PRE-FEASIBILITY REPORT

for

INSTALLATION OF 1 No. 9 MVA AND 1 NO. 6 MVA SUBMERGED ARC FURNACE FOR PRODUCTION OF FERRO-MANGANESE, SILICO-MANGANESE & FERRO SILICON

at

HALDIA, PURBA MEDINIPORE, WEST BENGAL

Project Proponent

ELECTROSTEEL CASTINGS LTD.

1 – INTRODUCTION

Electrosteel Castings Ltd., a renowned name in Ductile Iron pipe manufacturing sector, intends to install two (2) nos. submerged arc furnaces, 1 no. of 9 MVA and 1 no. of 6 MVA capacities for the production of Ferro-Manganese, Silico-manganese & Ferro-silicon alloy, mainly for domestic market consumption. The proposed site is located at Haldia, Dist. Purba Medinipore, West Bengal. The intended production of the plant will be to the tune of 34,687 M.T. of saleable Ferro-manganese or 24,645 M.T. of saleable Silico-manganese or 9,475 M.T. of saleable Ferro-silicon per annum by operating 1 no. 9 MVA & 1 no. 6 MVA submerged arc furnaces. Since the proposed site is located at an already grown up industrial area of West Bengal, it is expected that all the necessary infrastructural facilities shall be available including electrical power. It would be worthwhile to mention here that the required power shall be fed to the proposed unit at 11 KV. Power requirement of the proposed plant would be around 12.5 MW, which will be sourced partly from the Captive Power Plant of the Coke Oven Plant of the company, operating in the adjacent land and partly from the supply system of WBSEDCL.

The Ferro Alloy Industry is an essential and vital industry producing basic alloys, which are required for the growth of the steel industry to cater to both domestic and international market. Ferro alloys are the intermediate products used in making of steel as deoxidants alloying agent and for rust proofing.

Steel demand in India has been forecast mainly on the basis of past trends, taking into account the relationship between GDP and steel consumption and then projecting specific assumed GDP growth rate for future years. The forecast of steel demand for 2025-26 made by INSDAG as per standard methodology assuming 6 & 6.5 percent annual compounded average growth rate of the GDP seems to be fairly realistic. As per this, demand for finish steel is likely to rise to 165/171 million tones respectively. To meet this demand only, the country will have to set up adequate facilities for production of 190 – 205 million tonne crude steel.

The total steel demand and required level of finished steel production (alloy & non-alloy) for the 12^{th} Five Year Plan, i.e. 2012-2017 had been estimated by the competent authority and it was to the tune of 115.30 million tonne in the year 2016-2017. It is also estimated that about 3.02 million tonne manganese alloys shall be required to meet the demand of Ferro-manganese & silico-manganese alloys in the year 2016-2017. However, at present, existing installed capacity for the plants manufacturing above alloys is 3.16 million tones and corresponding capacity utilization is remained at 54% for a production of 1.7 million tonne as noted for the year ending 2011. As on today, it is seen that there is a positive growth for manganese alloys. Since it is linearly proportional with the growth of steel industry, it is apprehended that growth of the consuming industry would be substantial within a few years to come and therefore in order to meet the demand, manganese alloys industry shall have to make the way for it. Now, if it is assumed that all the plants those who are operating for manganese alloys now increased their operating efficiency level at 65% of the installed capacity, i.e. 11% higher than the earlier level then the total production would have been to the tune of 2.054 million tonne per annum whereas the demand for manganese alloys has been projected as 3.02 million tonne leaving a gap of 1.106 million tonne as short fall for the year 2016-17. However, the demand projection has been made after considering domestic as well as export demand for a year and it concludes that even after operating at appreciable level there would be enough scope for addition of new capacity plant in order to meet the growing demand.

From the foregoing discussion a conclusion may be drawn that a fairly constant demand for the ferro-alloys shall be maintained and it will rise proportionately in accordance with the growth of steel production. It is apprehended that the growth of steel production will reach to an appreciable level within near future and therefore capacity additions for production of manganese alloys would be a necessity. Having first hand knowledge about the demand/ supply of the products, the promoters have justifiably embarked on the production of the same.

All the figures mentioned in the above paragraphs have been obtained from the Papers "Long Term Perspectives for Indian Steel Industry submittd by Dr. A.S. Firoz, Chief Economist, Economic Research Unit, and Manganese Ore and Ferro Alloys for Steel Production" submitted by G.P. Kundargi, Director (Production & Planning), MOIL Limited.

