking.

A low ash fusion temperature is undesirable as it promotes formation of accretions in the kiln. The coal ash composition is also important as a siliceous ash might react with ferrous oxide to form low melting ferrous silicate and interfere with the reduction to metallic iron.

Product characteristics of Sponge Iron are as follow,

#### **Sponge Iron (coal based) characteristics**

Fe (total)	:	92% min
Fe (met)	:	83 % max
Metallization	:	90 % max
Carbon	:	0.25 % max
S	:	0.025% max
P	:	0.06% max
Re-oxidation	:	Non-pyrophoric characteristics

#### **Major plant facilities**

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

1. Day bins
2. Rotary kiln and cooler
3. Off gas system including waste heat power generation
4. Product processing and storage.

#### **Day bins**

There shall be a day bin building to cater to raw material requirement of the kiln. The day bin building will comprise of nine bins, two for iron ore, two for feed coal, one for dolomite and four bins for injection coal. These bins will generally have storage of about one day's requirement of Pellet, feed coal (4-8, 8-18 mm), dolomite (1-4 mm) and injection coal (0-4 mm, 4-8 mm). Weigh feeders will be provided to draw the required quantity of various materials in proportion from the bins and the same will be conveyed to the kiln feed and discharge end.

#### **Rotary kiln and cooler**

The rotary kilns will be provided for reduction of pellet into sponge iron using non-coking coal as reductant. The kilns will be lined with abrasion resistant refractory castables throughout its length with dampers at feed end and discharge end.

The rotary kiln will be supported on four piers. A slope of about 2.5% shall be maintained. The main drive of the kiln will be by A.C motors with VVF drive control. The speed of the kiln will be in the range of 0.3-0.9 & 1.05-3.15 rpm. The auxiliary drive of the kiln will be by A.C motors.

The other main components of the kiln will be as given below:

- a. Feed end and discharge end transition housing of welded steel construction with refractory lining including feed chute.
- b. Pneumatic cylinder actuated labyrinth air seal complete with auto lubricating at feed end and discharge end.
- c. On board equipments like fans, manifolds, ports, slip ring, instrumentation etc.
- d. Cooling fans at feed end and discharge end.
- e. Feed end double pendulum valve & dust valves.

In the pre-heater & kiln, the pellet will be heated to the reduction temperature of 1000-1050°C. The pellet will be reduced to metallic iron by carbon dioxide generated in the kiln from coal. The heat required for the reduction process will also be supplied by the combustion of coal.

Thermocouple will be installed along the length of the kiln shell for measurement of thermal profile of the kiln. The temperature will be controlled by regulating the amount of combustion air admitted into the kiln through no. of ports with help of fans mounted on the kiln will have variable speed drive. Auxiliary drive is provided for slow rotation.

The reduced material from the kiln will be cooled indirectly in a rotary cooler by an external water spray. The kiln will be provided with one rotary cooler. The rotary cooler will be of 2.3 m & 8.0 m dia. and 22 m & 77 m length and will be supported on two piers with a slope of about 2.5%. The main drive and the auxiliary drive of the cooler will be by separate AC motor. The speed of the drive will be about 0.3-0.9 & 1.05-3.15 rpm. The cooler will be provided with one plain riding ring and thrust riding ring and will be provided with four sets of support rollers at two piers and one set of hydraulic thrust rollers with antifriction bearings. About 1 m end portion of the cooler acts as a screening section, which separates all the accretions larger than 50 mm from the reduced material. These lumps will be discharged separately via lump gate. Rest of the material will be discharged on to the conveyor via double pendulum valve.

The other main components of the cooler will be the following:

- a. Feed end housing (part of reactor to cooler transition) of welded steel construction with refractory lining.
- b. Cooler discharge end housing of welded steel construction.
- c. Pneumatic cylinder acuted labyrinth air seal complete with auto lubricating system at feed and discharge end.

The cooler will be lined with refractory castable for about 4.0 m from the feed end. Bypass arrangement will be provided at discharge end of the cooler for emergency discharge of materials. The cooled product will be conveyed to the product processing building by a system of belt conveyors.

The cooling water will be collected in the trough below the cooler and sent to the cooling tower for cooling. The cooled water will be re-circulated. Closed circuit cooling system will be followed in the plant.

The rotary parts of the kiln and cooler will be sealed suitably against the stationary parts at the connecting points to avoid leakage of duct laden gas.

### **Product processing and storage**

There shall be one product processing unit for handling the cooler discharge. The product containing sponge iron, char and spent lime from the cooler discharge end will be discharged to a set of conveyors and sent to the product processing building. The kiln cooler system shall have a separate surge bin. Product from surge bin can be withdrawn through vibrating feeder and to the product will first be screened in a double deck screen having 3mm and 20 mm screens. +20 materials shall be dumped as rejects. The screened product i.e. +3 – 20 mm and -3 mm fraction shall separately be sent to the product storage separation. Sponge iron lump (3-20) shall be sent to the product storage building for storing in two no. of bunkers where three days storage has been proposed. The sponge iron fines (-3 mm) will be stored in the fines bunker in the product processing building itself where one day storage will be provided. The sponge iron lump and fines will be further conveyed from the respective bunkers by truck to the steel making unit as per the requirement. The char/non-magnetic shall be stored in a separate bin from where it will be sent to the power plant through conveyors for its utilization for power generation in FBC boiler.

