

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	Hot Rolling Mills (Automatic)	Doc. No: SG/37
		Rev no. : 00 Effective Date: --

1. OBJECTIVE

Rolling is the process of plastically deforming the metal by passing it between a set of rolls revolving in opposite direction. Rolling is the most widely used metal forming process. It is employed to convert metal ingots, Blooms, Billets, Slabs to products like Bars, Beams, Sections, Sheets, Plates and Strips etc. The main objective of rolling is to decrease the thickness of the metal and give it a desired profile. Rolled products are used for different engineering, constructional & fabrication purposes.

As steel is not ductile at room temperature, heavier reductions require it to be heated to temperatures of 1200-1500⁰C to make it ductile by converting it's crystal structure from BCC to FCC. In rolling mills, this operation is called reheating process and is carried out in reheating furnaces. Hot rolling operation is always preceded by reheating operation.

2. SCOPE

This safety guideline is applicable to High speed Automatic Rolling Mills Dept. of an Integrated Steel Plant.

3. PROCESS

Rolling mills consists of different type of Mills based on the desired products namely:

A. Long Product Mill

- a) Light and Medium Merchant Mill/ Bar Mill.
- b) Wire rod Mill.
- c) Medium merchant structural mill/ Structural Mill.

B. Flat Product Mill

- a) Plate Mill
- b) Hot Strip Mill

A. Long Product Mill

All Long Product Rolling Mills (Automatic) are having following main sections:

I. Charging grid:

In this section, the raw materials like Ingots/blooms etc. are received from Steel melting shop. Visual inspection is made to detect any defects like surface cracks, piping, bulge outs, Heat no's etc. The defective Ingots/blooms etc. are identified and is ejected from charging

roller tables. The material to be heated is put on the charging grid for charging into furnace. As per production/discharging rate, the material is charged / pushed into furnace at regular intervals with the help of motorized/ hydraulic pusher. Blooms/ billets etc. are charged into the reheating furnace.

- II.** a) **Reheating Furnace/ Walking beam furnace:** Mixed/ Coke oven gas is taken from the common gas network and is utilized for reheating the blooms/billets/slabs up to a required rolling temperature. The reheating furnace is walking beam type and uses mixed gas for fuel and indirect water cooling system for cooling skids, charging rollers and doors. The walking furnace is equipped with air recuperators, for waste gas heat recovery from flue gas, which pre-heats the combustion air from combustion fans before combustion. Inside the furnace the blooms can be heated up to the rolling temperature of around 1200°C. The heated blooms/ billets etc. are discharged from furnace through the side discharging door and are send to the roughing train of the mill for rolling process.
- b) **Roller table:** To discharge the hot blooms/billets/slabs to rolling mill for rolling operation.

III. Mill Section:

To roll the hot blooms / billets / slabs etc. into desired shape by passing it between set of revolving rolls. The rolls may be plain or grooved rolls depending on product. Rolling operation may contain one or more roll stands depending on reductions required.

The Mill section comprises of the following sub sections:

- I. Rolls & Guides preparation area
- II. Roughing stands
- III. Intermediate stands
- IV. Finishing Mill
- V. Cooling bed / Conveyors
- VI. Shearing section /cold saw
- VII. Oil cellars / Hydraulic room
- VIII. Shipping area

Some of critical Equipments/ facilities in Rolling mills (Automatic) are as follows:

SI.No	Area	Major equipments
1.	Charging grid	Bloom Storage Yard Roller Table, Lever type Pushers, Elevators and Take over devices.
2.	Reheating Furnace Section	Charging Roller Table, Bloom Pusher, Dilution Air Fans, Combustion Air Fans, Air Recuperators, Burners, Evaporative Cooling System, DMDA (Demineralized and Deaerated)

Sl.No	Area	Major equipments
		Pumps, Gas and Air Control Valves, U-Seals etc.
3.	Rolling Mill Section	Delivery Roller Table, Vertical & Horizontal Stands , Pinch Roll, Measuring Roll, Flying Shear, Runout Roller Table, Approach group Roller Table, Turnover Cooling Beds, Oil cellars, Scale Flume Tunnels, EOT Cranes, Cable cellars etc.

