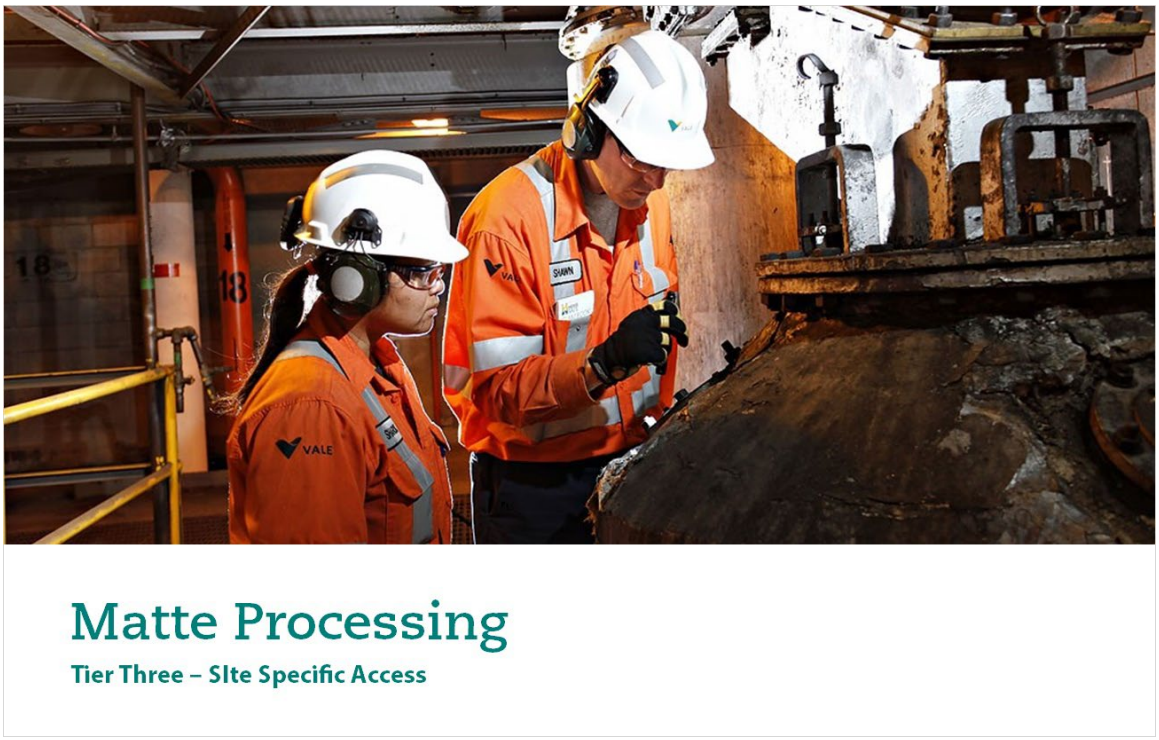
Tier 3: Matte Processing Orientation

1. Matte Processing

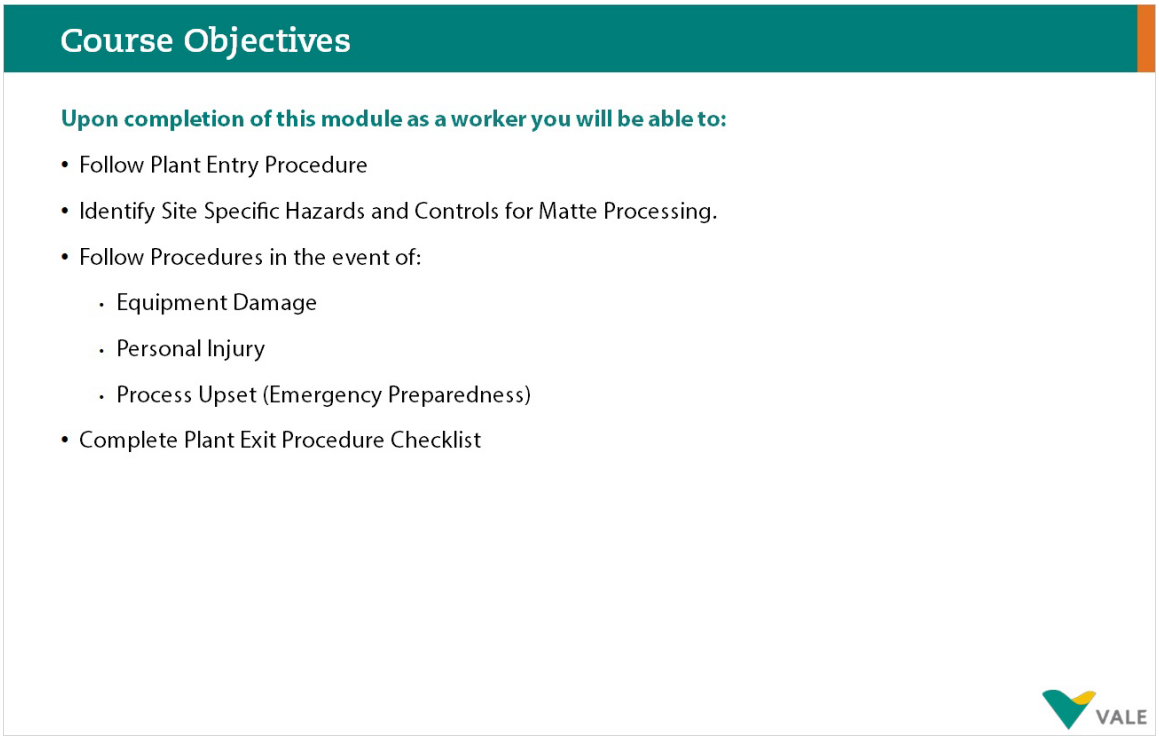
1.1 Matte Processing



Matte Processing

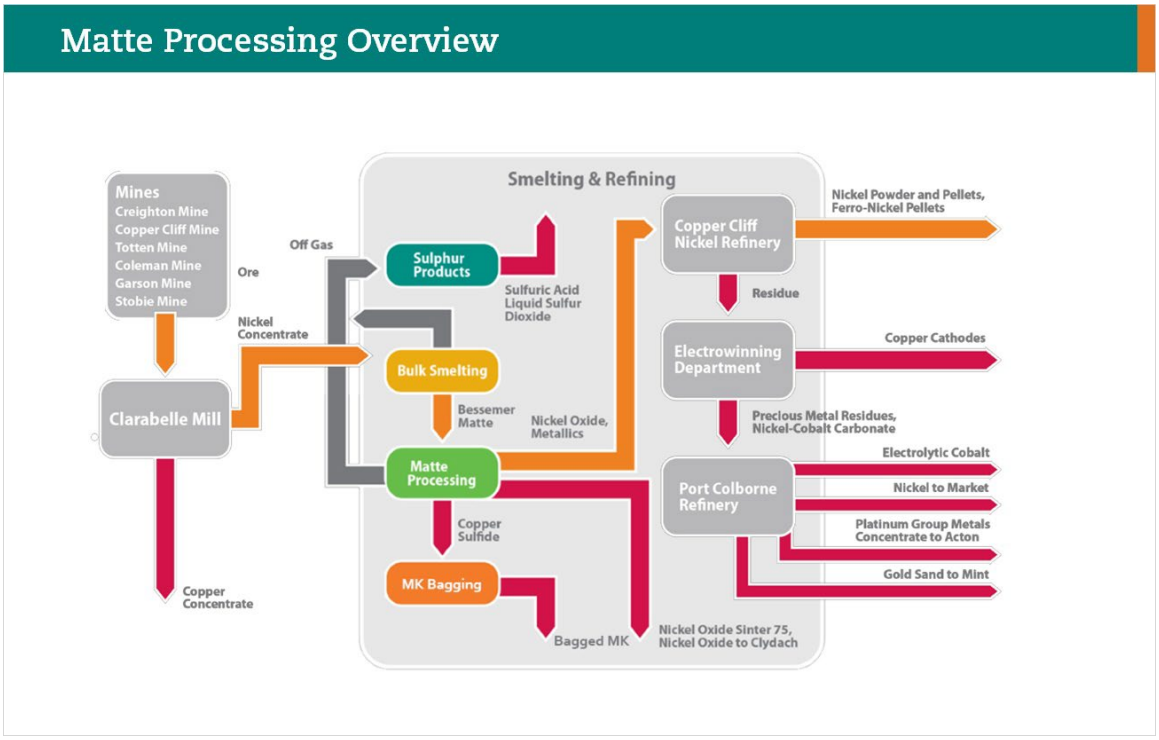
Tier Three – SIte Specific Access

1.2 Course Objectives



1.3 Quality Assurance

1.4 Matte Processing Overview



1.5 Matte Processing Overview

Matte Processing Overview

Matte Separation

Mills break down Matte into a fine slurry where Copper Sulphide (MK) is separated from Nickel Sulphide (ME, MR) and Magnetics (MYN).

(MK) is sent to the copper end for smelting; (ME and MR) are sent to the fluid bed roasters and (MYN) is shipped to CCNR.

1.6 Matte Processing Overview

Matte Processing Overview

Fluid Bed Roasting

Converts Nickel Sulphide from Separation (ME, MR) to Nickel Oxide in preparation for further refining at CCNR and Clydach, Wales or for direct sale to market.

1.7 Matte Processing Overview

Matte Processing Overview

Wet Gas Cleaning Plant

Processes the dirty SO_2 laden gas from the FBR prior to being sent to the Acid Plant for further processing.

Liquor produced from the gas cleaning process is pumped for further treatment and recovery at the Weak Acid Treatment Plant (WATP).

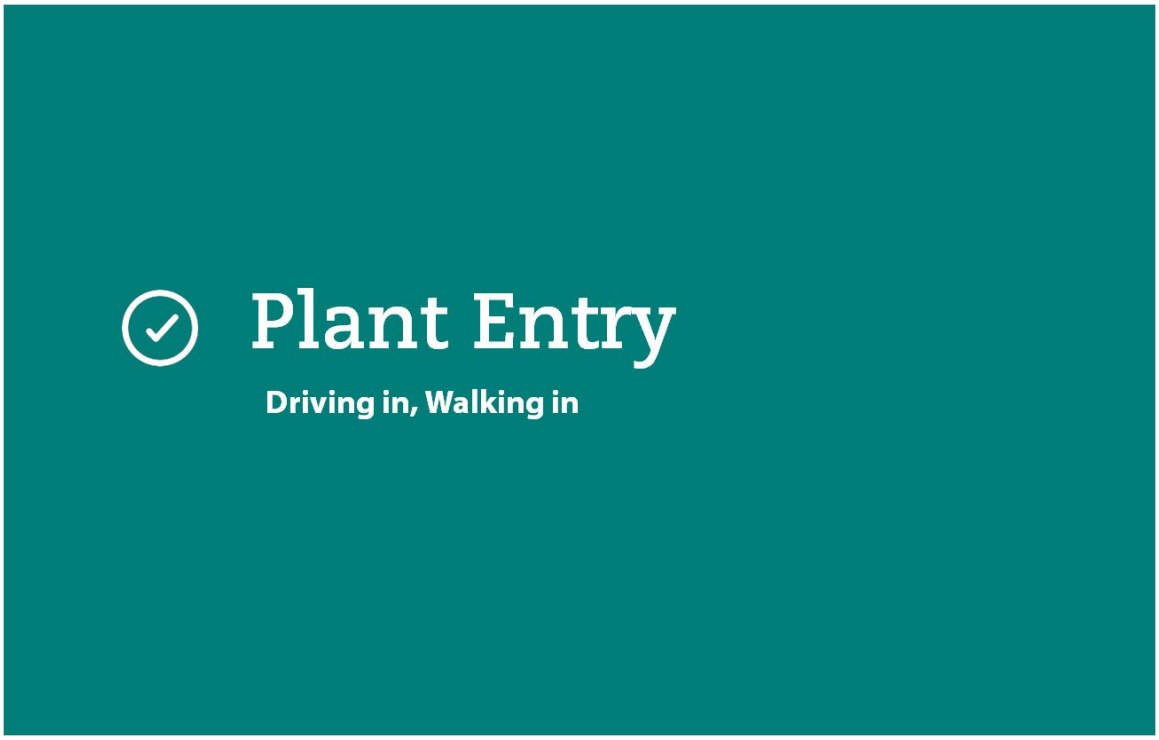
1.8 Matte Processing Overview

Matte Processing Overview

Shipping

Nickel Oxide is sent to bins in shipping and moved via conveyors into tankers or containers to the Copper Cliff Nickel Refinery, Clydach or market.