### **3.1.2 INDUCTION FURNACE**

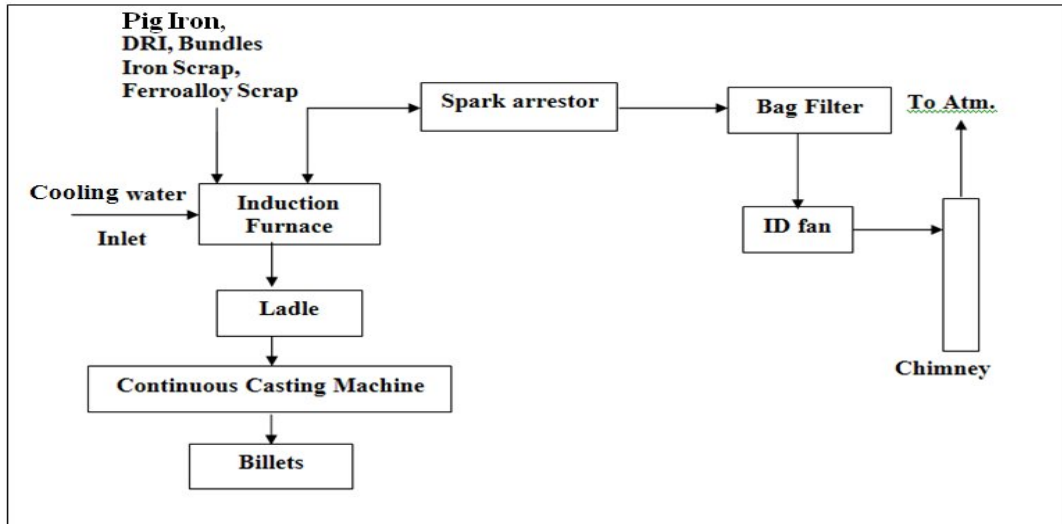
**M/s BSPL** is now planning to install 4x15 T Induction Furnace in the existing plant area for production of 1,80,000 TPA Billets.

The manufacturing process for Steel Billets through Induction Furnace – Continuous Casting Machine is discussed below:

- Ingot / Billets Making by Induction Furnace: The greatest advantage of the induction furnace is its low capital cost compared with other types of melting units. Its installation is relatively easier and its operation simpler. Among other advantages, there is very little heat loss due to radiation from the furnace as the path is constantly covered, and there is no noise attending its operation. The molten metal in an induction furnace is circulated automatically by electro-magnetic action so that when alloy additions are made, a homogenous product is ensured in minimum time. While making Alloy or carbon steel in an electric induction furnace, the foremost consideration is the optimum utilization of the furnace as well as elimination of delays. The time between tap and charge, the charging time, power delays, etc. are items of the utmost importance in meeting the objective of maximum output in tones/hour at a low operational cost.
- The Charge for Induction Furnace: Sponge iron and Scrap constitute the major raw material for steelmaking in the induction furnace where selected scrap of consistent quality, preferably the same as that of the steel to be produced, is mainly used. This is because elimination of some elements from the molten

metal is difficult in an induction furnace melting, and in the cases where these are present in high quantities; dilution is the only possible solution. That is why procurement of the appropriate kind of Sponge iron and scrap is of utmost importance in induction furnace melting practice.

- The charge should be compact and should consist of a number of small pieces of solid selected steel scrap mixed with sponge iron, clean turnings, borings or other light scrap and a moderate amount of larger pieces. This is to provide the initial conditions of a high-flux path through the charge for facilitating generation of heat and commencement of melting. The charge is collected in skips on the working platform and is charged into the furnace through the top opening by removing the top lid of the furnace and tripping the skips. If the charge consists of pieces of scrap varying size, the larger pieces are entered first and the smaller pieces are packed about them as closely as possible. Even with the closet packing it is necessary to gradually add the remaining charge as the melting progresses. As soon as the furnace is charged, the switches admitting ternating current to the induction coil are closed.



**PROCESS FLOW DIAGRAM**

- The Melting of Charge in Induction Furnace: After the furnace is switched on current starts flowing at a high rate and a comparatively low voltage through the induction coils of the furnace, producing an induced magnetic field inside the central space of the coils where the crucible is located. The induced magnetic fluxes thus generated cut through the packed charge in the crucible, which is placed centrally inside the induction coil. As the magnetic fluxes cut through the scraps and complete the circuit, they generate an induced eddy current in the scrap. This induced eddy current, as it flows through the highly resistive path of scrap, generates tremendous heat and melting starts. It is thus apparent that the melting rate depends primarily on two things (1) the density of magnetic fluxes, and (2) compactness of the charge. The charge arrangement has already been described. The magnetic fluxes can be controlled by varying input of power to the furnace, especially the current and frequency.
- This heat is developed mainly in the outer rim of the metal in the charge due to highly resistive path of scrap, but it is carried quickly to the center by conduction. A pool of molten metal is formed at the bottom of the Induction Furnace causing the charge to sink. At this point, any remaining charge is added gradually. The eddy current, which is generated in the charge, has other uses. It imparts a motor effect on the liquid steel, which is there by stirred and mixed and heated more homogeneously. This stirring effect is inversely proportional to the frequency of the furnace and so the furnace frequency is selected in accordance with the purpose for which the furnace will be utilized. The motion of the metal continues till all the charge is melted and the bath

develops a convex surface. However, as the convex surface is not favourable to slag treatment, the power input is then naturally decreased to flatten the convexity and to reduce the circulation rate when refining under a reducing slag. The reduced flow of the liquid metal accelerates the purification reactions by constantly bringing new metal into close contact with the slag. Before the actual reduction of steel is done, the liquid steel, which might contain some trapped oxygen, is first treated with some suitable de-oxidiser. When no purification is attempted, the chief metallurgical advantages of the process attributable to the stirring action are uniformity of the product, control over the super-heat temperature, and the opportunity afforded by the conditions of the melt to control de-oxidation through proper additions.

