ENV-ON-SUD-Environmental Emergency Response Plan (E2 Plan) Copper Cliff Smelter Complex

PGS-005913, Rev.02-1/1/2025

Issuer Area: Sudbury Operations – Environment Department
Technician Responsible: Name: Natalie Jones, Registration: LDD5373, Area: Environment Department.
Target Audience: Site Operators, Site Supervisors, Site Manager, Sudbury Environmental personnel
Need of training: (X)YES ( )NO

Expected results:

- ✓ To define roles and responsibilities, resources, equipment, and training requirements related to the emergency response plan.
- ✓ To summarize the site risk analysis by defining specific risk factors, including risk analysis, preparedness, prevention, and response.
- ✓ To define emergency response equipment and alerting/notification procedures.

This document applies to the following Vale facilities and jurisdictions:

Ontario: Copper Cliff Smelter Complex

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 PURPOSE

Facilities or responsible persons who own or have the charge, management or control of a substance that is included in Schedule 1 of the Environmental Emergency Regulations, 2019 (herein the Regulations) and in a quantity greater than that is listed in column 4 of Schedule 1 are required to prepare an environmental emergency response plan (an E2 Plan) that identifies potential environmental emergencies as defined in Section 193 of the Canadian Environmental Protection Act, 1999 (CEPA, 1999). Part 8 of CEPA, 1999 states the requirement to address the "prevention of, preparedness for, response to and recovery from environmental emergencies caused by uncontrolled, unplanned or accidental releases, and to reduce any foreseeable likelihood of releases of toxic or other hazardous substances listed in Schedule 1 of the Regulations" (Technical Guidelines for the Environmental Emergency Regulations, 2019).

These plans may be prepared in accordance with existing emergency response documents and systems (i.e. Emergency Preparedness or Crisis Management Plans) provided that they meet the requirements of subsection 4(2) of the Regulations or have been amended so that they meet all requirements.

A key pillar in E2 planning is the consideration of the risks present in the overall management of hazardous substances from movement, storage and disposal perspectives. Addressing key risks contributes to the overall reduction of risk severity through the implementation of critical controls and is an effective way to minimize potential catastrophic events.

2 FACILITY DESCRIPTION

2.1 Smelter Complex

Vale Canada Limited (Vale) has operated its Copper Cliff Smelter Complex (Smelter) for over a century, during which time it has undergone numerous transformations and upgrades. The Smelter is a pyrometallurgical facility which transforms metal-sulphide concentrate into copper sulphide, nickel sulphide and nickel oxide, with sulphuric acid as a by-product.

The current processes and streams at the Smelter, as of January 1st, 2021, are depicted in Figure 1. The process (and figure) changed in 2020. Operations started up the Converter Slag Cleaner process as well as startup of two new 450' stacks which effectively replace the existing Super Stack and Copper Stack.

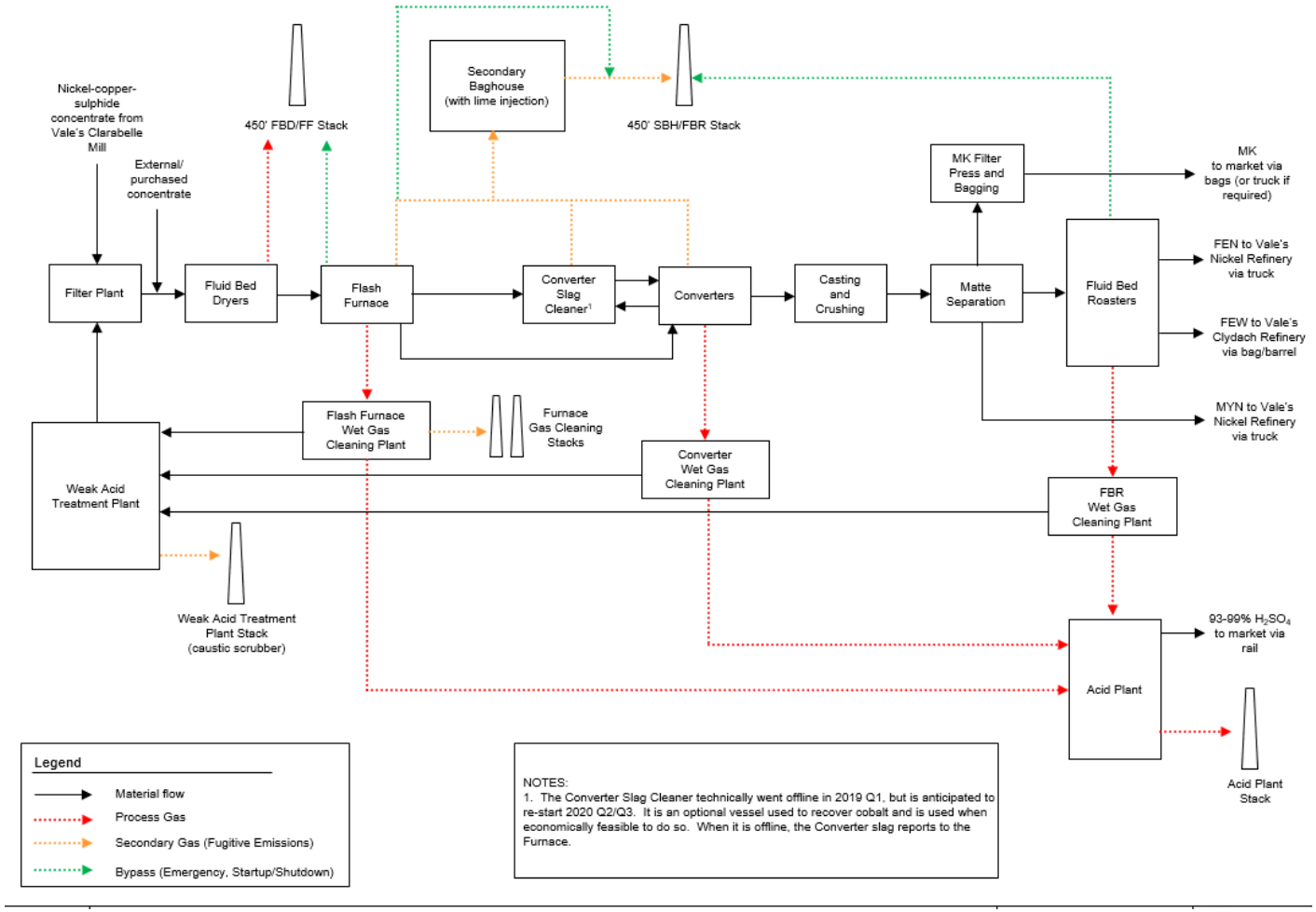

Figure 1: Copper Cliff Smelter Complex Process Flowsheet

2.2 Matte Processing

The Copper Cliff Smelter Complex has multiple facilities for different areas of metal processing. Matte Processing is the facility that produces the substance nickel oxide during the process. The Matte Processing plant comprises of Matte Separation, Fluid Bed Roasters (FBR) and Product Shipping. At the Matte Separation plant, crushed Bressemer matte from the Casting building is first ground in rod and ball Mills in order to liberate the three main fractions-copper sulphide(MK), nickel sulphides (ME and MR) and Magnetics (MYN). The metallics are recovered by magnetic separation and shipped to the C.C.N.R for processing. The remaining materials is subjected to a series of grinding classification and froth flotation operations to separate the copper sulphide from nickel sulphides. The copper sulphide concentrate, is filter pressed and shipped to customer in trucks or bags. The nickel sulphide concentrates are pumped to the FBR for further processing.

At the FBR plant (see Figure 2), the nickel sulphide concentrates (plus some Port Colborne Nickel Carbonate) are filtered and rolled into small pellets and fed with air into a fluid-bed roaster. Here the sulphur is burned off as SO2, and the nickel sulphide is converted to a nickel oxide containing about 71%-75% nickel and 0.3% to 0.1% sulphur. The resulting Nickel oxides are shipped to the Clydach refinery in Wales or to the Copper Cliff Nickel Refinery (see Figure 3). The FBR off-gas is directed to the Acid Plant via the FBR Wet Gas Cleaning Plant.