SUMMARY

Installed capacity:

• Ferro-manganese	:	38,156 TPA
		or
• Silico-manganese	:	27,109 TPA
		or
• Ferro-silicon	:	10,421 TPA

Main Production Equipment : 1 No. 9 MVA & 1 No. 6 MVA capacity submerged arc furnaces and material handling facility.

Charge Mix in M.T.		Mn-ore	Coke	Iron scrap	Quartzite	Mn Slag
• Ferro-manganese	:	2.14	0.50	0.1	-	-
• Silico-manganese	:	0.49	0.50	0.1	0.3	1.6
• Ferro-silicon	:	-	1.44	0.27	1.8	-

Utilities

- Maximum Demand : 14,000 KVA
- Annual energy consumption at targeted production in Million Kwh (MU) : 46.54
- Supply voltage : 11 KV

- Recirculation water : 500 M^3/hr.
- Make-up water : 17.5 M^3/hr.
- Compressed Air : 42 NM^3/hr. (approx)

Manpower

- Total no. in payroll : 178

2 – MANUFACTURING PROCESS & UTILITIES

Most of the Ferro-alloys e.g. Ferro-silicon, Ferro-manganese, Silico-manganese, Ferro-chrome, Charge Chrome, 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 in India during the decade of 90 is based on basic process parameters as offered by ELKEM, Norway, 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 Technology.

The process for the manufacture of Ferro Alloys viz. Silico Manganese, Ferro manganese and Ferro-Silicon by submersible Arc furnace technology is well established in India. All the companies manufacturing Ferro Alloys are using the above technology.

The submerged arc process is a reduction smelting operation. The reactants consist of metallic ores (ferrous oxides, silicon oxides and manganese oxides) and a carbon-source reducing agent, usually in the form of coke, charcoal, high and low-volatility coal. Dolomite may also be added as a flux material. Raw materials are crushed, sized, and, in some cases, dried, and then conveyed to a mix house for weighing and blending. Conveyors, buckets, skip hoists, or cars transport the processed material to hoppers above the furnace. The mix is then gravity-fed through a feed chute either continuously or intermittently, as needed. At high temperatures in the reaction zone, the carbon source reacts with metal oxides to form carbon monoxide and to reduce the ores to base metal.

Smelting in an electric arc furnace is accomplished by conversion of electrical energy to heat. An alternating current applied to the electrodes causes current to flow through the charge between the electrode tips. This provides a reaction zone at temperatures up to 2000°C. The tip of each electrode changes polarity continuously as the alternating current flows between the tips.

The lower part of the submerged electric arc furnace is composed of a cylindrical steel shell with a flat bottom or hearth. The interior of the shell is lined with 2 or more layers of carbon blocks. The furnace shell may be water-cooled to protect it from the heat of the process. A water-cooled cover and fume collection hood are mounted over the furnace shell. Normally, 3 carbon electrodes arranged in a triangular formation extend through the cover and into the furnace shell opening. Prebaked or self baking (Soderberg) electrodes ranging from 76 to over 100 cm (30 to over 40 inches) in diameter are typically used. Raw materials are sometimes charged to the furnace through feed chutes from above the furnace. The surface of the furnace charge, which contains both molten material and unconverted charge during operation, is typically maintained near the top of the furnace shell. The lower ends of the electrodes are maintained at about 0.9 to 1.5 meters (3 to 5 feet) below the charge surface. Three phase electric current arcs from electrode to electrode, passing through the charge material. The charge material melts and reacts to form the desired product as the electric energy is converted into heat. The carbonaceous material in the furnace charge reacts with oxygen in the metal oxides of the charge and reduces them to base metals. The reactions produce large quantities of carbon monoxide (CO) that passes upward through the furnace charge. The molten metal and slag are removed (tapped) through 1 or more tap holes extending through the furnace shell at the hearth level. Feed materials may be charged continuously or intermittently. Power is applied continuously. Tapping can be intermittent or continuous based on production rate of the furnace.