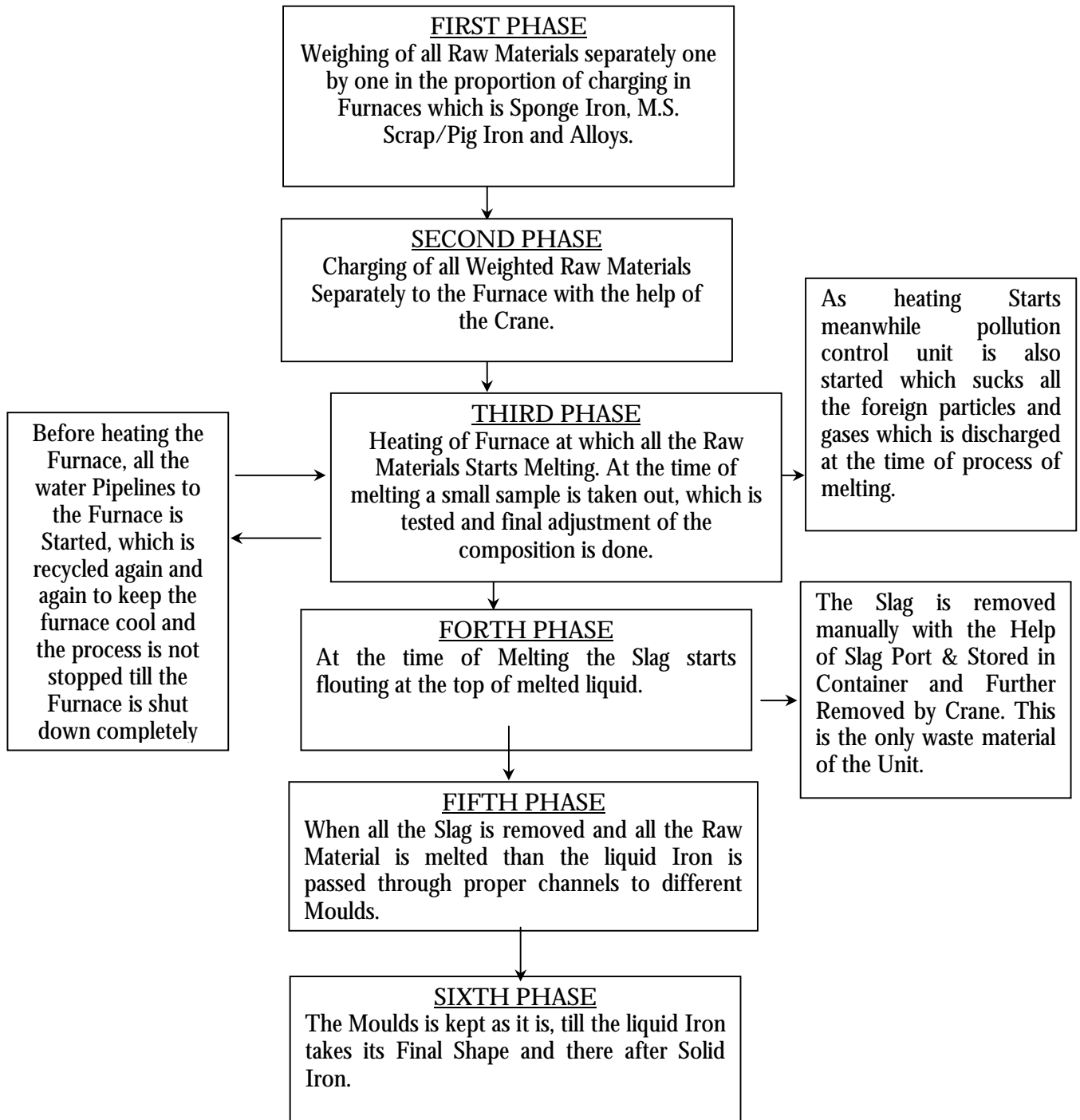
- As soon as the charge has melted clear and de-oxidising actions have ceased, any objectionable slag is skimmed off, and the necessary alloying elements are added, when these activities have melted and then been diffused through the bath, the power input may be increased to bring the temperature of metal up to the point most desirable for pouring. The current then is turned off and the furnace is tilted for pouring into a ladle. As soon as pouring has ceased, any slag adhering to the wall of the crucible is scraped out and the furnace is righted for charging again. As the furnace is equipped with a tight cover over the crucible very little oxidation occurs during melting. Such a cover also serves to prevent cooling by radiation from the surface of the molten metal. Hence the use of slag covering for preventing heat loss and protecting the metal is unnecessary, though slags are used in special cases. Another advantage of the Induction furnace is that there is hardly any melting loss compared with the arc furnace.
- The Ladle Preparation for Transfer of Liquid Metal in Steel Casting through Induction Furnace: It is preferable to have bottom-pouring ladles for ingot teeming purposes. After the teeming operation is over the liquid metal, which sometimes get cooled and solidify on the inner surface of the ladle as skull, is removed and the refractory lining is thoroughly examined and the necessary repairs are done. The loose and damaged bricks are withdrawn and new bricks are reset with fire clay mortar, and patchwork is done. Depending on its condition, the ladle may have to be completely relined. The general experience is that a newly lined ladle can withstand 40 heats on an average with minor repairs after each heat.
- After the repairing is over the ladle is preheated by the oil-fired ladle pre heated to a maximum temperature of about 900°C, according to the grades of the steel

to be poured and the estimated duration of teeming. Preheating of ladle is necessary for three reasons:

1. To prevent explosion due to generation of steam when liquid metal is poured in a cold ladle.
  2. To reduce the thermal shock to the bricks as hot metal is suddenly poured.
  3. To reduce the sudden chilling effect of the bricks on liquid metal.
- The stopper rod, also relined after each heat, is uniformly heated to ensure complete removal of moisture. It is then fitted to the gooseneck of the stopper rod mechanism and positioned correctly in respect of the bottom-pouring nozzle of the ladle. This operation is very important since an improperly adjusted stopper rod may lead to leakage of costly liquid metal. The preheated ladle with the stopper rod assembly is now ready to transfer the liquid steel from furnace to mould. The ladle is positioned over the central trumpet for the bottom pouring ingot moulds and liquid metal is allowed to fill the ingot moulds via trumpet and runners at the bottom.
- The ideal ingot produced through this Laddle Teeming Practice is homogenous both physically and chemically. It would have a fine equiaxed crystal structure and be free of chemical segregation, non-metallic inclusions and cavities. Unfortunately, the natural laws that govern the solidification of liquid metal operate against attainment of the ideal condition, and the ingots develop within their interiors the well-known phenomena of pipe, blowhole, chemical segregation, non-metallic inclusion, columnar crystal structure and internal fissures. Added to these manifestations of internal non-uniformity are detrimental surface occurrences such as ingot cracks, seams and scales. Technological progress, however now allows removal of these defects by suitable up gradation of the process. There are various methods of ingot casting. The methods have been devised to suit various types of steel, different sizes of ingots, and sometimes also the subsequent processes.
- The other method of Ingot Casting is Direct Teeming Practice where Direct teeming of liquid metal from induction furnace to mould assembly. It is a recent development of the ingot casting practice. In this process the mould assembly comprising bottom plate, ingot mould and trumpet properly lined with refractory are placed on top of a rail bound transfer trolley moving across in front of the crucibles. A refractory lined tundish is placed under the pouring spout of the crucible which is supported properly from the furnace structure. While teeming, the mould bogie transfer car is so positioned that the trumpet of the mould

