NORTHWEST TERRITORIES
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WASTE MANAGEMENT PLAN

SNARE HYDROELECTRIC FACILITY
PLANT #121
BIG SPRUCE LAKE, NORTHWEST TERRITORIES

Issue Date: October 2021

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3	All	Annual review and update	Joshua Clark	June 15, 2015
4	All	Annual review and update	Joshua Clark	July 25, 2016
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7	All	Updates to include additional fuel storage locations Site description, site figures, Appendix J and K	NTPC	October 2021

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1 INTRODUCTION

1.1 BACKGROUND

The Northwest Territories Power Corporation (NTPC) has prepared this Waste Management Plan (WMP) for the Snare Lake Hydroelectric Facility (the Facility) located on the South shore of Big Spruce Lake, Northwest Territories. The Snare Hydro system is a remote power generating facility located approximately 145 km northwest of Yellowknife on the Snare River (see Section 1.3). The system is a cascade type development comprised of four hydro plants: Snare Rapids, Snare Falls, Snare Forks, and Snare Cascades. The four plants are connected by an all-weather road. Air access to the Facility is available year round. Personnel and freight are delivered to the Facility by aircraft which land on Big Spruce Lake and at the all-weather landing strip located near Snare Falls. A winter road is constructed annually linking the Facility to Yellowknife via NWT Highway #3, allowing fuel, oversized equipment, and freight to be delivered to site.

The Dogrib Power Corporation is the holder of Water License W2014L4-0001 which permits the use of the Snare River for storage and hydroelectric production at Snare Cascades. NTPC operates and maintains the facility on behalf of the Dogrib Power Corporation. NTPC is the holder of Water License N1L4-0150 which permits the use of the Snare River for storage and hydroelectric production at Snare Rapids, Snare Forks and Snare Falls.

In addition, Snare Hydro operates under three Type A Land Use Permits (LUP) from the Wek' èezhìi Land and Water Board (WLWB) for the construction and operation of the winter roads (WR's) and quarry and borrow sites. In the fall of 2021 NTPC intends to apply for a site-wide Type A LUP that will consolidate the current LUP's under one permit to authorize existing and future land-use activities. This consolidated LUP will increase efficiencies for all regulatory undertakings related to land use at Snare Hydro, improving processes and interactions for the WLWB, GNWT Lands Inspectors, NTPC and all Snare Hydro stakeholders moving forward.

The production of waste material as a result of electricity generation and other activities is a normal result of ongoing activities. NTPC generates/handles waste materials at its power generation facilities and has a responsibility to protect and conserve the environment. Proper management of waste, sewage and hazardous materials is important for the protection of the health and safety of employees, the community, and the environment.

This WMP demonstrates that NTPC has appropriate measures in place to effectively manage waste at the Snare Hydroelectric Facility. This plan documents NTPC's local and regional waste management capabilities, presenting information specific to the Snare Hydro Facility. A copy of this WMP shall be maintained at each plant within the Facility and is also available on NTPC Intranet PowerLine (the Powerline) under Divisions> Health, Safety & Environment> Waste Management Plans. Plant Operators receive regular training on the procedures and information contained in this plan.

1.2 PURPOSE

The purpose of the WMP is to provide a consolidated source of information on the safe and environmentally sound transportation, storage, and handling of the solid waste, sewage and major hazardous products used and generated at the Snare Hydroelectric Facility. Solid waste or refuse is described as materials generated by Facility staff and operations equivalent to that generated in typical residential and commercial operations. Sewage waste, which includes grey water, is generated by personnel at the Facility. A hazardous material is one that, as a result of its physical, chemical or other properties, poses a hazard to human health or the environment when improperly handled, used, stored, disposed of, or otherwise managed.

This WMP was prepared following the 2011 Mackenzie Valley Land and Water Board (MVLWB) Guidelines for Developing a Waste Management Plan (available at: http://mvlwb.com/sites/default/files/documents/MVLWB-Guidelines-for-Developing-a-Waste-Management-Plan-Mar-31_11-JCWG.pdf).

NTPC is committed to preventing, to the greatest extent possible, both inadvertent release of solid waste, sewage and hazardous waste substances to the environment and accidents resulting from a mishandling or mishap. NTPC will institute programs for employee training, facility inspection, periodic drills to test systems, and procedural review to address deficiencies, accountability, and continuous improvement objectives. NTPC will actively work towards minimizing the generation of hazardous wastes by investigating alternatives to the use of hazardous materials, by recycling products and containers whenever feasible and by treating wastes using state-of-the-art technologies before any release to the environment. In addition, NTPC is actively working towards reusing used materials, solid waste reduction and recycling, as well as the use of low water use sewage systems.

The WMP will form a component of the Environmental Management System (EMS). The WMP is a working document that will be reviewed and updated on a regular basis.

1.3 SNARE HYDROELECTRIC FACILITY

1.3.1 Facility Setting

The Snare Hydro system is a remote power generating facility located approximately 145 km northwest of Yellowknife on the Snare River (see Figure 1). The system is a cascade type development comprised of four hydro plants: Snare Rapids, Snare Falls, Snare Cascades, and Snare Forks.

The four plants are connected by an all weather road. Air access to the Facility is available year round. Personnel and freight are delivered to the Facility by aircraft which land on Big Spruce Lake and at the all-weather landing strip located near Snare Falls. A winter road is constructed annually linking the Facility to Yellowknife via NWT Highway #3, allowing fuel, oversized equipment, and freight to be delivered to site.

Figure 1: Snare Hydroelectric System

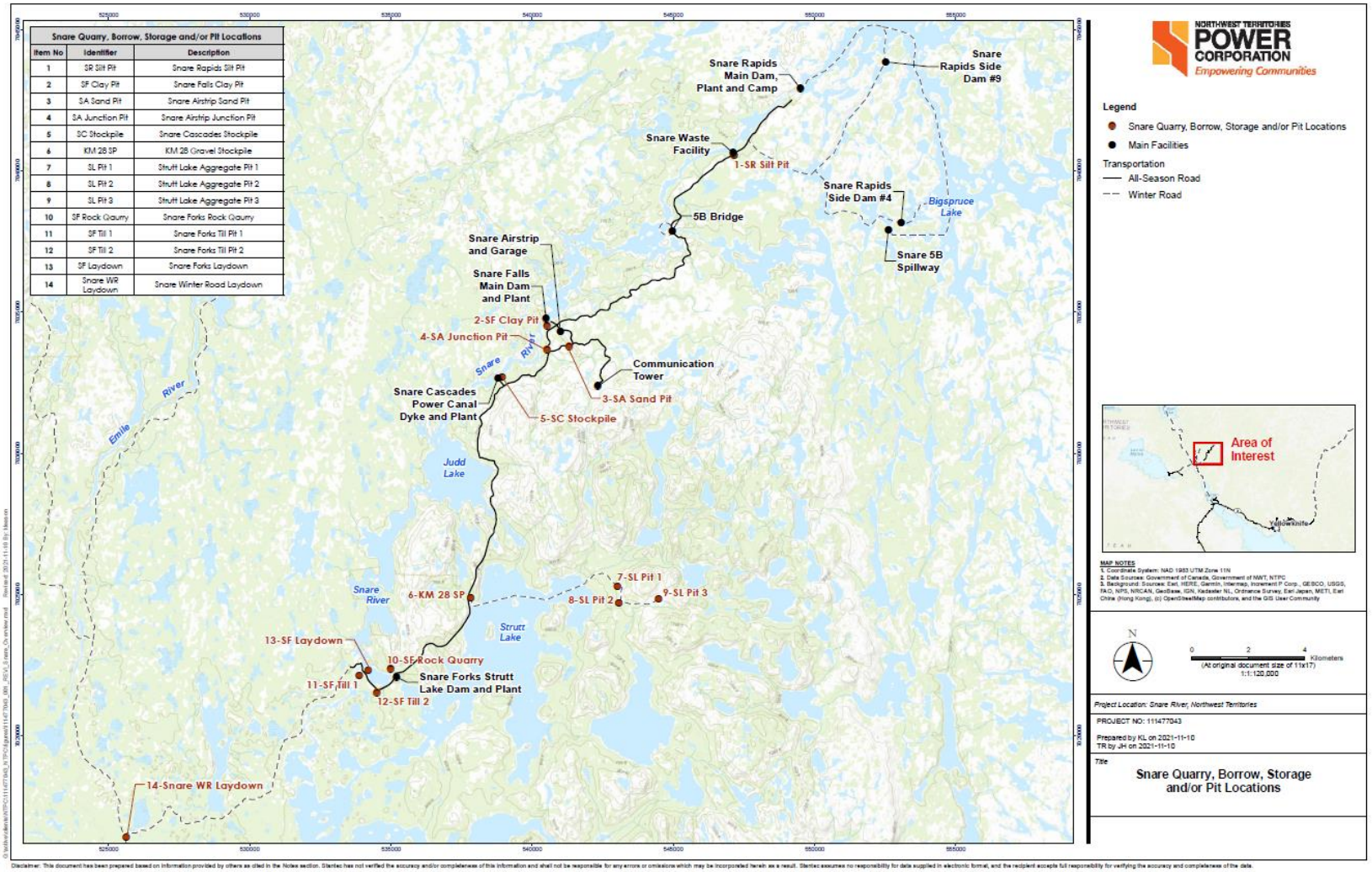


Figure 2: Snare Hydro Quarries, Winter Roads and Transmission Lines

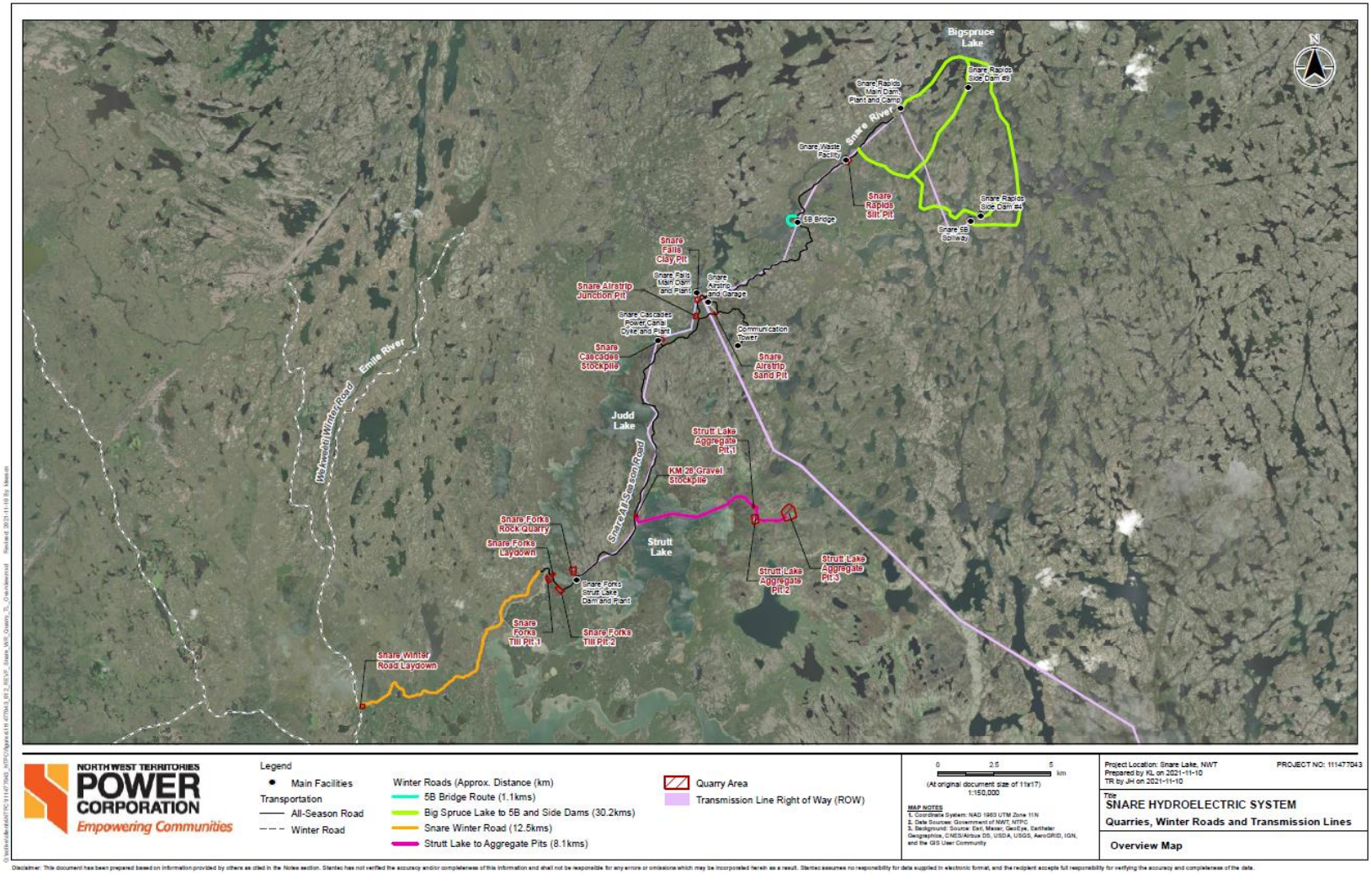
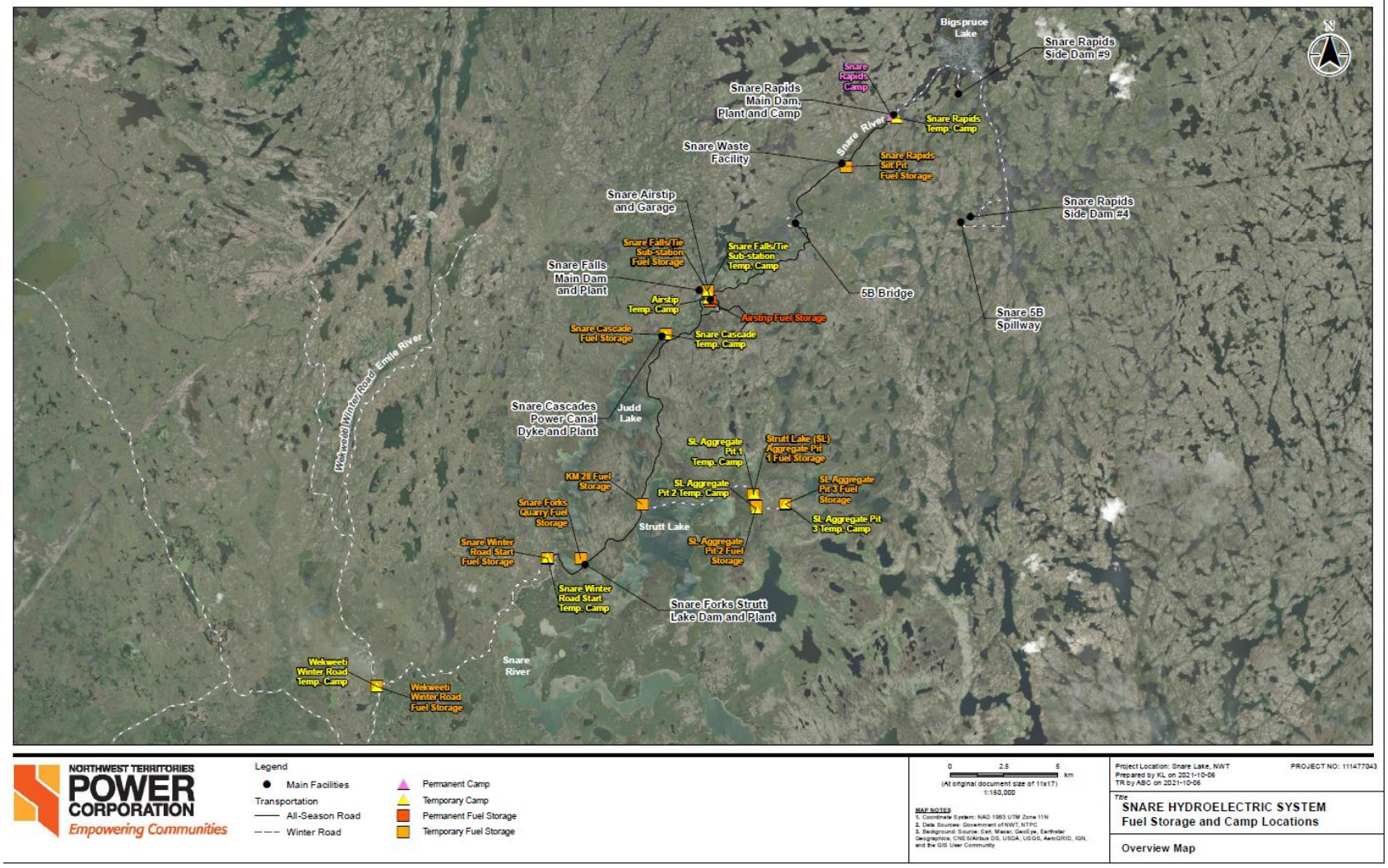


Figure 3: Snare Hydro Fuel Storage and Camp Locations



1.4 SITE DESCRIPTION

1.4.1 Snare Rapids

The Snare Rapids hydro plant (630 31' N, 1160 00' W) is located 145 km northwest of Yellowknife on the southwest end of Big Spruce Lake, the main storage reservoir for the hydro system. The rated plant capacity is 8.5 MW. Flow through the plant is controlled by the 5B spillway south east of the plant.

The plant is directly below the Snare Rapids Dam with the substation immediately south of the plant (see Figure 4). The headgate house sits on the upstream side of the dam above the plant and the boathouse sits on the south upstream side of the dam next to the dock. The camp site sits 100 metres (m) southwest of the plant and consists of a camp house (kitchen and sleeping quarters), staff trailer, and freezer building, all surrounded by an electric bear fence. West of the camp is a garage, fire shed, small line storage shed, an electrical shop, and a carpenter shop. In a clearing west of the carpenter shop sits the incinerator. 200 m south of the carpenter shop sits Knob Hill. Buildings on Knob Hill include a line storage shop and a staff house, which is no longer in use. Southeast of Knob Hill sits the helicopter pad and Emergency Response shed, and gas pumps.

Figure 4: The NTPC Plant Site Area – Snare Rapids.

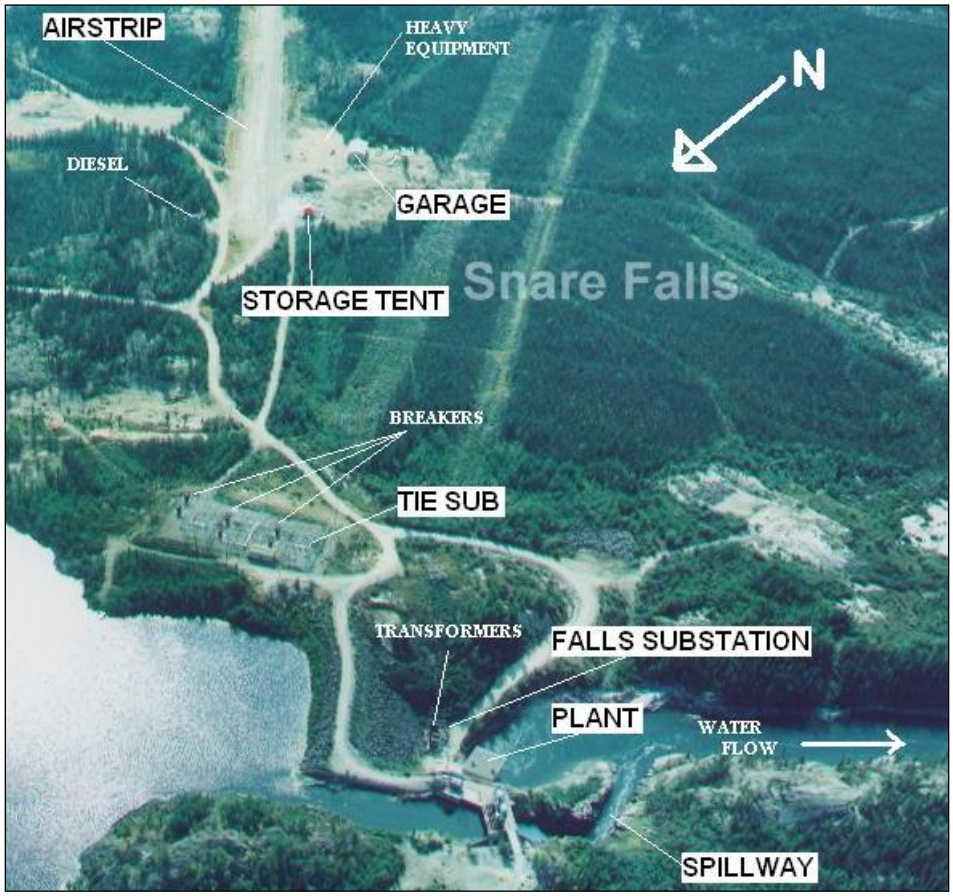
1.4.2 Snare Falls

The Snare Falls hydro plant and airstrip (630 26' N, 1160 11' W) is located 15 kilometres (km) southwest of Snare Rapids. The rated plant capacity is 7.4 megawatts (MW).

The plant sits directly below the Snare Falls Dam with the substation immediately east of the plant (see Figure 5). The headgate sits west of the plant and two spillway gates control flows through the spillway. The tie substation sits approximately 200 m east of the plant.

The airstrip sits approximately 250 m east of the plant. Airstrip facilities include the garage and storage tent on the south side of the strip, a hazardous waste containment berm west of the garage, and a soil remediation berm north of the airstrip. An oil storage shed, a parts storage shed, and the SSI Micro satellite dish and communication shed sit behind the garage. A sea-can with line equipment storage sits east of the garage.

Figure 5: The Snare Falls Facility.

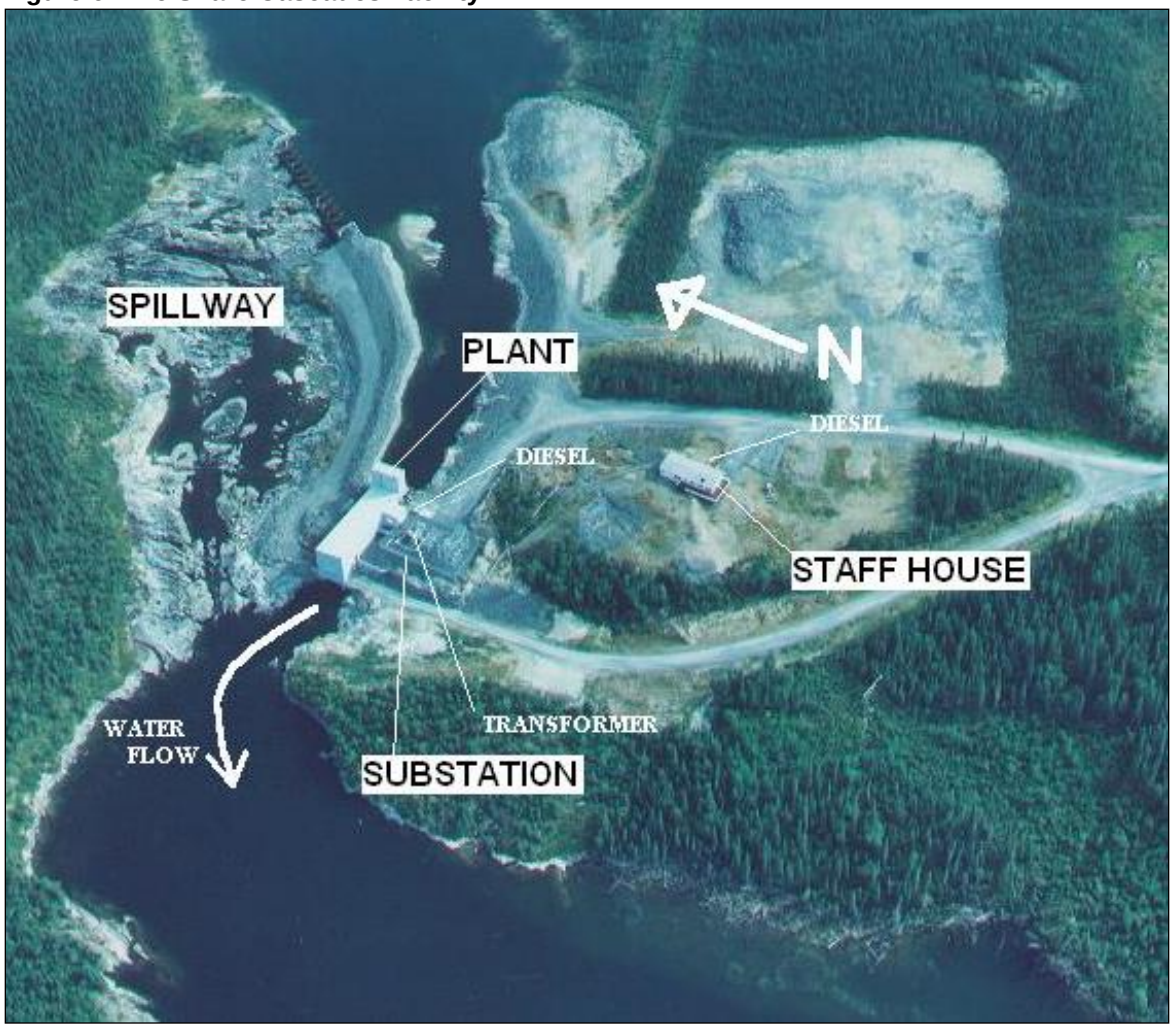


1.4.3 Snare Cascades

The Snare Cascades hydro plant (630 25’ N, 1160 13’ W) is located 2 km west of Snare Falls. The rated plant capacity is 4.3 MW.

The plant sits directly below the Snare Cascades Dam with a substation next to the plant (see Figure 6). The staff house sits southeast of the plant. Flow through the spillway north of the plant is controlled by a fixed elevation weir.

Figure 6: The Snare Cascades Facility.



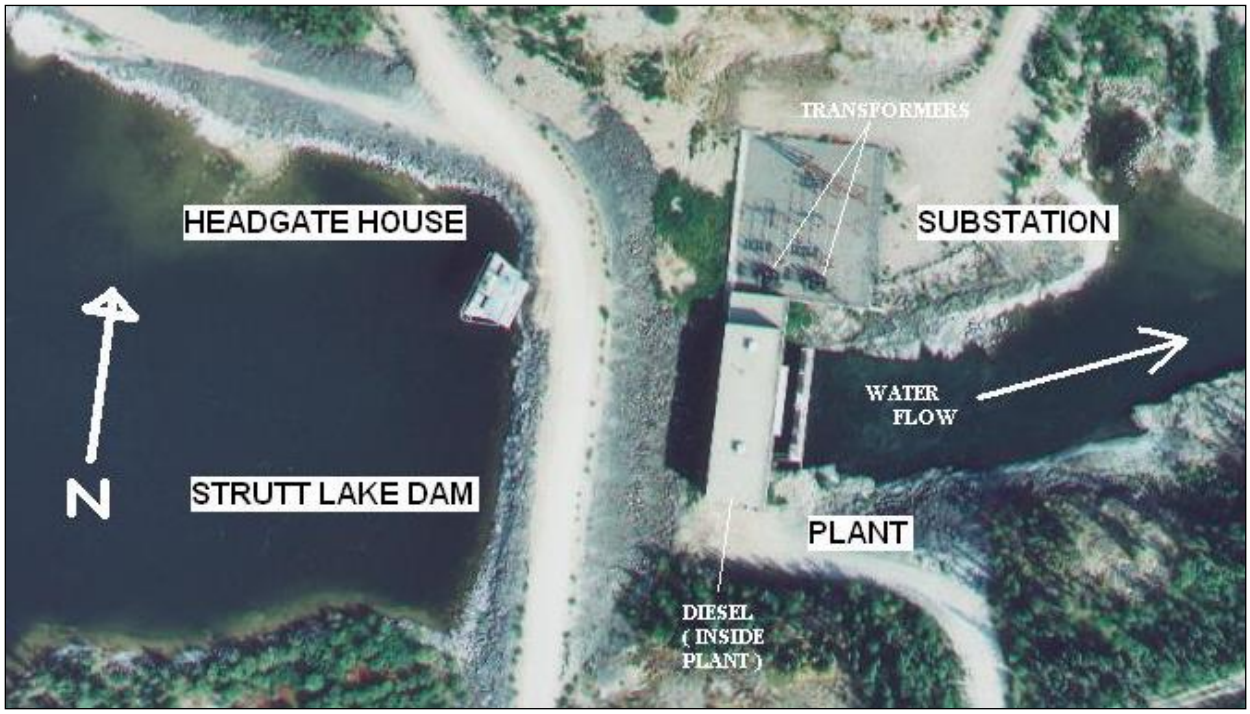
1.4.4 Snare Forks

The Snare Forks hydro plant (630 20’ N, 1160 20’ W) is located 10 km southwest of Snare Cascades. The rated plant capacity is 9.2 MW.

The plant is directly below the Strutt Lake Dam with the substation immediately east of the plant (see

Figure 7). The headgate house sits on the upstream side of the dam above the plant. A rock quarry sits approximately 200 m northeast of the plant. The Snare Forks dam sits 1.25 km northwest of the Snare Forks facility and is next to the Snare Forks spillway. Flow through the spillway is controlled by a fixed elevation weir.

Figure 7: The Snare Forks Facility.



1.4.5 Construction Scope under the Snare Hydro Land Use Permit

1.4.5.1 Winter Roads

NTPC annually constructs the historical Snare Winter Road (WR) from Snare Forks to the Wekweètì Winter Road, NT linking the facility to Yellowknife via NWT Highway #3, allowing access for resupply fuel, oversized equipment, and freight to be delivered to site. The Snare WR follows the same historical alignment of previous years, so relatively little brushing is required. The road does not cross any water courses and is 12.5km of portage winter road. The start point of the WR is a temporary laydown/marshalling area located at the southwest corner of Snare Forks, and the end point is a temporary laydown area located at the Wekweètì winter road junction. The temporary laydown at the Wekweètì winter road junction will be expanded to allow more space for staging of equipment and the potential for a temporary camp and/or fuel to be installed if required.

Three additional winter roads which have been used intermittently throughout the operation of the facility as required and will be included in the scope of the LUP include:

- Strutt Lake WR (8.1 km) connecting to three borrow locations on the east side of Strutt Lake. This winter road is currently authorized under Land Use Permit W2019Q0003, which expires on December 18, 2024 and is constructed when crushing is completed at Strutt Lake Pits every 4-8 years.
- The Big Spruce Lake WR 1 (17.8 km) connecting Snare rapids to the Side Dams, and Snare 5B Spillway. This route is entirely on Big Spruce Lake and is constructed every 10-20 years when major maintenance work is required at 5B or Side Dams. There is also a Big Spruce Lake WR 2 route that connects the side dams on Big Spruce Lake to the Snare site road using a couple portages and local inland lakes. The Big Spruce Lake WR 2 route would be used if ice conditions on Big Spruce Lake were not sufficient for WR construction.
- The 5B Bridge route (1.1 km) allowing for continued movement of equipment over the winter months if the 5B bridge every had any issues which impeded travel over the bridge in winter months. This is a contingency route only and would only be used in emergency situations.