B. Flat Product Mill

The Flat Product Hot Rolling Mill has following main sections:

I. Yard management Section:

In this section, the raw materials like Ingots / Billets / Slabs etc. are prepared for further rolling operation. Ingots / Billets / Slabs charging in furnace 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 like ingots/billets/slabs etc. transported to furnace for reheating through automated transfer trolley, roller tables and EOT /charging cranes.

II. Reheating Furnace:

Various sub-sections of reheating furnace section and their functions are as follows:

- a) **Fuel management Section:** The fuel management section may include, Different gas lines like CO gas, Mixed gas, Nitrogen gas etc., different Gas pipes, various types of electro pneumatic valves, Pressure Relief Valve, injector blowers ,waste gas exhaust system, chimney etc. The main function of this section is to prepare fuel for proper/efficient combustion in reheating furnaces.
- b) **Roller Conveyor/Roller table:** To transport and charge the material into the furnace as well as transfer discharge heated material to rolling mill for rolling operation.
- c) **Reheating Furnace:** To convert chemical energy of fuels into heat energy and heat the material to required temperature efficiently and economically. Reheating furnace prepares the material for further hot rolling operation. The reheating operation includes Charging, Pushing, heating and discharging/conveying to rolling mill.

III. Rolling mill:

To roll the hot crude steel products into desired shape by passing and squeezing it between set of revolving rolls. The rolls may be plain or grooved rolls depending on product. Rolling operation may contain one or more roll stands depending on reductions required.

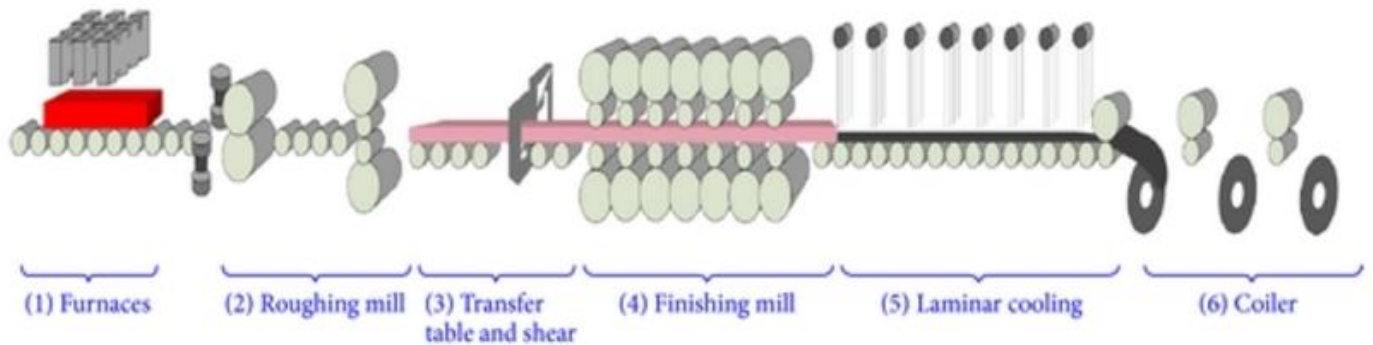
The Rolling Mill comprises of the following sections:

- i. Primary Descaling
- ii. Roughing stands/ Intermediate stands
- iii. Roller tables
- iv. Finishing Mill
- v. Cooling bed/laminar area
- vi. Down coiler
- vii. Shearing section/finishing yard
- viii. Dispatch yard
- ix. Oil Cellars
- x. Flume tunnels
- xi. Scale pit/settling tank
- xii. Drive mechanisms

Some of critical Equipment/ facilities in Re-rolling Mills are as follows:

Sl. No.	Area	Major equipments
1.	Yard management section	Slab/Billet handling transfer trolley, Roller tables and EOT /charging cranes etc.
2.	Reheating furnace section	Gas pipe line, blowers, burners, pressure regulators , explosion flaps, extractor table etc.
3.	Rolling Mill Section	Roller Table, Mill Stand, Crop Shear, Coil Box, Down coiler / Recoiler, Power transmission mechanism including oil cellars, Conveyors, Motors etc.

