

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	Cold Rolling Mills (Automatic)	Doc. No: SG/38
		Rev No. : 00 Effective Date: --

1. OBJECTIVE:

Rolling is a deformation process in which workpiece (slab or plate or sheet) thickness is reduced by compressive force exerted by two opposing rolls.

Cold rolling follows the hot rolling process step. Temperature ranges typically from 60°C to 180°C which is below recrystallization temperature and the desired reduction in thickness of the material is typically from 6 mm to 0.06 mm. Pickling is carried out in order to prepare (remove scale and oxides) the steel for the following cold rolling process. On the input side, the drives of the rolls need a corresponding energy supply. In order to cool the rolls and the work piece, they are lubricated and cooled by emulsion of oil and water.

As per the requirement, coil is further processed through galvanizing line or skin pass mill. Skin-pass rolling enhances the strip flatness, allows the setting of particular surface qualities and suppresses the yield point extension for subsequent forming free of flow lines. In galvanizing process, strip is dipped into a molten pool of zinc. First, the base metal is cleaned either mechanically, chemically, or both to assure a quality bond can be made between the base metal and the zinc coating. Once cleaned, the base metal is then fluxed to clear it of any residual oxides that might remain after the cleaning process. The base metal is then dipped into a liquid bath of heated zinc and a metallurgical bond is formed.

Depending on the further use strips are trimmed, packed and dispatched for further use.

This entire process of Rolling is associated with various safety hazards like hit / entanglement with moving object, burns, slip & fall, exposure to acid, alkali and other chemicals, fumes, noise, heat & gas etc. Most hazards in rolling process arise from Material handling, falling of materials, STF (Slip trip and fall), exposure of toxic gas, Steam, etc.

2. SCOPE:

This safety Guidelines is applicable to Cold Rolling mills (automatic) of a Steel Plant.

3. PROCESS BRIEF:

A typical Cold Rolling mill has following main facilities:

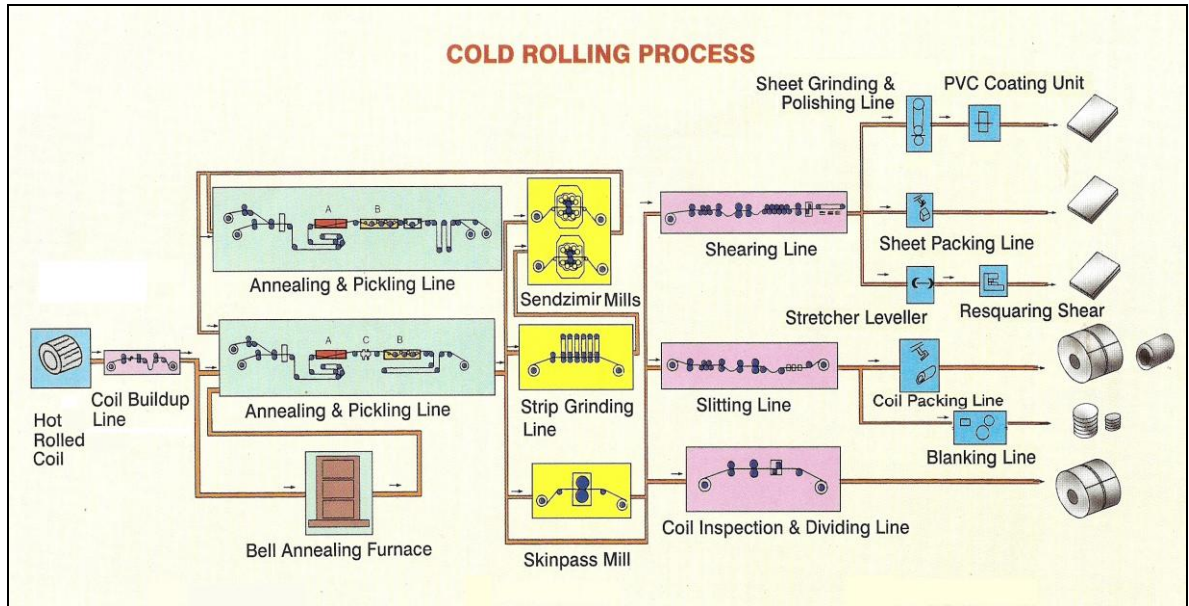
- I. **Coil tracking and transfer system-** In this section, the raw materials like coils are prepared for further rolling operation. A coil feeding is scheduled through automated planning management system and unique identification

number/code generated against the product to track the material till final dispatch. The raw materials in the form of coils are transported to processing line through coil transfer car, walking beam conveyors and EOT cranes.