The overland portion of the proposed WRs will follow previously constructed WR alignments (Strutt Lake WR, Snare WR), with an average width of the portages (overland) right-of-way of 8 to 10 metres (m). Widening of the existing portages is not expected, and only minimal brushing of the portages will be required for the Snare WR and the Strutt Lake WR. If ice and/or environmental conditions are not sufficient on the existing alignments minor changes may be required to ensure the safety of the route.

No soil stripping, removal of overburden, or draining of waterbodies/wetlands is expected during WR construction. However, small amounts of vegetation present on the portages and surface of the borrow sources will be removed. Vegetation clearing will be minimized to danger tree removal only. These activities will occur during winter months only. Any bushes or trees that are cleared will be moved to the edge of the WR corridor and left to naturally decompose.

Operation of the WRs will include use of the road for routine maintenance of the hydro facilities, and for transportation of materials and fuel for the planned upcoming construction activities.

For the Snare WR the road may be used for personnel transportation until the end of March or until the road is closed due to weather. The WRs are presented in Figure 2. Please refer to Appendix K for the Snare Winter Roads Waste Management Plan.

1.4.5.2 Quarries, Borrow and Storage Locations

Materials from 10 existing historical quarries and/or borrow locations across Snare Hydro will be excavated as required for future construction, resurfacing, upgrades and maintenance at the Snare Hydro Facility. All locations are existing historical borrow locations used intermittently since 1948 throughout the operation of the facility. Blasting would only occur at Snare Forks Rocks Quarry. Excavated aggregate will be stockpiled as needed at quarry and/or borrow locations, or alongside roadways or constructions sites for blending and utilizing. In addition, there will be 4 designated stockpile, storage and/or laydown locations at Snare Cascades Stockpile, KM 28, Snare Forks Laydown and the Wekweètì winter road junction.

In late 2021 GNWT will release the Quarry Sampling and Testing Guidance for the identification of Acid Rock Drainage and metal leaching potential guidelines which NTPC will reference to complete geochemical testing for all quarries and/or borrow locations across Snare Hydro in 2022 as per the requirements. The quarry, borrow and stockpile locations to be used include:

- Snare Rapids Silt Pit
- Snare Falls Clay Pit
- Snare Airstrip Sand Pit
- Snare Airstrip Junction Pit
- Snare Cascades Stockpile
- Strutt Lake Aggregate Pit 1
- Strutt Lake Aggregate Pit 2
- Strutt Lake Aggregate Pit 3
- Snare Forks Rock Quarry
- Snare Forks Till Pit 1
- Snare Forks Till Pit 2
- KM 28 Stockpile
- Snare Forks Laydown
- Snare Winter Road Laydown

Minimal vegetation clearing, overburden removal and/or disturbance to wildlife is expected throughout the quarrying, as all borrow locations have minimal overburden and vegetation present as they are historical borrow locations that have been used throughout the operation of the facility. Minor vegetation and overburden removal will be completed around the edges of the existing borrow locations when required. The existing historical quarries and/or borrow locations across Snare Hydro are presented in Figure 2

1.4.5.3 Snare Falls Substation

The existing substation at the Snare Falls Generating Station will be relocated approximately 70 m southeast of its current location and a new access road, 50 m in length and 6 m wide, will be constructed to link the existing road to the new substation (Figure 1). In addition, pole structures will be relocated and/or replaced to accommodate the new location. The area of the new substation will be approximately 475 m^2.

1.4.5.4 Operation of Temporary Camps and Fuel Storage

10 potential locations for temporary camps have been identified and are outlined in Figure 3. Temporary camps will be project specific and used only when required. Temporary camps will have a capacity of 20 people for 4 months at a time. Water Usage would be 250 L/p/day x 20 p= 1000L/day or 1m^3/day through a temporary self-sustaining water system in which water would be manually drawn from the forebay and stored in a water tank for use at the camp. Sewage would be discharged into temporary sewage pit similar to a winter road camp. All management plans and standard procedures for the Snare Land Use Permit would also apply to the overflow camps.

Temporary fuel storage has been included to support any of the temporary camps or locations where crushing would take place but only used when required. Each location would include:

- 1 60,000L double walled diesel tank
- 1 double walled 1000L gas tank

Locations for temporary fuels storage are outlined in Figure 3, and quantities at each location are discussed in Section 2.3.

1.4.5.5 Miscellaneous Construction Activities

In addition to the above noted land use activities, the following activities will be completed:

- Minor clearing for access roads and access to transmission lines for maintenance.
- Use of heavy equipment not on an existing Right-of-Way, including but not limited to:
    - Maintenance of site roads.
    - Maintenance of transmission infrastructure.
    - Maintenance of dams and side dams.
- Major civil works and construction upgrades over the next 5 years

1.4.6 Best Management Practices for Hazardous Materials

This WMP is based on the following principles of best management practice for hazardous materials:

- Identify and prepare materials and waste inventories;
- Characterize potential environmental hazards posed by those materials;
- Allocate clear responsibility for management of solid waste, sewage and hazardous materials;
- Describe methods for transport, storage, handling and use;
- Identify means of long-term storage and disposal;
- Prepare contingency and emergency response plans;
- Ensure training for management, workers and contractors whose responsibilities include handling waste and hazardous waste and materials;
- Maintain records of domestic waste and sewage waste managed at the Facility; and,
- Maintain and review records of hazardous material consumption and incidents in order to anticipate and avoid impacts on personal health and the environment.

1.5 SCOPE

This WMP will cover all solid waste, sewage and hazardous materials used at the Snare Hydroelectric Facility to ensure they will be stored, handled and transported on-site in compliance with all applicable territorial and federal regulations. For the purpose of this WMP, hazardous wastes generated at the Facility are included in the definition of hazardous materials. The WMP is specific to the Facility and is intended to supplement the NTPC Hazardous Waste Management Plan which addresses the specific requirements around disposal of hazardous wastes at NTPC facilities.

The WMP applies to all casual, permanent, part-time, and full-time employees and contractors who conduct work or provide services at the Facility. This WMP covers activities and operations conducted at the Facility.

1.6 ENVIRONMENTAL PROTECTION POLICY

Policy

NTPC is committed to protecting the environment for existing and future generations by meeting, if not exceeding, environmental regulations. Our environmental principles are based on the fundamental values of responsibility, accountability, and open communication. We will strive for continuous improvement in environmental performance and will manage our operations in an environmentally responsible manner.

Guidelines

NTPC will:

- Comply with all applicable environmental legislation and guidelines;
- Maintain an Environmental Management System;
- Incorporate environmental planning in the design phase of projects;
- Reduce waste and use resources as efficiently as possible;
- Take reasonable measures to prevent and reduce pollution to air, water, and soil;
- Manage hazardous waste in a manner that minimizes risk to the environment;
- Report all hazardous materials spills released to water, regardless of size;
- Report all hazardous materials spills greater than 5 L to ground or floor;
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- Clean up all hazardous materials spills to meet applicable environmental criteria;
- Promote the efficient use of energy to customers;
- Provide employees with the appropriate training and education to help them fulfill their environmental responsibilities;
- Communicate regularly with indigenous groups, government, regulators, industry, community groups, and the public regarding NTPC activities; and
- Respect the heritages of the people and communities that we serve.

NTPC recognizes that incorporating proper solid waste, sewage and hazardous material management into other environmental management plans and systems leads to risk reduction, improved process control, and cost savings. This WMP will form a component of the Facility's Environmental Management System (EMS). As such, it is a working document that will be reviewed and updated on a regular basis. At a minimum the WMP will be reviewed and updated annually. Training is provided on the following NTPC policies, procedures, and information sources, which are available at the Facility and/or on the NTPC Intranet PowerLine:

- Spill Response Plan
- Emergency Response Plan
- Hazardous Waste Management Plan
- Waste Management Plan (including Solid and Sewage Waste)
- Fuel Transfer Safe Work Practice
- Safety Handbook

The WMP is presented to all employees and contractors during their on-site orientation sessions.

1.7 APPLICABLE LEGISLATION

Both territorial and federal legislation regulate the management of hazardous materials and hazardous wastes in Northwest Territories. Management and safety personnel will provide an overview of the applicable regulations to all employees as part of their initiation and ongoing training. The acts, regulations and guidelines pertinent to hazardous products that will be used at the Snare Hydroelectric Facility are listed in Appendix B.

The federal Transportation of Dangerous Goods Act classifies hazardous materials into nine main classes according to an internationally recognized system, as follows:

Class 1 – Explosives

Class 2 – Compressed Gases

Class 3 – Flammable or Combustible Liquids

Class 4 – Flammable Solids

Class 5 – Oxidizing Substances

Class 6 – Poisonous and Infectious Substances

Class 7 – Nuclear Substances

Class 8 – Corrosives

Class 9 – Miscellaneous

The materials addressed in this document are also identified by class.

1.8 RESPONSIBILITIES

All employees will be expected to comply with all applicable precautions and handling procedures with regard to hazardous materials. Employees are also expected to report any concerns to their supervisors, the Plant Operator, the Joint Occupational Health and Safety Committee, or site management. Contractor employees working at the Facility will be expected to report any concerns to the Plant Operator. All staff, including contractors, are encouraged to bring forward suggestions for improvements that can be incorporated into procedure revisions.

On-site NTPC Employees and Contractors

- Ensure worksite and personnel safety.
- Ensure hazardous materials are stored in their appropriate designated storage area.
- Ensure appropriate storage of solid waste in designated, wildlife-proof containers.
- Know the location of designated storage areas, spill response materials, first aid stations, emergency and safety equipment, Safety Data Sheets (SDS), emergency exits, and Muster Point.
- Wear appropriate personal protective equipment (PPE).
- Know the waste handling, storage and spill prevention requirements.
- Comply with all NTPC and Facility policies and procedures when performing duties.

Plant Operator

- Ensure the safety of all personnel and the site.
- Ensure all new site personnel and contractors are oriented and have access to all the required documentation.
- Organize inspections of site hazardous material/waste management practices and storage areas, and ensure that appropriate records are maintained.
- Ensure all NTPC employees and contractors adhere to the requirements of the WMP.

Project Manager/Monitors

- Ensure the safety of all project personnel and the project areas.
- Ensure all new construction personnel and contractors are oriented and have access to all the required documentation.
- Organize inspections of site hazardous material/waste management practices and storage areas, and ensure that appropriate records are maintained.
- Ensure all construction employees, contractors and sub-contractors adhere to the requirements of the WMP.

Stores Person (Logistics Officer or Stock Keeper)

- Ensure that hazardous materials/wastes are received at the warehouse are stored, transported and disposed of according to the requirements of the HWMP and WMP.
- Maintain appropriate records.

Manager, Plant Operations

- Ensure that the Plant Operator has the available resources to effectively implement the WMP.

Director, Health, Safety & Environment

- Maintain and complete annual review of the WMP.
- Ensure that all WMP documentation remains up-to-date and the updated versions are distributed out to the personnel on site, external agencies and organizations.
- Periodically audit hazardous materials management at the Facility to support continuous improvement.
- In coordination with the Plant Operator, prepare and submit any formal reports to regulators and NTPC management regarding the management of hazardous materials.

Third Party Contractors and Suppliers

- Ensure worksite and personnel safety.
- Ensure hazardous materials are stored in their appropriate designated storage area.
- Ensure appropriate storage of solid waste in designated, wildlife-proof containers.
- Know the location of the designated storage areas, spill response materials, first aid stations, emergency and safety equipment, Safety Data Sheets (SDS), emergency exits, and Muster Points.
- Wear appropriate personal protective equipment (PPE).
- Know the waste handling, storage and spill prevention requirements.
- Comply with all NTPC and Facility policies and procedures when performing duties.

1.9 MAINTENANCE OF PLAN

The Director, Health, Safety & Environment will maintain and keep current the WMP. The Plan will be reviewed annually, but may also be reviewed more frequently as required (e.g. due to a new or amended legislation or the addition/deletion of a hazardous material or waste to/from Snare Hydroelectric Facility use).

A record will document all significant changes that have been incorporated in the WMP subsequent to the latest annual review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

1.10 ACCESS TO ADDITIONAL COPIES

Additional copies of the plan can be obtained by contacting the Environmental Analyst at (867) 874-5248.

1.11 SAFETY DATA SHEETS (SDS)

NTPC maintains Safety Data Sheets (SDS) for all controlled products that are used, stored, and handled at NTPC work sites

3E Online, a web-based program, is used to maintain and update the SDS for NTPC. All NTPC employees with computer access can view current SDS for NTPC products by visiting the following website:

https://www.3eonline.com/

In order to login to the site, the following username and password must be entered:

Username: ntpc
Password: msds

If employees cannot locate SDS on the website for products in use at NTPC sites, or if obsolete products are noted on the site, please advise the Manager, Logistics via phone or email using the following contact information:

Rod Gray, Phone: (867) 874-5208; Email: rgray@ntpc.com

All NTPC thermal and hydro sites also require current SDS binders (paper copy) to be maintained and kept up-to-date (i.e., updated every three years). It is the responsibility of the employee to request up-to-date SDS binders. To acquire an up-to-date SDS binder please contact the Environmental Analyst at (867) 874-5248.

1.12 GENERAL EMERGENCY RESPONSE

NTPC maintains procedures for responding to emergency situations and accidents, including any specific procedures that are required by environmental legislation. A summary is presented below:

Site Specific Emergency Response Plan

NTPC maintains Site Specific Emergency Response Plan that documents how to deal with incidents and emergency situations. The most common emergency situations or accidents that can occur at NTPC are spills and fires. For minor spills and fires that are safe to respond to, spill response materials and fire extinguishers are available in all NTPC buildings.

Spill Contingency Plan

In the NWT, under the *Environmental Protection Act*, the Spill Response Planning and Reporting Regulations set the standard for reporting spills of contaminants and preparing Spill Contingency Plans. A Spill Contingency Plan is required if contaminants are stored above ground in excess of 20,000 kg or 20,000 L, or below ground in excess of 4,000 kg or 4,000 L. A copy of the Spill Contingency Plan must be filed with the Chief Environmental Protection Officer. Although NTPC does not have below ground storage facilities, contaminants (e.g., fuel oil) are stored in excess of 20,000 L and therefore Spill Contingency Plans for all NTPC power plant sites have been established and registered with the Chief Environmental Protection Officer.

Emergency Response Assistance Plan

A person who offers for transport or imports a consignment of dangerous goods must have an approved emergency response assistance plan when the quantity of dangerous goods exceeds the Emergency Response Assistance Plan (ERAP) limit (Transportation of Dangerous Goods (TDG) Regulations sections 7.1, 7.4, and column 7 of Schedule 1). The ERAP is to be filed and approved by the Director General.

Currently no dangerous goods offered for transport or imported by NTPC require an ERAP.

Reporting of Spills

The procedures for reporting spills at the Facility are presented in the Snare Hydroelectric Facility Spill Contingency Plan.

A summary of reporting and response requirements for spills of dangerous goods during transport (as defined under TDG Regulations) and spills of hazardous materials (as defined in the NWT Environmental Protection Act and associated regulations) is presented in the NTPC HWMP.

NWT Spill Reporting

The minimum quantities for reporting of spills to the environment are specified in the Spill Response Planning and Reporting Regulations (refer to Table 1.1). NTPC has adopted a policy of reporting all spills of hazardous materials over 5 L, and spills of any size that reach water, to the 24-Hour Spill Report Line at (867) 920-8130 unless the minimum quantity specified in the regulation is more stringent (i.e. less than 5 L).

1.13 DISTRIBUTION LIST

The WMP and the most recent revisions are distributed internally to:

i. Environmental Health and Safety Department, Snare Hydroelectric Facility/NTPC (control copy)
ii. Operations Manager, Snare Hydroelectric Facility
iii. Plant Operator, Snare Hydroelectric Facility
iv. Manager, System Control, Hydro Region
v. Central Control Room, NTPC
vi. NTPC Intranet PowerLine

The Director of Health, Safety, and Environment at the Snare Hydroelectric Facility/NTPC is responsible for distribution of the WMP to outside third-party stakeholders.

2 OVERVIEW OF WASTE & HAZARDOUS MATERIALS

Gasoline and diesel fuel are the two main hazardous materials used and stored at the Facility. However, other materials and wastes such as propane, acetylene, used oil and glycol are also stored, and used and/or generated on-site. The primary and designated storage locations for hazardous materials, hazardous wastes and fuel are as follows:

The Facility fuel storage capacity is 128,400 L in Above Ground Storage Tanks as follows:

- Incinerator containing 1,700 L diesel – Snare Rapids (Figure 4);
- 60,000 L double-walled AST, diesel – Snare Airstrip (Figure 5);
- 60,000 L double-walled AST, gasoline – Snare Airstrip (Figure 5);
- 4,500 L double-walled skid mounted mobile tank – Snare Airstrip (Figure 5);
- 1,100 L double-walled AST, diesel – next to plant– Snare Cascades (Figure 6); and
- 1,100 L bermed AST, diesel – inside the plant - Snare Forks (Figure 7)

In addition to the Facility's fuel storage locations listed above, temporary fuel storage locations will be implemented as required to support the temporary camps or locations where crushing would take place at the following proposed locations. These locations are presented in Figure 2-3 and the capacities and containment description at each location are listed in Table 2-2.

Table 2.1 presents general information on the location of the main fuel, hazardous materials and hazardous waste storage areas. Estimated minimum and maximum quantities of hazardous materials are presented in Table 2.3.

Table 2.1: Main Fuel, Hazardous Material and Hazardous Waste Storage Facilities at the Snare Hydroelectric Facility

Storage Area	General Description	Location
Snare Falls Airstrip Tank Farm	One 60,000 L, double-walled AST containing diesel and one 60,000 L, double-walled AST containing gasoline.	Located at the Snare Airstrip.
Oil Storage Shed	Mainly 205 L and 20 L containers of new oil, lubricant and glycol.	Located at the Snare Airstrip.
Drum Storage Berm (20 m x 26 m)	Mainly 205 L drums for waste oil and glycol. Drums are tracked in the Hazardous Materials Inventory Log and shipped out every year on the Winter Road.	Located at the Snare Airstrip.

In addition, temporary fuel storage areas will be established only as required to support the temporary camps or locations where crushing would be place. Table 2-2 presents general information on the proposed locations of temporary fuel, hazardous materials and hazardous waste storage areas.

Table 2.2: Temporary Fuel, Hazardous Material and Hazardous Waste Storage Facilities at the Snare Hydroelectric Facility

Storage Area	General Description	Location
Snare Rapids Silt Pit Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at Snare Rapids Silt Pit
Snare Falls/Tie Sub-station Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at Snare Falls/Tie Sub-station Temp. Camp
Snare Cascade Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at Snare Cascade Temp. Camp
KM 28 Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at KM 28 Fuel Storage

Strutt Lake (SL) Aggregate Pit 1 Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at SL Aggregate Pit 1 Temp. Camp
SL Aggregate Pit 2 Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at SL Aggregate Pit 2 Temp. Camp
SL Aggregate Pit 3 Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at SL Aggregate Pit 3 Temp. Camp
Snare Forks Quarry Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at Snare Forks Quarry
Snare Winter Road Start Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at Snare Winter Road Start
Wekweeti Winter Road Fuel Storage	One 60,000 L, double-walled AST containing diesel and one 10,000 L, double-walled AST containing gasoline.	Located at Wekweeti Winter Road Temp. Camp

Table 2.3: List of Main Hazardous Materials On-Site

Material	Storage Container	Normally On-Site	Maximum On-Site	Storage Location (see Figure 4) and Uses
Diesel	See Table 2-1 and Table 2-2 above			
Gasoline	See Table 2-1 and Table 2-2 above			
Jet Fuel	205 L drum	2050 L (10 drums)	2050 L (10 drums)	Storage C-Can located at the Airstrip.
Lubricating Oil	205 L drum	2050 L (10 drums)	2050 L (10 drums)	New products stored in the Storage Shed, located at the Airstrip. Waste products stored in the Drum Storage Berm at the Airstrip.
Glycol	205 L drum	2050 L (5 drums)	2050 L (5 drums)	New products stored in the Storage Shed, located at the Airstrip. Waste products stored in the Drum Storage Berm at the Airstrip.
Transformer Oil	14,207 L (1 transformer)	28,414 L (2 transformers)	28,414 L (2 transformers)	Concrete berm at Snare Rapids substation.
	7,600 L (1 transformer)	15,200 L (2 transformers)	15,200 L (2 transformers)	Fibreglass berm at Snare Falls substation.
	180 L (2 transformers)	360 L (2 transformers)	360 L (2 transformers)	Fibreglass berm at Snare Falls substation.
	370 L (1 transformer)	370 L (1 transformer)	370 L (1 transformer)	Concrete berm at Snare Cascades substation.
	7,600 L (1 transformer)	7,600 L (1 transformer)	7,600 L (1 transformer)	Concrete berm at Snare Cascades substation.
	7,600 L (1 transformer)	15,200 L (2 transformers)	15,200 L (2 transformers)	Separate fibreglass berms at Snare Forks substation.
Acetylene	100 lbs tank	400 lbs (4 tanks)	400 lbs (4 tanks)	Garage at Airstrip
Propane	100 lbs tank	500 lbs (5 tanks)	500 lbs (5 tanks)	Garage at Airstrip
Oxygen	100 lbs tank	400 lbs (4 tanks)	400 lbs (4 tanks)	Garage at Airstrip
Nitrogen	100 lbs tank	200 lbs (2 tanks)	200 lbs (2 tanks)	Snare Rapids Plant

2.1 CAMP WASTE

NTPC maintains a permanent camp near the Snare Rapids hydroelectric generating facility – the Snare Rapids Camp. The Snare Rapids Camp houses 24 people at a maximum but rarely does the camp reach full capacity. On average, approximately 10 people are present at the camp on any given day. The temporary camps will be constructed as needed to support the winter roads and quarrying and will have a capacity of 20 people for 4 months at a time.

Domestic waste from the permanent camp is segregated for disposal using an on-site incinerator and camp sewage is treated in a Septic Field. Domestic waste that cannot be incinerated is stored until it can be removed from the site for disposal; KBL Environmental Ltd. (KBL) is collecting, transporting and disposing of non-incinerated domestic waste (Appendix I).

Sewage from the temporary camps will be discharged into temporary sewage pit. All management plans and standard procedures for the existing facility and permanent camp would also apply to the overflow camps.

2.1.1 Waste Segregation and Storage Methods

Only non-hazardous solid waste materials that meet those in Class I/II and III in accordance with Environment Canada's 2011 Technical Document for Batch Waste Incineration (provided in Appendix H) are incinerated. These materials are segregated at the source and are placed in specifically identified waste containers fitted with transparent bags and located throughout the Facility. These wastes include:

- food waste;
- food packaging, kitchen waste, and other food-contaminated waste;
- paper;
- cardboard; and,
- untreated wood

All non-hazardous solid waste that is generated at the Snare Cascades Facility is transported to the Snare Rapids Camp for incineration. Typically, there is only one operations staff present at the Snare Cascades Facility, so minimal amounts of waste are generated.

2.1.2 Human Domestic Waste Handling and Disposal

The majority of personnel at the Snare Hydro Facility remain at the Snare Rapids Camp which makes use of a Septic Field. NTPC's Snare Rapids Camp treats waste sewage and grey water using a Septic Field. The design includes two concrete tanks in tandem to form a sludge chamber and an effluent chamber. During operation, waste liquid spills into the effluent chamber and is then pumped into the septic field. The pump is operated by a float switch and pumps approximately 500L per cycle. The pump cycle is 3 minutes. The septic field is a network of 100 mm perforated pipe backfilled with free draining granular material.

The sludge chamber is required to be emptied every 5 years and trucked to a municipal sewage treatment facility. Snare Operations staff empty the sludge tank once per year and truck the sludge to the Yellowknife Municipal Treatment Facility via the winter road. When the Septic Field capacity was analyzed, it was expected that 20 people at the camp would produce a conservative estimate of approximately 1,000 Imperial Gallons per day (IGD) of waste water (~4.5 m^3/day). The maximum infiltration capacity of the Septic Field built is 36,000 IGD (~163 m^3/day). NTPC has not developed a stand-alone Sewage Management Proposal or Plan for the following reasons:

- the relatively low volume of human domestic waste that is processed at the Snare Rapids Camp is adequately contained in the large Septic Field; and,

- there is only minimal human presence at the Snare Cascades Facility.

All aspects of human domestic waste and disposal are addressed within this Waste Management Plan.

2.1.3 On-site Incinerator

The incinerator at the site is a CY-2020-FA "D" incinerator designed with a maximum batch capacity of 20 ft^3 and 140 lbs/hr. The Facility operator has been trained in the use of the incinerator and only authorized personnel are allowed to operate this equipment.

The incinerator is located at Snare Rapids Camp; all non-hazardous solid waste materials meeting the Class I/II and III criteria are transported to this area for incineration. The Snare Rapids incinerator is operated under a separate water license (see Section 1.1). The segregated waste streams that are incinerated include only those wastes identified in Section 2.2.1 Waste Segregation and Storage Methods.

Prior to loading the incinerator, the feed material is inspected by the incinerator operator to ensure it does not contain inappropriate waste materials. General classes of **inappropriate wastes** include, but are not limited to:

- Hazardous Wastes (refer to the NTPC Hazardous Waste Management Plan)
- Mercury containing materials / waste (e.g. fluorescent lamps, thermometers, thermostats, dental amalgam, batteries). Limiting the quantity of mercury placed in the incinerator is the most effective way to limit mercury emissions
- Metal and glass. These materials absorb energy from the furnace and increase the wear and tear on various incinerator components
- Materials / wastes containing heavy metals (e.g. mercury-containing wastes, pressure or chemically treated wood (i.e. Chromated Copper Arsenate [CCA] or creosote), lead painted materials
- Asbestos waste
- Liquid wastes including petroleum hydrocarbons and sewage.
- Uncontaminated plastics, including chlorinated plastics
- Inert materials such as concrete, bricks, ceramics, ash
- Bulky materials such as machinery parts or large metal goods such as appliances
- Radioactive materials such as smoke detectors
- Potentially explosive materials such as propane tanks, other pressurized vessels, unused or ineffective explosives

- Other hazardous materials such as organic chemicals (PCBs, pesticides), other toxics (arsenic, cyanide)
- Electronics
- Batteries
- Drywall
- Fluorescent light bulbs
- Tires
- Oily rags

When identified, inappropriate waste material will be removed from the incinerator feed. If the inappropriate waste is too intermixed with the desired incinerator feed, then the batch will be rejected and not incinerated. Removed inappropriate wastes and rejected batches will be stored and handled in accordance with the NTPC Hazardous Waste Management Plan.

The incinerator is designed with a maximum batch capacity of 20 ft^3 and 140 lbs/hr. The incinerator will not be loaded over the maximum capacity. The incinerator is operated in accordance with the Environment Canada (EC) Technical Document for Batch Waste Incineration (2010; Appendix H).

The incinerator will be operated according to the Operation and Maintenance Manual (see Appendix H). When the incinerator is loaded with the appropriate mix and quantity of waste, the door is closed and locked and the burn cycle is started. The incinerator operator observes the burn for at least 15 minutes after ignition of the primary chamber burner to ensure the volatility of the waste charged is not creating too much gas for the secondary chamber to handle. When satisfied that the burn is proceeding in a controlled manner, the incinerator operator may leave the incinerator area while the equipment completes the burn cycle.

The burn cycle will not be interrupted by opening the charging door until after the burn is complete and the unit has cooled down. No additional waste is allowed to be added to the primary chamber while in operation.

When the burn is complete and the unit has cooled, the incinerator operator will open the door only when wearing protective equipment (see Section 4.1, Appendix H).

The incinerator operator removes the ash from the previous burn cycle before reloading the incinerator. Any unburned combustible materials found in the ash will be recharged to the primary chamber after the incinerator operator has cleaned the air ports, and before putting a fresh charge into the incinerator. Non-combustible materials such as residual metal pieces will be disposed of with the ash. Two large metal bins are located next to the incinerator. Non-combustible materials and waste ash will be removed from the incinerator and stored in these bins. The bins are wildlife-proof, sealable, and have a storage capacity

that allows storage of one year's worth of waste ash. Waste ash will be stored until it is removed from the site annually when the winter road opens.

According to the Canada-wide Standards for Dioxins and Furans (adopted by the Canadian Council of Ministers of Environment [CCME] in 2001), facilities incinerate less than 26 tonnes of waste are not required to confirm stack test concentrations of 80 pg I-TEC / m^3 or less through annual testing but must make determined efforts to achieve this stack test concentration. The Snare Hydroelectric Facility incinerates significantly less than 26 tonnes of waste each year and NTPC does not currently undergo stack testing due to the small amount of waste that is incinerated at this facility.

2.1.4 Other Waste

Untreated wood and scrap lumber is open-burned. Scrap steel is stockpiled for removal via winter road. The remaining material is stored in sealed containers.

Hazardous materials are not incinerated and are discussed specifically in Section 2.3 General Hazardous Material Storage Guidelines. All domestic camp wastes that can not be incinerated, unburned combustible materials, non-combustible materials (e.g. metal pieces), and residual waste / incinerator ash will be stored on-site in airtight sealed containers until they can be transported offsite by KBL for disposal. The use of airtight sealed containers will minimize the possibility of wildlife being attracted to the potential odour on-site.

2.1.5 Waste Container and Storage / Staging Locations

Prior to removal from the site, the sealed waste containers are stored at the Snare Falls Airstrip which is located more than 100 meters (m) from the high water mark.

2.2 GENERAL HAZARDOUS MATERIAL STORAGE GUIDELINES

NTPC is committed to the safe and appropriate storage of fuels, hazardous materials and hazardous wastes. The following sections outline NTPC's general guidelines for storing hazardous materials and hazardous wastes.

2.2.1 General Precautions

General precautions for handling hazardous materials include:

- No person should handle a substance unless that person is familiar with the hazards.
- No person should use a substance unless that person is familiar with the proper use.

- Hazardous materials from different classes should never be mixed in the same container.