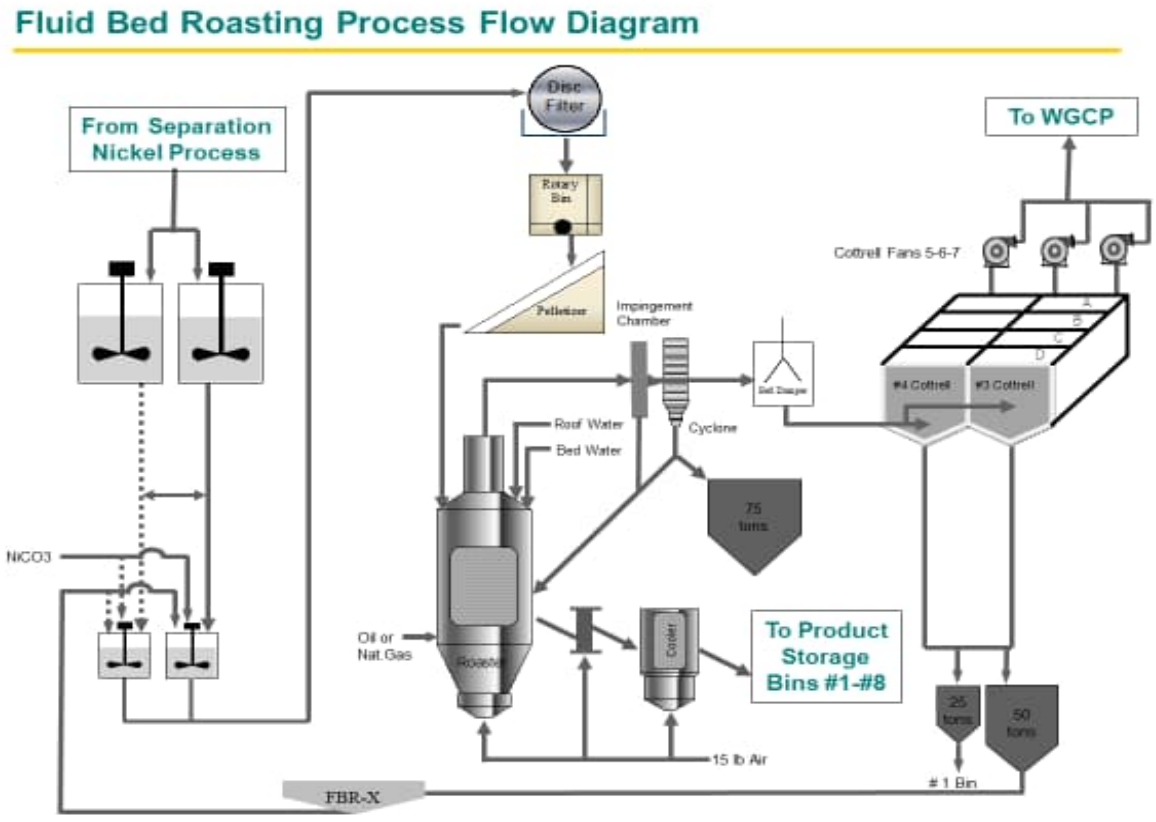

Figure 2: FBR Process Flow Diagram

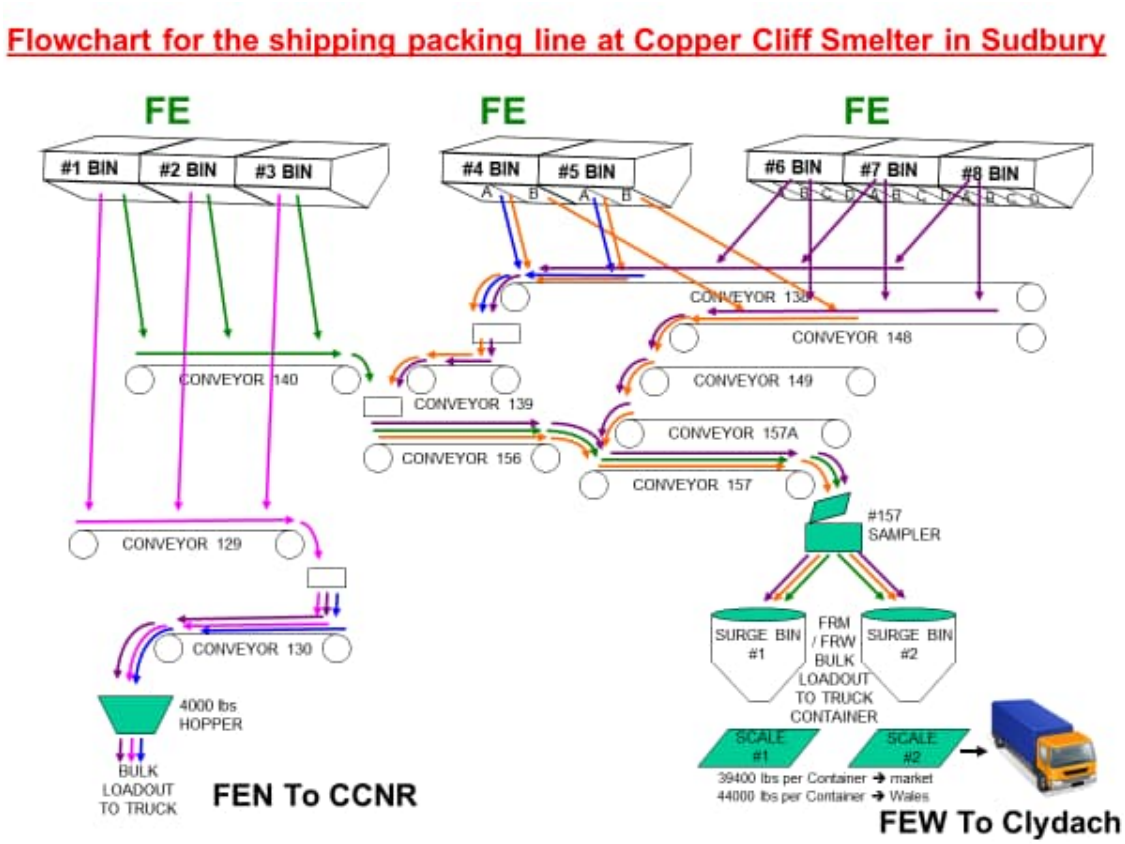

Figure 3: Flowchart for Packing and Shipping at Matte Processing

2.3 Surrounding Area

Sensitive receptors are places which would be significantly impacted by the adverse effects caused by an emergency at the Smelter. The sensitive receptors are listed below and have been incorporated in mapping the receptors associated with the Smelter Complex.

1. Hospitals;
2. Schools;
3. Residential, Commercial and Industrial buildings;
4. Highways;
5. Public Transit Infrastructure;
6. Parks;
7. Forests;
8. Wildlife habitats;
9. Water sources; and
10. Water Bodies

The following resources have been used to determine sensitive receptors that must be considered during the implementation of this plan:

- The City of Greater Sudbury's Official Plan (2008)

- Municipal Drinking Water Protection Plans to identify groundwater protection areas, waterbodies, capture zones and road networks (2008);
- Vale Monitoring/ Modelling Plans to identify locations of air monitors, buildings, emission sources, and sensitive receptors (2008);
- Land Use Map used to identify land uses near the property (2008);
- Natural Heritage Map used to identify ecological, cultural and First Nation values (2008);
- Flood Plain Plans to identify Special Policy Areas (2008).

All maps and figures can be found in the Spill Prevention and Contingency Plans which are located on the Vale Intranet site (http://intranet.valepub.net/en/canada/Pages/Sudbury-Safety-Health-Environment/Emergency-Management.aspx) for reference.

3 SCHEDULE 1 SUBSTANCES

The Smelter has one Schedule 1 substance that has quantities greater than the quantity listed in column 4 of schedule 1 and requires a substance specific emergency response plan. The substance is nickel oxide (<10 micron). Safety Data Sheets (SDS) are attached in Appendix A. A summary of physical and chemical properties for each substance is included in Table 1.

Table 1: Information on basic physical and chemical properties

Physical/Chemical Properties	Nickel Oxide
CAS Number	1313-99-1
UN Number	Not Regulated
Physical State	Solid
Colour	Granular, dark grey
Odour	Not provided
pH	Not Available
Melting Point	>1900ºC
Boiling Point	Not Applicable
Flash Point (close up)	Not Applicable
Explosive Limits	Not Applicable
Density	Not Applicable
Auto-Ignition Temperature	>400ºC
Soluble in Water?	3.52 E^{-5} g/l at 20ºC
E2 Hazard Category	Aquatically Toxic (A)

3.1 Nickel Oxide

Nickel oxide is a dark grey, granular, non-flammable solid that may cause irritation to skin upon contact. Symptoms of allergic reaction or asthma may present upon inhalation of the substance. The substance is considered insoluble in water. As such, limited environmental mobility in water is expected. However, it is classified as being aquatically toxic and may cause long lasting effects to aquatic life.

Nickel oxide is considered stable under normal conditions and there are no known incompatible substances for storage.

3.2 Maximum Expected Quantities

3.2.1 Nickel Oxide-Matte Processing

The Smelter has multiple facilities for different areas of metal processing. Matte Processing is the facility that produces the substance nickel oxide during the process. There are multiple containment systems that contain nickel oxide dust with a particle sizes of <10 microns. The Cottrell Dust Bin, the Baghouses, the Plenum Dust Bin, the Cyclone Dust Bin, the Cottrell Dust Slurry Mix tank, the Fluid Bed Roaster Extension Thickener Underflow FBRX-UF) and the Cottrell Electrostatic Precipitators (ESP). The largest containment system that contains the nickel oxide dust with a particle size of <10 microns is the FBRX-UF with a capacity of 76 tonnes. The maximum expected quantity of nickel oxide dust (wet and dry) with a particle size of <10 microns is a sum of the containment systems which has a total of 56.7 tonnes.

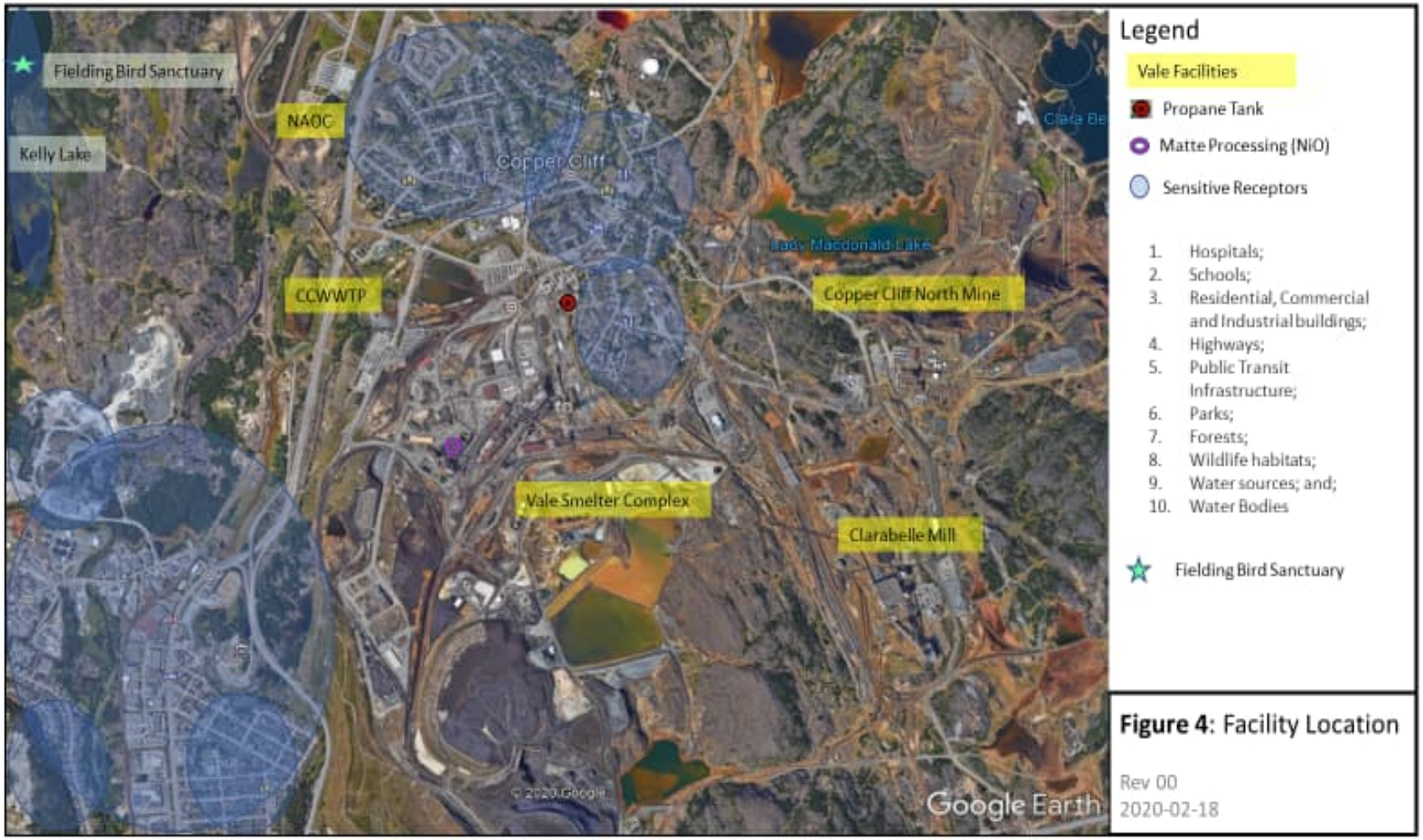

Figure 4: Vale's Copper Cliff Smelter Complex and Sensitive Receptors

3.3 Nickel Oxide production at Matte Processing

Nickel Oxide is produced during the Matte Processing process. Mills break down Matte into a fine slurry where Copper Sulphide (MK) is separated from Nickel Sulphide (ME, and MR) and Magnetics (MYN). MK is sent to the copper end for smelting; ME and MR are sent to the FBR and MYN is shipped to CCNR. The FBR converts Nickel Sulphide from separation (ME, MR) to Nickel Oxide in preparation for further refining at the CCNR and Clydach, Wales or for direct sale to market. The location of the Matte Processing facility is noted in Table 3 below, with its location shown on Figure 4 above.

Table 2: Nickel Oxide location at Matte Processing

Facility	Containment Location	Easting	Northing	Tank Size (tonnes)
Smelter Complex	Matte Processing	496149	5147048	56.7

4 POTENTIAL ENVIRONMENTAL EMERGENCIES

The potential for small or large releases of each of the substance at the Smelter exists and each has its own specific set of associated hazards. In the presence of an ignition source, some of the defined releases may result in fire at the site.