Typical Layout of Flat Product Hot Rolling Mill



4. PROCESS HAZARD ANALYSIS & NECESSARY RISK CONTROL MEASURES

A. Long Product Mill

SI.No	Area/Section	Hazards	Risk control measures
CHARGING GRID			
1	Charging Grid Section	Fall of Material	<ul style="list-style-type: none"> ❖ Keep away from moving cranes. Effective audible and visual communication devices should be installed on a crane or hoist. ❖ Crane operators are to be instructed to not to place billet when any person is working near charging grid area. ❖ Use crane fingers while carrying Ingots/blooms/billets/slabs etc. by using magnetic crane. ❖ Battery backup for the magnetic cranes to be ensured. ❖ Use of PPE's to be ensured. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage)</i></p>
		Material Stacking	<ul style="list-style-type: none"> ❖ Maintain floors in proper condition. ❖ Stack the material properly without any bloom/billet ends protruding out. ❖ Clearly define walkways and proper stacking of material. ❖ Ensure regular clearance of debris.

SI.No	Area/Section	Hazards	Risk control measures
		Hit by moving billet	<ul style="list-style-type: none"> ❖ Charging grid is to be stopped during billet cutting operation. ❖ Shutdown/permit to work with electrical isolation is to be ensured.
		Slip & fall	<ul style="list-style-type: none"> ❖ Regular removal of over length billet cutting pieces (Obstructions). ❖ Maintain clean surroundings by following housekeeping plan.
		Contact with hot billet	<ul style="list-style-type: none"> ❖ Use of PPEs like safety shoes, leather gloves etc.
REHEATING FURNACE			
1	Reheating Furnace	Gas poisoning due to leakage of gas	<ul style="list-style-type: none"> ❖ All the gas line to be insulated from circuit by "U" seal and also fill up water in water seal and ensure overflow of water to drain. ❖ Blanking of gas line to be done before removal of valves or flanges. ❖ Proper packing to be provided in fixing of valves or flanges. ❖ Regular inspection of gas lines to detect leakage if any. ❖ Use Portable & /Online "CO" monitors to detect gas leakage. ❖ Ensure the closure of main valve to cut off supply. ❖ Check all the flange/ welded joints for gas leakage. ❖ Purge the gas pipe line with nitrogen in small segments by opening the bleeder valve. ❖ Control the gas flow and air to gas ratio so that flame should not come out.
		Fire/ Explosion hazards	<ul style="list-style-type: none"> ❖ Purging of gas lines. Oil/ gas leakages to be arrested properly. ❖ Give clearance for cutting/welding etc. after ensuring that there is no leakage of gas. ❖ Keep the Portable fire extinguishers ready for any hazards. ❖ While lighting up or off of the furnace, laid down procedures are to be followed strictly. ❖ Pressure drop across gas

SI.No	Area/Section	Hazards	Risk control measures
			<p>recuperators is to be checked periodically.</p> <p><i>(Refer SG-16 : Safety Guideline for Fire Safety, SG-21 : Safety Guideline for Handling Fuel Gas)</i></p>
		Fire / Explosion hazards	<ul style="list-style-type: none"> ❖ Purging of gas lines. ❖ Oil/ gas leakages to be arrested properly. ❖ Give clearance for cutting/welding etc. after ensuring that there is no leakage of gas. ❖ Keep the Portable fire extinguishers ready for any hazards. ❖ While lighting up or off of the furnace, laid down procedures are to be followed strictly. ❖ Pressure drop across gas recuperators is to be checked periodically. <p><i>(Refer SG-16 : Safety Guideline for Fire Safety, SG-21 : Safety Guideline for Handling Fuel Gas)</i></p>
		Burn injury hazards, Exposed to hot flames and hot billets/ingots Fire / Explosion hazards	<ul style="list-style-type: none"> ❖ Ensure Furnace door in closed condition. ❖ Use of PPEs like Fire retardant coat, face shield etc. ❖ Purging of gas lines. ❖ Oil/ gas leakages to be arrested properly. ❖ Give clearance for cutting/welding etc. after ensuring that there is no leakage of gas. ❖ Keep the Portable fire extinguishers ready for any hazards. ❖ While lighting up or off of the furnace, laid down procedures are to be followed strictly. ❖ Pressure drop across gas recuperators is to be checked periodically. <p><i>(Refer SG-16 : Safety Guidelines for Fire Safety, SG-21 : Safety Guideline for Handling Fuel Gas)</i></p>
		Burn injury hazards, Exposed to hot	<ul style="list-style-type: none"> ❖ Ensure Furnace door in closed condition. ❖ Use of PPEs like Fire retardant coat,

