Smelter Tier 3 Orientation BOOK

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1.1 Smelter Orientation

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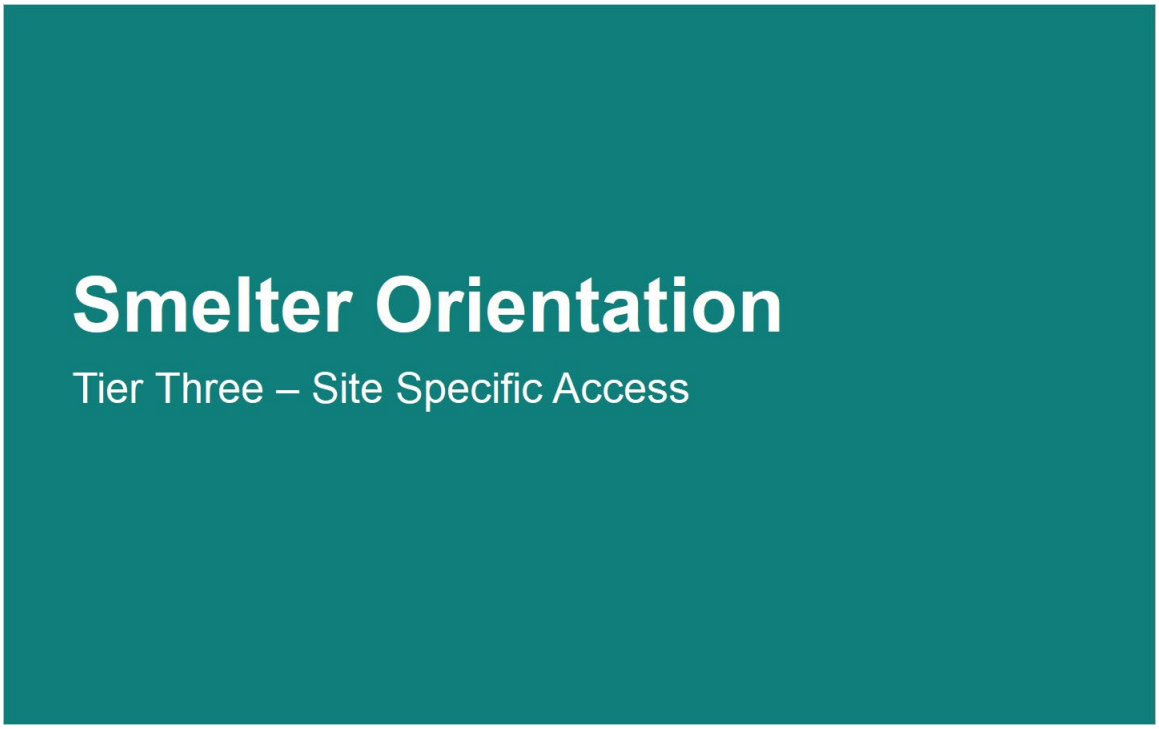
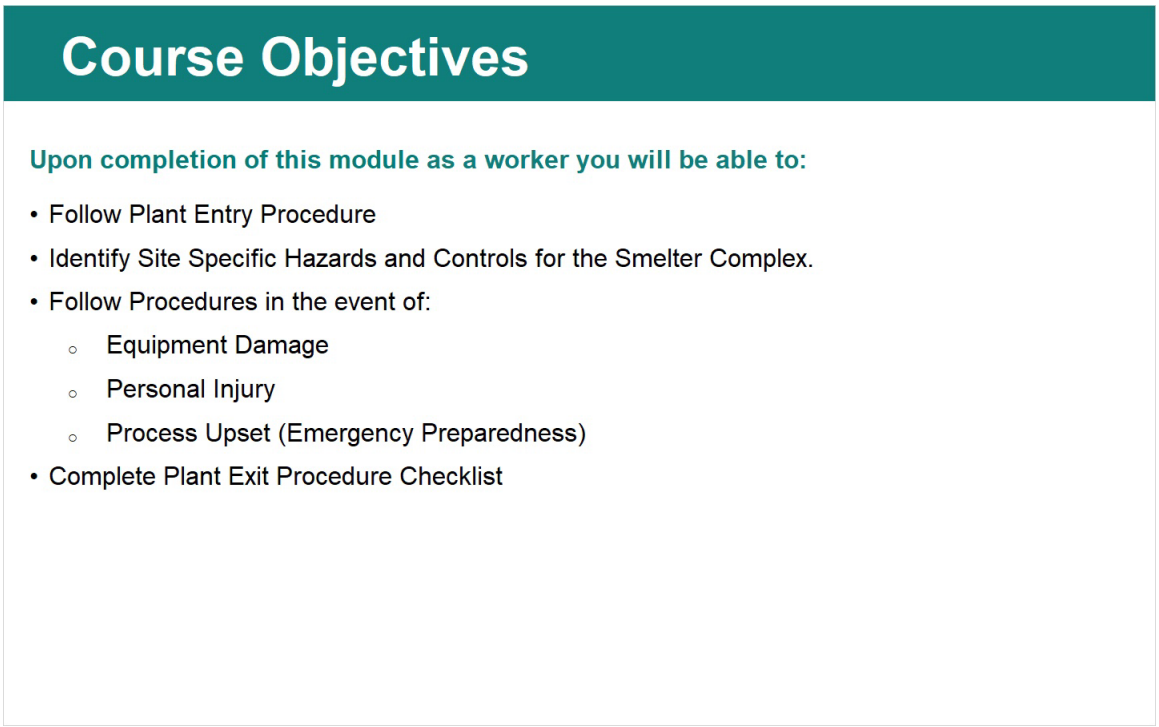
1.2 Smelter Orientation