2.2.2 General Guidelines for Storage Drums/Containers

Hazardous materials / waste shall be stored in drums or containers according to the following guidelines:

- No putrescible material will be stored in the containers as it will generate gas and odour. All organic waste will be incinerated.
- In the original containers, where possible or in containers manufactured for the purpose of storing the material, or use good quality 16 gauge or lower steel or plastic 205 L drums.
- Containers of hazardous materials shall be returned to their designated storage area at the end of each shift or when no longer in use.
- Reused steel or plastic drums must have an internal volume greater than or equal to 150 L to handle, offer for transport or transport dangerous goods that are liquid and are included in Class 3, 4, 5, 6.1, 8 or 9 (Section 5.12(2), TDGR 2001-286)
- Storage containers shall be in good condition, sealable and not damaged or leaking.
- Drums containing hazardous materials/wastes expected to be in storage for more than six months shall be placed on pallets or on a well-drained storage area to prevent rusting.
- Each container shall be clearly labelled to identify the substance being stored according to the requirements of the Workplace Hazardous Materials Information System (WHMIS) or the Safety Act or the relevant Transport Authority, if transport is planned.
- Containers shall be kept secure and closed except when adding or removing product.
- Containers with product shall be kept in the upright position; empty drums can be placed horizontally with bungs in place, or if missing, with bung on top.
- Containers shall be arranged to prevent damage from falling or dislodging.
- Containers shall be arranged to allow for easy access and inspections.
- Dispensing a container to another shall only be carried out within an area provided with drip / spill containment.

2.2.3 General Guidelines for Storage Areas

All hazardous materials / waste shall be stored in drums or containers and those drums and containers will be stored within an earthen berm lined with a geofabric protector. The bermed hazardous material storage area is located at the Snare Falls Airstrip adjacent to the Storage Tent (Figure 8 and Figure 9).

The bermed area measures 20 m by 26 m and includes the following engineering and design features:

- Compacted earth berms of granular material with a similar design to those at NTCP's Jackfish Plant;
- Earth berms are lined with a 60 millimetre heavy-duty polyethylene (HDPE) geosynthetic liner;

- Separate pieces of the HDPE liner are joined together using plastic welding and the weld tested;
- Sand backfill is placed on top of the HDPE liner for protection of the liner.

Figure 8: Snare Falls Hazardous Materials Storage Berm.

Figure 9: Snare Falls Storage Tent and Airstrip Locations.

To assist in the safe and secure storage of fuels, hazardous materials and hazardous wastes, the following general guidelines for storage areas/facilities will be considered:

- Design of storage areas shall be in compliance with the National Fire Code, where appropriate.
- Drainage into and from storage areas shall be controlled in order to prevent leaks or spills from migrating off-site and to avoid run-off from entering the storage areas.
- Storage areas shall have controlled access. Only authorized and trained personnel shall have access to storage areas.
- Leaking or deteriorated containers shall be removed and their contents transferred to a sound container.
- Storage areas shall be adequately signed indicating that there is to be no smoking, no sparks or flames and hazardous materials/wastes are stored therein.
- Storage locations shall be clearly defined and marked to prevent damage of storage drums and containers in the event they are covered by snow.

- Incompatible materials shall be segregated by chemical compatibility within the storage area to prevent contact between materials in the event of a release. Storage containers will be clearly labelled, visible to all staff and contractors.
- Storage areas shall be located at least 100 m from the high water mark of water bodies and on a low-permeability area, where possible.
- Storage areas shall be readily accessible for fire fighting and other emergency procedures.
- Storage areas shall be adequately ventilated to prevent the build up of noxious or toxic vapours.
- Secondary containment or an adequate spill collection system shall be installed to allow for the containment of at least 110% of the largest container or tank volume within the contained area, plus 10% of the aggregate capacity of all other containers or tanks (Details on the bermed waste storage area are provided in Section 2.2.3 and Figure 8)
- Secondary containment shall be kept free of debris, water accumulation and snow.
- Storage areas and associated secondary containment shall be protected from the elements, where possible. In case this is not feasible, the secondary containment area volume shall be large enough to allow for any precipitation (rain, snow, and storm water run-on) that may enter containment systems located outdoors, in addition to the required containment volume for stored materials. In addition, sufficient capacity to handle sprinkler water and other water from fire protection efforts will be provided.
- Storage areas shall be constructed, or provided with barriers, to protect containers from the environment and physical damage.
- Adequate spill and emergency response equipment shall be installed at each storage area (i.e. spill control, fire protection, etc.). A list of spill control equipment is provided in the Spill Response Plan.
- The site shall not be used for long-term storage of hazardous waste (in excess of one year).

3 WASTE MANAGEMENT PLAN

3.1 LIFE CYCLE MANAGEMENT

"Life cycle management" implies the assessment of a particular product over its entire life – from the time a material is needed to the time the product is fully consumed, reused, recycled or disposed of as waste. It covers product supply, transportation, storage, handling, recycling, and waste disposal. NTPC is committed to ensuring proper life cycle management of all products used including hazardous materials. All material used at the Facility will be handled in accordance with relevant legislation (e.g., *Environmental Protection Act* [EPA] and T*ransportation of Dangerous Goods Act and Regulations* [TDGA]). NTPC and its contractors will deal only with reputable, certified suppliers, transporters, and expediters.

3.1.1 Delivery

Hazardous materials will be delivered to sites by commercial carriers via ice road or helicopter with the appropriate transport authority: TDGA or International Civil Aviation Organization (ICAO). Carriers will be licensed and subject to inspections as required by the NWT Department of Transportation. All required permits, licenses, training and certificates of compliance will be obtained.

All shipments must be properly identified and labelled. Shipping papers must be accessible and include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures and emergency response telephone numbers.

Each commercial carrier is required to develop a spill prevention, control, and countermeasures plan to address the materials they are importing. In the event of a release during transport, the commercial transportation company is responsible for first response and cleanup. NTPC will periodically verify the qualifications of commercial carrier, their personnel and the existence of their spill prevention, control and countermeasures plan.

NTPC's registered waste generator, carrier, and receiver numbers are NTG000008, NTC000002, and NTR000007 respectively. The Snare Hydroelectric Facility is a generator of hazardous waste; however, it does not act as a carrier (transporter) or receiver of hazardous waste.

3.1.2 On-Site Handling

Once dangerous materials are received at the workplace, additional regulations apply. The federal Workplace Hazardous Materials Information System (WHMIS) calls for the proper labelling of products, the availability of product information in the form of the Safety Data Sheets (SDS), and employee education on how to identify and handle hazardous materials. NTPC maintains hard copy and electronic

SDS that are readily accessible by all employees. New SDS are added to NTPC's inventory when new products are procured and paper copy SDS are kept current (i.e. no older than 3 years).

All employees with computer access can view the current SDSs for NTPC products by visiting the website:

https://www.3eonline.com/

In order to login to the site, the following username and password must be entered:

Username: ntpc
Password: msds

Hazardous materials are to be stored in secured areas to prevent access by unauthorized personnel or any tampering. Tanks used for the storage of hazardous materials are double-walled or installed in secondary containment areas sized to hold at least 110% of the volume of the largest tank, plus 10% of the aggregate capacity of all other containers or tanks. Additional guidelines for the storage of hazardous materials are provided in Section 2.

In support of pollution prevention, regular inspections of storage containers/drums, tanks and the storage areas are completed each month and documented on Form 9.2: Safety Inspection Report (Appendix F). If deficient conditions are identified, appropriate corrective actions are taken and documented. Additional details for inspection of storage areas are provided in Section 5.

Emergency response procedures for spilled chemical substances are provided in the Spill Contingency Plan. These procedures outline the response to accidental spills or releases of hazardous materials to minimize health risks and environmental effects. Included are procedures for evacuating personnel, maintaining safety, cleanup activities, emergency contacts, internal and external notifications to regulatory authorities and incident documentation.

3.1.3 Hazardous Wastes

NTPC's Hazardous Waste Management Plan (HWMP) presents detailed information with respect to the management of hazardous wastes at all NTPC facilities, including the Snare Hydroelectric Facility. The reader is directed to the HWMP for specific information relating to the management of hazardous wastes. General information with respect to the management of hazardous waste is provided below.

Hazardous wastes are typically generated through operations involving the use/clean-up of chemicals or other hazardous materials/substances (waste oils, waste fuels, batteries, solvents, etc.). On becoming wastes, hazardous materials will be stored and/or disposed of in accordance with specific government legislation, regulations and guidelines.

As a waste generator, NTPC is ultimately responsible for ensuring hazardous waste will be properly managed from the time they are generated to final disposal. Waste must be properly identified, labelled, stored, transported, treated and disposed of. Contractors are responsible for handling and disposal of the hazardous wastes they generate through their work, unless alternate arrangements have been made with NTPC in advance.

Hazardous wastes must not be mixed or diluted with any substance or divided into smaller quantities to avoid meeting the definition of a hazardous waste. Incompatible hazardous wastes should be segregated by the TDG class to ensure safety. Open burning of hazardous waste is not acceptable.

It is NTPC practice to remove hazardous waste from all sites at least once per year. No NTPC site should maintain quantities of waste for a period of time sufficient to necessitate registration as a storage facility. If hazardous waste is stored for a period of 180 days or more, and the quantities to be stored exceed the quantities set out in the Guideline for the General Management of Hazardous Waste in the NWT Schedule VI: Registered Volumes for individual waste classes or if the aggregate quantity for all classes of waste stored exceeds 5,000 kg or L, the facility must be registered with the NWT Department of Environment and Natural Resources. The storage facility can be a building, locker, compound, or area used to store hazardous waste.

In cases where hazardous wastes are to be transported off-site for treatment or disposal, NTPC will only use hazardous waste management facilities registered with the appropriate provincial or territorial authorities having jurisdiction. Prior to selecting and engaging such companies, NTPC will verify their “approved” status as a waste facility with the appropriate provincial or territorial authorities having jurisdiction. A review of their “approved” status will be conducted at least annually. NTPC will employ only registered waste carriers to transport waste to registered waste receivers.

The NWT Environmental Protection and Waste Management Division, Department of Environment, Environment and Natural Resources (ENR) monitors the movement of hazardous waste, from the generator to final disposal through use of a tracking document known as a Waste Manifest. Accordingly, a completed Waste Manifest will accompany all movements of hazardous waste from the Snare Hydroelectric Facility. NTPC is registered with the ENR as a waste generator and the waste generator number is NTG000008.

Hazardous wastes from the Snare Hydro Facility, including glycol, oil, and fuel, are handled and disposed of by KBL in Yellowknife, NT (Appendix I). In 2009, they developed the first approved and licensed Hazardous Waste Transfer Facility in the NWT, which is regulated by the GNWT.

3.1.4 Final Disposal Methods for All Waste Streams

Non-hazardous Waste Disposal Methods

All non-hazardous domestic camp wastes that can not be incinerated, unburned combustible materials, non-combustible materials (e.g. metal pieces), and residual waste / incinerator ash is stored at the Facility in a designated area at the airpstrip in airtight sealed containers. They are collected, transported and disposed by KBL via the winter road.

Hazardous Waste Disposal Methods

Hazardous wastes are transported by KBL to their Hazardous Waste Transfer Facility located in Yellowknife's Kam Lake Industrial Park at #17 Cameron Road. This facility is regulated by the GNWT ENR. KBL first transports the hazardous wastes to the NTPC Jackfish Lake Waste Berm for temporary staging. KBL then provides NTPC with a quote for disposal of the hazardous wastes. Next, NTPC issues a purchase order to KBL.

A letter confirming KBL's commitment to the transport and disposal of hazardous and domestic waste for NTPC is included in Appendix I.

4 PRIMARY HAZARDOUS MATERIAL

4.1 PRODUCT DESCRIPTION

Two particular products – gasoline and diesel fuel – will be used in relatively large quantities at the facility. Detailed procedures have been developed to ensure that these materials are handled and used with no adverse effect on people or the environment. The other hazardous materials used on site are present in relatively small quantities. Products such as combustible diesel fuels and gasoline fuels, toxic anti-freeze, compressed gases, lubricants, and cutting oils are widely used in the North. These products meet vital needs for power generation, heating and vehicle operation.

The transportation, storage and handling of these petroleum and related products are strictly regulated by both federal and territorial legislation. NTPC will ensure that all such requirements are met. Standard procedures are discussed in Section 2 of this document. NTPC will emphasize the need for regular inspections of all storage and distribution facilities on site to assure mechanical soundness and to prevent leaks or any other uncontained release of fuel products.

Material categories, site handling and storage requirements, and PPE recommended by manufacturers in SDS are summarized in Tables 4.1 through 4.3 (also see the Spill Contingency Plan [SCP]). The primary hazardous material and waste storages areas at the Facility are described in Table 2.1.

Table 4.1 Fuel Products – Hazard Classes & Potential Impacts

Material	TDGA Class	Potential Environmental Impact
Diesel	3	Water & soil contamination
Gasoline	3	Water & soil contamination
Jet Fuel	3	Water & soil contamination
Lube Oil / Motor Oil	Not regulated	Water & soil contamination
Glycol	Not regulated	Toxic by ingestion, could potentially be consumed by wildlife
Propane	2	Fire/explosion
Acetylene	2	Fire/explosion
Oxygen	2	Fire/explosion

Table 4.2 Fuel Products – Safe Handling Procedures

Product	Handling Procedures
Diesel	Do not get in eyes, on skin or on clothing. Avoid breathing vapours, mist, fume or dust. Do not swallow. May be aspirated into lungs. Wear PPE and/or garments if exposure conditions warrant. Wash thoroughly after handling. Launder contaminated clothing before reuse. Eliminate all ignition sources. Store in a well-ventilated area. Store in a closed container. Bond and ground during transfer.
Gasoline	See diesel procedures above.
Jet Fuel	See diesel procedures above.
Lube Oil / Motor Oil	Wear protective clothing and impervious gloves when working with used motor oils. To be handled generally consistent with other petroleum hydrocarbons.
Glycol	Ensure adequate ventilation. Wear protective gloves and chemical safety goggles. Keep in tightly closed containers.
Propane	Secure cylinders to a wall, rack or other solid structure in an upright position. Keep valves closed and protective cap in place on cylinder when not in use. Do not handle with oily hands. Protect from heat. Protect against electrostatic charges. Pressurized container: protect from sunlight, store in a cool location and do not expose to temperatures exceeding 50°C. Empty containers may have product residue. Do not pressurize, cut, heat or weld empty containers. Store in a cool, dry and well-ventilated building. Eliminate all ignition sources. Keep product out of direct sunlight and away from incompatible or combustible materials.
Acetylene	See propane procedures above.
Oxygen	See propane procedures above.

Table 4.3 Fuel Products – Personal Protective Equipment

Product	Personal Protective Equipment		
	Eyes	Skin	Respiration
Diesel	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required.
Gasoline	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required. Ensure adequate ventilation.
Jet Fuel	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required. Ensure adequate ventilation.
Lube Oil / Motor Oil	Chemical goggles	Neoprene or nitrile gloves, protective garments.	Under normal handling, none usually required.
Glycol	Chemical goggles	Neoprene or nitrile gloves, protective garments	Under normal handling, none usually required.
Propane	Chemical goggles	Neoprene or nitrile gloves, protective garments. Insulated gloves suitable for low temperatures where liquid propane is involved.	Under normal handling, none usually required.
Acetylene	Chemical goggles	Neoprene or nitrile gloves, protective garments.	Respirator – see SDS.
Oxygen	Chemical goggles	Neoprene or nitrile gloves, protective garments.	Respirator – see SDS.

4.2 DELIVERY TO SITE

With the exception of diesel and gasoline fuel, most petroleum fuel and lubricant products will be delivered to site and stored in the original packaging container from the manufacturer/supplier. These types of containers include a variety of sealed drums (205 L), pails, cans, tubes and boxes. Supplies of diesel and gasoline are brought primarily by ice road using tanker trucks.

Upon arriving on site, and after checking in with Facility security, the bulk fuel is delivered to the fuel tank farm for transfer to the diesel and/or gasoline aboveground storage tanks. The small quantity hazardous materials contained within their original packaging will be delivered directly by the carrier to their designated storage area by the contractor under the direct supervision of Snare Hydroelectric Facility personnel.

All fuel transfer and storage facilities will be designed and operated in accordance with the National Fire Code, the Canadian Council of Ministers for the Environment (CCME, 2003) Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum, and the (CCME, 2008) Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

Appropriate measures are in place to minimize impacts to surface water, groundwater and soils from potential vehicle accidents when transporting hazardous materials across the Facility. Details of spill responses are presented in the SCP. The following general precautions will be taken:

- A maximum speed on the ice road and at the Facility for loaded and empty vehicles will be established based on the road design.
- Trucks will carry at least 10 m^2 of polyethylene material, a spark-proof shovel and oil absorbent blankets or squares.
- Trucks will be equipped with a reliable radio and/or satellite phone.
- NTPC commits to being prepared to respond to spills resulting from vehicle accidents in a timely and efficient manner.

4.3 FUEL TRANSFER PROCEDURES

Bulk transfer of fuel, oil and glycols is to follow NTPC's Fuel Transfer Safe Work Practice (Appendix C). The contract supplier will fill the storage tanks in the main tank farms under the supervision of NTPC personnel. General procedures to be followed are listed below. Similar procedures will be followed for fuelling remote tanks.

Before fuel transfer, verify that:

- All employees are wearing personal protective equipment as may be necessary to protect themselves from the hazards involved.
- Emergency equipment including fire extinguishers and spill kits are available and have been inspected.
- All fuel transfer hoses have been connected properly and couplings are tight.
- Transfer hoses are not damaged.
- All fuel transfer personnel are familiar with the general procedures at the site and of the product being transferred.
- Personnel are located at both the fuel delivery truck and fuel transfer tank(s) and can manually shut off the flow of fuel in the event of a system failure, fault, leak or fire.
- If a high liquid level shutoff device is installed at the delivery tank, verify that the shutoff is operating correctly each time it is used.
- Fuel transfer will then proceed per the established procedures of the contract supplier.

In the event, those personnel must leave the immediate transfer area, the transfer shall stop and the transfer point locked. If an employee leaves the site during the process of a transfer, the employee will be dismissed, except in extenuating circumstances.

Transfer points will be kept locked at all times except during the transfer process.

Any accidents or spills must be reported immediately to the Plant Operator and a Spill Report Form submitted to the regulators and NTPC management. Notification and response procedures are detailed in the SCP.

4.4 CONTAMINATED SOILS AND SPILLS

Contaminated soils resulting from the storage and handling of fuels and lubricants will be salvaged at the time such impacts are identified, and put into drums, labelled, stored at the appropriate storage location and shipped off-site to an approved disposal facility.

A suitable absorbent will be used to cleanup spillage on impermeable floor surfaces, and will be handled similarly to contaminated soil as described above. Internal and external notification requirements, record keeping and response procedures are detailed in the SCP. If required, the assessment and remediation of contaminated soil will be carried out in accordance with The Environmental Guideline for Contaminated Site Remediation.

4.5 USED PETROLEUM AND OTHER WASTE PRODUCTS

Used oil, solvents or glycol that are no longer suitable for its intended use is classified as a hazardous waste, and drummed and stored as appropriate. The discharge of used oil, solvents or glycol into the environment, including but not limited to landfills, sewers and water bodies is prohibited. Used oil will not be incinerated on site. Used oil will not be applied as a dust suppressant on site.

These materials will be managed in accordance with requirements of the *Used Oil and Waste Fuel Management Regulations, the Guideline for the Management of Waste Solvents and the Guideline for the Management of Waste Antifreeze.*

5 INVENTORY, INSPECTION & RECORDS

5.1 GENERAL

A contracted expediting company will arrange all deliveries from Yellowknife to the Snare Lake Hydroelectric Facility. This will include the hazardous materials discussed in this plan. The Plant Operator will have ultimate responsibility for supervising the receipt, inspection and recording of all material inventories on site. The Regional Director will reconcile total amounts received against amounts ordered.

5.2 FUELS & LUBRICANTS

5.2.1 Inventory Management

Diesel and gasoline fuel represent the most significant quantities of hazardous materials delivered to site. Diesel and gasoline fuel use will be metered automatically when they are pumped from the bulk/dispensing tanks. The metered volumes will be summarized weekly and reconciled against tank product and water levels determined manually with a dipstick from the top of the tanks, or electronically if an approved method is provided on a given tank. Diesel and gasoline fuel consumption for the machinery will be recorded weekly.

Lubricants and other petroleum products in storage areas will be inventoried monthly.

Inventory and reconciliation calculations and records will be maintained on site.

5.2.2 Inspection

The Plant Operator will coordinate the inspection of all fuel and lubricant storage sites areas. The inspection schedule and procedure to be followed are summarized in Table 5.1. All inspections will be logged with the date and time of inspection, area inspected and the name of the person making the inspection.

Drum / Container Storage Areas

The condition of hazardous materials storage areas will be checked on a regular basis. Observations on their condition will be logged, dated and kept near the corresponding storage area. Drums/containers will be inspected for the presence and legibility of symbols, words or other marks identifying the contents, signs of deterioration or damage such as corrosion, rust, leaks at seams or signs that the drum/container is under pressure such as bulging and swelling, spillage or discoloration on the top or sides of the drum/container. If leaks or deterioration is encountered it will be noted and addressed in a timely manner.

The hazardous materials area's secondary containment will be inspected and the condition of the secondary containment will be noted. Arrangements will be made for repairs if necessary. If precipitation (water or snow) is present within the secondary containment, it will be removed from the secondary containment area in a timely manner to prevent overflow or damage to the containment system due to large ponding.

The availability of suitable and suitable quantity of spill response materials will be verified during the inspections. Additional spill response materials will be provided as required.

Petroleum Storage Tanks and Tank Storage Facilities

Inspection of petroleum storage tanks and petroleum storage tank facilities will be in conformance with the requirements of the National Fire Code and the CCME Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum.

Visual inspection of a storage tank facility to ensure that there has not been a leak, deterioration of the facility that could result in a leak or equipment failure shall be conducted weekly and documented for the following where applicable:

- foundations, tank walls, roof, and tank attachments;
- dyke capacity, condition of the dyke wall and floor, and water removal systems;
- pumps and product-handling equipment;
- tank gauging equipment;
- mechanical and automatic electronic leak detection equipment;
- dispenser sumps and spill containment devices; and,
- overfill protection devices.

Inspection and performance testing in conformance with the manufacturer's requirements and procedures to ensure satisfactory equipment performance and operation of a storage tank facility will be conducted annually and documented where applicable for:

- automatic tank gauges and monitoring systems;
- high-technology sensors;
- electronic or mechanical leak detection equipment;
- corrosion protection equipment;
- pressurized piping emergency valves;
- emergency shut-down devices;

- containment sumps including dispenser, turbine and transition containment devices; and
- overfill protection devices.

Vertical tanks will also undergo periodic testing as per API 653 / API 653-01 as required.

Table 5.1 Inspection of Petroleum and Hazardous Materials Storage Sites

60,000 L (2 tanks) Aboveground Storage Tanks	Schedule: Weekly by the Plant Operator or designate; Procedure: Repair leaks and report promptly. Inspections will be reported annually and filed with the Plant Operator
Drum Storage Berm	Schedule: Monthly by the Plant Operator or designate; Procedure: Address leaks and report promptly. Inspections will be reported monthly and filed Health &Safety Manager
Spill Kits	Schedule: Weekly/Monthly as part of inspection schedule as per above by Plant Operator /designate;

Any accidental damage to containment structures will be inspected immediately and appropriate repairs undertaken. The extent of damage will be reported in writing to the Plant Operator or alternate. The report will identify any remedial repairs that may be made, the date of any repairs and the need for any follow-up inspection. The Safety Inspection Report form can be found in Appendix F.

5.2.3 Records

Records pertaining to storage, use, and loss of fuels and lubricants are required by CCME and the Fire Marshal (under the National Fire Code). The following records will be prepared and maintained for fuel and hazardous materials storage areas under the supervision of the Plant Operator:

- Receiver registration number;
- Carrier registration number;
- Waste generator registration number;
- Waste manifests;
- Reconciliation of bulk inventory from resupply logs;
- Waste accumulation log;
- Hazardous materials / waste storage inventory log;
- Weekly use summaries;
- Weekly reconciliation for each storage tank;
- Inspections and maintenance records;

- Any alterations to the systems;
- Reports of leaks or losses;
- Reports of spill responses; and
- Records of training.

Specific to storage tanks, the following records are also required, where applicable:

- Inventory control and reconciliation data;
- Inspections and maintenance records;
- Overfill alarm tests
- Cathodic protection monitoring;
- Precision leak detection tests;
- Maintenance and repairs;
- Monitoring well results;
- Construction, alterations, or upgrades;
- As-built drawings; and
- Excavation or nearby construction that could affect the integrity of the storage tank system.

The records will be maintained on-site for at least seven years.

6 TRAINING

6.1 GENERAL

As outlined in the NTPC's Health and Safety Management System, all employees and contractors at the Snare Hydroelectric Facility will receive the following training:

- WHMIS
- Emergency and spill response training (see also the SCP and ERP)
- Operations overview

Employees will receive additional training specific to their area of work and duties, including safe operation practices, safe handling and storage of chemicals, and use of PPE. This training will be the responsibility of NTPC.

Periodically, NTPC staff will carry out fire or other emergency drills. The drills will test emergency response procedures, and will be scheduled so as not to disrupt work. The results of the drills will be recorded and forwarded to the Plant Operator, JOHSC and NTPC. The results may indicate that additional or refresher training is required Safety committee recommendations will be enacted expeditiously.

Medical, emergency response and spill response staff will conduct periodic drills to test their emergency response procedures (see also the ERP and SRP). Reports on the drills will be provided to the Plant Operator, JOHSC and NTPC for action as required.

6.2 FUEL & LUBRICANTS HANDLERS

Personnel who handle fuel and lubricants will be expected to be conversant with relevant SDS information. As well, these personnel will be given training in the following:

- Transportation of Dangerous Goods (TDG)
- NTPC's fuel handling procedures (outlined in Section 3)
- Spill response and cleanup procedures for petroleum hydrocarbons (see the SCP)
- Emergency response procedures (see the ERP)

The attendants and persons involved in inspections of fuel storage locations will be trained in fuel reconciliation and inspection procedures to support leak prevention and early detection.

6.3 PLANT EMPLOYEES

Plant employees may receive TDG training, if appropriate. All plant employees will be trained in spill and emergency response procedures. Emergency response procedures for spilled chemical substances are provided in the SCP.

For more information on employee training and safety guidelines, see NTPC's Health and Safety Management System, SCP and ERP.

6.4 THIRD PARTY CONTRACTORS

It is expected that third party contractors receive adequate and comprehensive training to conduct their work tasks from their employer. NTPC intends to review the general qualifications of third party contractors prior to having them work at the site. In addition, the contractor companies may also be requested to confirm the qualifications of specific individuals that they may have working at the site.

Third party contractors working on the site will be expected to participate in, and complete a site specific health and safety orientation. The site orientation is valid for a period of one year, after which time the contractor may be required to complete the site orientation again. The site orientation will outline site specific hazardous and response procedures that they should be aware of in the course of conducting their work on site. The site orientation will cover hazardous materials management as well as instruction on the proper disposal of solid waste.

7 PLAN EVALUATION, AUDIT & IMPROVEMENT

7.1 GENERAL

NTPC's goal is to audit all aspects of the WMP for effectiveness. Environmental management procedures will be modified and updated to address changes in policy, regulations and technology advances. The primary purpose will be continued compliance with legislative requirements. The WMP will be reviewed and audited annually at a minimum, but may also be reviewed and audited more frequently as required to identify any components that need to be corrected, adjusted, upgraded, or otherwise modified. Aspects of the plan that affect the safety of employees at the facility and of the general public will be most important.

Formal evaluations of the plan will be documented, deficiencies will be noted, and progress in addressing deficiencies will be tracked in writing. Individual responsibilities and accountabilities will be assigned, and deadlines will be set for addressing the required changes. The Director, Health, Safety and Environmental will assume overall responsibility for the process.

In line with the NTPC's goal of continuous improvement in all health and safety matters, all employees will be encouraged to offer suggestions for more efficient and safer materials handling procedures.

APPENDIX A

GLOSSARY

A

- **Accredited** (accreditation):

A term used by analytical laboratories. Those that have been tested and evaluated by the Standards Council of Canada and Canadian Standards Association, and that have met certain standards, are assigned an accreditation number. Only Accredited Laboratories may be used to obtain analytical results required for legislative compliance.

B

- **None**

C

- **CALA**:

Canadian Association of Laboratory Accreditation (formerly Canadian Association of Environmental Analytical Laboratories (CAEAL). In cooperation with the Standards Council of Canada (see below), this Association governs the standards for and admission to the association of laboratories that have met all CAEAL standards to become accredited (see above).

- **Carrier:**

Any person engaged in the transport of hazardous waste whether or not for hire or reward.

- **Commissioner's Lands:**

Lands in the Northwest Territories that have been transferred by Order-Land in-Council to the Government of the Northwest Territories. This includes highways, block land transfers, and most lands within municipalities.

- **Consignee (Receiver):**

A site or facility that is licensed to accept certain subject wastes for disposal.

- **Consignor (Generator):**

A person who offers a consignment of hazardous waste for transport.

- **Contaminant:**

Any noise, heat, vibration or substance including such other substances as the Minister may prescribe that, where discharged into the environment:

(a) endangers the health, safety or welfare of persons,
(b) interferes or is likely to interfere with normal enjoyment of life or property,
(c) endangers the health of animal life, or
(d) causes or is likely to cause damage to plant life or property.

D

- **Dangerous Goods**

Any product, substance, or organism included by its nature or by the Transportation of Dangerous Goods Regulations (TDGR) in any of the classes listed in the schedule provided in the Transportation of Dangerous Goods Act (TDGA).

E

- **Empty Container**

A container that has been emptied, to the greatest extent possible, using regular handling procedures, the contents of which shall not exceed 1% of the container's original capacity or 2 litres, whichever is less. This does not include containers which previously contained mercury or class 2.3, 5.1, or 6.1 materials of TDGR.

- **Environmental Protection Service (EPS):**

Environmental Protection Service (EPS) of the Department of Environment and Natural Resources (ENR) is the Government of the Northwest Territories' (GNWT) agency responsible for initiatives which control the discharge of contaminants and their impact on the natural environment.

F

- None

G

- **Generator**

The owner or person in charge, management, or control of a hazardous waste at the time it is generated, or a facility that generates hazardous waste.

H

- **Hazardous Waste:**

A contaminant which is a dangerous good that is no longer used for its original purpose and is intended for recycling, treatment, disposal, or storage. A hazardous waste does not include a contaminant that is:

(a) household in origin;
(b) included in class 1, Explosives or class 7, Radioactive materials of TDGR;
(c) exempted as a small quantity;
(d) an empty container; or
(e) intended for disposal in a sewage system or by landfilling that meet the applicable standards set out in schedules I, III, or IV of the Guideline for Industrial Waste Discharges in the NWT.

- **Hazardous Waste Management Facility:**

A facility which is used for the collection, storage, treatment, recycling, or disposal of hazardous waste.

I

- **Incompatible Waste**:

Hazardous wastes which, when in contact with one another or other substances under normal conditions of storage or transportation, could react to produce heat, gas, fire, explosion, corrosive substances, or toxic substances.