assembly is properly aligned with the outlet nozzle of the tundish. The liquid metal from the spout is directed through the tundish to the trumpet for casting of ingots. After the teeming is over the car is moved aside for stripping and removal of ingots. Normally two such transfer cars are provided. While one is engaged for casting purposes the other is kept ready for the next melt. Direct teeming practice obviates the use of stopper sleeve; stopper head ladle refractories and requires only a nominal quantity of refractories for lining the tundish, and thus effects substantial saving in refractory costs.

**FLOW CHART OF MANUFACTURING PROCESS**



The Conventional Method of Ingot / Billet Casting with the help of Induction Furnace through Direct Teeming Practice or Ladle Teeming Practice have its drawbacks and with the technology advancements, Continuous Casting Machine is introduced for Billet Casting. The advantages of Continuous Casting Machine in Billet casting over conventional methods are:

1. It dispenses with much of the auxiliary equipments and facilities like Ingot Moulds, Mould Conditioning, Mould Yard, Liquid Metal Pouring Platform, Teeming aisle, Ingot Bogies, Transfer Facilities, Stripping Facilities, Stripper Cranes etc.
2. The yield is approx 97% of Finished Goods from Liquid Metal in CCM in comparison of 93% in conventional method.
3. The conventional method does not allow active control of the primary structure as solidification of liquid metal proceeds in Ingot moulds. Ingots suffer from many defects like central porosity, non metallic inclusion, V and inverted V segregation etc.
4. Material produced through CCM route has better grain structure as compared to conventional route. This makes possible to impart, even in a limited reduction in area, at the time of rolling. The necessary degree of mechanical working and refinement of metallographic structure contributing to the development of specified physical properties in the Finished Products. The Ingots with same average cross section, undergoing same reduction in the area.
5. In Alloy Steel, Double Rolling can be avoided with the Billets produced through CCM route.
6. Billets produced through CCM route saves considerably in manpower and energy consumption. It is much more economical from the point of view of the end products, annual capacity and overall investment costs.

### **3.1.3 ROLLING MILL**

The company is planned to install the proposed Rolling Mill for production of 2,00,000 TPA Structural Steel, TMT Bars, Angles, Channels, Wire Rod as a finished product.

**Hot rolling process**

Re-Heating Furnace is fired daily 4 hours before start up time of Rolling Mill. Ingots/Billets, when in the heating zone a temperature of 650°C is achieved, which is measured through Thermo Couples & in Soaking zone a temperature of 1250°C is achieved some sized samples approximately 1.5 m to 2 m long are put in & fed in every mill. This is already in running condition with all water circuitry on, to check the sizes on every pass. If some minute adjustment is required it is made & again samples are fed to confirm size of pass in Rolls, then 1<sup>st</sup> piece of Ingot is passed through & leader & tail end is cut in on line Rotary Shears & final size, which is put on cool Bed manual & again size is reconfirmed. Bar/ Structural material is cut into 48 M length through on line Rotary Shear before cooling Bed.

In the meantime charging Grate helpers put manually cold ingot or, which was stacked on charging Grate by EOT Electromagnetic Crane from stock Yard, to conveyor table which brings the piece in front of pusher on the back side of Re-Heating Furnace from where on getting signal from Ejector operator the pusher operator pushes the piece into the Furnace. In front side the Roughing pull pot operator gives Electric operated signal to ejector operator for pushing next piece and rolling of second piece stars, if rolling is going on without hindrance which is observed upto 10 approx. pieces the process become continuous. On an average when 8 MM size is being rolled & 3 Meter billet is use approximately 65-70 pieces come in one hour. Production increases for high sized sections 10 MM & above on Cooling Bed when quantity is collected, one piece of 48 M length is pushed manually/ automatically on pieces conveyor. Which when pass through cold shear is cut in to 12 M length & workers make bundles of these & stack these size wise for checking & dispatching.

**3.1.4 FERRO ALLOYS PLANT**

The company is planning to install 2x9 MVA Submerged Arc Furnaces (SAFs) for production of 20,460 TPA Ferro Manganese or 14,850 TPA Silico Manganese or 6,600 TPA Ferro Silicon or 24,750 TPA Pig Iron as a finished product.

Most of the ferro-alloys e.g. Ferro-silicon, Ferro-manganese, Silico-manganese, etc. are produced by smelting process. Smelting of the charged materials are carried out in submerged electric furnaces equipped with transformer of proper ratings.

The process developed recently in India during the decade of 90 is based on basic process parameters as offered by ELKEM, Sweden, in past. Various Indian furnace manufacturers successfully developed furnace design upto 12.5 MVA electrical ratings for manufacture of different grades of ferro-alloys based on ELKEM, Sweden Technology.

### **Basic Process**

Ferro-alloys are produced by reducing metals from their oxides contained in ores by using a suitable reductant under conditions created to ensure a high recovery of the valuable elements from the starting materials. Such reduction reactions are characterized by stability of all oxides at high temperatures. The stability of all oxides decreases with increasing temperatures, exception being only carbon mono-oxides which becomes more stable with increasing temperature. An element which forms a stronger oxide can, under appropriate conditions, be used as reductant for a less stronger oxide. The reaction will proceed successfully if the difference in free energies of oxidation reaction amounts to tens of Kilo-calories per mole of oxygen involved; with a small difference, favourable conditions should be formed to make the reaction proceed. The presence of iron or iron oxides can facilitate some reduction processes. Iron dissolves the reduced element, forms a compound with it, and thus lowers the activity of that element by removing it from the reaction zone. In many cases the melting point of an iron element alloy is lower than that of the pure element.