4.1 Nickel Oxide-Matte Processing

The potential for small or large releases of nickel oxide at the Smelter Matte Processing facility exists and has its own specific set of associated hazards. Considering the process includes dry and wet containment systems which creates various hazards that can occur during a large or small release. Table 5 summarizes worst case and alternate scenarios as prescribe by the Regulations. These scenarios are further described and assessed in subsequent plan sections.

Table 3: Potential Environmental Emergencies Related to Nickel Oxide

Facility	Tank Location	Potential Emergency Scenario	Scenario Description	Release of Maximum Quantity?[1]	Alternative Scenario?[2]
CC Smelter	Matte Processing	Small Release	Small release of Nickel Oxide (ex: spill while loading tanker truck)		x
CC Smelter	Matte Processing	Large Release	Large release (loss of complete tank capacity)	X	
CC Smelter	Matte Processing	Baghouse Failure	Partial baghouse failure (dust released to the atmosphere)		X
CC Smelter	Matte Processing	Release to watercourse	Tanker Truck looses load on the highway due to a collision or tip over		x

[1]Release of the maximum quantity of the substance that could be contained in the container system that has the largest maximum capacity

[2]Environmental emergency that is more likely to occur than the release of the maximum quantity of propane in the largest container at the facility and that would have the longest impact distance outside the boundary of the facility

4.2 Assessment of Possible Event

The 2016 Emergency Response Guidebook (ERG2016) issued by Transport Canada provides several emergency response guides for numerous hazardous material classes. The guides provide initial isolation distances that are protective of public health and safety in the event of a release. In addition, the guides provide downwind protection distances to consider. Wind speed and ambient air temperature should also be considered when assessing the severity of a release of any toxic substance. A study completed by Golder Associates Ltd., has been used as a guide to determine the effluent flow from Matte Processing.

Vale's Emergency Preparedness has the following measuring system in place to determine the level of emergency.

Level I Emergency – confined to a building within a mine or plant complex, with no effect to other parts of the mine, plant or public. The public is not notified for a Level I Emergency.

Level II Emergency – confined to a mine or plant complex but has no effect to the public. The public is not notified for a Level II Emergency.

Level III Emergency – any situation which could pose a significant hazard to personnel at other locations and/or to the public. Air horns are activated, and the public is notified for a Level III Emergency.

4.3 Nickel Oxide

4.3.1 Worst Case Scenario and Resulting Harm

The largest means of containment of nickel oxide at the Smelter is the FBRX-UF thickener tank at Matte Processing. The worst-case scenario would result in a complete failure of the thickener tank, causing a release of 32.39 tonnes of nickel oxide which is 50% of the slurry mixture. The flow of slurry would direct itself to the effluent system from Matte Processing's SLR box to the Lower Ponds which are located south of the building complex. The Lower Ponds outfall to Copper Cliff Creek where flows are directed for treatment at the Copper Cliff Waste Water Treatment Plant (CCWWTP) prior to any potential discharge to the environment. This would be considered a Level II emergency as it would be contained to the site as shown in Figure 6 below.

Information from the 2018 Selenium and Ammonia Management Options for Copper Cliff Waste Water Treatment Plant Influent Streams study report submitted by Golder Associates Ltd. has been used as a guide for the Matte Processing effluent flow. Discharge of the excess water from Matte Processing reporting via the SLR (waste water pipe at Matte Processing) discharge box to the Lower Ponds.

The excess water from the matte separation process reports via the SLR box discharged to the Lower Ponds which are located south of the building complex and receives runoff from the yard as well as inputs from Matte Processing. According to Matte Processing site personnel, this stream is relatively constant (except for extended plant shutdowns) and consists of:

- Overflow from two thickeners in the FBR
  - FBR Thickeners primarily for the filtrate from the feed filters, which is mainly nickel sub-sulphide but also most of the plant's clean -up pumps
  - The FBR Extension(FBRX-UF) thickener which is used exclusively for Cottrell dust, which is primarily a fine Nickel Oxide
- The overflow from the process water tank in Matte Separation
- Clean-up pumps in areas that typically see water without any major sources of solids

The thickener produces fine solids that become included in the discharge stream, primarily fine Nickel Oxide and Nickel Sulphide particles. The presence of Nickel Oxide can acidify the thickener and result in high levels of dissolved metals. This stream gets neutralized by mixing with the basic process water streams in the SLR box to precipitate out dissolved metals.

If nickel oxide enters a water body, it has the potential to harm local aquatic organisms. This can cause interference with cell growth and development as well as impair photosynthetic capability in aquatic plants[1]. Following a release of this nature, a preliminary assessment of the site would be conducted to determine the level of contamination present, if any. If metals were shown to be elevated, proper clean up and disposal of released materials would be coordinated through the Environment Department.

The effluent sewage system at Matte Processing has means of capturing industrial waste water and process water by gravitational pull through underground pipes. This system allows Vale to capture spills and overflow which is contained within its industrial sewage works and ponds and ultimately treatment

before or at the CCWWTP. It is unlikely that a spill from the FBRX-UF Thickener tank would be released outside the property boundaries.

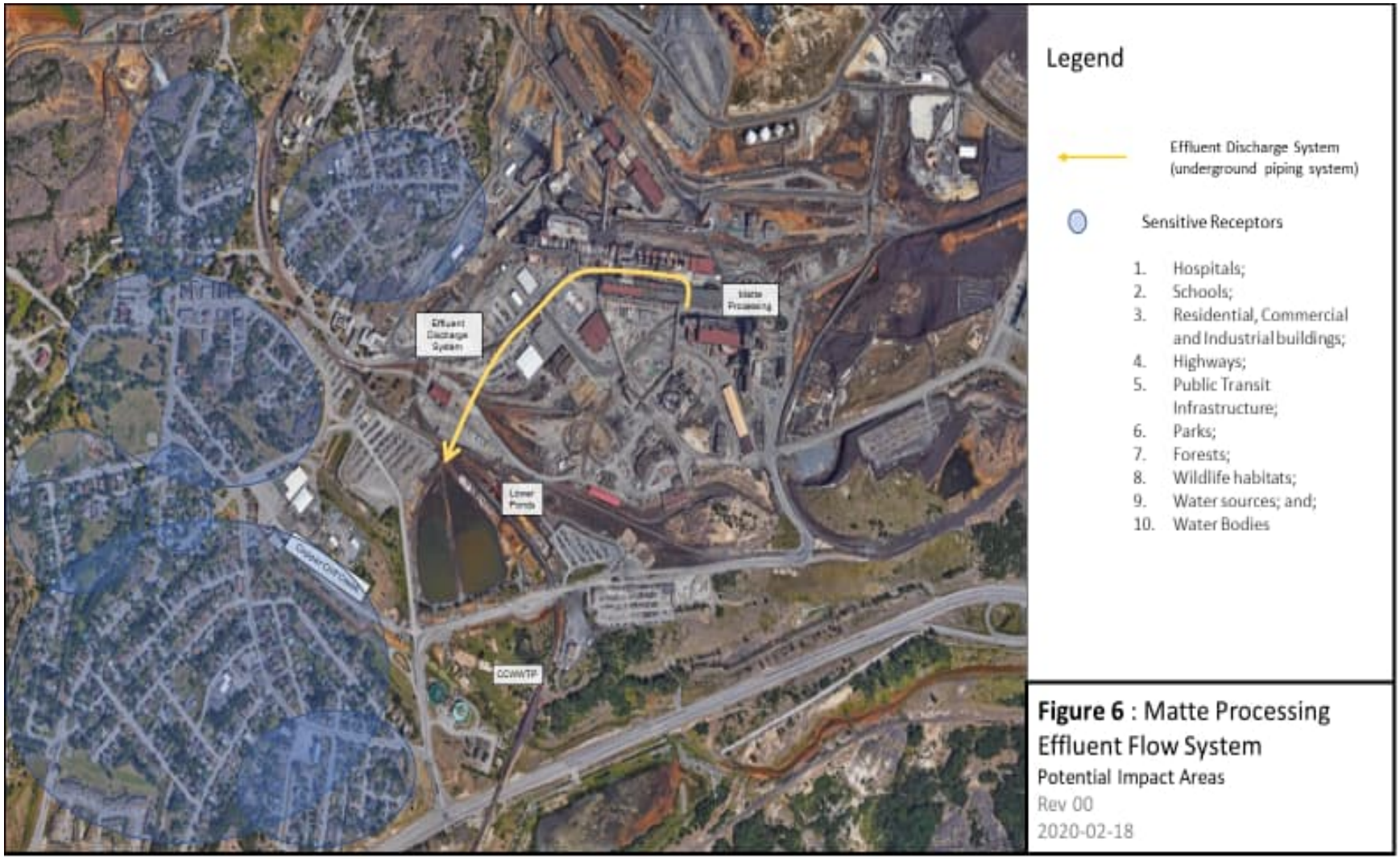

Figure 5: Matte Processing Effluent Flow System

4.3.2 Alternate Scenario and Resulting Harm

Baghouse Failure

A partial baghouse failure and/or fire is more likely to occur, than a complete release of the largest single container at Matte Processing facility. This scenario was developed by Matte Processing's Superintendent, Section Lead in Pyrometallurgy and the Metallurgical Pyrometallurgy Engineer based on the Risk Assessments likelihood/probability scale. This could be considered a Level II or III emergency, the meteorological conditions would need to be factored in as well as the season of the event. Although Nickel Oxide is not a regulated substance the Guide 170 within ERG2016 identifies isolation distances that are protective of public health and safety in the event of a fire for dust containing metals. Figure 7 below demonstrates the impact distances for a level III, that could possibly impact the areas outside of the property boundaries.

The potential health and physical hazards if exposed to nickel oxide particulates:

- Harmful if inhaled
- May cause an allergic skin reaction
- May cause allergy or asthma symptoms or breathing difficulties if inhaled
- May cause cancer by inhalation Causes damage to lungs through prolonged or repeated inhalation exposure
- Harmful to aquatic life with long lasting effects

EU REACH exposure scenarios for nickel oxide provided on Vale's intranet. (http://www.vale.com/EN/business/mining/nickel/product-safety-information/reach-scenarios-oxide/Pages/default.aspx)

Following a release from a partial baghouse failure or fire, a preliminary assessment of the site would be conducted to determine the level of contamination present, if any. If metals were shown to be elevated, proper clean up and disposal of released materials would be coordinated through the Environment Department.

