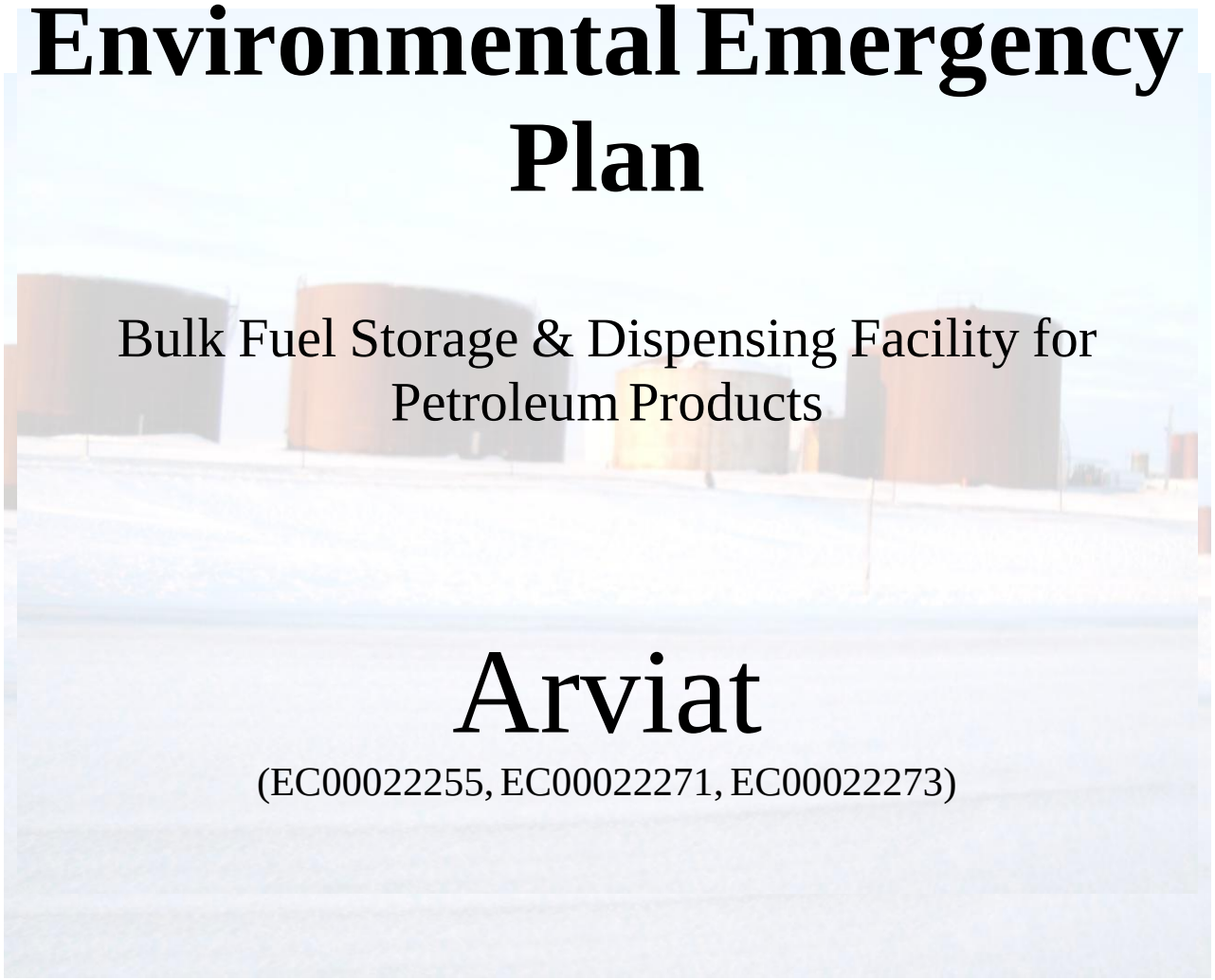
Environmental Emergency Plan



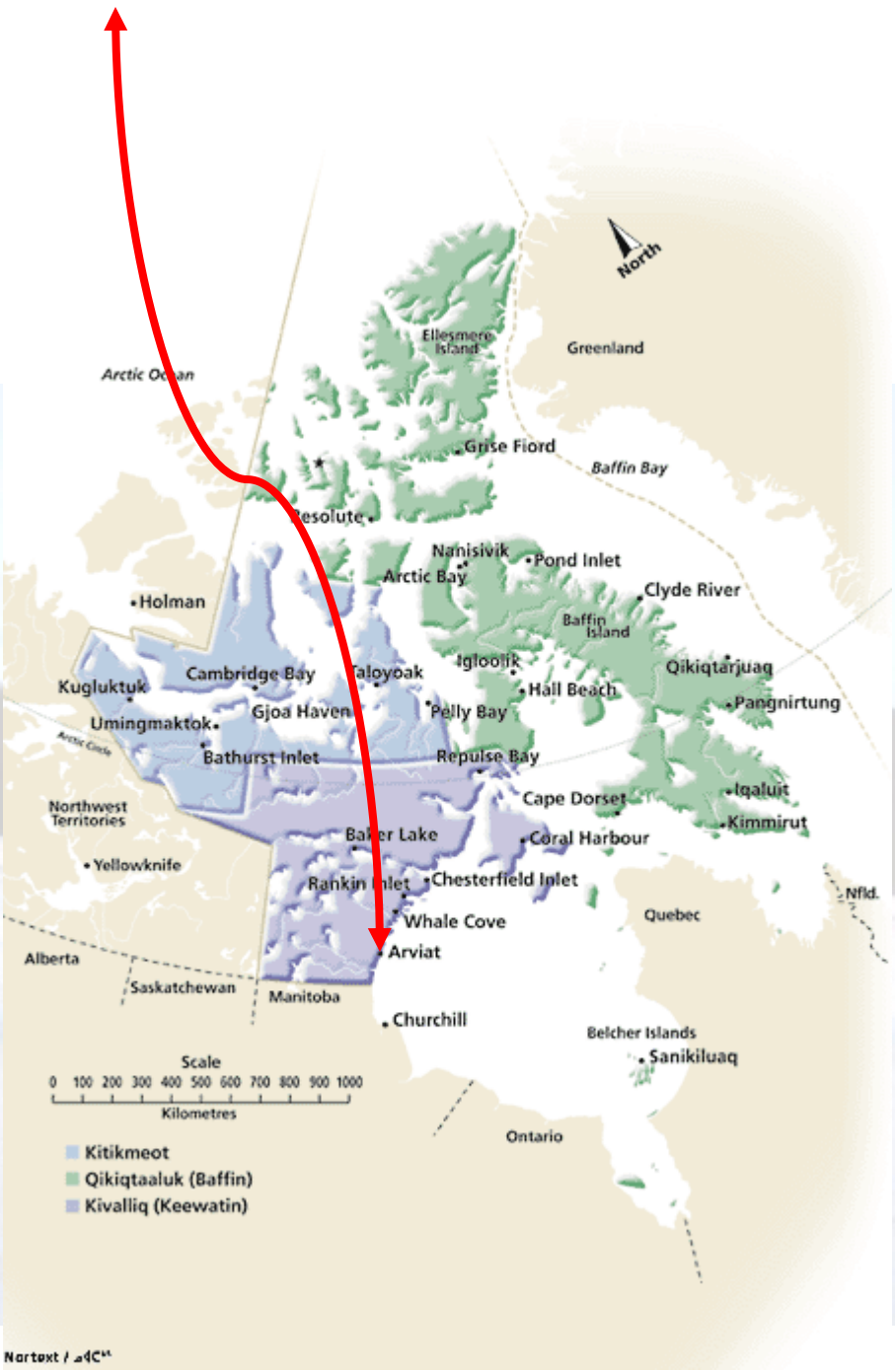
Bulk Fuel Storage & Dispensing Facility for Petroleum Products

Arviat

(EC00022255, EC00022271, EC00022273)

Petroleum Products Division Rankin Inlet
Department of Community & Government Services
Government of Nunavut

Arviat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Greenland
Arctic Ocean
Grise Fiord
Baffin Bay
Resolute
Nanisivik
Pond Inlet
Arctic Bay
Clyde River
Holman
Baffin Island
Igloolik
Qikiqtarjuaq
Cambridge Bay
Taloyoak
Hall Beach
Kugluktuk
Gjoa Haven
Pelly Bay
Pangnirtung
Umingmaktok
Arctic Circle
Bathurst Inlet
Repulse Bay
Cape Dorset
Iqaluit
Northwest Territories
Baker Lake
Coral Harbour
Kimmirut
Yellowknife
Rankin Inlet
Chesterfield Inlet
Nfld.
Whale Cove
Quebec
Alberta
Arviat
Saskatchewan
Manitoba
Churchill
Belcher Islands
Sanikiluaq
Scale
0 100 200 300 400 500 600 700 800 900 1000
Kilometres
Ontario
Kitikmeot
Qikiqtaaluk (Baffin)
Kivalliq (Keewatin)

Table of Contents

Plan Development – Background 8
Effective Date of Emergency Plan 10
Control Page 11
Distribution of Emergency Plan 12
Emergency Contact Information 13

Chapter: 1 Introduction 16
Brief History 17

Chapter: 2 Community and Fuel Storage Facility 20
2.1 Arviat 21
2.2 Tank Farm, Hamlet and Airport 21
2.3 Tank Farm 22
    2.3.1 Facility Description 23
2.4 Historical Fuel Sales 24
2.5 Hamlet 25
2.6 Airport 26
2.7 Climate: 26
    2.7.1 Frozen Season 26
    2.7.2 Unfrozen Season 26

Chapter: 3 Emergency Management Team Roles and Responsibilities 27
3.1 Emergency Management Team 28
3.2 Emergency Response Team 30
    3.2.1 Initial Team Response 31
3.3 Roles and Responsibilities 32
3.4 Resource Mobilization 32
3.5 Resource Coordination 33

Chapter: 4 Emergency Response 35
4.1 Emergency Response 36
4.2 Risk Assessment 38
4.3 Emergency Reporting Protocol 38
    4.3.1 Reporting to Environment Canada 38
    4.3.2 Reporting to 24 hour Spill Line 39
    4.3.3 Reporting to Transport Canada 41
    4.3.4 Reporting to Environment Protection Nunavut 41
    4.3.5 Notification to Community Stakeholders 41
    4.3.6 Reporting to PPD 42
    4.3.7 Reporting to Canadian Coast Guard 42
4.4 Response Strategy 43
    4.4.1 Tactical Priorities 43

4.4.2 Assessment and Notification 44
4.4.3 Remediation Measures to fuel leak 44
4.4.4 Spill Containment Effects 44
4.4.5 Strategic Partners for Clean-up Operation 45
4.4.6 Controlling a Fire at the Tank Farm 47
4.4.7 Substantial Loss of Fuel 47
4.5 Tank Farm Fire Hazard Analysis 48
4.6 Marine Safety 49
4.6.1Operational Spill Prevention 49
4.6.2 Pipeline Leakage 50
4.6.3Tank Overflow 50
4.6.4 Hull Leakage 51
4.6.5 Spills caused by Equipment in Machinery Spaces 51
4.6.6 Ship Grounded/Stranded 52

Chapter: 5 Health and Safety 53
5.1 Site Control 54
5.2 Protection to the Community 55
5.3 Decontamination 55

Chapter: 6 Training 56
6.1 Regular Training 57
6.2 Responder Training 57
6.3 Training for Casual Employees 58
6.3.1 Short Notice Employees/Volunteers 58
6.4 Response Training for Short Notice Employees/Volunteers 58
6.5 Training Exercise 58
6.6 Tabletop Exercise/In Class Exercise 58
6.7 Operational Exercise 59
6.8 Basic Health and Safety Training Course 59

Chapter: 7 Communication 61
7.1 Communication during Emergency 62
7.1.1 Communication with PPD Staff 62
7.1.2 Communication with other Contractors 63
7.1.3 Emergency Communication and the Media 63
7.1.4 The Role of the Spokesperson 63

Chapter: 8 Insurance and Legal 65
8.1 Insurance 66
8.2 Legal 66

Chapter: 9 Prevention of Emergency and Emergency Preparedness 67
9.1 Brief 68

9.2 Incident Prevention Strategy 70
9.2.1 Tank Cleaning and Fire Incidents 70
9.2.2 Precautions while Tank Cleaning 71
9.3 Provision of Tank Overfill Protection 72
9.4 Secondary Containment 74
9.4.1 Buried Fuel Delivery Pipes 74
9.5 Truck to Tank Fuel Transfer Procedures 75
9.6 Proper Inventory Reconciliation 76
9.7 Record Keeping 76
9.7.1 Preventative Maintenance 77
9.7.2 Ongoing Leak Detection and Monitoring 77
9.7.3 Tank Farm Design and Spill Containment 79
9.8 Preparedness to Combat Emergencies 79
9.8.1 Spill Response Supplies 80
9.8.2 Heavy Equipment 81
9.8.3 Spill Response Team Readiness 81
9.8.4 Fire Extinguishers 81
9.8.5 Provision of Corrosion Preventative Mechanisms 82
9.8.6 Warning and Safety Signage 82
9.8.7 Securing the Valves and Joints 83
9.8.8 Arrangements for Marine Resupply 83
9.8.9 Product Transfer Area 83

Chapter 10 Fuel Hazards and Potential Emergency Scenarios 84
10.1 Natural Hazards 85
10.2 Toxic Nature of Fuel 87
10.3 Fuel Related Emergencies 88
10.3.1 Persistent Fuel Leak 89
10.3.2 Fire or Explosion on the Tank Farm 90
10.3.3 Fuel Spill 91
10.3.4 Effect on Aquatic Life 91
10.3.5 Ground Water Contamination 91
10.3.6 Soil Contamination 92
10.4 Sabotage and Vandalism 92
10.5 Fuel truck Flipping 93
10.6 Fuel Quantity Related Emergencies 93
10.7 Marine Fuel Resupply Goes Wrong 93
10.8 Type of Vessel Unloaded at the Resolute Bay OHF 94
10.8.1 Tides and Currents 94
10.8.2 Environmental Sensitivities 94
10.8.3 Maximum Most Probable Case Scenarios 94
10.8.4 Staff for Monitoring 95
10.8.5 Notification of Incident Commander 95

10.8.6 Initial Response Actions of Shore and Ship Operations 95
10.8.7 Containment Strategies of Shore and Ship Operations 95
10.8.8 Resource Personnel 95
10.8.9 Resource Availability and Resource Procurement 96

Chapter: 11 Remediation Techniques 97
11.1 Remediation Techniques 98
11.2 Land Containment 99
11.2.1 Trenches 99
11.2.2 Berms 100
11.2.3 Marsh and Tundra 100
11.2.4 Dams 101
11.2.5 Weirs 101
11.2.6 Water Containment 101
11.2.7 Barriers-Snow fence and Sorbent Barriers 102
11.2.8 Barriers and Sorbent 102
11.2.9 Booms 102
11.2.10 Containment under Ice 103
11.2.11 Angled Ice Slot 104
11.2.12 Weather affects Response Activities 104
11.2.13 Larger Scale Water Containment 105
11.2.14 Barrel Containment 105
11.3 Recovery 105
11.3.1 Direct Suction Equipment and Techniques 105
11.3.2 Manual and Mechanical Recovery 106
11.3.3 Bio-Sparging 106
11.3.4 Bio-ventilation 106
11.3.5 Sorbent Material 107
11.3.5.1 Sorbent Capacity 108
11.3.6 Underground Wells 109
11.3.6.1 Monitoring Well Location 110
11.3.6.2 Sampling Quality Assurance and Quality Control 111
11.4 Storage of Contaminated Material 111
11.4.1 Vehicle Storage 112
11.4.2 Open-topped Tanks 112
11.4.3 Drums and Barrels 112
11.5 Disposal of Contaminated Material 112
11.5.1 Salvage and Recycle 113
11.5.2 Fuel Burning 113
11.6 Final Clean-up and Restoration 113
11.6.1 Replacement of Soil 113
11.6.2 Land Based Response 114
11.6.2.1 Scope and Purpose of Plan 114

11.6.2.2 Background 114
11.6.2.3 Preparation 114

Chapter: 12 Recovery and Land Reclamation 115
12.1 Introduction 116
12.2 Post Emergency Response Review 117
12.3 Maintenance of Damaged Equipment 117
12.4 Environmental Site Assessment 117
12.5 Soil Remediation 118
12.5.1 Remediation Criteria for Petroleum Hydro Carbons 120

Chapter: 13 Characteristics of Petroleum Products Stored and Dispensed 122
13.1 Diesel Fuel 123
13.1.1 Physical Properties 123
13.1.2 Chemistry of USLD 124
13.1.3 Diesel Related Environmental Concerns 125
13.2 Gasoline 126
13.2.1 Toxic Ingredients of Gasoline 127
13.2.2 Combustible and Physical Properties of Gasoline 127
13.2.3 Gasoline Storage 129
13.2.4 Energy Value of Gasoline 130
13.2.5 Safety and Environmental Issues Related to Gasoline 130

Chapter: 14 Material Safety Data Sheets 132
14.1 Diesel 133
14.2 Gasoline 140
14.3 Naphtha 147

Plan Development ----- Background

Developing an emergency plan helps owners/operators anticipate and take steps to prevent the most likely accidents. It also allows for a quick and efficient response if an accident does occur. A quick response limits damage and reduces clean-up costs. We must assess the potential emergencies for our system that could result in harm to the environment or human health, and then create a plan to prepare for, prevent, respond to and recover from each emergency scenario. An emergency plan that is adapted to a particular system and surroundings, while at the same time meeting the requirements in the regulations, is considered the right document.

The Petroleum Products Division (PPD) of the Government of Nunavut is responsible for the purchase, transportation and storage of fuel in a well-organized and environmentally friendly manner. PPD is constrained to abide by all regulations and pieces of legislations governing fuel related activities. Traditionally PPD maintained an Oil Pollution Prevention Plan (OPEP), which was originally created in 2001, as the Environmental Emergency Plan (E2P) was prepared on a voluntary basis. In 2010, PPD prepared its Emergency Plan under the guidance of the GN Emergency Preparedness document. This plan was generic in nature and copies were provided to fuel delivery contractors and other community stakeholders including Hamlet. However, now that the E2P is a requirement from Environment Canada, PPD maintains both an E2P and an OPEP document.