#### **3.1.5 CAPTIVE POWER PLANT**

A 18 MW captive power plant will be installed, out of which 10 MW will be generated based on waste heat recovery boiler and the balance 8 MW, based on AFBC boiler using dolochar from DRI plant & coal as fuel. The AFBC boiler has been proposed just to maintain the un-interrupted running and ultimately to sustain the turbine operation, as the proposed WHRB will not be able to maintain the consistent supply of steam to the turbine.

The steam generator shall be provided with one steam drum and the drum shall be fusion-welded type. The drum shall be provided with Torispherical / Semi-Ellipsoidal spinned dished ends. The steam drum shall be liberally sized to assure low steam space loading, with adequate space to accommodate the internals.

The furnace envelop shall be constructed of fully water cooled membrane/fin welded walls and they shall be adequately supported. The construction shall be gas pressure tight and the furnace shall be strengthened by providing bucks trays and tie bar system. The furnace design shall incorporate necessary man holes.

The boiler bank design shall be of inline arrangement and the tube spacing shall enable easy removal of the tubes in case of any failure. There shall be adequate approach space to the tubes of the bank for easy maintenance. Suitable numbers of soot blowers shall be provided to cover the maximum surface area of the bank. The sealing at the bank tube penetrations with the

boiler membrane wall shall be 100% leak tight. The tubes shall be of seamless construction.

The steam generator shall be provided with a complete system of soot blowers to effectively dislodge deposits from heat transfer areas. The necessary pressure reducing station shall be provided. In the zones where the gas temperatures exceed 700<sup>0</sup>C only long retractable soot blowers shall be used.

#### **Waste Heat Recovery Potential**

The 550 TPD capacity Sponge Iron Plant will produce waste gases, which will be able to generate around 10 MW of Electrical power.

The AFBC Boiler will use dolochar from DRI and coal.

The salient features of the boiler are as follows:

- Number of boilers
  - Waste Heat Recovery Boilers 1 No. (40 TPH)
  - AFBC Boiler 1 No. (32 TPH)
  
- Boiler Outlet Steam Parameters 67 KSC  
490°C±5°C
  
- Fuel used for the boilers
  - Waste Heat Boiler DRI Kilns exhaust gas
  - AFBC Boiler Dolochar & coal
  
- No. of turbo generators to be installed One
  
- Turbo Generator type Single extraction cum  
Condensing
  
- Turbo generator capacity 18 MW
  
- Plant load factor from 2<sup>nd</sup> Year 90%

## 4 – PLANT GENERAL LAYOUT & BUILDINGS

This chapter deals with the criteria for selection of the site and the general layout of the proposed plant. The salient aspects of the plant general layout, viz. storage and handling of the major input materials and proper location of the proposed units with respect to all requisite facilities are discussed here. The availability of industrial infrastructural facilities has also been noticed.

### **Selection of Plant Site**

The following major factors demand consideration when selecting the site for proposed plant with the requisite facilities, with provision for future expansion/ diversification:

- i) Availability of adequate land for the proposed plant and its future rational expansion;
- ii) Sources of supply of raw materials and their delivered cost;
- iii) Proximity to finished goods;
- iv) Existence of rail & road connection in the vicinity for transportation of incoming materials and outgoing products
- v) Availability of industrial infrastructural facilities, e.g. water, power, skilled personnel, etc.
- vi) Access to developed areas with markets, schools, hospitals, and other social amenities; and
- vii) The effect of all these factors on the capital and operating cost, and ultimately on the overall economics of the project.

The proposed plant will be located in 29.8 acres of land. In fact the entire area has been developed by Asansol Durgapur Development Authority (ADDA) and therefore necessary infra-structural facilities shall be available for the growth of the industries to be located in this area. The proposed location enjoys the territorial advantage of being situated near the National Highway as well as State Highways and therefore connected to most of the important cities of the country. The site thus combines many advantages such as access to market, transportation facilities, availability of manpower and other infrastructural facilities like electrical power and an already established industrial environment. Water shall be made available by ADDA as per the requirement.

### **Plant General Layout**

The plant general layout has been designed to provide a rational disposition of production facilities, material logistics facilities, auxiliary & ancillary facilities and plant utilities & services. The layout has been developed in such a way that future expansion & diversification may be readily feasible. A properly designed layout is obviously essential for operational efficiency, plant economy and saving of capital cost.

In developing the plant general layout, the factors which have been taken into consideration for appropriate flow of process materials are indicated below:

- i) Economical and uninterrupted receipt of major incoming materials, in plant movement of materials without hindrance and minimum counter-flow of materials particularly inside the production shop in which major equipment is located.
- ii) Logical locational arrangement of the proposed Units with respect to existing units, supporting facilities, plant services and ancillary facilities so as to ensure minimum capital and operating costs.
- iii) Compactness of the plant layout minimizing inter plant building for processing materials as well as adequate scope for future expansion.
- iv) Maximum utilisation of the available facilities / services as are available in the existing plant.

Of particular importance is the establishment of a correct spatial relationship between the production facilities, material logistic facilities and auxiliary & ancillary facilities. Especially the production shop must provide easy access to all other sections so as to allow unimpeded movement of input materials and manufactured products. The production facilities, it may be recalled will consist of proposed units, the utilities and auxiliary facilities will include the electrical power system, water system, compressed air system, general store, etc. and the ancillary facilities will comprise administrative building, ablution block, time & gate office, etc.

Taking all these aspects into consideration, an appropriate plant layout (ref. **Figure-4.1**) has been developed.

## 5 – MAJOR RAW MATERIALS

### Annual Requirement of Raw Materials & Supplies

The major raw material, which will be handled consist of pellet, Imported coal, Dolomite, Limestone, Sponge Iron, Manganese Ore, Quartzite, Coke etc. for the proposed project. The annual requirement of raw materials along with the source of materials, which will be required for the proposed project, is presented below.