1.3 Course Objectives



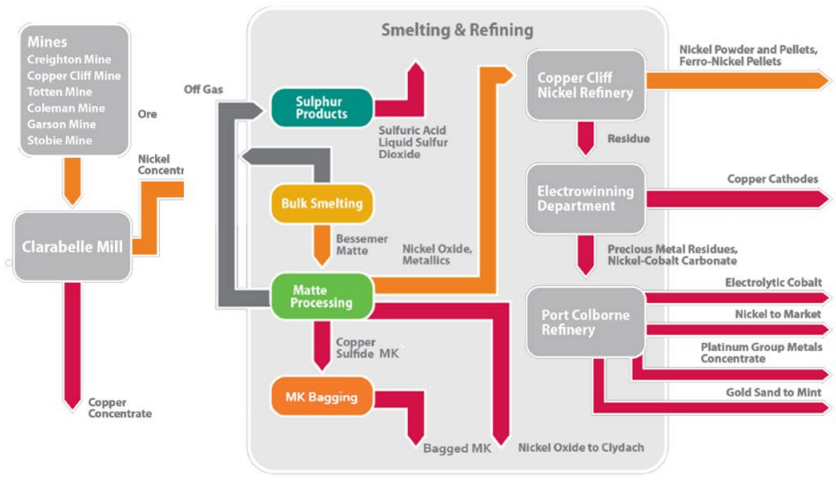
1.4 Introduction

Introduction

The Smelter Process

1.5 The Smelter Process

The Smelter Process



1.6 The Smelter Process

The Smelter Process

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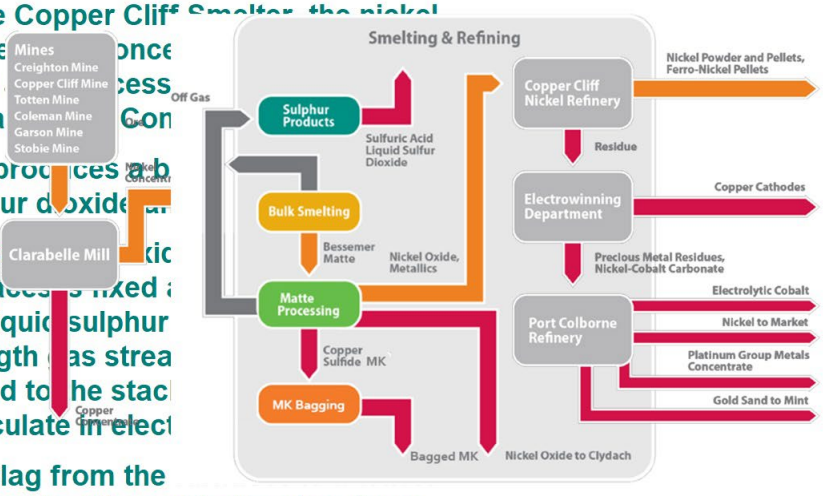


1.7 The Smelter Process

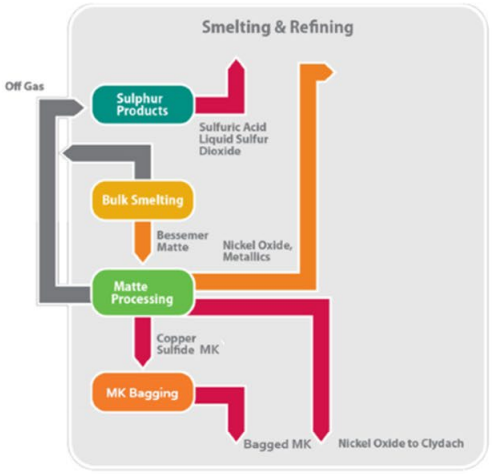
The Smelter Process

The converter matte is slow-cooled to produce a coarse crystalline structure Bessemer matte.

This is crushed, ground and separated into metallics, nickel sulphides and copper sulphides by magnetic separation and flotation in the Matte Separation Plant.

All of the precious metal bearing metallics and some of the nickel sulphide are sent to the Copper Cliff Refinery.

The remaining nickel sulphide is roasted in fluid bed roasters. The resulting nickel oxide is processed in the Copper Cliff Refinery, the Clydach Refinery, or is marketed. Sulphur dioxide from the roasters is fixed as sulphuric acid.



1.8 Plant Entry

Plant Entry

Driving In, Walking In

1.9 Approaching The Plant

Approaching The Plant

The Smelter is located within the Copper Cliff Complex and has several points of entry.

Vehicle access:
Through the Main Gate, General Office Gate and limited access through #7 Gate.

Vehicle access through the gates must be authorized through your Vale Contact Person.

Pedestrian access:
Through General Office Tunnel or #1 First Aid access.

1.10 Approaching The Plant

Approaching The Plant

Perimeter Warning Lights

To warn workers of process upsets, there is a Perimeter Warning Lights setup throughout the Copper Cliff Complex.

When these lights are activated, do not proceed any further. Wait in either the parking lot or off site until the emergency condition is controlled.

Let your Supervisor know you were unable to get onto the property due to the Perimeter Warning Lights being activated.

If you wait in the parking lot, remain in your vehicle with the windows closed.

Do not loiter outside your vehicle.

1.11 Parking

Parking

There are a number of parking areas for the Smelter:

Refer to your Orientation map for parking lot locations.

Workers walking into the Complex

- Use the Contractor Parking Lot by #1 First Aid.

Be aware of designated areas within this parking lot

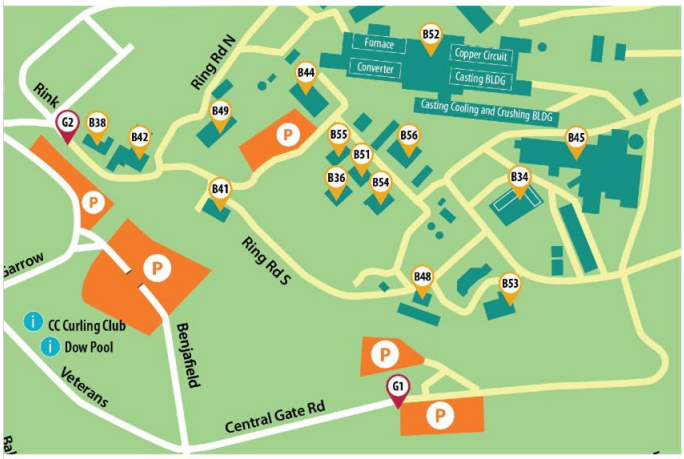
Workers driving into the Complex park in designated areas such as:

- Main Gate
- Upper Parking outside door 152
- Main Smelter Parking lot

1.12 Approaching Sign in Location

Approaching Sign in Location

Depending on the area of the Smelter you'll be working, in proceed from the parking lot to the sign in location.



- Flash Furnaces
- Converters / Casting / Crushing
- Copper End (Anode/MK)

1.13 Plant Entry Awareness - AEDs

Plant Entry Awareness

Automated External Defibrillators

Be aware that Vales operations are equipped with strategically placed AED's, which can provide life-saving support in case of sudden cardiac arrest.

An Automated External Defibrillator (AED) is a portable device used to treat sudden cardiac arrest (SCA).

An AED is a computerized device that detects abnormal heart rhythms.

It delivers an electrical current to restore a normal heartbeat.

AED's are designed for use by ***anyone, whether trained or untrained.***

Important!
Call #1 First Aid at 705-682-6622 immediately to initiate the emergency response process.

1.14 Plant Entry Awareness - AEDs

Plant Entry Awareness

The following is a simplified overview of how to use an AED.