J

- None

K

- None

L

- **Landfilling:**

The deposit of waste on land, as described in the GNWT Department of Municipal and Community Affairs' document Guidelines for the Planning, Design, Operation & Maintenance of Solid Waste Modified Landfill Sites in the Northwest Territories (2003).

- **Licensed Waste Disposal Facility:**

A facility or site that is authorized to accept and dispose of predetermined wastes.

- **Long Term Storage:**

The storage of hazardous waste for a period of 180 days or more and in excess of the minimum quantities, not including materials in transit.

M

- **Manifest (Waste Manifest):**

A six-part, colour-coded, and uniquely numbered document issued by the government to licensed waste generators/carriers that must be completed and carried with/filed for shipments of waste (certain exemptions are allowed). The Manifest consists of three Sections (Consignor, Carrier, and Consignee) each of which must be completed by the party in control of the waste at the time the Section is completed.

- **Manage:**

To handle, transport, store, recycle, treat, destroy, or dispose of hazardous waste.

N

- **None**

O

- **None**

P

- **None**

Q

- **None**

R

- **Receiver (Consignee):**

A person to whom a quantity of hazardous waste is being or is intended to be transported to.

S

- **Sewage System:**

A system for the collection, transmission, treatment or disposal of any liquid waste containing animal, vegetable, mineral, human or chemical matter in solution or in suspension.

- **Solid Waste:**

Solid waste or refuse is described as materials generated by Facility staff and operations equivalent to that generated in typical residential and commercial operations

- **Small Quantity:**

Hazardous waste that is generated in an amount that is less than 5 kilograms per month if a solid or 5 litres per month if a liquid, and where the total quantity accumulated at any one time does not exceed 5 kilograms or 5 litres. This does not apply to wastes that are mercury or in classes 2.3, 5.1, or 6.1 of TDGR. These wastes must be generated in an amount less than 1 kilogram per month if a solid or 1 litre per month if a liquid; and where the total quantity accumulated at any one time does not exceed 1 kilogram or 1 litre.

T

- **Toxicity Characteristic Leaching Procedure (TCLP):**

Laboratory test method developed by the USEPA for determining the leaching potential of contaminates.

- **Transport Authority:**

The regulations controlling the management of hazardous waste under that mode of transport. These include:

  - Road and rail - Transportation of Dangerous Goods Act (TDGA) and Regulations (TDGR).
  - Air - International Civil Aviation Organization Technical Instructions (ICAO).
  - Marine - International Maritime Dangerous Goods Code (IMDG).

- **TDGA/TDGR:**

The Transportation of Dangerous Goods Act and Regulations (Canada).

- **Treatment or Treat:**

The handling or processing of a hazardous waste in such a manner as to change the physical, chemical or biological character or composition of the hazardous waste in order to eliminate or reduce:

(a) one or more environmental hazards of the waste; and/or
(b) the volume.

U

- **None**

V

- **None**

W

- **Waste:**

Any material that is to be disposed of by any individual/company that is not considered to be inert.

- **Waste Dangerous Goods:**

Subject wastes that are also regulated by the terms and conditions contained in the Transportation of Dangerous Goods Regulations under the Transportation of Dangerous Goods Act (federal).

- **Waste Data Sheets:**

The pages in Tab 5 of this manual that describe the legislated requirements for managing the various wastes in accordance with the Transportation of Dangerous Goods Regulations, if applicable.

X

- **None**

Y

- **None**

Z

- **None**

APPENDIX B

LEGISLATIVE REQUIREMENTS

Federal Legislation

A summary of the relevant federal legislation and applicable sections that cover the collection, handling, transportation, and disposal of hazardous wastes in Canada is presented in Table B1.

Table B1 – Summary of Federal Legislation

FEDERAL LEGISLATION		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
Federal Transportation of Dangerous Goods Act	Waste Dangerous Goods	- Section 3 - Application of Act The Act applies to the Transportation of all dangerous goods in Canada. Dangerous goods are the following: Class 1 - Explosives Class 2 - Compressed gases Class 3 - Flammable or combustible liquids Class 4 - Flammable solids Class 5 - Oxidizing substances Class 6 - Poisonous and infectious substances Class 7 - Nuclear substances Class 8 - Corrosives Class 9 - Miscellaneous - Section 5 - Safety Requirements, Standards and Marks No person shall handle, offer for transport, transport, or import dangerous goods unless they comply with all safety requirements, have the means of containment and transport for the material, and can display the prescribed safety marks. - Section 7 - Emergency Response Assistance Plans The person offering for transport or importing certain dangerous goods must have a Minister-approved ERAP prior to transport. - Section 8 - Means of Containment Containment must display all the necessary safety marks prior to being sold, delivered, distributed, imported, or otherwise transported. - Section 15 - Monitoring Compliance An inspector can inspect any vehicle transporting dangerous goods to ensure compliance to this Act. - Section 18 - Duty to Respond If there is an accidental release of a dangerous good in excess of the prescribed amount as outlined in the TDG Regulations, the person in charge of the material at the time of discharge has the responsibility to immediately report the incident to the 24-Hour Spill Report Line at (867) 920-8130. The person responsible for making the report shall take all reasonable emergency measures to reduce or eliminate any danger to public safety that may occur as a result of the release.

FEDERAL LEGISLATION		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
Federal Transportation of Dangerous Goods Regulations SOR/DORS/2001-286	Waste Dangerous Goods	- Part 2 – Classification The consignor is responsible for determining the classification of dangerous goods. Classification includes, as applicable, the shipping name, primary class, compatibility group, subsidiary class, UN number, packing group and risk group of dangerous goods. - Part 3 – Documentation Before allowing a carrier to take possession of dangerous goods for transport, the consignor must prepare and give to that carrier a shipping document or, if the carrier agrees, an electronic copy of the shipping document. The information required on a shipping document must be easy to identify and legible. Information that must be included on a shipping document is outlined in Part 3.5 of the Regulations. - Part 4 – Dangerous Goods Safety Marks A person must not offer for transport, transport or import a means of containment that contains dangerous goods unless each dangerous goods safety mark required by this Part is displayed in accordance with this section. - Part 5 – Containment A person must not handle, offer for transport, transport or import dangerous goods in a means of containment unless the means of containment is required or permitted by this Part to be used for the transportation of the dangerous goods. - Part 6 – Training A person who handles, offers for transport or transports dangerous goods must either be adequately trained and hold a training certificate in accordance with this Part or perform those activities in the presence and under the direct supervision of a person who is adequately trained and who holds a training certificate in accordance with this Part. Adequate training is described in Part 6.2 of the Regulation. - Part 7 – Emergency Response Assistance Plan It is the responsibility of the person offering for transport or importing dangerous goods for which an emergency response assistance plan (ERAP) is required to establish such a plan and to have that plan approved by Transport Canada. - Part 8 – Accidental Release and Imminent Accidental Release Report Requirements In the event of an accidental release of dangerous goods from a means of containment, a person who has possession of the dangerous goods at the time of the accidental release must make an immediate report if the accidental release consists of a quantity of dangerous goods or an emission of radiation that is greater than a determined quantity or emission level. If an immediate report was required to be made for an accidental release, a follow-up report must be made by the employer of the person who had possession of the dangerous goods at the time of the accidental release within 30 days of the initial report. - Schedule 1 – Classes 1 to 9 Schedule 1 is a chart of all dangerous goods indicating UN

FEDERAL LEGISLATION		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
		numbers, Shipping Names and descriptions and other important information that must be addressed when handling or shipping dangerous goods. - Schedule 2 – Special Provisions This schedule provides extra requirements for certain dangerous goods that are not provided in Schedule 1. - Schedule 3 – Alphabetical Index This schedule is provided to quickly determine the UN number and class of a dangerous good using an alphabetized list.
National Fire Code	Waste Oily Rags	- Waste oily rags are to be kept in non-combustible receptacles with a melting point of no less than 650oC without openings on the sides or bottom. The container must have a self-closing tightly fitting cover.
Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations	Waste diesel fuel and waste lube oil	The owner or operator of the storage tank system must ensure that: • all liquids and sludge are removed and disposed of; • if a tank is being withdrawn from service, the tank is purged of vapours to less than 10% of the lower flammability limit and the presence of vapours is checked with a combustible gas meter; and • the withdrawal is done in such a way that there will be no immediate or long-term harmful effect on the environment and it will not constitute a danger to human life or health.
Canadian Environmental Protection Act – National Strategy for the Management of Post-Use Preservative Treated Industrial Wood	Preservative treated wood (e.g., creosote treated power poles)	The preferable option for treated wood poles is reuse as posts, braces, stubs or anchors. The following uses of treated wood are prohibited: • Fuel (e.g., open-burning, furnace, etc.) • Construction material in water (e.g., docks, walls, etc.) • Construction material with which people come into direct and frequent contact (e.g., playgrounds, garden, etc.) Post-use treated wood is not classified as a hazardous waste and can be sent to Class I or II landfills for disposal. The landfill Operator shall be made aware of the waste type so that the treated wood is buried and not open burned.

Northwest Territories Legislation/Guidelines

A summary of the relevant legislation and guidelines and applicable sections that cover the collection, handling, transportation and disposal of wastes in the Northwest Territories (NT) enacted under the NT Environmental Protection Act is presented in Table B2.

The Department of Environment and Natural Resources (ENR) is the NT government agency responsible for initiatives which control the discharge of contaminants and their impact on the natural environment, including the disposal of hazardous wastes.

Table B2 – Summary of Northwest Territories Legislation/Guidelines

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
Environmental Protection Act (EPA)	All hazardous wastes (i.e. contaminants that can enter the environment)	- Section 4 - Environmental Protection 4 (1) The chief Environmental Protection Officer may require that the storage facility have on hand at all times the equipment and the material necessary to alleviate the effect of any discharge of contaminants that may be specified in the order. - Section 5 - Discharge of Contaminants 5 (1) - No person shall discharge or permit the discharge of a contaminant into the natural environment without a permit. If there is a discharge to the environment, the person in charge of the contaminant prior to the discharge must: Report the discharge to the 24-Hour Spill Line (867) 920-8130; Stop the discharge if possible; and Make a reasonable effort to notify everyone who may be adversely affected by the discharge. - Section 9 - Unsightly Land If the inspector believes that the land is unsightly when compared to lands used for a similar purpose, the Chief Environmental Protection Officer may issue a written order to improve condition of the land.
Guideline for Industrial Waste Discharges in the NWT	Various Wastes	- Addresses discharge of effluent and process residuals from industrial operations. - Covers only waste for which there is not already a guideline or regulation in place. - Provides standards for discharge to municipal landfills and sewage systems.
Guideline for Ozone Depleting Substances (ODSs)	CFCs, HCFCs and Halons (used in heat pumps, air conditioning equipment, refrigeration equipment, motor vehicle air conditioners, and portable fire extinguishers)	- ODSs are found in certain air conditioners, refrigeration devices, and fire extinguishers. - A waste manifest must accompany waste ODS if moved for storage, recycling or disposal. - ODS should be removed from equipment by a certified technician prior to equipment disposal. - Any release of ODS from a compressed gas vessel (Class 2, TDG) with a capacity greater than 100 L must be reported to the 24 Hour Spill Report Line (867) 920-8130. - A release of 5 L or more of an ODS classified as a poisonous substance (Class 6, TDG) must be reported to the 24 Hour Spill Report Line (867) 920-8130. - Any ODS-containing equipment that requires disposal should be serviced by a technician to remove the CFCs or HCFCs and marked with the date of service, the certified technician and company name, and an indication that the equipment no longer contains refrigerant. After servicing the equipment can be recycled or landfilled. - If it is a remote community and a technician is not available, contact ENR for a plan to manage ODS equipment in remote areas at (867) 873-7654.

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
Guideline for the General Management of Hazardous Waste in the NWT	All hazardous wastes	- Complements existing acts and regulations regarding hazardous wastes. - Should be consulted in conjunction with applicable specific hazardous waste guidelines - The generator is responsible for the identification, labelling, and storage of the hazardous waste from the time of generation to the time of disposal (from the "cradle to the grave"). - Generators, carriers, and receivers must all be registered with ENR. The office of the Fire Marshal has authority over the storage of flammable, combustible, and hazardous materials under the National Fire Code. - Storage of Hazardous Waste: a) Stored in original containers or other containers manufactured for the purpose of storing hazardous waste. Containers must be sound, sealable and not damaged or leaking. b) Clearly labelled according to WHMIS if transport is planned. c) Bulked into 16 gauge or equivalent metal or plastic drums, as appropriate. d) Containers should be sealed or closed at all times unless in use. - Requirements for storage facilities: a) Drainage into and from the site is controlled to prevent spills from leaving the site. b) Incompatible wastes are segregated by chemical compatibility to ensure safety. c) A secure area with controlled access to trained persons only. d) Regular inspections of containers are performed and recorded. e) A record is maintained of the type and amount of waste being stored. f) Emergency response equipment is available on site. g) If the site stores over 1,000 L/kg of any one waste class or a total of over 5,000 L/kg of all waste classes combined for over 180 days, the site must be registered with ENR. - The company name, address, phone number and contact person including position, the location and description of the facility, the expected types, quantities, and method of hazardous waste storage, and the required approvals to occupy the land for the purpose of hazardous waste storage must be provided to the EPA and the local fire chief for emergency planning purposes. h) Storage site must meet local zoning and by-law requirements. - A completed Waste Manifest must accompany all shipments of hazardous waste. Waste Manifests are available from ENR. - Transportation is regulated by TDGR by road, International Civil Aviation Organization (ICAO) by air, and International Maritime Dangerous Goods Code (IMDG) by water. - Treated hazardous waste may be directed to a landfill or to a municipal sewage system if it meets the Guideline for Industrial Waste Discharges in the NWT and the municipal authority and facility water license are consulted. - Hazardous waste containers must be triple rinsed and punctured so they are rendered unusable or returned to distributor for recycling.

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
		* *Waste oil being transported from generator to receiver in the NWT does not require manifesting (e.g., by waste oil burners under the NTPC Waste Oil Agreement).*
Guideline for the Management of Waste Antifreeze	Antifreeze (ethylene glycol, propylene glycol)	- Waste Antifreeze is a contaminant under the NWT EPA and must be managed as a hazardous waste. - It shall not be landfilled or poured down any drain as it is toxic by ingestion and can easily contaminate the environment. - Both ethylene glycol (used in cooling systems) and propylene glycol (used in heating systems) are considered hazardous despite toxicity differences. - Waste Antifreeze has the potential to contain heavy metals, which are toxic in the natural environment. - Waste antifreeze can be recycled by registered companies or on-site using special equipment. Additives and filters can also be used to extend the life of antifreeze. - Store waste antifreeze as described in the Guideline for the General Management of Hazardous Waste in the NWT. - When transporting waste antifreeze use the following shipping information: WASTE TOXIC LIQUID, ORGANIC, N.O.S. (Waste Propylene/Ethylene Glycol) Class: 6.1 PIN: UN2810 Packing Group: I, II or III Special Provisions: 16 for I, 16 or 23 for II and III - The type of glycol must also be added to the shipping name (propylene or ethylene). - Transport the containers to a registered recycling or disposal facility. Do not landfill antifreeze, especially in landfills, which employ a permafrost protective barrier. Do not pour antifreeze into sewers or drains because it can destroy the bacteria that treat sewage.
Guideline for the Management of Waste Asbestos	Fibrous asbestos	- Waste asbestos is a contaminant under the NWT EPA and must be managed as a hazardous waste. - Store waste asbestos as described in the Guideline for the General Management of Hazardous Waste in the NWT. - When transporting waste asbestos use the following shipping information: ASBESTOS WHITE / BLUE / BROWN PIN: UN2590 / UN2212 / UN2212 Classification: 9 Packing Group: III / II / II - The removal of asbestos materials requires a thorough understanding of potential hazards and measures available to prevent worker, public and environmental exposure to asbestos fibres. - The Asbestos Safety Regulations require that employers conducting an asbestos removal project provide proper training to workers likely to come in contact with asbestos. - Asbestos can be landfilled if 0.5 m of cover is placed on the waste

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
		immediately. It must be buried where it will not be disturbed and mapped for future reference. - An asbestos abatement expert can be contracted to remove the material.

Guideline for the Management of Waste Batteries	Batteries (lead acid, potassium hydroxide, nickel cadmium)
	
	*Does not include dry cell batteries
		- Waste batteries are a contaminant under the NWT EPA and must be managed as a hazardous waste.
		- Store waste batteries as described in the Guideline for the General Management of Hazardous Waste in the NWT.
		- Transport of waste batteries (ensure no leakage):
		  - in sealed, upright drums with adsorbent material, cardboard, or plywood between battery layers, or
		  - on a good, solid pallet lined with a large piece of polyethylene plastic (if pallet is rough or has protruding nails cover it with plywood first to protect the plastic); place cardboard or plywood between battery layers, fold the poly over top of the package to seal it, and secure with banding.
		- When transporting waste batteries use the applicable shipping information as follows:
		
		WASTE BATTERIES, DRY, CONTAINING POTASSIUM HYDROXIDE SOLID, electric storage
		PIN: UN3028
		Classification: 8
		Packing Group: III
		
		WASTE BATTERIES, WET, FILLED WITH ACID, electric storage
		PIN: UN2794
		Classification: 8
		Packing Group: III
		Explosive Limit: 5
		
		WASTE BATTERIES, WET, FILLED WITH ALKALI, electric storage
		PIN: UN2795
		Classification: 8
		Packing Group: III
		Explosive Limit: 5
		
		WASTE BATTERIES, WET, NON-SPILLABLE, electric storage
		PIN: UN2800
		Classification: 8
		Packing Group: III
		Special Provisions: 39
		Explosive Limit: 5
		
		- Batteries should be shipped to a registered recycler or disposal facility.

Guideline for the Management of Waste Lead and Lead Paint	Lead paint	- Leaded paint is a contaminant under the NWT EPA and must be managed as a hazardous waste. - Products containing lead in excess of 600 ppm (0.06%) are considered hazardous waste. - Painted steel structures should be sampled for confirmation of lead amended paint and lead concentration prior to sandblasting or other maintenance activities. - Regardless of removal method, total containment of the leaded

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
		paint and abrasive debris or paint strippers is required under the EPA. - Store lead compounds in leak proof containers to prevent release into the environment. - When transporting waste lead paint use the following shipping information: WASTE LEAD COMPOUND, SOLUBLE, N.O.S. (Waste Lead Paint) or (Sandblasting Residue) PIN: UN2291 Classification: 6.1 Packing Group: III Special Provisions: 24 Explosive Limit: 5 - Leaded paint and sandblast residue should be transported to a registered hazardous waste disposal facility or a lead or metals foundry.
Guideline for the Management of Waste Paint	Alkyd paint (oil based paint) Latex paint (water based paint)	- Waste paint is a contaminant under the NWT EPA and must be managed as a hazardous waste. - Paint: includes lacquer, enamel, stain, shellac, varnish, polish, liquid filler, and liquid lacquer base. - Paint related material: includes paint thinning or reducing compounds. - Latex paint wastes are not a hazardous waste and can be disposed of into most sewage systems and landfills – municipal approval may be required. - Specialty paints are a mix between a base and a hardener (e.g. epoxy coatings). Consult individual SDS for disposal instructions. - Store waste latex and alkyd paint separately as described in the Guideline for the General Management of Hazardous Waste in the NWT. - When transporting most waste paint (flammable liquids) use the following shipping information: WASTE PAINT (or Waste Paint Related Materials) PIN: UN1263 Classification: 3 Packing Group I, II or III Special Provision 59 for I, 59 or 83 for II and III - When transporting certain specialty paints (corrosive) use the following shipping information: WASTE PAINT (or Waste Paint Related Materials) PIN: UN3066 Classification: 8 Packing Group II or III Special Provision 59 - Less than 5 L of alkyd paint can be allowed to fully dry and be taken to landfill. - Fully dried latex paint may be taken to landfill in any quantity. - Liquid paint should be shipped to a registered recycling or disposal facility.

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
Guideline for the Management of Waste Solvents	Alcohol or petroleum based liquids capable of dissolving another substance (e.g. Varsol, paint thinner)	- Waste solvents are a contaminant under the NWT EPA and must be managed as a hazardous waste. - Store waste solvents separately as described in the Guideline for the General Management of Hazardous Waste in the NWT. - Bulk drums must be grounded to avoid sparks. - When transporting waste solvents use the following shipping information (with Varsol as an example): WASTE PETROLEUM DISTILLATES, N.O.S. (Waste Varsol) PIN: UN1268 Classification: 3 Packing Group: I, II, III Special Provisions: 16 - Bulk containers should be shipped to a registered recycling or disposal facility.
Used Oil and Waste Fuel Management Regulations	Fuel (diesel fuel, gasoline, aviation fuel, kerosene, naphtha) Oil (transmission fluid, hydraulic fluid, crankcase oil, gear lube oil, lube oil) Grease	- Used oil and waste fuel are contaminants under the NWT EPA and must be managed as hazardous waste. - Used oil has the potential to contain heavy metals that are toxic in the natural environment. - Used oil and waste fuel should be bulked in containers as described in the Guideline for the General Management of Hazardous Waste in the NWT. - Used oil and waste fuel should be shipped to a registered recycler. - Waste oil can be burned in a CSA approved oil heating furnace, and can be shipped without a waste manifest in the NWT in this special case. - When transporting waste fuel use the following shipping information: WASTE FLAMMABLE LIQUID, N.O.S. (Waste Fuel Oil) PIN: UN1993 Classification: 3 Packing Group: I, II, III Special Provisions: 16 - When transporting waste oil use the following shipping information: WASTE OIL (Waste Lube Oil) PIN: NA Classification: NA Packing Group: NA
	Used oil filters	- Used oil filters must be punctured/crushed and drained of their contents for 24 hours prior to disposal. - Used oil filters do not have to be managed as hazardous waste if properly drained. - All used oil in filters must be drained for 24-hrs into bulk used oil containers. The filters can then be recycled by a registered facility or sent to landfill. - Used oil filters can be crushed using a filter crusher, where available, and then recycled or sent to landfill. - When transporting waste oil filters use the following shipping information: WASTE FILTERS (Fuel Oil or Lube Oil)

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
		PIN: NA Classification: NA Packing Group: NA
	Oily Rags	- Oily rags or sorbents must be drummed and disposed of at a registered facility. - Some landfarms accept oily rags. - When transporting waste oily rags/sorbents use the following shipping information: WASTE OILY RAGS PIN: NA Classification: NA Packing Group: NA
Environmental Guideline for Contaminated Site Remediation	Contaminated Soil	- When transporting hydrocarbon impacted soil with a flashpoint that is unknown or below 610C use the following shipping information: WASTE SOLIDS CONTAINING FLAMMABLE LIQUID, N.O.S. (Gasoline or Diesel, as appropriate) PIN: UN3175 Classification: 4.1 Packing Group: II Special Provisions: 16, 56 - When transporting glycol impacted soil or hydrocarbon impacted soil with a flashpoint higher than 610C use the following shipping information: WASTE SOIL (Gasoline, glycol, diesel or oil) PIN: NA Classification: NA Packing Group: NA Special Provisions: NA - All contaminated soil should be analyzed for flashpoint prior to transport so that it can be transported as waste soil rather than Class 4.1.
NWT Disposal Guideline for Fluorescent Lamp Tubes	Waste fluorescent tubes	- Fluorescent tubes are a contaminant under the NWT EPA and must be managed as a hazardous waste. - Fluorescent tubes contain mercury phosphor powder and traces of lead and cadmium. Compliance with the Canada Wide Standards for Mercury is necessary. - Waste fluorescent tubes should be shipped to a registered recycling/disposal service. - If tubes are not broken and are packaged in their original shipping box, transport as a hazardous waste is not necessary. It is recommended to obtain boxes from the manufacturer if not already on hand. - If tubes are broken compliance with the Guideline for the General Management of Hazardous Waste in the NWT and TDG Regulations is required. - As an alternative to shipping waste bulbs for disposal the ENR Environmental Protection Service (EPS) owns a fluorescent bulb crusher which crushes the bulbs and separates the glass from the contaminants. Contact the EPS for more information.
	Waste mercury vapour bulbs	- Mercury vapour lights are a contaminant under the NWT EPA and must be managed as a hazardous waste.

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
		- Mercury vapour bulbs contain mercury. Compliance with the Canada Wide Standards for Mercury is necessary. - Waste mercury vapour lights should be shipped to a registered recycling/disposal facility. - If bulbs are not broken and are packaged in their original shipping box, transport as a hazardous waste is not necessary. It is recommended to obtain boxes from the manufacturer if not already on hand. - If tubes are broken compliance with the Guideline for the General Management of Hazardous Waste in the NWT and TDG Regulations is required.
Spill Contingency and Reporting Regulations (under EPA)	All spills	- Section 3 - Spill Response Plan A Spill Response Plan must be implemented and filed with the Chief Environmental Protection Officer for facilities with above ground storage of 20,000 L or 20,000 kg or with a below ground storage of 4,000 L or 4,000 kg. If the facility has less than the above storage, a Spill Response Plan should be in place, but does not have to be filed with the Officer. - Section 4 The owner or operator of the facility is responsible for the Spill Response Plan. It must include: a) the name, address and job title of the person in charge of the facility b) the name, job titles and 24-hour phone number of the person in charge of activating the Spill Response Plan c) a description of the facility including location, size and storage capacity d) a description of the type and amount of contaminants stored at the facility e) a site map of the location described in (c) f) the steps to be taken to report, contain, cleanup and dispose of contaminants in case of spill g) inventory and location of available response and cleanup equipment h) the date the plan was prepared. When a review is completed the plan shall be updated and the Officer shall be alerted. - Section 9 Spills shall be reported when the amount spilled is equal to or exceeds that described in schedule B. Report spills to the 24-Hour Spill Report Line at (867) 920-8130. The following details should be provided regarding the spill: date and time of spill, spill location, direction spill is moving, name and number of contact person close to spill, type and amount of contaminant spilled, cause of spill, whether spill is continuing or has been stopped, description of existing containment, action taken to contain, recover, cleanup and dispose of spilled material, name, address and phone number of person reporting spill, and name of person in charge of contaminants at time of spill.
Consolidation of Pesticide Act Chapter P-2 Pesticide Regulations	Pesticides	- Section 4 - Consolidation of Pesticide Act 1988 No person shall dispose of a pesticide or a container that contained a pesticide in any way except at a site or in the manner that is prescribed in regulations. - Pesticide Regulations: report spills to the 24-Hour Spill Report Line (867) 920-8130.

NORTHWEST TERRITORIES LEGISLATION/GUIDELINES		
Legislation	**Hazardous Waste**	**Relevant Details in Legislation**
Guideline for Industrial Waste Discharge in the NWT	Ash	Each 205L drum of ash collected from an incinerator must be sampled independently and sent to a registered laboratory for analysis before it can be discarded at a sanitary landfill or registered disposal facility. • Residues of incinerator ash must pass the leachate extraction test described in the Guideline for Industrial • Waste Discharges in the NWT, Schedule IV before it can be sent to a sanitary landfill. • Ash residues that fail the leachate extraction test must be handled as a Hazardous Waste accordingly and sent to a registered disposal facility.
PCB Regulations under the Canadian Environmental Protection Act, 1999	Streetlight ballasts (capacitors) manufactured before 1979	• Many capacitors found inside fluorescent streetlight ballasts manufactured before 1979 contain high levels of PCB (Polychlorinated Biphenyls). • Check the date code on the ballasts to determine the year it was manufactured. • If the ballast was manufactured before 1979 the ballast must be shipped as a hazardous waste to a registered treatment facility for disposal. POLYCHLORINATED BIPHENYLS (PCB) PIN: UN2315 Classification: 9 Packing Group: III

APPENDIX C

FUEL TRANSFER SAFE WORK PRACTICE

1 Purpose	To outline the safety requirements for conducting fuel and bulk product transfers.
2 Application	Applies to all NTPC workers and contractors who are involved in fuel and bulk product transfers, custody transfers and the loading or unloading of tanker trucks, barges and ships used for the movement of these products.
3 Definitions	**Worker** An NTPC employee or any employee of a contractor or subcontractor working on an NTPC owned project or site. **Static Electricity** Static is the electricity produced on dissimilar materials through physical contact and separation. A spark generated by it can ignite flammable vapour. A static electrical charge can build up during refuelling when the fuel moves through a pipe.
4 References	• Nil
5 Equipment	• Spill Kit • Fire Extinguisher • Approved grounding devices • Hoses and hardware
6 PPE	• High-visibility vest • Work gloves • CSA-approved safety glasses • CSA-approved foot protection
7 Training	• On-the-job training • Spill Response Training
8 Work Practice	• Before the start of any work a Tailboard Meeting shall be conducted with all individuals involved in the transfer process and documented on Form 2.3: Tailboard Meeting. • The Worker responsible for the transfer process shall notify the person in charge of the site (e.g., Plant Operator, Plant Superintendent, Manager, etc.) to receive approval to begin the transfer. The Worker shall also notify the person in charge of the site after the transfer is complete. The date, start time and end time of the transfer shall be recorded in the Plant Log Book. • The Worker responsible for the transfer process shall remain onsite throughout the process.

	• The Worker shall immediately shut down the transfer process in the event of a system failure, fault, leak, spill or fire.
	• In the event that the Worker responsible for the transfer process must leave the immediate transfer area, the transfer process shall be stopped and the transfer point shall be locked.
	• If the Worker responsible for the transfer process leaves the site during a transfer without stopping the transfer and locking the transfer point, the Worker shall be subject to discipline up to and including dismissal.
	• Transfer points shall be locked at all times except during the transfer process.
	• Prior to refuelling the refuelling system must be inspected to ensure it is properly grounded and bonded. Grounding devices shall be installed to safeguard against the build-up of static electricity.
	• Emergency equipment including fire extinguishers and spill kits shall be available throughout the transfer process and shall be inspected prior to each transfer.
	• The local transfer procedure specific to the site and product shall be followed. This includes:
	  ○ Properly calculating the amount of fuel to be transferred and documenting the volume on Form 2.3: Tailboard Meeting
	  ○ Flow rates
	  ○ Emergency shutdown procedures
	  ○ Emergency and spill response procedures
	• After completion of the fuel transfer all hoses shall be disconnected, drained into an appropriate container and securely blanked.