- II. **Pickling line**- Pickling is a process used to remove the oxide scale that forms on the coil surface during hot rolling using hydrochloric acid. A typical pickling section consists of pickling bath, auxiliary tanks for circulating and storing the acid, rinse section, steam heat exchangers, acid fume exhaust system etc.
- III. **Cold Rolling Mill**- Cold rolling is a process by which hot rolled coil/ strip is introduced between rollers and then squeezed or compressed to the desired thickness. Cold rolling is done to produce a product with good formability, superior surface finish, reasonable strength and close dimensional tolerance. Cold rolling mill comprises Roll Coolant System, Roll change car, Hydraulic & lubricating system, fume exhaust system etc.
- IV. **Skin Pass Mill**- Skin passing involves a least amount of reduction. It is used to achieve the optimum mechanical properties to prevent occurrence of stretcher strains in annealed steel, to impart desired surface finish - “matte” on the strip surface and to improve strip shape. Skin pass mill comprises roll change car, different type of rolls, Hydraulic & lubricating system, electrostatic oiler etc.
- V. **Continuous Galvanizing Line**- Galvanizing is one of the most widely used to methods for protecting metal from corrosion. It involves applying a thin coating of zinc to a thicker base metal, helping to shield it from the surrounding environment. Galvanizing line consists of a zinc bath, alkali section, zinc ingot charging mechanism, furnace etc.

Some of critical equipment/ facilities in Cold Rolling Mill are as follows:

Sl. No.	Area	Major equipment
1.	Coil tracking and transfer system	Coil handling transfer trolley, EOT cranes etc.
2.	Pickling line	Acid tanks and bath, Acid pipelines, Steam supply pipes, fume exhaust system, recoiler, uncoiler, crop shear, edge trimmer etc.
3.	Cold Rolling Mill	Mill stand, Crop shear, Coil looper, Uncoiler / Recoiler, power transmission mechanism including oil cellars, drives mechanism etc.
4	Skin Pass Mill	Mill stand, Uncoiler / Recoiler, Hydraulic oil cellars, Belt wrapper, Drive mechanism etc.
5	Continuous Galvanizing Line	Gas pipe line, blowers, burners, pressure regulators, explosion flaps, furnace, zinc bath, coil loopers etc.



4.0 PROCESS HAZARD ANALYSIS & NECESSARY RISK CONTROL MEASURES:

Sl. No.	Area / Section	Hazards	Risk Control Measures
A	Yard management system		
1		Hazards in coil handling	<ul style="list-style-type: none"> ❖ Good flooring and adequate Illumination level to be maintained at material storage yards. ❖ Store the coils safely on saddles to avoid the rolling of coils in the yard. ❖ Clearly define and mark the walkways maintaining safe distance from material storage area. ❖ Walkaways should be well barricaded. ❖ Unauthorized entry prohibited in storage yards. ❖ Develop and Follow SOP
B	Pickling line		
1		Acid splash/ steam exposure/Burn Injury	<ul style="list-style-type: none"> ❖ Emergency stop to switch off the pumps. ❖ Follow Work permit. ❖ Schedule maintenance and replacement of pipe joints (Expansion bellow). ❖ Relevant PPE to be used. ❖ Safety showers in close proximity of hazards.
2		Cut injury	<ul style="list-style-type: none"> ❖ Access control deployment to