1.9 Quality Assurance



1.10 Approaching The Plant

Approaching the Plant

Matte Processing is located within the Copper Cliff Complex and is accessible from several different ways, most notably:

Yellow = From General Office direction

Orange = From Main Gate direction

The routes are single laned roadways with strict restrictions for passing any vehicles.

Be sure to follow general roadway rules.

1.11 Approaching The Plant

Approaching the Plant

Matte Processing Sign in Procedure

All contractors and visitors going to Matte Processing Plant must proceed to door 234A and sign in at the podium to access the following locations:

- Matte Separation
- Fluid Bed Roasting (FBR)
- Wet Gas Cleaning Plant (WGCP)
- Shipping

Front Entrance of the Office Complex

1.12 Approaching The Plant

Approaching the Plant

Matte Processing Sign in Procedure

All workers must be accounted for on the Matte Processing Sign-In Form by name.

You must call your contact person upon arrival.

All work on equipment within Matte Processing must be approved by a Vale Contact Person through the Work Permit Checklist.

If you are unable to reach your contact by phone call the FBR Control Room @ 6252

Matte Processing Sign-In/Out Procedure

Front Entrance of the Office Complex

2. Site Specific Hazards

2.1 Quality Assurance

2.2 Site Specific Hazards

Site Specific Hazards

Using the tools that you learned in Tier 1 Orientation, ensure you apply the necessary operation controls to mitigate risk associated with the identified hazards.

Be Aware
Be aware of your surroundings and the risks around you.

Follow Policies & Procedures
Our internal policies and procedures guide us in doing our work in a manner that reduces risk.

The following section lists identified hazards that may be encountered in the work you're doing. Knowing if these hazards apply to your work can be found through:

- Vale Contact Person
- PHA/PHR (or other Risk Assessment Tools)
- SLAM

2.3 Working with Nickel: Hazards

Working with Nickel: Hazards

Due to the arrangement of Matte Processing's operating areas, a table outlining the plant hazards is summarized before the individual areas are introduced.

As you can see from the table, nickel is a common part of this plant, therefore this section of the orientation will provide you a detailed segment on **Working with Nickel.**

Area	Matte Sep	FBR	WGCP	Shipping
Mobile Equipment	✓	✓	✓	✓
Crane Activity	✓			
Arsenic	✓	✓		
Lead	✓			
Silica	✓			
Sulphur Dioxide	✓			
Oxygen	✓			
Natural Gas	✓			
Process Dust	✓	✓	✓	✓
Nickel Subsulphide	✓	✓		
Nickel Oxides		✓	✓	✓
Nickel Carbonate		✓	✓	

2.4 Working with Nickel: Hazards

Working with Nickel: Hazards

Feed coming into Matte Processing contains significant amounts of Nickel.

Part of the feed is categorized as "Nickel Insoluble" and is the primary species throughout the Copper Cliff Complex.

There is also "Soluble Nickel" and "Nickel Sub-Sulphide" (a form of insoluble).

Soluble Nickel: Contains smaller particles that can be excreted through the body and do not accumulate. Soluble nickel is found in Separation and FBR.

Insoluble Nickel: Known to accumulate in tissue such as lungs, where, depending upon particle size, it may only slowly be absorbed over time. Insoluble nickel is found in FBR and Shipping.

2.5 Working with Nickel: Hazards

Working with Nickel: Hazards

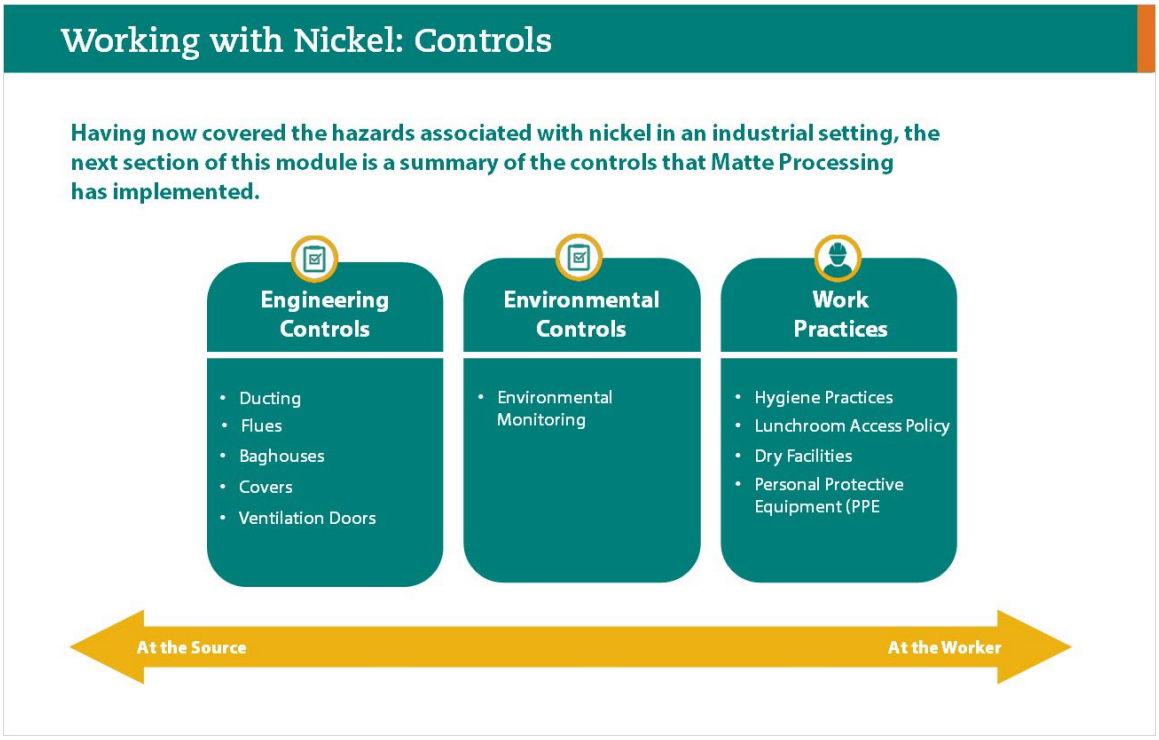
How does Nickel enter my body?

- Primary routes of entry are inhalation and ingestion.
- Skin absorption (very little absorbed through skin and into the bloodstream).

How can it affect me?

- Continuous exposure to nickel dust increases risk of long term lung damage and in past, has been associated with increased respiratory cancers.
- Allergic contact dermatitis or "nickel itch" can result after prolonged and direct contact.
- Reproductive toxicity (female effect- is pregnancy effects-baby developmental problems).

2.6 Working with Nickel: Controls



2.7 Working with Nickel: Controls

Working with Nickel: Controls

Engineering Controls

A number of engineered controls have been put in place to contain workplace contaminants, for example:

Cyclone Tub Cover

Column Cover

Disk Filter Cover

Feed Overflow Pipe

2.8 Working with Nickel: Controls

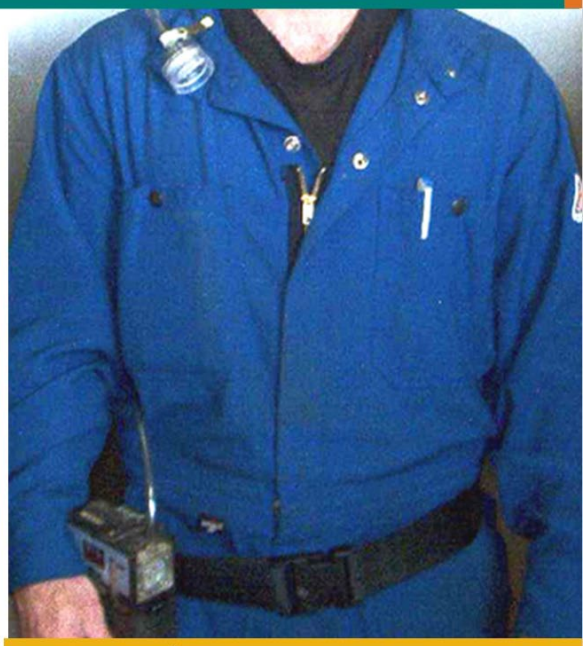
2.9 Working with Nickel: Controls

Working with Nickel: Controls

Environmental Monitoring

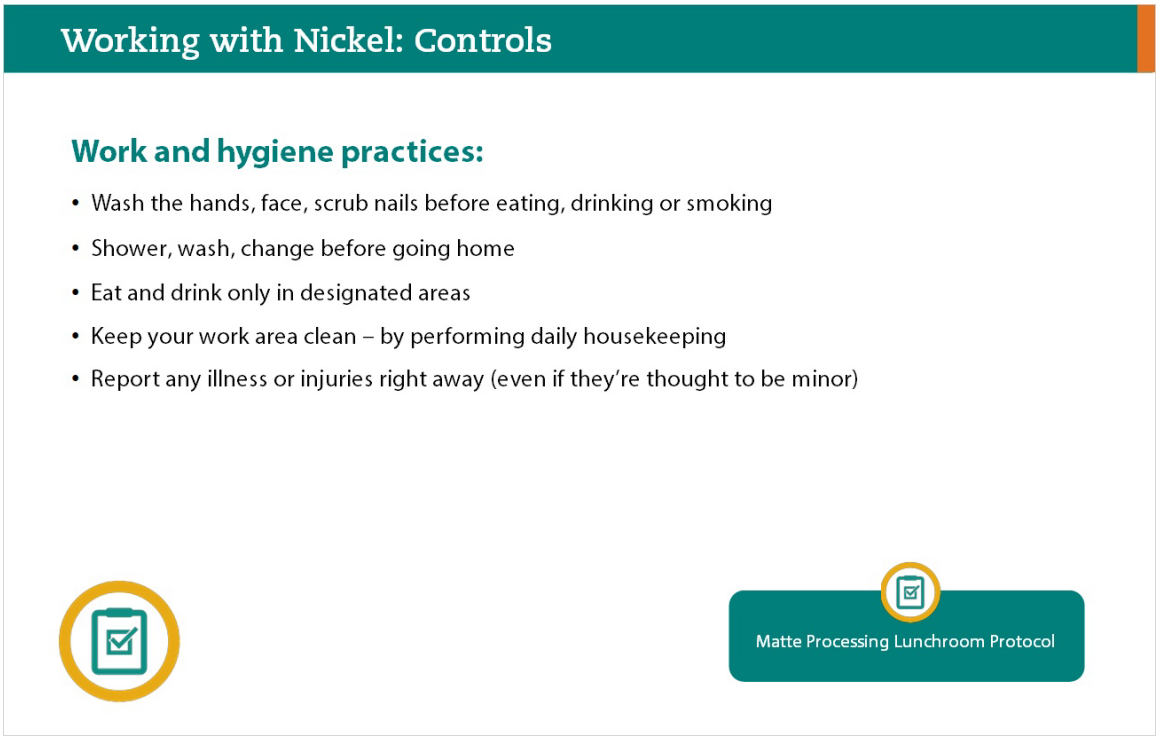
Air Sampling is done by a Senior Environmental Analyst. Personal Sampling (wearing a dust monitor) determines personal dust exposure.