Tanker Truck Looses Load with on the Highway – causes NiO to enter watercourse

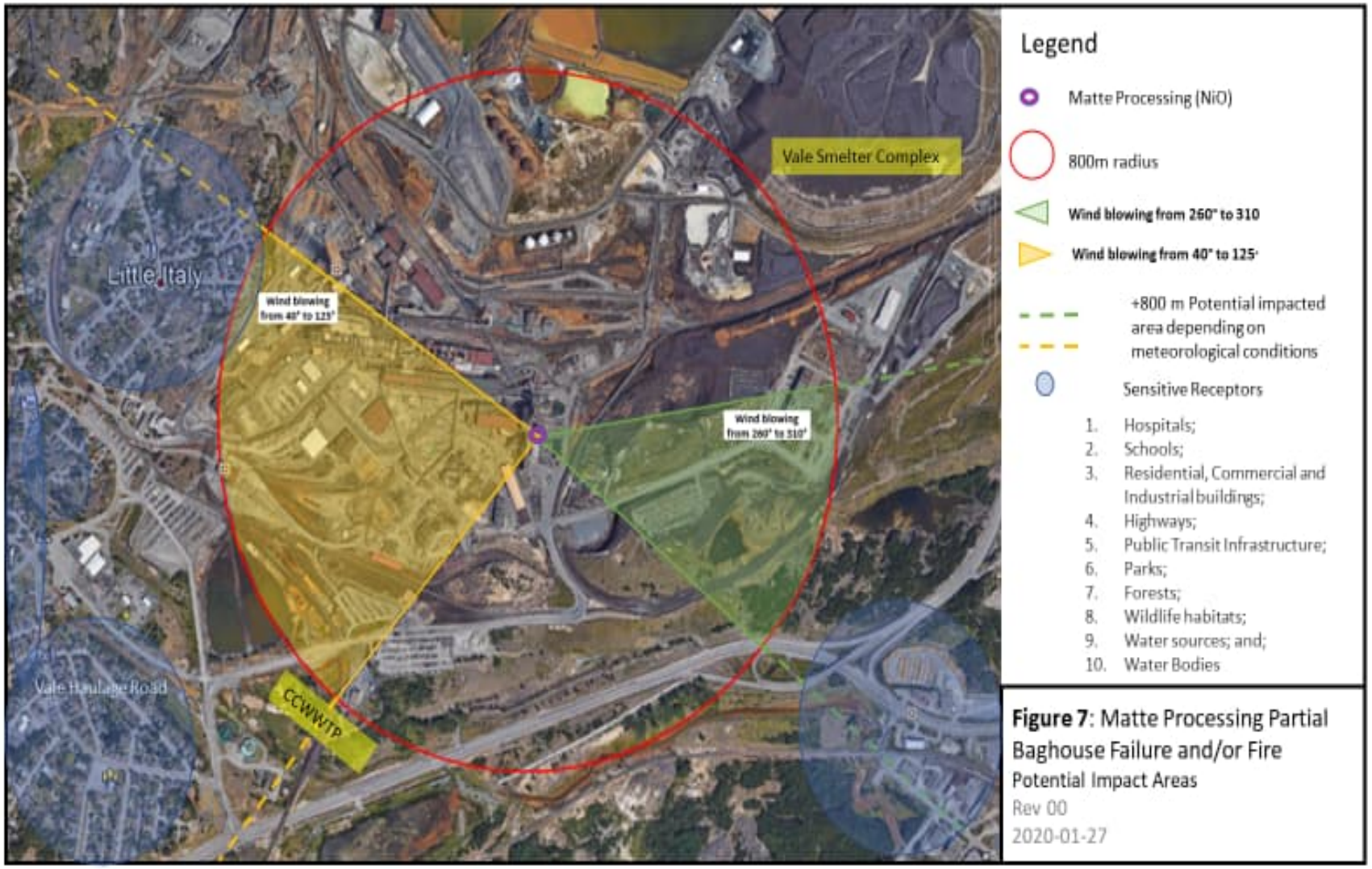

Figure 6: Matte Processing Potential Impact for Baghouse Failure and/or Fire

5 ENVIRONMENTAL EMERGENCY ACTIONS

The following section includes potential causes of environmental emergencies at the Smelter Complex involving the release of a regulated substance at the facility, the preventative measures in place, how the facilities are prepared to deal with such emergency as well as the recovery methods that will take be used in such event.

5.1 Potential Causes of Nickel Oxide Environmental Emergencies

Each identified environmental emergency involving nickel oxide containment systems at Vale's Sudbury, Ontario's Operations would stem from various circumstances. A release of dry or wet material could occur from: corrosion of the containment system, pipe failure, mobile equipment contacting and rupturing tank, improper maintenance or training, any process upset. Any of these causes has the potential to result in a release small or large and wet or dry. A partial baghouse failure and/or fire could result from having hot work performed near baghouses or dust build up and overheating of equipment.

6 PREVENTION

To prevent the release of any hazardous substance to the environment, there are several written documents that outline standard operations for the Matte Processing facility at the Smelter and the preventative controls in place to reduce the risk of a release and potential harm to people and the environment. Vale's intranet gives access to the Copper Cliff Smelter Job Procedures which can be searched by the procedure number, word in the procedure title or by searching the list procedures by job class. This system gives access to routine inspections, repairs, change and installation, start-up and shutdown, operations and daily checks.

7 PREPAREDNESS

An emergency resulting from the substances included in this Plan may cause substantial harm to people and/or the environment. As such, Vale has several means of preparing for such an emergency. They include, but are not limited to:

- Copper Cliff Smelter Complex Emergency Preparedness Manual
- Copper Cliff Smelter Complex Spill Prevention and Contingency Plan
- Annual testing of emergency response plans
- Ambient Air Particulate Dust Monitoring Program
- Training for all Control Room Operators
- Copper Cliff Waste Water Treatment Plant Operator Training
- Safety Health & Environment Management System (SHE MS)

In addition, the Smelter ensures that emergency and protective equipment is available if emergency response is required.

- SCBA (BMR Ultra-elite)
- Jumbo Cylinder Cascade Systems (for Recharging SCBA-Cylinder)
- Spill Kits
- Fire Extinguishers
- Hose Reel Extinguisher Stations
- Water Sprinkler Systems
- Fire Hydrants
- Fire Alarms and Pull Stations
- Emergency Kit Boxes
- Stretcher Boxes
- Fire Hydrants
- Emergency Exit Signs
- Suppression Systems

8 RESPONSE

The response that is required in the event of an emergency is outlined in detail in the Copper Cliff Complex Emergency Preparation Manual, the Spill Prevention and Contingency Plans, the EMRG2016 Guide 115 and Guide 170. In addition to the emergency response procedures listed below, the site also maintains several standard job procedures for all facilities at the Smelter that can be referenced in the event of a site emergency.

8.1.1 Emergency Response: Nickel Oxide Release

Nickel Oxide is not a regulated substance however, the following response information is related to the ERG2016 Guide 170 based on dust containing metal. The following actions should be taken if a spill or leak of Nickel Oxide occurs;

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area)
- Do not touch or walk through spilled material
- Stop leak if you can do it without risk
- Prevent entry into waterways, sewers, basements or confined areas.

First Aid measures to follow;

- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.
- Move victim to fresh air
- Call Emergency Services
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Keep victim calm and warm.

In the event of a Large Spill Response (volume > 100 L), it is recommended that a qualified person/company (i.e.KRT) assists in the environmental remediation to ensure that the proper remediation standards are applied and to assess the need for any adverse effect monitoring. Adverse effect monitoring can include Phase I and Phase II Environmental Assessments, Contaminant Management Planning and Site Remediation. The Vale Environmental Department will advise on situations, which may pose a “significant” risk to the environment.

For medium and large spill response, determine and acquire any heavy equipment, operators, labourers and contractors required to remediate the spill.

- Vac truck
- Excavator
- Licensed petroleum mechanic
- Front end loader
- Qualified personnel
- Bobcat loader
- Licensed waste hauler (trucks, waste bins)
- Kubota
- Licensed waste receiver
- Trained spilled response labourers

- Digging permits (area locate) - Environmental Filed Technician

A list of contractors and additional resources can be found in the Spill Prevention and Contingency Plans for the Smelter (Appendix F-Additional Resources).

8.1.2 Emergency Response: Nickel Oxide Baghouse Fire

Nickel Oxide is not a regulated substance however, the following response information is related to the ERG2016 Guide 170 based on metal containing dust. The following actions should be taken if a fire containing Nickel Oxide dust occurs;

- DO NOT USE WATER FOAM OR CO_2.
- Dousing metallic fires with water will generate hydrogen gas, an extremely dangerous explosion hazard, particularly if fire is in a confined environment (i.e., building, cargo hold, etc.).
- Use DRY sand, graphite powder, dry sodium chloride-based extinguishers, G-1 or Met-L-X powder.
- Confining and smothering metal fires is preferable rather than applying water.
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads

- If impossible to extinguish, protect surroundings and allow fire to burn itself out.

A Fire Safety Plan Checklist has been developed to assist with compliance to the Ontario Fire Code Requirements. (Refer to Emergency Preparedness Manual for the Copper Cliff Smelter Complex-Appendix B -Fire Safety Document/Forms.)

Fire Protection Equipment
The following fire equipment is in place:
• Fire Extinguishers
• Hose Reel Extinguisher Stations
• Water Sprinkler Systems
• Fire Hydrants
• Fire Alarms and Pull Stations
Refer to Emergency Preparedness Reference Maps for Hydrant locations. A detailed list of Fire Protection Equipment is kept with the Smelter Emergency Systems Group.

9 RECOVERY FOR ANY LEVEL OF EMERGENCY

The recovery process for any level of emergency at the Smelter is detailed in the Copper Cliff Complex Emergency Response Manual in section 5.11.1. The Smelter must ensure that emergency operations are carried out to their logical conclusion. This involves making sure that, where applicable, the following issues are addressed.

- Damage assessment
- Clean up
- Post-Emergency Response review
- Repair of damaged equipment
- VALE internal investigations
- Government investigations & notifications
- Critical Incident Stress Management
- Business Continuity

9.1 Damage Assessment

An emergency will often cause structural damage to buildings or operating units. In this case a thorough examination of the structural integrity of the damage structures must be carried out before any repair work is undertaken. The Operating Superintendent will work with the Accounting Department to ensure that damage assessments are carried out in a timely manner.

9.2 Clean-up

External contractors will be called to support clean up efforts by providing equipment such as a vac truck or an excavator. The Material will be collected and reprocessed as required.

All emergency response equipment used in emergency operations will be cleaned and repaired prior to response personnel returning to their regular duties.

9.3 Post Emergency Response Review

A thorough review of all aspects of response to an emergency will be conducted as soon as possible after the conclusion of operations.

The post emergency review will examine:

- Activation of First Response team
- Activation of Emergency Response teams
- Communications
- Resource allocation
- Alert Call Centre response

A written report of the review findings will be produced after each Emergency Response and is to be forwarded to the Plant Manager and area OSHE Committee for review. Qualified company personnel will carry out all investigations. Where applicable, a member of the Emergency Preparation Committee should

participant in the post review. Alternatively, VALE may decide that it may be appropriate to retain the services of qualified consultants and other service providers to conduct investigations of behalf of the company.

The Emergency Preparation Committee will continue to audit the progress of the investigation's recommended actions once findings are made.

9.4 Repair of Damaged Equipment

All equipment damaged in an emergency will be repaired or replaced as required. Repairs will not be started until after all required investigations have been completed and investigators have released the site of damage. This applies to all investigations, both by VALE and by Government.

9.5 Vale Internal Joint Investigations

Investigations are required to identify causes and ways to prevent future incidents. They are also required to satisfy company policy requirements. Investigations by VALE into the emergency are distinct and separate from the Post Emergency Response Review referred to in section 5.8.4 noted above.

The Operating Superintendent in conjunction with the Worker Safety Representative ensures that investigations are initiated and followed through to completion.

- Root cause analysis of the emergency
- Safety investigation
- Environment investigation

The Operating Superintendent will continue to audit the progress of the investigation's recommended actions once findings are made.

10 ROLES AND RESPONSIBILITIES

The following sections outline the general responsibilities of those identified in the emergency organization.

Smelter Manager- The Smelter Manager is accountable for the Smelter during an emergency. The Smelter Plant On-Call assumes this accountability outside of regular office hours or in the Manager's absence. The responsibility to manage an emergency has been delegated to the On-scene Emergency Coordinator.

