SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	**PELLET PLANT**	Doc. No: DG/40
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1. OBJECTIVE:

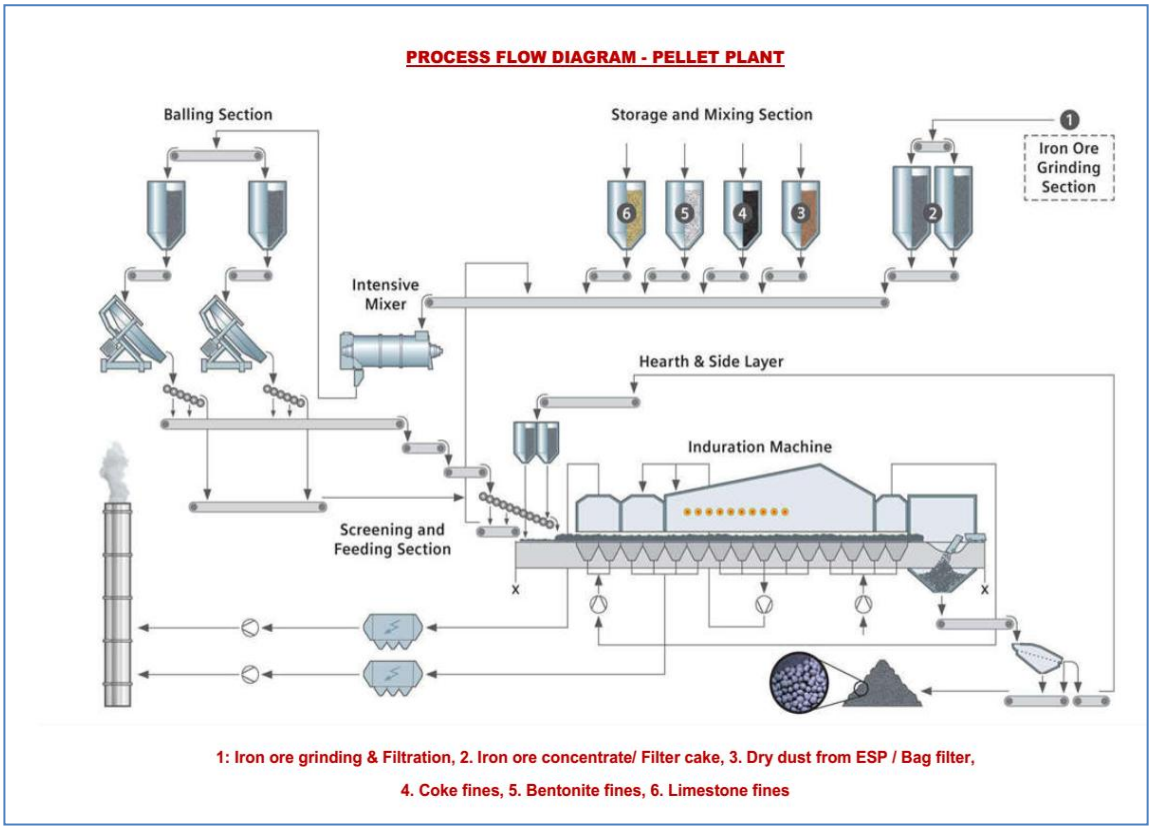
The objective of this guideline is to identify the Safety hazards associated with the day to day operations and implement risk control measures associated with the running of the Pellet Plant. The entire process of production of Iron Oxide Pellets is associated with various Safety Hazards like burns, fire, slip and fall, exposure to dust, smoke, noise, heat and gas etc.

2. SCOPE:

These guidelines are applicable to Pellet Plants operating either as standalone or as part of integrated steel plants.

3. PROCESS:

Pellet Plant produces Pellets using Iron ore and additives such as limestone, bentonite, coke, anthracite coal, quartzite which are passed through balling disc/drum and the green pellets so formed are passed through a furnace either straight grate or rotary kiln to produce High Grade Pellet which are used in Steel making in Blast furnace or Direct reduction plants for steel making



A pelletizing plant includes five processes:

1) Raw material receiving,
2) Pre-treatment
3) Additive and Binder proportionating and Mixing
4) Balling
5) Indurating
6) Pellet screening /HL Segregation

2.1 Process of receiving raw material

The location of a pelletizing plant affects the method of receiving raw materials such as iron ore, additives and binders.

2.2.1 Pre-treatment process of Iron Ore Fines

In the pre-treatment process, iron ore fines are ground into finer size, suitable for green ball formation. Dry or wet grinding process is adopted for grinding the iron ore fines. In dry grinding process, equipment i.e. drier, ball mill, cyclones/bag filters, hot air generator recirculation fan, air slide, bucket elevator etc. are required. In wet grinding process, equipment i.e. ball mill, cyclones, slurry pumps, thickener, filter press, etc. are required. In dry grinding, coal / lime stone/ additives is added with iron ore fines for grinding in ball mill.