Environmental Sampling determines dust levels in the work place. Results assist in identifying problem areas and implementing adequate controls.

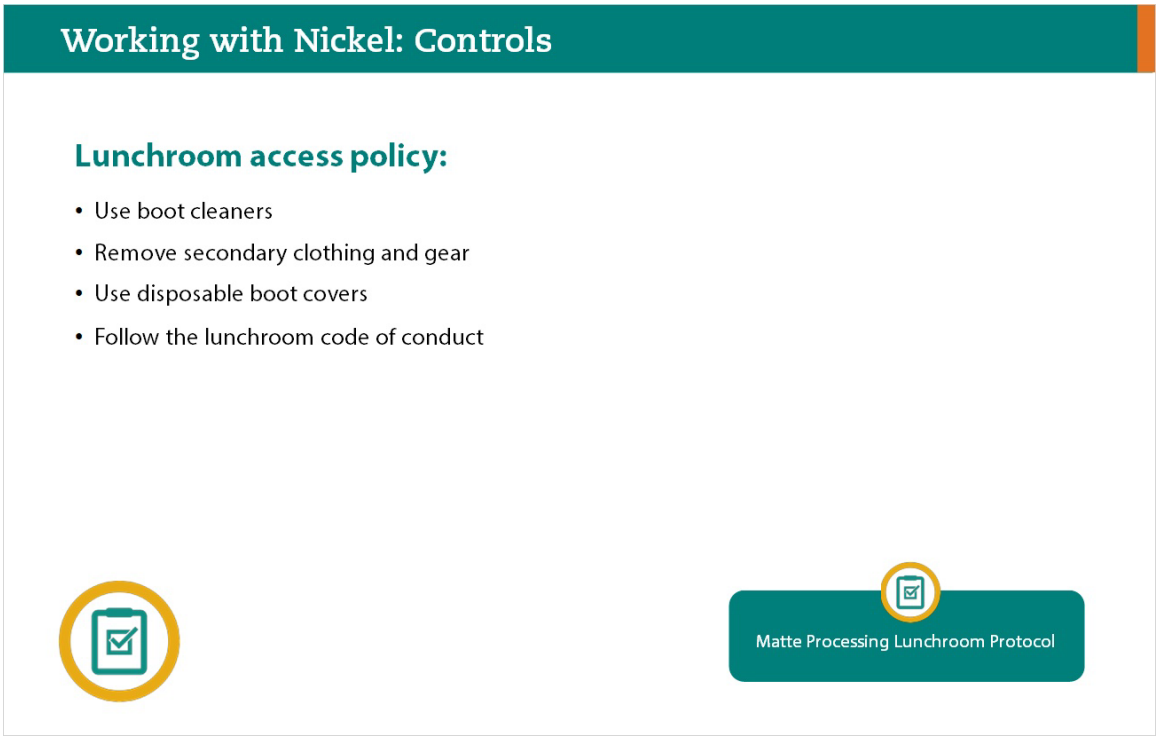


Worker Wearing a Dust Monitor

2.10 Working with Nickel: Controls



2.11 Working with Nickel: Controls



2.12 Working with Nickel: Controls

Working with Nickel: Controls

Matte Processing Respirator Policy

In order to protect workers from residual dust concentrations, adhere to the Mandatory Respirator Dust Policy which stipulates:

All employees, contractors, or visitors entering Matte Processing's process areas (except Shipping main floor) shall don at a minimum, an approved ½ face respirator with combination particulate and gas cartridge.

Matte Processing Respirator Protocol

2.13 Working with Nickel: Controls

2.14 Working with Nickel: Controls

3. Matte Separation Area Hazards and Controls

3.1 Quality Assurance

3.2 Site Specific Hazards

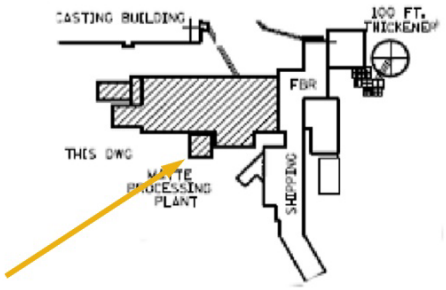
Sign-in Procedure

DCS Control Room

Workers entering Matte Separation have already signed in at door 234A but are still required to inform the Matte Separation Supervisor that they are doing work in the area. The contact Number is #6839.

Workers would need to contact the Supervisor for the following reasons:

- Obtain work permits
- When access to equipment is necessary
- Obtain Hot Work Permits
- Whenever workers require access to the Matte Processing Hoistwell



Inform your Vale contact person when you are on site so that you may start your job. And If you are unfamiliar with the area, arrange for a site tour with a contact familiar with the site.

3.3 Site Specific Hazards

Site Specific Hazards

The Matte Separation area has workplace specific hazards that have been identified and need to be controlled.

These include but are not limited to:

- Reagents
  - DPG
- Rotating Equipment
- Overhead Crane
- Spilled Material
- Magnetic Separators
- Radiation
- Pinch Points

Communicate with your Vale contact person concerning the procedures pertaining to designated substances, product locations, and process hazards in your work area.

* Separate training is required for handling working with designated substances.

3.4 Reagents (General): Hazard

Reagents (General): Hazard

Reagents are compounds or mixtures that are added to process to cause chemical reactions.

Some of these reactions create additional hazards due to the reaction.

The following reagents are *some* of the ones used in Matte Processing's floatation process:

Diphenyl Guanidine (DPG): coats the particles of copper to make them float better during the floatation part of the process.

Lime: Provides pH control. This product is caustic, upwards of pH12

Flocculant (Magnafloc 338): Used to modify the density of liquids

3.5 Reagents (DPG): Hazard

Reagents (DPG): Hazard

DPG is combined with acetic acid and due to its prevalence in Matte Separation has some additional hazards that workers should be aware of while working in this area.

These include:

- Chemical burns
  - May cause blindness
  - If swallowed, chemical burns to mouth, throat and stomach
  - Prolonged or repeated exposure can cause dry skin and dermatitis
- Respiratory tract irritation
- Possible reproductive effects

3.6 Reagents (All): Control

Reagents (All): Control

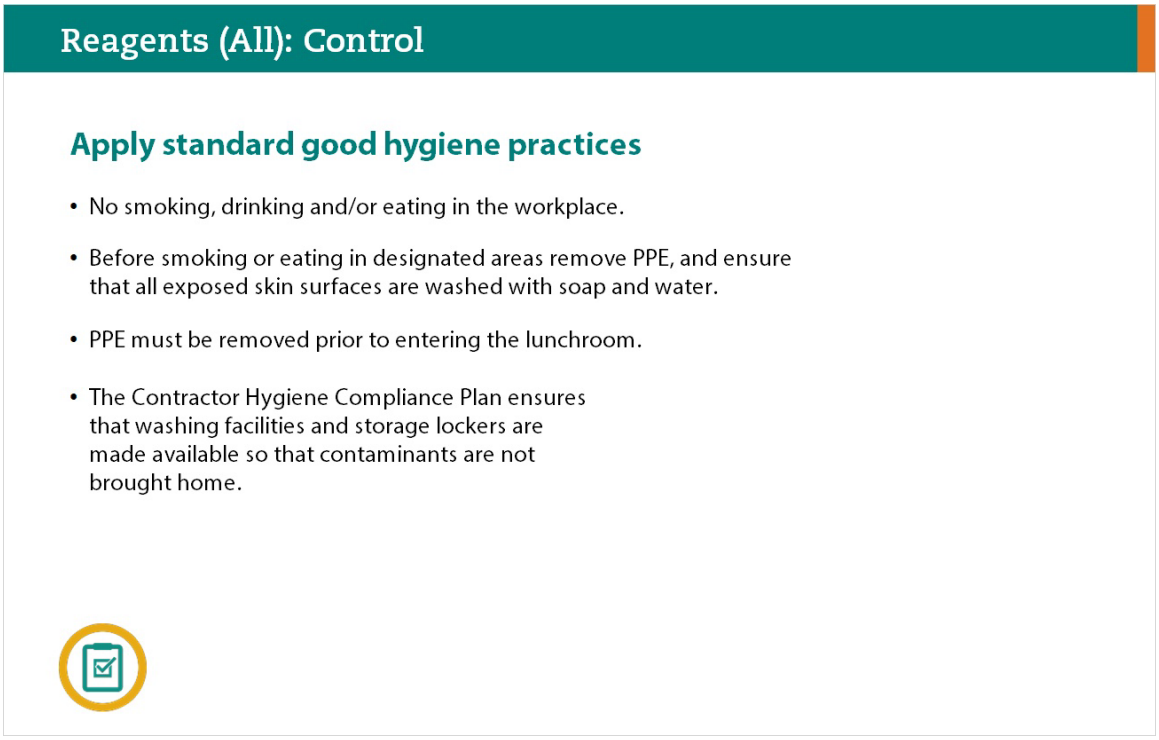
For the most part, workers will not come into direct contact with reagents at Matte Processing however the following are good work practices that will help mitigate any exposures to reagents in the Matte Processing operating areas:

***Standard PPE requirements* apply and in addition:**

- Neoprene rubber where prescribed
- Confirm with a reputable supplier for their chemical compatibility to DPG.
- Matte Processing Respirator Policy
- Chemical goggles/faceshields in accordance with procedures

If exposed to reagents, follow emergency eyewash and shower procedures.

3.7 Reagents (All): Control



3.8 Rotating Equipment: Hazard

Rotating Equipment: Hazard

The purpose of the Matte Separation area is to separate Bessemer matte received from the Smelter Casting Building then separate copper, nickel and magnetic fractions into a suitable form for direct sale or for further processing.

The Mill Floor of Matte Separation houses several rod mills, ball mills that rotate at a high rate of speed.

The hazards that relate to this equipment are:

- The possibility of entanglement in rotating equipment
- Exposure to noise and vibration

3.9 Rotating Equipment: Control

Rotating Equipment: Control

To maintain the safety of employees working around rotating equipment, the following controls need to be adhered to:

- Ensure that guarding is in place
- Interlocks and shutdown devices
- Local and remote stop stations
- Report any leaks, vibrations or abnormal noise to an operator
- Designated walk areas
- Installation of sound boxes
- Lubrication and maintenance programs are maintained

3.10 Overhead Crane: Hazard

Overhead Crane: Hazard

Cranes are used to facilitate the movement of materials throughout Matte Separation.

Hazards associated with crane movement include:

- Suspended loads
- Contact with stationary equipment

3.11 Overhead Crane: Control

Overhead Crane: Control

To maintain the safety of employees working around cranes the following controls are in place:

- The mill aisle is equipped with several red flashing lights to indicate crane activity. If lights are activated in a particular area, beware of crane activity and the possibility of overhead loads.
- Locate and be aware of the crane's position and status prior to entering the aisle.
- Do not walk under a suspended load.

Listen and watch for crane travel before crossing any part of the Separation Mill Aisle

3.12 Spilled Material: Hazard

Spilled Material: Hazard

Matte Separation's process includes the use of water and slurries. In the case of equipment or process failure there is the potential for material and/or water to be present in work areas.