On-scene Emergency Coordinator- The On-Scene Emergency Coordinator is the on-site person designated to manage an emergency event. The role is held by Smelter Production Superintendents; they are backed up by Hot Metal Supervisors and Maintenance Shift Supervisor.

On-scene Coordinator Responsibilities

- Confirm the declared emergency and level classification
- Assumes responsibility over the emergency
- Coordinates on-site emergency response activities
- Directs Emergency Response and/or First Response operations as required
- Summons external assistance and conveys notifications as required
- Liaise with on-site outside emergency agency activities
- Determines changes to the level of emergency as the situation evolves (reductions and escalations). Communicates changes via the Communication Centre.
- Declares the ALL CLEAR for Level I and II Emergencies
- Ensure the workplace is secure for the re-entry
- Obtain On-Scene Coordinator training and EQUAL code SSS503 qualifications. Maintain associated qualifications in SCBA use.

First Responders - The First Responders are comprised of:

- Smelter Shift Electrical
- Smelter Shift Instrumentation
- Smelter Shift Maintenance
- Smelter Shift Combustion

First Responder Responsibilities

- Continually monitor radio communications for emergency notification
- Serve as a knowledgeable guide for external emergency services (fire, police, EMS). Meet them at a specified location and direct them to the scene. Provide communication and future outside guidance as required.
- Obtain First Responder training and EQUAL code SSS500 qualification. Maintain associated qualifications in SCBA use.

Plant Responders - The Plant Responders are comprised of:

- Area Supervisor or designates assigned by the Area Manager

Plant Responder Responsibilities:

- Continually monitor radio communications for emergency notification.
- Provide direction for location of emergency and meeting of emergency responders to #1 First Aid.
- Receive emergency responders at the stipulated location.
- Serve as a knowledgeable guide for external emergency services (fire, police, EMS). Safely guide them to the emergency site and provide information on area potential hazards.
- Ensure that all personnel are accounted for in a Surface Safe Assembly or Evacuation Area.
- Coordinate isolations as required.
- Remain in contact with the On-Scene Coordinator.
- Assist the On-Scene Coordinator in declaring the ALL CLEAR.
- Maintain Associated qualifications in SCBA use.

Warden - The Wardens are comprised of:

- Area Supervisors or designates assigned by the Area Manager

Warden Responsibilities:

- Continually monitor radio communication for emergency notifications.
- Provide direction for location of emergency and meeting of emergency responders to #1 First Aid.
- Receive emergency responders at the stipulated location.
- Serve as a knowledgeable resource for external emergency services (fire, police, EMS. Provide information on area potential hazards.
- Ensure that all personnel are accounted for in a Surface Safe Assembly or Evacuation Area.
- Remain in contact with the On-Scene Coordinator.
- Assist the On-Scene Coordinator in declaring the all clear.

Protection Services Personnel - In an emergency, Plant Services Personnel (PSPs) provide First Aid and security support for the plant during an emergency (Level I, II, III).

Protection Services Personnel Responsibilities:

- Secure site.
- Prepare to provide first aid, as may be required.
- Assist #1 First Aid as may be required.

#1 First Aid (Alert Call Centre & Communication Centre)

The PSP in #1 First Aid runs the Alert Call & Communication Centres. (There is a Back-Up location at the Nickel Refinery- that Nickel Refinery PSP would take over if #1 First Aid had to be evacuated.)

Alert Call Centre Responsibilities:

- Receives calls advising of an emergency.
- Activates Vale Emergency Notification system advising Sudbury Operations of emergency.

- Notifies outside emergency services as required.
- Notifies Safety, Environment & Executive On-Call
- Runs SAFER when applicable and provides vital information to emergency responders.
- When necessary, provides on-going communications with outside emergency services.
- On directions from Executive On-Call or the On-Scene Coordinator, advises of the "ALL CLEAR".
- Keeps written records of all events.

Communication Centre Responsibilities:

- Receives calls advising of an emergency.
- Activates Vale Emergency Notification system and Gaitronics Tone Alerts.
- Activates Smelter Air Horn and directs activation of the Nickel Refinery Air Horn (in Level III events)
- Activates First Responders and On-Scene Coordinator (via Radio "All Call").
- Upgrades or downgrades the Level as per direction from the On-scene Coordinator.
- Keeps written record of all events.

Assembly Area Coordinator - Assembly Area Coordinators take charge of the Assembly Area. It is expected that the first person arriving at the Assembly Area assume responsibility. Instructions are in Emergency Lockers and Boxes in Surface Safe Assembly Area and Evacuation Areas.

Assembly Area Coordinator Responsibilities:

- Assume control of the Assembly Area.
- Delegates personnel to perform accounting of workgroups by passing out attendance sheets.
- Ensures that all visitors sign in books have been retrieved and personnel are being accounted for.
- Delegates personnel to take the required action to secure the Assembly Area (i.e seal room, shutdown H&V's, or use air sampler).
- Receives emergency information during the event (via radio or Emergency Phone). Conveys all information received to personnel assembled.
- Communicates the "ALL CLEAR" when the event is over.
- Completes and returns documentation to the Emergency Management Coordinator for post emergency/drill evaluation: - Personnel accounting lists

Copper Cliff Complex Master Accountant - Copper Cliff Complex Master Accountants have been selected (and back-up individuals designated) to cross-reference the information obtained from Assembly Area Coordinators to determine who may be missing. In the absence of a designated individual, someone else must assume this responsibility. Instructions are located on the Copper Cliff Complex Emergency Management Intranet Site

Copper Cliff Complex Master Accountant Responsibilities

- Obtains the names of those who are suspected "missing" and those who are "extra" to the expected occupants (contractors, visitors) of all Assembly Areas:
  - Dayshift weekdays (Smelter Administration Building Personnel):
    - Phones each Assembly Area records the names of missing and extra personnel.
    - Once all areas are contacted, the names are consolidated by reviewing each area to determine if the missing personnel are appearing extra at other locations.
    - If required, each area is contacted again to see if there are any changes to their lists.

- The status of the accounting process is relayed to the On-Scene Coordinator on Smelter Channel 16.

o Backshift (Flash Furnace Control Room, with FBR Control Room, as the alternate):

- Phones each Assembly Area records the names of missing and extra personnel.
- Once all areas are contacted, the names are consolidated by reviewing each area to determine if the missing personnel are appearing extra at other locations.
- If required, each area is contacted again to see if there are any changes to their lists.
- The status of the accounting process is relayed to the On-Scene Coordinator on Smelter Channel 16.

Matte Processing Control Room Operator - The emergency shutdown process for Matte Processing facility is stated in the following:

- Stop feed conveyors
- Shutdown 1A and 1B rod mills.
- Shutdown Roasters.
- Shut water off coolers.
- Wet Gas Cleaning Circuit

11 TRAINING

The Smelter employees receive emergency and fire safety training annually (code SA216) so they can recognize the difference between invac and outvac emergencies and any area specific assembly area procedures that they will be required to follow when they enter a department. Individuals who are part of the emergency response teams for the Smelter Complex are required to annually complete the First Response Review (SSS500.75) for their respective facility as well as complete the MSA SCBA (SRP 4500) Operation and Full-Face Mask Fit Test.

Drills and Exercises
An Emergency Surface Safe Assembly Area drill and a Fire Emergency Drill will be conducted at least once each year for staff and employees. It will test the response of employees to a gas emergency event and the process used in the assembly areas. A debriefing process will be used to identify any deficiencies in response and of the audible alarm systems. The Copper Cliff Complex Emergency Management Coordinator will facilitate the process to address all deficiencies.

Responsibility for Coordinating Training
The Copper Cliff Complex Emergency Management Coordinator is responsible to:

- Establish and maintain the training criteria for key roles within emergency plans.
- Establish and maintain the training criteria for general worker emergency awareness review.

Training Program
First Responders are trained on an annual basis. Training includes:

- First Response Review SSS500
- MSA SCBA Operation SRP 4500
- MSA full face mask fit test

On-Scene Coordinators are trained on an annual basis. Training includes:

- On Scene Coordinator Response Review SSS503
- MSA SCBA Operation SRP 4500
- MSA full face mask fit test

There are quarterly communication exercises with the City to test/verify the Standard Operation Procedures and well as Sudbury Alert systems (aka Everbridge).

<u>Training for the FBR Control Room Operator</u>

Job shadowing is a type of on-the-job employee training in which a new employee, or an employee desiring to become familiar with a different job, follows and observes a trained and experienced employee. The FBR control room operator's training is completed by job shadowing. Job shadowing allows employees to gain comprehensive knowledge about what an employee who holds that role does every day. Job shadow training duration is on-going for approximately six months.

12 NOTIFICATIONS AND ALERTS

12.1 Potential Environmental Emergencies

Vale utilizes several different means of communicating with the public. Examples include, but are not limited to:

- Vale Open Houses (i.e. during Emergency Preparation Week)
- Information Pamphlets
- Posters

Information on potential environmental emergencies, as defined in the Regulations and applicable to the Smelter Complex and Vale's operations, will be provided to the community using one of the above means of communication and will specifically address the hazards associated with each substance included in this Plan. In addition, it will identify all scenarios that are most likely to occur at the site and the corresponding potential effects that could be anticipated. The public will be made aware of the emergency response procedures outlined in this Plan (Section 8 in this plan) and will be advised of how Vale will communicate an emergency should it occur. All information contained in this plan will be communicated by the Corporate and Indigenous Affairs Specialist.

12.2 Actual Environmental Emergencies

The public will be notified in the event of a Level III Emergency involving any of the two substances in this Plan. Once the site has determined that a Level III Emergency has been called, the Communication will notify the Vale Alert Call Centre (Smelter #1 First Aid). The Alert Call centre is responsible for contacting all other plants using the Vale Notification System.

Alerts and notifications will follow from roles and responsibilities listed above and, in the case of emergencies, the emergency response plans in this Plan should be followed. Notifications to regulators will be made by the Superintendent, Environment or a designate including both initial notifications and follow-up written reports or responses to inquiries, as required.

This Plan is available on the Vale Emergency Management Intranet site (http://intranet.valepub.net/en/canada/Pages/Sudbury-Safety-Health-Environment/Emergency-Management.aspx) and any environmental emergency involving the scenarios included in this Plan that have the potential to impact the public will require notifications to be made.

12.3 Consultation with Local Authorities

Vale is prepared for all types of incidents and emergencies through a robust and multi-faceted emergency response program. Nickle Oxide will not cause a level III emergency, but if residents are affected by Nickel Oxide, alerts will go out via Sudbury Alerts (Figure 7 and 8).

Consultation with local authorities is ongoing. Sudbury Fire is now our emergency response contact and will be notified of an environmental emergency concerning Nickel Oxide.