2.2.2 Pre-treatment process of additives

Additives i.e. Lime stone, dolomite, coal/coke are required to be ground before mixing with iron ore fines. Un-like iron ore dry grinding process, Lime stone/dolomite and coke are ground in ball mill/ roller mill together and bentonite is ground in a separate roller mill. The grinding system shall consist of mill proper, re-circulation fan, HAG, cyclone/ bag filter etc.

2.3 Proportionating & Mixing

Pre-wetting includes adding an adequate amount of water homogeneously into the dry ground material to prepare pre-wetted material suitable for balling with optimum moisture. This material requires to be mixed with other materials called binders and additives to prepare the green balls and to achieve the required quality in final product i.e. iron oxide pellet.

2.4 Balling process

In this process, balling equipment produces green balls from the pre-wetted mixed material prepared in the previous process. The green balls are produced either by a balling drum, or by a balling disc. Both of the units utilize centrifugal force to form the fine materials into spheroids. The green balls produced by a drum are not uniform in diameter. A significant portion of the discharge (about 70%) is smaller than target size and must be returned to the drum after screening. It is difficult to adjust the drum operation for varying raw material conditions. The operation, however, is stable for uniform raw material conditions (chemical composition, particle size, moisture, etc.). A balling disc, on the other hand, classifies green balls by itself, reducing the amount of pellets returned. The disc operation can easily be adjusted for varying raw material

conditions by changing the speed, inclination of the disc, feed rate & moisture addition.

2.5 Indurating process

The firing of pellets establishes the binding of hematite particles at an elevated temperature ranging from 1,250 to 1,350℃ in oxidizing condition. Slag with a low melting point may form in the pellets during this firing step, if the raw material contains fluxed gangue, or if limestone is added to it. In these cases, the product may have an intermediate structure with both metallic binding and slag binding. The firing process is characterized by process temperatures lower than those required by sintering which requires partial melting and sintering fine ore mixed with coke breeze, a fuel which generates combustion heat.

Major / Critical Equipments of Pellet Plant

S.No.	Area / System	Different critical equipments
1.	Raw Material Handling System	Reclaimers, Conveyor System, Bunkers
2.	Wet Grinding System of Iron Ore	Storage Bins, Primary Screens, Ball Mills, Slurry Pumps, Hydro Cyclones, Sizing Screens, Thickener, Slurry Tanks, Filter press, Vacuum Pumps, Air Compressors
3.	Dry Grinding System of Iron Ore	Primary Screens, Fuel handling System, Hot gas generator, Dryer, Ball Mills, Cyclone Separators, Storage bin, Bucket elevator, Air separator, Dust collector, Re-circulation Fans
4.	Mixing Unit	Bins for Iron Ore concentrate/ Coke Breeze/ Lime stone/ Bentonite, Tramp Magnet Conveyors, Mixers, Dosing Equipment, Belt Weighers
5.	Additive Grinding	Ball mill/ Roller mill, Hot gas generator (HAG), Cyclone / Bag Filter, Re-circulation fan
6.	Green Balling Circuit	Pelletising Disc/Drum, Screens, Feeding Conveyors/ Roller Screens/ Feeders
7.	Induration & Process gas handling	Indurating machine, Process Fans, Induration hood & furnace, Grate machine/ rotary kiln/ cooler, ESPs, Process fans, Fines/ spillage handling conveyor, Electro Static Precipitator (ESP)
8.	Product Handling	Conveyors, Hopper/Bin, Vibrating Screen, Gates

4. PROCESS HAZARD ANALYSIS & NECESSARY RISK CONTROL MEASURES:

S.No.	Equipment	Hazards	Risk Control Measures
1.	Conveyors, Screens	Rotating parts of conveyor system, like head pulley, tail pulley, snub pulley, coupling guards etc.	1. Guarding of all rotating parts of conveyor system. 2. Pull chord in conveyors. 3. Emergency switch. *(Refer SG-09: Safety Guidelines for Equipment and Machine*