Causes may include:

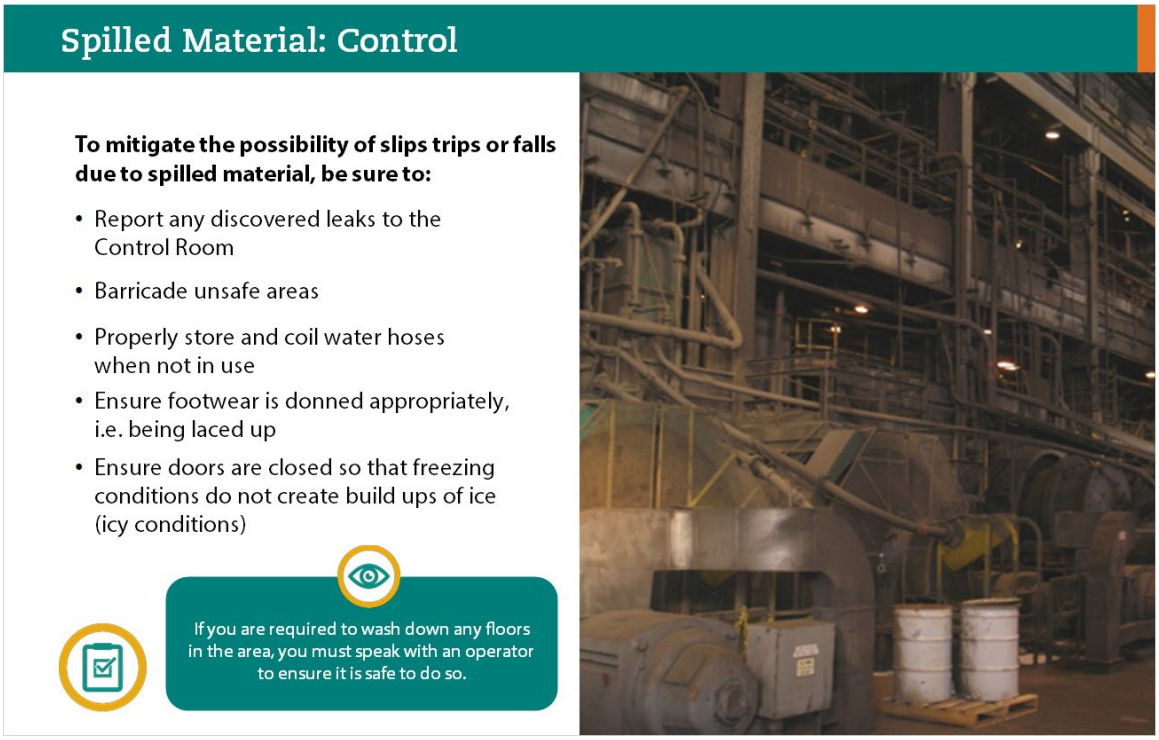
- Obstructed feed lines into mills or other equipment
- Overloaded system due to excessive feed rates
- Cleanup water from hoses

The most significant hazard that exists is slips and falls due to slippery conditions or uneven walkways.

To keep welding machines from getting damaged, keep wheels/carts off the floor to avoid the possibility of coming into contact with water from a flood or spill.

Welding machines must be turned off at end of shift.

3.13 Spilled Material: Control



3.14 Magnetic Separator: Hazard

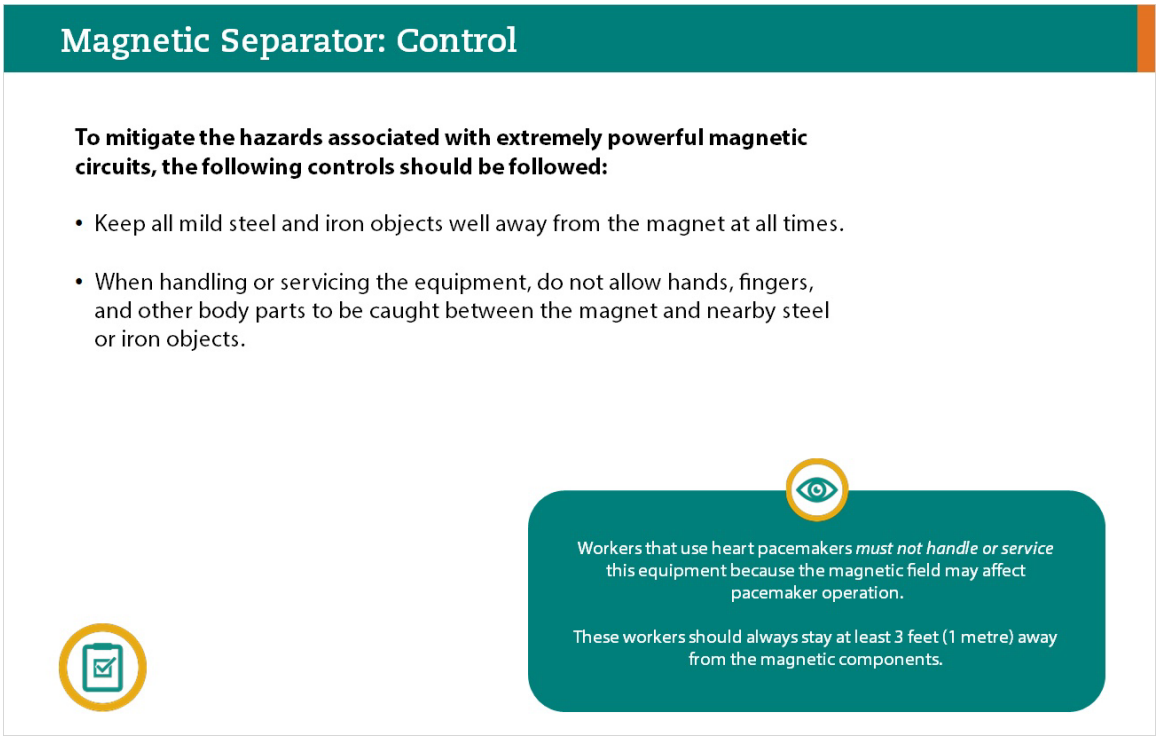
Magnetic Separator: Hazard

Matte Processing uses magnetic separators for part of it's process to pull magnetic particles from the feed. The magnets associated with this equipment have the following hazards:

- Extremely powerful magnetic circuits will strongly attract steel and iron tools which may jump suddenly and unexpectedly.
- Workers that use heart pacemakers must not handle or service this equipment as the magnetic field may affect pacemaker operation.

The magnetic separators are located on the 2nd floor and 4th floors of Matte Separation

3.15 Magnetic Separator: Control



3.16 Radiation: Hazard & Control

Radiation: Hazard & Control

There are density gauges used in the plant that may contain radioactive materials.

Density gauges that pose the danger of radiation are labeled throughout the plant.

If a radiation emitting device appears damaged, notify your plant contact immediately.

In the event of physical damage to the radioactive device, a 15 ft. radius area will be secured.

If a vehicle is involved, remain stopped until the extent of contamination hazard is determined.

3.17 Pinch Points: Hazard & Controls

Pinch Points: Hazard & Controls

Valves on pumping systems sometimes have pinch point around the valve, which in some cases can be automatic or remotely opened and closed.

Ensure all guarding around valves is kept in place.

Do not start or stop a pump if you are not authorized.

Pump box covers must be replaced if removed.

Lock and Tagging includes electrical source and process piping.

4. Fluid Bed Roasting

4.1 Quality Assurance

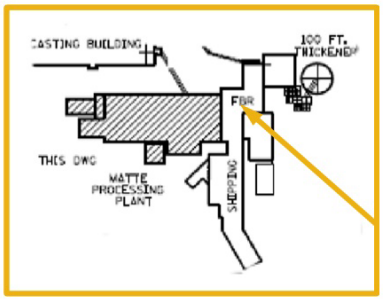
4.2 Site Specific Hazards

Sign-in Procedure

DCS Control Room

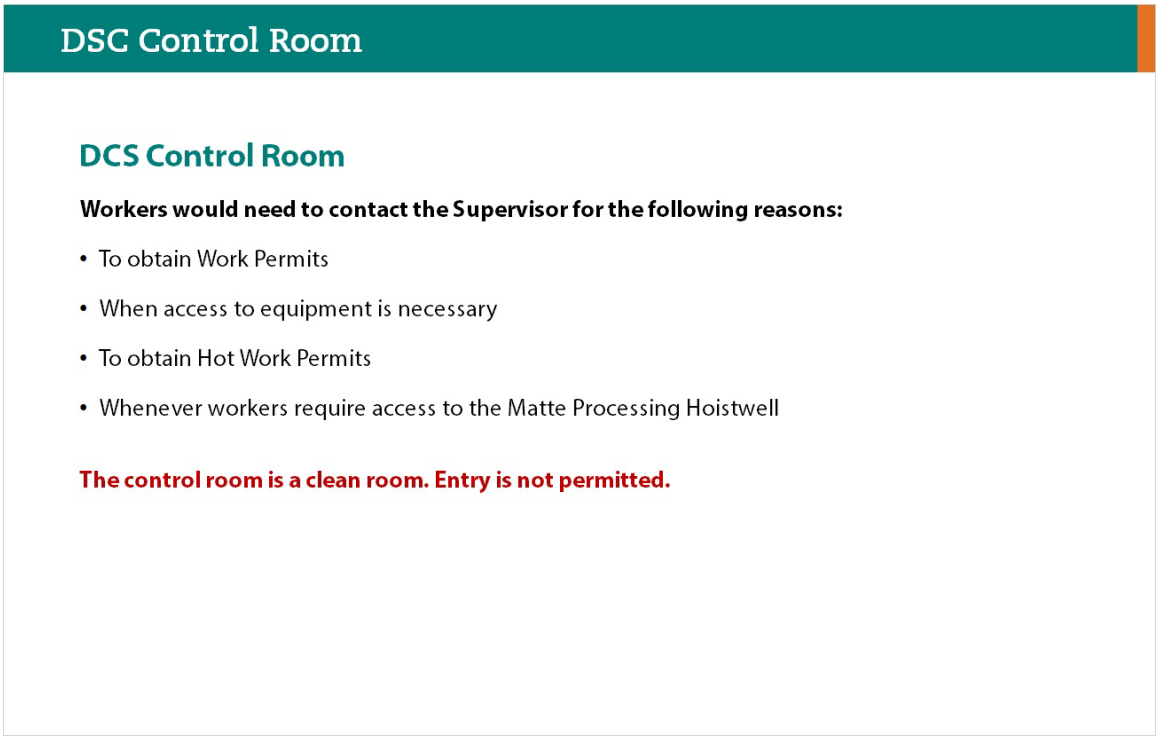
Workers entering the Fluid Bed Roasting (FBR) area have already signed in at door 234A but they are still required to inform the FBR Control Room Operator that they are doing work in the area.

The location of this Control Room is on the 4th floor, on the west side of the building, directly beside the freight elevator.



Matte Processing sign in at door 243A

4.3 Site Specific Hazards



4.4 Site Specific Hazards

Site Specific Hazards

The Fluid Bed Roasting (FBR) area has workplace specific hazards that have been identified and need to be controlled.

These include but are not limited to:

- SO_2
- Hot equipment / Calcine (Nickel Oxide)
- Asbestos
- Electrostatic Precipitator (ESP)
- Mobile Equipment – forklift traffic - totes

Communicate with your Vale contact person concerning the procedures pertaining to designated substances, product locations, and process hazards in your work area.

* Separate training is required for handling working with designated substances.

4.5 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

A by-product of the smelting process is the creation of Sulphur Dioxide, a colourless gas with a sharp, pungent, suffocating or choking odor.

- SO_2 is soluble in water. In water, Sulphur Dioxide is converted to sulfurous acid; this acid is what causes irritation of the nose and throat, rhinorrhea, choking, cough and in some instances reflex bronchoconstriction with increased pulmonary resistance.