PPD decided to use the already existing generic plan to comply with sections 199 and 200 of the Canadian Environmental Protection Act 1999, part 8, as per Environment Canada. However, upon later examination of the plan in 2013 by EC representatives, the plan was found to be neither site specific nor covering the broad range of emergencies. Therefore PPD received an Oder of Compliance to revise the plan.

PPD has now revised the document and made it site specific in order to comply with the *Storage Tank Systems for Storage of Petroleum Products and Allied Petroleum Products Regulations and Environmental Emergencies Regulations*. At the community, level fuel delivery contractors represent PPD and are trained to implement emergency plan when need arises. However, PPD as an owner of the facility has the responsibility to update the plan, ensure its implementation and arrange the necessary training for the personnel to carry out the plan. This plan will be updated and tested annually.

The Environmental Emergency Plan has been prepared by PPD's Manager of Technical & Environmental Services with the information gathered from PPD's operations and local fuel delivery contractor of Arviat. The content selection and format of the document have been developed under the directions laid out in the;

- *Storage Tanks Systems for Petroleum Products and Allied Petroleum Products Regulations*,
- Tank Tips fact sheets,
- *Environmental Code of Practice for Aboveground Storage tanks*,
- *Canadian Environmental Protection Act 1999*,
- Guidelines for E2 Planning,
- CEPA Registry, and
- Nunavut Guideline for Contaminated Site Remediation.

The contribution of Maria Kasaluak, Environmental Services Specialist is also acknowledged.

Kaitlin Heron
A/Manager Technical & Environmental Services Petroleum Products Division- Rankin Inlet, Nunavut

Effective Date of Emergency Plan

This ***OIL POLLUTION EMERGENCY PLAN*** is effective from:

DD	MM	YY
16	10	2015

This plan will remain IN EFFECT until advised otherwise by the DIRECTOR, PETROLEUM PRODUCTS DIVISION of COMMUNITY AND GOVERNMENT SERVICES.

This plan applies to the OIL HANDLING FACILTY (OHF) and the AIRPORT OIL HANDLING FACILITY if an airport facility is maintained by the PETROLEUM PRODUCTS DIVISION.

Additional copies of this plan may be obtained by writing to:

MANAGER
OPERATIONS
PETROLEUM PRODUCTS DIVISION
P.O. BOX 590
RANKIN INLET, NUNAVUT
XOC OGO

This plan will be updated annually, to take into account changes in law, in environmental factors and in facility characteristics and policy: and after every oil pollution incident and exercise.

Control Page

On Receipt of Revisions or Updates, the plan holder will complete this section to ensure that the plan is always current.

Revision Number	Date Inserted	Description/Purpose	Signature
1	Aug.24/2015	Amendment: Env.Services Specialist	Kaitlin Heron
2	Oct.16/2015	Draft Revision	Kaitlin Heron
3	Sept.13/2017	Contact names	Maria Kasaluak

Distribution of Oil Pollution Emergency Plan

MANAGER
Operations
Petroleum Products Division
Rankin Inlet, NU

HEAD OF OPERATIONS
Petroleum Products Division
Region: Kivalliq
Rankin Inlet, NU

CANADIAN COAST GUARD

ENVIRONMENTAL PROTECTION SERVICES REGIONAL OFFICE
Region: Kivalliq
Arviat, NU

DIRECTOR, COMMUNITY AND GOVERNMENT SERVICES
Region: Kivalliq
Rankin Inlet, NU

FACILITIES MANAGER, COMMUNITY AND GOVERNMENT SERVICES
Region: Kivalliq
Rankin Inlet, NU

MAYOR
Arviat, NU

FIRE CHIEF
Arviat, NU

RCMP DETACHMENT
Arviat, NU

CONSERVATION OFFICER
Arviat, NU

PETROLUEM PRODUCTS DIVISION FUEL CONTRACTOR
Arviat, NU

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Fax Number: (867) 873-6924

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ENVIRONMENTAL PROTECTION SERVICES

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Business Fax Number: (867) 857-2936

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HAMLET OFFICE
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Fax Number: (867) 857-2519

SENIOR ADMINISTRATIVE OFFICER (FIRST CONTACT)
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Telephone Number: (867) 857-2841

MAYOR (SECOND CONTACT)
Name: Bob Leonard
Telephone Number: (867) 857-2841

FIRE
Emergency Telephone Number: (867) 857-2525

AMBULANCE
Emergency Telephone Number: (867) 857-2525

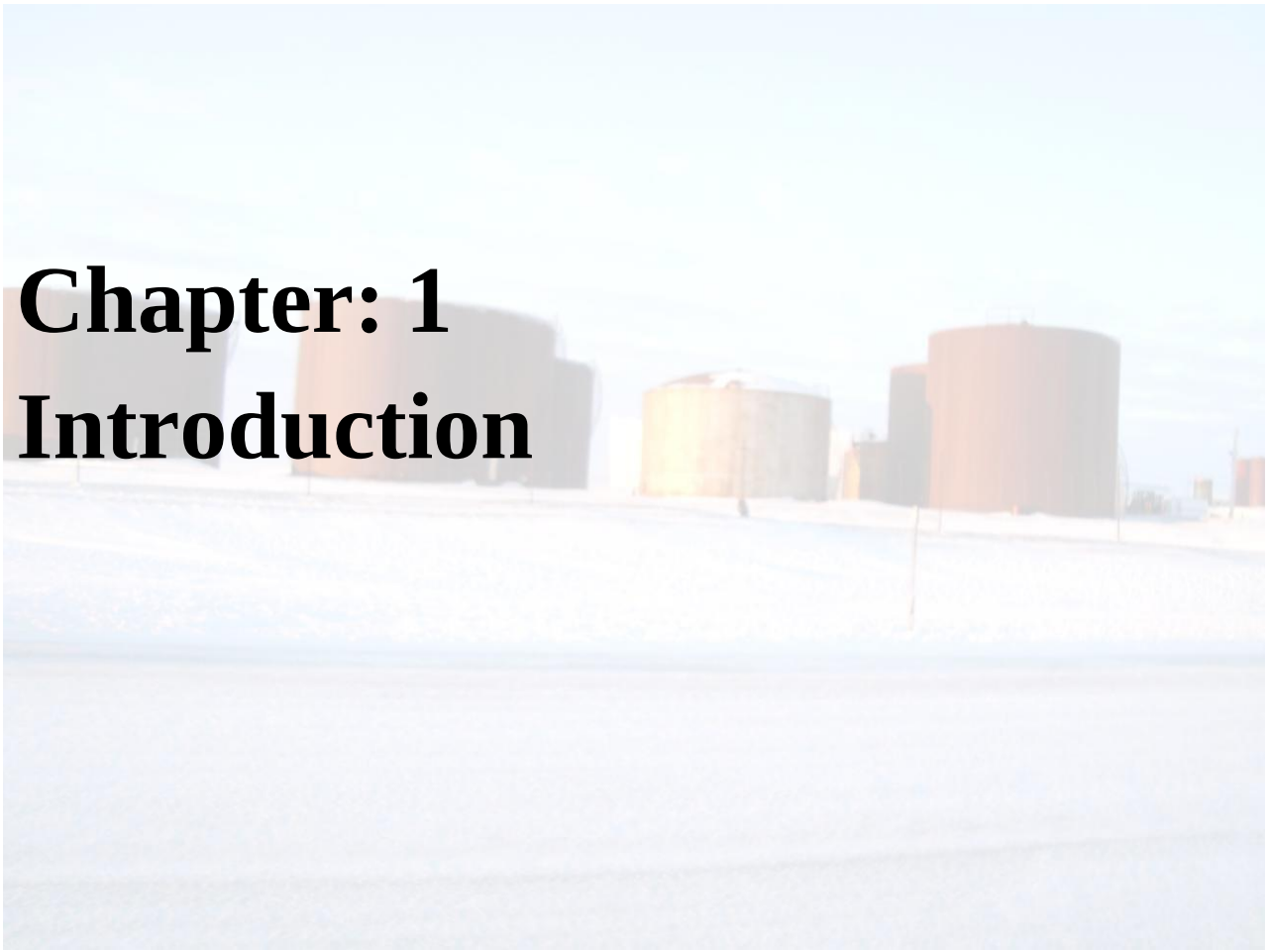
RCMP
Emergency Telephone Number: (867) 857-1111

COMMUNITY AND GOVERNMENT SERVICES
Emergency Telephone Number: (867) 857-2860

GOVERNMENT OF CANADA EMERGENCY PHONE NUMBERS

CANADIAN COAST GUARD (CCG)
Operations Centre (Spills)
105 South Christina
Sarnia, Ontario
Spills Reporting 1-800-265-0237

NORDREG
TRANSPORT CANADA
Chief, CANUTEC, Regulatory Affairs
Transport Dangerous Goods
Ottawa, Ontario
K1A 0N5
Information (613) 992-4624
Emergencies (613) 996-6666



Chapter: 1
Introduction

Brief History

The Petroleum Products Division (PPD) of the Government of Nunavut (GN) owns the fuel storage facilities and related infrastructure in twenty-seven communities of the territory. Mainly three petroleum products, i.e. diesel, gasoline and jet fuel, are purchased, stored and dispensed in bulk quantities. Considering the similar types of emergencies that are associated with transporting, storing and dispensing of these three products, a single emergency response plan has been prepared for the community that covers a full range of emergency situations.

"Emergencies" as defined by Environment Canada, are "situations or impending situation caused by the forces of nature, accidents or intentional acts that constitute a danger of some proportions to life and property and/or damage the natural environment, land, water and air." These emergencies can have the potential to affect people's physical and emotional health, harm property and interfere with normal business operations, as well as affect the economic and environmental well-being of people.

The PPD Emergency Response Plan is intended to provide direction to the PPD's fuel delivery contractor on the procedures to follow in the event that an emergency or disaster occurs that has the potential to affect all or a significant portion of the PPD's operations in the community of Arviat. The Local PPD fuel delivery contractor shares the responsibility with PPD to guarantee the safe and smooth operation of fuel distribution including the protection of all field staff and the environment. However, there are extraordinary situations which can occur that are outside of the realm of PPD's capabilities. In this instance, all community stakeholders are to be actively involved in order to respond to such situations.

The PPD Emergency Response Plan is intended to guide the PPD's response in regards to everything from a minor incident through to a facility-wide disaster originating from fuel storage and distribution operation. A large portion of the E2P is intended to function as an umbrella plan for all locations. However, each site is provided with site specific direction meeting the needs of each facility and community.

For PPD's organizational and operational requirements, the plan aims to reduce the potential risks and addresses the following elements:

- The properties and characteristics of the three petroleum products stored at the facility in bulk quantities,
- The maximum expected quantities of these products at the tank farm at any time during a calendar year,

- The characteristics of the place where these products are stored and of the surrounding area that may increase the risk of harm to the environment or of danger to human life and health,
- The potential consequences of an environmental emergency on the environment and on human life and health,
  The identification of any environmental emergencies that can reasonably be expected to occur at the place and that would likely cause harm to the:
    - environment or constitute a danger to human life or health, and identification of the harm or danger
- A description of the measures to be used to prepare, prevent, respond to and recover from the emergency situation,
- A list of the individuals, identified by name and position, which are to carry into effect the plan in the event of an emergency and description of their roles and responsibilities, and
- Identification of the training required for each of those individuals.

Research shows that an emergency response plan gives responders an enhanced ability to react to an event with a substantial reduction in property damage and casualties. The PPD Emergency Plan will build upon existing structures and routine activities of the organization; it will also require PPD and local fuel delivery contractor to assume responsibilities that were never before realized fully. New functions must be performed and existing relationships must integrate with those that emerge to manage the event. A variety of emergency response roles and functions are described in this plan and the situations in which they are recommended.

The Emergency Management Team, comprising of PPD staff, has undertaken the responsibility to oversee the plan's development under the leadership and direction of the Manager of Technical and Environmental Services. For the plan to serve its purpose the contents must be known and understood by those responsible for its implementation. Staff of fuel delivery contractor needs to be trained and adequately prepared to execute the plan when emergency situation arises.

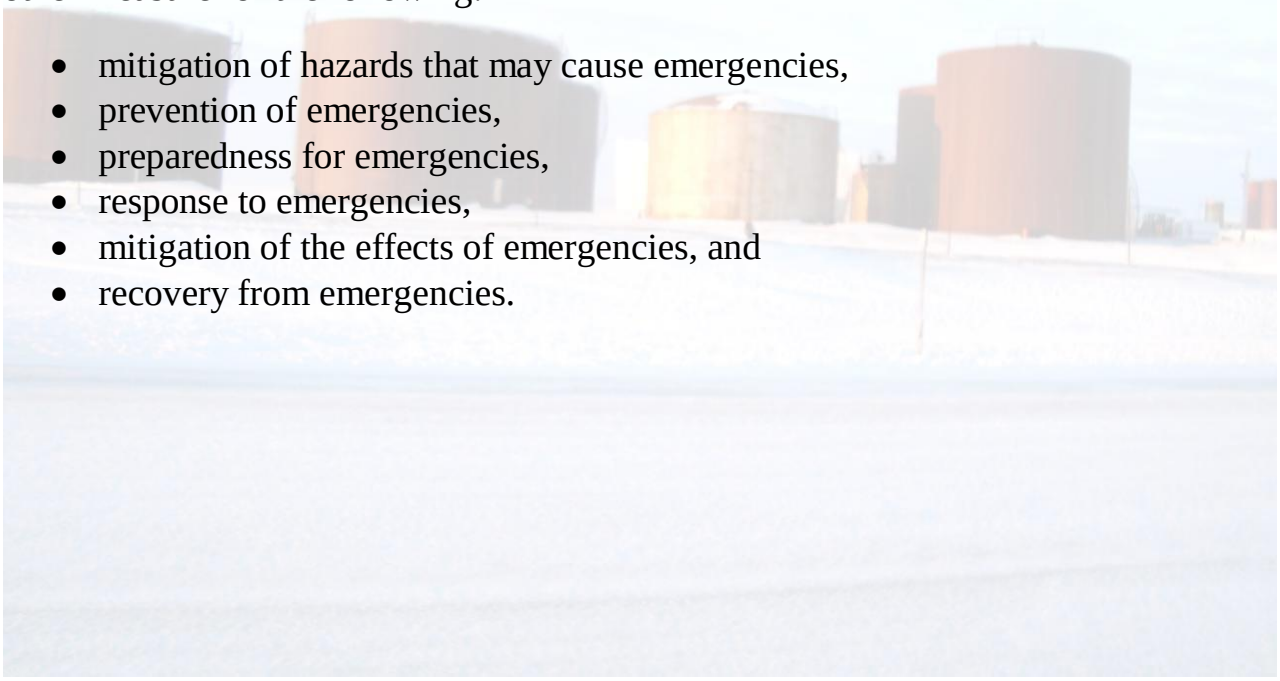
The PPD's Emergency Plan has several objectives. A large focus of the plan is outlining the role and responsibilities of field staff and administration on how to manage and prevent the emergency. The plan also addresses the wide issues to ensure that PPD and its contractor are equipped and fully prepare to respond. The PPD Emergency Response Plan is designed to assist the staff in being proactive, coordinated, and effective during an emergency situation by helping to:

- ensure the safety of staff and general public,
- protect the public and private property,
- protect environment; air, water and land,
- lead to the resumption of normal operations as soon as possible,

- reduce the risk of oversights while operating under the stress of an emergency and the publicity it generates,
- facilitate action through a system-wide awareness of procedures and policies,
- clearly identify responsibilities and roles of staff members,
- minimize the negative impact of the emergency situation or emergency, and
- facilitate communications with all partners and thereby managing the emergency or emergency situation.

In cases of fire, the protocols set out in the fire safety plan shall apply. Circumstances may arise, however, where a fire affects critical PPD's operation and as a result, activation of the ERP may be necessary. This plan is also intended to apply to emergencies that are isolated and readily contained.

For example, a situation or an individual may create an emergency in a particular Hamlet, however these types of emergencies may not give rise to the activation of the ERP. "Emergency management program" means a program, plan, arrangement or other measure for the following:



- mitigation of hazards that may cause emergencies,
- prevention of emergencies,
- preparedness for emergencies,
- response to emergencies,
- mitigation of the effects of emergencies, and
- recovery from emergencies.

Chapter: 2
Community and Fuel Storage Facility

2.1 Arviat

The name Arviat comes from the Inuktitut language meaning “place of the bowhead whale”. Arviat is the southernmost community on the Nunavut mainland and is close to the geographical centre of Canada. In Arviat, Inuktitut and English are primarily spoken. Arviat has the highest population in the Kivalliq region with Rankin Inlet being a close second.

2.2 Tank Farm, Hamlet and Airport

In the Arviat community, the fuel storage facility and airport are close geographically. The Tank Farm Facility is located between the community and the airport. The distance between the airport and the community is less than a kilometre.

Any emergency situation at the tank farm is unlikely to affect the normal life in the community and regular activities at the airport directly. The biggest disruption this may cause is a shutdown of the road to the airport. However, an accident at the tank farm can halt the fuel dispensing and fuel distribution operation, which in turn can influence regular life activities in the community. Moreover, the release of any petroleum product can potentially contaminate the water of nearby Bay and evaporated fuel can pollute the atmosphere. The people of Arviat would have to pay the price of that contamination in terms of facing the adverse effects of polluted environment.