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		hazards from CR sheet and binding strap	<p>ensure stoppage of strip movement/ moving equipment while people movement.</p> <ul style="list-style-type: none"> ❖ Use of cut resistant hand gloves and sleeves. ❖ Defined position for strap cutting people at safe distance. ❖ Use of shin guard to protect leg.
3		Cut injury due to side edge trimming	<ul style="list-style-type: none"> ❖ CCTV inside pulpit for monitoring the scrap spillage. ❖ Inspection of track before scrap bucket operation. ❖ Cut resistant hand gloves and arm guard. ❖ Access control deployment.
C	Cold rolling mill		
1		Fire hazard/ cut injury during strip breakage recovery	<ul style="list-style-type: none"> ❖ Fume exhaust system should be in off condition. ❖ Cleaning of oily surface before gas cutting. ❖ Ceramic cloth placement over oily surface. ❖ Water spray before gas cutting. ❖ Removal of oil soaked cloth. ❖ Inspection of strip puller before usage. ❖ Usage of full sleeve cut resistant hand gloves. ❖ Lock pin in Carry over table. ❖ Panel lock switch. ❖ Usage of full body safety harness. ❖ Fire extinguisher and fire hydrant availability at site.
2		Noise hazard during line running	<ul style="list-style-type: none"> ❖ Regular noise level monitoring. ❖ Use of ear muff/ ear plug. ❖ Visual Display of noise level.
3		Strip feeding threading related hazards	<ul style="list-style-type: none"> ❖ Access control deployment to ensure stoppage of strip movement/ moving equipment while people movement. ❖ Use of relevant PPEs. ❖ Proper communication with control pulpit.

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4		Working on mill stands/ housing	<ul style="list-style-type: none"> ❖ "Permit to work" practice to be followed strictly. ❖ Display of "Men at Work" board is to be done at Operator Control Panel. ❖ Unauthorized entry should be restricted at mill stand area. ❖ Hooter /Siren to be used before start or stop the mill. ❖ Develop and Follow SOP. <p><i>Refer SG-04 : Safety Guidelines for Permit to Work (Operation & Maintenance)</i></p>
5		Hazards during Roll Change	<ul style="list-style-type: none"> ❖ Ensure safe distance of working personnel from suspended load /swing load. ❖ When roll change command is given, mill should not be in ready to run condition. ❖ Ensure Hooter/ warning signal to be used when roll change car movement takes place. ❖ Develop and Follow SOP. <p><i>Refer SG-04 : Safety Guidelines for Permit to Work(Operation & Maintenance)</i></p>
6		Hazards in Cellar	<ul style="list-style-type: none"> ❖ Readiness of sump pump in cellar area. ❖ Adequate illumination inside cellar area. ❖ Access control deployment. ❖ CCTV surveillance. ❖ Active fire control system. ❖ Regular housekeeping. ❖ Hot job under strict supervision and hot work permit deployment. ❖ Communication system in case of emergency. ❖ Mock drill to check preparedness.
7		Handling of work roll, Intermediate rolls and Back up rolls	<ul style="list-style-type: none"> ❖ Audio visual hooter should be activate in roll change car. ❖ Indicative barricading to be used to restrict the pedestrian movement during roll changing car movement.

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			<ul style="list-style-type: none"> ❖ Ensure safe distance of working personnel from suspended load / swing load while handling the rolls with EOT cranes. ❖ Display “Men at Work” board at Operator Control Panel. ❖ Develop and Follow SOP.
8		Mill maintenance	<ul style="list-style-type: none"> ❖ Follow work permit and positive isolation procedure including all Energy source isolation. ❖ Ring spanners and impact wrenches should be used for maintenance job in mill area. ❖ Bent-out, open-ended spanners not to be used. ❖ Competent and trained persons should only perform job on mill equipment. ❖ Tested and certified lifting tools, tackles, jacks to be used in mill area. ❖ Develop and Follow SOP. <p><i>(Refer SG-04 Safety Guidelines for Permit to Work(Operation & Maintenance))</i></p>
9		Major Repair Job	<ul style="list-style-type: none"> ❖ All the power shutdowns of the required system to be taken as per the dully filled work permit form and necessary clearance from concerned operation and electrical area. ❖ Using required PPE as per requirement. ❖ Ensure that all lifting tools & tackles (winches, hydraulic jacks, Chain Pulley Blocks, slings etc.), Mobile cranes, Forklift should be tested by a competent person and certified driver should only operate the mobile equipment. ❖ For working at height, a “Work at heights pass” to be obtained from safety department and use of