#### Raw Materials for Sponge Iron Plant

S. No.	Raw material	Quantity in TPA
1.	Pellet	2,65,000
2.	Imported Coal	1,23,000
3.	Dolomite	9,000

#### Raw Materials for Induction Furnaces

S. No.	Raw material	Quantity in TPA
1.	Sponge Iron	1,81,500
2.	Pig Iron	31,700
3.	Scrap	25,000
4.	Ferro Alloys	1,500

**Raw Materials for Ferro Alloys Plant**

<b>Raw Material</b>	<b>Annual Requirement in Tonnes (TPA) of installed capacity</b>
<b>For Ferro-Silicon</b>	
1. Quartzite	13,200
2. Mill Scale/Scrap	1650
3. Coke & Charcoal	6,600
<b>For Ferro-manganese</b>	
1. Manganese-Ore	38,780
2. Coke Breeze	12,280
3. Mill Scale	2,090
<b>For Silico-manganese</b>	
1. Manganese-Ore	21,490
2. Coke Breeze	9,400
3. Mill Scale	1,470
4. Quartzite	4,410
5. Dolomite	410

## 6 – MECHANICAL SERVICES

The essential mechanical services required for the proposed plant can be broadly classified into four parts, viz –

1. Water System
2. Air System
3. Material Handling System
4. Fume Extraction/ Pollution Control System

Although the plant is proposed to be installed in the Jamuria Industrial Estate of West Bengal, other Infrastructural facilities for the plant maintenance etc. are expected to be available in and around the plant site. While an elaborate material handling system is required for the plant operation, this will be the major part of the production facility and hence has been included in the cost of the main plant and equipment and therefore has not been covered separately as auxiliary equipment.

### **Water System**

The water system of the proposed plant will provide for the following usages:

- a) Cooling of equipments & DM Water
- b) Human consumption for drinking, washing & sanitary needs

Generally the water for cooling of the equipment is circulated in a closed circuit. It is pumped from the cold sump and sent to the equipments through necessary pipelines. After cooling different parts of the equipments, the hot water returns to the top of cooling tower.

The required degrees of cooling of hot water are done through the cooling tower and it is stored in the cold sump for recirculation. Some make up water is always necessary to be added to the cold sump to compensate for evaporation loss, drift loss, process loss and leakage loss. The water in the cooling system for the furnace and for compressors are required to be treated to the levels as specified by the equipment manufacture.

The entire break-up of water requirement for equipment cooling system, general drinking, sanitary and other miscellaneous purpose including related auxiliary facilities has been discussed below.

In the proposed unit, water will be required mainly for the following:

IF/Submerged Arc Furnaces : Cooling of transformers, furnace mechanicals, viz. water cooled jacketed furnace hood, electrode holder cooling, water cooled guides, etc.

To minimize the requirement of cooling water, a recirculation system with replenishment by make-up water will be adopted. The re-circulating routes of cooling water for the different kinds of equipment are indicated below:

<u>Equipment</u>	<u>Circulation Routes</u>
IF, Submerged Arc Furnace : & Air Compressor	Cold Sump – Equipment – Cooling Tower – Cold Sump

During recirculation of the cooling water through the above systems certain unavoidable losses will occur in the water flow circuits, because of evaporation in sumps, drift and leakage losses in machinery as well as evaporation, drift and blow down/ bleed-off losses from cooling towers. These losses in cooling tower circulation for the furnaces amounts to about 5%. Thus a continuous supply of make-up water to replenish these losses will be required.

Turbine and Boiler Auxiliaries will be cooled by Cooling Water circulated with the help of Cooling Water pumps. Hot Water coming out of the said Auxiliaries will be cooled in the Cooling Tower. Small percentage of Cooling Water will be required to be blown down at regular intervals to keep concentration within limit by supplying Make-up Water. Boiler Blowdown Water will be collected in a pond for utilization in Coal Handling Plant, Dust Suppression system within the Plant Premises.

To keep concentration of Boiler Water within limit, some percentage of Boiler water will be blown down. This will require supply of DM Water for Make-up. DM Water shall be supplied from DM Water Plant.

In addition, water will also be required for general drinking and sanitary purposes. It is envisaged that the required quantity of total make-up water including that for drinking & sanitary purposes will be available from an underground reservoir. Water from underground reservoir will be pumped by suitable lift pump and after passing through water treatment plant will be stored in the cold sump for recirculation. Drinking, laboratory & sanitary water needs to be supplied after filtration & chlorination, if necessary.

Quantity of Water Requirement

The quantity of water required for meeting various specific needs is given below.

<b>Quantities of Water required for Meeting Specific needs</b>		
<b>Make-up Water (in cu.m/day)</b>		
1	Sponge Iron Kilns	160
2	Induction Furnaces (with matching LRF & CCM)	35
3	Rolling Mills	25
4	Ferro Alloys Plant	52
5	Captive Power Plant	211
6	Domestic Water	20
<b>Total</b>		<b>503</b>

For cooling of different furnace parts and transformer, centrifugal pumps have been considered for the furnaces. The pressure rating of the pumps have been selected in such a way that after cooling of different furnace parts & compressor, the residual pressure of the return water shall be sufficient to drive it on the top of cooling tower. After getting the required degree of cooling through cooling tower, the water shall be accumulated in the cold sump for recirculation. Suitable pump room has been provided for housing the above pumps.

It is envisaged that total water will be supplied by Asansol Durgapur development Authority (ADDA) from Ajoy River. The water will be taken into an underground reservoir suitably located inside the plant site. Necessary pipelines, pumps and other accessories have been considered for making this secondary water source be effective at all times for plant operation.

Compressed Air System

Compressed air will be required for pneumatic operation as well as for the general cleaning of various items of equipment. The major utilization of compressed air for operating equipment in the proposed plant is for pneumatic control. Apart from operation of equipment compressed air will also be required for general cleaning of equipment during operation of the plant.