1. **Turn on the AED:** Open the AED case and turn on the device. Some models turn on automatically when the case is opened.
2. **Attach the Pads:** Expose the person's chest and attach the adhesive pads to their skin. One pad goes on the upper right side of the chest, and the other goes on the lower left side. *(Follow images, apply firmly).*
3. **Stand Clear:** Ensure no one is touching the person while the AED analyzes their heart rhythm.
4. **Follow Prompts:** The AED will give you voice prompts. If a shock is needed, the device will instruct you to press the shock button.
5. **Resume CPR:** After the shock is delivered, or no shock is advised, resume CPR until emergency medical services arrive or the person shows signs of life.

2. Flash Furnaces

2.1 Flash Furnaces

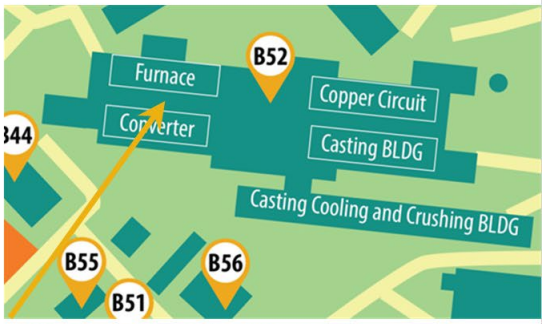
2.2 Sign in Procedures

Sign in Procedures

For workers working at the Furnaces, Cottrells, the sign in location is in the foyer of Door 151.

- The area can be accessed via door 151 or door 152.
- The areas in and around the foyer are PPE free, however to proceed past the administrative area, you require PPE.
- When accessing via door 152, walk in designated areas as identified.
- If you're unfamiliar with the area, arrange for a site tour with a contact familiar with the site.

Note that during PMP's, this sign-in location is subject to change.



Furnaces - sign in at door 151

Inform your Vale contact person when you are on site so that you may start your job.

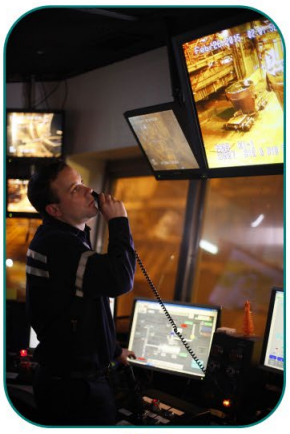
2.3 DCS Control Room

DCS Control Room

The DCS Control Room in the Furnace area is located on the South side of C-Floor, between the two furnaces.

Workers would need to report to this DCS for the following:

- Obtain Work Permits during off shifts
- When access to equipment is necessary
- Obtain Hot Work Permits
- Whenever workers will be accessing the Super Stack
- Whenever workers require access to the Furnace Hoistwell



Workers would need to Contact (not necessarily report) if:

- Working in Fugitive Fan Building
- Working in the Gas Cleaning area

Phone number for furnace DCS control room is 705-682-8640

2.4 Smelter Flash Furnace Help call protocol

Flash Furnace Help Call Protocol

A 'HELP CALL" is broadcasted over the Gaitronics or Radio to a specific location in which assistance is required – this protocol is exclusively carried out in the Flash Furnace department of the Smelter.

ONLY QUALIFIED FURNACE OPERATORS and SUPERVISORS are to respond to a HELP CALL.

Non-qualified personnel will NOT respond to the help call and remain out of the affected area.

ABORT CALL:

The 'ABORT CALL' is broadcasted over the Gaitronics or Radio when there is a loss of control, and immediate danger to personnel who are responding to a 'HELP CALL'.

The Furnace Control Room Supervisor will IMMEDIATELY activate a Level I OUTVAC for the Flash Furnace Department, the Main Aisle (including the Copper End and the Casting Crushing Building).

ALL personnel are expected to evacuate immediately, staying clear of the furnace area and proceed to the nearest Fire Evacuation Area.

2.5 Plant Hazards and Controls

2.6 Site Specific Hazards

Site Specific Hazards

Using the tools that you learned in Tier 1 Orientation, ensure to use operation controls to mitigate risk associated to 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

2.7 Site Specific Hazards

Site Specific Hazards

The Furnace Building has workplace specific hazards that have been identified and need to be controlled. These include but are not limited to:

- *Sulphur Dioxide (and mist [signs in place for mist])
- *Nickel
- *Dust: (mandatory respirator areas; M-floor, furnace roof, furnace burner platforms)
    - Arsenic
    - Lead
    - Silica
    - Nickel
    - Other metals

2.8 Site Specific Hazards

Site Specific Hazards

The Furnace Building has workplace specific hazards that have been identified and need to be controlled. These include but are not limited to:

- *Hot Metal
- Mobile Equipment Activity
- Stationary Equipment Activity
- General Chemicals:
- Sodium hydroxide (in 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 or working with designated substances.**

2.9 Nickel - Hazard

Nickel - Hazard

Feed coming into the Smelter contains significant amounts of Nickel. Part of the feed is categorized as "Nickel Insoluble" and is the primary species throughout the Smelter. 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.

Insoluble Nickel: Known to accumulate in tissue such as lung, where, depending upon particle size, it may only slowly be absorbed over time.

2.10 Nickel - Hazard

Nickel - Hazard

How does Nickel enter my body?

- Primary routes of entry are inhalation and ingestion.
- Skin absorption (very little is absorbed through skin and into 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- pregnancy effects-baby developmental problems).

2.11 Nickel - Control

Nickel - Control

To mitigate the health hazards of Nickel, controls have been put in place to reduce the risks associated with acute and chronic exposure.

Work and hygiene practices:

- Wash hands, face, scrub nails before eating, drinking or smoking
- Shower, wash, change before going home
- Eat, drink only in designated areas
- Keep your work area clean – daily housekeeping
- REPORT any illness or injuries right away (even if you think they are minor)

2.12 Nickel - Control

Nickel - Control

To mitigate the health hazards of Nickel, controls have been put in place to reduce the risks associated with acute and chronic exposure.

PPE – Respirators

- Ensuring respirators are worn according to conditions and/or mandatory respirator protection areas
- Follow Clean Shaven Policy for a proper fit and seal (includes being fit tested)

Air Monitoring

- Workplace air monitoring program by Occupational Health

2.13 Hot Metal - Hazard

Hot Metal - Hazard

The Furnace Building has one flash furnace which is heated to 1340°C and then fed with Oxygen and Dry Concentrate resulting in molten metal and it is in turn separated into two main layers; Slag on the top, and Matte on the bottom.

Hazards associated with hot metal:

- Hot metal burns – Splashes associated with tapping and skimming, hot metal spills
- Explosions – molten metal coming into contact with water, "matte at the back"
- SO_2 Gas – a by-product of the Flash Furnace process
- Hot Ladle/Car Movement – Movement of pots and ladles through the back-track and matte-hauls

2.14 Hot Metal - Hazard

Hot Metal - Hazard

The Furnace Building has one flash furnace which is heated to 1340ºC and then fed with Oxygen and Dry Concentrate resulting in molten metal and it is in turn separated into two main layers; Slag on the top, and Matte on the bottom.

