1. OBJECTIVE:

The main function of making Sponge Iron in the Kiln is to convert Iron ore into sponge iron by using Iron ore, coal and dolomite / limestone. The Sponge Iron is processed further for making liquid metal at Steel Melting Shop.

The entire process of making Sponge Iron is associated with various Safety hazards. If not mitigated, it may lead to collapse in dust settling chamber, back pressure problem during fall shaft opening and blow coal pipe changing, ID fan tripping while grizzly cleaning. Apart from these, slip trip, burn, fire, dust, noise hazards may occur.

2. SCOPE:

This guideline of safety is applicable to all coal based Direct Reduction Plants.

3. MAJOR AND CRITICAL EQUIPMENT FOR MANUFACTURING OF SPONGE IRON IN THE DIRECT REDUCTION PLANT

a) Raw Materials Handling System (RMHS- Belt Conveyers, Crusher, Vibrating Screen etc. & Silos/ Sheds/ Storage Yards for Raw Materials storage purposes)

b) Kiln Charging Equipment (storage bins, double deck screen, vibrating feeders, conveyors, kiln feed pipe, etc.)

c) Kiln & Cooler Area Rotary kiln, Rotary cooler, shell air fans, coal injection system, Rotary cooler cooling system, kiln & cooler sealing system, electric slip ring, support rollers, kiln & cooler drive system.

d) Cooler discharge area - Conveyors, bins, Magnetic separators, vibrating feeder, double deck screen.

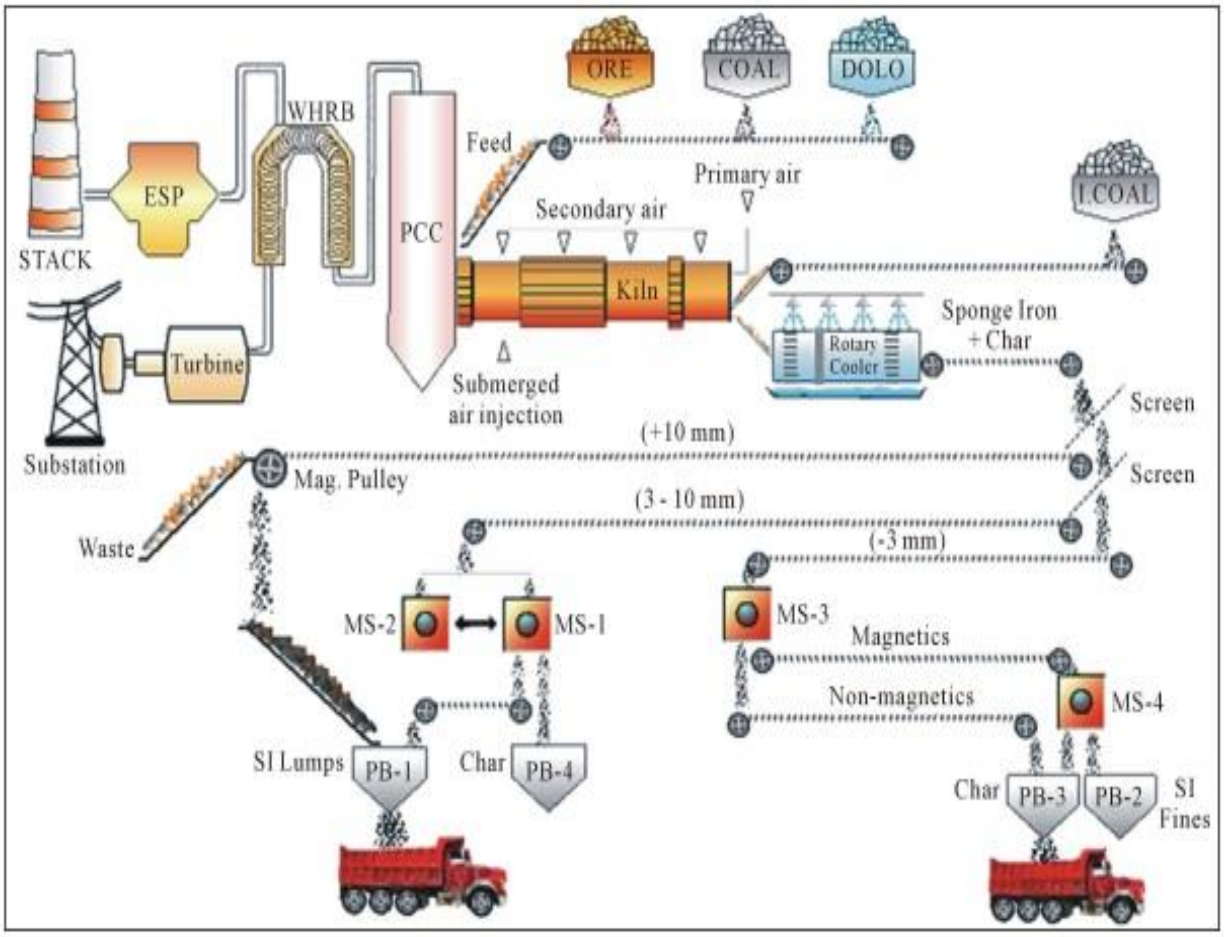
e) Off-gas Handling area - Dust Settling Chamber, After Burning Chamber, WHRB, ESP and ID Fan with Chimney etc.