### **Material Handling System**

The plant shall be provided with material handling system for uninterrupted supply of raw material to the proposed units. The system will however, consist of the following basic equipment.

1. Vibrating screen for feeding to the belt conveyor;
2. Belt conveyor for transfer of material from raw material storage area to day bins;
3. Fabricated day bins;
4. Load cells and transfer conveyor for feeding of raw materials to skip hoist;
5. Skip hoist, transfer cars, monorails for transfer and feeding of raw material to charging bins;
6. Charging bins and chutes with flow control/ regulation valves for storage & charging of mixed raw materials to the furnace.

Bulk raw material will be handled by means of Dumper Trucks & Pay Loaders and proposed arrangement has been considered to be adequate for handling the raw material for all the furnaces.

### **Fume Extraction/ Pollution Control System**

Adequate control measures like installation of electrostatic precipitator (ESP), bag filters, dust suppression system to limit the outlet emission of particulate matters to 50 mg/Nm<sup>3</sup>.

There will be Dust Extraction/Dust Suppression Systems/Foggy Dust Arresters to control fugitive emissions at Furnace Tapping Points, raw material handling section and various other facilities inside the plant. Besides, there will arrangement for mobile water sprinkler for the dust suppression at all relevant places including internal roads of the plant.

Fume extraction system has now become a statutory obligation in the various industries specially in a melting or smelting unit. In order to minimize the abuse of the environment prevailing in the Smelting Shop, a system has been proposed by which fumes are to be sucked through suction hoods and the hood is required to be located immediately above the fume generating zone. In the proposed plant, fume shall be generated in the furnaces so long as smelting process runs. Fumes generated shall be sucked through a hood/ canopy suitably located just above the main furnace mouth and shall be carried away by means of blower through ducting system and bag filter to the chimney for discharging it to the atmosphere. The

system shall comprise Hood / Canopy, Duct, Exhaust Blower, Bag Filter, Chimney and other accessories.

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## 7 – PLANT CONSTRUCTION

Installation of the equipment and systems of a plant and construction of the plant & ancillary buildings, utilities & services and auxiliary facilities demand coordination of various activities like procurement of equipment and materials of construction, designing the plant and other buildings, award of contracts and supervision of all construction jobs at site.

Considering the delivery period of major equipment and the time required for construction of buildings and miscellaneous items as well as for installation of machinery & equipment, a project implementation schedule has to be developed. The factors involved in the execution of this schedule are discussed in the following sections.

### Steps involved in implementation

It is estimated that the implementation of this project will take around 18 months if the jobs are executed efficiently and as far as practicable simultaneously. The major steps involved in the implementation of proposed expansion project making facilities are: -

- i) Arrangement of the requisite finance for the project
- ii) Finalisation of the layout of the proposed plant
- iii) Completion of site survey and soil testing, design of all plant buildings, auxiliary & ancillary buildings, utilities & services.
- iv) Issue of tender documents and specifications for all equipment, selection of equipment supplier and placement of orders.
- v) Finalisation of arrangement for the construction of the substation for electric power supply system.

For the constructional jobs and for bringing the plant into operation, the following major steps are needed:

- a) Arranging for all constructional facilities at site
- b) Procurement of bulk steel, cement and other construction materials and arranging for their delivery in accordance with the construction schedule.
- c) Creating an organizational set up for the execution of the project.
- d) Obtaining foundation load and other relevant data of the major plant & machinery etc.
- e) Preparation of Tender documents for construction.

- f) Issue of Tender documents and selection of contractors for handling civil, structural, mechanical & electrical jobs and equipment installation.
- g) Installation & erection of equipment including power supply and distribution system, water system and other utilities.
- h) Securing personnel for the operation of the plant.
- i) Arranging for necessary raw materials and services.
- j) Trial run & commissioning of the individual items of equipment and finally the entire plant.

### Project Implementation Schedule

#### Commissioning

It has been planned to complete the installation and commissioning of the proposed plant within 18 months of “go-ahead”. The construction schedule has been prepared on the basis of the delivery periods of the major items of equipment as indicated by the supplier and the volume of civil, mechanical and constructional jobs involved. In view of the long delivery periods of some of the major items, particularly the submerged arc furnace, material handling equipment, pollution control equipment, etc. It is imperative to finalise orders for them at the initial stage of the project. The delivery of the components of these major items should be so in order that their assembly at the plant site may not suffer.

#### Procurement of Equipment & Installation

The delivery period of the furnaces & other equipment will be 8-9 months. The next long delivery items are the material handling equipment, electrical equipment, cranes and the water pump sets; all of which may take 6 to 8 months for delivery. Pending the delivery of these items, all such work as the laying of cables, pipelines for water systems, compressed air systems should be taken up and completed by the time equipment is installed and test trial run may commence as per schedule.

#### Civil Work

The soil testing data should be made available at the earliest. On the basis of soil data, the columns and other structural for all the buildings can be designed. The foundation of the columns of all buildings should be started immediately after the go-ahead signal and completion of leveling of the site. The civil & structural construction of all the building sheds can proceed simultaneously. On receipt of foundation load and other data, laying of foundation for the furnaces and other items of equipment can be taken up simultaneously and

completed before the equipment arrive at site. The laying of internal roads & drainage system should be completed and made ready to facilitate transportation of structural material, raw materials and equipment.

#### Structural Steelwork

An appropriate & economical structural design of the plant buildings will be adopted and the required quantity of structural steel and other building materials should be procured after the “go-ahead” decision has been taken. Along with the civil work, the fabrication of column, roof trusses, etc. can be started. The fabrication & erection of structural steelwork including roofing & cladding should be completed within the allocated time.

#### Equipment Erection

The erection of the submerged arc furnace should be carried out under the guidance & supervision of the personnel deputed by the equipment supplier, who will also be responsible for commissioning of the equipment & demonstrating the fulfillment of performance guarantees.