9 Documentation	• Plant Log Book • Form 2.3: Tailboard Meeting

Development		
Name	**Position**	**Date**
Prepared by: Paul Pascoe	Pozniak Safety Associates	July 15, 2014
Reviewed by: Joshua Clark	Environmental Analyst	July 30, 2014
Approved by: Eddie Smith	Director Health, Safety & Environment	Aug 15, 2014

Revision History					
#	**Revised Sections**	**Description of Revisions**	**Revised by** (name, position)	**Approved by** (name, position)	**Issue Date**
01					
02					
03					
04					
05					
06					
07					

APPENDIX D

WASTE ACCUMULATION LOG

NORTHWEST TERRITORIES POWER CORPORATION

Environmental Protection

Submit

EV-01-02

WASTE ACCUMULATION LOG

Page ___ of ___

Year			Plant					
		Working drum ID (plant - unique drum # - year, e.g.,120-01-10)						
Month	Day	Oil	Glycol	Varsol	Other (specify drum ID and waste type)	Litres in Drum		Initials
						Added	Total	

Please fax to Environment Department at month end (1-888-371-9433)

APPENDIX E

HAZARDOUS MATERIALS / WASTE STORAGE INVENTORY LOG

Submit

WASTE STORAGE INVENTORY

Year				Drum ID (plant - unique drum # - year, e.g.,120-01-10)	# of Drums		
Plant					Full	Empty	Initials
Month		Oil	Shipped				
			Stored				
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				
		Oil	Shipped				
			Stored				
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				
		Oil	Shipped				
			Stored				
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				
		Oil	Shipped				
			Stored				
		Glycol	Shipped				
			Stored				
		Other (Specify)	Shipped				
			Stored				

APPENDIX F

SAFETY INSPECTION REPORT

Inspection Details	
Location:	Plant:
Inspected by:	Date:

#	Inspection Item	Y/N/NA	Notes
1.0	**Housekeeping**		
1.1	Are all buildings clean & organized inside?		
1.2	Is the yard clean & organized with no vegetation control required?		
1.3	Is the transformer storage platform: solid and well-organized?		
1.4	Is the pole storage rack solid and well-organized?		
1.5	Are garbage cans fire resistant with self-closing lids? Are they emptied at the end of each day?		
1.6	Are all spills and leaks cleaned up?		
1.7	Are floors clean and tidy and free of slippery substances (e.g., water, oil, grease)?		
1.8	Are floors level and well maintained with no projecting surfaces and no tripping hazards?		
1.9	Are windows clean, both inside and outside, and kept obstruction free?		
1.10	Is ventilation equipment clean, obstruction free, well maintained, functions correctly?		
2.0	**Storage**		
2.1	Are tools and materials properly stored in racks, shelves, and bins wherever possible?		
2.2	Are commonly used and heavy items stored between mid-thigh and shoulder height?		
2.3	Are floors around racks, shelves, pallets, etc. clear?		
2.4	Are racks, shelves, pallets, etc. kept in good condition?		
2.5	Are storage areas safe from falling objects?		

#	Inspection Item	Y/N/NA	Notes
2.6	Are storage racks, shelves, etc. free of sharp edges?		
2.7	Is there a safe means of accessing high shelves?		
3.0	**Tools & Equipment**		
3.1	Are tools & equipment maintained in good condition, clean, and suitable for intended use?		
3.2	Are all necessary machine guards in place?		
3.3	Are spill pads, drip trays, and crankcase vent containers emptied or replaced as required?		
3.4	Are batteries free of leaks with terminals clean and protective covers in place?		
3.5	Are line & electrical tools available, properly stored, certified, and in good condition?		
3.6	Is rigging & lifting equipment available, properly stored, certified, and in good condition?		
3.7	Are compressed gas cylinders undamaged, stored upright, and secured?		
3.8	Are pipes leak-free, colour coded, and properly painted?		
4.0	**Personal Protective Equipment (PPE)**		
4.1	Is all PPE available onsite?		
4.2	Is all PPE properly stored?		
4.3	Is all PPE clean?		
4.4	Is all PPE in good condition?		
4.5	Is all PPE correctly used?		
5.0	**Emergency Equipment**		
5.1	Is the Emergency Response Plan available onsite and current?		
5.2	Is the Spill Response Plan available onsite and current?		
5.3	Is the Hazardous Waste Management Plan available onsite and current?		

#	Inspection Item	Y/N/NA	Notes
5.4	Are the NWT Safety Act and General Regulations available onsite?		
5.5	Are emergency phone numbers posted and up-to-date?		
5.6	Are emergency lights functional for a 30 second test?		
5.7	Are eyewash stations available and functional with the solution changed every 6 months?		
5.8	Are fire extinguishers available, charged, and inspected monthly?		
5.9	Are fire extinguishers secured on the wall and not free standing?		
5.10	Is access to fire extinguishers free and unobstructed?		
5.11	Are first aid kits available, fully stocked, and inspected monthly?		
5.12	Are exits clearly marked with exit signs?		
5.13	Are exits functional and free from obstructions?		
6.0	**Chemicals**		
6.1	Are MSDS available and up-to-date within the last 3 years?		
6.2	Are all chemicals properly labelled and stored in proper containers (WHMIS)?		
6.3	Are all flammable products stored in proper containers in kept in a flammable cabinet?		
6.4	Are unused or unnecessary substances disposed of in a safe manner?		
6.5	Are all chemical containers and drums leak free?		
7.0	**Building**		
7.1	Are buildings in good condition on the inside with no repairs required?		
7.2	Are buildings in good condition on the outside with no repairs required?		
7.3	Are floors level and well maintained with no projecting surfaces and no tripping hazards?		

#	Inspection Item	Y/N/NA	Notes
7.4	Are windows clean, both inside and outside, and kept obstruction free?		
7.5	Is ventilation equipment clean, obstruction free, well maintained, functions correctly?		
7.6	Is the air temperature comfortable?		
7.7	Are all inside & outside lights functional?		
7.8	Do existing lights provide adequate lighting?		
7.9	Are all necessary warning signs in place with no new or additional signs required?		
7.10	Are signs and notices in good condition?		
7.11	Are employee facilities (e.g., washrooms, lockers, crew trailers) clean, tidy, maintained, and adequate?		
8.0	**Security**		
8.1	Are all fences in good condition with barbwire intact?		
8.2	Are all gates and doors kept locked when unattended?		
8.3	Are all locks in working order?		
9.0	**Electrical**		
9.1	Are ground connections present and in good working condition?		
9.2	Are electrical boxes & breakers properly covered?		
9.3	Are all plugs and switches in good condition?		
9.4	Are all cords in good condition?		
9.5	Are all power tools in good condition?		
9.6	Is all temporary wiring properly routed?		

#	Inspection Item	Y/N/NA	Notes
10.0	**Work Protection**		
10.1	Are sufficient Work Protection tags and forms available onsite?		
10.2	Is the Work Protection Log book available and up-to-date?		
10.3	Are all Single Line Diagrams posted and up-to-date?		
11.0	**Hazardous Waste Storage Area**		
11.1	Are all wastes properly separated to ensure no mixing of wastes?		
11.2	Are all waste storage containers in good condition with lids securely in place and no leaks?		
11.3	Are all waste containers labelled clearly and accurately?		
11.4	Are spill response materials available onsite (e.g., spill kits, sorbents, hand tools, PPE)?		
11.5	Are all sources of ignition kept away from the waste storage area?		
11.6	Is a fire extinguisher kept close to the waste storage area? Is it inspected monthly and charged?		
11.7	Does the storage area have proper drainage to prevent leaks or spills from leaving the site?		
11.8	Is the *Waste Accumulation Log* up-to-date?		
11.9	Is the *Waste Storage Inventory Log* up-to-date?		

Provide completed form to manager.

Corrective Actions (to be assigned by manager and followed up until completed)		
Manager:	Signature:	Date:

#	Corrective Action	Responsible Party	Due Date	Completed
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
12				
13				

APPENDIX G

OPERATOR'S MANUAL FOR THE SNARE HYDRO INCINERATOR

Environment Canada Environnement Canada

Technical Document for Batch Waste Incineration

January 2010

Canada

Acknowledgements:
Environment Canada would like to acknowledge the work of A.J. Chandler & Associates Ltd. in the preparation of this technical document.

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Aussi disponible en français.

Table of Contents

Executive Summary

Incineration is recognized as an effective and environmentally sound disposal method for a wide range of wastes, and is used in facilities and jurisdictions across Canada. Waste generators located in remote areas may have limited options for cost-effective and environmentally sound waste management, and incineration may therefore be considered an appropriate waste management option. Remote commercial activities, such as exploration and development of natural resources, can create large volumes and varieties of wastes that must be managed appropriately. Residual wastes from industry, research activities, and the health care sector may require thermal treatment as an environmentally sound method to control the spread of disease from plants, animals or humans. Furthermore, there are certain locations in Canada where incinerating waste is an important means of avoiding potentially dangerous interactions between humans and wildlife. In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option.

There are, however, some important potential environmental concerns associated with waste incineration that must be addressed through proper equipment selection, operation, maintenance and record keeping. These include potential releases of mercury, as well as dioxins and furans (PCDD/F), which are persistent organic pollutants (POPs). Mercury and POPs bio-accumulate in the environment and may cause adverse effects to human health and the environment. They can also be transported over long ranges; data from measurements in the North reveal concentrations far greater than what might be explained by local production. Dioxins/furans can be generated when inadequate incineration technology is used or when an incinerator is improperly operated. Mercury is not created in an incineration system; emissions are directly related to the presence of mercury in certain waste materials. Therefore, the best method to control mercury emissions is to limit the quantity of mercury in the waste fed to the incinerator.

The *Stockholm Convention on Persistent Organic Pollutants (POPs)* (which entered into force in May 2004 and to which Canada is a Party), identifies incineration as a potential source of POPs, and establishes a range of measures to reduce and, where feasible, eliminate their release. It also requires that the best available techniques (BAT) and best environmental practices (BEP) be applied for both new and substantially modified sources of POPs. Additionally, the Canadian Council of Ministers of the Environment (CCME) adopted the Canada-wide Standards for Dioxins and Furans in 2001, identifying incineration for action to reduce emissions, and adopting specific air emission standards. The CCME also adopted the Canada-wide Standards for Mercury Emissions in 2000 which include limits on mercury emissions from incinerators. Both mercury and dioxins/furans are on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999).

The Technical Document for Batch Waste Incineration was developed to provide guidance for owners and operators on proper system selection, operation, maintenance and record keeping, with the goals of achieving the intent of the Canada-wide Standards for dioxins/furans and mercury, and reducing releases of other toxic substances. The document includes:

- A discussion of the importance of reducing, reusing and recycling to divert wastes from disposal;
- Methods for the selection of appropriate incineration technologies to meet specific waste management requirements;

- Operational requirements that should allow batch incinerators to meet the intent of the Canada-wide Standards for dioxins/furans and mercury, and to reduce the release of other toxic substances; and
- Recommendations on record keeping and reporting.

This Technical Document focuses on minimizing dioxins/furans and mercury emissions from batch waste incinerator systems ranging in size from 50 kg to 3000 kg of waste/batch, the latter representing the largest batch incinerator currently in use in Canada. Batch waste incinerators are those that operate in a non-continuous manner (i.e. they are charged with waste prior to the initiation of the burn cycle, and the door remains closed until the ash has cooled inside the primary chamber). Air emission testing completed by Environment Canada in 2002 using a modern Canadian-built batch waste incinerator demonstrated that, when properly operated and maintained, these systems are capable of meeting the Canada-wide Standards for dioxins/furans (80 pg I-TEQ/Rm^3 @ 11% O_2) and mercury (20 µg/Rm^3 @ 11% O_2). Stack testing can be carried out as required by the regulatory authorities (e.g. federal, provincial/territorial) to verify that these standards are met.

The Technical Document recommends and describes a six-step process for batch waste incineration:

Step 1 – Understand Your Waste Stream

Step 2 – Select the Appropriate Incinerator (or Evaluate the Existing System)

Step 3 – Properly Equip and Install the Incinerator

Step 4 – Operate the Incinerator for Optimum Combustion

Step 5 – Safely Handle and Dispose of Incinerator Residues

Step 6 – Maintain Records and Report

This process will assist owners and operators of batch waste incinerators to achieve the intent of the Canada-wide Standards for dioxins/furans and mercury, and reduce the potential for releases of other toxic substances to the environment.

Overview of the Six-Step Process for Batch Waste Incineration

Step 1: Understand Your Waste Stream

The first step in managing waste is to understand the quantity and composition of the waste that is generated. A waste audit should be completed, where practical, to:

- Determine the quantity of waste generated in the various parts of an operation;
- Characterize the waste from each type of operation;
- Examine the waste stream to determine what opportunities exist for:
    - Reducing the quantity of waste generated;
    - Reusing materials; and
    - Recycling as much as possible before considering disposal.

Where waste audits are not practical, it is still necessary to develop an estimate of the waste quantities and characteristics before a strategy for waste diversion and disposal can be completed. Owners should investigate waste generation and diversion data from similar operations/facilities in order to estimate the waste types and quantities that will be generated at their own facilities. Sources of such information may include industry associations, waste industry consultants, provincial/territorial authorities and other regulatory bodies.

Based on the results of the waste audit/characterization, an assessment of appropriate disposal options should be undertaken. Where possible, disposal alternatives (other than incineration) for the residual waste stream (i.e. post 3Rs – Reduce, Reuse, Recycle) should be examined. When assessing disposal options, it is important to note that waste should neither be open-burned nor burned in a barrel. In both cases, the appropriate temperatures for a clean burn will not be achieved, and toxic contaminants, in particular dioxins and furans, will be released.

Step 2: Select the Appropriate Incinerator (or Evaluate the Existing System)

The characteristics of the residual waste stream destined for incineration should be incorporated into a call for proposals from incinerator manufacturers. Specifying the quantity and composition of the waste stream will ensure that proposals include suitable incinerators. It should be noted that incinerators built for a specific waste stream, such as animal carcasses, liquid wastes and hazardous wastes, are available and should be used as required.

For facilities with existing incinerators, owners/operators should reassess the suitability of the existing system to manage the current waste stream.

For facilities incinerating **more than 26 tonnes of waste per year,** dual chamber controlled air incinerators are the recommended configuration. These systems are capable of incinerating a wide range of wastes and, when properly maintained and operated, will achieve emissions of PCDD/F and mercury below the level of the Canada-wide Standards. These systems should be equipped with a large secondary chamber sized to provide a residence time of at least one second at a temperature higher than $1000^{O}C$, to ensure complete combustion and minimize PCDD/F emissions.

For facilities incinerating **less than 26 tonnes of waste per year**, "determined efforts" as defined in the Canada-wide Standards for dioxins and furans[1] should be undertaken. Should circumstances restrict the ability to use a dual-chamber incinerator with a large secondary chamber, a single chamber incinerator with an afterburner should be used. It should be noted that such systems are less likely to be able to meet the emission standards than dual chamber incinerators.

Step 3: Properly Equip and Install the Incinerator

Building Considerations

- Incinerators should be installed inside a building to protect the equipment and the operators from weather conditions.
- In designing the installation site, care should be taken to maximize clearance between incinerator components, including the stack, and combustible construction materials.
- Insulation should be used to protect combustible building materials.
- The building should be equipped with sufficient fresh air inlet capacity for the incinerator. Both combustion air and dilution air for the barometric damper are required. Care should be taken to introduce air in a manner that does not lead to low-temperature operating problems.

Equipment Considerations

The incinerator system should come complete with the following equipment to monitor and record performance parameters:

- A scale to measure the weight of all materials charged to the incinerator; and
- A computerized process control and data acquisition system to store operating data from the incinerator.

Operational data should be collected and stored, at a minimum, every minute that the system is operating. The intent is to be able to summarize operating parameters during start-up, operation and cool-down for every cycle. If the required operating conditions are not achieved these data will allow the operators, the manufacturers and the regulator to identify the contributing factors for the failure. From this information, operating procedures can be adjusted to improve performance. Provisions should be made for the manufacturers to be able to remotely access and review the operating data for trouble shooting purposes.

It is highly recommended that batch incinerators not be equipped with heat recovery devices. The temperature of the stack gases in heat recovery systems will be lower than in systems without heat recovery, and may be in a temperature range that can lead to the formation of greater quantities of PCDD/F. Similarly, air pollution control systems are not recommended for batch waste incineration systems to control PCDD/F emissions. Stack gases should be released directly to the atmosphere at temperatures higher than $700^{O}C$ to reduce the chances of the inadvertent formation of PCDD/F through the *de novo* synthesis process.

[1] Available on-line at: http://www.ccme.ca/ourwork/air.html?category_id=97

If it is necessary to introduce additional waste to the incinerator during the burn cycle, the incinerator should be equipped with a ram charge system to limit the disruption of combustion in the primary chamber during the waste charging process.

Step 4: Operate the Incinerator for Optimum Combustion

Operational Considerations

Wastes received at the incinerator building should be separated according to their heating value characteristics: wet or low-energy wastes (e.g. food waste); mixed wastes with average energy values; and other materials with high energy values, such as oily waste materials. To facilitate this separation, all waste should be collected in transparent bags. To further assist with separation, wastes could be collected in coloured-coded bags.

Batch incinerators are designed to accept wastes within a specified range of energy (i.e. calorific) values. The operator should select waste from each category and mix it to achieve the manufacturer's specified input calorific value. Each bag should be weighed, its source should be noted, and the total weight of each category should be tallied before completing the loading. This information should be recorded by the computerized data acquisition equipment installed with the incinerator. (Refer to step 6 for further record keeping requirements).

Batch incinerator systems have limited charging capacity (both in terms of waste quantity and the calorific value of the waste charge). To assist the operator with the charging task, particularly for smaller incinerators, several batches could be weighed and placed in their own containers prior to loading the incinerator. The same weighing and logging procedures should be used for each batch and, once recorded, the batch can be charged when appropriate.

When the incinerator is charged with the appropriate mix and quantity of waste, the operator should close the door, ensure all interlocks are engaged, and start the burn cycle. The operator should observe the burn for at least 15 minutes after ignition of the primary chamber burner to ensure the volatility of the waste charged is not creating too much gas for the secondary chamber to handle. The rate of combustion can be slowed by reducing the quantity of under-fired air. The primary chamber should be operated in the temperature range specified by the manufacturer (typically $500^{O}C$ to $800^{O}C$).

When satisfied that the burn is proceeding in a controlled manner, the operator may leave the incinerator area while the equipment completes the burn cycle.

The burn cycle should not be interrupted by opening the charging door until after the burn is complete and the unit has cooled down. No additional waste should be added to the primary chamber unless the incinerator is equipped with an appropriate ram feed device.

When the burn is complete and the unit has cooled, the operator should open the door only when wearing protective equipment such as gloves, dust mask, face shield and goggles.

The operator should remove the ash from the previous burn cycle before reloading the incinerator. Any unburned materials found in the ash should be recharged to the primary chamber after the operator has cleaned the air ports, and before putting a fresh charge into the incinerator.

Training Considerations

Operators should be properly trained by the incinerator manufacturer. The training course should include, as a minimum, the following elements:

- System safety including identification of hazards that the operator should recognize;
- Waste characterisation and how waste composition can affect operation;
- Loading limitations, including materials that should NOT be charged to the incinerator, and the allowable quantities of different types of wastes that can be charged;
- Start-up procedures for the incinerator and the normal operation cycle;
- Operation and adjustment of the incinerator to maximise performance;
- Clean out procedures at the end of the cycle;
- Troubleshooting procedures;
- Maintenance schedule; and
- Record keeping and reporting.

Managers should be involved in the training session so that continuity can be maintained with different operators.

Step 5: Safely Handle and Dispose of Incinerator Residues

Ash from the primary chamber of the incinerator can contain materials deleterious to the operator's health and the environment. Operators should use personal protective equipment when handling this material. The material should be carefully removed from the hearth and placed in covered metal containers suitable for transporting the ash to an approved disposal site. The operator should weigh, and maintain records of, the quantity of ash produced.

Step 6: Maintain Records and Report

To demonstrate appropriate operation and maintenance of the incinerator, the facility should maintain records and prepare an annual report containing at least the following information:

- A list of all staff who have been trained to operate the incinerator; type of training conducted and by whom; dates of the training; dates of any refresher courses;
- All preventative maintenance activities undertaken on the equipment;
- Records of operation of the incinerator - in electronic format with full data backup;
- Summarized annual auxiliary fuel usage;
- A list of all shipments of incinerator residues, including the weight transported and disposed of by type if necessary, and the location of the disposal site;
- Results of any emissions measurements or any ash sampling data collected during the period.

All raw data records from the operation of the incinerator should be retained for inspection by the appropriate authorities for the period designated by those authorities, or for at least 2 years. The owner should work with the incinerator manufacturer or supplier and the regulators to determine the appropriate level of summary data that should be sent to the regulatory body (e.g. federal, provincial/territorial). The reports should be approved by the facility's senior management before submission.

1.0 Introduction

1.1 Purpose

This *Technical Document for Batch Waste Incineration* was developed to provide guidance for owners and operators of batch waste incinerators regarding proper system selection, operation, maintenance and record keeping, with the goals of assisting them in achieving the intent of the Canada-wide Standards (CWS) for dioxins/furans and mercury, and reducing releases of other toxic substances. This technical document focuses on batch waste incinerators ranging in size from 50 to 3,000 kg of waste/batch. Batch waste incinerators are those that operate in a non-continuous manner (i.e. they are charged with waste prior to the initiation of the burn cycle, and the door remains closed until the ash has cooled inside the primary chamber). Air emission testing completed by Environment Canada in 2002 using a modern Canadian-built batch waste incinerator revealed that, when properly operated and maintained, these systems are capable of meeting the CWS for dioxins/furans (80 pg I-TEQ/Rm^3 @ 11% O_2) and mercury. Stack testing can be carried out as required by the regulatory authorities in order to verify that these standards are met.

The document includes:

- A discussion on the importance of reducing, reusing and recycling to divert wastes from disposal;
- Methods for the selection of appropriate incineration technologies to meet specific waste management requirements;
- Operational requirements that should allow batch waste incinerators to meet the intent of the CWS for dioxins/furans and mercury, and to reduce the release of other toxic substances; and
- Recommendations on record keeping and reporting.

Owners and operators are advised to undertake a full review of relevant local legislation and consult with the appropriate regulators before proceeding with any waste management operation.

1.2 Background

Incineration is recognized as an effective and environmentally sound disposal method for a wide range of wastes, and is used in facilities and jurisdictions across Canada. Waste generators located in remote areas may have limited options for cost-effective and environmentally sound waste management, and incineration may therefore be considered an appropriate waste management option. Remote commercial activities, such as exploration and development of natural resources, can create large volumes and varieties of wastes that must be managed appropriately. Residual wastes from industry, research activities, and the health care sector may require thermal treatment as an environmentally sound method to control the spread of disease from plants, animals or humans. Furthermore, there are certain locations in Canada where incinerating waste is an important means of avoiding potentially dangerous interactions between humans and wildlife. In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option.

This section provides background information on batch waste incineration, including: substances of concern; international and national initiatives; and provincial/territorial initiatives.

1.2.1 Substances of Concern

There are some important potential environmental concerns associated with waste incineration that can be addressed through proper equipment selection, operation, maintenance and record keeping. These include potential releases of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F), which are persistent organic pollutants (POPs), and mercury.

Dioxins and Furans

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDD/F), commonly known as dioxins/furans (D/F), are toxic, persistent, bioaccumulative, and result predominantly from human activity.

Data from the measurement of dioxins/furans in the North shows that these chemicals are frequently found at concentrations far in excess of those that might be explained by local production. With the increased social and economic development in Canada's North, it is important to control these persistent chemicals.

Dioxins and furans can be generated from incomplete combustion resulting from the use of inadequate technology and/or operating the incinerator improperly.

Mercury

Another possible contaminant released from incinerators is mercury. Mercury bio-accumulates in the environment and, like POPs, is found in polar regions at higher concentrations than can be explained by local anthropogenic releases.

Mercury is not emitted from the incinerator unless items containing mercury are placed into the incinerator. The best method to control mercury releases is therefore to limit the amount of mercury in the waste fed to the incinerator.

1.2.2 International and National Initiatives

Over the years, Canada has participated in numerous initiatives to reduce dioxins and furans as well as mercury releases such as:

- Stockholm Convention on Persistent Organic Pollutants;
- CCME Policy for Management of Toxic Substances;
- Federal Toxics Substances Management Policy (TSMP),
- Canada Wide Standards for Dioxins and Furans;
- Canada Wide Standards for Mercury; and,
- Chemicals Management Plan.

Stockholm Convention on Persistent Organic Pollutants

Canada is a Party to the Stockholm Convention on Persistent Organic Pollutants (POPs), which entered into force in May 2004. The Stockholm Convention sets out a range of measures to reduce and, where feasible, eliminate POP releases[2].

Incineration was identified as a potential source of the POPs listed in Article 5 of the Stockholm Convention. Article 5 of the Convention requires Parties to take measures to reduce, and where feasible, eliminate releases of unintentionally produced POPs, including dioxins, furans, hexachlorobenzene (HCB) and dioxin-like polychlorinated biphenyls (PCBs) which are "*unintentionally formed and released from thermal processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions*".

Article 5 also requires that Best Available Techniques (BAT) and Best Environmental Practices (BEP) be applied for both new and substantially modified sources. "Best Available Techniques" are defined as using the most effective and advanced techniques that can be practically adopted to:

- *prevent or minimize* harmful emissions of by-product POPs and other environmental impacts; or,
- *reduce* by-product POPs releases to acceptable limits.

"Best Available Techniques" techniques can be applied by an operator to a specific facility since they have been developed to a state that they are economical and technically viable. Similarly, "best environmental practices" implies the application of the most appropriate combination of environmental control measures and strategies. Annex C states that for the purposes of the Convention there are a series of measures that are appropriate:

> *"Improvements in waste management with the aim of the cessation of open and other uncontrolled burning of wastes, including the burning of landfill sites. When considering proposals to construct new waste disposal facilities, consideration should be given to alternatives such as activities to minimize the generation of municipal and medical waste, including resource recovery, reuse, recycling, waste separation and promoting products that generate less waste."*

CCME Policy for Management of Toxic Substances and the Federal Toxics Substances Management Policy

Canada took steps to improve the management of POPs even before the Stockholm Convention was adopted. Polychlorinated dioxins-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) were designated as Track 1 substances and scheduled for virtual elimination from the Canadian environment under the 1995 federal *Toxic Substances Management Policy* [3] and the 1998 CCME *Policy for the Management of Toxic Substances*[4].

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2 At the Conference of Plenipotentiaries on the Stockholm Convention on Persistent Organic Pollutants, held May 22 to 23 2001 in Stockholm, Sweden, the Convention was adopted and opened for Signature. It remained open for signature at the United Nations Headquarters, Treaty Section, in New York, until May 22, 2002. Available on-line at: http://chm.pops.int/

3 Environment Canada, Toxic Substances Management Policy. 1995. Available at http://www.ec.gc.ca/toxics/TSMP/en/tsmp.pdf

4 CCME, 1998. CCME Policy for the Management of Toxics Substances. January 29, 1998. Available at http://www.ccme.ca/assets/pdf/toxics_policy_e.pdf

PCDD/F are on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act, 1999*[5].

Under the federal 1995 *Toxic Substances Management Policy* and the 1998 *CCME Policy for Management of Toxic Substances*, mercury was designated as a Track 2 substance. As such, mercury must be managed through its life cycle to minimize releases. Mercury is on the List of Toxic Substances in Schedule 1 of the *Canadian Environmental Protection Act* (CEPA 1999).

Canada-wide Standards for Dioxins and Furans

The Canadian Council of Ministers of the Environment (CCME) examined the incidental release of dioxins and furans in emissions from various combustion systems. This led to the development of the *Canada-wide Standards for Dioxins and Furans*, which were adopted by the CCME in 2001. The standards identify incineration for action to reduce emissions, and include specific air emission standards.

In a 2007 review of the Dioxins and Furans Canada-wide Standards for waste incineration[6], a series of recommendations were made by the Dioxins and Furans Incineration Canada-wide Standards Review Group regarding batch incinerators in remote locations. These recommendations suggest that:

- The company/department should take appropriate measures to ensure good operation and provide adequate records of such operation;
- The company/department should only use incinerators that are equipped with monitoring equipment (temperature probes, differential pressure meters and auxiliary fuel flow) to ensure that proper operation is maintained. The monitoring equipment should be connected to a computer which will continuously log the data recorded;
- All installations should install weigh scales to record the weight of each load charged to the incinerator;
- All data from these systems should be available to inspectors;
- The computerized data acquisition equipment should be integrated with all the operating controls of the incinerator in a manner that would facilitate remote access to the data to enable the manufacturer to assist the operator with trouble shooting the operation;
- Operators should be trained, either through an appropriate site specific training program or through a certification program provided by a qualified body;
- Operators should be instructed to distinguish between broad categories of waste, in terms of their calorific value, and be given clear instructions on how much from each category is suitable for charging to the primary chamber for a given batch;
- All facilities should be required to file, with the appropriate regulatory authority, their annual waste throughput data. This filing should include details on the quantity and disposition of residues discharged from the facility.

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[5] CEPA, 1999. Canadian Environmental Protection Act, 1999. 1999, c. 33 (Assented to September 14, 1999). Available at http://www.ccme.ca/assets/pdf/mercury_emis_std_e1.pdf

[6] Chandler, A.J., 2007. Review of Dioxins and Furans from Incineration In Support of a Canada-wide Standard Review: A Report Prepared for The Dioxins and Furans Incineration Review Group through a contract associated with CCME Project #390-2007. Available at: http://www.ccme.ca/assets/pdf/1395_d_f_review_chandler_e.pdf

Canada-wide Standards for Mercury

The Canada Wide Standards for Mercury Emissions were adopted in 2000 in order to reduce atmospheric emissions derived from both deliberate use of mercury and from incidental releases of mercury[7]. The standards include limits for mercury emissions from waste incinerators.

The Mercury Containing Product Stewardship: Manual for Federal Facilities[8] provides useful information on how to develop an inventory of mercury within a facility, reducing mercury through life-cycle management practices, and monitoring and reporting on mercury stewardship activities.

Chemicals Management Plan

Canada's efforts to improve the environment have also led to new measures under the Chemicals Management Plan (CMP)[9], which was first brought forward in 2006. The CMP develops measures to better protect human health and the environment from the risks posed by chemical substances. Since CEPA was adopted, all new chemicals have received rigorous pre-market assessments; however, approximately 23,000 "legacy" chemicals were in use in Canada before CEPA came into effect. The CMP identified a list of 193 substances as priority for action. Industry is required to provide Environment Canada and Health Canada with information regarding these substances on a quarterly basis within the next three years. The information that is received, along with that gathered from other sources, will be assessed and used to decide, if necessary, the appropriate actions required to protect the health of Canadians and the environment.

The Waste Sector has been identified as a sector under the CMP due to potential releases to the environment from incinerators and landfills.

1.2.3 Provincial / Territorial Initiatives

The CWS for both dioxins/furans and mercury have been incorporated into regulations related to new incinerators in various provinces. One example is the Ontario Guideline A-7[10] which incorporated the CWS emission values for new incinerators shortly after they were adopted and Guideline A-7[11] which clarified the approach for existing facilities in 2004. In many cases, the adoption of the CWS by provincial regulators has resulted in the closure of older incineration facilities. Some facilities have been upgraded to meet the new standards.