Hazards associated with hot metal:

- Cutouts – hot spots on ladles and pots resulting in uncontrolled flow of molten metal
- Radiant Heat Exposure – surfaces absorbing temperature of the process (furnace walls, launders, flues, pots and ladles, etc.)
- Radiation – ultraviolet rays emanating from hot metal flows
- Heat Stress/Environment – atmospheric conditions combined with process heat exposure

2.15 Hot Metal - Control

Hot Metal - Control

To mitigate Hot Metal hazards, controls have been put in place to reduce the risks.

Wear appropriate PPE:

- Appropriate clothing
- Long pants over boots
- Long-sleeved shirts rolled down
- FR (Fire Retardant) clothing (if required)
- Insulated mitts or gloves
- Boots laced to the top
- Tinted face shields (if required)

2.16 Hot Metal - Control

Hot Metal - Control

To mitigate Hot Metal hazards, controls have been put in place to reduce the risks.

- Report any water leaks to the DCS Control Room
- Obey lights and alarms associated with ladle and pot movements
- Report “hot spots” on ladles and pots
- Be aware of your and your co-workers symptoms of heat-related conditions

2.17 Dust - Hazard

Dust - Hazard

Feed coming into the Smelter may contain various elements (ie: lead, arsenic, silica, nickel and other metals) that could cause health problems without proper controls. Due to the nature of the smelting process, dust is generated and present in the work environment.

How can dust enter my body?

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

2.18 Dust - Hazard

Dust - Hazard

Feed coming into the Smelter may contain various elements (ie: lead, arsenic, silica, nickel and other metals) that could cause health problems without proper controls. Due to the nature of the smelting process, dust is generated and present in the work environment.

How can it affect me?

- Various types of cancers
- Lung diseases (silicosis)
- Skin conditions (dermatitis, nickel rash)
- Nervous system (weakness, tremors, behavioural changes, impaired vision, hearing
- Kidney damage
- Reproductive system (may harm developing fetus, affect male fertility (lower sperm count)

2.19 Dust - Control

Dust - Control

To mitigate the health hazards of Dust, controls have been put in place to reduce the risks associated with acute and chronic exposure.

Work and hygiene practices:

- Wash hands, face, scrub nails before eating, drinking or smoking
- Shower, wash, change before going home
- Eat, drink only in designated areas
- Keep your work area clean – daily housekeeping
- REPORT any illness or injuries right away (even if you think they are minor)

2.20 Dust - Control

Dust - Control

To mitigate the health hazards of Dust, controls have been put in place to reduce the risks associated with acute and chronic exposure.

PPE – Respirators

- Ensuring respirators are worn according to conditions and/or mandatory respirator protection areas
- Follow Clean Shaven Policy for a proper fit and seal (includes being fit tested)

Dust Collection Systems

- Baghouses, dust filters, planned maintenance (i.e. vacuuming, sweepers)

Air Monitoring

- Workplace air monitoring program by Occupational Health

2.21 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.

2.22 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

2.23 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".**

2.24 Sulfur Dioxide (SO2) - Hazard

Sulfur Dioxide (SO_2) - Hazard

Long Term Health effects:

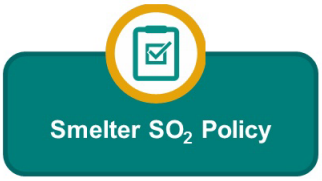
- **Sulfur dioxide is not known to be a human carcinogen. Several human population studies have examined the possibility that sulfur dioxide may cause cancers such as lung cancer, stomach cancer or brain tumours. In all of the studies, there were uncontrolled confounding factors, such as concurrent exposure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

2.25 Sulfur Dioxide (SO2) - Control

Sulfur Dioxide (SO_2) - Control

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

- 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 Smelter Process Buildings.
- Site personnel coordinating or providing a field visit for visitors shall be responsible to ensure all visitors possess an appropriate escape respirator for SO_2. These visitors will be provided with and will carry the respirator provided to them.



2.26 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.

2.27 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.

2.28 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.

2.29 Sulfur Dioxide (SO2) - Control

Sulfur Dioxide (SO_2) - Control

In addition to the Policy for the Smelter, the areas listed below require further precautions and have been posted as "respiratory protection required" areas:

- Converter Sand floor
- Furnace Building:
  - D Floor quench dyke areas
  - Furnace roof area
  - Furnace burner platforms
  - Furnace Building M-Floor
  - Furnace Building Gas Cleaning
- East Crane Bay
- Copper Anode Furnace platform

In Gas Cleaning Areas:

- Sign-in prior to entry at DCS
- Respirator must be worn around neck
- Double Hearing Protection required on J Floor Gas Cleaning
- Entry is not permitted when HIGH SO_2 sign is activated

2.30 Equipment - Hazard

Equipment - Hazard

The Furnace Building is large with various numbers of floors to aid in production. Various pieces of mobile and stationary equipment are used.

Mobile:

Forklifts: transporting supplies and materials, launder replacements, remove and add bedding

Sweepers: dust control and collection

TAZ: used to clean inlets on furnace uptakes

Hoistwell: vertical area used to hoist materials too heavy or large to fit into freight elevator

Skid Steer Loaders: used for miscellaneous cleanup (i.e. feed spills)

Elevated Work Platforms: used to perform various maintenance activities

2.31 Equipment - Hazard

Equipment - Hazard

The Furnace Building is large with various number of floors to aid in production. Various pieces of mobile and stationary equipment are used.

Mobile:

Tapping and Skimming guns: open the Furnace Matte Tapping/Slag skimming holes, allowing matte or slag to be drained from the furnace into a ladle or slag pot

Mobile Cranes: used to perform various maintenance activities

Trains: used in the backtrack to move slag pots in and out of under the furnaces

2.32 Equipment - Hazard

Equipment - Hazard

The Furnace Building is large with various number of floors to aid in production. Various pieces of mobile and stationary equipment are used.