For concentrations between 10-20ppm the following symptoms typically occur:

- Inhaled SO_2 is only slowly removed from the respiratory tract. After absorption in the blood stream, the sulfurous acid is widely distributed throughout the body, quickly converted to sulfite and bisulfite, which in turn is oxidized to sulfate and excreted in the urine.

4.6 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

Individuals with asthma can be much more susceptible to the respiratory effects of sulfur dioxide (SO_2).

The **TWA** or "time-weighted average limit" for SO_2 to which a worker may be exposed in a work day or work week is:

- **TWA** (8 hour shift) = 2 ppm
- **TWA** (10 hour shift) = 1.6 ppm
- **TWA** (12 hour shift) = 1.33 ppm

STEL" or "short-term exposure limit" means the maximum airborne concentration of SO_2 to which a worker may be exposed in any 15-minute period.

STEL (15 min) = 5 ppm

4.7 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

Long Term Health effects

- NIOSH has recognized the phenomenon that adaptation to irritating concentrations of SO_2 occurs in experienced workers. Other studies have shown that acclimatization to the subjective effects of SO_2 does occur. This will result in detection and recognition in the upper concentration ranges outlined previously.
- Long-term occupational exposure to sulfur dioxide has been associated with respiratory effects such as decreased pulmonary function and an increased incidence of chronic bronchitis. However, the information located is not sufficient to draw firm conclusions (CCOHS).
- **Sulfur dioxide is not known as a respiratory sensitizer. However, in some cases workers have developed asthma following short or long-term exposure to sulfur dioxide. This effect is most likely due to airway hypersensitivity caused by severe irritation of the respiratory tract, which occurs following "gassing".**

4.8 Sulfur Dioxide (SO2): Hazard

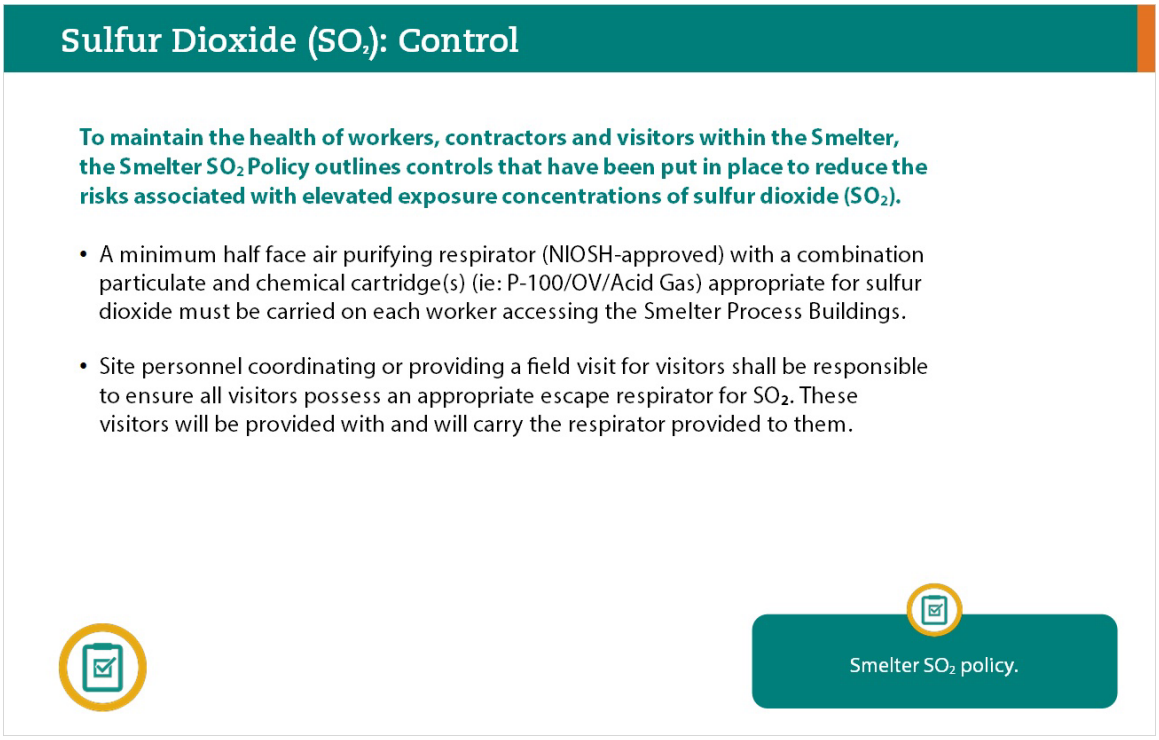
Sulfur Dioxide (SO_2): Hazard

Long Term Health effects

- **Sulfur dioxide is not known to be a human carcinogen. Several human population studies have examined the possibility that sulfur dioxide may cause cancers such as lung cancer, stomach cancer or brain tumours. In all of the studies, there were uncontrolled compounding factors, such as concurrent exposure to other chemicals.**

- The International Agency for Cancer (IARC) has reviewed these studies and concluded there is inadequate evidence for carcinogenicity in humans. There is limited evidence of carcinogenicity in animals.

4.9 Sulfur Dioxide (SO2): Control



4.10 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

Users Shall:

- Wear the appropriate respirator when required.
- Use respirator in accordance with instructions and training received.
- Check that the respirator is in good operating condition.
- Fit-check the face to facepiece seal immediately after donning.
- Take all precautions to prevent damage to the respirator and report any malfunction or damage to your supervisor.
- Clean the respirator after each use.
- Be clean-shaven where the facepiece seals to the skin.

4.11 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

If you encounter the smell or taste of $S0_2$ (0.33 to 5ppm):

- Don your half face respirator and continue with your task.

If you experience respiratory irritation and/or burning of the eyes (estimated concentration to be in the range of 10 – 20 ppm:

- Don your respirator (if it has not already been donned), ensure equipment and/or process is safe, immediately exit the area and report the occurrence to the supervisor and/or nearest control room.
- **Plant Supervision** will investigate the area wearing the proper respiratory protection and measure the $S0_2$ concentration to identify the source of emission and establish a plan of action to correct the problem and reduce SO_2 concentrations.

4.12 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

At 100ppm, the condition of $S0_2$ is considered IDLH to be an (Immediate danger to life and health) and an SCBA must be worn. Fit testing and training are required to use an SCBA.

In the case of sulfur dioxide related adverse health effects, workers shall notify their supervisor and report to first aid for evaluation.

An incident report form needs to be created as per the established process.

4.13 Hot Equipment – Calcine (Nickel Oxide): Hazard

Hot Equipment – Calcine (Nickel Oxide): Hazard

During the FBR process, the fluid bed roasters generate heat and a hot nickel dust called Calcine.

The dust is associated with various steps of the operation in airlifts, screw conveyors, hoppers and totes.

The hazards associated with hot equipment and Calcine are:

- Will burn or set fire to clothing
- Spilled calcine on floors makes the area slippery; introducing the risk of slips and falls.

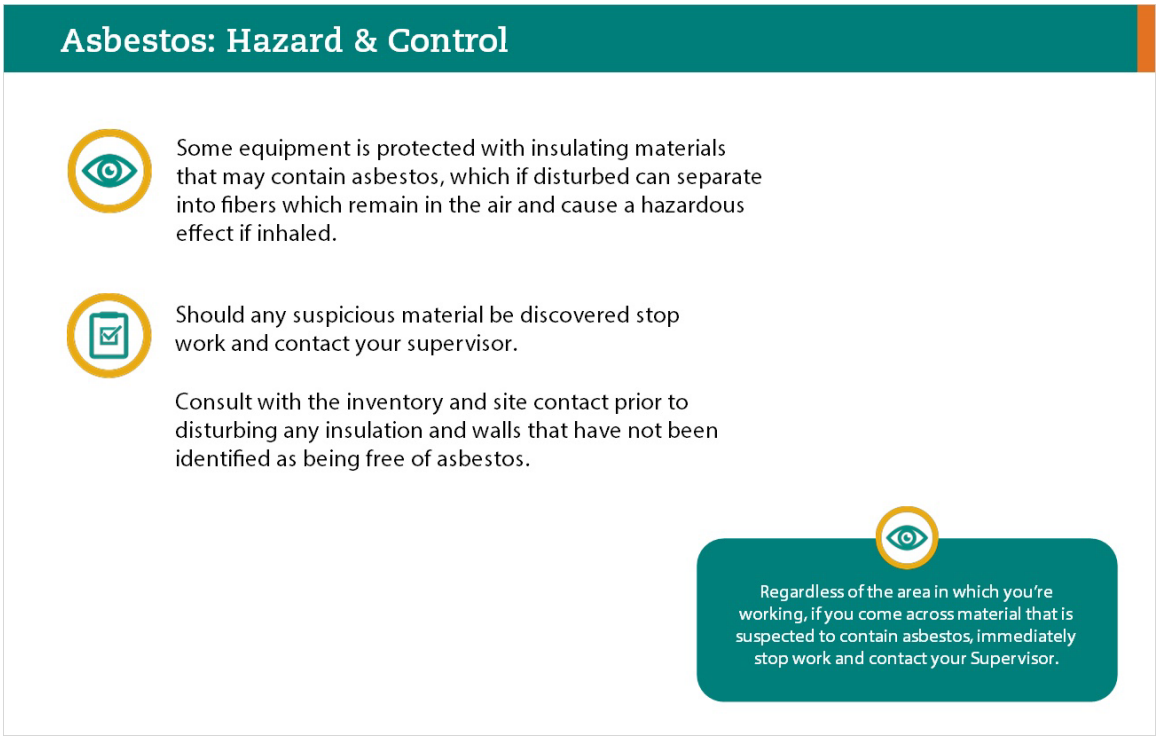
4.14 Hot Equipment – Calcine (Nickel Oxide): Control

Hot Equipment – Calcine (Nickel Oxide): Control

To mitigate the hazards associated with hot equipment and calcine, the following controls are implemented:

- Totes containing hot dust are marked "Hot Metal"
- Because Calcine is collected in various steps of the operation, always treat pipes, screw conveyors and hoppers as hot
- Do not touch equipment or equipment containing calcine without proper PPE

4.15 Asbestos: Hazard & Control



4.16 ESP (Electrostatic Precipitator): Hazard & Control

ESP (Electrostatic Precipitator): Hazard & Control

In the FBR area, an electrostatic precipitator (ESP), sometimes referred to as "#3/4 Cottrell" is used to remove particulates from SO_2 gas before it is sent for further processing.

The ESP operation involves high voltages which can be hazardous to workers with existing medical conditions.

Additionally, ESP dust is acidic in the presence of moisture.

Only Authorized Personnel can access the gated area around the ESPs. If access is required, the FBR control room operator must be notified and will provide the authorization.

5. Wet Gas Cleaning Plant

5.1 Quality Assurance

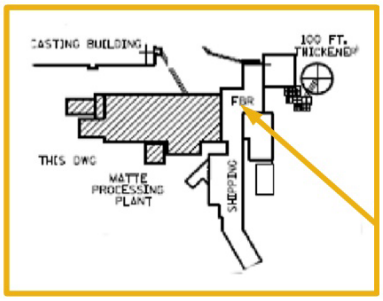
5.2 Site Specific Hazards

Sign-in Procedure

DCS Control Room

Workers entering the Wet Gas Cleaning Plant (WGCP) area have already signed in at door 234a but are still required to inform the FBR Control Room Supervisor that they are doing work in the area.

The location of this Control Room is on the 4th floor, on the west side of the building, directly beside the freight elevator.



Matte Processing sign in at door 243A

5.3 Site Specific Hazards

Sign-in Procedure

Restricted Access

Access may only be granted by contacting the **FBR Control Room Operator**.

Vale personnel must have WGCP orientation or be accompanied by person having WGCP orientation in order to gain access.