f) Plant de-dusting system.

g) Control Rooms, Electrical Panel Rooms and Transformers Rooms.

h) Emergency DG Set.

Process Flow Diagram of Sponge Iron Plant/ Direct Reduction Iron Plant is given below:



4.0 PROCESS HAZARD ANALYSIS & NECESSARY RISK CONTROL MEASURES

S.No.	Equipment	Hazards	Risk Control Measures
1)	Belt Conveyors	a. Rotating parts of conveyor system, like head pulley, tail pulley, snub pulley, coupling guards etc. b. Moving conveyor belt	a) Guarding of all rotating parts of conveyor system. b) Pull chord in conveyors. c) Emergency switch. *(Refer: SG-09: Safety Guideline for Equipment and Machine Guarding, SG-19: Safety guideline on Operation and Maintenance of Conveyor Belts)*
2)	Silos /Charging Bins / Hoppers	a. Fine Dust deposition b. Electrical Drives	a) Use of PPEs. b) Dust Extraction (DE) System. c) Guarding of all rotating parts of

S.No.	Equipment	Hazards	Risk Control Measures
		c. Noise d. Work in confined spaces e. Falling of material f. Falling out from working platform g. Exposure to dust h. Use of hand held work equipment during cleaning	conveyor system. d) Pull chord in conveyors. e) Emergency switch. f) Display of Noise level at site. g) Adherence to electrical safety precautions. *(Refer: SG-18: Safety guideline for Personal Protective Equipment (PPE) management, SG-19: Safety guideline on Operation and Maintenance of Conveyor Belts, SG-15: Safety Guideline for Electrical safety, SG-03: Safety guideline for working in confined space)*
3)	Kiln & Cooler	a. Rotating Machineries b. Burden Spillage c. Noise d. Falling of materials e. Falling out from platform f. Fire hazard g. Hotspot	a) Guarding of all rotating parts. b) Use of PPEs. c) Regular Inspection for hotspot. d) Monitoring Shell temperatures. e) Regular inspection & repair of cracks and Corrosion. *(Refer SG-03: Safety guideline for working in confined space, SG-09: Safety Guideline for Equipment and Machine Guarding, SG-18: Safety guideline for Personal Protective Equipment (PPE) management)*
4)	Magnetic Separators / Vibrating Screen	a. Rotating Machineries b. Burdon Spillage c. Noise d. Falling of materials e. Fall out	a) Guarding of all rotating parts. b) Use of PPE. c) Cooling the spillage material by water. d) Proper housekeeping. *(Refer SG-03: Safety guideline for working in confined space, SG-09: Safety Guideline for Equipment and Machine Guarding, SG-18: Safety guideline for Personal Protective Equipment (PPE) management)*