Sl. No.	Area / Section	Hazards	Risk Control Measures
			<p>appropriate safety harness, scaffold to be ensured before executing the job at site.</p> <ul style="list-style-type: none"> ❖ All portable electrical equipment, welding machines to be earthed effectively (body earthing). RCCB/ELCB to be checked in all welding machine before the usage. ❖ Heavy structural member should well be supported and guided by ropes, chains or any other means to prevent its falling or swinging during gas cut or removal from site. ❖ Suitable fire extinguishers/ Fire tender/Fire hydrant lines should provide at site before executing the maintenance jobs at site. ❖ Rolling of gas cylinders to be avoided and transferred / shifted by proper trolleys. ❖ Proper protection to be provided to conveyors and electrical cables to prevent fall of sparks from welding/ gas cutting. ❖ Isolation of electrical power and written clearance to be obtained from electrical section before start of dismantling operation. ❖ Adequate illumination to be ensured before starting the job at site. ❖ Unauthorised entry should be restricted at working site. ❖ All the openings created during dismantling to be immediately covered/ barricaded. ❖ Compressed air vessels and pipelines to be de-pressurized before dismantling. ❖ Combustible/Inflammable materials should be removed from the place where gas cutting/ welding jobs are to be

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			<p>carried out.</p> <ul style="list-style-type: none"> ❖ HOT work permit to be implemented during gas cutting and welding in non-designated area. ❖ A charged water hose pipe may be kept near the place of work. ❖ Emergency response training should be imparted to working persons. ❖ Prior to actuation it must be ensured that no persons are in the active area of the dangerous energy (mechanical, electrical, hydraulic, pneumatic etc.). <p>Only the hydraulic/pneumatic specialist is allowed to perform switching operations on hydraulic / pneumatic valves, provided the following conditions are fulfilled:</p> <ul style="list-style-type: none"> ✓ personnel involved in plant start-up and control must be warned of any operations that are to be carried out in the enclosed area before starting the machine. ✓ No persons should present in the danger zone. ✓ Voice contact must be established with a responsible person at the workplace in charge of monitoring the sequence of functions. <ul style="list-style-type: none"> ❖ Develop and Follow SOP.
D	Skin Pass Mill		
1		coil preparation hazards	<ul style="list-style-type: none"> ❖ Use full sleeve arm guard and cut resistant hand gloves. ❖ Cleaning of oil during gas cutting. ❖ Flash back arrester in gas cutter. ❖ Awareness of workers on SOP. ❖ Crane tong inspection & maintenance.
2		Hazards during	<ul style="list-style-type: none"> ❖ Full sleeve arm guard and

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		collection of scrap and sample	double hand gloves. ❖ Unauthorized entry should be restricted at scrap collection area.
3		Hazards of Moving machineries at finishing mill	<ul style="list-style-type: none"> ❖ Fencing of all moving equipment i.e. rolls spindles, couplings etc. ❖ Smart fencing to prevent man machine interface. ❖ Loose cloths to be prohibited. ❖ Visual inspection from safe distance. ❖ Moving equipment potential hazards should display near moving equipment. ❖ Access control deployment. ❖ Use of relevant PPEs. ❖ Work permit and positive isolation procedure to be followed before performing any maintenance job. ❖ Develop and Follow SOP. <p><i>(Refer SG-11 : Safety Guidelines for Barricading)</i></p>
E	Galvanizing		
		Burn injury during zinc dross removal	<ul style="list-style-type: none"> ❖ Restriction of Zinc Ingot charging during drossing. ❖ Access Control in Zinc Pot Area. ❖ Use of Required PPEs and Safety Harness. ❖ Use of Jig with Long handles to scoop out Dross. ❖ Safety shower availability at close proximity. ❖ First aid kit and stretcher availability.
1		Burn injury hazards, Exposed to hot water, steam, and hot zinc	<ul style="list-style-type: none"> ❖ Use fire resistant personal protection equipment to protect from burn injury /heat exposure. ❖ Keep the first aid kit at shop floor and ensure availability of burn injury medicines. ❖ Maintain safety shower /Eye shower as per standard at shop floor area. ❖ Follow work permit and