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7 Canadian Council of Ministers of the Environment (CCME). Canada-wide Standard for Mercury Emissions, 2000. Available at: http://www.ccme.ca/ourwork/air.html?category_id=87

8 Mercury-containing Product Stewardship: Manual for Federal Facilities. (2004). Environment Canada. Available at http://www.ec.gc.ca/Mercury/ffmis-simif/Manual/index.aspx?lang=E

9 Chemicals Management Plan (CMP), 2006 Notice of intent to develop and implement measures to assess and manage the risks posed by certain substances to the health of Canadians and their environment. Under the *Canadian Environmental Protection Act*, 1999. http://www.chemicalsubstanceschimiques.gc.ca/en/index.html

10 Ontario Ministry of the Environment, 2004. GUIDELINE A-7 Combustion and Air Pollution Control Requirements for New Municipal Waste Incinerators. Legislative Authority: *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9. Last revision February, 2004. Available at: http://www.ene.gov.on.ca/envision/gp/1746e.pdf

11 Ontario Ministry of the Environment, 2004. GUIDELINE A-8 Guideline for the Implementation of Canada-wide Standards for Emissions of Mercury and of Dioxins and Furans and Monitoring and Reporting Requirements for Municipal Waste Incinerators Biomedical Waste Incinerators Sewage Sludge Incinerators Hazardous Waste Incinerators Steel Manufacturing Electric Arc Furnaces Iron Sintering Plants. Legislative Authority: *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9, August 19, 2004. Available at: http://www.ene.gov.on.ca/envision/gp/4450e.pdf

2.0 The Waste Incineration Process

This section provides background information on the waste incineration process in order to provide a basis for understanding the recommendations contained later in the report. This chapter discusses: controlling combustion and emissions; waste incineration technologies; and, general design and operation considerations.

2.1 Controlling Combustion

2.1.1 Overview of the Waste Incineration Process

Gases, liquids and solids containing carbon and hydrogen can be burned. The way each state of matter burns is different. In the context of this document, waste being incinerated is mostly in solid form as opposed to a liquid or a gas.

Most solid fuels contain both volatile materials and fixed carbon. During combustion, two different processes occur: the gaseous volatile materials are released and oxidised; and, the fixed carbon is oxidised.

In the first process, the volatile materials are released by pyrolysis reactions that convert the waste into gases consisting of hydrogen, carbon monoxide (CO), light hydrocarbons and tars. Once released in the high temperature environment, the hydrogen reacts instantaneously with oxygen to form water vapour. The CO oxidises to form carbon dioxide (CO_2) at a slightly slower rate. The hydrocarbons and tars react to form hydrogen and carbon, which in turn are oxidised. The gaseous reactions require oxygen and an elevated temperature. If the gases and the air are not well mixed some of the reactions do not go to completion and tars and other products of incomplete combustion, such as dioxins/furans, can also be released to the flue. Under these circumstances, the stack gases will be cooler and tars and other products of incomplete combustion will condense on the flue walls as soot or tar deposits.

In the second process, the remaining fixed carbon oxidizes and releases CO. This reaction takes longer than the release of the volatile materials because oxygen must diffuse to the material's surface where it can react. The rate of this reaction is proportional to the exposed surface area available.

Throughout the combustion process, the oxidation of CO to CO_2 occurs through reactions with hydroxyl (OH) radicals. If excessive air is present in the combustion zone, the combustion temperature and the concentration of hydroxyl radicals will be reduced and the CO oxidation reaction will be inhibited. This results in elevated concentrations of CO in the exhaust gases. Insufficient air can also lead to high CO concentration because there will be insufficient oxygen to oxidise the CO.

The burning of waste in an incinerator is essentially a rapid oxidation process that generates heat and converts the waste to the gaseous products of combustion, namely carbon dioxide and water vapour, which are released to the atmosphere. At the end of the burning process, there may be residual materials and ash that cannot burn.

2.1.2 Controlling Combustion

Controlling combustion during the waste incineration process is very important for in order to minimize the formation and release of products of incomplete combustion such as dioxins and furans. The intent is to ensure that the combustion process is as complete as possible, yielding residues with little carbon, and stack gases containing only carbon dioxide and water vapour.

Solid waste is generally characterized as heterogeneous, with materials that burn at different rates. The rate of burning is determined by the amount of air added to the waste. When burning waste in a well designed incinerator, air flows are controlled to ensure high temperatures and a clean burn.

Burning is an oxidation reaction that requires a precise amount of oxygen to mix with the material being burned. This is termed the stoichiometric oxygen requirement. There must be just enough oxygen molecules to combine with the carbon and hydrogen from the waste to create carbon dioxide and water. If the quantity of oxygen available is just enough, the temperature generated by the reactions will reach its maximum. If too little or too much oxygen is present, the temperature achieved in the system will be lower.

In batch incinerators, the waste sits stationary on a solid surface referred to as the hearth. The heterogeneous mix of waste on the hearth changes as the waste is reduced to ash through gasification and oxidation reactions. The initial heat required to ignite the waste is supplied by a burner that uses propane, natural gas or oil. Since the fuel supply to the burner is continuous, the burner can stay on indefinitely during the burn cycle. However, this would increase operating costs, and so the incinerator controls shut off the burner once the waste on the hearth has generated sufficient heat to allow the reactions to become self sustaining.

Air must be provided to sustain the combustion process. In batch incinerators, the air is supplied through holes in the incinerator walls. These holes are positioned so that the air is directed to the base of the hearth. In larger continuously operated incinerators, these air ports are under the fuel bed. In either case the air introduced in this manner is termed “under fired” air to denote where it is injected. Air must also be added above the hearth to burn the gases generated. This air also enters through air ports, and is referred to as “over fired” air. In dual chamber incinerators the over fired air is added in the secondary chamber. It is not sufficient just to add the over fired air, it must be well mixed with the volatile gases to ensure good combustion. This mixing is typically accomplished by passing the volatile gases through a “flame port” that is smaller than the primary chamber dimensions. Air can be added in the flame port or immediately after it. The flame port increases the gas velocity and introduces turbulence into the gas stream to promote mixing.

The oxidation reactions require a finite amount of time for completion, meaning that the duration of exposure at elevated temperatures must be controlled. Since batch incinerators typically lack any mechanism for agitating the waste, the temperature in the system must be maintained by re-igniting the primary burner. The combustion cycle for a batch waste incinerator is thus set to ensure maximum carbon reduction of the waste on the hearth.

The type of waste incinerated can have significant implications for the control of combustion. Paper and plastics have a higher energy value and require more air to complete the combustion process. Food wastes, with lower energy levels, require less air to complete the burning process. However, the moisture in food waste has to be evaporated before the carbon can sustain combustion. Thus, food wastes must be heated for longer periods before the combustion process commences and the primary burner can be shut off.

Combustion in the secondary chamber of a dual chamber incinerator will respond to the quantity of volatile gases present. As the volatile gas release rate drops, the temperature in the secondary chamber will also drop. To address this issue, most batch waste incinerators are equipped with secondary chamber auxiliary fuel burners. These burners maintain the desired temperature in the secondary chamber and assist with heating the incinerator during start up. The secondary chamber is typically sized to provide the gases with a one second residence time at 1000^{O}C.

2.1.3 Reducing Dioxin and Furan Emissions

Emissions of air contaminants from batch waste incinerators are a function of the design and operation of the equipment, and the nature of the materials being processed. Heavy metals present in the waste will be released with the exhaust gases. If there is mercury in the waste, mercury will be found in the emissions. If no mercury enters the incinerator, it cannot exit the stack. However, the same approach cannot be used to reduce the emissions of POPs, and in particular, dioxins and furans (PCDD/F).

It is known that at temperatures in excess of 600^{O}C, any PCDD/F will be destroyed. However, even in incinerators with good combustion there is a potential for PCDD/F formation due to *de novo* synthesis reactions. *De novo* reactions occur at temperatures in the 250 - 450^{O}C range when stack gases and fly ash are in contact for periods exceeding a few seconds. It has been postulated that residual carbon in the fly ash reacts with components in the exhaust gases to form PCDD/F. Given this behaviour, it should not be surprising that facilities with low temperatures have been identified as those having higher PCDD/F emissions.

Chemical reactions are driven by concentration gradients, so the higher the concentrations of carbon and fly ash the more likely the reaction will produce high emissions. Similarly, incinerators with higher concentrations of fly ash in zones with lower temperatures are anticipated to produce significantly more *de novo* reactions.

Carbon monoxyde (CO) concentrations in the exhaust gases are a good indicator of combustion efficiency. Most incinerators can be adjusted to give a minimum CO concentration. For batch waste incinerators, CO concentrations should be below 50ppm. If the incinerator is not operated appropriately (for instance, if the waste has a high calorific value and insufficient air is provided to complete the combustion process), CO levels will rise and black smoke will be released. Such smoke will contain large quantities of carbon that can react to produce higher PCDD/F emissions. Conversely, if the waste cannot create enough heat in the primary chamber to achieve the target temperatures, perhaps because too much air is leaking into the incinerator, there will be zones in the incinerator where temperatures could be in the *de novo* reaction range. The extra air can also entrain particulate matter from the hearth raising fly ash levels in the gas stream. The result will be higher PCDD/F concentrations than might be found in a properly operating system.

2.2 Waste Incineration Technologies

A waste incinerator is a system constructed to thermally treat (i.e. combust or pyrolyze) a waste for the purpose of reducing its volume, destroying a hazardous substances or pathogens present in the waste. There are two main types of waste incinerators: batch and continuous. Batch waste incinerators are loaded with waste through an open door which is then closed

before the waste is ignited. The door remains closed until the ash residues remaining on the hearth have cooled and can be safely removed. The duration of a batch waste incinerator cycle is measured in hours. In comparison, continuously operated incinerators receive fresh waste and discharge ash residues periodically throughout their operation, which can last from weeks to months. This Technical Document focuses on minimizing dioxins/furans and mercury emissions from batch waste incinerator systems ranging in size from 50 to 3,000 kg of waste/batch.

For facilities incinerating more than 26 tonnes of waste per year (tpy), the preferred incinerator for new installations is the dual chamber controlled air incinerator. The dual chamber controlled air incinerator has two chambers and each chamber is equipped with air ports that allow the quantity of air added in various parts of the incinerator to be controlled. They are capable of achieving the higher operating temperatures required to minimize the emissions of POPs, and particularly dioxins/furans. Figures 2.2 and 2.3 illustrate the design of a typical dual chamber controlled air incinerator.

Batch waste incinerators have a zone where the waste is ignited and mixed with air to promote combustion, and a second zone where additional air is added to complete the combustion process. In large continuously operated incinerators, the energy available in the hot exhaust gas stream may be recovered in a heat recovery steam generator (HRSG) or hot water boiler. The steam generated can be used to produce electricity or it can be used for process or space heating. Heat recovery is not recommended for batch waste incinerators, as it lowers the gas temperatures in the system and can lead to *de novo* synthesis formation of PCDD/Fs.

Large continuously operated incinerators are equipped with air pollution control (APC) systems to treat the hot gases leaving the heat recovery system. The gases leaving the heat recovery system are cooled by a fine water mist to reduce the size of the required air pollution control equipment and to protect the incinerator from high gas temperatures. If a large continuously operated incinerator is not equipped with a heat recovery system, a rapid water quench system is used to achieve the desired gas temperatures. Such quenching will limit the potential for *de novo* synthesis of PCDD/Fs because the gases do not remain in the critical temperature range for sufficient time to allow the *de novo* reactions to proceed.

APC systems are not recommended for batch waste incineration systems to control PCDD/F emissions. Stack gases should be released directly to the atmosphere at temperatures in excess of 700^{O}C to reduce the chances of inadvertent formation of PCDD/F through the *de novo* synthesis process.

After the waste has been oxidized in the primary chamber, residues, generally referred to as bottom ash, must be removed. Bottom ash from well-operated incinerators has been shown to contain low PCDD/F concentrations (<20 pg TEQ/g of bottom ash). Solid residues deposited in the heat recovery system of large continuously operated incinerators typically have <50 pg TEQ/g of PCDD/F whereas residues from air pollution control systems typically have <300 pg TEQ/g of PCDD/F. The deposits from heat recovery systems and air pollution control systems are generally referred to as fly ash because the ash has travelled suspended in the exhaust gases. Because of low gas velocities, batch waste incinerators create much less fly ash than large continuously operated incinerators.

Figure 2.2 Typical Controlled Air Dual Chamber Incinerator

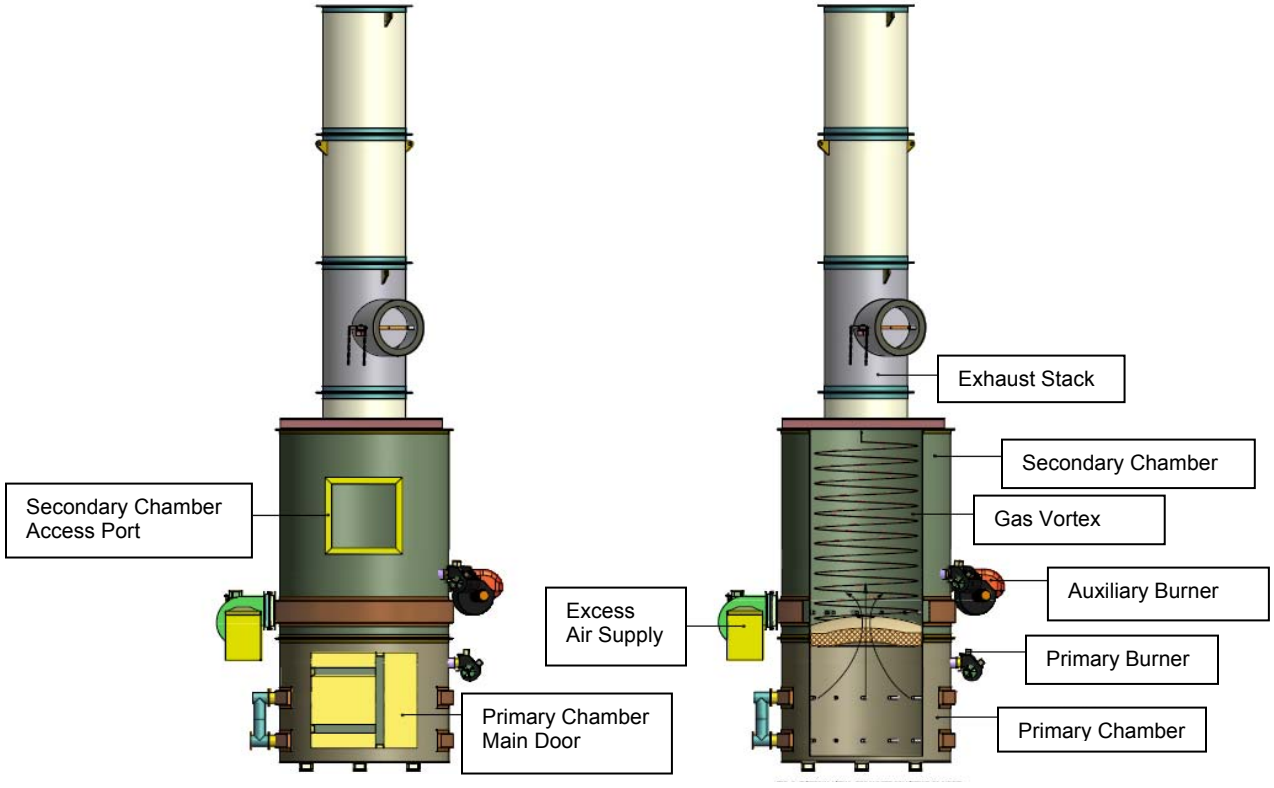

Figure 2.3 Schematic of Typical Controlled Air Dual Chamber Incinerator

2.3 General Design and Operation Considerations

2.3.1 Design and Operation

The design features addressed below are deemed to be most important for those contemplating buying a dual chamber controlled air batch incineration system. As mentioned previously, the emphasis is on batch waste incinerators that are capable of disposing of up to 3,000 kg of waste per batch.

The degree to which the combustion process is completed is a function of:

- the temperature the combusting gases reach;
- the length of time the gases remain at elevated temperatures;
- how well the air and the gases are mixed; and
- whether there is adequate oxygen to permit complete combustion.

Combustion temperatures downstream of the primary chamber and the residence time for gases at this temperature are frequently specified in regulations. In Ontario, for example, waste incinerators must provide a 1 second residence time for gases at $1,000^{O}C$[12]. In the European Union, the requirements are two seconds at $850^{O}C$[13]. These values reflect operating conditions in incinerators with low emissions.

The incinerator designer has more discretion in defining the temperatures in the primary chamber. Primary chambers are designed with consideration of the wastes that will be destroyed. Materials that are harder to burn require higher operating temperatures. The design temperature is governed by the rate at which heat is released in the primary chamber, which is known as the target volumetric heat release rate and expressed in MJ/m^3/hour. This value is based upon the calorific value of the waste in MJ/kg, the quantity of waste to be charged to the incinerator in kg/batch, and the volume of the primary chamber in cubic metres. The operating temperature in a system provides a limit for the volumetric heat release rate. For the typical dual chamber incinerator, the primary chamber should operate in the 500 – $800^{O}C$ range.

Since the temperatures achieved in a specific primary chamber are a function of the heat release rate and the waste mass, it is important that the incinerator be loaded with waste that matches its particular design characteristics. It should be remembered that by design, incinerators are heat release limited devices. Too little heat and the material will not burn properly; too much heat will lead to damage to the incinerator. When the appropriate amount of energy is introduced into the primary chamber, the primary chamber temperature in a batch waste incinerator can be controlled principally through adjusting the air to fuel ratio.

Air addition to the primary and secondary chambers of batch waste incinerators will result in exhaust oxygen concentrations in the range of 6 – 12%. Operation in this zone will minimize the release of CO and thus also minimize trace organic releases. This range can be reduced based upon testing of a given system to produce minimum CO levels. Maintaining oxygen

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12 Ontario Ministry of the Environment, 2004. GUIDELINE A-7 Combustion and Air Pollution Control Requirements for New Municipal Solid Waste Incinerators.

13 Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste. 2000.

concentrations within the manufacturer's recommended range will ensure that the system is operating at in the most efficient manner.

As noted, temperature control involves regulating the air to fuel ratio. To lower the temperature, more air is added, up to the maximum flow. Alternatively the auxiliary fuel flow rate can be reduced. The primary chamber of a batch waste incinerator is designed for a waste mass of a certain calorific value. The air supply system is sized to provide the appropriate level of excess air to control the temperature to the desired level, even if the heat input varies from design.

It is considered poor practice to introduce wastes at either extreme of the calorific value range if good combustion is the objective. In order to prevent any situation where the temperature might be damaging to the primary chamber, the quantity of high calorific waste in any charge must be limited. Wastes should be mixed to achieve a relatively uniform heating value close to the design point of the unit. If the operator controls the quality of the waste mix, any variability in the rate that the waste burns can usually be managed by the control systems of the incinerator.

2.3.2 Heat Recovery

In most cases, batch waste incinerators should not be equipped with heat recovery because this can lower temperatures and lead to *de novo* synthesis formation of PCDD/Fs.

2.3.3 Air Pollution Control Systems

Air Pollution Control (APC) systems with evaporative cooling towers and dry scrubbers are seldom recommended for small batch fed incinerators for two main reasons:

- Due to the non-continuous nature of batch waste incineration, gas temperatures will vary from ambient to operating levels as high as 1,200^{O}C each time the system is operated. When not at high temperature, condensation can occur and cause corrosion in the system. Furthermore, deposits remaining in the duct work during the cool down phase pass through the *de novo* synthesis temperature and can increase the production of PCDD/Fs.
- Since the non-continuous nature of batch waste incinerator operation generally makes it impractical to install a heat recovery system, there will be no initial cooling of the gas stream and higher temperatures will enter the APC system. To prevent equipment damage, some means of rapid gas cooling would need to be installed. This would require large volumes of water, some of which will collect hydrochloric acid and other acidic gases, and would require treatment or at the least re-circulation in the system. In certain areas of the country, obtaining the water and treating it could present significant challenges.

Adding an APC system to a batch waste incinerator will also increase the pressure drop across the system. This will result in the need for induced draft fans to exhaust the combustion gases. The induced draft fan and the air pollution control system will increase the energy requirements of the incinerator.

In most cases, APC systems are not recommended for batch incineration systems to control

PCDD/F emissions. By ensuring good combustion control and exhaust gas temperatures in excess of 700^{O}C, there should be little opportunity for the formation of PCDD/F through *de novo* synthesis

However, in certain jurisdictions and/or operating conditions it may be necessary to employ an APC system. Owners and operators should consult with manufacturers and local regulatory authorities regarding any such requirements.

3.0 The Six-Step Process for Batch Waste Incineration

The recommended Six-Step Process for Batch Waste Incineration includes:

Step 1 – Understand Your Waste Stream

Step 2 – Select the Appropriate Incinerator (or Evaluate the Existing System)

Step 3 – Properly Equip and Install the Incinerator

Step 4 – Operate the Incinerator for Optimum Combustion

Step 5 – Safely Handle and Dispose of Incinerator Residues

Step 6 – Maintain Records and Report

The Six-Step Process will assist owners and operators of batch waste incinerators, ranging from 50 to 3,000 kg/batch, in achieving the intent of the CWS for dioxins/furans and mercury, and reducing the potential for releases of other toxic substances to the environment.

3.1 Step 1: Understand Your Waste Stream

The first step in managing waste is to understand the quantity and composition of the waste that is generated. A waste audit should be completed, where practical, to:

- Determine the quantity of waste generated in the various parts of an operation;
- Characterize the waste from each type of operation;
- Examine the waste stream to determine what opportunities exist for:
    - Reducing the quantity of waste generated;
    - Reusing materials; and
    - Recycling as much as possible before considering disposal.

Where waste audits are not practical, it is still necessary to develop an estimate of the waste quantities and characteristics before a strategy for waste diversion and disposal can be completed. Owners should investigate waste generation and diversion data from similar operations/facilities in order to estimate the waste types and quantities that will be generated at their own facilities. Sources of such information may include industry associations, waste industry consultants, provincial/territorial authorities and other regulatory bodies.

Based on the results of the waste audit/characterization, an assessment of appropriate disposal options should be undertaken. Where possible, disposal alternatives (other than incineration) for the residual waste stream (i.e. post 3Rs – Reduce, Reuse, Recycle) should be examined. When assessing disposal options, it is important to note that waste should neither be open-burned nor burned in a barrel. In both cases, the appropriate temperatures for a clean burn will not be achieved, and toxic contaminants, in particular dioxins and furans, will be released.

3.1.1 Conducting a Waste Audit or Estimating Waste Characteristics

A waste audit is the best way to define the waste stream at a given location. Ideally, an audit should account for seasonal variations in the waste generation rates, so it might have to be conducted in each season.

Performing a waste audit will provide an estimate of the total quantity of waste that could be generated, and allow the user to develop diversion activities that will reduce the amount of material requiring disposal. The residual waste remaining after diversion activities represents the waste requiring disposal. After other disposal options have been investigated, the characteristics of the remaining waste can be used to estimate the energy of the waste that will be charged to an incinerator. This information will be required to select an incinerator.

If the facility is only in the design stage a waste audit cannot be conducted. Even if a facility is operating, the cost of a waste audit could be seen as prohibitive. Where waste audits are not practical, it is still necessary to develop an estimate of the waste quantities and characteristics before a strategy for waste diversion and disposal can be finalized. Owners should investigate waste generation and diversion data from similar operations / facilities in order to develop an estimate of the waste types and quantities that will be generated at their facility. Sources of such information may include: industry associations; waste industry consultants; provincial / territorial authorities; and, other regulatory bodies.

3.1.2 Choosing Appropriate Waste Management Options

In all cases, reduction and diversion should be the primary waste management objectives, prior to considering any disposal option. Facilities should have a Waste Management Plan that outlines waste generation data and defines the acceptable recycling and disposal options. Hazardous waste and hazardous recyclable materials should be handled appropriately in accordance with local, provincial/territorial, and federal legislation.

3.2 Step 2: Select the Appropriate Incinerator (or Evaluate the Existing System)

The characteristics of the residual waste stream destined for incineration should be incorporated into a call for proposals from incinerator manufacturers. Specifying the quantity and composition of the waste stream will ensure that proposals include suitable incinerators. It should be noted that incinerators built for a specific waste stream, such as animal carcasses, liquid wastes and hazardous wastes, are available and should be used as required.

For facilities with existing incinerators, owners/operators should reassess the suitability of the existing system to manage the current waste stream.

For facilities incinerating **more than 26 tonnes of waste per year,** dual chamber controlled air incinerators are the recommended configuration. These systems are capable of incinerating a wide range of wastes and, when properly maintained and operated, will achieve emissions of PCDD/F and mercury below the level of the Canada-wide Standards. These systems should be equipped with a large secondary chamber sized to provide a residence time of at least one second at a temperature higher than 1000^{O}C, to ensure complete combustion and minimize PCDD/F emissions.

For facilities incinerating **less than 26 tonnes of waste per year**, "determined efforts" as defined in the Canada-wide Standards for dioxins and furans[14] should be undertaken. Should circumstances restrict the ability to use a dual-chamber incinerator with a large secondary chamber, a single chamber incinerator with an afterburner should be used. It should be noted that such systems are less likely to be able to meet the emission standards than dual chamber incinerators.

The results of the waste audit conducted for the site should be provided to incinerator suppliers. Suppliers will be able to use these data to provide the appropriate type of incinerator. However, the owner should consider a number of issues when preparing the request for proposals. These include the type of incinerator that should be installed and the size of the incinerator. These issues are discussed in the following sections.

3.2.1 Classification of Batch Waste Incinerators

The emphasis in this report is on batch waste incinerators having a capacity of 50 to 3000 kg/batch. Even with this restriction there are various configurations of incinerators that could be used as noted in Table 3.2.

[14] Available on-line at: http://www.ccme.ca/ourwork/air.html?category_id=97

Table 3.2 Batch Waste Incinerator Types and Features

FEATURE	TYPE
A. Number of chambers	1. Single-chamber (with afterburner)
	2. Dual-chamber
	a. Excess air in primary chamber
	b. Starved air in primary chamber, excess in secondary chamber
B. Waste feeding mode	1. Batch (one load per cycle)
	2. Intermittent (with ram feeder)
C. Ash removal mode	1. Batch
D. Air Pollution Control	1. No
	2. Yes (variety of technologies)
E. Use of blowers and fans	1. Forced air (blower(s) to supply air to combustion chamber(s))
	2. Combination (blower(s) AND an induced draft fan, necessary for APC systems)
F. Heat Recovery System	1. No
	2. Yes

3.2.2 Incinerator Selection Considerations

New Incinerators

For facilities incinerating **more than 26 tonnes of waste per year (tpy), the preferred incinerator for new installations is the dual chamber controlled air incinerator**. This type of incinerator has two chambers and each chamber is equipped with air ports that allow the quantity of air added in various parts of the incinerator to be controlled. These incinerators are capable of achieving the higher operating temperatures required to minimize the emissions of POPs, and in particular dioxins and furans.

As noted in Table 3.2 there are single chamber incinerators on the market. Suppliers may offer single chamber units equipped with afterburners, but they are not desirable. They are unlikely to provide the low emissions levels achievable by properly sized dual chamber incinerators. A properly sized secondary chamber is required to accommodate the volatile gases that are released from the primary chamber. Small secondary chambers are unlikely to provide sufficient time at elevated temperatures to ensure destruction of volatile compounds.

Another important factor to consider is the frequency of operation of the incinerator. While operating procedures should minimize the release of unwanted contaminants to the atmosphere, even during start-up and shut-down, there is a higher probability of emissions during these transition conditions than during the normal steady-state operation.

Incinerators sized in a way that allow them to operate only on alternate days, or even only 2 or 3 times per week, will generate lower annual emissions than those operated frequently each day. For this reason, a larger incinerator which can be operated less frequently is preferred.

The designer undertakes detailed calculations to size the incinerator and the control systems. Manufacturers recognize that wastes will not be consistent day after day and provide a margin

of safety in their instructions. While the manufacturers would prefer tighter control on the feed rate, it is not unusual to see instructions state that the primary chamber should only be half filled. Based on the waste audit data, the manufacturer assumes a density and heat value for the waste and specifies a safe quantity of material that can be burned in a given cycle.

Existing Incinerators

If an existing incinerator is still being used as originally intended (i.e. the nature of the waste has not changed over the intervening years, and the unit has been properly maintained), consideration could be given to the unit's continued operation. Stack testing of the emissions can determine the incinerator's emission performance and allow the status of the emissions to be compared to the Dioxins and Furans Canada-wide Standards for incinerators.

Annual Throughput Considerations

The Canada-wide Standards for Dioxins and Furans[15] distinguishes incinerators by their capacity and use, setting an annual throughput threshold of 26 tonnes.

Any system capable of handling greater than 26 tonnes per year should have a primary chamber and a large secondary chamber sized to match the nature of the waste characteristics developed from the waste audit.

If the unit is unlikely to process 26 tonnes of waste per year, and a smaller secondary chamber is chosen to facilitate transport, additional care must be taken in ensuring the correct types of wastes and volume of material are charged to the primary chamber. This will reduce the possibility of high PCDD/F emissions.

Special Waste

Special wastes such as liquid waste (e.g. waste oil), wet waste (e.g. kitchen wastes, sludges), and animal carcasses require special consideration when selecting an incinerator. Liquid and wet waste in small quantities can usually be mixed with other wastes, but large quantities of either material will require special provisions.

For instance, waste oil can be used as an auxiliary fuel in an incinerator. Should its use be contemplated to offset virgin oils in the incinerator, this strategy should be made known to the manufacturer. They will recommend appropriate systems to separate sludge and moisture from the used oils, and the installation of two burners in each chamber (one for waste oil and one for virgin oil). These are necessary steps to ensure that temperatures in the chambers can be maintained should operating problems arise with the waste oil burner. In the context of the batch waste incinerators addressed in this report, liquid hazardous wastes, other than oil, should not be injected into the incinerator.

The incinerator hearth should be designed to contain any free liquid anticipated in the waste stream. Free liquids can drain into air ports if they are situated below the liquid level in the incinerator. Liquid may also leak through the doors of a standard flat hearth incinerator and damage their seals. Leaks in other areas can lead to poor combustion performance.

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[15] Available at: http://www.ccme.ca/assets/pdf/d_and_f_standard_e.pdf

Wet waste is challenging to handle unless the incinerator is properly designed. For example, it is strongly recommended that batch incinerators not be used to treat sewage waste, unless they have been designed specifically for this type of waste. If it is anticipated that the waste to be incinerated on a routine basis will contain wet wastes, the auxiliary burner may need to be larger to dry the waste in a reasonable amount of time.