Do not take any shortcuts through buildings in WGCP to gain access to the FBR.

You must have authorization to enter the WGTP.

5.4 Site Specific Hazards

Site Specific Hazards

The Wet Gas Cleaning Plant (WGCP) has workplace specific hazards that have been identified and need to be controlled.

These include but are not limited to:

- SO_2
- Sulphuric Acid (weak acid)
- Arsenic and Arsenic Sludge
- Wet Electrostatic Precipitator (ESP)

Communicate with your Vale contact person concerning the procedures pertaining to designated substances, product locations, and process hazards in your work area.

* Separate training is required for handling working with designated substances.

5.5 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

The purpose of the WGCP is to capture and clean solid particulate from the off gases from the FBR.

This allows for a clean stream of SO_2 to be supplied to the acid plant and prevent emissions from the FBR through the Superstack to the environment.

As a result of this process, workers can be exposed to Sulphur Dioxide, a colourless, gas with a sharp, pungent, suffocating or choking odor.

5.6 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

A by-product of the smelting process is the creation of Sulphur Dioxide, a colourless gas with a sharp, pungent, suffocating or choking odor.

- SO_2 is soluble in water. In water, Sulphur Dioxide is converted to sulfurous acid; this acid is what causes irritation of the nose and throat, rhinorrhea, choking, cough and in some instances reflex bronchoconstriction with increased pulmonary resistance.

For concentrations between 10-20ppm the following symptoms typically occur:

- Inhaled SO_2 is only slowly removed from the respiratory tract. After absorption in the blood stream, the sulfurous acid is widely distributed throughout the body, quickly converted to sulfite and bisulfite, which in turn is oxidized to sulfate and excreted in the urine.

5.7 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

Individuals with asthma can be much more susceptible to the respiratory effects of sulfur dioxide (SO_2).

The **TWA** or "time-weighted average limit" for SO_2 to which a worker may be exposed in a work day or work week is:

- **TWA** (8 hour shift) = 2 ppm
- **TWA** (10 hour shift) = 1.6 ppm
- **TWA** (12 hour shift) = 1.33 ppm

STEL" or "short-term exposure limit" means the maximum airborne concentration of SO_2 to which a worker may be exposed in any 15-minute period.

STEL (15 min) = 5 ppm

5.8 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

Long Term Health effects

- NIOSH has recognized the phenomenon that adaptation to irritating concentrations of SO_2 occurs in experienced workers. Other studies have shown that acclimatization to the subjective effects of SO_2 does occur. This will result in detection and recognition in the upper concentration ranges outlined previously.
- Long-term occupational exposure to sulfur dioxide has been associated with respiratory effects such as decreased pulmonary function and an increased incidence of chronic bronchitis. However, the information located is not sufficient to draw firm conclusions (CCOHS).
- **Sulfur dioxide is not known as a respiratory sensitizer. However, in some cases workers have developed asthma following short or long-term exposure to sulfur dioxide. This effect is most likely due to airway hypersensitivity caused by severe irritation of the respiratory tract, which occurs following "gassing".**

5.9 Sulfur Dioxide (SO2): Hazard

Sulfur Dioxide (SO_2): Hazard

Long Term Health effects

- **Sulfur dioxide is not known to be a human carcinogen. Several human population studies have examined the possibility that sulfur dioxide may cause cancers such as lung cancer, stomach cancer or brain tumours. In all of the studies, there were uncontrolled compounding factors, such as concurrent exposure to other chemicals.**

- The International Agency for Cancer (IARC) has reviewed these studies and concluded there is inadequate evidence for carcinogenicity in humans. There is limited evidence of carcinogenicity in animals.

5.10 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

To maintain the health of workers and contractors within the WGCP, controls have been put in place to reduce the risks associated with elevated exposure concentrations of sulfur dioxide (SO_2).

Engineered Control: The Wet Gas Cleaning Plant is equipped with SO_2 monitors that alarm at 5 ppm. An orange light indicates the presence of SO_2 and alarms in the Control Room. If the monitors are alarming, avoid entering the plant or don your respirator and exit the plant immediately.

5.11 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

Respiratory Protection Program

A minimum half face air purifying respirator (NIOSH-approved) with a combination particulate and chemical cartridge(s) (ie: P-100/OV/Acid Gas) appropriate for sulfur dioxide must be carried on each worker accessing the WGCP.

5.12 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

Users Shall:

- Wear the appropriate respirator when required.
- Use respirator in accordance with instructions and training received.
- Check that the respirator is in good operating condition.
- Fit-check the face to facepiece seal immediately after donning.
- Take all precautions to prevent damage to the respirator and report any malfunction or damage to your supervisor.
- Clean the respirator after each use.
- Be clean-shaven where the facepiece seals to the skin.

5.13 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

If you encounter the smell or taste of $S0_2$ (0.33 to 5ppm):

- Don your half face respirator and continue with your task.

If you experience respiratory irritation and/or burning of the eyes (estimated concentration to be in the range of 10 – 20 ppm:

- Don your respirator (if it has not already been donned), ensure equipment and/or process is safe, immediately exit the area and report the occurrence to the supervisor and/or nearest control room.
- **Plant Supervision** will investigate the area wearing the proper respiratory protection and measure the $S0_2$ concentration to identify the source of emission and establish a plan of action to correct the problem and reduce SO_2 concentrations.

5.14 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

At 100ppm, the condition of $S0_2$ is considered IDLH to be an (Immediate danger to life and health) and an SCBA must be worn. Fit testing and training are required to use an SCBA.

In the case of sulfur dioxide related adverse health effects, workers shall notify their supervisor and report to first aid for evaluation.

An incident report form needs to be created as per the established process.

5.15 Sulfur Dioxide (SO2): Control

Sulfur Dioxide (SO_2): Control

If you encounter the smell or taste of SO_2 (0.33 to 5ppm):

- All air purifying chemical cartridges used within the WGCP for protection against sulfur dioxide (SO_2) shall be changed annually, based on a calculated service life for 3M and MSA cartridges.
- North respiratory protection does not meet the necessary service life hours in comparison to 3M and MSA. Therefore, it is recommended that North manufactured respirators and chemical cartridges should not be used for Vale's application at the Smelter.
- In the case of breakthrough (i.e. an worker can taste or smell SO_2 or feels irritation), the worker shall immediately exit the work area, dispose of their current cartridge and replace with a new cartridge.

5.16 Sulphuric Acid (weak acid): Hazard

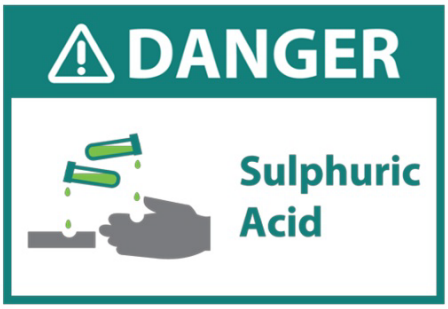
Sulphuric Acid (weak acid): Hazard

The products of the WGCP area are a cleaned gas, approx. 4-6% SO_2 gas concentration and a weak acid that contains all impurities cleaned from the gas coming into the plant.

The cleaned gas and weak acid are then sent to the Acid Plant and Weak Acid Treatment Plant for further treatment.

Hazards associated with sulphuric acid contact include:

- Exposure to skin can cause chemical burns if left untreated.
- Brief skin contact with the acid will result in an itching sensation.
- Prolonged skin contact will result in redness, deep irritation and eventual ulceration of the skin if not properly treated.



5.17 Sulphuric Acid (weak acid): Control

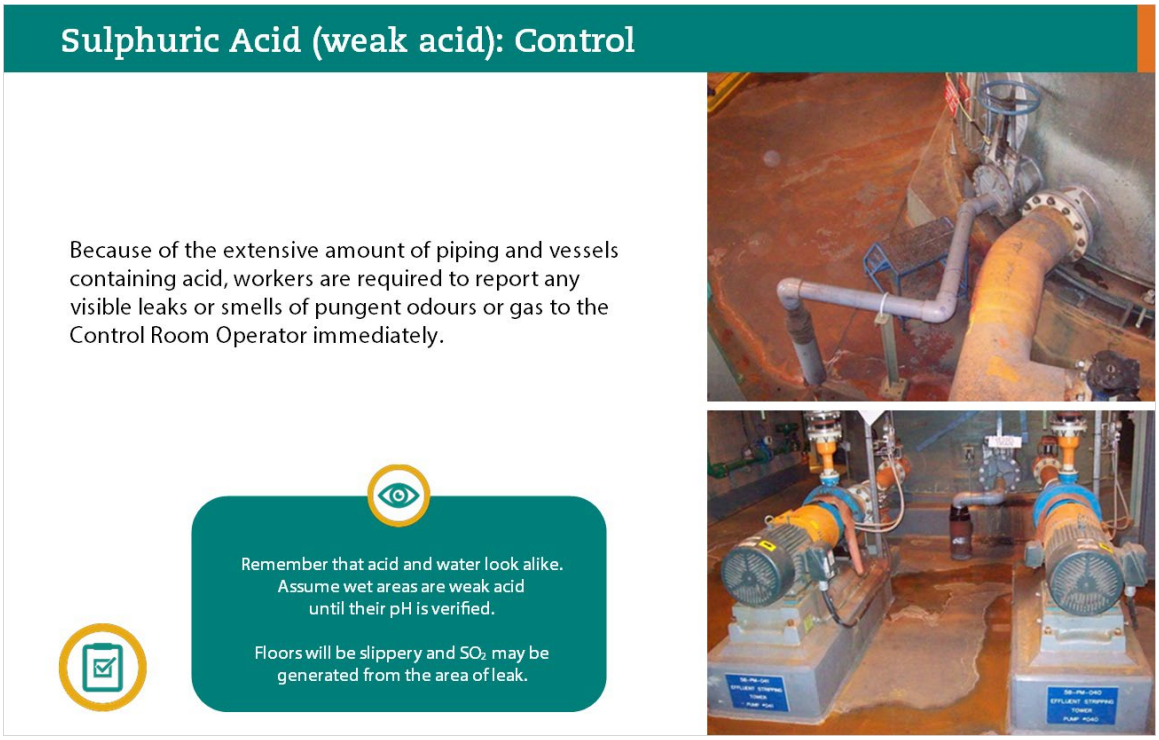
Sulphuric Acid (weak acid): Control

Weak acid is contained within pipes but workers still have the potential to be exposed.

To mitigate the risk of exposure:

- Lines are labeled throughout the plant.
- Workers must wear rubber gloves when working on anything that contains weak acid.
- If exposed to acid on skin or in the eyes:
  - Use eyewash station and emergency showers
  - Immediately and thoroughly flush with large quantities of clean water for 20 minutes
  - Report to Supervisor and First Aid.

5.18 Sulphuric Acid (weak acid): Control



5.19 Arsenic and Arsenic Sludge: Hazard

Arsenic and Arsenic Sludge: Hazard

Arsenic is collected in the scrubbing and cooling system, removed and treated via the Effluent Treatment plant.

Arsenic oxide (As_2O_3), typically appears in the form of white crystals or powder, but in the WGCP's case, it is dissolved in the weak sulfuric acid.

Most arsenic compounds are toxic so the utmost care must be taken when removing any arsenic accretions or crystallized deposits from equipment.

5.20 Arsenic and Arsenic Sludge: Control

Arsenic and Arsenic Sludge: Control

To minimize the hazards of Arsenic and Arsenic Sludge, workers need to don the appropriate PPE:

- Tightly sealed protective goggles
- Masks with colloidal filter (fine-grain filter)
- Protective gloves made of plastics or rubber
- Plastic aprons
- Pant legs must be tucked inside of workboots
- Water must be provided for flushing eyes and skin

5.21 ESP (Electrostatic Precipitator): Hazard & Control

ESP (Electrostatic Precipitator): Hazard & Control

Wet Electrostatic Precipitators use high voltages to perform their task. Improper work on the equipment may lead to electrocution.