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		flames and hot billets/ingots	face shield etc.
		Hazards associated with re-lining of furnace with refractory bricks	<ul style="list-style-type: none"> ❖ Work permit system to be followed. ❖ Monitor the temperature of area before starting work. ❖ Hand held 24 V bulbs to be used during repairs in furnace. ❖ Detail job safety protocol may be prepared to undertake the job, if job is Non Routine. <p><i>(Refer SG-04 : Safety Guideline for Permit to Work(Operation & Maintenance))</i></p>
		Material handling	<ul style="list-style-type: none"> ❖ Ensure proper condition and load carrying capacity of slings before use. ❖ Ensure use of PPE's. ❖ Material Handling practices training to personnel to be given. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage)</i></p>
		Slip & fall	<ul style="list-style-type: none"> ❖ Maintain clean surroundings by following housekeeping plan.
MILL SECTION			
1	Rolling	Caught in between machinery	<ul style="list-style-type: none"> ❖ Coupling/Spindle guards to be in place. ❖ Loose clothes to be prohibited. <p><i>(Refer SG-11: Safety Guidelines for Barricading)</i></p>
		Person hit by rolling hot material during cobble	<ul style="list-style-type: none"> ❖ Auto Announcement during pusher/ejector/ roughing operation. ❖ Proper guards to be provided to avoid material coming in the way of workmen. ❖ Proper pathways to be provided for safe movement. ❖ All required safety Interlocks of the Equipment & Process including auxiliary system for sequencing of operation. ❖ Provision of Emergency stop of Mill during cobble. ❖ Reviewing previous incident reports ❖ Periodic Check/Maintenance including critical process safety equipment.

SI.No	Area/Section	Hazards	Risk control measures
			<i>(Refer SG-11 : Safety Guidelines for Barricading)</i>
		Burn injuries during removal of cobble by Gas cutting/ Lancing	<ul style="list-style-type: none"> ❖ Use of appropriate PPE hand gloves, gum boots, Face shield, dust mask, goggles by persons working on stands and handling hot materials. ❖ Proper leg/arm guard's/safety goggles/ Safety gloves/ Face shield to be provided while removing loops/ cobble. ❖ Maintain clean surroundings with good housekeeping. ❖ Permit to work to be taken prior to undertaking any maintenance job. <p><i>(Refer SG-07 : Safety Guideline for Gas cutting & Gas Welding, SG-18 : Personal Protective Equipment (PPE) Management)</i></p>
2	Roll Change/ Pass Change	Material handling	<ul style="list-style-type: none"> ❖ Ensure proper condition and load carrying capacity of slings before use. ❖ Ensure use of PPE's. ❖ Proper crane signalling is to be given and by one person only. ❖ Material handling and safety practices training to personnel to be given. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage)</i></p>
		Caught in between objects	<ul style="list-style-type: none"> ❖ Ensure to take Power Shutdown for Roller Table and connected drive. ❖ Ensure written Work Clearance to be given to concerned personnel for doing the work.
		Burn injury	<ul style="list-style-type: none"> ❖ During Roll Change, rolls to be cooled with water spray before work to avoid burn injury.
		Slip & Fall from height	<ul style="list-style-type: none"> ❖ Suitable platforms are to be provided near roller table for smooth entry of personnel. ❖ Use of Double lanyard safety belt to be ensured.
		Electric shock	<ul style="list-style-type: none"> ❖ Ensures safety precautions like Power Shutdown/ LOTO procedure to be followed before stating the