Metallurgical Reactions involved during production of Ferro-manganese & Silico-manganese:

- $2MnO_2 + C \rightarrow Mn_2O_3 + CO$
- $3\ Mn_2O_3 + C \rightarrow 2Mn_3O_2 + CO$
- $Mn_3O_2 + C \rightarrow 3MnO + CO$
- $MnO + C \rightarrow Mn + CO$
- $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
- $SiO_2 + 2C \rightarrow Si + 2CO$
- $P_2O_5 + 5C \rightarrow 2P + 5CO$

In the Ferro Silicon process, the important reactions are:

- $SiO_2 + C = SiO + CO$
- $SiO + 2C = SiC + CO$
- $2SiO_2 + SiC = 3SiO + CO$
- $SiO + SiC = 2Si + CO$

FERRO- MANGANESE

High-carbon ferro-manganese is made in three phase open or closed top furnace of a power of 7,500-18,000 KVA at a linear voltage of 120-130 V with a current of 33-38 kA, operating at a voltage of 120-130 V. The charge for making high-carbon ferro-manganese is composed of manganese ore and coke/coal.

Physico-Chemical Conditions of the Process: High carbon ferro manganese is smelted by a continuous process with the electrodes submerged deep into the charge. The following processes take place when making high carbon ferro manganese:

- Pre-heating of the materials;
- Drying and removal of volatiles and moisture from the charge and heating of the charge by the heat of burning gases which leave the furnace and after-burn at the top;
- Reduction of oxides;
- Melting of the elements reduced with the formation of molten ferro-manganese;
- Formation and melting of slag;

The iron contained in the manganese ore is reduced to a high extent in the process. Ferric oxides are reduced with carbon monoxide and hydrogen at low temperatures. Ferrous oxide is first reduced with carbon monoxide and hydrogen at 500-600°C temperature and after that with solid carbon in the deeper zones of the bath.

The reduction of manganese from pyrolusite occurs stepwise: MnO_2 > Mn_3O_4 > MnO > Mn_3C. With a reducing atmosphere in the furnace, the dissociation of manganese oxides can take place at low temperatures. Carbon monoxide and hydrogen can also reduce Mn_3O_4 to MnO at low temperatures.

High Carbon ferro-manganese can be smelted with addition of fluxes or by fluxless process. In the latter case, a valuable by-product of the process is high manganese low phosphorus slag which is used in smelting silico manganese and manganese metal.

SILICO-MANGANESE

High-carbon Silico-Manganese is made in three phase open or closed top furnace of a power of 5,000-12,000 KVA, operating at a voltage of 90-100 Volt.

The composition of different grades of silico-manganese is given below:

Content (in %)				
Manganese (Mn%)	Silicon (Si%)	Carbon (C%)	Sulphur (S%)	Phosphorus (P%)
60-65	14-18	2.30	0.04	0.30
65-70	15-18	2.00	0.04	0.25

Size: 10-50mm (90% minimum)

The charge for making high-carbon Silico-Manganese is composed of manganese ore, Quartz and coke.

Physico-Chemical Conditions of the Process: The following processes take place when making high-carbon Silico-Manganese:

(a) Removal of volatiles and moisture from the charge and heating of the charge by the heat of burning gases which leave the furnace and after-burn at the top;
(b) Reduction of iron and ores with simultaneous formation of metal carbides;
(c) Melting of the elements reduced with the formation of molten metal;
(d) Formation and melting of slag;
(e) Reduction of Manganese and silico from the slag.

FERRO-SILICON

Silicon is a metalloid having an atomic mass of 28.086, density of 2.37 gm/cm^3, melting point of 1414°C, and boiling point of 2287°C. In its electric properties, silicon is a semiconductor.

Silicon reacts with oxygen to form silica (SiO_2), whose melting point is 1710°C. Silica can exist in several modifications: quartz, tridymite, cristobalite, and silica glass.

Ferro-silicon is made in submerged arc provided with three-phase transformers having power rating of 7,500-9,000 kVA operating at a voltage of 145-175 V. Generally, Semi-Closed-type stationary or tilting furnaces are mainly used for manufacturing ferro alloys.

The physical state of the charge is of prime importance for successful operation of a furnace. The charge materials must have constant moisture content and lumps of coke breeze and quartzite should have only slightly varying size.

The process of making Ferro-silicon produces little slag; this is tapped together with the metal through the same tap hole.

Physico-chemical Conditions of the Process:

The reaction of reduction of silicon from silica occurs with solid carbon:

$$SiO_{2_l} + 2CO_g \leftrightarrows 2CO_{2g} + Si_l$$
$$2CO_{2g} + 2C_s \leftrightarrows 4CO_g$$

$$SiO_{2_l} + 2C \leftrightarrows Si_l + 2CO_g$$

A typical reaction producing ferro-silicon is shown below:

$$Fe_2O_3 + 2SiO_2 + 7C \rightarrow 2FeSi + 7\ CO$$

During the course of the reaction of silicon reduction is determined by the applied pressure of carbon monoxide.