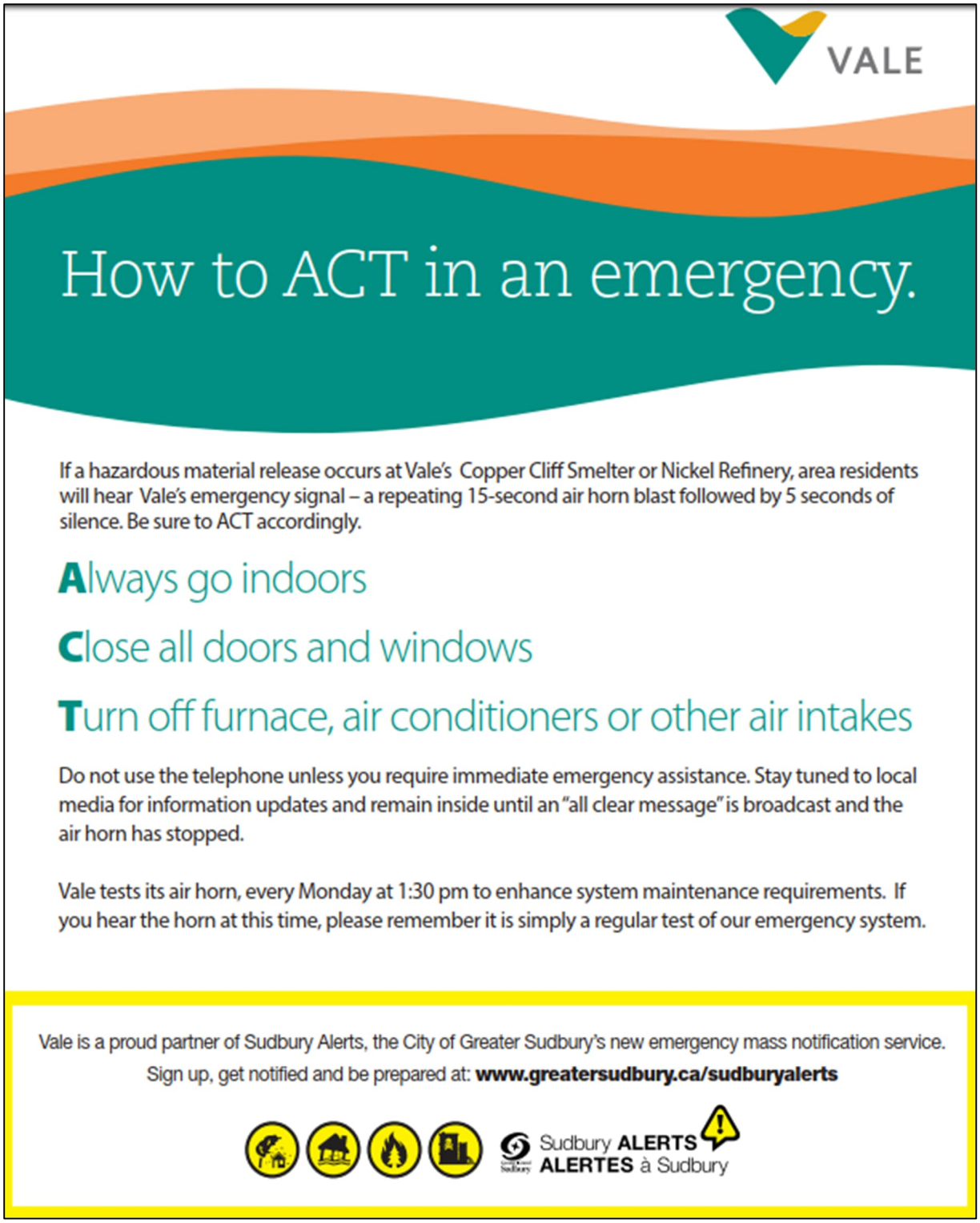

Figure 7: How to ACT in an emergency

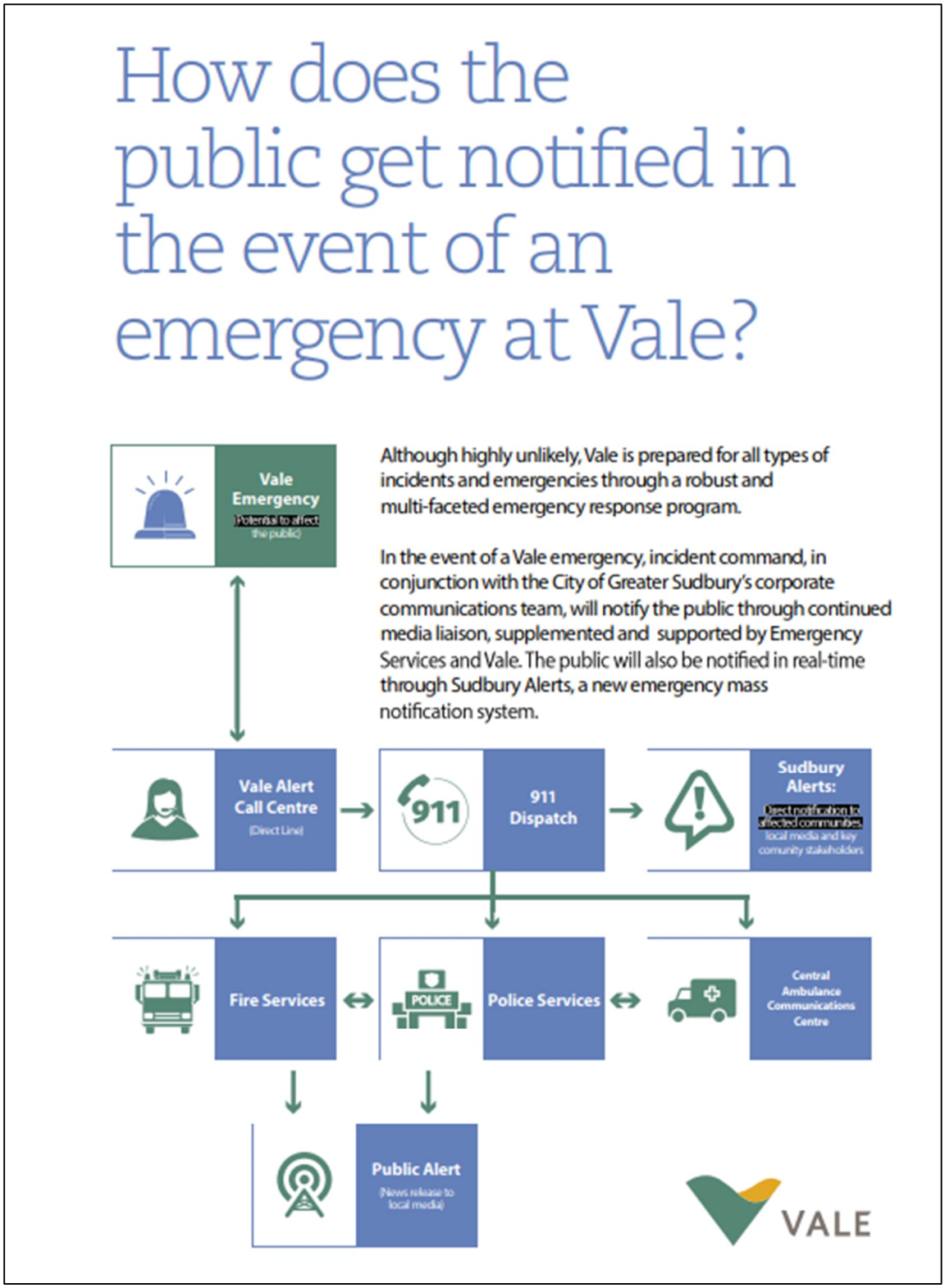

Figure 8: Vale's Public Emergency Notification System

13 REVISION HISTORY

Version Number	Date	Revision Type	Content	Reason for Edit	Name	Approver
—	24 Feb 2020	Original	E2 Plan	Plan preparation; first draft	—	—
—	10 Feb 2021	Update	E2 Plan	Propane Tank (**9.56 tonnes tank**) was removed from site. Propane is no longer required to be regulated under E2 regulation.	—	—
—	29 Nov 2022	Update	E2 Plan	Removed reference to TSSA related to propane, updated table of contents, added specific information around resources such as certified spill response and other documents for spill prevention. Removed notification with respect to activating horns. Nickel oxide will not cause a level III emergency and a release would remain on site, not impacting beyond the boundaries.	—	—
00	1 Jan 2023	Uploaded to SISPAV	E2 Plan	Integrated into ISO 14001 template.	A. Corson	N. Jones; L. Lanteigne
01	1 Jan 2024	Update	Appendix	Added Annual Test of Plan Template Form	A. Corson	N. Jones; L. Lanteigne
02	1 Jan 2025	update	E2 plan	Added scenario regarding tanker looses load on public highway – Nickel Oxide impacts watercourse	A.Corson	N.Jones

*If no changes come out of annual plan review, a revision record must still be entered. Include the date of revision and a note that no changes resulted from annual plan review.

Appendix A – Safety Data Sheets

Nickel Oxide

Section 1. Identification of the Substance and Company

1.1 Product Identification:

Product Name: Nickel Oxide

Synonyms:

Nickel oxide sinter 75	NOS75	Nickel (II) Oxide
FMW	FEW	FEN
Green nickel oxide	Nickel oxide (NiO)	Nickel monoxide
Japanese Nickel Oxide	TNOS	Bunsenite
Ni Oxide Chunks		

EC No: 215-215-7 / 234-323-5

CAS No: 1313-99-1 / 11099-02-8

REACH Registration number: **see Section 15**

1.2 Uses

Identified Uses:

- Use of nickel oxide for the formulation of nickel oxide-containing catalysts and catalyst precursors
- Use of nickel oxide-containing catalysts
- Industrial use of nickel oxide-containing catalyst precursors for the manufacture of other nickel substances in catalysts
- Use of nickel oxide for the manufacture of nickel-containing powders
- Use of nickel oxide for the manufacture of nickel-containing frits
- Use of nickel oxide for the manufacture of nickel-containing inorganic pigments
- Use of nickel oxide for the manufacture of nickel-containing glass
- Use of nickel oxide sinter in the production of stainless, special steels and special alloys
- Use of nickel oxide for the production of nickel-containing electronics and thermally functioning ceramics
- Use of nickel oxide for the production of nickel-zinc ferrite cores
- Service life of nickel-containing electronics/ferrite cores in industrial settings
- Service life of nickel-containing electronics/ferrite cores in professional settings
- Service life of nickel-containing electronics/ferrite cores (consumers)
- Production of nickel oxide-containing automotive catalysts
- Service life of manufacture of vehicle exhaust system in industrial settings
- Service life of manufacture of vehicle exhaust system in professional settings
- Catalyst application in vehicles

Uses Advised Against:

- None Identified.

1.3 Company Identification

Manufactured by:

Vale Canada Limited
Ontario Operations
Sudbury, ON
Canada PoM 1No

Vale Japan Limited
Matsusaka Plant
345-52 Ryoshicho, Matsusaka City
Mie 515-0802, Japan

Distributed by:
Vale Canada Limited
200 Bay St., Royal Bank Plaza
Suite 1600, South Tower, PO Box 70
Toronto, Ontario
Canada, M5J 2K2
Email: msds@vale.com

Imported by:

In North & South America
Vale Americas Inc.
140 E. Ridgewood Avenue
Suite 415, South Tower
Paramus, NJ 07652
U.S.A

In Asia (Except India & Pakistan)
Vale Base Metals Asia Pacific PTE. Ltd
One Temasek Avenue #39-01
Millenia Tower
Singapore, 039192

In Europe, Middle East, Africa, India & Pakistan
Vale International SA
Route de Pallatex 29
1162 Saint-Prex
Switzerland

EU REACH Contact
Vale Europe Limited
Clydach,
Swansea
SA6 5QR
Telephone number: +44 (0) 1792 8412501
Email: REACH@vale.com

For Fire, Spill, or chemical emergency call CHEMTREC: +1 703 527-3887
for Europe call CHEMTREC: +(44) 870 8200418

Section 2. Hazards Identification

2.1 Classification of the Substance:

Acute toxicity inhalation – Category 4
Skin Sensitization – Category 1
Respiratory Sensitization – Category 1
Carcinogenicity – Category 1A
Specific Target Organ Toxicity, Repeated exposure – Category 1
Aquatic Chronic – Category 3

Hazard Pictograms:	GHS07 - Exclamation mark, GHS08 - Health Hazard,
Signal Word:	Danger
Hazard Statements:	H332 – Harmful if inhaled H317 - May cause an allergic skin reaction H334 – May cause allergy or asthma symptoms or breathing difficulties if inhaled H350 - May cause cancer by inhalation

H372 - Causes damage to lungs through prolonged or repeated inhalation exposure
H412 –Harmful to aquatic life with long lasting effects.