Figure 2.1: Geographical location of Arviat

Figure 2.2: Relative locations of Tank farm, community and airport

Figure 2.3: Tank farm within its neighbourhood

2.3 Tank Farm

The Tank Farm serves as the primary storage and distribution point for petroleum products in the community. All of petroleum products arrive at the Tank Farm by resupply pipe line once or twice a year during summer months. A piping system comprising of two pipes, one for each product and shore manifold has been provided for the refilling of the tanks with petroleum products. The pipeline system delivers products to the Tank Farm at a high flow rate so an operator stays on duty as long as filling continues. In the event of any major spill, including tank

overfilling or rupture of a pipe, orders must be given to shut down the resupply by the operator on duty. It takes several minutes to fully stop the incoming flow. Large quantities of these products, primarily flammable and combustible liquids, are stored at this location and distributed to the users by delivery vehicles. A complex system of piping interconnects the tanks with same products on the facility allowing products to be delivered or transferred without contaminating each other.

2.3.1 Facility Description

The facility consists of ten tanks, four vertical and six horizontal. Three of the vertical tanks are filled with Diesel and the fourth is filled with Gasoline. The six horizontal tanks are kept as reserve tanks and could be used in the event of an emergency. None of the six horizontal tanks are connected to a pipeline. The Pipeline that runs from the shoreline manifold to the tank farm is approximately 1,065 metres long.

There are also two other vertical tanks on this facility but they belong to Qulliq Power Corporation.

Arviat Tank Farm				
Product	**EC Identification #**	**Tank #**	**Tank Type**	**Capacity (L)**
Diesel	EC 00022255	Tank # 6	Vertical	631,253
		Tank # 11	Vertical	1,345,363
		Tank # 12	Vertical	2,551,313
		Total Diesel		**4,527,929**
Gasoline	EC 00022271	Tank # 10	Vertical	1,345,363
		Total Gasoline		**1,345,363**
Reserve	EC 00022273	Tank # 1	Horizontal	92,117
		Tank # 2	Horizontal	91,786
		Tank # 4	Horizontal	91,786
		Tank # 5	Horizontal	92,117
		Tank # 7	Horizontal	91,882
		Tank # 8	Horizontal	91,786
		Total Jet A-1		**551,474**

Table 2.1: Product-wise storage capacity

Figure 2.4: Systems identification with Environment Canada

2.4 Historical Fuel Sales

During the last ten years fuel demand has nearly doubled for Diesel. A for Gasoline, the increase is a lot slower, increasing by about 140,000 litres. Product wise annual sales for the last ten years are provided to demonstrate the trend in ever growing fuel demand in this community.

With Arviat having the largest population in the Kivalliq region, most of which are young, you can expect the demand for fuel to increase more as the youth begin buying their own vehicle and houses.

Historical fuel sales, Arviat		
Year	Volume in litres	
	Diesel Fuel	Gasoline
2011/12	4,091,033	960,466
2010/11	3,327,601	873,260
2009/10	3,177,527	863,916
2008/09	3,419,334	844,832
2007/08	3,170,993	776,132
2006/07	3,031,083	874,860
2005/06	2,873,172	883,487
2004/05	2,917,558	837,702
2003/04	2,726,790	841,439
2002/03	2,602,728	819,469
2001/02	2,549,014	822,168

Table 2.2: Historical fuel sales at Arviat

2.5 Hamlet

The population in Arviat is the highest in the Kivalliq region with Rankin Inlet a close second. The population is at approximately 2,350 people. Arviat has recently overpassed Rankin Inlet with its population, according to the latest census. Most of the modern life amenities are available in the community like school, health centre, RCMP detachment, drinking water supply, power supply, sewage system, high speed internet, cable TV etc. Electricity is generated by diesel and all houses and building are heated by diesel fuel as well. For all of its fuel needs the community depends upon petroleum products supplied by PPD fuel delivery contractor.

Any run short of fuel especially during winter months can jeopardize the community. Any fuel spill or fire at the fuel storage facility is unlikely to hurt the community directly but substantial loss of fuel or paralyzed fuel distribution operation can take a serious toll on routine life in the community.

2.6 Airport

The airport in Arviat has flights in and out daily. Most of the flights into Arviat come from either Winnipeg or Rankin Inlet. Most flights through Arviat are known as the "milk run" because the flights begin in Winnipeg then to Churchill then Arviat, then Whale Cove and then Rankin Inlet. This is the normal route on the way south as well. The airlines that fly into and out of Arviat are First Air and Calm Air. You are able fly south to Winnipeg or fly to Rankin Inlet and make connections into other southern Cities.

2.7 Climate

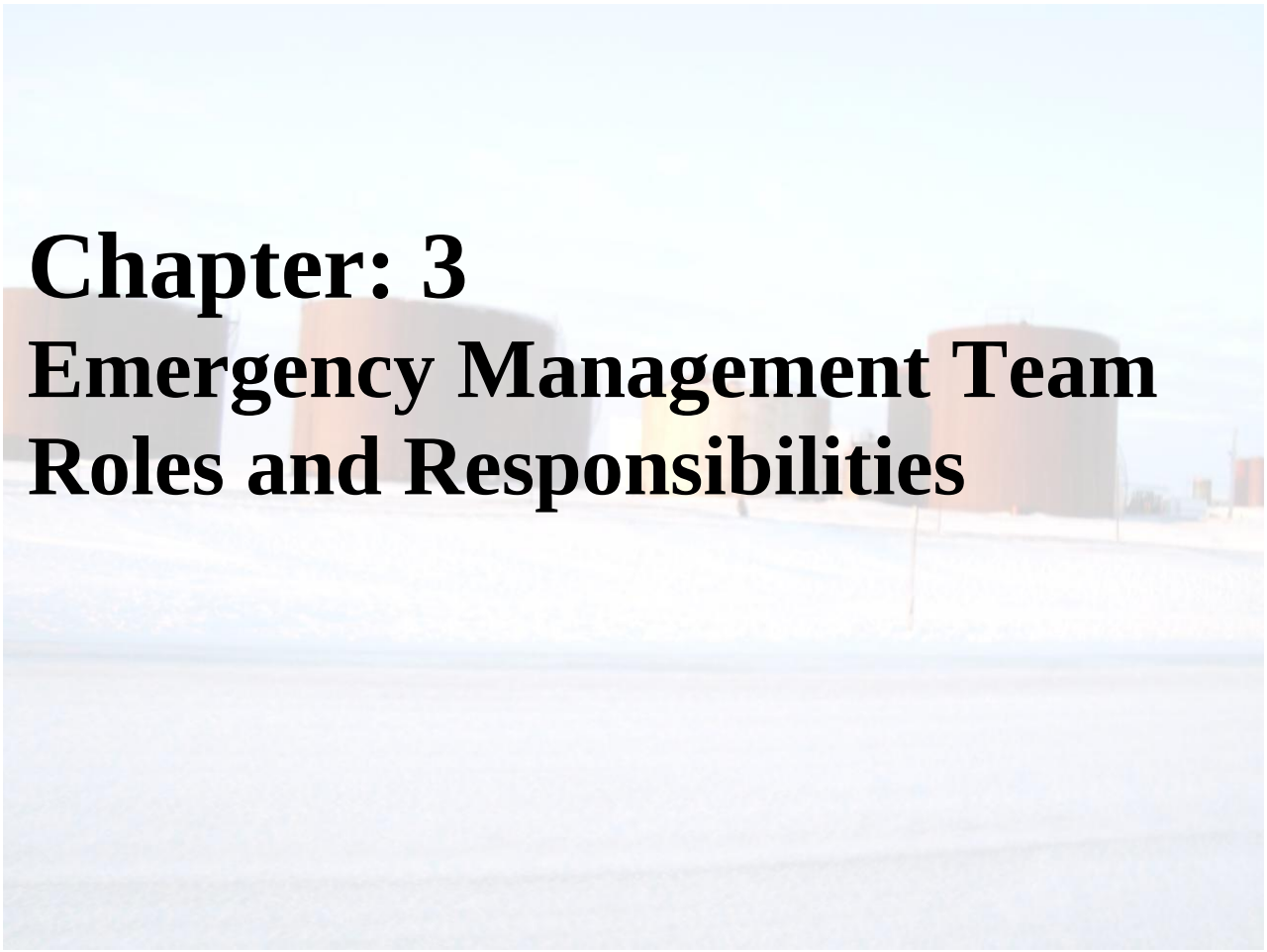
The knowledge and understanding of the local climate and weather pattern are instrumental to develop and execute at emergency plan so a short description about them has been made a part of that document. Arviat's average high for the year is −5.75 °C while the average low for the year is −13.2°C. Arviat has a very dry climate with an average precipitation of 20.75 mm a year, most of it falling as rain from June to September.

2.7.1 Frozen Season

The frozen season begins in Late October as new ice forms in coastal areas and skims over the surface of open water areas. The frozen season ends in late June to early July. Once the open water areas are ice covered, the abundant source of moisture for low cloud and fog is cut off. The snow routinely gives obscured ceilings by snow and restricted visibility. The frozen season is also the blowing snow and blizzard season.

2.7.2 Unfrozen Season

At Arviat, the months of June, July and August have mean daily maximum temperatures above zero degrees Celsius of these months only July has an above zero mean daily minimum. During the unfrozen season, low cloud and fog are the routine across ice-covered waterways and open water areas. Onshore flows readily bring these conditions inland. During summer, Arviat is vulnerable to onshore flow that moves the cloud easily across low terrain.



Chapter: 3
Emergency Management Team Roles and Responsibilities

3.1 Emergency Management Team

As an owner of the fuel storage facility at Arviat, PPD is accountable to the GN as well as to Federal regulatory agencies if unable to handle fuel related emergencies and environment protection. Developing Environmental Emergency Plans and keeping them up to date is the sole responsibility of PPD. PPD doesn't physically exist in most of the communities but whole territory is under its jurisdiction for managing the emergencies related to fuel storing, transferring and distribution. It is a great undertaking to ensure that things are managed properly at community level. In the case of mismanaging the emergency, PPD would be liable to penalty.

PPD's fuel delivery contractors serve as the PPD's eyes and ears in all communities. PPD has established an internal team, an Emergency Management Team, to work with fuel delivery contractors' emergency teams, the Emergency Response Team, to effectively respond to environmental emergencies. PPD's emergency management & emergency response teams are a professional emergency response force with a full complement of spill response supplies, a complete inventory of firefighting and related equipment, and an efficient staff trained for emergency response.

These teams are equipped, positioned, and trained to respond in a timely and effective manner to unpleasant occurrences. PPD intends to enhance the capabilities of the emergency teams through regular instruction, onsite drills, the ongoing development of the Baseline Needs Assessment and periodic evaluations to the requirements of NFCC and other applicable standards related to emergency response. Based on the above, all fire protection programs and related engineering and administrative safeguards, the identified spill/fire hazards and associated risk are acceptable. Four of the most important PPD's staff members constitute the Emergency Management Team, each with a unique set of duties. The names and positions along with their contact information and main duties have been summarized in the following table.

Emergency Management Team				
Name/Position	Address	Phone #	Email	Duties
Kaitlin Heron A/Manager Tech & Envir. Services	PPD HQ Rankin Inlet	867-645-8444	KHeron@gov.nu.ca	1. Receive information from fuel delivery contractor and report to environmental regulatory agencies 2.Arrange Environmental Site Assessment, ESA, of the affected area 3.Develop a long term remediation action plan 4. Attend the site if necessary
Bobby Makpah A/Manager Nunavut Field Operations	PPD HQ Rankin Inlet	867-645-8443	BMakpah@gov.nu.ca	1.Guide the fuel delivery contractor for containing and cleaning the leaked/spilled product 2. If fuel delivery contractor is not able to handle the cleaning process, arrange another contractor to help him 3. Work with contractor and inventory control specialist to estimate the lost product 4. Attend the site if necessary
Tony Dias PPD Regional Head Kivalliq	PPD Regional Office, Rankin Inlet	867-645-8430	TDias@gov.nu.ca	1.Under the supervision of Nunavut field operations, investigate the reason of incident 2. Send spill response supplies to fuel delivery contractor 3. Liaise between fuel delivery contractor and PPD HQ 4. Attend the site
Maria Kasaluak A/Envir. Services Specialist	PPD HQ Rankin Inlet	867-645-8421	MKasaluak1@gov.nu.ca	1.Maintain records of emergency incidents 2. Assist Manager Tech. & Envir. Services to revise Environmental Emergency Plan 3.Edit the information on fuel storage system with Environment Canada, if necessary after recovery from emergency situation

Table 3.1: Emergency Management Team

The Emergency Management Team exists to aid in the Emergency Response Plan implementation and to ensure on-going emergency preparedness at PPD. These individuals have a key role to play in providing either emergency guidance or support. They have also been a primary source of information by which the Plan was developed. Most staff from PPD's operation would likely comprise the Emergency Management Team should the plan be activated.

3.2 Emergency Response Team

In case of an emergency at the fuel storage facility, PPD's fuel delivery contractor will be the first one to respond to the incident. The fuel contractor must establish an Emergency Response Team. As discussed, an emergency could range from a small leak to a complete catastrophe.

If it is a small leak, the fuel delivery contractor with his team will try to identify the source of leak and disable it. At the same time he will inform the PPD regional office and PPD HQ to receive advice if he feels the situation is out of his control. He will fulfill all reporting requirements. If necessary and agreed with PPD HQ, he will stop the fuel distribution operation until next order. The contaminated area will be closed to the general public. PPD's fuel delivery contractor will also establish an incident command centre close to the storage facility to coordinate the response to the incident.

PPD's staff will help and guide fuel delivery contractor, but the contractor will have to take the lead on the ground. In the event of an on-site evacuation, all locations will establish an escape route and 1-2 evacuation sites. The evacuation sites will be identified on the facility. In the event that an evacuation off-site is required, all locations will be evacuated. The fuel delivery contractor has been advised to furnish a memorandum of understanding with other community stakeholders to ask for their help in case of emergency. Local labourers will be hired for the clean-up operations, if needed. The need would be identified by fuel delivery contractor, but PPD HQ's approval would be mandatory, if PPD is to pay the services.

Emergency Response Team		
Name/Position	Phone #	Duties
Team Leader	867-	1.Disable the spill/leak source and assess the product loss 2.Make the initial call to NWT spill line 3. If it is spill or leak, prepare standard spill report and fax it to 24 hour spill line 4. Assign duties to team members 5.Execute all facets of Environmental Emergency plan
Site Superintendent	867-	Respond as directed by the team leader
Heavy Equipment Operator	867-	Respond as directed by the team leader
Helper	867-	Respond as directed by the team leader
Helper	867-	Respond as directed by the team leader

Table 3.2: Emergency response team

3.2.1 Initial Team Response

The Emergency response team will assess the area for hazardous conditions such as fire, health and safety issues. Stop the source of the spill. The contractor could continue the normal operation only if the area is safe from hazardous conditions. The Response Team will check the area for any people and if they are injured, First Aid and CPR will be provided. Warn people in and around the Tank Farm Facility or the shore manifold of the danger and evacuate them. Move vehicles, only in case of fire and only if the conditions are safe. We can summarize the steps to be taken by Emergency Response Team while responding to a spill.

- Remove non-essential personnel from the scene.
- Restrict public access to the area.
- Put on PPE.
- Approach spill from upwind.
- Shut off all the valves causing fuel transfer.
- Absorbing pads and rolls are to be placed on the visible spill.
- Susceptible area will be flag barricaded in such a way that is visible to anyone entering the neighborhood.
- Intrinsically safe equipment will be used to do the cleanup.
- Eliminate all ignition sources.
- Fuel soaked pads and rolls will be placed in a drum.
- Contained liquid fuel will be dumped into a slop tank.
- If fuel contact with the skin occurs, remove contaminated cloths, dry wipe exposed skin and cleanse with waterless hand cleaner and follow by washing thoroughly with soap and water.
- If product is found under the skin, regardless of the wound size, immediately contact your doctor.

Once the immediate threat to public health and the environment has been mitigated, the incident is further stabilized and cleaned up under the supervision of PPD's managers. Fuel delivery contractor will dispose of recovered material classified as a "special waste" or "non-recoverable" according to the approved procedure.

Figure 3.3: Fuel absorbing pads

3.3 Roles and Responsibility

The local fuel delivery contractor will ensure the timely and appropriate implementation of the Environmental Emergency Plan. He will make the resources including personnel available to combat the emergency. Overall, supervision is the responsibility of the fuel delivery contractor. He has a joint responsibility with PPD to ensure all employees receive training on their roles and responsibilities during an emergency. He will ensure that all members of the emergency response team participate in emergency exercises and reviews. He will ensure that his employees have clear understanding of their roles and responsibilities during an emergency.

The PPD Emergency Response Plan will operate on the pre-determined procedures for command, control and coordination set out within this plan. Within it there will exist an immediate means of sharing information and advice between the Emergency Response Team, PPD and other response group leaders. This Centre would also be shared with external emergency response agency leaders as required.

3.4 Resource Mobilization

Most of the environmental emergencies require equipment and operators. It is not possible to dedicate a complete set of personnel and machinery to deal with an emergency situation and put them in a reserve forever. Mostly the same resources are engaged on routine work when the operation is running smoothly. Emergency events don't follow a schedule, resources will be required immediately. However, an emergency is an unexpected event therefore the intended resources may not be available right away. PPD's fuel delivery contractor might have already deployed them on regular work at that time. An initial assessment determines how much manpower and equipment would be enough to effectively respond to a particular emergency situation.

Figure 3.4: Spill Kits

Resource mobilization refers to the process of activating the Emergency Response Team fully equipped with required machinery as defined in action plan. This

could only be achieved by re-deployment of the resources. Situation Reports are gathered to further define the event and briefings with the Response Teams determine how best to deploy the available resources. For a successful resource mobilization some questions need to be answered such as:

- Have all members of Emergency Response Team been contacted?
- Has the Emergency Response Team been briefed for a coordinated response?
- Has an agenda and time frame for response activities been established?
- Have monitoring procedures been initiated to report on problems and progress?
- Are communication channels and equipment being provided adequate?
- Have response priorities been clarified and communicated to each team member?
- Is it necessary to activate the Emergency Operations Centre?
- Have External Emergency Response Agencies been notified on how to reach the Emergency Operations Centre?
- Have any time critical activities been identified and responded to?
- Have essential services been relocated from affected areas?
- Have roles and responsibilities been assigned for critical missing functions?