In an industrial furnace for smelting ferro-silicon, the pressure at the top is equal to atmospheric and the partial pressure of carbon monoxide that is established in the reduction zone is slightly above atmospheric pressure. With a constant value of P_2CO, the equilibrium constant for a 45 per cent alloy is lower than that for 75 per cent alloy, which means that a lower temperature is required for making the former.

During a melt for ferro-silicon, the iron dissolves the reduced silicon thereby removes it from the reaction zone and thus causes the reaction to be proceeded from left to right.

The mechanism of reduction of silica is not described exhaustively in the above resulting reaction. An intermediate oxide – silicon dioxide, and silicon carbide can also form in the process.

Carbon causes final reduction of silica. The latter reacts with carbon both at the surface of lumps of coke breeze and in their core upon having penetrated through pores and fissures.

Samples taken from lower levels in the furnace usually contain much silicon carbide. According to P. V. Geld, the formation of SiC from the elements can only occur with large kinetic difficulties and requires a high mobility of atoms, which can only be achieved at temperatures above 1700°C. On the other hand, the reaction is thought to be probable. Thus, silicon carbide forms as an intermediate product.

Solid inclusions of silicon carbide, if present in the slag, can impair the fluidity of already tough siliceous slags.

At corresponding temperatures, silicon carbide can be destroyed by metals and oxides, its destruction by iron following the reaction

$$SiC_s + Fe_l = FeSi_l + C_{gr}$$

At high temperatures and in the presence of a solvent (iron with silicon) the aluminium and calcium, if present in the charge, are reduced by carbon and silicon. Industrial grades of ferro-silicon can thus contain up to 2 per cent Al and up to 1.5 per cent Ca.

Under the reducing conditions, a great amount of phosphorus from the charge and ash pass to the melt, while sulphur is volatilized in the form of SiS2.

In operation with rich quartzites, the process occurs with little slag, only 2-6 per cent of the mass of melt. The slag is formed from the alumina, calcium oxide and magnesia that are present in quartzite and coke breeze. A typical composition of slag is 35-39 per cent Al_2O_3, 22-26 per cent SiO_2, 9-18 per cent CaO, 7-13 per cent BaO, 1-3 per cent MgO, 7-14 per cent SiC, and 0.2-2.0 per cent FeO. The melting temperature of slag is 1650-1700°C, i.e. low enough to cause slagging of the hearth. In practice, a trend is to operate with silica-rich quartzite and low-ash reducer in order to minimize the bulk of slag of this composition.

The charge materials, prepared as indicated earlier, should be stored separately in furnace-bay bins. Before supplying to the furnace, they should carefully be weighed and mixed. A dosing carriage is loaded first with coke breeze, then with turnings and quartzite, and finally with graphitization wastes.

The general composition of a charge in kg, may be as follows:

Material	FS45	FS75
Quartzite	300	300
Coke breeze	141	144
Iron turnings/ Mill Scale	170	38

The flow diagram of Ferro Alloys Plant is presented hereunder:

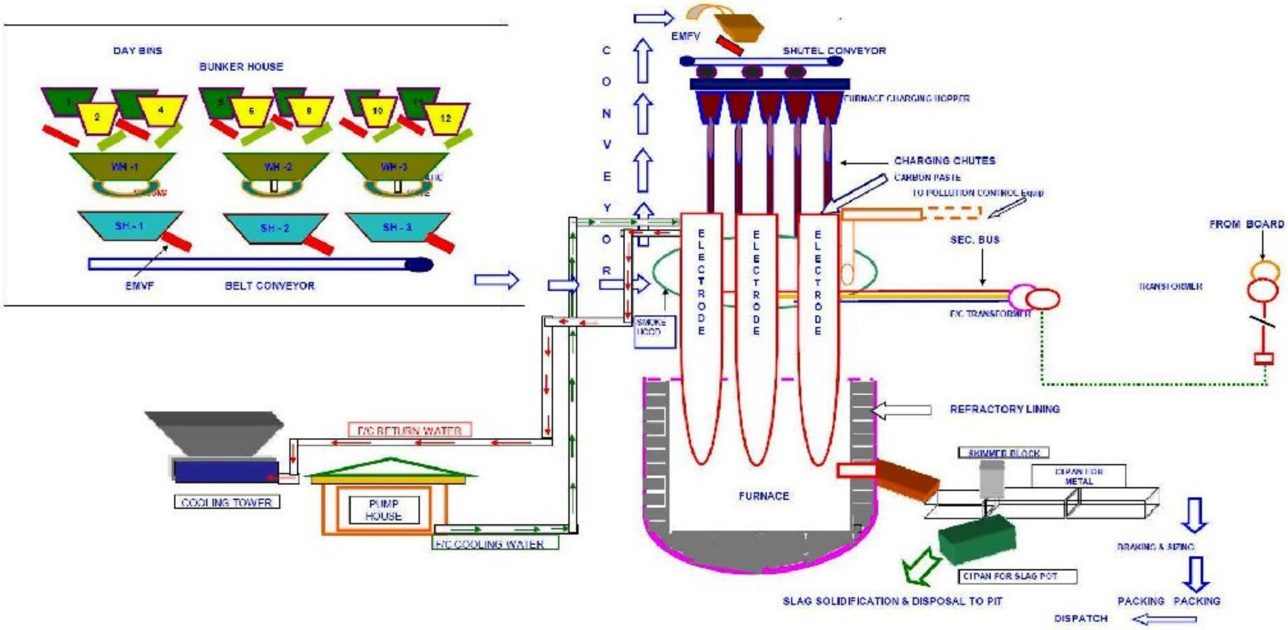

FIGURE 1.0: FLOW CHART OF FERRO ALLOYS PLANT

Material Balance for the different products is presented as “Annexure 1”.

Project Location

The proposed plant is located adjacent to the existing site of the Coke Oven Plant at Mouza Kashbere, JL No.146, at Haldia, Purba Medinipore, West Bengal. The site falls under Sutahata CD Block and adjacent to Haldia Municipal Area. Haldia is a major river port town with an existing industrial base and therefore necessary infrastructural facilities shall be available for 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 Highway 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. Industrial water shall be available from Haldia Development Authority. Water pipeline for the same is available already in the area. The nearest electrical power substation is installed at Chiranjeevpur which is around 5/6 Kms from the site.

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. 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 molten Ferro-alloys 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 production unit with respect to 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.

Most important aspect while making the layout 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 two (2) submerged arc furnace, the utilities and auxiliary facilities will include the electrical power system, water system, compressed air system, testing laboratory, 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 production shop layout of the plant has been developed as shown in Figure 2.0; It shows the general arrangement of the smelting shops with buildings for auxiliary facilities.

Behind the furnace bay, provision has been made for a two storied building for housing the furnace transformers, control panels and space for shop office & laboratory.

The electrical power substation as proposed shall be utilized and provision of adding new panels, etc. will be there for future installations.

RAW MATERIALS REQUIREMENT & SOURCE

Based on the production envisaged, the estimated requirements of raw materials & sources are given below:

	Raw Materials	Annual Requirement in Tonnes	Source of Supply
1.	Quartzite	18,144	Mines in Chattisgarh, Bankura in W.B.
2.	Mill Scale/ Iron Scrap	3,,468	Local Rolling Mills, Local market
3.	Coke Breeze/Coal	17,343	Durgapur Steel Plant, DPL Coking Plant at Haldia & other major steel plants
4.	Electrode Paste	772	Maharashtra Carbon Ltd. Graphite India Ltd.
5.	Electrode Casing	43	SAIL/TISCO
6.	Manganese ore	74,230	Mines in Orissa/M.P.
7.	Dolomite	6,777	Mines in North Bengal

Water System

There will be no process water requirement. Water will be required for cooling purposes only.

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

a) Cooling of equipment

b) Human consumption for drinking, washing & sanitary needs

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

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

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

Equipment		Circulation Routes
Submerged Arc Furnace & Air Compressor	:	Cold Sump – Equipment – Cooling Tower – Cold Sump

Quantity of Water Requirement

The quantity of water required for meeting various specific needs is given in the following Table:

QUANTITIES OF WATER REQUIRED FOR MEETING SPECIFIC NEEDS

		Equipment		Requirement of Water in M^3/hour
A.	Recirculation Water			
	1.	Submerged Arc Furnace, Transformer Electrode Holder & other components	..	500.00
B.	Make-up Water			
	1.	Submerged Arc Furnace & other components and air compressor	..	17.5
	2.	Drinking & Sanitary purposes	..	1.5

Water Balance is presented in “Annexure 2”.

