1. OBJECTIVE:

The entire process of making Sponge Iron by coal based DRI process is associated with various Safety hazards like Fire, Explosion, Radiation, Burns hit / entanglement with mobile equipment, slip & fall, electrocution, exposure to dust, smoke, noise, heat & gas etc. This guideline has been prepared to introduce safe methods applicable to all equipment of gas based Direct Reduction Iron Plant for mitigation & prevention of accidents.

2. SCOPE:

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

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

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

(ii) Kiln Charging Equipment - storage bins, Lime coating station, vibrating feeders, conveyors, shaft feed hopper

(iii) Shaft furnace & cooler Area - Shaft furnace, cooler, Burden feeders, feed cone, hydraulic system, etc.

(iv) Process gas system- Process gas reformer/heater, CO2 removal system, process & cooling gas scrubbers, mist eliminators, process & cooling gas compressors etc.

(v) Shaft furnace / Cooler Discharging Equipment - Conveyors, bins, Briquetting machine, vibrating feeder).

(vi) Plant de-dusting system.

(vii) Control Rooms, Electrical Panel Rooms and Transformers Rooms.

(viii) Emergency DG Set
4. PROCESS HAZARD ANALYSIS & NECESSARY RISK CONTROL MEASURES:

<table>
<thead>
<tr>
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<th>Section</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Material Handling</td>
<td>• Fire Hazard</td>
<td>❖ Guarding of all rotating parts of conveyor system.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Nip point Hazard</td>
<td>❖ Pull chord in conveyors.</td>
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<tr>
<td></td>
<td></td>
<td>• Belt sway</td>
<td>❖ Emergency switch.</td>
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<tbody>
<tr>
<td>2.</td>
<td>Charge Hopper</td>
<td>• CO leakage</td>
<td>∗ Installation of online CO gas monitor &amp; use of Portable monitors to detect gas leakage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Falling of Pellets</td>
<td>∗ Prohibition of unauthorized people going the kiln as there are chances of gas leakage. If at all, one needs to go, he should be accompanied a safety man with proper safety precautions under intimation to control room.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shell crack &amp; Corroded structure</td>
<td>∗ Regular inspection &amp; repair as per requirement.</td>
</tr>
<tr>
<td>3.</td>
<td>Reduction shaft furnace and cooler for gas based DR plant</td>
<td>• Heat</td>
<td>∗ Display of noise level.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Radiation</td>
<td>∗ Installation of on-line Gas monitor at strategic locations &amp; use of Portable “CO” monitors to detect gas leakage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Confined space entry</td>
<td>∗ Regular inspection of shell temperature to observe any Hot spot development and provision of water spray cooling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Gas leakage</td>
<td>∗ Restricted access to higher platforms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shell crack &amp; Corroded structure</td>
<td>∗ Regular inspection &amp; repair of cracks and corrosion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Slip, trip &amp; fall hazard</td>
<td>∗ Preparation of layout showing hazardous area classification.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Material fall from height</td>
<td>∗ Prevent materials or objects falling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fire &amp; Explosion</td>
<td>∗ Uses of appropriate PPE, such as helmets, gloves, aprons and boots.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>∗ Barricade Area/ declare Prohibited area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>∗ Cooling arrangement.</td>
</tr>
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</table>
|       | 4.      | Process & cooling gas SG rubber / mist eliminators etc. | • Gas Leakage  
• Confined space entry  
• Shell crack / Corroded structure  
• Slip, Trip and fall hazards | ❖ Provision of Online Gas monitor & Portable “CO” (Carbon Mono Oxide) monitors to detect gas leakage.  
❖ Pressure drop monitoring.  
|       | 5.      | Hot DRI Briquette Machine/Cold DRI | • Steam  
• Hot Water  
• Dust  
• Hot Product  
• Fumes  
• Hot fines  
• Fire Hazard | ❖ Stack to be provided.  
❖ Pond and Clarifier to be provided.  
❖ De-dusting system to be provided.  
❖ Process safety management.  