The fuel contractor, as a team lead for the response, has to re-deploy the resources to handle the emergency situation. Initially after assessing the scale of emergency, he can make a request to PPD for additional resources. Moreover, community stakeholders should also be asked for the help.

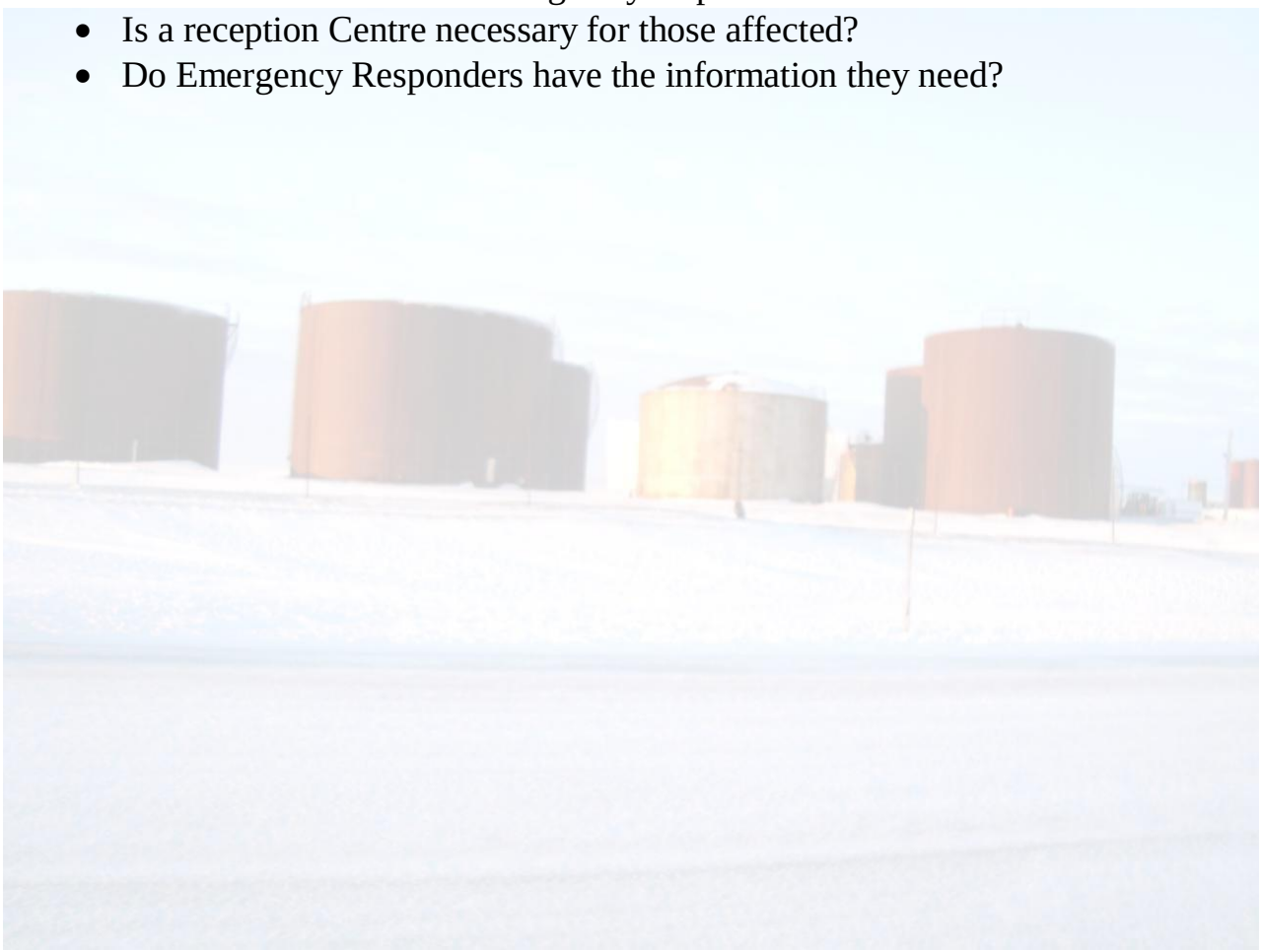
3.5 Resource Coordination

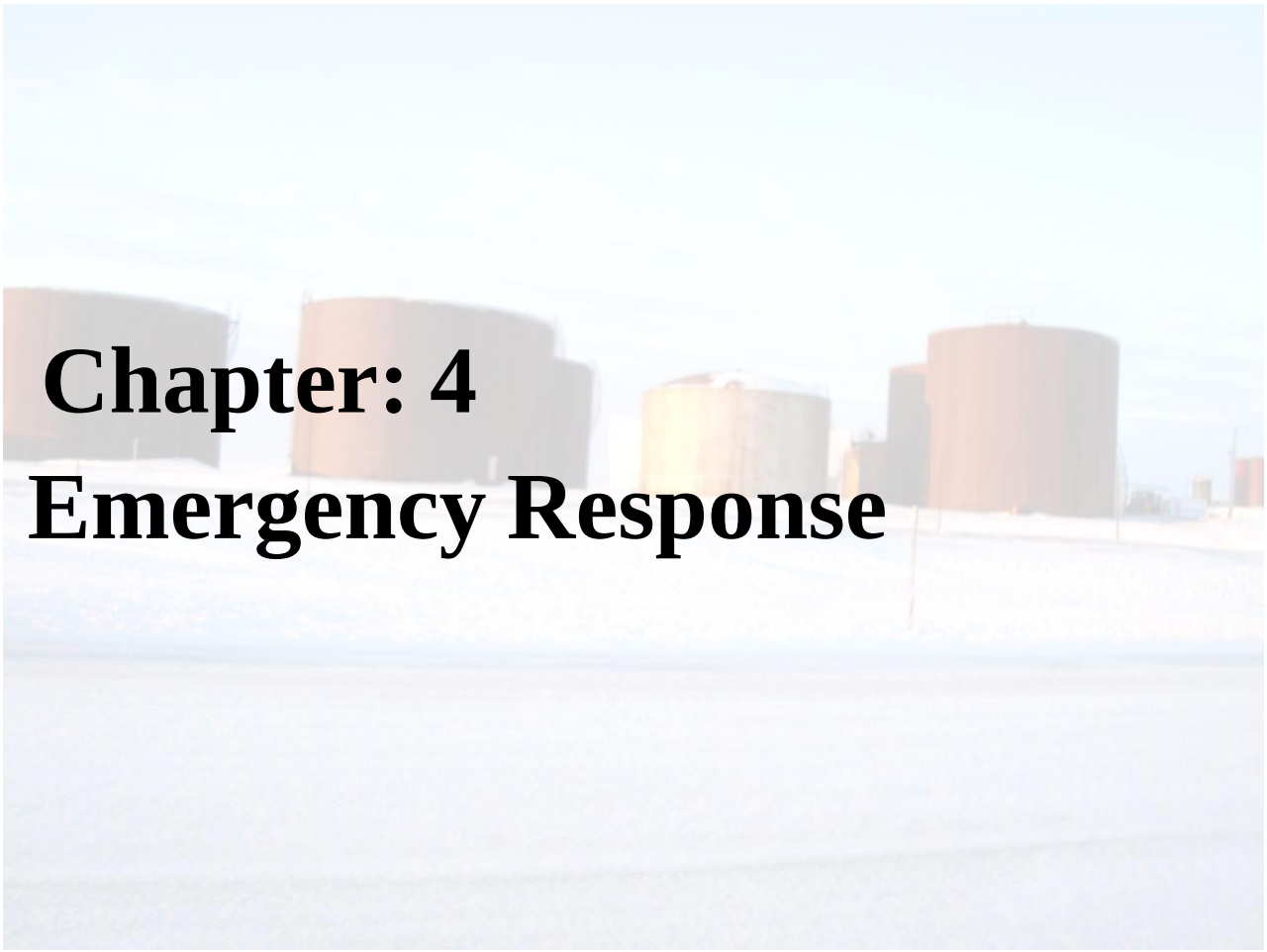
PPD HQ and the regional office will extend their cooperation, but it is sole responsibility of the contractor to coordinate resources on the ground. Resource coordination means to deploy resources to address the needs of the event.

It includes coordinating teams and communication networks for reporting and modifying the Response Team activities as required. Coordination begins once the necessary Emergency Management and Response Roles are filled and coordinating centers have been established. While dealing with the emergency the following questions regarding the resource coordination need to be answered:

- Is traffic or crowd control necessary?
- Have missing resources, equipment and supplies been identified?
- Is it necessary to salvage or protect critical PPD property or assets?
- Is a perimeter established around the event site?
- Is a casualty collection area and temporary morgue required?
- Is a staging area required to support the event site?

- Do the Response Teams have the necessary materials, staff and support?
- Have the necessary Response Team representatives been sent to the Site?
- Are emergency purchases required and the arrangements in place?
- Is an advisory system in place to update PPD staff and all others who could be affected?
- Has the public been informed of the event and its consequences?
- Is a media center or public inquiry service necessary?
- Are updated situation reports available to the Response Team?
- Have the necessary victim support services been summoned?
- Are victims of the event being fully responded to?
- Is a reception Centre necessary for those affected?
- Do Emergency Responders have the information they need?





Chapter: 4
Emergency Response

4.1 Emergency Response

Response to an environmental emergency includes many facets, such as maintaining communication systems between stakeholders, alerting and warning regulatees, evacuating the facility and accounting for personnel and public. The variety of responses can vary greatly in scope depending upon the nature and magnitude of the emergency. To exercise a quick and effective emergency response PPD does sound planning and pre-established partnership with other community groups. In fact effective response calls for cooperation between shipping companies, environmental regulatory agencies, communities, local organizations and government through affiliation formed before emergencies occur. PPD believes in strengthening these partnerships by regular and combined exercise of the environmental emergency plan with all of those involved. Communication from the facility to off-site agencies and between the responder is important and necessary for coordinated and successful response effort. Effective emergency response includes quick activation of the emergency plan, proper notification of the emergency to first responders and affected parties, rapid assessment of the probable path of impacts of an emergency, adequate resource mobilization and reporting activities. PPD's response is intended to include all aspects of managing and emergency situation until the emergency phase of the event is considered over.

As a part of emergency preparedness, PPD developed a list of emergency response equipment along with equipment locations and the identified measures to be taken to notify members of public who may be adversely affected by an environmental emergency. Under the directive of Environment Canada, PPD is intending to document a facility's five year accident history including all accidental fuel releases that have resulted in personnel injuries, facility evacuations, sheltering in place, property damage and environment damage. By developing a site specific emergency plan PPD expresses its senior level commitment to environmental emergency planning measures that is critical both at territorial level and the fuel storage facility at Arviat.

Under the recommendation of Environment Canada, PPD completed consultations with the community, other interest groups, and local and territorial authorities in the development and preparation of the plan. PPD also shared the implemented plan with these persons. Communication of risks to surrounding communities is an essential component of both prevention and preparedness activities. PPD's fuel delivery contractor has the responsibility to communicate the information on what the public should do in the event of an emergency and their ability to react appropriately is an essential component of preparedness. This kind of communication can help dispel undue fears over risk that may not be present and can also assure the community that risks that are present are under proper control.

However, PPD may hold onto some information whose widespread can cause disarray and chaos among the masses and may lead to security issues. PPD intends to arrange the drills and table top exercises to assess the applicability of emergency plans. These tests and exercises are a simulation of a possible emergency. Testing of the environmental emergency plan shows if the team can adequately deal with the scenario that is presented in the exercise. As a first step of exercise, PPD informs those affected that a test being planned. This will enable responders and participants to react in the proper manner through adequate pre-planning. Once the skills and knowledge have been demonstrated, the scenario can be tested with only the exercise design team knowledge in advance.

PPD ensures that the testing reflects a credible type of event for the fuel storage facility. PPD will design the exercise in such a way that it ensures the reinforcement of any previous training. PPD will do a post-exercise evaluation, document the lesson learned and identify the areas where further improvement is possible. The type of exercise chosen depends on its purpose, availability of resources and the limitations of conducting exercises that apply to the location of operations. Exercises can either be administrative or operational. Administrative exercises are usually held in a conference room environment and can be table top or synthetic. Synthetic exercises are pre-programmed exercises in which all participants use computers. Operation exercises include those where communication is tested and are major or full-blown exercises. A major exercise is similar in content to a table top exercise except that it is intended to provide a realistic simulation of an emergency response and all the required sources are actually deployed. The exercise design process is composed of following main steps:

- Devising a multi-year program; a full blown exercise may not be necessary every year, but should be conducted at least once as part of multi-year cycle
- Planning the annual exercise
- Holding the exercise
- Evaluating the outcome
- Reporting on the outcomes

PPD stores three petroleum products at the Arviat storage facility, however the emergency situations associated with all products are similar. Therefore PPD intends to undertake only one exercise. The insights gained through these exercises are invaluable for PPD and its fuel contractor should a real emergency ever occur. Responding to an actual incident is not usually a valid or appropriate test of the emergency plan. An actual incident may be considered a test of environmental emergency plan only if certain conditions are met.

For an actual incident to be recognized as a test, it must include the appropriate agencies, proper debriefing and evaluation, corrective actions and documentation as in a typical exercise. It would be detrimental to apply an untested plan as it may not

be adequate to handle emergency at hand. Testing or exercising enables critical aspects of the plan to be examined in a structural way, simulating conditions to reveal major mistakes and omissions that they can be subsequently corrected without disastrous consequences. PPD's environmental emergency plan will be tested annually and records will be maintained on what did and didn't work.

4.2 Risk Assessment

A wide range of emergency situations are possible on fuel tank farm. In the event of an emergency first step is to assess the damage and devise a risk management strategy to limit the damaging effects. If incident results in fatalities or personnel injury then emergency responder will have their top priority to take the injured persons to health centre and close the area for public. Fuel delivery contractor may have to get involve RCMP. Once all the affected people have been attended then Emergency Response Team will turn to protect the environment. Realizing the proximity of bay to the tank farm fuel would not let to migrate to shore line.

4.3 Emergency Reporting Protocol

PPD, as owner, and the fuel delivery contractor, as operator, of the fuel storage facility are jointly responsible to inform the environmental regulatory agencies and affected parties of the emergency situation.

4.3.1 Reporting to Environment Canada

Section 201 of Canadian Environmental Protection Act, CEPA, 1999 requires that when an environmental emergency occurs for any of the substances on the list established on Schedule 1 under the *Environmental Emergency Regulations*, any person who owns or has the charge, management or control of the substance, immediately reports the emergency to EC enforcement officer. Within thirty (30) days of the emergency, a report is also to be submitted to EC. PPD's fuel delivery contractor as facility operator has the obligations to notify emergency to the Environment Canada within the same time frame. Environment Canada has different offices to be notified of the emergency. Any environmental emergency within Nunavut would be reported to:

Director of Environmental
Protection Prairie and Northern region
Environment Canada
Twin Atria No. 2
210-4999 98th Ave
Edmonton AB
T6B 2X3

PPD HQ will prepare a written report on the emergency situation and the efforts made to respond the emergency and will send it to Environment Canada within 30 days of the incident. Here are the main content of that report:

- The names of owner (PPD) and operator (Fuel contractor) of the storage tank system
- EC identification number of storage tank system
- The date on which the spill occurred, if known
- The type of petroleum product that is subject of the report
- Quantity of the spilled product, if not known give estimate
- Description of circumstances of spill/leak
- Description of measures taken to contain, cleanup of the spill and to prevent subsequent occurrences

4.3.2 Reporting to 24 hour Spill Line

PPD is not present in most of the communities so fuel delivery contractors represent the PPD at community level and these are the people who get to know about the emergencies first of all. Fuel delivery contractor prepare a standard spill report and fax it to 24 hour spill line.

24 hour spill line phone 867-920-8130
24 hour spill line fax 867-873-5763

Northwest Territories | Nunavut | Canada

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR	REPORT NUMBER ____-_____
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME	☐ UPDATE # _____ TO THE ORIGINAL SPILL REPORT	
C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)		
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN		
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS		
F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION		
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION		
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES	
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT	
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS			

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC	SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN	FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

Figure 4.1: spill report

4.3.3 Reporting to Transport Canada

If a fuel spill occurs during offloading from a vessel, some fuel is likely to enter the sea water. The owner or/and operator of the facility is obligated to report the spill to Transport Canada and prepare a report to be sent as soon as possible. The carrier Company is also under obligation to do the same reporting from their end. Either PPD or PPD's fuel delivery contractor shall provide the following information to TC in the initial report:

- Specific location - name of shipper involved,
- Type of incident - leak, spill, fire or no fire, and
- Extent of spill, leak or fire.

4.3.4 Reporting to Environment Protection Nunavut

The office of the Director of Environment Protection, Department of Environment (DOE), is a territorial regulatory body that ensures environmental protection. PPD always informs DOE in case a spill occurs. PPD also shares Environmental Site Assessment Reports on fuel storage facilities with the DOE in Nunavut. Site specific Remediation Plans are also developed in collaboration with the DOE office.

4.3.5 Notification to Community Stakeholders

Environmental Emergency Plan includes the measures to be taken to notify members of the adversely affected public in the case of an emergency. This could involve the use of emergency announcements on local radio and television, door- to-door notification and/or the use of emergency e-mail and text messages.

Depending upon the severity of the emergency situation, PPD's fuel delivery contractor will call for assistance from the other community stakeholders such as local Fire Department, the Nursing Station, the RCMP, and Public Works or Hamlet Maintenance staff. Here is the list of important community stakeholders to be notified as soon as possible:

Fire Department	867-857-2525
RCMP	867-857-0123
Nursing Station	867-857-3100
Public Works	867-857-2503
Hamlet Office	867-857-2841
Wildlife/Environmental officer	867-857-2828
Airport	867-857- 2802
Nunavut Power corporation	867-857-2853
Radio station	867-857-2135

4.3.6 Reporting to PPD

Regional Head PPD Field Operation Kivalliq	867-645-8430
Manager, Nunavut Field Operations	867-645-8443
PPD Maintenance Coordinator	867-645-8442

The fuel delivery contractor shall call the Regional PPD Head (formerly known as the Regional PPD Officer) with an account of the cause of the incident and what action was initiated to control situation. The Regional PPD Head shall call the Manager of Nunavut Field Operations with an account of the emergency situation. The Manager of Field Operations shall share the information with the Director of Petroleum Products Division Headquarters Rankin Inlet. Once PPD's Director is fully aware of the situation, he will involve the other staff from PPD's operation to fully control the situation.