S.No.	Equipment	Hazards	Risk Control Measures
			Guarding, SG-19: Safety Guidelines on Operation and Maintenance of Conveyor Belts, SG-04: Safety Guideline for Permit to Work (Operation & Maintenance))
		Spillage accumulation	1. Regular cleaning to be ensured. 2. Engineering controls to be applied to arrest the spillage points.
		Conveyor belt hazards / Cleaning running conveyors.	1. SOP (Standard Operating Procedures) for conveyor safety to be developed & followed strictly. *(Refer SG-19: Safety Guidelines on Operation and Maintenance of conveyor belts).*
		Fall into raw material bins.	Railings are provided around the bins.
		Materials falling	Open-mesh walkways to prevent objects from falling through and causing injury to people below.
		Releases of dust	1. Respiratory protection dusk mask. 2. Dust and fume collectors ESP /multiclone system
2.	Tramp Magnet	1. Electrical & magnetic	Switch off power before work. *(Refer SG-15 : Safety Guideline for Electrical safety)*
3.	Charging bins/Hoppers	1. Fine Dust deposition 2. Electrical Drives 3. Noise 4. Confined space	1. Use of PPEs 2. Dust Extraction (DE) System 3. Guarding of all rotating parts of conveyor system 4. Pull chord in conveyors 5. Emergency switch 6. Display of Noise level at site 7. Adherence to electrical safety precautions. *(Refer SG-18: Safety Guidelines for Personal Protective Equipment (PPE) management, SG-19: Safety Guidelines on Operation and Maintenance of Conveyor Belts, SG-15: Safety Guidelines*

S.No.	Equipment	Hazards	Risk Control Measures
			for Electrical safety, SG-03: Safety guideline for working in Confined space and SG-04 : Safety Guideline for Permit to Work(Operation & Maintenance))
4.	Ball mill	1. Rotating Machineries 2. Confined space 3. Electrical hazard 4. Noise	Adherence to shutdown system/ PTW during maintenance *(Refer SG-03: Safety Guidelines for working in confined space. SG-18: Management of PPE, SG-19: Safety Guidelines for Material Handling, SG-01: Safety Guideline on storage, handling & use of gas cylinders,SG-04: Safety Guidelines for work permit system, SG-03, Safety Guidelines for Electrical Safety)*
5.	Filters-slurry tanks-Thickeners	1.Noise, 2.Dust, 3.Rotating Machines, 4.Slippery floor, 5.Fall from height Hazard 6.Drowning hazard	1. Provide PPE. 2. Provide guard to moving machinery. 3.Improve housekeeping. 4. Maintain Platforms. Provide adequate illumination. *(Refer SG-18: Management of PPE, SG-19: Safety Guidelines for conveyors, SG-02: Safety Guidelines for working at height, SG-05: Safety Guidelines for Illumination and SG-04: for work permit system)*
6.	Tailing Pumps	1. Rotating Machineries	Proper shutdown during maintenance *(Refer SG-04 for work permit system, SG-03, Safety Guidelines for Electrical Safety)*
7.	Hot air generators	1. Fire and explosion	1.Training to employees on Operation and maintenance safety of Mechanical equipments 2. Fire fighting Engineering controls. 3. Administrative (procedural) controls. *(Refer: SG-16: Safety Guidelines for Fire Safety)*
8.	Mixers	1. Rotating Machineries 2. Material	1. Guarding of all rotating parts. 2. Use of Ear Plug

S.No.	Equipment	Hazards	Risk Control Measures
		Spillage 3. Noise	*(Refer SG-09: Safety Guidelines for Equipment and Machine Guarding and SG-04 for work permit system).*
9.	Pelletising Disc	1. Rotating Machinery 2.Noise	1. Provide guarding *(Refer SG-04: Safety Guidelines for Work permit system)*
10.	Process Fans	1. Rotating Machineries 2. Confined space 3. Electrical hazard 4. Noise	1. Proper shutdown during maintenance and *(Refer SG-03: Safety Guidelines for working in confined space, SG-18: PPE management, SG-01: Safety Guidelines for Handling, and Use of LPG cylinders, SG-04: for work permit system, SG-15 Safety Guideline for Electrical safety)*
11.	Indurating Machine	1.Hot pellet, 2.Conveyors 3.Rotating pulleys 4. SOx/ NOx Generation 5. Fall from height 6. Pellet car loading 7. Contact with hot surface 8. Spillage (pellets) 9.Gas leakage	1. Training to employees on Operation and maintenance, safety of Mechanical equipments. 2.Gaurding of rotator parts 3. Display of Hot Area at site. 4. Use of PPE 5 Adherence to electrical safety procedures 6. Proper care while loading of Pellet cars 7. On-line gas detector on both sides of Indurating hood, portable gas detector 8. Ensure dedusting suction Indurating machine discharge hood to avoid localized eating. 9. Application of heat insulation at required places 10. House-keeping/cleaning of Indurating unit floors *(Refer SG-11: Safety guideline for barricading, SG-19: Safety Guideline on Operation and Maintenance of Conveyor Belts, SG-03: Safety Guidelines for working in confined space, SG-04: Safety Guideline for Permit to Work (Operation & Maintenance), SG-23: Safety Guideline for Safe handling of Liquid Metal, SG-16:*