SI.No	Area/Section	Hazards	Risk control measures
			<p>job.</p> <ul style="list-style-type: none"> ❖ Displaying of "Men at Work" caution board near the electrical panel. ❖ Proper earthing to be ensured. <p><i>(Refer SG-15 : Safety Guideline for Electrical safety, SG-02 : Safety Guideline for Working at Height & SG-04 : Safety Guideline for Permit to Work(Operation & Maintenance))</i></p>
		Hazards during Grinding operation	<ul style="list-style-type: none"> ❖ Never use a grinder without the grinding wheel guard which is provided for protection. ❖ Check the grinding wheel for any kind of crack or damage before using the grinder. ❖ Wear safety goggles, dust-proof mask and other necessary PPE during operation. ❖ Check that the maximum operating speed, dimensions and other specifications of the grinding wheel are correct for the machine where it will be used. ❖ Pass Grinding/cleaning is to be done from delivery side only (Opposite direction of Roller rotation).
3	Mill maintenance	Slippage of tools	<ul style="list-style-type: none"> ❖ Bent-out, open-ended spanners not to be used. ❖ Ensure use of correct sized tools.
		Hazards during Working on EOT Cranes	<ul style="list-style-type: none"> ❖ For safe working, ensure "Power Shutdown," ❖ Stoppers are to be welded on both sides of crane on LT rails. ❖ All the lifting tools and tackles to be checked every year as per statutory requirement. <p><i>(Refer SG-14 : Safety Guideline for work on Electric Overhead Travelling (EOT) Crane)</i></p>
SHIPPING AREA			
1	Shipping area	Loco movement	<ul style="list-style-type: none"> ❖ Automatic siren system is to be installed wherein the siren starts as soon as the wagon enters the shed in two places i.e. one at entry of shed and the other inside the shed caution the movement

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			<p>of wagon.</p> <ul style="list-style-type: none"> ❖ Barricading is to be done on both sides of the track. ❖ Attendant from traffic department is to be ensured along with moving wagons at the front carrying the signal lamp/flag alerting the personnel along the track way. ❖ Blowing of horn by engine driver for alerting the personnel. ❖ The maximum safe height of stacking is up-to 2 meters. ❖ Track maintenance and levelling is to be done regularly by traffic maintenance group to prevent unexpected rolling-over of idle wagons. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage)</i></p>
		Trailer Movement	<ul style="list-style-type: none"> ❖ Loading areas are to be earmarked clearly. ❖ Systematic distribution of trucks /trailers to various loading points to be ensured to prevent congestion. ❖ In case of multi-layered loading of trailers, coils are to be additionally secured in place by proper lacing arrangement before leaving the shop floor. ❖ Ensure that the vehicles move within the safe speed limits in the shop floor as per state specific guidelines. ❖ Vehicles personnel are not allowed to crowd near the loading points. <p><i>(Refer SG-24 : Safety Guideline for Transportation in steel industry)</i></p>
		Material handling	<ul style="list-style-type: none"> ❖ Keep away from moving cranes. ❖ Effective audible and visual communication devices should be installed on a crane. ❖ Battery backup for the magnetic cranes to be ensured. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage)</i></p>

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SHEAR AREA			
1	Shear Area	Cut piece flying away	<ul style="list-style-type: none"> ❖ The shears shall have safety cage. ❖ Maintenance of shear shall be done only after complete shutdown of the shear drive. In hydraulic operated shear, the line shall be de-pressurised completely. ❖ Danger sign shall be put near to the shear. ❖ The mesh of safety cage shall be less than the minimum size rolled (rod/bar mill).
CELLAR AREA			
1	Oil Cellars	Hazards during working in oil cellars	<ul style="list-style-type: none"> ❖ Proper Covering of all openings. ❖ Safety Slogans/Boards/Banners. ❖ Proper Lighting in Cellars including Tunnels etc. ❖ Suitable working Platforms wherever required. ❖ All required safety Interlocks of the Equipment & Process including auxiliary system for sequencing of operation. ❖ Safety guard for rotating part in cellar like coupling Guard etc. ❖ More than one Entry & Exit in oil cellar. The Entry & Exit should be marked properly for easy escape in case of fire. ❖ Proper Ventilation system as applicable. ❖ Proper Fire fighting system to be provided for cellar to take care any fire accidents. ❖ Anti Skid tiles to be provided for flooring to avoid any slipping. ❖ Sump pump should be installed in Cellar to avoid any flooding inside cellar.
GENERAL			
1	General		<ul style="list-style-type: none"> ❖ The crossovers in the mill shall have wire mesh. ❖ Emergency phone nos. shall be displayed throughout the mill. ❖ The entire conduit opening shall be sealed with fire clay. ❖ Emergency stop button shall be installed near to major drives/roller