4.3.7 Reporting to Canadian Coast Guard

The maximum oil transfer rate from vessel to fuel storage tanks in Arviat tank farm is 75m^3 /hour. This will rate the Arviat tank farm a **"Level One Facility".**

Excerpts from the CCG Letter of Promulgation:

"Through legislation such as the *Canada Shipping Act*, the *Arctic Waters Pollution Prevention Act*, the *Oceans Act*, and subject to various inter-agency agreements, the Canadian Coast Guard of the Department of Fisheries and Oceans has lead agency responsibility for ensuring responses to ship-source spills, mystery spills, and ship-source pollution incidents that occur as a result of loading or unloading to or from ships at oil handling facilities in waters of Canadian interest".

The Canadian Coast Guard *Marine Spills Contingency Plan* defines the scope and framework within which the Canadian Coast Guard will operate to ensure a response to marine pollution incidents. The polluter is expected to respond to incidents, while the Canadian Coast Guard will monitor and, whenever necessary, augment or assume management of the response when it is in the interest of the public. The Canadian Coast Guard also provides assistance to other federal, provincial, territorial or local agencies.

The Canadian Coast Guard *Marine Spills Contingency Plan* is divided into the following three chapters:

- National Contingency Chapter, which establishes the Canadian Coast Guard policy for the conduct and procedure for monitoring a polluter-led response or responding to a marine pollution incident for which it is the lead agency or where it supports another agency leading the response;

- Regional Contingency Chapter, that corresponds to the Canadian Coast Guard regional geographic areas of responsibility and which translates policy direction into operational measures appropriate to the geographic area;
- Area Contingency Chapter, which is local level, plans pursuant to the Regional Contingency Chapter.

The custodian for the overall coordination of the Canadian Coast Guard *Marine Spills Contingency Plan* is the Director General, Rescue, Safety and Environmental Response, Canadian Coast Guard Headquarters, Ottawa.

David B. Watters
Commissioner

4.4 Response Strategy

Upon the discovery of a leak, spill or fire, a response strategy is to be developed by the Emergency Response Team. PPD's fuel delivery contractor has the responsibility to set the priorities to safeguard health and safety of his personnel and general public. Initial actions should be directed toward the tactical priorities listed below:

- Action should proceed cautiously
- High level of safety
- Avoid committing personnel to dangerous situations

Most incidents at the Tank Farm will involve either a constant leak or a massive spill of a petroleum product. The situation may or may not involve a fire.

4.4.1 Tactical Priorities

- Ensure that GN and contract employees are not within a hazardous atmosphere or have the potential to be exposed.
- Cover the spill with absorbing pads or foam blanket to control fire and/or prevent ignition.
- Control potential sources of ignition.
- Have a trained personnel monitor the foam blanket to determine its effectiveness.
- Contain the spill or run-off.
- Identify and control the source of the spill or leak.
- Maintain foam blanket until product can be picked up. Keep all personnel and vehicles out of the spill area.
- Maintain an adequate volume of foam solution on scene for the duration of the incident.

4.4.2 Assessment & Notification

This is the process by which the event is assessed for its response requirements and the necessary personnel and resources summoned along with meeting the notification requirements.

- Have the necessary agencies been notified?
- Have people been notified and moved to safety?
- Are rescue or evacuation efforts required?
- Are medical services on their way?
- Are escalating factors identified and controlled?
- Do threats exist to nearby populations contained?
- Has the nature and effects of the event been fully assessed?
- Have damaged utilities been shut off?
- Are there any critical services, which need restoring immediately?
- Are any hazardous materials located at the site?

4.4.3 Remedial Measures to Fuel Leak

At Arviat tank farm all tanks and piping are aboveground installation. Regular visual inspections are performed on them for leak detection. On the discovery of any stains of fuel near the tanks, PPD's contractor will immediately inspect the walls and floor of the tank thoroughly.

On the confirmation of a leak, the leaking component will be isolated from the rest of system and will not put in service until fully repaired. The remaining system could be stay in operation. If the isolation of the leaking component is not possible, then the whole system will be withdrawn from service until the leak is repaired. Sometimes it may not be possible to withdraw the leaking component from service, in this case PPD's contractor will:

- Complete immediate measures to reduce the amount of fuel entering into the environment. Minimize any short or long-term harm to the environment and/or danger to human life or health.
- Notify Environment Canada in writing of the circumstances that resulted in the withdrawal of the leaking component impossible and the associated measures taken to comply with the EC requirements.

4.4.4 Spill Containment Efforts

The whole fuel storage facility has been provided with secondary containment in the form of lined, bermed and fenced area. Additionally a big spill catchment basin is available to contain a large spill on the facility. It is highly unlikely for a spill to

migrate beyond the lined area but it is still imaginable. A strategy must be devised to deal with a spill that has a potential to affect sensitive marine environment of the east side of the facility.

The scale of efforts to be initiated to contain the spill depends upon the magnitude and location of spill.

- If it is a small spill (under 100 L) within the lined area, fuel contractor's response team will disable the source of spill and use absorbing pads and rolls to clean up the visible fuel and dump the used spill kit supplies to a drum.
- If there is a spill greater than 100 L but within lined area, spill will be cleaned as described above and contaminated soil/snow will be hauled to spill catchment basin.
- If spill goes beyond the tank farm lined area, it will be cleaned by absorbing pads; efforts will also be made to transfer the spilled products into drums which later would be emptied in a slop tank. If fuel is absorbed in snow, contaminated snow will be hauled to catchment basin. If it is a summer time and fuel is absorbed in the soil, a formal ESA study will be conducted on the contaminated area and soil remediation will be done, if deemed necessary.
- Measures will be taken not to let the contamination spread beyond the catchment basin especially during spring freshet. A detailed snow management and removal plan will be developed and implemented on catchment basin.
- In case of a massive spill out of the lined area, besides executing the regular spill response, help will be asked from other community stakeholders as well as from PPD. If there is a suspicion of fuel migration to sensitive marine environment, a barrier wall or trench will be made to hinder the possible movement of fuel towards the shoreline.

4.4.5 Strategic Partners for Cleanup Operation

In case of small leak or spill, PPD's fuel delivery contractor should be capable of cleaning operation but when there is a massive spill; situation may be out of his control. The clean-up strategy will be discussed with the following personnel:

- Manager, Nunavut Field Operations, PPD
- Manager, Local Heavy Equipment Company
- Head, PPD Kivalliq Field Operations
- PPD Maintenance Coordinator
- Local Wildlife/Environmental Officer
- Local Senior Administrative Officer (SAO)
- Local Fire Chief

The clean-up strategy will determine the following information:

- An estimated cost for materials and labour

- An estimated time-frame from start to finish of the clean-up
- A contaminated storage site with the assistance of the SAO, the Fire Chief, the Wildlife/Environmental Officer and Head, PPD Baffin Field Operations
- The Fire Chief and the Wildlife/Environmental Officer will determine if the spilled product can be incinerated.
- If storage containers are to be used, the PPD Manager of Field Operations will be consulted.
- The Wildlife/Environmental Officer will be notified of the contaminated storage location.

If a Clean-up Strategy meeting cannot be arranged the following steps will be taken to ensure immediate clean-up procedures.

- Use sorbent material to soak up the spilled product.
- Place the soaked material into empty 45 gallon drums.
- If drums are not available, find a non-flammable container to place the material, until it can be removed from the site.
- Contact the local Wildlife Office to determine a suitable site to store or dispose of the contaminated gravel or sorbent material.
- Contact the Hamlet Office and advise them of the contaminated storage site approved by the Wildlife Office and confirm their written approval.
- When the clean-up is completed have a Hamlet and DOE representative inspect the site. If the contaminated product is to be kept in storage and will be moved at a later date, the GN Department of the Environment will be sent a written notice.
- The Wildlife/Environmental Officer will close the file when he is satisfied with the completion of the clean-up operations.
- A copy of the Spill Closure will be sent to the Manager, PPD Field Operations

A level one response usually involves a response using only on-site resources with the expectation of escalation being limited or unlikely. An example of this level of response would be a minor spill. The Emergency Management Team shall be notified but not assembled for the purpose of a level one response.

A level two response requires support from outside authorities. These types of incidents may result in the evacuation of PPD facilities. The Emergency Management Team shall be notified and shall respond to ensure the safety of all staff and general public. The Emergency Management Team may be called upon to activate the Emergency Operations Centre or attend. Any communications to media or stakeholders shall be done only with the approval PPD Director or designate.

A level three response is an unusual and serious event that requires extensive support from outside authorities or agencies. This type of response may result in the

evacuation of PPD facilities. An example of this level of response would be a large fuel spill or fire.

- The Emergency Management Team may be called upon to activate the Emergency Operations Centre.
- Any communications to media or stakeholder shall be done only with the approval of PPD Director or designate.

NOTE: A large spill can create an extremely large vapor problem and may flash back from ignition sources at significant distances. While covering the spill to suppress vapors, the direction and extent of vapor travel must be determined.

4.4.6 Controlling a Fire at the Tank Farm

When attempting to control a large flammable liquid fire, the strategy should be to wait until enough foam concentrate to control the fire is on the scene before beginning the attack. If the attack runs out of foam before the fire is controlled, all of the foam will have been wasted. The minimum foam solution supply and the total amount of foam water solution required for each storage tank has been calculated and is available in the Storage Tank Tactical Guidelines.

Foam 34 carries approximately 400 gallons of Class A Foam and 200 gallons of Class B Foam. Foam Tanker 34 carries approximately 1,000 gallons of 3% AFFF-6% ATC concentrate. Foam 44 carries approximately 400 gallons of Class A Foam and 200 gallons of Class B Foam.

Fires, which are controllable with the foam supply on hand, should be attacked without delay. This applies to most spill fires and tank vehicle incidents. If the fire is too large to be controlled by the initial attack capability, PPD's contractor will ask the help from local fire department and other community stakeholders. At the same time contractor should consider a holding action to protect exposures and prevent spread until additional foam supplies can be assembled and prepared for use.

4.4.7 Substantial Loss of Fuel

If there is a total loss of fuel but no devastating fire resulted, even then there will be an emergency situation because fuel is life line for every community including Arviat. All the buildings and houses are heated by diesel. Once the fuel is short all of the services will get suspended and life would be a nightmare in the community. To deal with this sort of emergency we need to fetch fuel by airlift from neighboring communities to sustain life activities for few days. It is not possible to get fuel from refineries in few days. It will take at least three weeks to bring the fuel from refineries located in Southern Canada but most likely it will take more because

refineries may not have the fuel handy which could meet our specs, especially in winter when sealift is impossible due to frozen water.

If such emergency situation arises in Arviat, fuel could be airlifted from Whale Cove, Rankin Inlet, Baker Lake and Chesterfield Inlet to meet the community needs for a couple of weeks maximum. Each community has a limited supply of fuel for its own needs. To survive throughout the year, an immediate order would be placed to the appropriate refineries to produce the fuel that we need on urgent basis. PPD would make all of these arrangements with the assistance of other departments of GN.

4.5 Tank Farms Fire Hazards Analysis (FHA)

The revised Tank Farms Fire Hazards Analysis (FHA) evaluates the spectrum of fire and related hazards for the bulk fuel storage facilities in relation to existing safeguards and fire protection program features. The conclusions of the analysis dictate that the fire risk associated with the Tank Farms is within acceptable limits, an adequate margin of fire safety exists, and fire protection defense in depth (DID) has been provided in accordance with applicable fire safety criteria.

The conditions in place are deemed not to be safety significant and that a comparable level of safety has been achieved through the implementation of a multifaceted fire safety program. Fire and related hazards associated with the Tank Farm facilities are both delineated in the FHA and described elsewhere in corresponding documents and related studies. They include a spectrum of common hazards, such as conventional ignition of ordinary combustible materials, through various scenarios associated with the ignition of off gases related to stored waste, among other accidents. For each of the hazards, PPD has evaluated the risk associated with credible (and beyond credible) events.

Similar analyses have already been conducted by a diverse group of qualified and experienced fire protection engineers, accident analysts, and supporting experts. Resulting from these analyses and consistent with Integrated Safety Management principles, appropriate safeguards could be implemented with the intention of minimizing the occurrence of an ignition or limiting the consequences of a fire or related event if one should occur. In addition to a range of specific fire prevention and protection features, fire safety could be achieved through design and operational safeguards, such as tank ventilation systems and equipment inspection, testing and maintenance programs. No single safeguard is relied upon to assure an adequate margin of safety. The fire protection program that has been recommended by different regulatory agencies for the Fuel Tank Farms is multifaceted. It includes, among other attributes, a range of fire prevention measures, such as combustible material and ignition source controls. It also manifests both passive fire safety features (such as fire barriers within buildings and combustible free zones around facilities) and active fire protection systems for facilities (principally fire suppression

and detection systems). As a risk management outcome, PPD has established a clear understanding on how to control and emergency on tank farms. The overall program encompasses the training of employees in hazard recognition, fire prevention, and emergency response. It includes a number of fire protection engineering related activities such as routine fire safety assessments of all facilities, the review of planned modifications to assure conformance to fire applicable standards, and the development of hazards analyses for work activities. All are intended to minimize the risk from fire and related events.

The capacity of these systems is sufficient to suppress any credible fire as confirmed by water flow tests and is suitably redundant to avoid interruption as a result of a single component failure. The fire protection systems are provided to correspond with and mitigate distinct fire hazards associated with these facilities. PPD has provided portable fire extinguishers of appropriate type to fuel delivery contractor. PPD's contractor got the responsibility to get them certified annually by the office of Fire Marshal and make them readily accessible to those trained in their use. Ignition sources, such as energized electrical equipment, smoking materials, cutting torches, etc. are also controlled in such a manner as to minimize the potential for ignition and the development of uncontrolled fires. To assure that the contractor's staff and general public are capable of evacuating any gas station in the event of a fire, proper notification system is in place

4.6 Marine Safety

4.6.1 Operational Spill Prevention

The maximum oil transfer rate from vessel to fuel storage tanks in Arviat tank farm is 75 m^3 /hour. This will rate the Arviat tank farm a **"Level One Facility".**

All crew members shall maintain a close watch for the escape of oil or NLS during bunker or cargo operations.

Prior to bunker or cargo transfer, the competent crew members should mobilize the spill equipment, as far as available on board, and place it close to the planned operation. E.g. Along the railing on the side at which bunker operation takes place. All deck scuppers and open drains must be effectively plugged. Accumulations of water should be drained periodically and scupper plugs replaced immediately after the water has run off. Any free floating substances should be removed prior to draining. Bunker or Cargo tanks which have been topped up should be checked frequently during the remaining operations to avoid an overflow. Unless there are permanent means for retention of any slight leakage at ship / shore connections for bunker or cargo transfer, it is essential that a drip tray is in place to catch any leaking substance.

All crew members of the ship's crew should be familiar with the fundamentals of the ship's vital systems including the ventilation and electrical systems. Crew members should be able to isolate the accommodation and/or machinery spaces using the louvers and fan shutoffs and, from the distribution panels, isolate electrical circuits in areas of risk.

In the event of an operational spill, which occurs during bunkering or cargo operations, it is important that the bunkering party terminate any and all bunkering operations and close all manifold valves.
Before closing any manifold valves, the bunkering / cargo party must immediately inform the terminal / loading master so that they may take action to eliminate the possibility of over- pressurization of the shore side transfer components.
After dealing with the cause of the spill, it may be necessary to obtain permission from local authorities and/or the terminal before resuming bunkering or cargo operations.
If the possibility of fire or explosion exists, nonessential air intakes to accommodations and machinery spaces should be closed and all sources of ignition should be eliminated.
Care must be taken to consider stability and stress when taking action to mitigate the spillage of oil. Internal transfers should be undertaken only with a full appreciation of the likely impact on the vessel's overall stress and stability.

4.6.2 Pipeline Leakage

In the event of leakage from an oil / NLS pipeline, valve, hose or metal arm, the Chief Engineer must ensure that the following actions are taken:

- Stop oil flow, close manifold and other valves.
- Sound emergency alarm and mobilize Oil Pollution Prevention Team
- Locate source and drain affected section into an available empty or slack tank. Repair if possible
- If there is any possibility of vapours entering the engine room or accommodation intakes, appropriate preventative steps must be taken quickly.
- Absorb spill with any absorbent materials on hand and dispose of oil soaked materials in an appropriate container.
- If oil is overboard, report to proper authorities immediately

4.6.3 Tank Overflow

In the event of an oil tank overflow, the Chief Engineer must ensure that the following actions are taken:

- Stop oil flow, close manifold and other valves.

- Sound emergency alarm and mobilize Oil Pollution Prevention Team
- Place drain buckets under overflow pipes to contain possible spills.
- If there is any possibility of vapours entering the engine room or accommodation intakes, appropriate preventative steps must be taken quickly.
- Drain or transfer oil to slack or empty tanks if possible with due consideration paid to vessel stability. If no slack or empty tanks are available, oil may be pumped back ashore through delivery lines, having first gained permission to do so.
- Absorb spill with any absorbent materials on hand and dispose of oil soaked materials in an appropriate container.
- If oil is overboard, report to proper authorities immediately

4.6.4 Hull Leakage

If oil is noticed on the water near the vessel during normal operations and cannot be accounted for, the possibility of hull leakage should be suspected. In the event of a hull leakage, the Master must ensure that the following actions are taken:

- Sound emergency alarm and mobilize Oil Pollution Prevention Team.
- Stop any transfer or bunkering operations.
- Identify damage and report to proper authorities immediately (as per section 4 of this plan). Consider a diver if necessary and possible.
- If possible, contain spill using materials on hand and dispose of oil soaked materials in an appropriate container.
- If there is any possibility of vapours entering the engine room or accommodation intakes, appropriate preventative steps must be taken quickly.
- Transfer fuel away from suspected leaks to empty or slack tanks if possible, or to a ballast tank if necessary. If in port, arrangements can be made to pump oil ashore to tanks or trucks. Due consideration is to be paid to vessel stress and stability.
- If it is not possible to identify the leaking tank, reduce level in all tanks in the vicinity, giving due consideration to vessel stress and stability.