#### Management of the Project

It is necessary to fix responsibilities for the project management on suitable persons headed by a Chief of Project who will monitor the progress of work and take proper steps for its timely completion. The critical factors that may cause delay should be identified at an early stage of implementation and necessary steps should be taken to overcome the obstacles. It needs emphasizing that delay in execution of the inter-related jobs will increase the capital cost and therefore all likely delays should be avoided so that the project may not over run. Delays in completion of a project lead to enormous escalation in capital cost and instead of bringing in revenue it causes loss of earnings to the company. If needed, a task force can be formed for timely execution of the full project.

## 8 – ORGANISATION & MANPOWER REQUIREMENT

The efficient management of proposed units demands judicious manpower planning, selection of qualified & experienced personnel and an appropriate organizational structure clearly defining the functions & responsibilities of individual, managerial & supervisory staff of various level, dealing with secretarial & administration, financial & budgetary control, purchase, sales, plant operation & maintenance, quality control, personnel management & discipline, plant safety, etc.

The estimated requirement of manpower of the proposed plant in the various departments has been worked out purely on technical & management grounds.

### Basis of Manpower Estimation

The manpower requirement has been estimated on the following basis:

- i) the anticipated production and productivity level achievable in various sections of the plant with its installed equipment, supporting facilities and routine production norms;
- ii) number of personnel required to perform various duties associated with the different processing steps leading to the production, maintenance of equipment, services & utilities, auxiliary facilities, quality control and all other related jobs;
- iii) requirement of personnel for secretarial, administration, budgetary & finance control, purchase of input materials and sale of manufactured products, security & labour welfare.

For realistic estimate of manpower, an appropriate organization structure demarcating the duties & responsibilities of individual senior plant personnel engaged in a specific job needs to be considered. It will be considered that the head of the organization will be the Chief General Manager who will formulate policies and exercise overall management control. He will be assisted by Works Manager for all technical matters relating to the plant operation and its maintenance and Company Secretary dealing with personnel management, administration, legal, secretarial, finance, etc.

### Works Manager

The Works Manager will be accountable and answerable to the Chief General Manager for all operations including planning, purchase, material management, production, plant utilities, maintenance, quality control, production cost and budgetary control, plant safety, discipline, labour relation, dispatches of finished goods. He should solve technical problems and exercise operational and administrative control of the plant. His main function should be to ensure achievement of quality & quantity targets of production at reasonable cost and should constantly strive to improve plant performance.

### Maintenance Manager

The Maintenance Manager shall be responsible for the maintenance and installation of all mechanical & electrical equipment of the plant. He is accountable to the Works Manager. He should undertake preventive maintenance services regularly to minimize break-down. He should arrange for timely procurement of spares.

### Quality Control Manager

The Quality Control Manager will be responsible for ensuring the required quality of the end product. He will work in co-operation with the Works Manager and will be assisted by Quality Control Officers.

### Foreman (Production)

The shift Foreman (Production) is in-charge of manufacturing facilities and supporting equipment. He should be responsible for operation, administration & discipline of the production shop and accountable to Works Manager. He shall be responsible for timely procurement of all spares and efficient operation of the shop. He should work in collaboration with the Maintenance Department to solve all maintenance problems so that frequent failure of plant & equipment does not impede production.

### Personnel of Various Categories

The personnel of various categories and disciplines required for integrated operation, functional activity should be main criteria in the discharge of duties and selection of staff at different levels. In order to provide incentive to the staff and workers, the production chain has to be kept in view.

### Estimate of Manpower Requirement

A preliminary estimate of manpower requirement for smooth and efficient operation of various sections of the plant & services, administrative & commercial departments has been prepared purely on technical and management grounds primarily to indicate the order of manpower requirement and to make preliminary estimate of the annual salary & wage bill, which will reflect on the production cost estimate. In estimating the manpower requirement, the proper ratio between the administrative, managerial, supervisory and shop floor staff has been maintained. The estimated manpower required for smooth operation of the plant is around 500.

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## 9 – CAPITAL COST ESTIMATE

This Chapter deals with the capital cost estimate for the proposed units along with other auxiliary facilities. The cost associated with the proposed installation for manufacture of sponge iron, Billets, ferro-alloy etc. construction of production buildings, auxiliary & ancillary buildings and miscellaneous civil construction, installation of basic & auxiliary production equipment, plant services & utilities and contingency & escalation provision have been considered for estimation of plant cost. The cost to be incurred on other items such as engineering & consultancy charges, preliminary expenses, preoperative & start-up expenses, interest during construction period, power connection charges & security deposit to DVC, margin money for working capital, etc. are added to the plant cost to arrive at the total investment.

### Plant Cost

The plant cost has been estimated on the basis of the designed capacity and manufacturing process proposed to be adopted as discussed in earlier chapters. The equipment cost is based on recent quotations from reputed manufacturers/dealers and provisions have been kept for escalation as well as contingency. The cost of construction is based on current rates of civil & structural construction in West Bengal.

### Land & Land Development

The company has already in possession of about 29.8 acres of land for the proposed project.

### Civil & Structural Work

The estimates for civil & structural work are based on estimates on quantities of the major items of work as derived from preliminary design as well as the unit rates and prevailing cost of construction materials and erection charges in West Bengal.

### Plant & Machinery

The cost estimates of the plant & machinery are based on recent available quotations received from various manufacturers for the proposed scheme and out of the quotations received from different equipment manufacturers, only the most suitable quoted price has been considered for the estimates.

### Miscellaneous Fixed Assets

The cost of miscellaneous fixed assets comprising of utilities, services, testing, etc. has been considered on the capital cost estimate.

### Foundation & Erection

The cost of foundation & erection of plant & machinery has already been incorporated while computing the cost of plant & machinery and foundation & erection cost has not been shown separately.

### Contingency & Escalation

A provision of about 3% of the Direct Cost has been kept towards contingency and price escalation.

### Total Investment

Various expenses such as preliminary & pre-operative expenses including interest during construction period and start-up expenses, service connection charges and security deposit for supply of electric power, margin money for working capital, etc. have to be added to the plant cost to arrive at the total investment. The estimated Total Investment will be around Rs 324.0 Crores.