Stationary:

Conveyors: belts, screws and drags

Robot and Soot Blower: used for cleaning inlets

2.33 Equipment - Control

Equipment - Control

To maintain the safety of employees working with or around equipment the following controls are in place:

- Training
- Authorization to use
- Pre-Op Checks
- Adhering to signage
- Horns/Sirens/Lights/Backup Signals
- Designated pedestrian walkways
- Guards

3. Converters / Casting / Crushing

3.1 Converters

3.2 Sign in Procedures

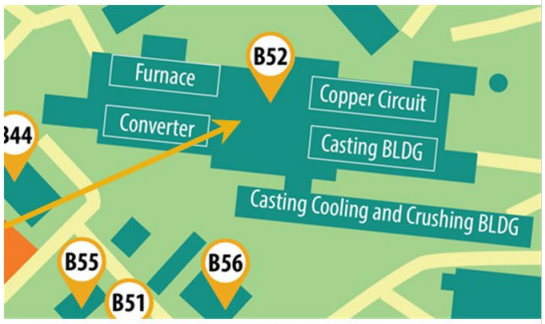
Sign in Procedures

For workers working in the Converters and/or the Casting/Crushing area, the sign in location is at the door of entrance 119. (often referred to as the "old admin building")

- The area leading up to door 119 is PPE free, however to proceed past the administrative area, you do require PPE.
- If you're unfamiliar with the area, arrange for a site tour with a contact familiar with the site.

Note that during PMP's, this sign-in location is subject to change.

Inform your Vale contact person when you are on site so that you may start your job.



Converters and Casting
sign in at door 119 (old admin building)

Inform your Vale contact person when you are on site so that you may start your job.

3.3 DCS Control Room

DCS Control Room

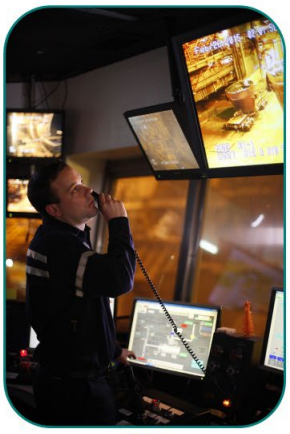
The Nickel Control Room (Bubble) for the Converter area is located on the South side of C-Floor, between the two furnaces.

Workers would need to report to this DCS for the following reasons:

- When access to equipment is necessary in the Main Aisle

For other items, workers would need to contact their Vale Shift Supervisor or Superintendent:

- Hot Work Permits
- Confined Space Permits
- Matters related to areas outside of the Main Aisle, such as Casting/Crushing, Area 10, Pole Track Aisle.



Phone number for furnace DCS control room is 705-682-8640

3.4 Plant Hazards and Controls

Converter / Casting / Crushing Area Hazards and Controls

3.5 Site Specific Hazards

Site Specific Hazards

Using the tools that you learned in Tier 1 Orientation, ensure to use operation controls to mitigate risk associated to 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

3.6 Site Specific Hazards

Site Specific Hazards

The Converters/Casting/Crushing area has workplace specific hazards that have been identified and need to be controlled. These include but are not limited to:

- *Sulphur Dioxide (and mist [signs in place for mist])
- *Hot Metal
- *Dust: (mandatory respirator areas)
  - Arsenic
  - Lead
  - Silica
  - Nickel
  - Other metals

3.7 Site Specific Hazards

Site Specific Hazards

The Converters/Casting/Crushing area has workplace specific hazards that have been identified and need to be controlled. These include but are not limited to:

- Mobile Equipment Activity
- Stationary Equipment Activity
- General Chemicals:
- Sodium hydroxide (in totes)

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

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

3.8 Sulfur Dioxide (SO2)

Sulfur Dioxide (SO_2) - Hazard

The converting area has the potential to generate SO_2 when converting Furnace Matte to Bessemer Matte. As a result the hazards outlined in the Furnace Building Section applies in this area as well.

3.9 Sulfur Dioxide (SO2) - Control

Sulfur Dioxide (SO_2) - Control

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

- 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 Smelter Process Buildings.
- Site personnel coordinating or providing a field visit for visitors shall be responsible to ensure all visitors possess an appropriate escape respirator for SO_2. These visitors will be provided with and will carry the respirator provided to them.

Smelter SO_2 Policy

3.10 Nickel - Hazard

Nickel - Hazard

How does Nickel enter my body?

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

How can it affect me?

- Continuous exposure to nickel dust increases risk of long term lung damage and in the 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- pregnancy effects-baby developmental problems)

3.11 Nickel - Control

Nickel - Control

To mitigate the health hazards of Nickel, controls have been put in place to reduce the risks associate with acute and chronic exposure.

Work and hygiene practices:

- Wash hands, face, scrub nails before eating, drinking or smoking
- Shower, wash, change before going home
- Eat, drink only in designated areas
- Keep your work area clean – daily housekeeping
- REPORT any illness or injuries right away (even if you think they are minor)

3.12 Nickel - Control

Nickel - Control

To mitigate the health hazards of Nickel, controls have been put in place to reduce the risks associated with acute and chronic exposure.

PPE – Respirators

- Ensuring respirators are worn according to conditions and/or mandatory respirator protection areas
- Follow Clean Shaven Policy for a proper fit and seal (includes being fit tested)

Air Monitoring

- Workplace air monitoring program by Occupational Health

3.13 Dust - Hazard

Dust - Hazard

Dust that is present in and around the converting/casting/crushing areas may contain various elements (lead, arsenic, silica, nickel) that could cause health problems without proper controls.

There are a number of reasons dust would be present in the work environment; some examples include:

- Movement of mobile equipment creating dusty conditions (stirs up dust)
- Movement of product on conveyor belts
- Additional material fed to converters becoming airborne during the charging process
- Crushing process (Crushers, Matte Breaker)
- Mould preparation and repair process

3.14 Dust - Hazard

Dust - Hazard

How can dust enter my body?

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

How can it affect me?

- Various types of cancers
- Lung diseases (silicosis)
- Skin conditions (dermatitis, nickel rash)
- Nervous system (weakness, tremors, behavioural changes, impaired vision, hearing
- Kidney damage
- Reproductive system (may harm developing fetus, affect male fertility (lower sperm count)

3.15 Dust - Control

Dust - Control

To mitigate the health hazards associated with dust, controls have been put in place to reduce the risks associated with acute and chronic exposure.

Work and hygiene practices:

- Wash hands, face, scrub nails before eating, drinking or smoking
- Shower, wash, change before going home
- Eat, drink only in designated areas
- Keep your work area clean – daily housekeeping
- REPORT any illness or injuries right away (even if you think they are minor)

3.16 Dust - Control

Dust - Control

To mitigate the health hazards of Dust, controls have been put in place to reduce the risks associate with acute and chronic exposure.