Unlike sludges and liquids, animal carcasses should not cause liquid leaks from the primary chamber even though they contain high levels of moisture. They must be handled in incinerators that can accept this type of waste. Animal wastes should only be charged to an incinerator that is capable of completely calcining the bones in order to ensure that all pathogens are destroyed in the incinerator. Those anticipating the need to destroy animal carcasses should discuss their needs with regulators and the manufacturers of waste incinerators.

3.3 Step 3: Properly Equip and Install the Incinerator

Building Considerations

- Incinerators should be installed inside a building to protect the equipment and the operators from weather conditions.
- In designing the installation site, care should be taken to maximize clearance between incinerator components, including the stack, and combustible construction materials.
- Insulation should be used to protect combustible building materials.
- The building should be equipped with sufficient fresh air inlet capacity for the incinerator. Both combustion air and dilution air for the barometric damper are required. Care should be taken to introduce air in a manner that does not lead to low-temperature operating problems.

Equipment Considerations

The incinerator system should come complete with the following equipment to monitor and record performance parameters:

- A scale to measure the weight of all materials charged to the incinerator; and
- A computerized process control and data acquisition system to store operating data from the incinerator.

Operational data should be collected and stored, at a minimum, every minute that the system is operating. The intent is to be able to summarize operating parameters during start-up, operation and cool-down for every cycle. If the required operating conditions are not achieved these data will allow the operators, the manufacturers and the regulator to identify the contributing factors for the failure. From this information, operating procedures can be adjusted to improve performance. Provisions should be made for the manufacturers to be able to remotely access and review the operating data for trouble shooting purposes.

It is highly recommended that batch incinerators not be equipped with heat recovery devices. The temperature of the stack gases in heat recovery systems will be lower than in systems without heat recovery, and may be in a temperature range that can lead to the formation of greater quantities of PCDD/F. Similarly, air pollution control systems are not recommended for batch waste incineration systems to control PCDD/F emissions. Stack gases should be released directly to the atmosphere at temperatures higher than $700^{O}C$ to reduce the chances of the inadvertent formation of PCDD/F through the *de novo* synthesis process.

If it is necessary to introduce additional waste to the incinerator during the burn cycle, the incinerator should be equipped with a ram charge system to limit the disruption of combustion in the primary chamber during the waste charging process.

3.3.1 Building Considerations

The recommendation from the previous section that incinerators be over-sized so they can be operated on a less frequent basis implies that the facility will need to store waste between incinerator operation periods. The incinerator should be installed in a building with sufficient space for waste storage. Operating the unit in a building will ensure that the operators are more comfortable and thus spend more time ensuring proper operation and conducting the necessary maintenance on the system. Furthermore, it will protect the unit from weather conditions, extend its life, and make operation more reliable.

Care must be taken to avoid the exposure of combustible building material to the high temperatures on the surfaces of the incinerator and the stack. Suitable fire proof insulation and air gaps must be provided to avoid igniting the building structure.

Since combustion reactions require air, provisions should be made to ensure that sufficient fresh air is available in the vicinity of the incinerator. The air flow should be unimpeded by louvers or doors in the building. At the very least, if louvers are required to isolate the incinerator room during power outages, their status should be interlocked to the incinerator controls so the incinerator does not operate when the dampers are closed. The manufacturer's advice should be sought on the fresh air supply requirements for the incinerator. It should be remembered that in extremely cold climates, fresh air impinging upon fuel lines or other parts of the operating system can created operating problems so the air should be properly tempered to minimize equipment freezing and/or staff discomfort.

3.3.2 Equipment Considerations

The operation of the incinerator should be monitored at all times and this data should be recorded to provide a record of such operation. A list of monitoring equipment recommended for all installations follows:

- **Weigh Scale:** Every incinerator operation should have a weigh scale so that every load can be weighed and the results recorded.
- **Continuous Monitoring:** In order to confirm the status of the incinerator at all times, it is recommended that measurements of the parameters described below be continuous regardless of the operational status of the incinerator. Gaps in the readings could be interpreted as periods where the incinerator was not operating in an appropriate manner. Thus, continuous readings, once per minute, are the best way of proving that the system is operating in compliance with the various approvals and guidelines. The measurements should be captured in a computerized data acquisition system that logs the date and time of the readings as well as the readings themselves.
    - **Temperature:** The most basic of all measurements associated with incinerator operation is temperature. Temperature should be monitored in both the primary and secondary chamber and the stack at all times. The sampling location for the stack measurement should be above the barometric damper if one is installed. Such measurements will ensure that the system has achieved the desired temperature levels. Temperatures outside the normal range can serve to warn the operator that the system is not working as intended.
    - **Differential Pressure in the Primary Chamber:** A second operating parameter that is important is the differential pressures in the primary chamber. The

primary chamber should operate at negative pressure. Should the differential pressure track towards the positive, it is an indication that insufficient draft is present in the system and combustion fumes could be building in the system. The operator should be able to adjust this parameter either by changing the inlet flows or adjusting the barometric damper. If the pressure goes too negative, the combustion air fans may have failed, or the damper needs adjustment. The data acquisition system can be programmed to warn the operator of potential draft limitations in the system.

- **Auxiliary burner operation:** The auxiliary fuel burners in some incinerators are not reliable. This type of failure will likely be reflected in lower than desired temperatures in the incinerator. A combination of no fuel flow in the auxiliary burners and low temperatures in either chamber could indicate an auxiliary burner failure. The operator should be able to monitor the auxiliary burner operation.
- **Fan Amperage:** Failure of the combustion air fans will lead to inappropriate operating conditions. Recording the fan amperage will provide some indication that the fans are operating at their design loads.
- **Interlocks:** The data acquisition system should monitor the state of all interlocks on the system. Loading doors and other components of the system are frequently connected to the incinerator control system. Recording the status of sensors on various doors or dampers will assist in confirming the system is operating in the desired manner.

The type of data acquisition system described above can store data and can also be used as a means of allowing the manufacturer to look at operational data remotely to assist with trouble shooting the operation. In this manner, the operator can quickly obtain the assistance of the manufacturer. Owners should request that the manufacturer provide recommendations for the data acquisition system. This will likely open up a line of communication concerning what they can do to help operational staff adjust the incinerator if it is not operating correctly.

Other Considerations

Most batch incinerator systems are factory fabricated and shipped to the site where they are to be used. Larger systems may be shipped in sections to be assembled on the site. Typically the stack will be installed on the incinerator as one of the final steps. Stacks should be properly designed to ensure that emissions can freely disperse in the atmosphere and not be re-entrained into fresh air intakes on nearby buildings.

3.4 Step 4: Operate the Incinerator for Optimum Combustion

Operational Considerations

Wastes received at the incinerator building should be separated according to their heating value characteristics: wet or low-energy wastes (e.g. food waste); mixed wastes with average energy values; and other materials with high energy values, such as oily waste materials. To facilitate this separation, all waste should be collected in transparent bags. To further assist with separation, wastes could be collected in coloured-coded bags.

Batch incinerators are designed to accept wastes within a specified range of energy (i.e. calorific) values. The operator should select waste from each category and mix it to achieve the manufacturer's specified input calorific value. Each bag should be weighed, its source should be noted, and the total weight of each category should be tallied before completing the loading. This information should be recorded by the computerized data acquisition equipment installed with the incinerator. (Refer to step 6 for further record keeping requirements).

Batch incinerator systems have limited charging capacity (both in terms of waste quantity and the calorific value of the waste charge). To assist the operator with the charging task, particularly for smaller incinerators, several batches could be weighed and placed in their own containers prior to loading the incinerator. The same weighing and logging procedures should be used for each batch and, once recorded, the batch can be charged when appropriate.

When the incinerator is charged with the appropriate mix and quantity of waste, the operator should close the door, ensure all interlocks are engaged, and start the burn cycle. The operator should observe the burn for at least 15 minutes after ignition of the primary chamber burner to ensure the volatility of the waste charged is not creating too much gas for the secondary chamber to handle. The rate of combustion can be slowed by reducing the quantity of under-fired air. The primary chamber should be operated in the temperature range specified by the manufacturer (typically 500^{O}C to 800^{O}C).

When satisfied that the burn is proceeding in a controlled manner, the operator may leave the incinerator area while the equipment completes the burn cycle.

The burn cycle should not be interrupted by opening the charging door until after the burn is complete and the unit has cooled down. No additional waste should be added to the primary chamber unless the incinerator is equipped with an appropriate ram feed device.

When the burn is complete and the unit has cooled, the operator should open the door only when wearing protective equipment such as gloves, dust mask, face shield and goggles.

The operator should remove the ash from the previous burn cycle before reloading the incinerator. Any unburned materials found in the ash should be recharged to the primary chamber after the operator has cleaned the air ports, and before putting a fresh charge into the incinerator.

Training Considerations

Operators should be properly trained by the incinerator manufacturer. The training course should include, as a minimum, the following elements:

- System safety including identification of hazards that the operator should recognize;
- Waste characterisation and how waste composition can affect operation;
- Loading limitations, including materials that should NOT be charged to the incinerator, and the allowable quantities of different types of wastes that can be charged;
- Start-up procedures for the incinerator and the normal operation cycle;
- Operation and adjustment of the incinerator to maximise performance;
- Clean out procedures at the end of the cycle;
- Troubleshooting procedures;
- Maintenance schedule; and
- Record keeping and reporting.

Managers should be involved in the training session so that continuity can be maintained with different operators.

3.4.1 Operation

3.4.1.1 General Batch Waste Incinerator Operation Considerations

Effect of Waste Characteristics

The characteristics of the waste loaded to the incinerator will affect the temperature profile in the various sections of the incinerator during the burn cycle. These variations will also influence the duration of auxiliary burner operation.

Wastes with a high percentage of volatile matter (e.g. paper >75%, plastics >85%) will release more volatile gases from the primary chamber than wastes with low percentage of volatile matter (e.g. vegetable wastes <20%). When mixed with additional air in the secondary chamber, the combustion of the volatile gases maintains the secondary chamber operating temperatures and limits the need for auxiliary fuel. At this point in the burn cycle, the temperature in the secondary chamber will be higher than that in the primary chamber. However, as the release of volatile gases from the primary chamber decreases, combustion in the primary shifts and begins to consume the fixed carbon. This results in a drop in temperature in the secondary chamber and an increase in temperature in the primary chamber. The secondary temperature can drop to the point where the secondary chamber auxiliary burner must come on to maintain the temperature at or above the required setpoint, typically 1000^{o}C.

Higher moisture levels in the waste require more auxiliary fuel to evaporate the moisture and allow the waste to burn. The moisture released in this way passes through the secondary chamber taking heat from that chamber as well. This could mean that the secondary burner must operate for longer periods during the early phases of the cycle.

The ash percentage in the waste can also influence auxiliary fuel consumption and overall cycle time. The ash must be heated to sufficient temperatures to drive off volatile gases and the fixed carbon. The ash remaining in the primary chamber retains heat and lengthens the time required for the incinerator to cool so it can be handled safely.

Incinerator Loading

To properly load the incinerator, the following steps need to be followed:

- Determine the source of the waste – kitchen, vehicle shop, bunkhouse area, etc.;
- Weigh the waste to determine how much must be disposed; and,
- Proportion the waste fed to the incinerator on the basis of the anticipated heating value.

The wastes from different operations in the facility would need to be designated, either by colour codes or in different waste containers. Each source would be assumed to produce waste that was similar in composition on a daily basis.

For batch waste incinerators with charge sizes between 50 kg and 200 kg, individual bags of waste can be weighed before they are put into the incinerator.

For larger batch incinerators it would likely be onerous to have to weigh each bag in a 1,000 kg charge and alternative approaches could be adopted. The incinerator building should have a tipping floor sized to allow segregation of the various types of waste streams. All waste arriving at the facility should be weighed before being placed in the appropriate area. Knowing the mass of waste in each pile, the incinerator could be loaded with the appropriate volume of a specific type of waste to create a mixed load that has an appropriate calorific input for the incinerator. Possible mixes could be developed from the waste characteristics so the operator has clear guidance on loading the incinerator. For instance adding some higher calorific value plastic waste to the kitchen waste could reduce the amount of auxiliary fuel needed to evaporate the moisture. It is important to segregate known high calorific value materials so that the quantity of these materials in a batch can be limited.

Controlling Air

Ideal combustion is achieved when the exact amount of air needed to oxidize the carbon and hydrogen in the waste is supplied to the incinerator. This stoichiometric air addition rate will result in the highest temperatures from burning a given batch of waste. If too little or too much air is supplied, the temperatures in the primary chamber will change. Indeed, controlling air is the basis of many batch waste incinerators.

The typical starved air incinerator operates by controlling the primary chamber air injection so that the primary chamber operates under sub-stoichiometric or pyrolytic conditions. The air added to the system is only sufficient for the primary chamber to reach pyrolysis temperatures. This is typically between 70% and 80% of the ideal amount of air needed to burn the waste.

The volatile gases from the primary chamber can be burned in the secondary chamber after being mixed with extra air. The amount of air in the secondary chamber is typically 140% to 200% of the amount required to complete the reaction in the secondary chamber. Part of this excess air is added to control temperatures in the secondary chamber as explained below.

If too little air is supplied to the primary chamber the temperature will drop because the waste cannot burn sufficiently to increase the temperature. The operating ideal is to allow the waste to burn at a rate that generates sufficient volatile gases to maintain the desired temperature in the secondary chamber. If too much air is added in the primary chamber the combustion rate is accelerated and much of the volatile gases will consumed before they get to the secondary chamber. This will lead to higher temperatures in the primary chamber, premature failure of

refractory and potentially other damage to the incinerator. In turn, because insufficient volatile gases will pass to the secondary chamber, the temperature in the secondary chamber will be lower and the auxiliary burner will need to operate to maintain temperature. Adding additional air to the secondary chamber will decrease the temperature in the secondary chamber, while limiting air addition will raise the temperature. This is opposite to the temperature response to additional air in the primary.

Controlling the amount of air added to the incinerator can be done in a number of ways:

- Manually by the operator;
- Automatically based upon the temperatures in the primary and secondary chambers; and,
- Automatically based upon changes in the oxygen level in the gas stream.

The control methods represent an increasing level of complexity so oxygen sensors are usually found only on larger systems. The operator must understand the cause and effect when making changes to the system and should be present for the duration of the cycle if manually controlling the operation. For this reason, automatic temperature sensing controls are preferred for batch incinerators.

Controlling Temperature

The primary chamber should be operated in the appropriate temperature range (typically 500^{O}C to 800^{O}C) specified by the manufacturer.

During operation, the secondary chamber temperature is controlled by varying the amount of air introduced to the secondary chamber and by operating the secondary chamber burner. As discussed earlier, regulators usually specify the secondary chamber temperature set point in the range of 850 ^{O}C – 1000 ^{O}C. The secondary chamber temperature set point may vary by jurisdiction and according to the residence time in the secondary chamber. As noted above, adding air to the secondary chamber decreases its temperature, while decreasing the amount of air raises its temperature. A secondary chamber temperature sensor controls the operation of the secondary burner. This sensor has low and high temperature set points that govern burner operation on pre-heating of the secondary. If the temperature drops below the selected set point the burner comes back on to increase the temperature. To avoid having the air and burner control compete with each other, the set point for the air control system is usually set at least 40^{O}C above the burner's high temperature set point.

Typical Problems

Temperatures indicate how the combustion system is performing. Another way to judge the operation of the incinerator is to observe the colour of the flame in the two chambers. Hotter temperatures will drive the flame colour from dull red, through orange to yellow. In the primary chamber any colour brighter than dull red would suggest that too much air is being introduced into the system. In the secondary chamber, red flames indicate a temperature around 760^{O}C, which is generally considered to be too low. An orange flame will be seen in the 1,100^{O}C temperature range whereas at 1,200^{O}C yellow flames are an indication that the temperature is too high for normal waste destruction.

Typical operating problems with batch waste incinerators are:

- **High fuel consumption**

  High fuel consumption occurs when the operator is trying to burn extremely moist waste, or when too much air is added to the system.

  As noted earlier, water must be evaporated from the wet waste before volatilization can occur. Since heat is not released from the waste until it starts to volatilize, the auxiliary burner must supply the extra energy needed. To reduce energy consumption, one must limit high moisture waste in any particular load.

  If the combustion chambers have leaks, excess air will be introduced to the incinerator. Air could enter the incinerator through doors that have become warped due to over heating, or through deformed seals or holes in the incinerator due to corrosion. If excess air is introduced in the primary chamber, the volatile gases will be partially burned in the primary chamber and will not be available to heat the secondary chamber. If excess air enters the secondary chamber, temperatures will drop and the burner will operate for longer periods.

- **The formation of fused ash, or clinker, in the primary chamber**

  Clinkers form when localized temperatures of the ash bed lead to melting of the ash and fusing of the melted material. With municipal solid waste, this occurs at temperatures above 1,200^{O}C. While this should be far above the operating gas temperature of the primary chamber (typically 500^{O}C to 800^{O}C), localized bed temperatures can be higher than the gas temperature. Wherever air is introduced into the primary chamber, there will be zones where the stoichiometric amount of air is present for complete combustion. This air addition rate will result in the highest combustion temperatures possible (in excess of 1,500^{O}C). This condition is more likely to occur if a harsh jet of air is introduced into the primary chamber due to blocked air ports. If this occurs, the flames near the bed would be bright yellow. The operator needs to check the air ports and ensure that the air is evenly distributed throughout the primary chamber each time he removes ash from the incinerator. Cleaning the air injection ports will limit clinker formation.

- **Visible stack emissions**

  The appearance of the stack plume can also provide some indication of the adequacy of the combustion process. Typically stack emissions increase when there is one or a combination of the following situations occurring:

  - The high set point temperature in the secondary chamber is too low;
  - Excessive air infiltration;
  - Excessive negative draft;
  - Excessive primary air addition;
  - Excessive secondary air addition; or,
  - Waste characteristics that prevent the unit achieving design settings.

Plume Characteristics

Figure 3.2 shows different conditions that may be observed with malfunctioning dual chamber controlled air incinerators.

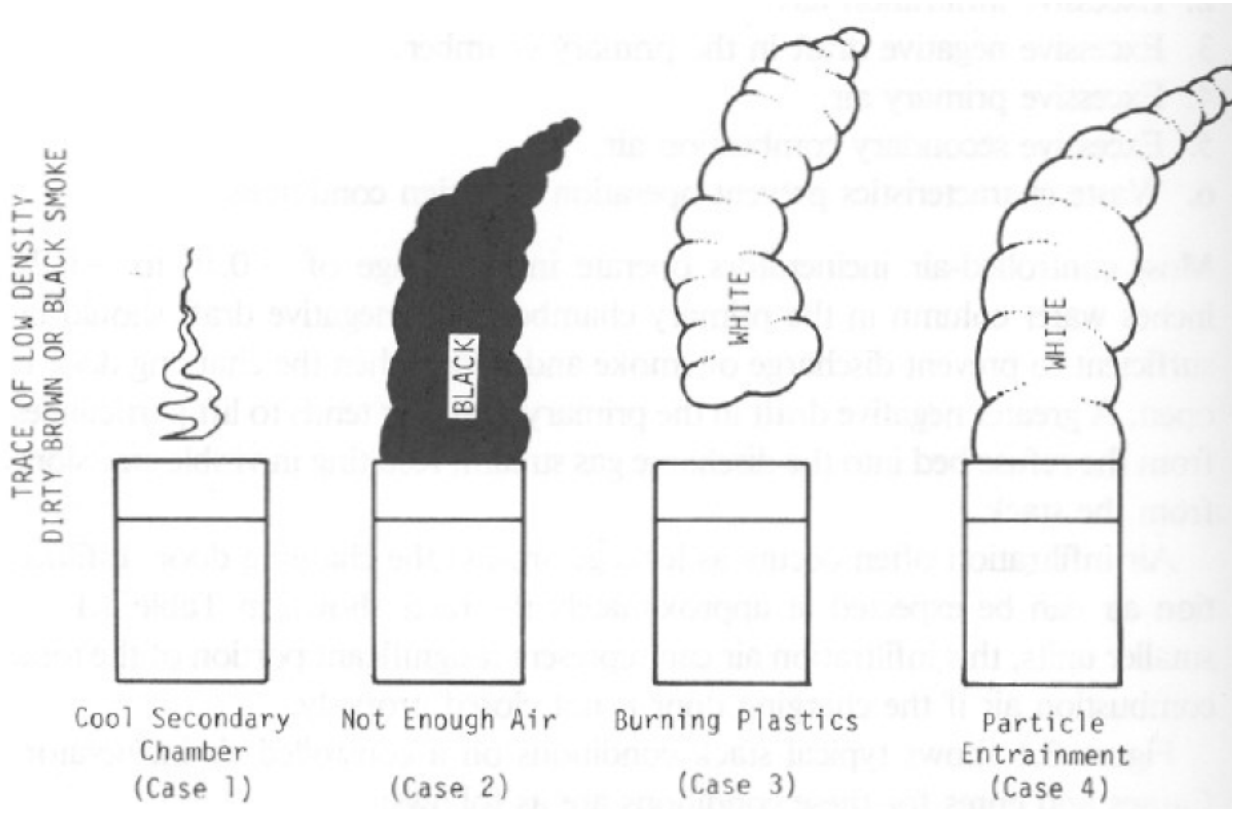


Figure 3.2 Plume Characteristics related to Operating Conditions [16]

Case 1, with traces of dirty brown or black smoke in a wispy plume, generally occurs when the secondary chamber set point temperature is too low. Raising the temperature in the secondary chamber should improve the situation. Secondary chamber temperatures could also be low due to burner failure. Incinerators should not be operated without functioning secondary chamber burners.

Case 2 is the classic "not enough air for the waste being burned" situation as black smoke indicates incomplete combustion. There are a series of steps that the operator should go through to rectify this situation:

- increase the air flow to the secondary chamber to the maximum;
- reduce the air flow to the primary chamber to reduce the rate of volatilisation; and/or
- temporarily increase the set point of the auxiliary burner to 1,200^{O}C to overcome the burning of a very high calorific waste charge.

If the situation persists after these steps have been taken, check the charging capacity for the

[16] Cross, F.R, and H.E. Hesketh, 1985. Controlled Air Incineration. Publishing by Technomic Publishing Company Inc. ISBN No. 87762-396-1

incinerator and the characteristics of the wastes being burned. If the energy content of the waste is very high, the amount of that waste charged to the incinerator will need to be reduced in the future.

Case 3 is a detached white plume that could be the result of burning chlorinated wastes. Hydrogen chloride can cause this type of plume in high concentrations. To rectify this situation, ensure that chlorinated plastics are segregated from the waste stream.

Case 4 is a white plume that persists for long distances downwind. It is indicative of high quantities of fine particulate matter in the stack gases. This can be caused by high rates of air addition to the primary chamber, or by the particular components in the waste stream. If reducing the primary air flow does not rectify this situation, the operator needs to determine the types of materials being burned and take steps to reduce or eliminate their introduction to the system.

High moisture levels in a plume, particularly when exhausting into cold air, will also appear to be white. Water vapour forms a mist as it comes out of the stack and takes on the appearance of a white plume. This plume dissipates rapidly as the plume travel downwind and as the saturated air mixes in the atmosphere reducing moisture levels. The difference between Case 3, Case 4 and a high moisture plume is that typically the moisture plume will only exist for a short distance downstream of the stack. Moreover, the high moisture plume will typically not be visible as the plume exits the stack, but rather appears to form some distance above the stack tip as the vapour condenses in the cold atmosphere.

3.4.1.2 DOs and DON'Ts of Incinerator Operation

It is important to ensure that the incinerator is operating properly according to its design purpose. The following figure provides some significant DOs and DON'Ts to consider when operating a batch waste incinerator.

Some Significant DOs and DON'Ts of Batch Waste Incineration

DO:

- Use specially designed incinerators to dispose of animal carcasses, sewage, liquid wastes, or hazardous waste materials.
- Develop a waste collection and handling program that will allow the operators to mix the waste to provide a uniform heat input to the incinerator;
- Use waste oil and waste fuel for other heating purposes where practical, rather than disposal through incineration;
- Limit the quantity of waste oil or waste fuel in any specific charge to the incinerator to ensure the energy contained in the waste charge is within the limits specified by the manufacturer;

DO NOT:

- Overload the incinerator.
- Put mercury containing waste (e.g. fluorescent lamps, thermometers, thermostats, dental amalgam, batteries) into the incinerator. Limiting the quantity of mercury placed in the incinerator is the most effective way to limit mercury emissions.
- Introduce metal and glass into the incinerator when alternative options exist (e.g. recycling, landfilling). These materials absorb energy from the furnace and increase the wear and tear on various incinerator components.
- Incinerate wastes containing heavy metals (e.g. mercury-containing wastes, wood treated with Chromated Copper Arsenate (CCA), lead paint).
- Incinerate asbestos waste.
- Introduce large quantities of plastics or high calorific wastes into incinerators designed for low calorific value wastes such as animal carcasses and food waste. Incinerators capable of disposing of low calorific value waste are not suited to burning large quantities of high calorific wastes.

3.4.1.3 Standard Operating Procedures

To ensure good operation of the incinerator, there are certain standard operating procedures that should be followed. The list below should serve as a starting point for building the site specific procedures. These procedures must be tailored to the individual facility, and all operators should be trained to follow the site specific version of these procedures.

Cleaning and Loading

- The primary chamber should be cleaned of all ash before any new charge is introduced. Operators should check to ensure that the previous cycle is complete and that the primary chamber has cooled to room temperature before commencing clean out.
- Turn OFF all power to the incinerator before opening the primary chamber door.
- Wear personal protective equipment (gloves, face shield, dust mask) and use appropriate equipment to remove the ash. Rake and shovel the ash from the hearth and place it in a metal container for transport to an approved disposal site.
- Material that was not completely reduced to ash should be placed into the primary chamber for the next burn cycle. If it is necessary to remove this material for inspection and maintenance of the chamber it should be placed in a metal container until it can be reloaded to the incinerator. If this material is still smouldering, it should be sprayed with water when in the metal container.
- Inspect the interior of the primary chamber for wear, or damage to refractory. Refractory that has failed should be replaced before using the incinerator for the next cycle.
- Clean all the air pipes into the primary chamber. Vacuum the pipes to remove fine materials and carefully chip away any slag around the tip of the air pipes, so as not to damage the air pipes.
- Inspect all the door seals to ensure that the door will maintain a tight seal upon closure. Clean any deposits from the seals. Replace seals that are damaged, worn or crushed.
- Clean the inspection view ports.
- Measure and record the weight of the materials to be combusted on the next burn cycle. Fill the primary chamber with the material to be combusted on the next burn cycle. Ensure waste loaded to the primary chamber does not block the burner. Follow the manufacturer's instructions concerning the mass or volume of waste that can be loaded.

Pre-Start Check

- Close and lock the primary chamber door. Ensure that all the latches are properly engaged and that the PRIMARY DOOR CLOSED safety switch is energized.
- Check that no alarms are displayed on the operating panel.
- Ensure that all the temperature set points are at the correct settings.
- Ensure that the cycle times are appropriate for the nature of the waste (volume, energy content, moisture, density, etc.). Typically the burn cycle will be 2 to 6 hours in duration with the cool down cycle being approximately 2 to 3 hours.
- If the incinerator is equipped with an EMERGENCY STOP BUTTON ensure that it is properly armed and that it is unlocked and pulled out.

- Ensure that primary and secondary manual air dampers are 100% open. Set all fuel valves to the open position.

Starting the Burn

Typically the operator will push the start button for the burn cycle and the control system will take over the operation of the incinerator. The operator should observe the operation during start-up to ensure that the following steps are completed.

- Starting the cycle will initiate an air purge of the chambers. This is followed by a purging of the secondary chamber burner prior to igniting. As the secondary burner operates, the temperature in that chamber will rise. When the temperature reaches the appropriate set point, the primary chamber burner will purge and ignite.
- If the secondary burner does not raise the temperature to the manufacturer's recommended set point, the operator should not override the controls and continue the burn. Any failures during the start-up should result in the incinerator shutting down. At this time the operator will need to commence fault identification procedures to overcome the deficiencies.
- The incinerator control system should maintain proper operating conditions throughout the timed burn cycle. Following the burn cycle, the system will go into a cool down mode. During this period air is introduced into the primary chamber to speed the cool down.
- Under no circumstances should the operator attempt to open the primary chamber doors when the system is operating. This practice can cause flashbacks that can injure personnel. The extra air entering the primary chamber will disrupt the combustion process, possibly leading to increased emissions.

3.4.1.4 Preventative Maintenance

All mechanical equipment requires routine preventative maintenance to operate efficiently. The operating conditions for the equipment dictate how frequently maintenance should be carried out. Incinerators have a service cycle that involves repeated heating to high temperatures followed by cooling. This can lead to refractory failures. Furthermore, moving waste and ash into and out of the incinerator creates wear on surfaces. Surfaces need to be refurbished on a routine basis and the seals around the openings require regular inspection and replacement as necessary.

Incinerators are waste disposal devices and should be managed in a manner similar to other disposal options. Incinerator owners need to recognize that money will be required to maintain the facility and to mitigate any unexpected events.

In addition, money should be set aside for routine maintenance. The cost of maintenance will be proportioned between labour, maintenance supplies, and equipment replacement. At least 3-5% of the capital cost of the unit should be set aside for annual maintenance and capital equipment replacement.

The maintenance budget should also include a capital reserve fund to cover repair and upgrades necessitated by unbudgeted circumstances. A suggested allowance for this would be 20% of the annual maintenance costs, labour and supplies, or about 1% of the capital cost.

The owner should consider establishing a service contract with the manufacturer (or a manufacturer-trained/ qualified local technician). These people should visit the site annually, and preferably quarterly if the incinerator is used daily. The owner should discuss the costs of such a program with the manufacturer and inquire about assistance the manufacturer can provide if the incinerator control and operating system can be accessed remotely.

Thus annual maintenance and capital reserve fund costs should be on the order of 4 - 6% of the original cost of the incinerator system.

3.4.2 Training

The cornerstone of ensuring good operation of any incinerator is that the staff understands how the system operates and takes appropriate steps to ensure the continued good operation of the equipment[17].

Every incinerator manufacturer has its own unique approach to designing incinerators. The control systems, while following the general logic of the previous section, are likely to differ as well. Any person who will be operating an incinerator should be trained by the manufacturer before being asked to operate it. It is not good practice to have operators train operators. The manufacturer and its agents are the people most familiar with good operating procedures that will ensure minimal emissions.

Management staff should be involved in the training sessions wherever possible. Management are likely to provide long-term continuity at most sites. They can assist operators with their tasks, and ensure that substitutes or replacements are suitably trained.