Sl.No	Area/Section	Hazards	Risk control measures
			<p>table group drive.</p> <ul style="list-style-type: none"> ❖ Fumigation of tunnels shall be done on regular basis to keep the snakes/pests away. ❖ Fire alarm system shall be checked regularly.

B. Flat Product Mill

YARD MANAGEMENT SECTION			
1	Yard Management	Hazards due to material transfer trolley	<ul style="list-style-type: none"> ❖ Avoid standing or moving near material handling transfer trolley. ❖ Audio visual hooter shall provide in trolley to generate alert during its auto movement. ❖ Never perform maintenance while transfer trolley is in operation. ❖ Ensure correct operation sequence of transfer trolley movement. ❖ Avoid loose clothing, long hair, jewellery and other loose items near moving equipment/transfer trolley/Roller tables. ❖ Emergency "shut-off" devices to be provided. ❖ Follow lock-out/tag-out procedures for maintenance, ❖ Including all Energy source isolation - like fluid energy gas energy, power etc. ❖ Unauthorized entry prohibited in billet / slab storage yards. ❖ No human interface/ ground movement allowed in billet /slab yard during material handling with EOT/charging cranes. ❖ Only authorized/trained personnel to operate or maintain the yard management section equipment. <p><i>Ref: SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage</i></p>
		Hazards in Material handling & stacking area (Loading and unloading point hazards related	<ul style="list-style-type: none"> ❖ Good flooring and adequate Illumination level to be maintained at material storage yards. ❖ Stacked the materials safely to avoid the Stack pile collapse in yards.

SI.No	Area/Section	Hazards	Risk control measures
		with trailer and wagon movement inside yard area)	<ul style="list-style-type: none"> ❖ Clearly define and marked the walkways maintain safe distance from material storage area. ❖ Walkways should well barricaded and material stacking height should less beside pathway area to improve visibility for pedestrians and crane operators. ❖ Unauthorized entry prohibited in billet / slab storage yards. ❖ Access control deployment in yards to minimize human machine interface especially at trailer and wagon loading points. ❖ Audio visual hooter/alarm provision at wagon loading points. ❖ No human interface/ ground movement allowed near roller table or transfer trolley moving area. ❖ Follow lock-out/tag-out procedures for maintenance, Including all Energy source isolation - like fluid energy, power energy etc. <p><i>Refer: - SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage and SG-24 : Safety Guideline for Transportation in steel industry</i></p>
REHEATING FURNACE			
1	Furnace	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"

SI.No	Area/Section	Hazards	Risk control measures
			<p>detectors to detect gas leakage and system should generate auto alarm /hooter/ /siren in case of gas leakage.</p> <ul style="list-style-type: none"> ❖ 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 emergency preparedness. ❖ Develop and Follow SOP. <p><i>Ref: SG-21 : Safety Guideline for Handling Fuel Gas</i></p>
2		Fire hazards	<ul style="list-style-type: none"> ❖ Hot work permit clearance should implement 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>
3		Burn injury hazards, Exposed to hot water, steam, flames, and hot billets/ingots	<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.