4.6.5 Spills caused by Equipment in Machinery Spaces

- If operational spills are caused by failure of equipment in machinery spaces, any further operation of this equipment should be stopped immediately and measures are to be taken to avoid a spill. Such equipment may be
    1. Oily - water separating equipment or oil filtering equipment or oil filtering equipment to de-oil bilge water from the engine room bilges.
    2. Valves in pipes connecting ballast / cargo systems
    3. Cooling pipes in cooler systems
    4. Gearing of bow thruster

5. Stern tubes

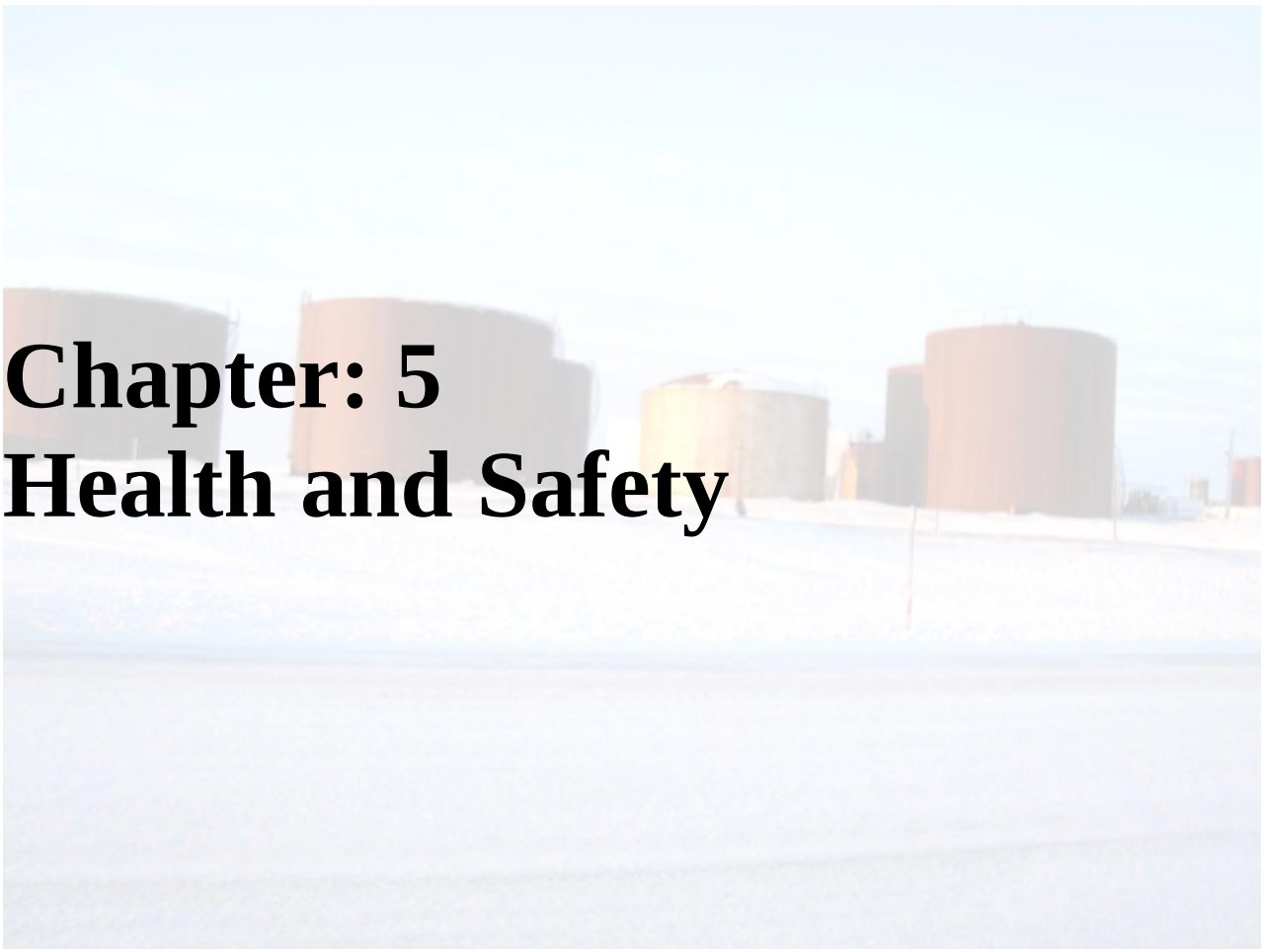
- Sound emergency alarm and mobilize Oil Pollution Prevention Team.
- Absorb spill with any absorbent material in hand and dispose of oil soaked materials in an appropriate container.
- Do not restart equipment until problem has been rectified.

4.6.6 Ship Grounded / Stranded

If the vessel grounds, the Master must ensure that the following actions are taken:

- Sound emergency alarm, muster crew, and Mobilize Oil Pollution Prevention Team once safe to do so.
- Eliminate all avoidable sources of ignition and ban smoking onboard. Action bust be taken to prevent hazardous vapours from entering accommodation and machinery spaces.
- Identify damage by means of a visual inspection.
- Take soundings around vessel to determine the nature and gradient of seabed.
- Check differences in tidal range at grounding site.
- Evaluate tidal current in grounding area.
- Take soundings of all tanks on shell and compare with departure soundings.
- Determine probability and/or quantity of oil released
- If oil release is determined or is probably, this is to be included in the casualty report.

Determine other possible hazards to the vessel such as sliding off the grounding site or further damage from seas / swell, and torsion forces.



Chapter: 5
Health and Safety

5.1 SITE CONTROL

In the event of an Oil Pollution Incident (OPI), an immediate assessment will be made to ensure that the site is secure. Oil Pollution Incidents (OPIs) can attract curious onlookers, and the site must be controlled in such a way as to ensure that they are kept well outside any hazardous-area zone. Only those directly involved in the containment, control or cleanup of the Oil Pollution Incident (OPI) should be allowed in the general vicinity of the spilled product.

This rule is very important as there are many issues surrounding the possible injury of non-authorized and unqualified individuals. Insurance, liability, capability and general health and safety of the public are a few. If the Oil Pollution Incident (OPI) escalates to involve the services of the Canadian Coast Guard (CCG), the Canadian Coast Guard (CCG) will have an established Health and Safety protocol.

a) **Fires:** There will be two fully charged 20 lb. Class ABC fire extinguishers and a hand-held horn to alert personnel. This is an integral part of the response equipment.

b) **Slippery rocks, decks or other wet surfaces:** All Persons working on an Oil Pollution Incident (OPI) must wear oil-resistant rubber steel-toed safety boots with textured bottoms while working on a cleanup site.

c) **Work on or near water:** All persons working on docks, piers, jetties or in close proximity to the water must wear the appropriate Personal Flotation Devices (PFDs). Persons working on shore near water do not have to wear PFDs unless they are actually working over the water.

d) **High noise exposure:** All personnel must wear hearing protection when operating equipment or machinery or when in areas where noise levels require personnel to raise their voices to be heard.

e) **Buddy System:** A buddy system must be observed at all times when workers are in the work area. Persons must work within sight of their assigned partner (buddy) at all times.

f) **Personal Protective Equipment (PPE) requirements:** Selection of outer PPE will be based on the potential for whole body contact with the product. A potential for repeated contact will require rain gear (top/bottoms). Clothing will be kept fully zippered when handling those materials. Supervising personnel may authorize the removal of suit tops if there is not potential for upper body contact. Personnel with high body-contact potential will tape gloves and boots.

   Personnel with limited skin contact potential may wear disposable clean guard garments or equivalent. Personnel with no exposure potential (inspectors,

monitors etc.) need not wear protective clothing. All personnel on shore cleaning operations will wear safety glasses (regular glasses will be satisfactory). Personnel handling contaminated materials will wear outer chemical resistant gloves. Sleeves will be taped whenever handling heavily contaminated wet materials. This will happen during removal of oil-soaked sorbents or shoveling oil-soaked snow and dirt.

g) **Hypothermia:** Hypothermia is a condition of having the body temperature fall below 36°C (96.8°F), at which point the individual will likely suffer reduced mental alertness, reduction in rational decision-making and loss of consciousness with the threat of fatal consequences.

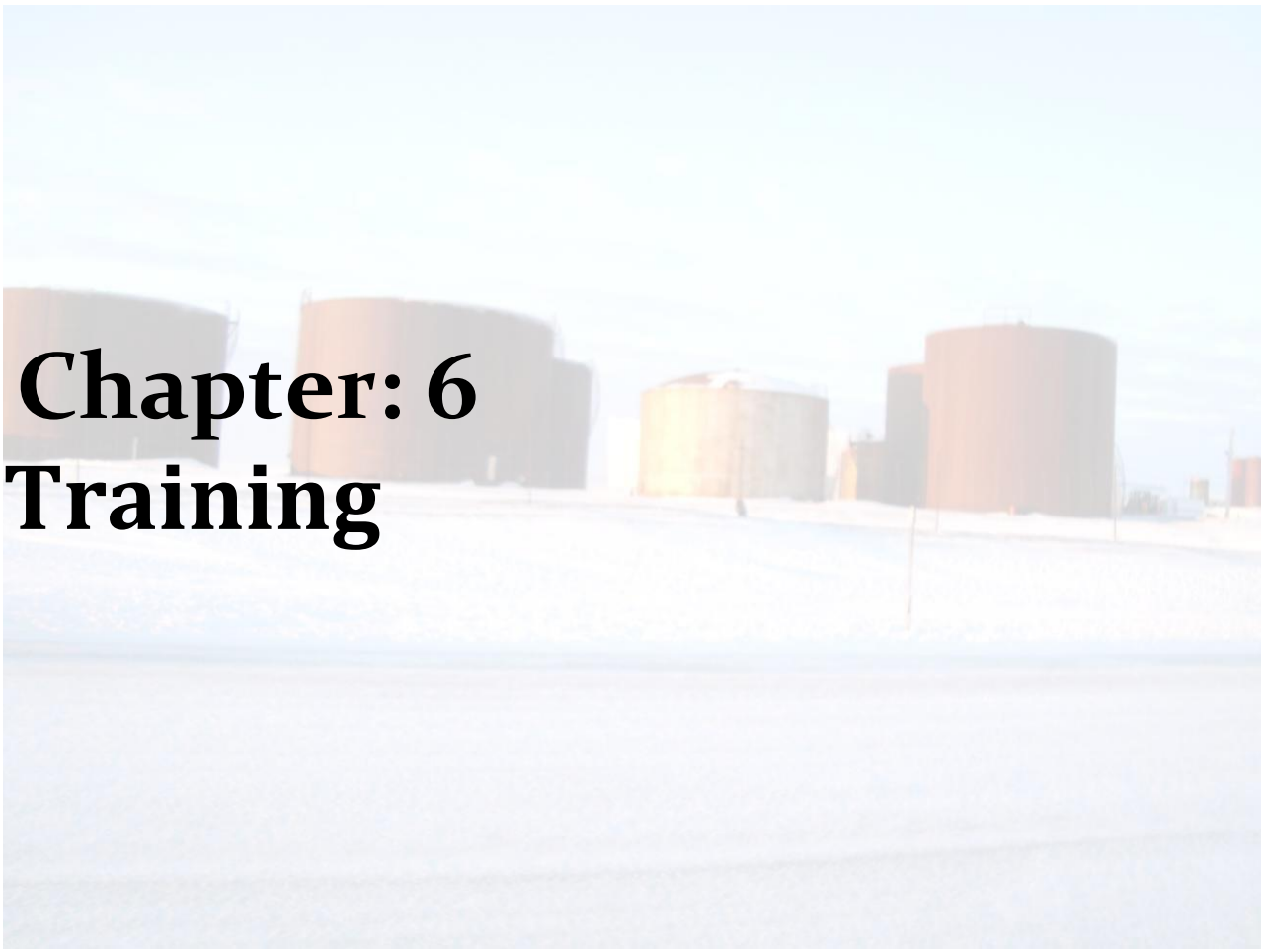
5.2 Protection to the Community

Any significant spillage of product such as diesel may cause a significant threat to the community if the vapour plume approaches a populated area. Based on the wind direction a determination of the potential area of impact will be made and the community notified of any potential hazard. If the spill approaches or enters a watercourse, lake or ocean the community will be notified of any potential hazard to drinking or recreational activities.

5.3 Decontamination

Adjacent to, or near the Oil Pollution Incident (OPI) zone, decontamination stations will be established. The decontamination stations will be laid out so that personnel will pass through the station prior to leaving the contaminated area. The decontamination stations may be bermed and lined with plastic sheeting. Washing solutions may be placed near the "Oil Pollution Incident Zone". All solutions in tubs will be clearly marked.

Note: Notwithstanding the preceding, all applicable health and safety rules, regulations, and legislation will be adhered to. The health and safety specialist will be consulted as well as any other staff that may possess expertise regarding the health and safety of all involved.



Chapter: 6
Training

6.1 Regular Training

A significant number of the spills that occur at aboveground storage tank facilities result from improper procedures during routine activities. These accidents can be reduced or eliminated if operating personnel are properly trained about correct safety procedures and the importance of following them to prevent injury and environmental incidents. Training must be periodically followed up to ensure that proper procedures are being followed. All employees will be trained in their roles and responsibilities under the emergency response program and will participate in emergency exercises annually. Following trainings are to be received by all members of Emergency Response Team:

- WHMIS
- First Aid
- CPR Level C

Employees who are involved in transporting the fuel especially fuel truck drivers need additional training programs:

- TDG, Transport of Dangerous Goods
- SOTO, Supervisor for Oil Transfer Operation
- Aviation Fuel Handling Training

New or transferred employees shall receive orientation on the emergency response procedures as part of their general workplace safety orientation. They should receive Emergency Response Plan, participate in Emergency Exercises and receive Safety Briefing.

In the next chapter PPD has listed the people designated to carry out environmental emergency plan along with their roles and responsibilities in an emergency. PPD is intended to conduct an emergency exercise at least annually to ensure the emergency response plan is current, comprehensive and effective.

6.2 Responder Training

The success of any Oil Pollution Incident (OPI) response depends on a clear mandate as to expectations and adequately trained personnel. The level of training has to be tailored to the functions to be performed and the skills of the individual. In this case of the Facility, it provides specific training to the Facility employees. For all ship to shore fuel transfers, all employees are trained in the Supervisor of Oil Transfer Operations (SOTO) course. It is assumed that if the Canadian Coast Guard (CCG) is called in, its employees and contractors are adequately trained.

6.3 Training For Casual Employees

PPD hires casual employees from time to time to help the regular staff during resupplies and other O&M works. Casual employees will be trained based on the program PPD has in place to comply with applicable health and safety requirements. Upon hire, every employee and contractor will receive a safety orientation and copy of the PPD Safety Rule Book. PPD has a strict non-smoking policy during fuel handling and in the fuel storage facilities.

6.3.1 Short-Notice Employees/Volunteers

Incase PPD should hire short-notice employees or use volunteers; they will be used in specific jobs working under the direction of a qualified person. PPD will ensure that these persons receive the Basic Health and Safety Training Course.

6.4 Response Training For Short-Notice Employees/Volunteers

During oil spill incident, contractors, short-notice employees and volunteers may be called upon to assist in the control, recovery or disposal of the spilled fuel. Before anyone is allowed in what is considered the "HAZARDOUS AREA", appropriate training /orientation will be given by a trained official.

6.5 Training Exercise

PPD will ensure that fuel handling staff are trained for the Environmental Emergency Plan. Training may consists of mock exercises in the form of a tabletop or an operational exercise. The training exercises serve the purposes of training personnel, evaluating the ability of the staff to respond to a spill, and demonstrating the ability to respond to a spill. The result of a training exercise should be to identify areas for improvements for the existing contingency plan and the application of the contingency plan.

6.6 Tabletop Exercise/In Class Exercise

A tabletop exercise is mainly theory. It can be organized during a meeting of the operational staff in the regional offices.

Prior to proceeding for tabletop exercise, the Environmental Emergency Plan should be reviewed and discussed to make sure everyone understands the information. A tabletop exercise consists of writing a spill scenario and goes through the steps in dealing with the spill using the Environmental Emergency Plan. A thorough discussion should be held and improvement, if required, should be made to the environmental emergency plan.