(Refer SG-16: Safety Guideline for Fire Safety, SG-18: Safety Guidelines for Personal Protective Equipment (PPE) management) |
|       | 6.      | Hot DRI handing & storage system | • Spillage of Hot DRI  
• Explosion  
• Exposure to high temperature  
• Oxygen deficient zone  
• Rotating parts (Rollers & chain guide) | ❖ Preparation of proper protocol.  
❖ Adherence to SOP.  
❖ Water sprinkler system.  
❖ Provision of safe contained breathing apparatus.  
❖ Complete purging of system before operation.  
❖ Level alarm at bins.  
❖ Guarding of nip points.  
❖ Cooling of spillage material by water.  
(Refer SG-03: Safety guideline for working in confined space, SG-18: |
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| 7.    | Process gas compressors, cooling, cooling gas compressor, seal gas compressors etc. | • CO leakage  
• Work at height  
• Noise                                                                 | ❖ Guarding of all rotating parts.  
❖ Access control.  
❖ Adherence to electrical safety  
❖ Precautions.  
❖ Use of Ear Plug.  
❖ Display of Noise level at site.  
❖ Provision of Online Gas monitor & Portable “CO” monitors to detect gas leakage.  
(Refer SG-09: Safety guideline for equipment & machine guarding, SG-15: Safety Guideline for Electrical safety) |
| 8.    | Process gas system including Process gas heater/reformer/recuperator etc. | • Heat  
• Gas leakage  
• Fire hazard  
• Mechanical failure                                                                 | ❖ Maintenance of hot briquette cooling arrangement.  
❖ Preparation of layout with Hazardous area classification.  
❖ Provision of Fire & Gas detection system.  
❖ Steam purging of the system before any repair, maintenance, etc.  
❖ Fire proofing of cables.  
❖ Safety showers in case of CO₂ removal plant.  
❖ Regular Maintenance.  
| 9.    | CO₂ removal plant | • CO leakage  
• Noise  
• Exposure to chemicals                                                                 | ❖ Installation of fixed CO monitors & use of portable monitors to detect leak.  
❖ Purging of system before any maintenance job.  
❖ Use of PPEs.  
❖ Water showers (for amine based plant).  
(Refer SG-09: Safety guideline for equipment & machine guarding, SG-
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| 10.   | Dedusting system  | Noise, Dust, Slippery floor, Fall | ❖ Provide PPEs.  
❖ Maintain platform.  
❖ Improve housekeeping.  
❖ Provide adequate illumination.  
(Refer: SG-02: Safety guideline for working at height, SG-05: Safety Guidelines for Fire Safety) |
| 11.   | DRI Storage       | Fire hazard                      | ❖ Sponge iron should be loaded dry and it should be below temperature of 65°C.  
❖ The bin temperature should be monitored regularly (at least once every day).  
❖ Water ingress to the bin to be avoided.  
❖ Facility for inert gas purging in case the bin temperature shows an increasing trend.  
(Refer: SG-16: Safety Guidelines for Fire Safety) |
| 12.   | Electrical panels | Electric shock, Flash over        | ❖ Ensure permit to work / shutdown before start of job.  
❖ Proper earthing.  
❖ Display of “Men at work” at HT switchgear on panels.  
❖ Develop & follow SMP.  
(Refer: SG-15: Safety Guidelines for Electrical Safety) |
| 13.   | Transformer room  | Electric shock, Oil leakage       | ❖ Ensure permit to work / shutdown before start of job.  
❖ Proper earthing.  
❖ Display of “Men at work” at HT switchgear on panels.  
❖ Develop & follow SMP.  
❖ High velocity water spray system / Nitrogen injection system as per requirement.  
❖ Fire extinguishers to be provided at site.  
(Refer: SG-15: Safety Guidelines for Electrical Safety) |
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| 14.   | Capital repair | • Slip & fall  
       |                             | • Electrical shock                                                                   | ❖ Preparation of protocol.  
       |                             | ❖ Adherence to SOP & SMP.                                                          | ❖ Taking shutdown & complete  
       |                             | ❖ Blanking as per requirement.                                                    | purging of system.  
       |                             | ❖ Barricading to prevent unauthorized entry.                                        | ❖ Refer SG-03: Safety guidelines for working in Confined space,  
       |                             |                                                                                   | SG-15 for Electrical Safety, SG-18 for PPE management) |

**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.