S.No.	Equipment	Hazards	Risk Control Measures
5)	ESP	a. Hot Flue Gas b. Fine Hot Dust c. Electrical Transformer High Electrical Voltages	a) Access control. b) Use of dust mask. c) Energy Isolation. d) Application of heat insulation at required places. *(Refer SG-03: Safety Guideline for working in confined space; SG-15: Safety Guideline for Electrical safety; SG-18: Safety Guidelines for Personal Protective Equipment (PPE) Management; SG-22: Safety guidelines for Energy isolation)*
6)	Dust Settling Chamber	a. Hot burden Spillage b. Fire c. Explosion d. Hot dust	a) Use of auto sprinklers. b) Regular maintenance of wet scrapper. c) Regular removal of dust from wet scrapping area. d) Inspection of hot spot and crack and repair. e) Fan Interlock. f) Inert gas blanketing (in dry dust system. *(Refer SG-03: Safety Guideline for working in confined space; SG-18: Safety guideline for Personal Protective Equipment (PPE) management)*
7)	After Burning Chamber	a. Gas leakage b. Fire c. Explosion	a) Use of auto water sprinklers. b) Inspection of hot spot & crack and repair. c) Interlocking of fans with CO monitoring device to check % CO in off-gas. *(Refer SG-03: Safety Guideline for working in confined space; SG-09: Safety Guideline for Equipment and Machine Guarding; SG-18: Safety guideline for Personal Protective Equipment (PPE) management)*
8)	DRI Storage	Fire Hazards	a) Sponge iron should be loaded dry and it should be below a

S.No.	Equipment	Hazards	Risk Control Measures
			temperature of 65°C. The bin temperature should be monitored regularly (at least once every day). b) Water ingress to the bin should be avoided. *(Refer SG-16 Safety Guidelines for fire safety)*
9)	ID Fan with motor	a. Rotating parts b. Electric Shock	a) Guarding the rotating parts. b) Permit to work before S/D maintenance. c) Interlock. d) Use of ear plug. *(Refer: SG-09: Safety Guideline for Equipment and Machine guarding, SG-15 Safety Guidelines for electrical safety)*
10)	Electrical Panels	a. Electric Shock	a) Energy isolation as per "Work Permit". b) Display of "Men at Work" at HT switching on panel. c) Use of PPEs as per requirement. d) Develop and Follow SOP. *(Refer SG-15: Safety guidelines for Electrical Safety)*
11)	Transformer Room	a. Electric Shock b. Oil leakage c. Fire	a) Energy isolation as per Work Permit. b) Use of PPEs. c) Develop and follow SOP. d) High velocity spray system/ Automatic Nitrogen gas flooding system as per requirement. e) Fire extinguisher at site. *(Refer SG-15: Safety guidelines for Electrical Safety; SG-16: Safety guidelines for Fire Safety)*
12)	Capital Repair	a. Electric shock b. Fall out c. Slips	a) Preparation of proper protocol. b) Adherence to SOP & Protocol. c) Taking shut down and complete purging of the system.

S.No.	Equipment	Hazards	Risk Control Measures
			d) Cordoning of repair area and prohibition of any unauthorized persons. e) Adequate precautions during storage & handling of material, gas cylinder, electrical equipment, work at height, etc. f) Proper Illumination. g) Adequate fire measures. *(Refer SG-01: Safety Guideline on storage, handling & use of gas cylinders; SG-02: Safety Guideline for Working at Height; SG-03: Safety Guideline for Working in a Confined Space; SG-04: Safety Guideline for Permit to Work (Operation & Maintenance); SG-05: Safety Guideline for Illumination at workplace; SG-07: Safety Guideline for Gas cutting & Gas Welding; SG-10: Safety Guideline for Hydraulic System; SG-11: Safety Guideline for Barricading; SG-13: Safety Guideline for Material handling (manual and mechanized) & storage; SG-15: Safety Guideline for Electrical safety; SG-16 : Safety Guideline for Fire* Safety*; SG-18: Personal Protective Equipment (PPE) Management).*
13	Transfer chute operation.	a. Hot flames b. Exposure to dust c. Falling out from working platform	a) Open stack cap, keep kiln in negative pressure. b) Maintain distance and stay away. c) Use of full-body Aluminized suit, other required PPEs d) Provide safe platform & fall protection. e) Ensure proper illumination. f) Develop and follow SOP.

Note:

1) The operating procedure as given in the write-up may vary from shop to shop due to different equipment disposition and type. Safety precautions under each head may be separately identified.
2) Other standard plant safety procedures shall be followed.
3) Signages and emergency escape route shall be shown covering the entire shop.
4) Provision & operability of safety fences should be ensured covering the entire shop.
5) The above safety guidelines have been prepared keeping in view standard points applicable to the area of work in the steel industry. SOPs (Standard Operating Procedures) & SMPs (Standard Maintenance Procedures) are to be developed and followed by users as per specific processes / equipment/ technologies deployed as well as prevailing site conditions, in respective plants.