PPE – Respirators

- Ensuring respirators are worn according to conditions and/or mandatory respirator protection areas
- Follow Clean Shaven Policy for a proper fit and seal (includes being fit tested)

Dust Collection Systems

- Baghouses, dust filters, planned maintenance (i.e. vacuuming, sweepers)

Air Monitoring

- Workplace air monitoring program by Occupational Health

3.17 Dust - Control

Dust - Control

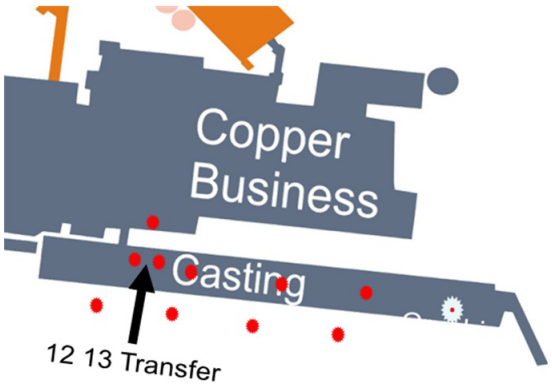
Perimeter Warning System Crushing Circuit

To warn and control access for individuals wishing to enter the Casting Building that crushing is in progress, the perimeter warning system is activated. This includes flashing red lights at Door 161,162 and 162A-F.

The warning lights are deactivated when the crushing circuit is shut down.

Individuals wishing to enter the crushing area while lights are activated are required to contact the crusher operator for permission to enter the area.

Signage at each door provides direction to contact on Channel 1 or using the telephone located at Door 162.



3.18 Hot Metal - Hazard

Hot Metal - Hazard

The Converter and Casting areas handle hot metal through various stages of the process:

- Matte ladle transfers from the furnaces and converters via crane
- Matte ladle transfers from Main Aisle to casting building via transfer cars
- Pouring (casting) hot metals into moulds in casting building via crane
- Converter vessel activity (charging, skimming, blowing, transferring)

3.19 Hot Metal - Hazard

Hot Metal - Hazard

Hazards associated with hot metal:

- Hot metal burns – Splashes, "blowing", sampling
- Reactions – foaming of converters due to chemical reaction within the shell
- SO_2 Gas – a by-product of converting
- Hot Metal Transfers
- Cutouts – hot spots on ladles and pots resulting in uncontrolled flow of molten metal
- Radiant Heat Exposure – surfaces absorbing temperature of the process, converter shell, flues, pots and ladles, etc.)
- Radiation – ultraviolet rays emanating from hot metal flows
- Heat Stress/Environment – atmospheric conditions combined with process heat exposure

3.20 Hot Metal - Control

Hot Metal - Control

To mitigate Hot Metal hazards, controls have been put in place to reduce the risk.

Respect signage and barricades

- Converter Platform barricades
- Warning lights, floor markings, signage

3.21 Hot Metal - Control

Hot Metal - Control

To mitigate Hot Metal hazards, controls have been put in place to reduce the risks.

Wear appropriate PPE:

- Appropriate clothing
  - Long pants over boots
  - Long-sleeved shirts rolled down
  - FR (Fire Retardant) clothing (if required)
- Obey lights and alarms associated with ladle movements
- Report “hot spots” on ladles and pots
- Be aware of your and your co-workers symptoms of heat-related conditions

3.22 Hot Metal - Control

Hot Metal - Control

In order to get matter from the Main Aisle, ladles are placed on a transfer car which moves from the Main Aisle to the Casting Building on a track which crosses the Pole Aisle and the pedestrian aisle between the nickel and copper end.

To mitigate … whenever the cars are being pulled, flashing lights, an audible alarm and a flashing message are initiated notifying people to not cross.

Hazards include:

- Cut-outs & spills
- Cable on puller breaking or catching clothing
- Suspended loads while crane operators are placing ladles on cars

3.23 Crane Movement - Hazard

Crane Movement - Hazard

Cranes are used to facilitate the movement of hot metal throughout the Converting and Casting areas. Additionally, cranes can be used to hoist materials. Some of the hazards associated to crane movement are:

- Suspended Loads.
- Contact with stationary equipment.
- Hot Metal Splashes from ladles while in transport.
- Hot spots and subsequent cut-outs which can lead to uncontrolled flows of metal on ladles being hoisted.

3.24 Crane Movement - Control

Crane Movement - Control

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

- When pouring into #5, #6 Converter, or when dumping a ladle into the Slag Return, Red Flashing Lights, Warning siren (bee-bop) are activated when pouring molten metal.
- When there is a full ladle of hot metal on the transfer car in a Matte Haul, a yellow light is activated.
- Sirens are sounded during crane movement or to alert of a hazard (cutout on ladle).

Listen and Watch for Crane travel before crossing any part of the Main Aisle

3.25 Crane Movement - Control

Crane Movement - Control

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

- When doing work/maintenance/repairs in Matte Tunnels, workers notify the crane with a white flashing strobe affixed to the wall.
- In the casting building, whenever the crane is pouring moulds, the entire building is restricted, identified by red flashing lights.

Listen and Watch for Crane travel before crossing any part of the Main Aisle

3.26 Equipment - Hazard

Equipment - Hazard

The Converter/Casting/Crushing areas utilize various pieces of mobile equipment to aid in the process.

Mobile:

Forklifts: transporting supplies and materials

Sweepers: dust control and collection

Skid Steer Loaders: used for miscellaneous cleanup (i.e. feed spills)

Elevated Work Platforms: used to perform various maintenance activities

Gradealls: chipping the mouths of vessels

Matte Breaker: for breaking up ingots at the start of the crushing process

Front End Loaders: Main Aisle cleanup and the movement of scrap materials

3.27 Equipment - Hazard

Equipment - Hazard

The Converter/Casting/Crushing areas utilize various pieces of mobile equipment to aid in the process.

Stationary:

- Converter Platforms
- Hoods
- Conveyor Belts
- Bins
- Moulds
- Crushers (Jaw & Cone)
- Natural Gas Burners (for converters and moulds)