Precautionary Statements: P201, P202, P260, P261, P264, P270, P271, P272, P273, P280, P284, P302+P352, P304+P340, P308+P313, P333+P313, P314, P321, P342+P311, P362+P364, P405, P501

2.2: Label elements

Product identifier: Nickel Oxide
CAS #: 1313-99-1 / 11099-02-8
Symbols:

GHS07 - Exclamation mark

GHS08 - Health Hazard

Signal Word: Danger

Hazard Statements:
H332 – Harmful if inhaled
H317 - May cause an allergic skin reaction
H334 – May cause allergy or asthma symptoms or breathing difficulties if inhaled
H350 - May cause cancer by inhalation
H372 - Causes damage to lungs through prolonged or repeated inhalation exposure
H412 –Harmful to aquatic life with long lasting effects.

Precautionary Statements:
P202 – Do not handle until all safety precautions have been read and understood
P261 - Avoid breathing dust or fume; Wear respiratory protective equipment if fine dusts are generated
P273 - Avoid release to the environment.
P302+P352 - If on skin: Wash with plenty of soap and water.
P501 - Dispose of contents/container in accordance to local/regional/national/international regulations

(Note: P-statements have been reduced)
For full text of Precautionary statements see section 15.

Section 3. Composition

☒ **Substance** ☐ **Mixture**

Typical Analysis:

Hazardous Ingredients	Typical Composition (%)	C.A.S. Number	EINECS/EC Label No.
Nickel Oxide (NiO)	90-96	1313-99-1	215-215-7
Copper Oxide (CuO)	0.2-9.0	1317-38-0	215-269-1
Cobaltous Oxide (CoO)	0.5- 1.5	1307-96-6	215-154-6
Nickel hydroxide	0 – 0.5	12054-48-7	235-008-05

Section 4. First Aid Measures

Ingestion: No specific first aid required.

Inhalation: No specific first aid required.

Skin: Remove contaminated clothing, and wash affected areas thoroughly with soap and water. If skin irritation or rash occurs: Get medical advice/attention. Show label if possible.

Eyes: Irrigate eyeball thoroughly with water for at least 10 minutes. If discomfort persists seek medical attention.

Most important symptoms and affects, both acute and delayed Skin contact: Rash
Eye contact: Redness

Indication of immediate medical attention and special treatment needed No special requirements

Section 5. Fire Fighting Measures

Suitable extinguishing media: Any, type to be selected according to materials stored in the immediate neighbourhood.

Special risks: Non-flammable. Extinguish surrounding fires with appropriate methods.

Special protective equipment for fire fighting: None needed. Wear protective equipment if required for other materials within the immediate vicinity.

Section 6. Accidental Release Measures

Person related precautionary measures:	Avoid generation of dusty atmospheres. Do not inhale dusts. Contaminated work clothing should not be allowed out of the workplace. Use personal protective equipment as required. Wash hands, and face thoroughly after handling.
Environmental Protection measures:	Spillages and uncontrolled discharges must be prevented from entering waterways.
Procedures for cleaning/absorption:	Pick up and replace in original container. Nickel-containing material is normally collected to recover nickel values.

Section 7. Handling And Storage

Precautions for Safe Handling:	Prevent the generation of inhalable dusts e.g. by the use of suitable ventilation. Do not inhale dust. Wear appropriate nationally approved respirators if handling is likely to cause the concentration limits of airborne nickel to exceed the locally prescribed exposure limits. Wear suitable protective clothing and gloves. Contaminated work clothing should not be allowed out of the workplace
Conditions for Safe Storage:	Keep in the container supplied, and keep container closed when not in use. Local regulations should be followed regarding the storage of this product.

Section 8. Exposure Controls / Personal Protection

8.1.1 Exposure Limits:

Nickel Oxide (NiO) – CAS 1313-99-1		
	Exposure Limit (mg/m^3)	Year
ACGIH TLV-TWA [1]	0.2 * ‡ as Ni	2008
UK WEL [2]	0.5 as Ni	2011
Japan	1 as Ni	2012
Korea	0.1 as Ni	2006
China	1 as Ni	2007

* Inhalable fraction
‡ Insoluble inorganic fraction

DNEL's

	Unit	DNEL
Dermal		
Long-term local	$mgNi/cm^2/day$	0.035
Inhalation		
Acute local	$mgNi/m^3$	11.9
Long-term systemic	$mgNi/m^3$	0.05

Long-term local	mgNi/m^3	0.05

8.1.2 Environmental Limits:

PNEC's

Compartment	Unit	PNEC
Freshwater	µg Ni/L (bioavailable)	7.1
Sediment (freshwater)	mg Ni/kg	109
Marine water	µg Ni/L	8.6
Sediment (marine	mg Ni/kg	109
Agricultural soil	mg Ni/kg	29.9

8.2.1 Occupational exposure controls:

Do not inhale dust. Mechanical extraction ventilation may be required if user operations change it to other physical or chemical forms, whether as end products, intermediates or fugitive emissions, which are inhalable. Maintain airborne nickel levels as low as possible. Avoid repeated skin contact.

PPE

Respiratory protection: If required, use an approved respirator with particulate filters.

Eye protection: None

Hand & Skin Protection: Wear suitable protective clothing and gloves, which should be selected specifically for the working place, depending on concentration and quantity of the hazardous material (overalls and leather/rubber gloves). Wash skin thoroughly after handling and before eating, drinking or smoking. Change contaminated clothing frequently. Launder clothing and gloves as needed. Use of skin-protective barrier cream advised.

Section 9. Physical And Chemical Properties

Solid, granular dark grey material.

Physical state at 20°C and 101.3 kPa	Solid
Melting / freezing point	>1900°C
Boiling point	Not applicable
Decomposition temperature	Not applicable
Relative density	6.75g/cm^3 at 20°C
Vapour pressure	Not applicable
Vapour density	Not applicable
Surface tension	Not applicable

Water solubility	$3.52x10^{-5}$ g/l at 20°C (typical for green nickel oxide)
pH	Not applicable
Evaporation rate	Not applicable
Partition coefficient n-octanol/water (log value)	Not applicable
Flash point	Not applicable
Flammability	Non-flammable
Explosive properties	Not applicable
Self-ignition temperature	>400°C
Oxidising properties	Non-oxidising
Granulometry	<0.1% of particles with a diameter <100µm
Stability in organic solvents and identity of relevant degradation products	Not applicable
Dissociation constant	Not applicable
Viscosity	Not applicable
Packaged density	See relative density

Section 10. Stability And Reactivity

Reactivity:	Stable under normal conditions.
Chemical stability:	Stable under normal conditions.
Possibility of hazardous reactions:	Stable under normal conditions.
Conditions to avoid:	None.
Incompatible materials:	None.
Hazardous Decomposition Product(s):	No information available

Section 11. Toxicological Information[3]

As a mixture the toxicological properties of this product are unknown. The toxicology of the reported ingredients are summarized below.

Nickel Oxide

Acute Toxicity:

a) Oral: Non toxic - LD_{50} ORAL RAT >11,000 mg/kg (green); 9,990 (black)

b) Inhalation: Non toxic - LD_{50} INHAL RAT >5.08 mg/m^3 (green); >5.15 mg/m^3 (black)

c) Dermal: No information available.

Corrosivity/Irritation:
a) Respiratory Tract: No classification

b) Skin: Not corrosive/irritating.

c) Eyes: Mildly irritating.

Sensitization:
a) Respiratory tract: Nickel metal induced asthma is very rare. 3 case reports are available; the data is not sufficient to conclude that nickel metal is classified as a respiratory sensitizer.

b) Skin: Nickel oxide is currently classified as a dermal sensitizer according to the 1st ATP to the CLP Regulation. Recent studies evaluating the bioaccessibility of a series of nickel compounds in synthetic sweat indicated very low nickel ion release from nickel oxide suggesting very low or no sensitization potency. Early Guinea pig maximization and Beuhler test results show low potential for nickel oxide to act as a dermal sensitizer.

c) Pre-existing conditions: Individuals known to be allergic to nickel should avoid contact with nickel whenever possible to reduce the likelihood of nickel allergic contact dermatitis reactions (skin rashes). Repeated contact may result in persistent chronic palmar/hand dermatitis in a smaller number of individuals, despite efforts to reduce or avoid nickel exposure.

Chronic toxicity:
a) Oral: No information available

b) Inhalation: Exposure related toxicities were noted following 13 weeks and two years of exposure to nickel oxide in both rats and mice in the US NTP chronic rat inhalation study. Adverse effects in rodents were primarily limited to the lung (*e.g.*, increased tissue weight, inflammation, macrophage hyperplasia). The LOAEC from the chronic study in rats was 0.6 mg NiO/m^3 or 0.5 mg Ni/m^3.

c) Dermal: No information available.

Mutagenicity / Reproductive toxicity: Not classified for reproductive/developmental toxicity. Not classified for mutagenicity.

Carcinogenicity:
a) Ingestion: No information available. Not classified
b) Inhalation: Cat. 1A; Human epidemiological and animal data suggest that at least some forms of nickel oxide can be carcinogenic to the respiratory tract of humans after inhalation.

Cobaltous Oxide (CoO)

Acute toxicity oral: LD_{50} ORAL RAT: 202 mg/kg

Inhalation: Causes irritation to the respiratory tract, symptoms may include coughing, shortness of

breath, and nausea. Respiratory hypersensitivity, asthma may appear. Inhalation of cobalt dust and fumes is associated with an increased incidence of lung disease.

Ingestion: Causes abdominal pain, nausea, vomiting, flushing of the face and ears, mild hypotension, rash, and ringing in the ears. May have cumulative toxic action where elimination cannot keep pace with absorption. Large amounts depress erythrocyte production.

Skin Contact: May cause dermatitis. Cause irritation to skin. Symptoms include redness, itching, and pain.

Eye Contact: Causes irritation, redness, and pain.

Chronic Exposure: Repeated oral administration may produce goitre and reduced thyroid activity. Prolonged or repeated skin exposure may cause dermatitis. Chronic exposure associated with kidney, heart and lung damage.

Pre-existing Conditions: Persons with pre-existing skin disorders or eye problems, or impaired liver, kidney or respiratory function may be more susceptible to the effects of the substance. Persons with allergies or sensitivity to cobalt may also be more susceptible to the effects of the substance.

Nickel Hydroxide

No information currently available.

Copper Oxide

Acute toxicity oral: LD_{50} ORAL RAT: >2500 mg/kg

Inhalation: Copper fume, dusts and mists from copper ore smelting and related metallurgical operations have been associated with irritations of the respiratory tract and metal fume fever. Symptoms of metal fume fever include chills, fever and sweating.