For cooling of different furnace parts and transformer, three (e) nos. centrifugal pumps have been considered for the furnaces. For two (2) Nos. furnaces, two (2) nos. pumps shall be in operation having flow rate of around 200-300 M^3/hour at a pressure of 4 kg/Cm.sq. When two pumps are in operation, one pump having a flow rate of around 200-300 cu.m/hr. at a pressure of 4 kg./cm.sq.g. shall be kept as stand-bye for the system. The pressure rating of the above mentioned 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 main source of water will be Haldia Development Authority. The water shall be available through a dedicated pipeline and will be taken to a 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 utilisation of compressed air for operating equipment in a Ferro-alloy producing plant is for pneumatic control of submerged arc furnace component, e.g. clamping of electrodes, electrode adjustment, i.e. slipping of electrode hydro-pneumatically, etc.

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 furnace. Since the charge to be handled is directly proportional to the output of molten metal from the submerged arc furnaces, the furnace feeding has been designed accordingly to ensure that the raw material feeding is maintained at adequate level. 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.

The basic raw materials to be handled for production of ferro-manganese/silico-manganese are Quartzite, Mn Ore, Coke Breeze, Iron Scrap, Dolomite, etc.

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

In the smelting process it generates large quantities of hot fumes consisting of mainly CO_2 along with dust particles having dust concentration of 500 mg/NM^3.

Fume extraction system has now become a statutory obligation in the various industries specially in a melting or smelting unit. In order to minimise 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 submerged arc furnace 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. This will contain the dust concentration to below 50 mg/NM^3 before the ultimate discharge into the atmosphere.

Ancillary Facilities

The ancillary facilities comprising the administrative office, ablution block, time & gate office, security goomty, weighbridge goomty, canteen, etc. are required to be provided and to be located at appropriate places to ensure proper plant operation and administration.

Project Implementation

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.

Project Cost

The total capital cost of the project has been estimated as Rs. 50 crores. The capital cost towards Environment Management has been estimated as Rs. 2.0 Crores.

ELECTROSTEEL CASTINGS LTD.

MATERIAL BALANCE

For Production of High Carbon Ferro Manganese:

Basis: 1000 kg. Finished Product

Materials to be charged into the Submerged Arc Furnace	:	1.	Mn ore	2140 kg.
		2.	Coke	500 kg.
		3.	Iron scrap	100 kg.
			Total:	2740 kg.

Output from the furnace :

1. 1000 kg. solid High Carbon Ferro-manganese
2. 1000 kg. slag mainly containing MnO, SiO_2, Al_2O_3, FeO
3. 740 kg. shall be lost in gaseous phase

For Production of Silico Manganese Alloy:

Basis: 1000 kg. Finished Product

Materials to be charged into the Submerged Arc Furnace	:	1.	Mn ore	490 kg.
		2.	Mn slag obtained rom Fe.Mn operation	1400 kg.
		3.	Coke	500 kg.
		4.	Quartzite	300 kg.
		5.	Iron scrap	100 kg.
		6.	Dolomite	275 kg.
			Total :	3065 kg.

Output from the Furnace :

1. 1000 kg. solid silico manganese alloy
2. 680 kg. slag mainly containing MnO, SiO_2, Al_2O_3, CaO, MgO, etc.
3. 1385 kg. shall be lost in gaseous phase.

For production of Ferro-silicon

Basis 1000 Kg finished product

Inputs	:	1.	Quartzite	1915 Kg
		2.	Coke	1275 Kg
		3.	Iron turnings	240 Kg
			Total:	3430 Kg
Output	:	1.	Liquid metal	1063 Kg
		2.	Slag	64 Kg
		3.	Gas	2057 Kg
		4.	Volatiles	170 Kg
		5.	Moisture	
		6.	Dust in Gas	76 Kg
			Total:	3430 Kg

ELECTROSTEEL CASTINGS LTD.

WATER BALANCE

1.	Water flow rate required for 1x9 MVA + 1x6 MVA furnace	=	500 M^3/hr.		
2.	Losses of circulating water during operation of the furnace is considered as follows	=	1.	Evaporation :	1.53% of the flow rate
			2.	Cooling tower blow down :	0.51% of the flow rate
			3.	Drift/leakage loss :	0.5% of the flow rate
				Total:	2.54 %

Make-up water considered: 2.5% of the total flow rate.