To work on this equipment, workers must:

- Receive authorization from the FBR Control Room prior to entering the area
- Strictly follow all procedures related to this equipment

6. Shipping

6.1 Quality Assurance

6.2 Site Specific Hazards

Sign-in Procedure

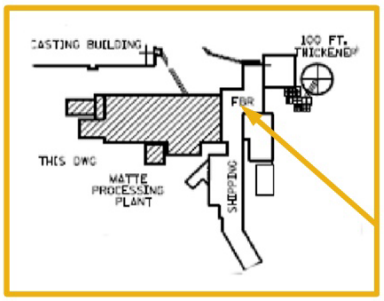
Shipping Dispatchers Office

Workers entering the Shipping area have already signed in at door 234A but are still required to notify:

- Shipping Supervisor – Day Shift
- FBR Control Room Supervisor - Off Shift

Workers would need to contact the Supervisor for the following reasons:

- Obtain work permits
- When access to equipment is necessary
- Obtain Hot Work Permits
- Whenever workers require access to the Matte Processing Hoistwell



6.3 Site Specific Hazards

Site Specific Hazards

The Shipping area has workplace specific hazards that have been identified and need to be controlled.

These include but are not limited to:

- Mobile equipment
- Docking hazards
- Congested areas

Communicate with your Vale contact person concerning the procedures pertaining to designated substances, product locations, and process hazards in your work area.

* Separate training is required for handling working with designated substances.

6.4 Mobile Equipment: Hazard

Mobile Equipment: Hazard

The Shipping Department utilizes various pieces of mobile equipment to aid in the movement of materials.

Forklifts: transporting supplies and materials

Sweepers: dust control and collection

Service Vehicles: ½ ton trucks or cube vehicles deliver small quantity goods to the building

Transport Trucks: most of the larger equipment brought on-site for shipping is done so with large transport trucks.

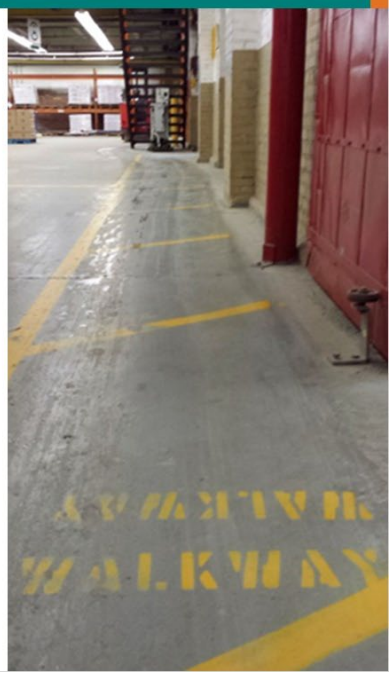
Mobile equipment presents several hazards including restricted visibility, limited clearance, shifting loads all lending to collisions with pedestrians, machinery or other mobile equipment.

6.5 Mobile Equipment: Control

Mobile Equipment: Control

In addition to the general controls associated with mobile equipment, Shipping has mandated the following controls applicable to mobile equipment in their area:

- The use of overhead doors is restricted to mobile equipment only. Pedestrians are to use man-doors only.
- Walk within designated walkways (hatched yellow lines) where available.
- Horns are to be sounded at all aisles and exits.
- Mobile equipment shall not enter work area without authorization from employee present in work area.



6.6 Docking: Hazard

Docking: Hazard

Loading and unloading materials, goods and products from trucks are daily activities at the shipping dock. Globally, these activities are also a regular and frequent source of workplace injuries and incidents.

- Congestion and traffic
- Inadequate lighting
- Uneven surfaces
- Contaminants in the air such as exhaust
- Equipment in poor working order
- Lack of safe working procedures
- Hazards associated with lifting devices, trucks, rolling conveyors, doors and other moving equipment and parts

6.7 Docking: Control

Docking: Control

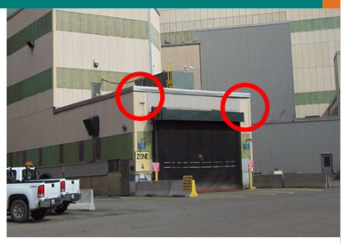
Good Practices to follow in docking areas include:

- All personnel on foot must be clear of the loading zones during all mechanized loading or unloading operations
- Identify potential hazards before loading or unloading
- Properly secure loads before moving
- Protect all drop-offs, and pinch points on loading docks and lift gates
- Never be downhill from a moving load
- Use chocks and other devices
- Comply with Vale High Vis Clothing Standard (SPI-23)

6.8 Congested Area: Hazard & Control

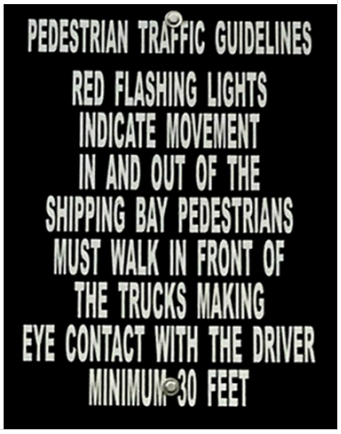
Congested Area: Hazard & Control

The shipping dock area for Matte Processing is located in an area known for high traffic; both with vehicles and pedestrians. This creates potential for collisions or injury to workers in the area.



To mitigate these hazards the following controls have been implemented:

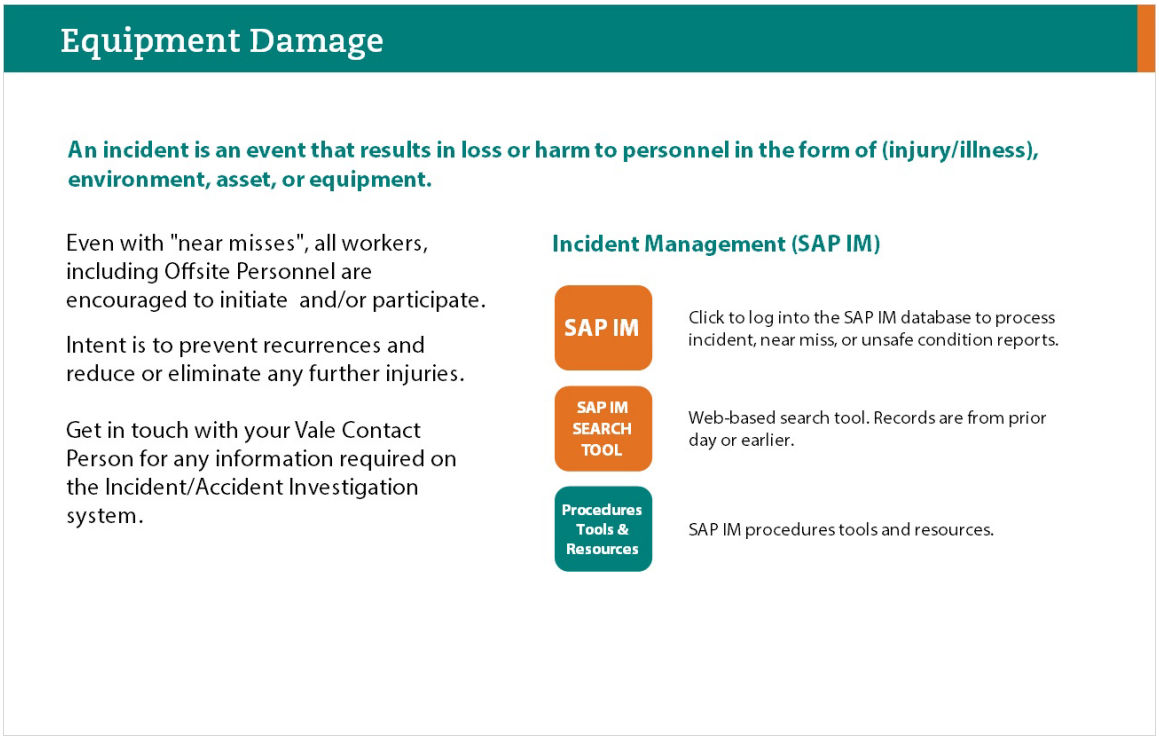
- Red lights on either side of Shipping Door 180 alerts workers to transport trucks moving in or out of the shipping loading area.
- Stay alert and stay away during loading.
- Traffic is not permitted between the shipping building and the Acid Plant Warehouse. This route is for bulk loading transports only.
- This policy is strictly enforced.



7. Equipment Damage

7.1 Quality Assurance

7.2 Equipment Damage



8. Personal Injury

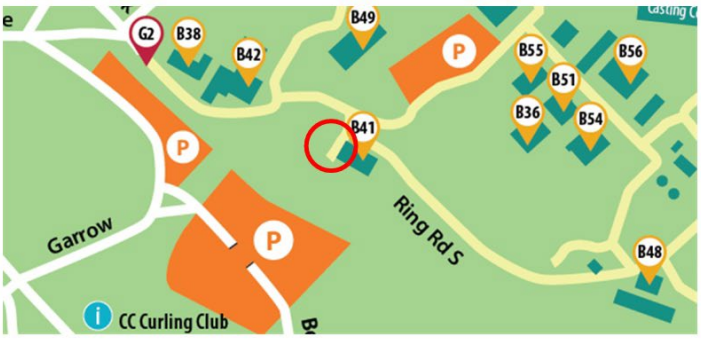
8.1 Quality Assurance

8.2 Personal Injury

Personal Injury

In the case of personal injury, generally, contact your Supervisor… report immediately to First Aid.

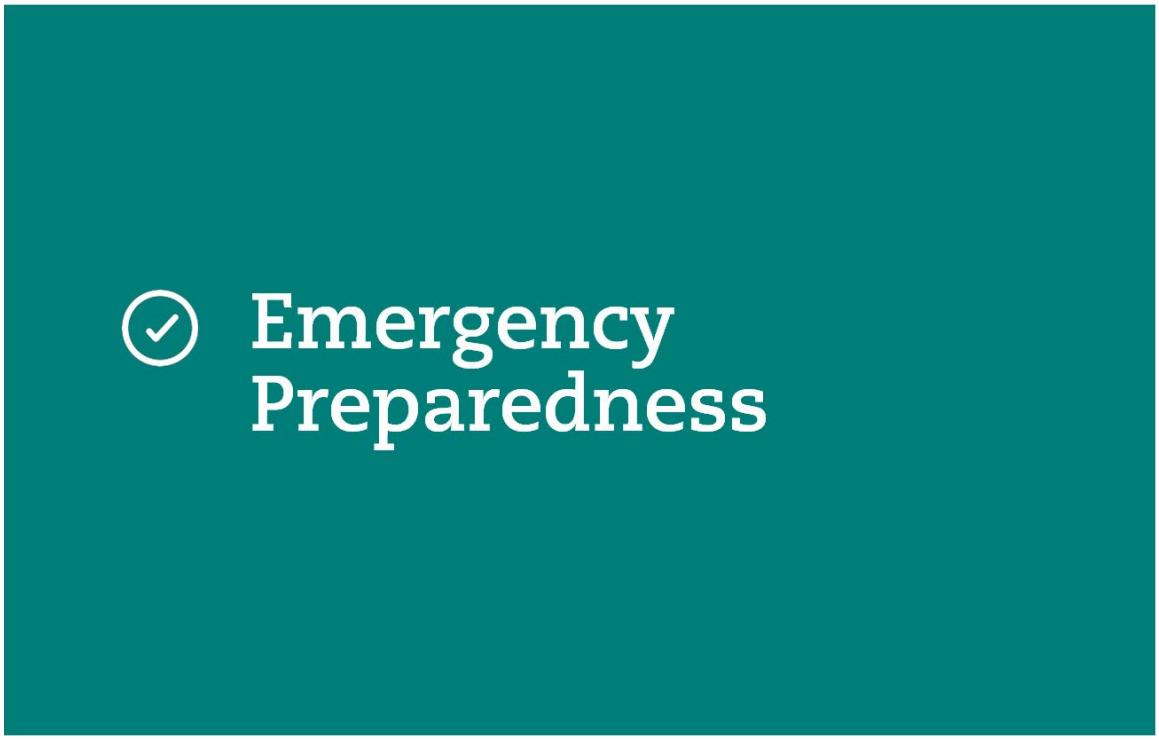
Your supervisor will report the injury to the Vale Contact Person.