6.7 Operational Exercise

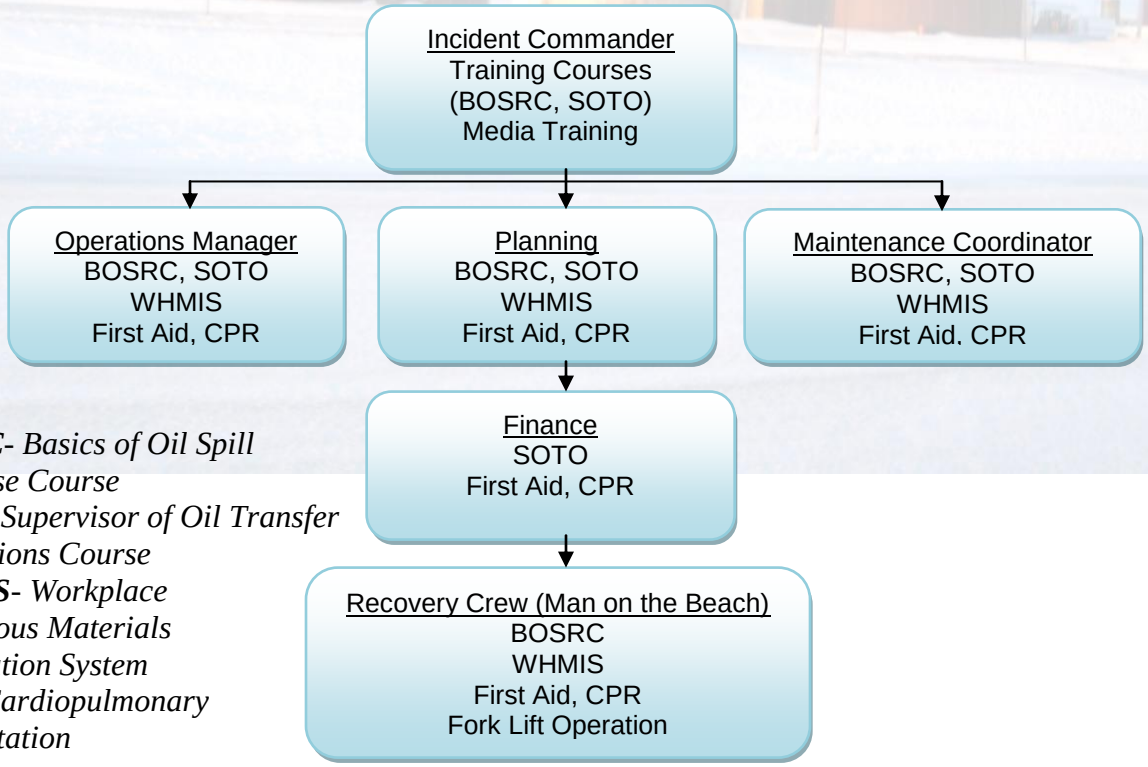
Operational exercise training involves the deployment of resources required to test the emergency plan. The equipment required for an emergency plan is deployed and will indicate the knowledge and readiness of the responder to use the equipment for containment and clean-up. The operational exercise is designed in the stages of programming, planning, conducting and reporting of a spill scenario. Operational exercises will be organized in the regional offices to make sure responders can make best use of time and resources.

6.8 Basic Health And Safety Training Course

This course will provide response personnel with the information and knowledge to understand the health and safety issues associated with the provision of spill response services.

This course outlines the responsibilities of both the employer and the employee concerning health and safety at the work site. It also explains the hazardous associated with petroleum products and safety procedures associated therein.

Training - Basic Standard Organizational Chart



BOSRC- *Basics of Oil Spill Response Course*
SOTO- *Supervisor of Oil Transfer Operations Course*
WHMIS- *Workplace Hazardous Materials Information System*
CPR- *Cardiopulmonary Resuscitation*

Training /Exercise Programme

ACTIVITY DESCRIPTION	YEAR 1	YEAR 2	YEAR 3
Internal Notification Exercise External Notification Exercise	Every Two Years Every Two Years	Every Two Years Every Two Years	Every Two Years Every Two Years
Operational Drills With Ships: i.e. Communication/ Emergency Shut-down With Contractors: ATR Contracting	Every Three Years	Every Three Years	Every Three Years
Operational Deployment With Ships: i.e. Communication/ Emergency Shut-down With Contractors: ATR Contracting	Every Three Years	Every Three Years	Every Three Years
Management Tabletop Exercise Discussion of Response Issues/SOP Review	Every Three Years	Every Three Years	Every Three Years
Full Scale Functional Exercise	One, over the three-year cycle		

PPD Personnel Training Record

Name & Position	Course & Training	Expires DD/MM/YY	Community	Comments

Chapter: 7
Communication

7.1 Communication During an Emergency

There is nothing more important during an emergency than effective communication. All crises will eventually end either in a positive or somewhat negative way. Effective communication can often help hasten the end of an emergency and minimize any negative after-effects.

Communication is a critical part of emergency management. GN officials, PPD Staff, contractors and the media expect to be informed promptly about any emergency situation, with up-to-date and accurate information. Immediately upon becoming aware of any emergency, the senior management of PPD and/or the Emergency Management Team shall be notified, as laid out in the notification section.

If needed, the Emergency Management Team shall be assembled in the Emergency Operations Centre. This centre could be a virtual conference to decide a course of action for the event that is ongoing, has taken place or is about to take place. The PPD Director, or some higher official within GN & CGS department, will appoint someone as a Public Information Officer. This Public Information Officer, or designate, should take the time to prepare a written statement for release. It is very important to stay away from verbal *off the cuff* communications during an emergency.

A report should be a clear, concise statement of the basic facts, including: who was involved, where it happened, when, why (if known), and what is being done in response to the situation. If the occurrence is ongoing, the Public Information Officer or designate should indicate how frequently he/she will provide updates and when the next one will come.

7.1.1 Communicating with PPD's Staff

When an unpleasant incident, emergency, or disaster occurs the staff should be informed by the Emergency Management Team or designate as quickly as possible regarding the emergency, the response and how it will affect the PPD operations. Staff members should also be informed of any role they may be asked to play either during or after the emergency. Staff members shall be updated as the situation develops.

All inquiries made to staff members during an emergency shall be referred to the Public Information Officer or designated spokesperson. Staff members should explain to the person or media member asking the question(s) that the spokesperson will handle all the dissemination of information and is more up to date with the situation and therefore better qualified to answer any questions. If more than one

spokesperson addresses the media, make sure that all are using the most current facts and that messages are consistent in consultation with the Public Information Officer or designate. The staff shall receive all messages being distributed; staff should read them and become familiar with them.

7.1.2 Communicating with Other Contractors

When an unpleasant incident, emergency, or disaster occurs the PPD's fuel delivery contractors should be informed by the Public Information Officer or designate as quickly as possible regarding the emergency, the response and how it will affect the PPD operations. Fuel related emergencies in one community can have the potential to affect the PPD's operation in other communities. Fuel delivery contractors share the problems and responses to emergency situation. If as a result of an incident, fuel is lost in one community then PPD may have to look for another community to obtain the fuel from to meet the needs of the affected community. Emergency response supplies and even trained personnel could be shared to effectively manage the emergency situation.

7.1.3 Emergency Communication and the Media

An emergency generates rumors, speculation, and misinformation. It is how the PPD officials handle the emergency and how they are portrayed as handling it in the news media that will directly affect their credibility and reputation. It is up to the Public Information Officer, or designate, to provide the media with accurate information about the emergency and what PPD is going to do about the emergency.

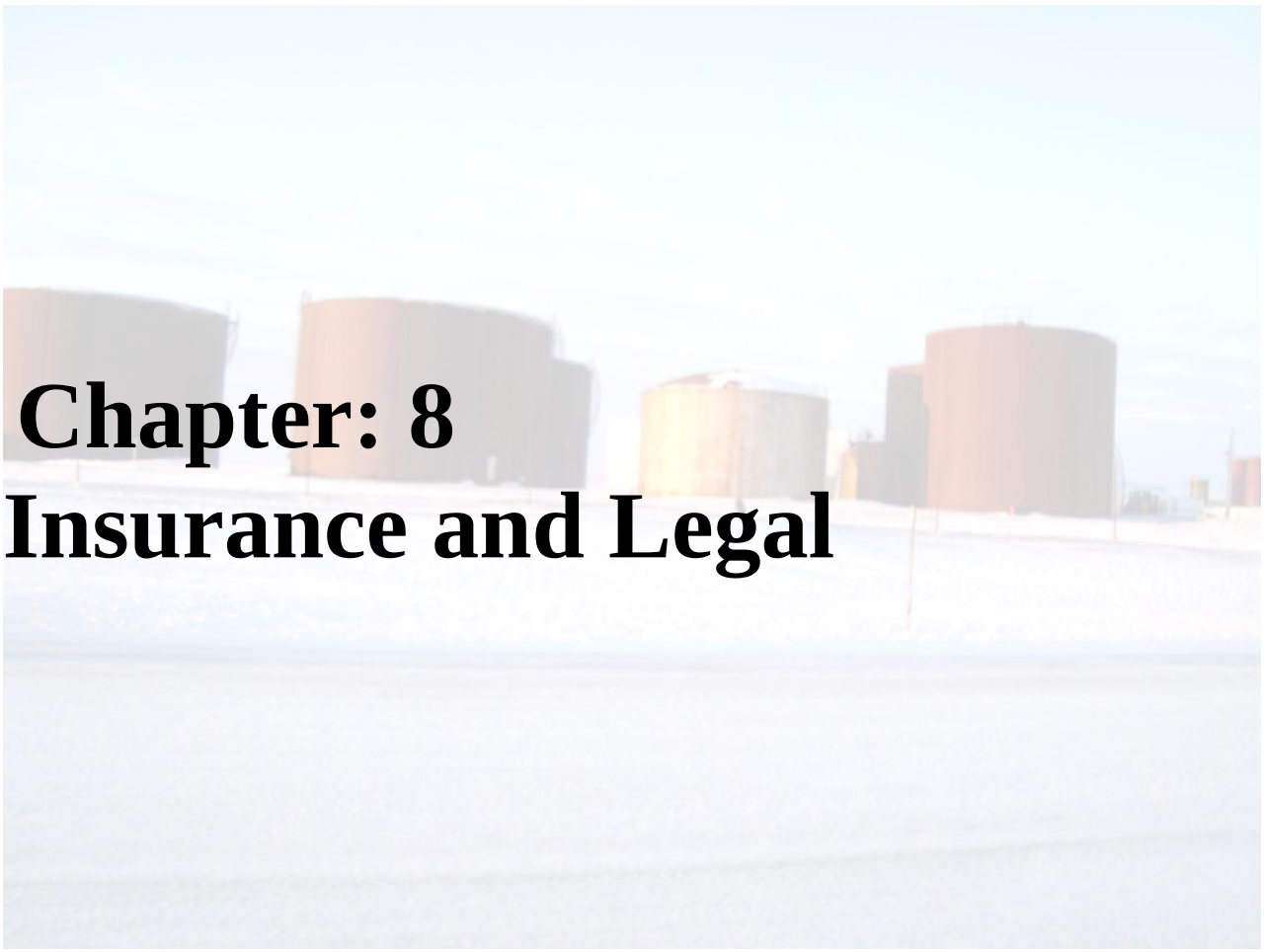
The primary communication goal is to keep the public informed about the emergency while protecting the reputation of PPD and its officials as competent, sensible, responsible, and caring. Special care must be taken during the emergency communication to maintain staff privacy and avoid disruption to normal PPD operations. Any communication with the media during an emergency should be done in consultation with the Public Information Officer, or designate of PPD.

7.1.4 The Role of the Spokesperson

The Public Information Officer, or designate, should be prepared to come under news media scrutiny. As GN officials, they must be prepared for media coverage, not all of which will be flattering about the GN or its policies. One person should be designated as the media spokesperson and contact. Sometimes during the event the PPD Director or designate will be required to speak with the media. If or when this situation occurs the PPD Director or designate, shall consult with the Public Information Officer and review all media reports that have been issued. The Public Information Officer should:

- be familiar with the media and the media's relationship with the PPD;

- be relaxed, calm, confident, and credible;
- be accessible, open, transparent, trustworthy, and truthful;
- know what is being done to help cope with the situation and show empathy and be supportive;
- anticipate questions and prepare possible responses, including the description of the event itself and engage stakeholders;
- consult with subject matter experts for information and support; should be reflective of PPD's organizations culture and reputation



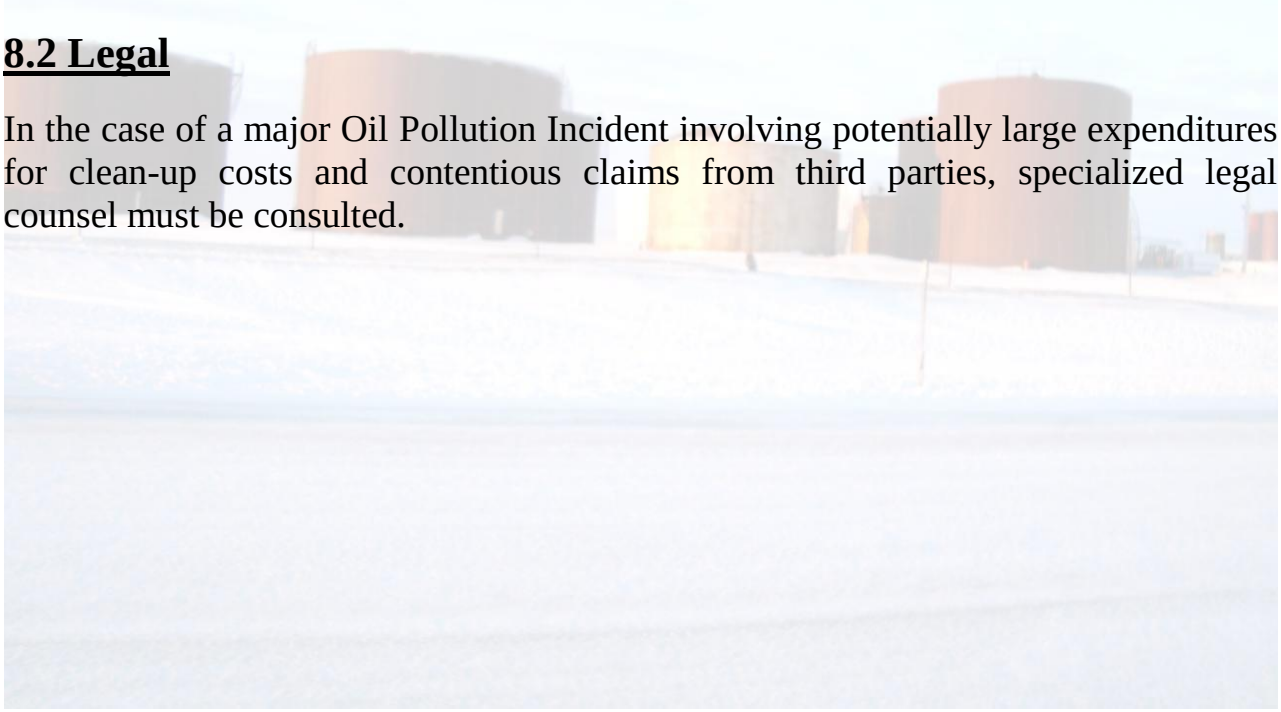
Chapter: 8
Insurance and Legal

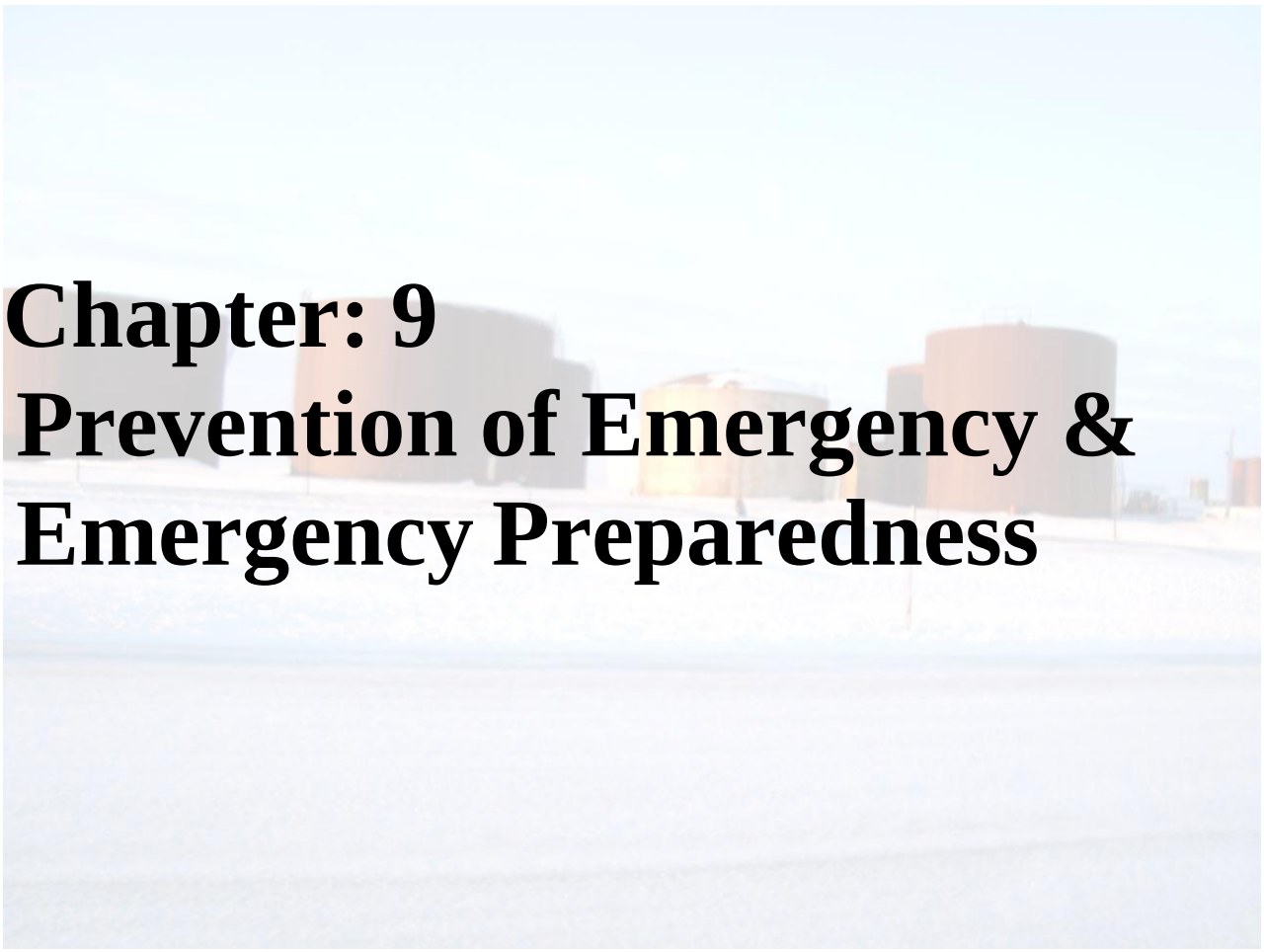
8.1 Insurance

Where the Vessel is owned or operated by a third party, if the vessel is involved in and deemed responsible for an Oil Pollution Incident, prompt notice must be given to the third party advising them that PPD will be holding them responsible for the clean-up costs and damages resulting from the Oil Pollution Incident. The facility employees must recognize that the vessel/companies involved in delivering products to the facility are required to carry insurance to cover their operations. Claims will therefore be made against the vessel's insurance coverage. The facility's role is to ensure that the clean-up is done effectively and efficiently. However, when the expenses incurred are to be recovered from the third party, records for the costs, which have been incurred, are essential. In the case of a major Oil Pollution Incident, specialized representatives from the various insurers will assist on this. For Oil Pollution Incidents of a minor nature resulting in damage to a third party's property, the facility's adjuster can provide assistance.