SI.No	Area/Section	Hazards	Risk control measures
			<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 before executing any maintenance activity. ❖ Develop and Follow SOP ❖ Competent and trained persons should only deploy to work on critical equipment. <p><i>Refer : SG-22 : Safety Guideline for Energy isolation</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 provide 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. ❖ 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-03 : Safety Guideline for Working in a Confined Space and SG-04 : Safety Guideline for Permit to Work(Operation & Maintenance)</i></p>
5		Hazard due to mechanical & Electrical Maintenance	<ul style="list-style-type: none"> ❖ All electrical equipment/ machines to be earthed properly. ❖ Use electrical PPEs ❖ Follow work permit and positive

SI.No	Area/Section	Hazards	Risk control measures
			<p>isolation procedure including all Energy source isolation (fluid energy, gas energy, electrical power etc.) before executing maintenance activity.</p> <ul style="list-style-type: none"> ❖ Competent and trained person should only perform the job on electrical equipment. ❖ Tested and calibrated machine tools, lifting tools and tackles should be used at site. ❖ All Tools and tackles should be checked before use. ❖ Scaffolding and safety harness to be used during work at height area. ❖ Mobile crane boom and overhead crane should not operate simultaneous on shop floor in close vicinity. ❖ Develop and Follow SOP. <p><i>Refer SG-04 : Safety Guideline for Permit to Work(Operation & Maintenance)</i></p>
HOT ROLLING MILL			
1	Rolling Mill	Moving Roller Table	<ul style="list-style-type: none"> ❖ Follow work permit and positive isolation procedure including all Energy source isolation (fluid energy, gas energy, electrical power etc.) ❖ No work to be done on roller table/walking beam conveyor in running condition. ❖ Local emergency switch with key arrangements to be operated for approaching roller table /walking beam Conveyor. ❖ Conveyor guards to be provided on moving conveyor area. ❖ Siren system prior to restarting walking beam conveyor/Roller table. ❖ Loose cloths prohibited. ❖ Area barricading if material is removed from height. ❖ Develop and Follow SOP. <p><i>(Refer SG-09 : Safety Guidelines in Equipment & machine Guarding)</i></p>
2		Rotating machineries	<ul style="list-style-type: none"> ❖ Coupling guards to be in place. ❖ Loose cloths to be prohibited.

SI.No	Area/Section	Hazards	Risk control measures
			<ul style="list-style-type: none"> ❖ Only Visual inspection from safe distance may allow in rotating machines. ❖ Moving equipment potential hazards should display near moving equipment. ❖ Develop and Follow SOP. <p><i>Refer SG-11 : Safety Guidelines for Barricading</i></p>
3		Working on Mill Stands	<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. ❖ Mill stop/Control Stop (Red and Green signal) light to be used. ❖ 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>
4		Roller Table Change	<ul style="list-style-type: none"> ❖ During Roll Change, Rolls to be cooled with water spray before work to avoid burn injury. ❖ Ensure safe distance of working personnel from suspended load /swing load. ❖ Follow work permit and positive isolation procedure including all Energy source isolation (fluid energy, electrical power etc.) before roll change activity. ❖ Cleanliness of area with respect to presence of oil, grease, jute and other inflammable materials before gas cutting/ welding job. ❖ Availability of fire hydrant to be ensured if job involves gas cutting etc. ❖ Display "Men at Work" board at Operator Control Panel. ❖ Place a plate on rollers table for smooth entry of personnel. ❖ Use required PPE when changing roll and after completion of jobs, ensure that men and materials are

SI.No	Area/Section	Hazards	Risk control measures
			<p>removed from site.</p> <ul style="list-style-type: none"> ❖ Ensure that "Job completion Report" is given in writing and then cancel "Power Shutdown," remove "Caution Tags" and give clearance for operation. ❖ Ensure Hooter/ warning signal to be used before taking trial /start the equipment. ❖ Develop and Follow SOP. <p><i>Refer SG-04 : Safety Guidelines for Permit to Work(Operation & Maintenance)</i></p>
5		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>
6		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 welded on both sides of crane on 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