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			<p>positive isolation procedures including isolation of all Energy sources - like fluid energy, power energy etc. before executing any maintenance activity.</p> <ul style="list-style-type: none"> ❖ Develop and Follow SOP. ❖ Competent and trained persons should only deploy to work on critical equipment. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage)</i></p>
2		Gas exposure due to leakage of gas	<ul style="list-style-type: none"> ❖ All the gas line to be isolated from main circuit by "U" seal and also filled up water in water seal and ensure continuous overflow of water to drain. ❖ Blanking of gas line to be done before Removal of valves or flanges. ❖ Follow lock-out/tag-out procedures for maintenance, ❖ Including all Energy source isolation - like fluid energy, power energy etc. ❖ Proper packing to be provided in fixing of valves or flanges. ❖ Regular inspection of gas lines to detect leakage if any. ❖ Use Fixed and Portable "CO" detectors to detect gas leakage and system should generate auto alarm /hooter/ /siren in case of gas leakage. ❖ Ensure the isolation of main inlet valve to cut off the gas supply. ❖ Check all the flange/ welded joints for gas leakage. ❖ Purge the gas pipe lines with nitrogen in small segments by opening the bleeder valve. ❖ Oxy pack and stretcher should readily available. ❖ Mock drills should conduct in critical areas to evaluate the

Sl. No.	Area / Section	Hazards	Risk Control Measures
			<p>emergency preparedness.</p> <ul style="list-style-type: none"> ❖ Develop and Follow SOP. <p><i>(Ref : SG-21 : Safety Guideline for Handling Fuel Gas)</i></p>
3		Fire hazards	<ul style="list-style-type: none"> ❖ Hot work permit clearance should be implemented before executing any maintenance activity like Gas cutting/welding etc. to eliminate fire hazards in gas area. ❖ Keep the Fire hydrant line /Portable fire extinguishers ready for mitigate the Fire hazards. ❖ While lighting up or off of the furnace, laid down procedures/SOP to be followed strictly. ❖ Keep Emergency announcement/ Siren/Hooter system ready. ❖ At least 20% employees should be imparted Emergency response training and should participate in mock drills. <p><i>Refer SG-16 : Safety Guidelines for Fire Safety</i></p>
4		Hazards associated with re-lining of furnace with refractory bricks	<ul style="list-style-type: none"> ❖ Follow work permit and positive isolation procedures Including isolation of all Energy sources - like fluid energy, power energy etc. ❖ Monitor the temperature of area before starting work. Force drafting /Cool Air arrangement should be provided to maintain the normal temperature inside the furnace. ❖ 24 Volt lighting arrangements to be used during repair job inside furnace. ❖ Detail job safety protocol may be prepared to undertake the job if job is irregular. ❖ Confined area permit to be taken from competent person.

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			<ul style="list-style-type: none"> ❖ Wes guard to be used in welding machines inside furnace/confined space. ❖ Regular disposal of refractory bricks and housekeeping to be maintained in that area. ❖ Temporary material handling conveyor may install to safely and easily transporting of material inside furnace. ❖ Develop and Follow SOP. <p><i>Refer SG-04 : Safety Guidelines for Permit to Work (Operation & Maintenance)</i></p>
5		<p>Scrap handling hazards</p> <ol style="list-style-type: none"> 1. Handling of scrap bin through EOT crane 2. Handling of scrap coil /pup coil/ transfer bar. 3. Hoop iron/ trimmed scrap handling. 4. Chemical drum handling. 5. Sludge and muck handling. 	<ul style="list-style-type: none"> ❖ Warning bell and Auto Audio alarm while crane running. ❖ Ensure no pedestrian movement below suspended load. ❖ Access control deployment in material handling area. ❖ Trained driver and flagman deployment for mobile equipment. ❖ Inspection of lifting tools and tackles and mobile equipment by competent person. ❖ Dyke wall provision at chemical drum storage area. ❖ Fire hydrant and fire extinguisher provision. ❖ Safety shower provision near chemical drums storage area. ❖ Use of relevant PPEs. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage)</i></p>
F	Transformers, HT panel, MCC and Electrical control rooms		