S.No.	Equipment	Hazards	Risk Control Measures
			Safety Guidelines for Fire Safety, SG-15: Safety Guidelines for Electrical safety, SG-21: Safety Guidelines for Handling Fuel Gas)
12.	Rotary Kiln	Gas leakage	1. Installation of Online Gas monitor at strategic locations & use of Portable monitors to detect gas leakage. 2. Prohibition of unauthorised 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. 3. Training to employees on Operation and maintenance safety of Mechanical equipments. 4. Guarding of rotator parts. 5. Display of Hot Area at site.
		Shell crack Corroded structure	Regular inspection & repair as per requirement.
		Fine Dust deposition	Installation of ESP & regular cleaning etc.
		Sound from Leakages	Plug the leakage points, use Ear Plugs.
		Slip, Trip and fall hazards	1. Ensure proper housekeeping.
		Material falling from height.	1. Prevent materials or objects falling. 2. Uses of appropriate PPE, such as helmets, gloves, aprons and boots.
		Fire and explosion	1. Fire fighting. 2. Engineering controls & Administrative (procedural) controls. *(Refer SG-16: Safety Guidelines for Fire Safety, SG-18: Safety Guidelines for Personal Protective Equipment (PPE) management, SG-21: Safety Guidelines for Handling Fuel Gas)*

S.No.	Equipment	Hazards	Risk Control Measures
13.	Annular coolers	1. Rotating Machineries 2. Confined space 3. Electrical hazard 4. Noise	1. Proper shutdown during maintenance 2. Guarding of rotator parts *(Refer SG-03: Safety Guidelines for working in confined space. SG-19: PPE management, SG-01 : Safety Guideline on storage, handling & use of gas cylinders, SG-04: Safety Guideline for Permit to Work(Operation & Maintenance), SG-15: Safety Guideline for Electrical safety)*
14.	Bucket elevators	1. Spillage accumulation 2. Water accumulation	1. Regular cleaning. 2. Water draining system to be maintained. 3. Regular inspection to be done. 4. Conveyor belt hazards Development. 5. Adherence to SOP.
15.	Air Separators & Dust collectors	1.Noise, 2.Dust, 3.Slippery floor, 4.Fall from height Hazard	1. Provide PPE. 2. Improve housekeeping, 3. Maintain work platforms. 4. Provide adequate illumination. 5. Monitoring working of dust disposal system from hoppers below dust collectors & corrective measures. *(Refer SG-18: PPE Management, SG-02: Safety Guidelines for working at height, SG-05: Safety Guidelines for Illumination at workplace and SG-04: Safety Guideline for Permit to Work (Operation & Maintenance))*
16.	Screen	1. Rotating machinery 2.Caught between rollers	1.Provide guards *(Refer SG-09: Safety Guideline in Equipment & machine Guarding)*
17.	Thickeners and Agitators	1.Slippery floor, 2.Fall from height Hazard 3. Water accumulation	1. Provide PPE 2. Improve housekeeping, 3. Maintain work Platforms. 4. Provide adequate illumination.

S.No.	Equipment	Hazards	Risk Control Measures
		4. Drowning Hazard	5. Water draining system to be maintained. Regular inspection to be done. *(Refer SG-18: PPE Management, SG-02: Safety Guidelines for working at height, SG-05: Safety Guidelines for Illumination at workplace and SG-04: Safety Guideline for Permit to Work (Operation & Maintenance))*
18.	ESP	1. Hot Flue Gas 2. Fine Hot Dust 3. Electrical Transformers 4. High Electrical Voltages	1. Access control 2. Use of dust mask. 3. Monitoring working of dust disposal system from hoppers below dust collectors & corrective measures *(Refer SG-18: Safety Guidelines PPE management, SG-02: Safety Guidelines for working at height, SG-05: Safety Guidelines for Illumination at workplace, SG-04: Safety Guideline for Permit to Work (Operation & Maintenance), SG-21: Safety Guidelines for Handling of Fuel Gas, SG-15: Safety guideline for electrical safety)*
19.	Main Step Down station/Motor Control Centre	1.Electrical Shock, 2.Electrical Flash, 3.Electrical Burn, Fire, 4.Slip/ Trip/ Fall, Hit/ Press/Cut hazard, 5.Fall of Person or materials from height etc.	1. Access Control 2. Use of PPE 3. Provide adequate illumination 4. Electrical Shock Charts 5. Emergency contact Numbers 6. Single line diagrams, First Aid Boxes *(Refer SG-15: Safety Guidelines for Electrical Safety, SG-02: Safety Guidelines for working at height, SG-05: Safety Guidelines for Illumination at workplace)*

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.