3.28 Equipment - Control

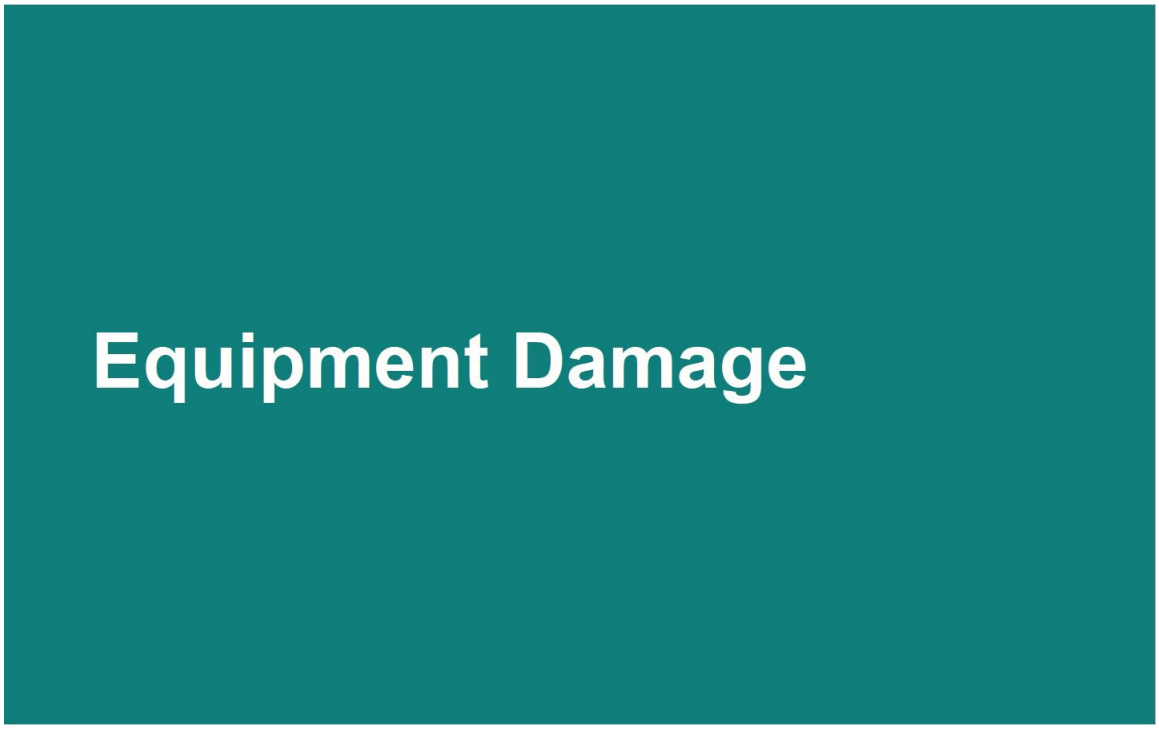
Equipment - Control

To maintain the safety of employees working with or around equipment the following controls are in place:

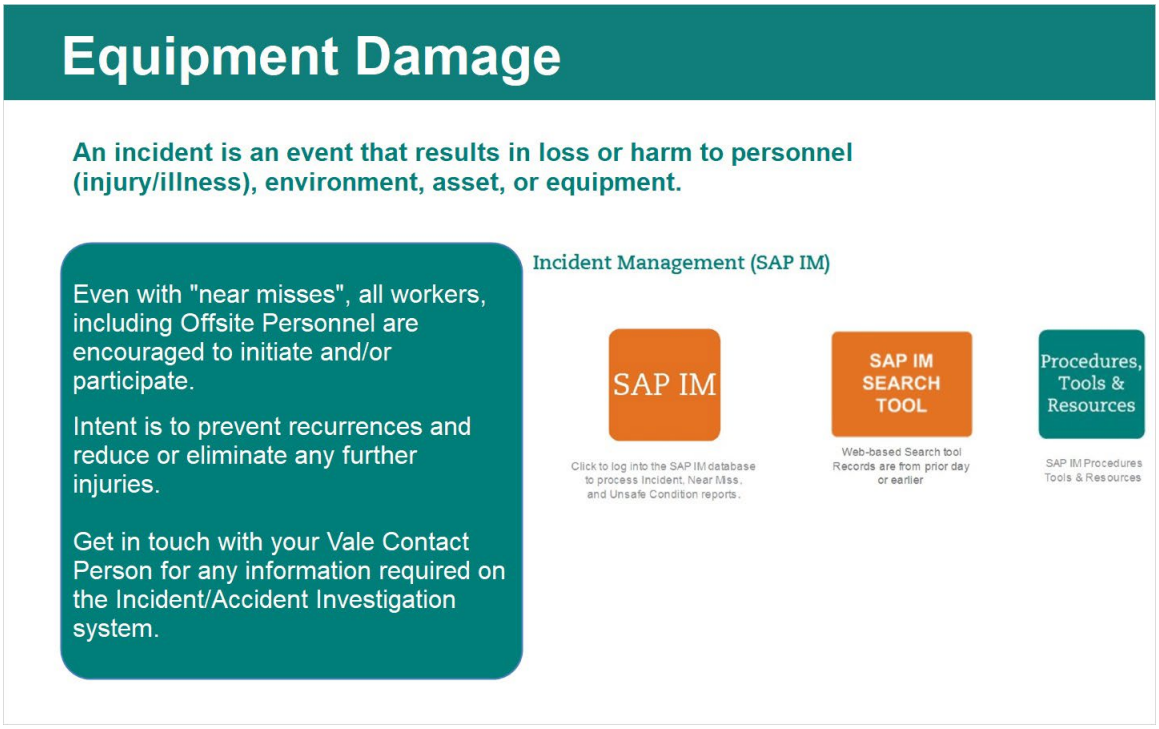
- Training
- Authorization to use
- Pre-Op Checks
- Adhering to signage
- Horns/Sirens/Lights/Backup Signals
- Designated pedestrian walkways
- Guards

4. Equipment Damage

4.1 Equipment Damage



4.2 Equipment Damage



5. Personal Injury

5.1 Personal Injury

5.2 Personal Injury

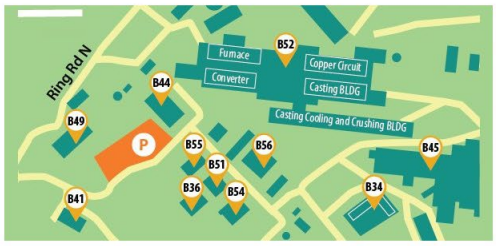
Personal Injury

Smelter Emergency Numbers

In the case of personal injury, generally, contact your Supervisor….. report immediately to First Aid. In the event you cannot physically report to First Aid, phone first aid:

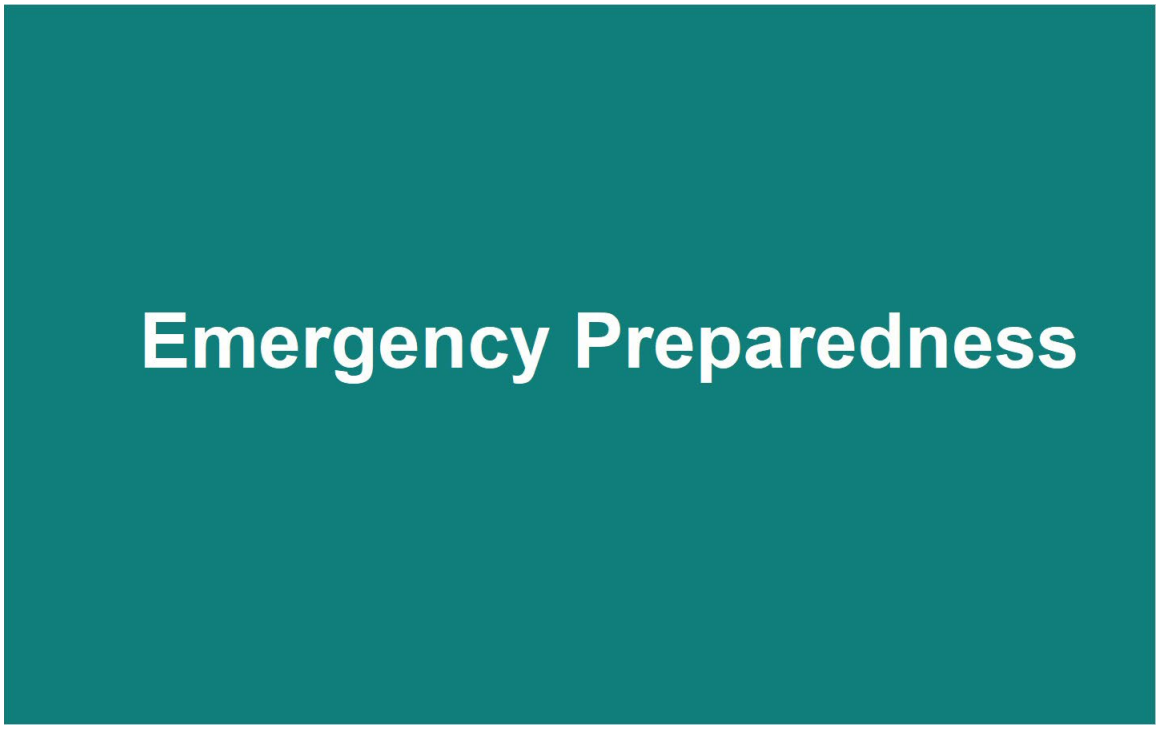
Copper Cliff Complex
Emergency Numbers

First Aid ---------- 6622
Ambulance ---------- 6622
Fire ---------- 6622



6. Emergency Preparedness

6.1 Emergency Preparedness



6.2 Emergency Preparedness

Emergency Preparedness

The Surface Tier 2 Orientation provided guidance on the application of Emergency Preparedness including activating an emergency and how to classify. The following is how to respond to an emergency at the Smelter.

6.3 Notification – Central Tailings Area

Notification – Smelter

Fire Evacuation - OUTVAC

Continuous Tone

Leave the building by the nearest exit.

Assembly Area - INVAC

Intermittent Tone

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.

Go to the nearest Safe Assembly Area.

6.4 Approaching The Plant

Notification – Smelter

Acid Plant Perimeter Warning Lights

As mentioned in the Tier 2 Orientation, Perimeter Warning Lights are activated during a plant emergency to protect workers from entering an area during a process upset.

The Acid Plant has established a boundary that is identified by signs and activated with flashing lights and sirens.

The test for the Perimeter Warning lights is on Mondays at 1:35pm.
Do not enter the area during a test

6.5 Notification - Smelter

Notification – Smelter

Acid Plant Perimeter Warning Lights

As a reminder, if you are approaching this area and the warning lights and sirens have been activated, the instructions are as follows:

- Do not enter the plant or property and keep entry routes clear for Emergency Response vehicles.
- Remain in vehicles, close windows and shut off ventilation.
- Follow any instruction from Vale Emergency Response or Plant Protection personnel.
- If safe to do so, drive off site until the emergency condition is controlled (if unable to do so, remain parked in vehicle).
- Inform your supervisor of your current location due to entry restrictions and remain in contact until the emergency is resolved.
- Return to site once emergency has been deemed “all clear”.

7. Plant Exit

7.1 Plant Exit

7.2 Plant Exit

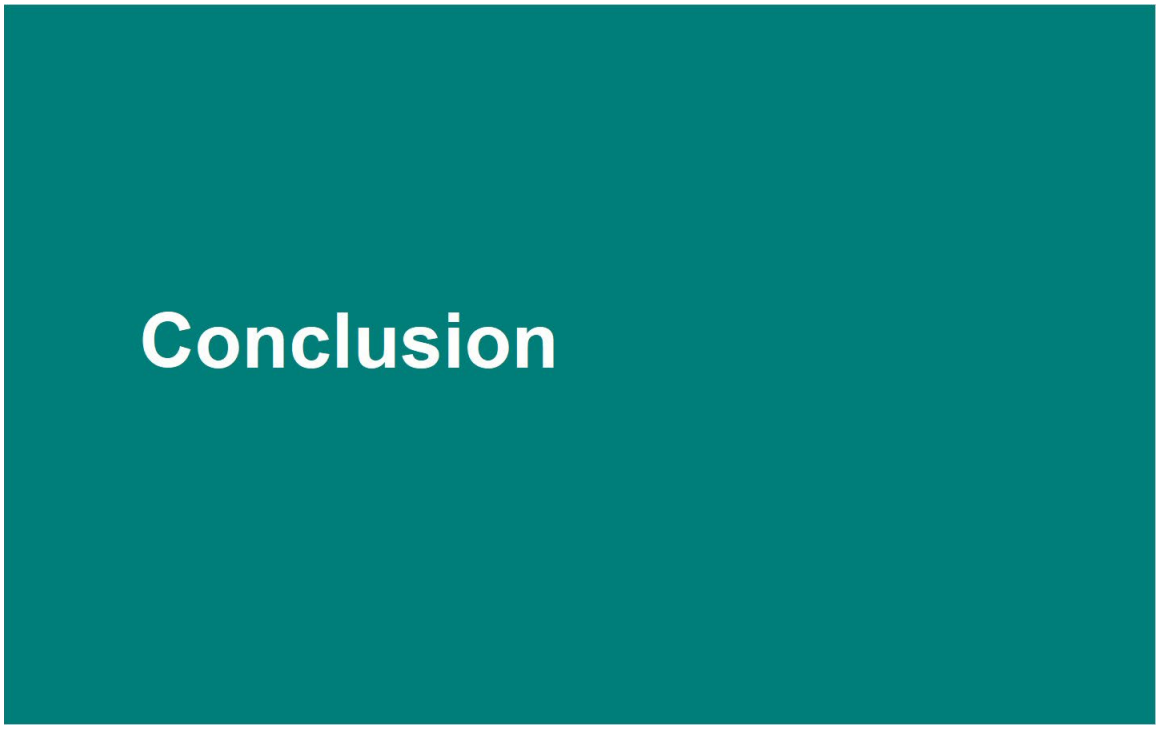
Plant Exit

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.

8. Conclusion

8.1 Conclusion



8.2 Conclusion

Conclusion

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

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

This Orientation provided information to access the Smelter. 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 the 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.

8.3 Conclusion

Conclusion

Remember, at Vale we believe
Life Matters Most
and that no job is worth doing
if it cannot be done safely.

Thank-you for your participation
and your commitment to safety at Vale.

HOME SAFE

8.4 Conclusion