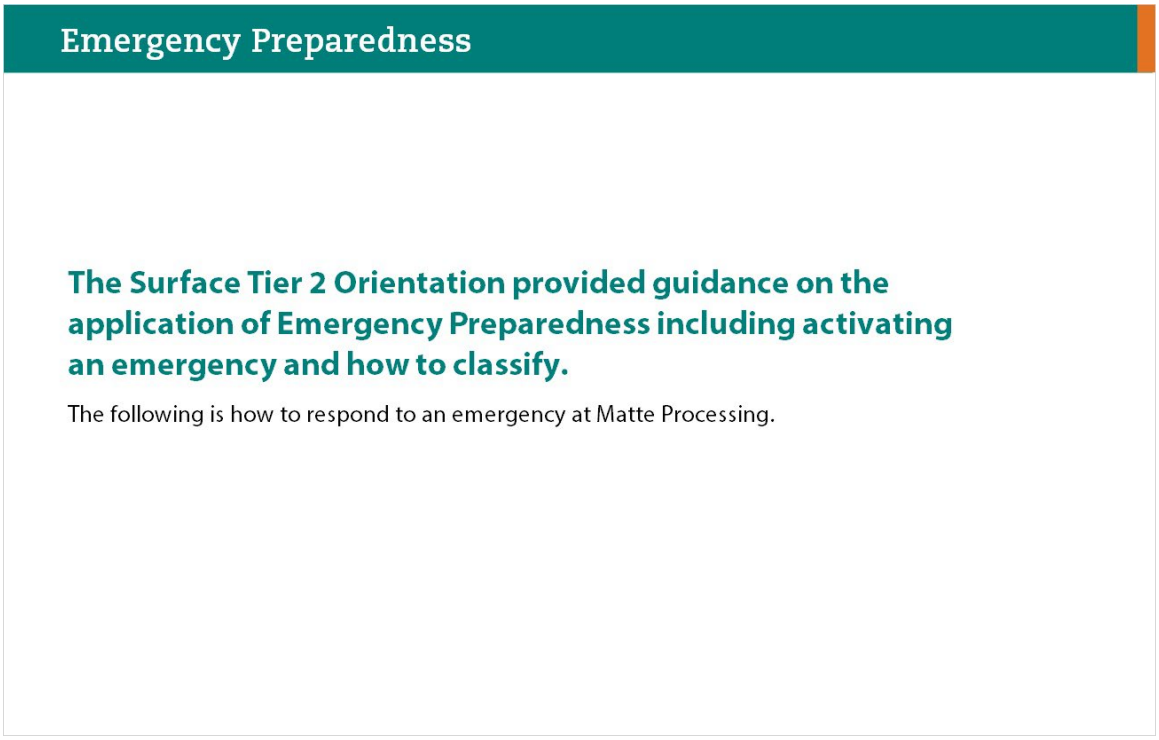
In the event you cannot physic ally report to First Aid, phone first aid at: 705-682-6622

9. Emergency Preparedness

9.1 Quality Assurance



9.2 Emergency Preparedness



9.3 Notification – Central Tailings Area

Emergency Notification

Fire Evacuation: OUTVAC

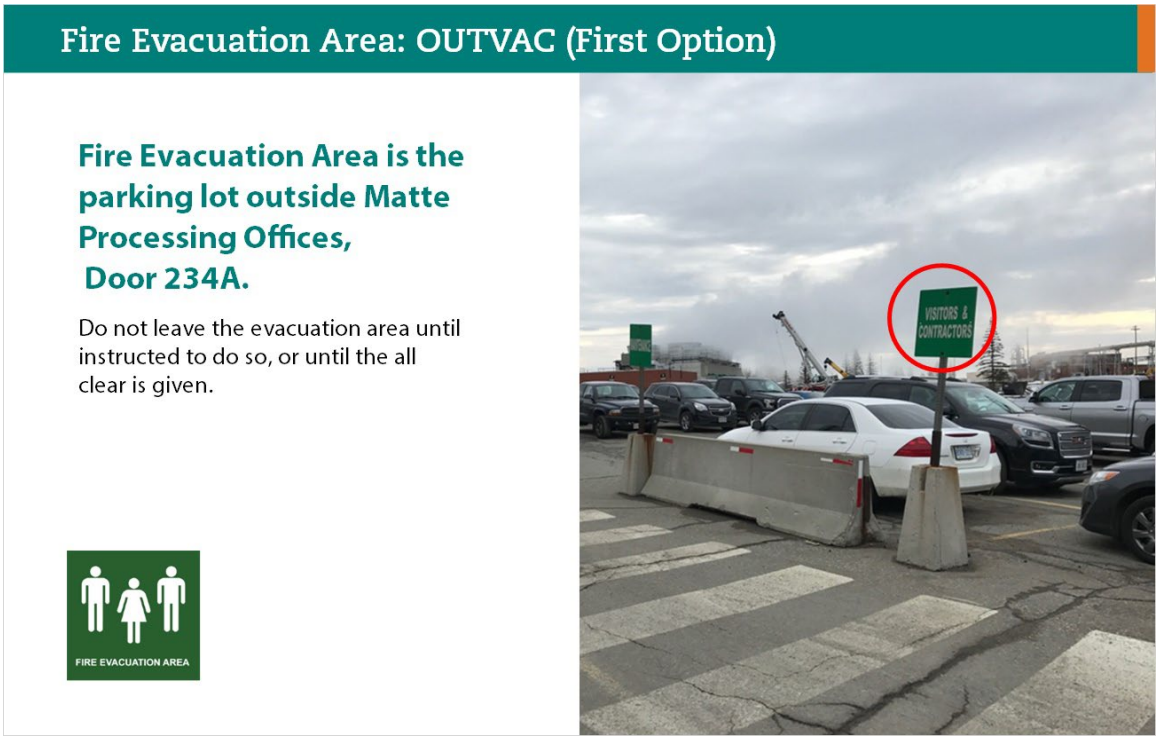
Leave the building by the nearest exit.

Assembly Area: INVAC

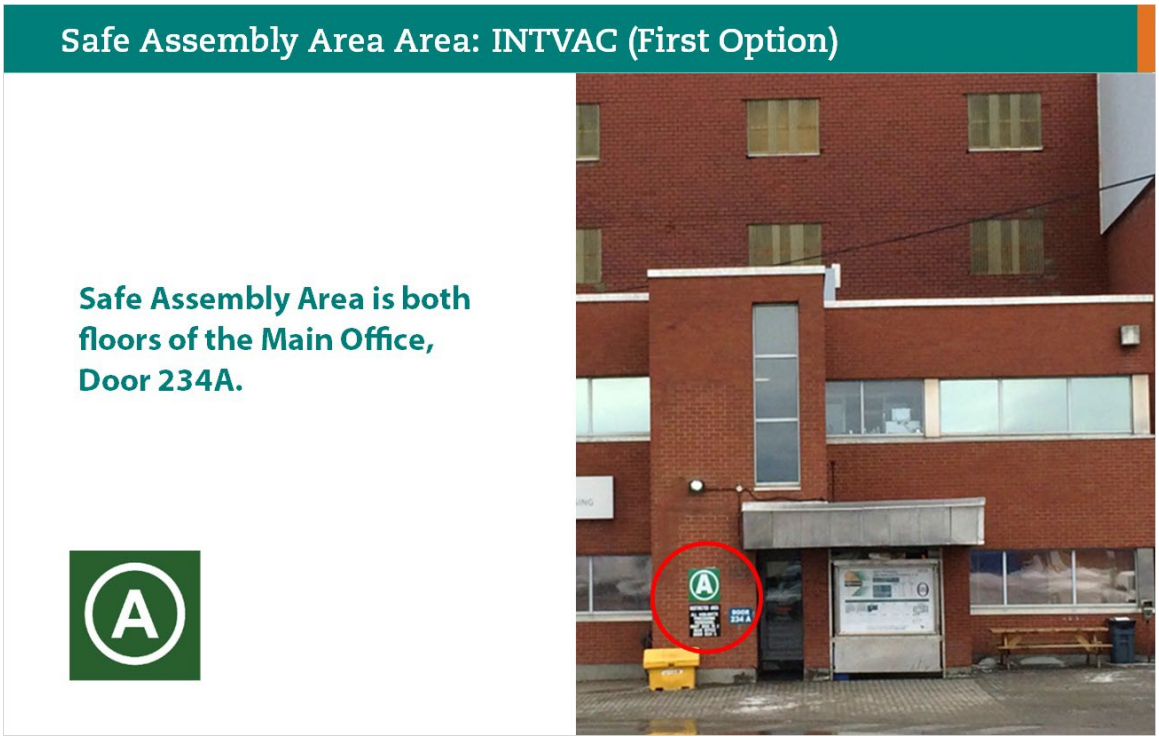
Go to the nearest Safe Assembly Area.

Alarm testing is conducted each Monday at 1:30 pm. Report any malfunctions immediately to your Supervisor to ensure that it is corrected in a timely manner.

9.4 Fire Evacuation Area: OUTVAC (First Option)



9.5 Safe Assembly Area Area: INTVAC (First Option)



10. Plant Exit

10.1 Quality Assurance

10.2 Plant Exit

Plant Exit

Good work practices dictate that you close the loop on work you were doing to avoid creating risks or hazards for other work groups, cross shifts, or other work in the area. Here are some tasks to consider when getting ready to exit the plant to ensure your safety and that of those around you:

- ✓ **Housekeeping** - Is your worksite cleaned up after your job?
- ✓ **Personal Lock and Tag** - Has your personal protection been removed at the end of the shift?
- ✓ **Status Tagging** - Is there ongoing work that needs a status tag placed or is there equipment in Bad Order that needs to be identified?
- ✓ **End States** - Have you left the process in the proper state?
- ✓ **Waste Segregation** - Have you disposed of materials in the appropriate waste receptacles/bin/area?
- ✓ **Control room** - Do I need to let the control room know that I'm clear of an area?
- ✓ **Vale Contact Person** - Do they need an end of shift report from me?
- ✓ **Permits** - Do I need to close or hand in any permits?
- ✓ **Sign out -** At the gate or other designated areas.

11. Conclusion

11.1 Quality Assurance

11.2 Conclusion

Conclusion

This concludes the material for the Matte Processing Plant Tier 3 Orientation.
You should now have a working knowledge and understanding of:

- Plant Entry
- Site Specific Hazards and Controls for Matte Processing
- Procedures in the event of:
  - Equipment Damage
  - Personal Injury
  - Process Upset (Emergency Preparedness)
- Plant Exit Procedure

This Orientation provided information to access the Matte Processing Plant. In order to feel comfortable with the area, you may arrange a field visit with your Vale Contact Person to specifically identify procedures provided in this Orientation.

Additionally, depending on the site or work you're doing, you may require task-specific information through either the local Learning & Development Group or your Vale Contact Person.