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			<p>shutdown job completes.</p> <ul style="list-style-type: none"> ❖ Submit job completion report after repair. ❖ All the lifting tools and tackles to be checked every year as per statutory requirement. ❖ Develop and Follow SOP. <p><i>Refer SG-14 : Safety Guidelines for work on Electric Overhead Travelling (EOT) Crane</i></p>
7		<p>Moving machinery hazards</p> <ol style="list-style-type: none"> 1) Motors with belt/chain drives 2) Combustion blowers/Injector blowers 3) Grinding machines 4) Moving conveyors 	<ul style="list-style-type: none"> ❖ Provide guards on all the motors having belt/chain type transmission mechanism, grinding machines, blowers, moving walking beam conveyors etc. ❖ Smart fencing may implement 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/09 : Safety Guidelines for Equipment and Machinery guarding</i></p>
8		<p>Handling of Heavy loads (Mill gear box, Mill motors, Blowers, etc.)</p>	<ul style="list-style-type: none"> ❖ Use appropriate lifting tackles like chain pulley block, hoist etc. to lift heavy spares. ❖ Use forklift, mobile cranes, trailers to transport the materials from one place to other place. ❖ No job should perform under suspended load and maintain safe distance from mobile equipment. ❖ Guy rope should be used to restrict the swing of materials while handling with cranes. ❖ Develop and Follow SOP. <p><i>Refer SG-13 : Safety Guidelines for Material handling (manual and mechanized) & storage</i></p>

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9		Handling of Work Rolls and Back up Rolls	<ul style="list-style-type: none"> ❖ Audio visual hooter should activate in roll change car. ❖ Indicative barricading to be used to restrict the pedestrian movement during roll changing car movement. ❖ Ensure safe distance of working personnel from suspended load swing load while handing the rolls with EOT cranes. ❖ Display “Men at Work” board at Operator Control Panel. ❖ Develop and Follow SOP. <p>Refer SG-13 : Safety Guidelines for Material handling (manual and mechanized) & storage</p>
10		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>
11		Oil Cellar hazards	<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. ❖ Oil Cellar to be checked every day/week as per DM (Daily

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			<p>Management) checklist for leakages.</p> <ul style="list-style-type: none"> ❖ Flume tunnels /Scale pit area cleaning job executed as per schedule or during the shutdown. <p><i>Refer SG-16 : Safety Guidelines for Fire Safety</i></p>
12		<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 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.
13		Major Repair Job in Rolling Mill (Automatic)	<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 appropriate safety harness, scaffold to be ensured before executing the job at site. ❖ All portable electrical equipment,

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			<p>welding machines to be earthed effectively (body earthing). RCCB/ELCB to be checked in all welding machine before the usage.</p> <ul style="list-style-type: none"> ❖ 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 be 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 remove from the place where gas cutting/ welding jobs are to be carried out. ❖ 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.

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			<ul style="list-style-type: none"> ❖ Prior to actuation it must be ensured that no persons are in the active area of the dangerous energy (mechanical, electrical, hydraulic, pneumatic etc.). Only the hydraulic/pneumatic specialist is allowed to perform switching operations on hydraulic / pneumatic valves, provided the following conditions are fulfilled: ✓ 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. ❖ Develop and Follow SOP. <p><i>(Refer SG-13 : Safety Guideline for Material handling (manual and mechanized) & storage SG-02 : Safety Guideline for Working at Height)</i></p>
GENERAL			
1	General	General safety norms for Rolling Mills (Automatic)	<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, availability of fire hose/extinguishers.

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			<ul style="list-style-type: none"> ❖ 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 cleaning job executed as per schedule or during the shutdown. ❖ Proper loading / unloading procedure for raw materials/finished products to be prepared and followed. ❖ Ensure the availability of fire fighting equipment. ❖ Ensure proper illumination at shop floor and working area. ❖ Proper housekeeping to be done. ❖ Before restoration of power of the equipment, it is to be ensured that men, materials including tools and tackles, supports, scaffolding etc. are removed. <p><i>Refer SG-04 Safety Guidelines for Permit to Work(Operation & Maintenance) and SG-22 : Safety Guideline for Energy isolation)</i></p>
2		General safety norms for rolling mills (Automatic)	<ul style="list-style-type: none"> ❖ 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.

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			<ul style="list-style-type: none"> ✓ 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.
3		General safety norms for rolling mills (Automatic)	<ul style="list-style-type: none"> ❖ In addition to the signs listed above, the user of the equipment shall clearly and distinctly indicate and place signs for the following: <ul style="list-style-type: none"> ✓ Escape routes/emergency exits. ✓ First-aid stations. ✓ Places where stretchers are available. ✓ Emergency showers/eye washing facilities.
4		General safety norms for rolling mills (Automatic)	<ul style="list-style-type: none"> ❖ 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.