[17] Chandler, A.J., 2007. Review of Dioxins and Furans from Incineration In Support of a Canada-wide Standard Review. A Report Prepared for The Dioxins and Furans Incineration Review Group through a contract associated with CCME Project #390-2007. Available at: http://www.ccme.ca/assets/pdf/1395_d_f_review_chandler_e.pdf August 18, 2008.

3.5 Step 5: Safely Handle and Dispose of Incinerator Residues

Ash from the primary chamber of the incinerator can contain materials deleterious to the operator's health and the environment. Operators should use personal protective equipment when handling this material. The material should be carefully removed from the hearth and placed in covered metal containers suitable for transporting the ash to an approved disposal site. The operator should weigh, and maintain records of, the quantity of ash produced.

3.5.1 Residue Handling Practices

The quantity of ash (residues) generated by the facility should be documented, and the facility's weigh scale should be used to determine the mass of ash that is shipped from the facility to the disposal site.

For every 1000 kg of waste burned, approximately 300 kg of bottom ash is generated[18]. If the quantity of ash exceeds this amount, the material should be examined to determine whether the increased mass is due to the presence of non-combustible materials, or because there is a high quantity of unburnt carbon in the ash. If the latter situation is the case, operation of the incinerator should be adjusted to enhance the oxidation of carbon.

Representative samples of the bottom ash should be collected and forwarded to a laboratory for leachate toxicity testing. The International Ash Working Group provides guidance on sampling and analysis of ash[19]. At least 10 samples of ash are required to adequately characterise the material, and as a precaution it is recommended that testing on each sample be completed in triplicate. The results of the tests should be forwarded to the appropriate regulatory agency.

[18] International Ash Working Group, 1997. Municipal Solid Waste Incinerator Residues. Published by Elsevier, ISBN 0-444-82563-0.

[19] Ibid

3.6 Step 6: Maintain Records and Report

To demonstrate appropriate operation and maintenance of the incinerator, the facility should maintain records and prepare an annual report containing at least the following information:

- A list of all staff who have been trained to operate the incinerator; type of training conducted and by whom; dates of the training; dates of any refresher courses;
- All preventative maintenance activities undertaken on the equipment;
- Records of operation of the incinerator - in electronic format with full data backup;
- Summarized annual auxiliary fuel usage;
- A list of all shipments of incinerator residues, including the weight transported and disposed of by type if necessary, and the location of the disposal site;
- Results of any emissions measurements or any ash sampling data collected during the period.

All raw data records from the operation of the incinerator should be retained for inspection by the appropriate authorities for the period designated by those authorities, or for at least 2 years. The owner should work with the incinerator manufacturer or supplier and the regulators to determine the appropriate level of summary data that should be sent to the regulatory body (e.g. federal, provincial/territorial). The reports should be approved by the facility's senior management before submission.

Recording:

One of the most important records that should be available for review by the regulators is the maintenance log. This should record routine maintenance activities, date completed, by whom, and any problems encountered. This routine maintenance should correspond to the preventative maintenance recommendations provided by the manufacturer. A record should be kept of any upsets or equipment failures that necessitated special maintenance activities. The data for special maintenance activities should include the description of the issue being addressed, the date the work was completed, and who was responsible for that work. Most importantly, the operators/maintenance personnel should analyse the cause of the failure and ascertain if there are operating procedures that can avoid a repeat of the failure.

Continuous monitoring (once per minute) of incinerator operation should be recorded regardless of whether or not the incinerator is in use. To prevent any uncertainty about the waste disposal data, the information on the quantity of waste incinerated should be cross referenced by date and start time to the incinerator operating data. While some might question the usefulness of collecting operating data when the incinerator is not operating, a complete record for all 8760 hours of the year will validate the production data.

Reporting:

Licenses issued to waste disposal operators in all parts of Canada require some degree of reporting on operations to the appropriate authorities. There is some basic information that should be included in any report:

- **Quantity of Waste Incinerated:** Since the CWS for PCDD/F and Mercury both set limits

on the amount of waste that can be burned before different levels of proof of compliance are required, the basic measurement for every incinerator site must be the quantity of waste charged to the incinerator during the year. Because the incinerator is limited to a fixed quantity of waste on every charge, each load should be recorded separately, and the quantities totaled for the year, and preferably weekly and monthly. Such data will also assist the owner in determining waste generation rates at the facility, and in turn, provide data on the effectiveness of diversion and reduction programs.

- **Operating Data:** Operating data that is important are temperatures, carbon monoxyde, and oxygen levels, along with other data such as differential pressures and auxiliary burner operating times. If the auxiliary burners are of fixed output, it would be satisfactory to record the signal controlling its operation. If the input is variable, motor amperage from the pump would provide some indication of the rate of fuel use. Raw one minute monitoring data should be preserved in electronic format for analysis.
- **Ash shipment weights:** The report should include ash shipment weights and the name of the operator for any particular load along with notes on observations or problems experienced with the load.
- **Auxiliary fuel receipt data:** Auxiliary oil receipt data should be recorded in the log book and receipts for the shipments should be kept for verification by regulators.
- **Training:** The report should contain records of the training received by the staff, who conducted the training and when.
- **Changes in Operation:** Any major changes to the operation should be noted in the annual report, as should the results of any testing undertaken on the stack emissions or ash.

It is important to note that waste any incinerators incinerating: $\geq$ 26 tonnes of non-hazardous solid waste per year, $\geq$ 26 tonnes of biomedical or hospital waste per year, hazardous waste, or sewage sludge must report emissions of PCDDF, hexachlorobenzene, and mercury under the National Pollution Release Inventory (NPRI). For more information, please see www.ec.gc.ca/inrp-npri/.

APPENDIX H

ENVIRONMENT CANADA TECHNICAL DOCUMENT FOR BATCH WASTE INCINERATION

APPENDIX I
KBL ENVIRONMENTAL LTD - LETTER OF CONFIRMATION FOR NTCP WASTE TRANSPORT AND DISPOSAL

KBL Environmental LTD.

#17 Cameron Road
P.O. Box 1108
Yellowknife, NT X1A 2N8

P 867.873.5263
F 867.669.5555
kblenvironmental.com

Northwest Territories Power Corporation
Yellowknife, NT

Re: NTPC Waste Management

KBL is a northern owned and operated waste management company that specializes in the management of Industrial wastes, both Hazardous Waste and Non-regulated in nature. KBL is an approved receiver through the GNWT – ENR (# NTR000123) and we operate a 4,000 sq ft. Industrial Waste Transfer Station in the Kamlake Industrial Park in Yellowknife, NT.

KBL has been handling the Waste Management for the Northwest Territories Power Corporation (NTCP) for several years. As part of our ongoing Services, we have trained Technicians that attend the Power Corp sites and identify, label, transport and dispose of waste from their remote locations. After the waste is disposed of according to federal and territorial regulations, KBL provides a 'Certificate of Disposal' (COD)

If you require any further information, please don't hesitate to get back to me

Kind Regards

John Oldfield
President
KBL Environmental Ltd.

APPENDIX J

SNARE HYDROELECTRIC FACILITY WINTER ROADS

1 INTRODUCTION

The Northwest Territories Power Corporation (NTPC) has prepared this appendix to the Snare Hydroelectric Facilities Waste Management Plan (WMP) for all the Winter Roads (WRs) located at the Snare Hydroelectric Facility, including the Snare Winter Road (WR), Strutt Lake WR, Big Spruce Lake WR, and the 5B Bridge route. The WRs at Snare Hydro facility are required to support upgrades and maintenance activities. The Snare WR is tentatively scheduled for construction and operation for three to five seasons, beginning in January 2022. Strutt Lake WR, Big Spruce Lake WR, and the 5B Bridge route will be constructed on an as-needed basis.

This appendix outlines the waste management procedures and guidelines for contractors and companies operating on the WRs and complements and complements the waste management procedures, guidelines, and information provided in the WMP. For the purposes of waste management contingency planning and the scope of this appendix, Snare WR comprises of marshalling/laydown areas at Snare Forks and at the Wekweeti junction.

The WR corridors includes the WRs plus any pullouts, turnaround areas, rest areas, parking areas and other support areas that are constructed and maintained as part of the Snare Hydroelectric Facility WR system.

This appendix demonstrates that NTPC has appropriate measures in place to effectively manage waste on the Snare WRs. This appendix documents NTPC's local and regional waste management capabilities, presenting information specific to the Snare Hydro Facility's WRs. This appendix is not a standalone document and it must be read in conjunction with the Facility WMP. Copies of the WMP with this appendix should be provided to all third-party contractors and suppliers operating on the WRs so that their personnel (e.g. equipment operators and drivers) are familiar with its contents and understand their responsibilities with respect to managing waste on the WRs.

1.1 PURPOSE

The purpose of this appendix is to expand the scope of the Facility WMP to include information on the safe and environmentally sound transportation, storage, and handling of the waste, sewage, and hazardous products used and generated on the Snare Hydroelectric Facility WR's.

1.2 SCOPE

This appendix applies to the solid waste, sewage, and hazardous materials generated and transported during construction and operation of the Snare Hydroelectric Facility WRs, to ensure they will be handled and transported in compliance with all applicable Federal and Territorial regulations.

1.3 GENERAL RESPONSIBILITIES

Same as described in Section 1.7 of the WMP with the following additions.

1.3.1 NTPC Employees

- Comply with all NTPC policies and procedures when performing duties on the WRs, including not disposing of waste on the WRs.

1.3.2 Plant Operator

- Responsible for dispatching vehicles travelling on the WR's from the Facility to Yellowknife.

1.3.3 Winter Road Manager

- Responsible for dispatching vehicles travelling on the WR's Yellowknife to the Facility (ensure only one diesel-containing vehicle travelling on the WR per day).
- Ensure that any vehicles transporting hazardous materials arrive loaded at the marshalling area near the start point of the WR.
- Organize inspections of vehicles leaving Yellowknife and carrying waste or hazardous material (i.e. diesel) and ensure that appropriate records are maintained.
- Ensure all construction employees, contractors and sub-contractors adhere to the requirements of the WMP, including not disposing of waste on the WRs.
- Ensure that all received hazardous materials/wastes are transported on the WRs according to the requirements of the WMP.

1.3.4 Director, Health, Safety, and Environment

- In coordination with the Plant Operator, prepare and submit any formal reports to regulators and NTPC management regarding the management of hazardous materials on the WRs.

1.3.5 Third Party Contractors And Suppliers

- Ensure that contractors and carriers working on the WRs adhere to the requirements of the WMP. This includes not disposing of waste on the WRs, and proper handling and spill prevention for hazardous materials (i.e. diesel) being transported on the WRs.

2 ADDITIONAL PLANS AND RESOURCES

This appendix is to be used in conjunction with the following references:

- Snare Hydroelectric Facilities Waste Management Plan

- Snare Hydroelectric Facility Spill Contingency Plan
- Snare Winter Road Spill Contingency Plan
- Snare Hydroelectric Facility Operations and Maintenance and Reclamation Plan

3 PROJECT DETAILS

NTPC annually constructs the historical Snare Winter Road (WR) from Snare Forks to the Wekweètì Winter Road, NT linking the facility to Yellowknife via NWT Highway #3, allowing access for resupply fuel, oversized equipment, and freight to be delivered to site. The Snare WR follows the same historical alignment of previous years, so relatively little brushing is required. The road does not cross any water courses and is 12.5km of portage winter road. The start point of the WR is a temporary laydown/marshalling area located at the southwest corner of Snare Forks, and the end point is a temporary laydown area located at the Wekweètì winter road junction. The temporary laydown at the Wekweètì winter road junction will be expanded to allow more space for staging of equipment and the potential for a temporary camp and/or fuel to be installed if required.

Three additional winter roads which have been used intermittently throughout the operation of the facility as required and will be included in the scope of the LUP include:

- Strutt Lake WR (8.1 km) connecting to three borrow locations on the east side of Strutt Lake. This winter road is currently authorized under Land Use Permit W2019Q0003, which expires on December 18, 2024 and is constructed when crushing is completed at Strutt Lake Pits every 4-8 years.
- The Big Spruce Lake WR 1 (17.8 km) connecting Snare rapids to the Side Dams, and Snare 5B Spillway. This route is entirely on Big Spruce Lake and is constructed every 10-20 years when major maintenance work is required at 5B or Side Dams. There is also a Big Spruce Lake WR 2 route that connects the side dams on Big Spruce Lake to the Snare site road using a couple portages and local inland lakes. The Big Spruce Lake WR 2 route would be used if ice conditions on Big Spruce Lake were not sufficient for WR construction.
- The 5B Bridge route (1.1 km) allowing for continued movement of equipment over the winter months if the 5B bridge every had any issues which impeded travel over the bridge in winter months. This is a contingency route only and would only be used in emergency situations.

The overland portion of the proposed WRs will follow previously constructed WR alignments (Strutt Lake WR, Snare WR), with an average width of the portages (overland) right-of-way of 8 to 10 metres (m). Widening of the existing portages is not expected, and only minimal brushing of the portages will be required for the Snare WR and the Strutt Lake WR. If ice and/or environmental conditions are not sufficient on the existing alignments minor changes may be required to ensure the safety of the route.

No soil stripping, removal of overburden, or draining of waterbodies/wetlands is expected during WR construction. However, small amounts of vegetation present on the portages and surface of the borrow sources will be removed. Vegetation clearing will be minimized to danger tree removal only. These activities will occur during winter months only. Any bushes or trees that are cleared will be moved to the edge of the WR corridor and left to naturally decompose.

Operation of the WRs will include use of the road for routine maintenance of the hydro facilities, and for transportation of materials and fuel for the planned upcoming construction activities.

For the Snare WR the road may be used for personnel transportation until the end of March or until the road is closed due to weather. The Snare winter roads are presented in Figure 1.

Figure 1: Snare Hydroelectric Facility Winter Roads Map

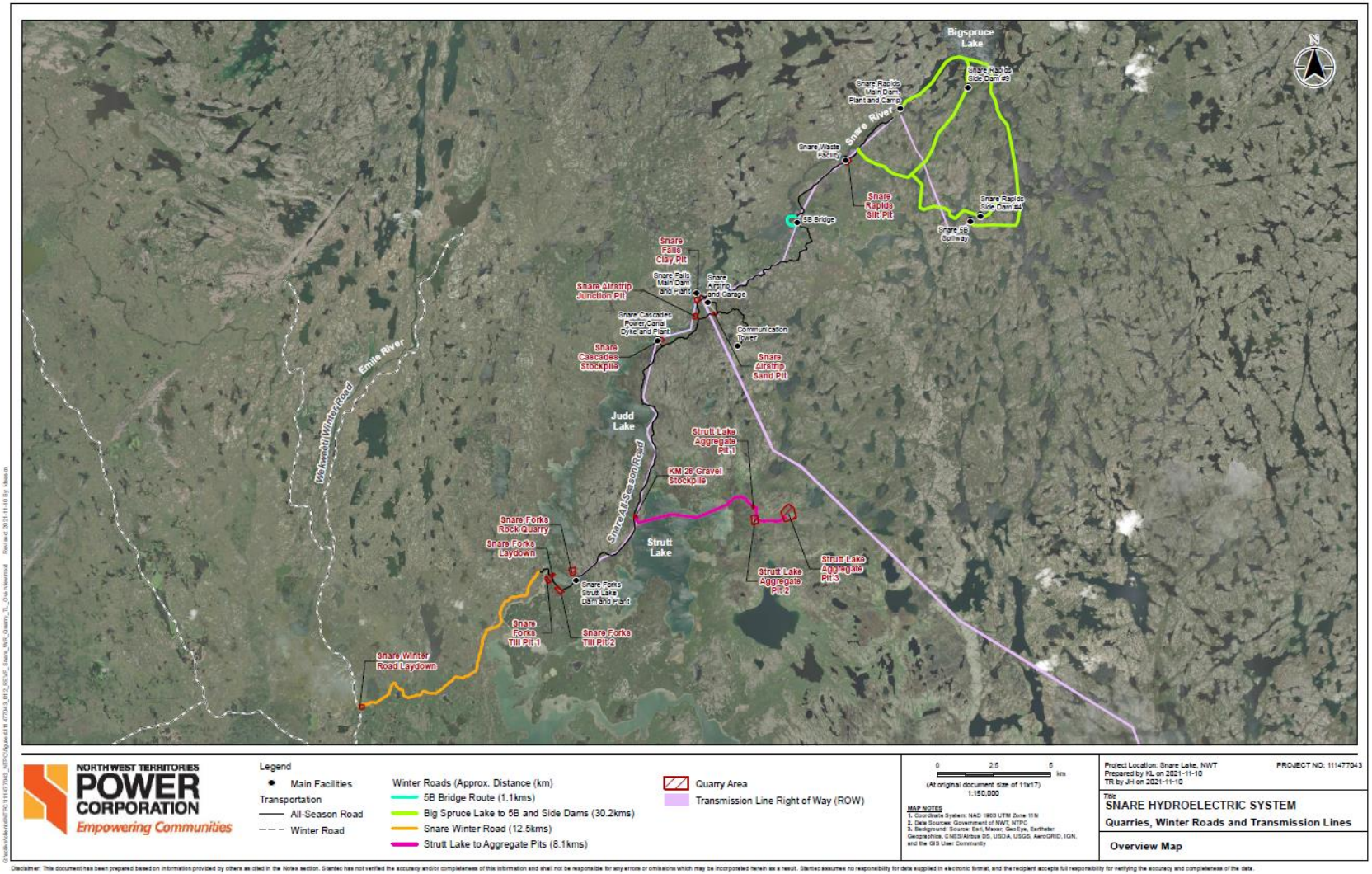
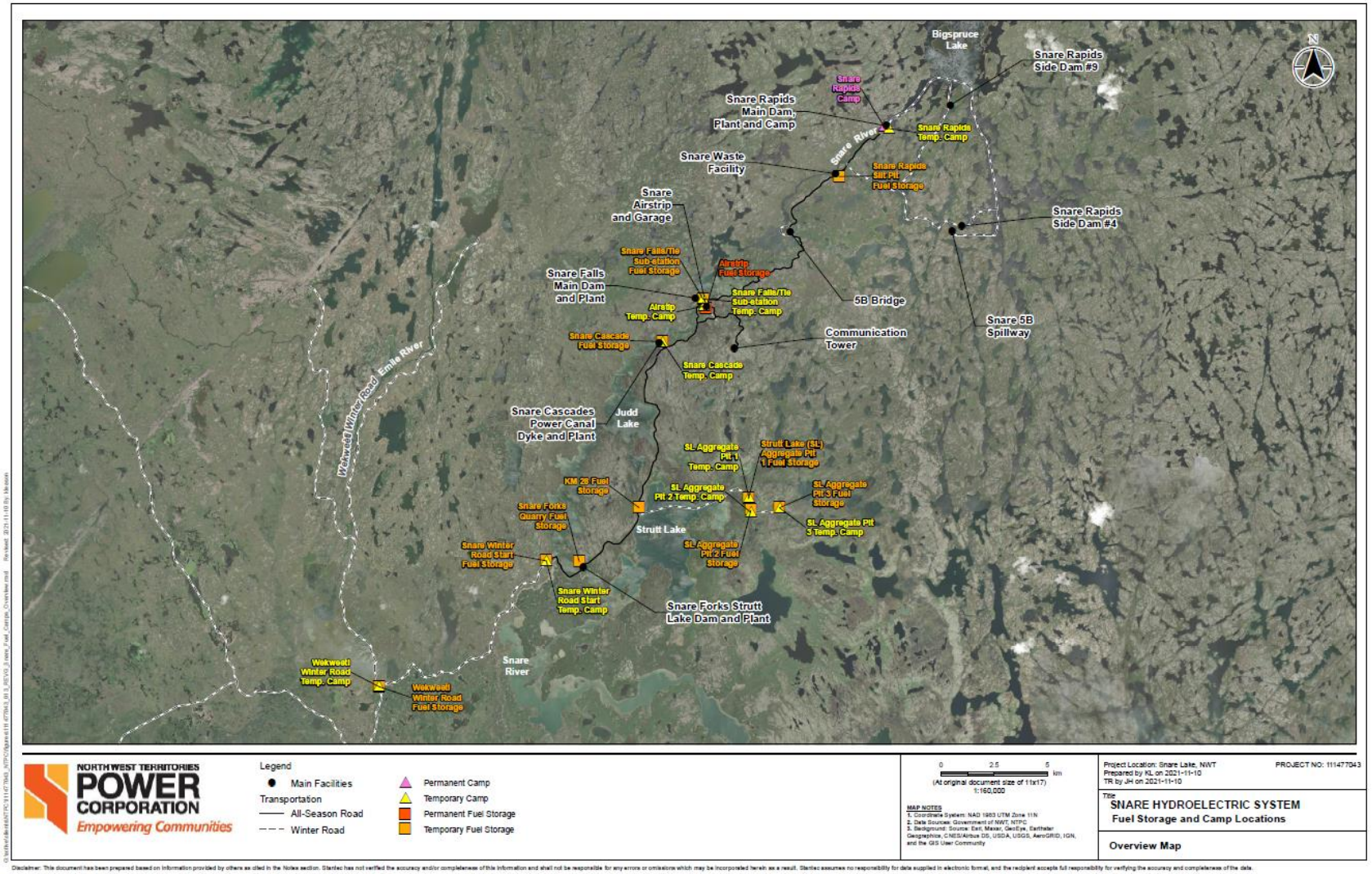


Figure 2: Snare Hydroelectric Facility Fuel Storage and Camp Locations



3.1 WASTES AND HAZARDOUS MATERIALS

3.1.1 Waste

There will be temporary facilities constructed (washrooms, fuel storage, and accommodations) at the start and end of the Snare Hydro WR to GWNT North Slave System. Domestic waste will be stored until it can be removed from the site for disposal; KBL Environmental Ltd. (KBL) will be collecting, transporting and disposing of non-incinerated domestic waste. All non-hazardous solid waste that is generated at the temporary facilities will be transported to the Snare Rapids Camp for incineration. Sewage from the temporary camps will be discharged into temporary sewage pit. The general locations of the proposed camps are shown on Figure 2.

All management plans and standard procedures for the existing facility and permanent camp would also apply to the overflow camps.

Any brush or trees removed from any WR corridors prior to or during WR construction will be moved to the edge of the WR corridor and left to naturally decompose. Small quantities of fuels (Jet A or gasoline), oils, lubricants, and hydraulic fluids may be shipped to support construction activities at the Snare Hydroelectric Facilities.

Any contaminated soil encountered onsite will be packed and sealed in salvage drums and backhauled to Yellowknife for disposal with a registered hazardous waste material company.

Sand/gravel used for traction control on portage on/off ramps will be scraped off and left on a flat area on each portage a minimum of 10 m above the high-water mark at the end of each WR season, so that it is not washed into the lakes and streams during the spring freshet and create sedimentation issues. A relatively small amount of sand/gravel will be used over the WR seasons. It is estimated that less than 1 m^3 of sand/gravel will deposited on each portage on/off ramp each season. The sand/gravel deposited on the portage will be left there when the WR is closed and abandoned.

Refuse generated during construction and operation of the WRs by contractors and material carriers will not be left on the WRs and will be disposed of offsite.

3.1.2 Hazardous Materials

Temporary fuel storage locations will be implemented at the start of the Snare WR at the temporary camp located at Snare Forks, at the winter road temporary camp located at Wekweeti if required. The permanent fuel storage for the site is located at the airstrip.

The only hazardous material being shipped in large quantities to the Facility on the WR is bulk diesel. Any vehicles transporting hazardous materials will arrive loaded at the marshalling area near the start point of the WR. All fuel offloading (bulk or drums) will occur at the Facility. Any spills caused by third party contractors and suppliers prior to arrival at the WR marshalling area are the responsibility of the third party and are outside of the scope of this appendix.

NTPC's Hazardous Waste Management Plan (HWMP) presents detailed information with respect to the management of hazardous wastes at all NTPC facilities, including the Snare Hydroelectric Facility. The reader is directed to the HWMP for specific information relating to the management of hazardous wastes.

4 INSPECTION AND RECORDS

In addition to the inspection procedures detailed in Section 3, inspections of diesel carriers on the WR's will be conducted. The Project Manager, Engineering will be responsible for organizing inspections of vehicles leaving Yellowknife and carrying waste or hazardous material (i.e. diesel), to ensure that proper containment is in place.

All inspections will be logged with the date and time of inspection, vehicle inspected, and the name of the person conducting the inspection.

5 TRAINING PROGRAM

As outlined in the NTPC's Health and Safety Management System, all employees and contractors working on the Snare Hydroelectric Facility WR's are required to have the following training:

- Workplace Hazardous Materials Information System (WHMIS);
- Orientation, including emergency and spill response procedures (see also the Spill Contingency Plan and Emergency Response Plan); and
- Operations overview.

Both employees and contractors must complete the NTPC Site Orientation upon entering the Facility for the first time and prior to conducting work. The NTPC Plant Operator provides the site orientation, which provides an overview of this WMP. All contractors are required to have basic first aid and WHMIS training before being allowed to work at the Facility. All Facility employees and supervisors are also required to have WHMIS and first aid training.

An up-to-date training matrix is kept by the NTPC Training Coordinator and contains records of all environmental, health and safety training completed by employees. Third-party contractors and suppliers are required to maintain records of all WR-related HSE training completed by their personnel. On request by the NTPC Training Coordinator, third-party contractors and suppliers must provide proof of the WR-related HSE training and/or qualifications of any personnel that will work or travel on the Snare Hydroelectric Facility WRs.

APPENDIX K

SNARE WASTE DISPOSAL STANDARD OPERATING PROCEDURE

NORTHWEST TERRITORIES POWER CORPORATION
Empowering Communities

November, 2017

Snare Waste Disposal Standard Operating Procedure

In accordance with ENR and water licence requirements the procedure for the disposal of waste at the Snare Facility has been updated. The disposal site has been subdivided into seven segregated areas based on the type of material being discarded. The layout of the disposal area is presented in Figure 1. The seven categories of waste are:

1. **Untreated Lumber, Brush and Cardboard (burn pile)**
2. **Plastics and Rubber**
3. **Concrete, Bricks, Ceramics**
4. **Pressure Treated Lumber**
5. **Old Boilers and Appliances**
6. **Scrap Metal**
7. **General- Waste that does not fall into another category**

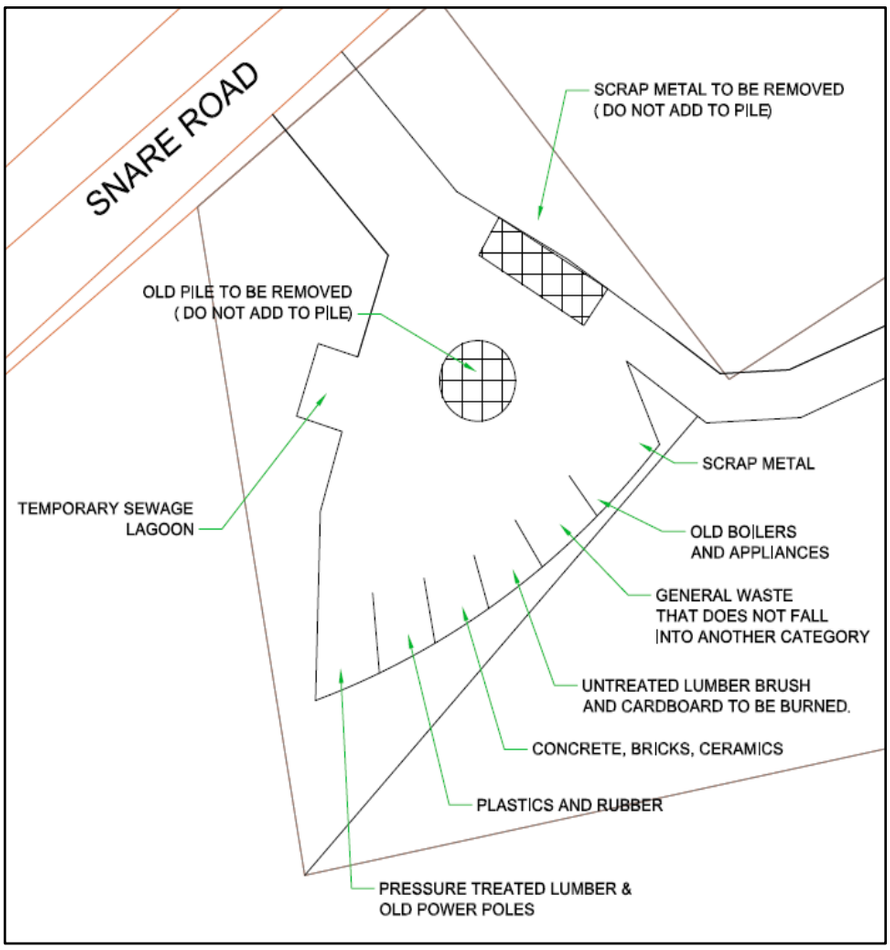


Figure 1- Layout of the Snare Disposal Site

- All waste going into the disposal site needs to be sorted as per this procedure and posted signage
  - **Do not** put all waste into the General location; this is only for waste that does not fall into another category
- All hazardous materials must be disposed of as per the Snare Hydro Hazardous Waste Management Plan and not enter the disposal site
- Specialized Material must be disposed of as per specific departmental procedures and not enter the disposal site
- **The burn pile is burned regularly and only the burn pile is burned**
  - This should be done when no forest fire risk is present (winter months are ideal)

Figure 2- Photo of the Snare Disposal Site

Waste Segregation Rules at Snare Hydro

1. Materials approved for open-burning at the Snare Hydro dump:
    - Untreated wood
    - Scrap lumber
    - Waste cardboard and paper products
    - Organics (e.g., vegetation)

2. Non-hazardous materials to be stockpiled at the Snare Hydro dump to be sent out for disposal on the winter road:
    - Scrap metal
    - Plastics
    - Rubber materials (e.g., tires)
    - Glass
    - Inert materials such as concrete, bricks, ceramics, etc.
    - Electronics
    - For all other non-hazardous materials not listed above either consult the Snare Hydro Waste Management Plan or contact Josh Clark (867-874-5248)

3. All hazardous materials must be disposed of as per the Snare Hydro Hazardous Waste Management Plan or contact Josh Clark (867-874-5248) for proper disposal procedures. These materials included, but are not limited to:
    - Hazardous liquids (petroleum hydrocarbons, glycol, solvents, sewage, etc.)
    - Mercury containing materials/wastes (fluorescent lamps, thermometers, thermostats, etc.)
    - Materials containing heavy metals (treated wood, lead paint, etc.)
    - Asbestos waste
    - Radioactive materials (smoke detectors)
    - Potentially explosive materials (propane tanks, pressurized vessels, etc.)
    - Batteries
    - Fluorescent light bulbs
    - Oily rags and absorbents