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1		Electric shock	<ul style="list-style-type: none"> ❖ Follow work permit and positive isolation procedure including all Energy source isolation. ❖ Displaying of "Men at Work" at HT switching on panel. ❖ Use non-contact type testers to check the residual voltage after isolation of electrical power from main source. ❖ Ensure Proper grounding of electrical power before executing job on electrical equipment ❖ Competent and trained person only allowed to perform job on electrical equipment. ❖ Use proper Electrical PPE's for working in HT line and ECR rooms. ❖ Ensure safety showers provision near ECR buildings. ❖ Develop and Follow SOP. <p><i>(Refer SG-15 : Safety Guidelines for Electrical safety))</i></p>
G	EOT Cranes		
1		Hazards during working on EOT Cranes	<ul style="list-style-type: none"> ❖ Follow work permit and positive isolation procedure including all Energy source isolation. ❖ Scotch Block /Stoppers are to be bolted on both sides of crane LT rails to restrict the entry of running cranes in that area. ❖ "Crane under shutdown" Red flag to be displayed to alert the other moving crane operators. ❖ Indicative barricading (Red tape/Ribbon) to be provided on shop floor to restrict the pedestrian movement below the crane till the shutdown job completes. ❖ Submit job completion report after repair. ❖ All the lifting tools and tackles

Sl. No.	Area / Section	Hazards	Risk Control Measures
			<p>to be checked every year as per statutory requirement.</p> <ul style="list-style-type: none"> ❖ Develop and Follow SOP. <p><i>(Refer SG-14 : Safety Guideline for work on Electric Overhead Travelling (EOT) Crane)</i></p>
H	General safety norms for rolling mills		
			<ul style="list-style-type: none"> ❖ All required PPEs are to be used while working. ❖ Use properly maintained tools & tackles. ❖ Hand tools to be checked in every six months. ❖ All the lifting tools and tackles to be checked every year as per statutory requirement. ❖ Permit-to-work to be filled up before taking any job. ❖ Before starting any job Positive isolation procedure to be ensured by concerned agencies. ❖ Compliance of special measures to be undertaken such as cooling of rolls in hot areas, use of supports, use of stoppers, closing of valves, housekeeping in the area and availability of fire hose/extinguishers. ❖ Standard Operation Practices (SOPs) and Standard Maintenance Practices (SMPs) are to be followed strictly. ❖ All the mechanical moving equipments are to be barricaded / guarded properly. ❖ All electrical equipments to be earthed properly. ❖ All high- pressure vessels are to be tested as per statutory requirements. ❖ Oil Cellar to be checked every day/week as per DM (Daily Management) checklist for leakages. ❖ Flume tunnels /Scale pit area

Sl. No.	Area / Section	Hazards	Risk Control Measures
			<p>cleaning job to be executed as per schedule or during the shutdown.</p> <ul style="list-style-type: none"> ❖ Proper loading / unloading procedure for raw material/finished products to be prepared and followed. ❖ Ensure the availability of firefighting equipment. ❖ Ensure proper illumination at shop floor and working area. ❖ Before restoration of power of the equipment, it is to be ensured that men, materials including tools and tackles, supports, scaffolding etc. are removed. ❖ Safety signs are intended to ensure the safety of personnel at their workplace. Depending on the kind of hazard, the following signs must be placed: <ul style="list-style-type: none"> ✓ Prohibitive signs ✓ Warning signs ✓ Mandatory signs ✓ Rescue signs ✓ Informative signs ✓ Signs identifying permanent danger areas ✓ Signs for operating areas requiring individual safeguarding ❖ In operating and danger areas of the plant/machine, it is necessary to place the signs listed above before equipment is put into operation. ❖ Before commencing their activities, all personnel must be instructed as to the significance of the safety signs, and renewed instruction must be given at appropriate intervals, but at least once per year. ❖ In addition to the signs listed above, the user of the equipment shall clearly and

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			<p>distinctly indicate and place signs for the following:</p> <ul style="list-style-type: none"> ✓ Escape routes/emergency exits ✓ First-aid stations ✓ Places where stretchers are available ❖ Emergency showers/eye washing facilities ❖ The operational reliability and the safe use of the plant /machine are ensured (among other things) by electrical and mechanical interlock devices. These must be inspected at regular maintenance intervals. ❖ Emergency push buttons / switches to be checked for their functioning at regular intervals. ❖ All fixed guards, when removed for any work on the machine, must be correctly replaced and secured at the end of the work.

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) Signage's 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.