Ingestion: No data available

Skin Contact: Not classified for skin irritation or corrosion

Eye Contact: Causes immediate irritation and conjunctival inflammation, which will subside without permanent damage soon after the eye is cleansed by irrigation

Pre-existing Conditions: Wilson's disease can occur in certain individuals with a rare, inherited metabolic disorder characterized by retention of excessive amounts of copper in the liver, brain, kidneys and corneas. These deposits eventually lead to tissue necrosis and fibrosis, causing a variety of clinical effects, especially liver (i.e. hepatic) disease and neurologic changes. Wilson's disease is progressive and, if untreated, leads to fatal liver (i.e. hepatic) failure.

Section 12. Ecological Information

Toxicity	Aquatic Chronic 3. May cause long lasting harmful effects to aquatic life.
Persistence and degradability	The PBT and vPvB criteria of Annex XIII to the Regulation do not apply to inorganic substances, such as nickel oxide. The methods for determining the biological degradability are not applicable to inorganic substances.
Bioaccumuative potential	Nickel does not tend to bioaccumulate or biomagnify in aquatic or terrestrial systems.
Mobility in soil	The substance is essentially insoluble in water.
Results of PBT and vPvB assessment	Not classified as PBT or vPvB.
Other adverse effects	None anticipated.

Section 13. Disposal Considerations

Waste treatment methods	Recover or recycle if possible. Dispose of contents in accordance with local, state or national legislation.
Additional Information	No information available.

Section 14. Transport Information

International Maritime Dangerous Goods Code	Not regulated.
International Civil Aviation Organization Technical Instructions for the Carriage of Dangerous Goods by Air	Not regulated.
U.S. Dept. of Transportation Regulations	Not regulated.
Canadian Transportation of Dangerous Goods Act	Not regulated.
European Agreement Concerning the International Carriage of Dangerous Goods by Road	Not regulated.

MARPOL Annex V
Under the 7 Criteria contained within the MARPOL Annex V, This material is classified as:

	Harmful to the Marine Environment (HME)
X	**Not Harmful to the Marine Environment (non-HME)**

Section 15. Regulatory Information

Europe:
REACH Registration #'s:
01-2119467172-41-XXXX – Vale Europe Limited
01-2119467172-41-XXXX – Vale Japan Limited (Vale Europe Limited acting as Only Representative)

Exposure Scenarios: See Annex 1

Classification according to Part 3 of Annex VI of EU Regulation No. 1272/2008
Acute toxicity inhalation – Category 4
Skin Sensitization – Category 1
Respiratory Sensitization – Category 1
Carcinogenicity – Category 1A
Specific Target Organ Toxicity, Repeated exposure – Category 1
Aquatic Chronic – Category 3

Symbols:
GHS07 - Exclamation mark GHS08 - Health Hazard

Signal Word: Danger

Hazard Statements:
H332 – Harmful if inhaled
H317 - May cause an allergic skin reaction
H334 – May cause allergy or asthma symptoms or breathing difficulties if inhaled
H350 - May cause cancer by inhalation
H372 - Causes damage to lungs through prolonged or repeated inhalation exposure
H412 –Harmful to aquatic life with long lasting effects.

Precautionary Statements:
Prevention:
P201 - Obtain special instructions before use
P202 - Do not handle until all safety precautions have been read and understood

P260 - Do not breathe dust or fume
P261 - Avoid breathing dust or fume; Wear respiratory protective equipment if fine dusts are generated.
P264 - Wash hands, and face thoroughly after handling.
P270 - Do not eat, drink or smoke when using this product.
P271 – Use only outdoors or in a well-ventilated area
P272 - Contaminated work clothing should not be allowed out of the workplace.
P273 - Avoid release to the environment.
P280 - Wear protective gloves and protective clothing
P284 – [In case of inadequate ventilation] wear respiratory protection

Response:
P302+P352 - If on skin: Wash with plenty of soap and water.
P308+P313 - If exposed or concerned: Get medical advice/attention
P304+P340 – IF INHALED: remove person to fresh air and keep comfortable for breathing
P333+P313 - If skin irritation or rash occurs: Get medical advice/attention.
P314 - Get medical advice/attention if you feel unwell.
P321 - See Safety Data Sheet for specific treatment
P342+P311 – If experiencing respiratory symptoms: Call a POISON CENTER/doctor
P362+P364 – Take off contaminated clothing and wash it before reuse

Storage:
P405 - store locked up

Disposal:
P501 - Dispose of contents/container in accordance to local/regional/national/international regulations

Canada:
WHMIS 2015 Classification:
- Acute toxicity inhalation – Category 4
- Skin Sensitization – Category 1
- Respiratory Sensitization – Category 1
- Carcinogenicity – Category 1A
- Specific Target Organ Toxicity, Repeated exposure – Category 1

United States of America:
Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200)
This product contains *NICKEL* which is subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40 CFR 372. Refer to the Hazardous Ingredients section of this MSDS for the appropriate CAS numbers and percent by weight.
All components are listed on the US Toxic Substances Control Act (TSCA) inventory

Australia:
Classified as Hazardous according to ASCC criteria
All components are listed on the Australian Inventory of Chemical Substances (AICS)

P.R. Korea:
All components are listed in the Korean Toxic Substances Control Act inventory; KE-25818

Philippines:
All components are listed in the Philippine Inventory of Chemicals and Chemical Substances (PICCS)

Japan:
All components are listed in the Japanese Handbook of Existing and New Chemical Substances.

P.R. China:
All components are listed in the Inventory of Existing Substances in China (IECSC).

Section 16. Other Information

Indications of Change

1.0 – Original Document
2.2 – Formatting Changes
3.0 – Added new GES title to Annex I, Update P-Statements
4.0 – Removal of classification according to Directive 67/538/EEC, update of DNELs
4.1 – Corrections in DNEL table
5.0 – Updated exposure scenarios and for compliance with EU CLP/WHMIS 2015
6.0 – Classification update for cobalt oxide impurity for acute toxicity and respiratory sensitisation

The following acronyms may be found in this document:

ACGIH	American Conference of Governmental Industrial Hygienists
DNEL	Derived No Effect Level
LTEL	Long Term Exposure Limit
LR	Lead Registrant
MMAD	Mass Median Aerodynamic Diameter
NIOSH	National Institute of Occupational Safety and Health
OEL	Occupational Exposure Limits
OR	Only Representative
OSHA	Occupational Safety and Health Administration
PBT	PBT: Persistent, Bioaccumulative and Toxic

PNEC	Predicted No Effect Concentration
STEL	Short Term Exposure Limit
STOT	Specific Target Organ Toxicity
TLV-TWA	Threshold Limit Value – Time Weighted Average
vPvB	very Persistent and very Bioaccumulative
WEL	Workplace Exposure Limit (UK HSE EH40)

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Note:
Vale Canada believes that the information in this Safety Data Sheet is accurate. However, Vale Canada makes no express or implied warranty as to the accuracy of such information and expressly disclaims any liability resulting from reliance on such information.

1. Threshold Limit Values of the American Conference of Governmental Industrial Hygienists. 2016
2. Maximum Exposure Limit of the Health and Safety Executive in the U.K. in EH40/2005.
3. Describes possible health hazards of the product supplied. If user operations change it to other chemical forms, whether as end products, intermediates or fugitive emissions, the possible health hazards of such forms must be determined by the user.

SDS
SAFETY DATA SHEET

ANNEX 1 – Exposure Scenarios

Exposure Scenarios can be obtained by clicking on the following link: Vale Nickel Oxide Exposure Scenarios. Exposure Scenarios are listed on the page according to GES # and by language.

If you are unable to retrieve the document or have difficulties, please contact one of the following email addresses for assistance: REACH@vale.com or msds@vale.com

ES2-F1 - Use of nickel oxide for the formulation of nickel oxide-containing catalysts and catalyst precursors
ES3-Is1 - Use of nickel oxide-containing catalysts
ES4-Is2 - Industrial use of nickel oxide-containing catalyst precursors for the manufacture of other nickel substances in catalysts
ES5-IS3 - Use of nickel oxide for the manufacture of nickel-containing powders
ES6-IS4 - Use of nickel oxide for the manufacture of nickel-containing frits
ES7- IS5 - Use of nickel oxide for the manufacture of nickel-containing inorganic pigments
ES8- IS6 - Use of nickel oxide for the manufacture of nickel-containing glass
ES9- IS7 - Use of nickel oxide sinter in the production of stainless, special steels and special alloys
ES11- IS9 - Use of nickel oxide for the production of nickel-containing electronics and thermally functioning ceramics
ES12 – IS10 - Use of nickel oxide for the production of nickel-zinc ferrite cores
ES13 – SL-IS1 - Service life of nickel-containing electronics/ferrite cores in industrial settings
ES14- SL-PW1 - Service life of nickel-containing electronics/ferrite cores in professional settings
ES15-SL-C1 - Service life of nickel-containing electronics/ferrite cores (consumers)
ES16_IS12 - Production of nickel oxide-containing automotive catalysts
ES17-SL-IS2 - Service life of manufacture of vehicle exhaust system in industrial settings
ES18-SL-PW2 - Service life of manufacture of vehicle exhaust system in professional settings
ES19-SL-C2 - Catalyst application in vehicles

Appendix B – Annual Test of Plan Template Form

Annual Test of Environmental Emergencies Plan (E2)

Site	

Location	
Test Type	
Participants	
Test Coordinator	
Test Date	
Who Prepared the Test?	
Date of Most Recent Revision to Plan	

Context and Purpose of the Test
Under the Environmental Emergency Regulations, 2019 (SOR/2019-51) section 7, each year, beginning on the day on which the plan is brought into effect, a simulation exercise in respect of one substance from each of the hazard categories will be tested. Every five years, beginning on the day on which the plan is brought into effect, a full-scale simulation exercise in respect of any one substance, using an environmental emergency (in paragraph 4(2)(e) or (f) of the regulation) as the emergency being simulated. The purpose of this exercise is to determine reaction time of operator/ maintenance personnel and if notification procedures are consistent with plan. Also, any changes to the plan can be identified and plan revisions made as a result. If at any time during the exercise you observe that an activity is not safe, advise test coordinators and emergency personnel immediately to stop the unsafe activity or the full exercise. SAFETY FIRST!

EXERCISE PREPARATION

	YES	NO
Was the exercise a surprise to participants?		
Did participants know when and where the exercise was going to take place?		
Were participants aware of the scenario in advance?		
Was pre-exercise training provided for exercise participants?		
Are participants familiar with the location of Emergency Safe Assembly Areas?		
Will any facilities/sites be set up in advance? Please summarize what set-up activities will take place and what will be left up to the exercise participants.		
Were necessary site personnel advised of time and location of live test? If so, please identify them.		
Has a cancellation procedure/message been prepared in the event of a real emergency?		
The exercise will be terminated in the event that notification is received of an actual emergency. All test participants will proceed to assembly areas and respond appropriately in the even that an emergency is discovered.		

EXERCISE EXECUTION

Scenario

Summary of Responses

EXERCISE EVALUATION

	YES	NO
Was an informal debriefing held immediately after the exercise?		
If NO, has a formal debriefing been scheduled?		
Date:		

Effectiveness of the Plan (Identify problems with plan, procedures, equipment, facility and training)

Follow Up Items

	YES	NO
Did this exercise result in a need to update the E2 Plan?		
Did this exercise result in an NC or OFI under ISO 14001?		
If YES, was this documented in the NC/OFI tracker?		