8.2 Legal

In the case of a major Oil Pollution Incident involving potentially large expenditures for clean-up costs and contentious claims from third parties, specialized legal counsel must be consulted.





Chapter: 9
Prevention of Emergency & Emergency Preparedness

9.1 Brief

The chances of environmental emergency events can be reduced by identifying in advance the frequency, potential consequences and impact of such events. The prevention of such emergencies includes several components, the most important being the knowledge gained from evaluating the risks associated with the substance of concern. As most incidents leading to an emergency are caused by deviations from normal conditions within a facility, the evaluation of past emergency events occurring at the site and at other similar places in Canada and the range of potential scenarios, including the worst probable case, is critical to understand a facility's capabilities and resources in the event of a crisis. We cannot plan for every imaginable worst probable case, as it is not practical; however PPD's environmental emergency plan addresses those worst probable cases and other scenarios that may be credible. Prevention is better than a cure. The key to reducing the frequency and severity of the environmental emergency events is preventing them from happening in the first place.

We have combined the prevention activities with appropriate preparedness and response to make it the most effective risk management strategy. Different case histories have shown that it is much more cost effective to implement an appropriate risk management program in advance than to repair any resulting damage done to the people, place and environment after the fact. PPD believes that with preventive action, problems can be anticipated, corrective action can be taken and risks can be managed to avoid environmental damage. The incident preventive strategy laid out in this plan refers not only to mitigation measures such as maintenance and spill containment, but also to the management systems for design and operation to ensuring that the facility operates as intended. For the smooth running of PPD's operation, an operation safety management exercise will be carried out yearly by applying the management principles and systems to the identification, understanding and control process hazards to prevent operation related injuries and accidents. The following are the salient features of our safety management:

- Risk assessment,
- Facility design and construction to specific standards,
- Preventative maintenance checks and programs,
- Maintaining effective operating procedures and safety documentation,
- Operator competence assurance,
- Procedure to ensure that changes in design or service or staff are effectively managed and to minimize effect on operations,
- Incident investigation and analysis to minimize recurrence,
- Assessment of compliance to standards, and
- Document the lesson learnt from past incidents.

Normally, issues such as operation risk management, management of change and management of human factors are documented and complemented with traditional health and safety programs and applicable federal/territorial legislation. Learning from the past history is definitely important for the future safe operation of storage tanks. After the review of relevant literature we can say that at a fuel tank farm lightning is generally the most frequent cause of accident and the maintenance error is the second most frequent cause. The rest were operational error, equipment failure, sabotage, crack and rupture, leak and line rupture, static electricity, open flames etc.
A fishbone diagram (Figure 9.1 The cause and effect diagram) is used to summarize the effects and the causes that create or contribute to those effects. Figure 9.2 summaries how we can prevent these accidents.

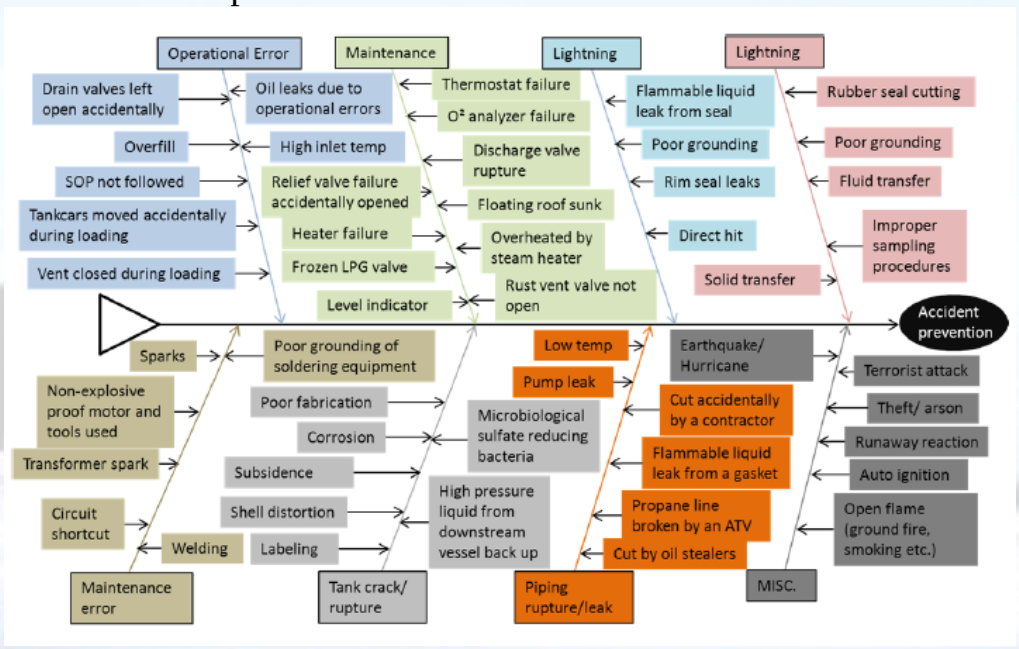


Figure 9.1: Fishbone diagram of accident cause

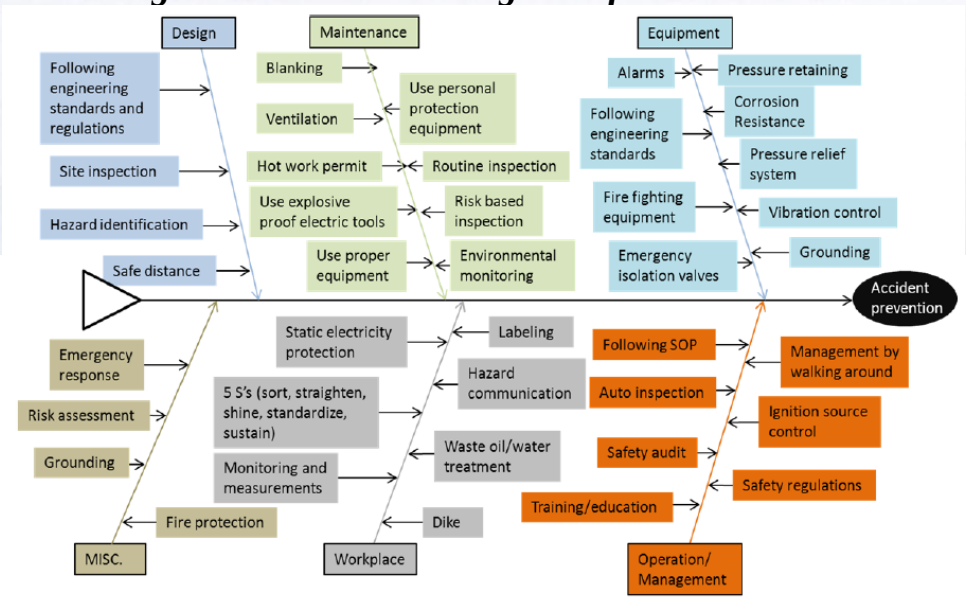


Figure 9.2: Fishbone diagram for accident prevention

9.2 Incident Prevention Strategy

Fire/explosion, leak and spill incidents on the tank farm could be avoided if we use standard safe practices for routine work on the facility.

There is a Monthly Checklist in all communities that must be filled out and sent to Regional offices. This is then forwarded to Headquarters in Rankin Inlet. The checklist is used for preventative maintenance purposes. If an issue does occur it will be found as soon as possible and can be dealt with before a larger problem arises.

PETROLEUM PRODUCTS DIVISION FUEL CONTRACTORS

'ISUAL MONTHLY INSPECTION STORAGE TANK SYSTEM CHECKLIST FOR LEAK DETECTION

Contractor: Padlei Cooperative AssociationLtd. **Community: Arviat**

Date (YY/MM/DD):_____ ***(Must be submitted to PPD Regional office each month)***

	INSPECTION	OK	REPAIRS
A	FENCING		
B	BERM/STAIRWAYS		
C	GASOLINE/DIESEL METERS		
D	GASOLINE/DIESEL PUMPS		
E	HOSES		
F	BUILDING & TANK FARM LIGHTS		
G	CLEANLINESS-BUILDINGS & TANK FARM		
H	FIRE EXTINGUISHERS		

Identify Repair/Replacement Items:

Enter date of last Fire Extinguisher Inspection:

		EC00022255 Diesel Tanks 9,11,12		EC00022271 Gasoline Tank 10		EC00022273 Emergency Tanks 1-	
No.	INSPECTION	OK	REPAIRS	OK	REPAIRS	OK	REPAIRS
1	TANKS						
2	VALVES						
3	PIPELINES						
4	GAUGE HATCHES						
5	AIR VENTS						
6	DISPENSING CABINETS/LOADING RACK						
7	LOCKS						
8	STAIRWAY						
9	LIGHTS						

SIGNATURE:_____ _____

Figure 9.3: Example of the Monthly Checklist for Arviat

9.2.1 Tank Cleaning and Fire Incidents

By adopting the well-established safe practices for tank cleaning, we can prevent some of the fire and spill incidents on the tank farm. The cleaning process on these tanks has a specific protocol which all field staff are obligated to follow. The standard procedure is well explained in the API 650 publication.

It is recognized that circumstances determine the specific applications of the procedure described. If the work is done by a contractor, a designated owner's representative should ensure that the contractor is made aware of the correct procedure to be followed. Personal injury and property damage are less likely to

occur when employees have thorough knowledge of the operation, proper use of the approved equipment and the hazards involved before the job begins. Mixtures of hydrocarbons can be ignited only if the fuel-air ratio is within lower and upper limits (1-10% hydrocarbons vapours by volume in air). Tank cleaning involves the following major steps:

- Preliminary preparations, external inspection of the tank and surveying the immediate area, training and indoctrination of the crew and inspection of equipment.
- Determining the dike area is free of flammable or toxic materials before personnel are permitted to work around.
- Controlling sources of ignition in, around and on the tank.
- Emptying the tank by pumping and floating with water. Before the tank is opened all residual product should be pumped or drained off to the lowest possible level through the water draw.
- Blinding of the tank and de-energizing electrical circuits.
- Vapour freeing the tank.
- Testing the tank for oxygen, hydrocarbons vapours and toxic gases.
- Opening the tank for entry for removal and disposal of sludge.
- A qualified person, authorized to do so, should sign and issue an entry permit before a worker enter a petroleum storage tank.
- While workmen are inside the tank completing the cleaning process, a workman should be available outside the tank to assist those within the tank in the event of an emergency.

9.2.2 Precautions While Tank Cleaning

- When being vapour freed by ventilation, tanks containing rich vapour space will be in the flammable range sometime during the ventilation process. Don't consider the tank risk free during ventilation.
- During the tank vapour freeing operation, all sources of ignition in the tank and in the vicinity of the tank should be eliminated.
- Even after tank has been freed of vapour, flammable mixtures may still be formed from residual products or sludge, keep monitoring the vapour concentration.
- Vapour and liquid may enter through un-blinded lines to gas freed tank.
- Tank vapours should be checked frequently even if initial measurements indicate airborne quantities are within acceptable limits.
- Flammable mixtures may be ignited by a variety of ignition sources that may include electrical lamps, power tools, explosion proof appliances and static electricity, be aware of all of them.

- Unexpected sources of ignition often occur so it is not sufficient just to eliminate conditions known to be a possible source of ignition; every effort must be made to avoid the release of vapours near ground level during ventilating and cleaning operations.

9.3 Provision of Tank Over-Fill Protection

Overfills of aboveground fuel storage tanks are and should be a concern to anyone interested in safety and the environment. Tank overfills have the potential to negatively impact both. More importantly, overfills can cause injury or death to people. We will review current industry practices and rely heavily on the most comprehensive approach to overfill prevention that is currently in the public domain-API 2350. Overfills typically occur because a transfer of petroleum liquid exceeds the capacity of the tank. Tanks generally receive transfers in 3 basic ways:

- From pipelines,
- From marine sources (barge or ship), and
- Transfers from other tanks at the same facility or from a process which is manufacturing the stored product.

Thus, there are at least three ways that overfills can occur. However, overfills can occur from unexpected scenarios. For example, if there is a tall tank and a short tank that are connected by piping, gravity can cause the taller tank to flow through open or failed valves to the shorter tank causing and overflow. The same applies to tanks that are at different elevations. This is commonly called "gravitating", a movement that occurs without operator intervention. An unsecured check valve has been the cause of this scenario more often. However, overfills in tanks can occur in so many ways, that there is no single method that will prevent overfills. A comprehensive approach must be taken and this includes at least the following factors:

- Operating practices,
- Written procedures,
- Training,
- Equipment systems, selection, testing, inspection and maintenance, and
- Management of change.

While it should be understood that the impact of overfilling can vary from minimal to serious, there are two impacts of concern to the industry. The other consequence of concern is frequent overfills that result in environmental damage. These collectively lead to the conclusion by the regulatory community that the industry is not sufficiently concerned with protecting the people and the environment. There is some truth to this as more can be done. Most of the occurrences of overfilling are attributed to human negligence and system failure. These incidents in recent years have resulted in loss of life and billions of dollars in damages to petroleum facilities word-wide.

Incidents of overfilling have also occurred on PPD's storage facilities repeatedly. In the wake of overfilling occurrences, the American Petroleum Institute (API) recommended practice (RP) 2350, which then was adopted by Environment Canada to protect the environment here. Therefore the most widely accepted guideline for overfill prevention of petroleum storage tanks has been revised. Vital to these new requirements is the application of level instrumentation as one part of a comprehensive Overfill Prevention System (OPS).

All of the tanks on PPD's facilities are subject to this requirement because they have capacity more than 5,000 L of combustible liquid and they receive liquid from marine vessels with the exception of those built before Jun 12, 2008. An OPS typically includes an alarm signal system and allied support systems- shutdown or diversion valves, communications, sensors, and logic solvers. OPS should be on an uninterrupted power supply. API 2350 categorizes storage tanks by the extent to which personnel are in attendance during receiving operations. The overfill prevention methodology is based upon the tank category.

Category I: Personnel must always be on site during the receipt of product, must monitor the receipt continuously during the first and last hours and must verify receipt each hour. Level instrumentation is not required but may be used. Output will be local only. The alarm may be point or continuous level devices. Termination of receipt is done manually by site personnel or by the transporter as instructed by site personnel.

Category II: Personnel must be present during the initial and final 30 minutes of the receipt. The transporter must assist in monitoring the high-high alarm. Tanks must be equipped with an Automatic Tank Gauge System (ATGS) that includes a high-high alarm and has a transmittable output signal. The level sensor would be continuous or point and a single sensor may be used for both level and high-high alarm. If a separate sensor is used for high-high level it may be point or continuous.

Category III: Personnel are not required to be present during receiving operations but are remotely located at a control centre. The transporter must monitor the level and high-high alarm. Tank must be equipped with an ATGS consisting of a level sensor and independent high-high sensor. The outputs of both of instruments must be transmitted to a control centre in real time. The level sensor will be continuous. The high-high level sensor may be continuous or point. The control centre has the ability to terminate receipt. In addition the HH sensor must automatically terminate flow to the tank or alert the transporter to terminate receipt. Failure of the ATGS must also automatically terminate flow.

9.4 Secondary Containment

Secondary containment means containment that prevents leaks and spills from the primary storage tank system from reaching outside the containment area. It includes double–wall aboveground storage tanks and piping, and impermeable barriers. Single-walled storage tanks must be installed in an impervious secondary containment with a minimum holding capacity of 110%. If one tank is on the lined area, the volume of secondary containment must be $\geq$ 110% of the tank capacity. If two or more tanks are installed on the lined area, the volume of secondary containment must be $\geq$ 100% of largest tank plus 10% of greatest volume of either largest tank or aggregate of the other.

- The containment area may also be roofed or have rain shields.
  Containment floor surfaces should extend 30 cm beyond the edge of the tanks in order to collect any dripping and enable visibility of all parts of the tanks for a visual leak inspection.

Figure 9.4: Spill

Secondary containments are generally not considered necessary for double-walled tanks. However, secondary containments can provide an extra level of protection, particularly when the tanks are located in a sensitive area. These containments are meant to confine leaks and fuel overflow. Double walled tanks and double walled piping can serve as secondary containment. For the berm area, polythene liners are used to contain the spill and leak.

9.4.1 Buried Fuel Delivery Pipes

Section 5 of CCME guidelines requires, underground buried piping and piping through berm should contain secondary containment in the form of double walled pipe or have leak detection system/Cathodic protection.

9.5 Truck to Tank Fuel Transfer Procedures

Whenever fuel is transferred from a truck to a live storage tank (90,000L or less) the following procedures must be followed:

- Walk the line from the truck fill point to the open fill valve at the tank.
- Ensure the valve at the fill point is closed; open the fill valve at the tank.
- Inspect the tank vent line, ensure there are no blockages.
- Check that the drip tray under the truck fill connection is fully drained and empty.
- Dip the fuel levels and record the readings.
- Determine the amount of fuel in the tank and the amount required to fill it.
- Ensure that the truck static line is properly connected to the fill point piping.
- Ensure that the hose is properly connected to the truck fill point and locked.

The truck-fill point and hose connection shall be of the 'Cam lock Quick Coupling' types with a dry disconnect.

It is illegal to truck fill the storage tank from the top of the tank due to potential static electricity hazards

Establish visual communication signals by hand with the driver for the start and stop of the pump and make sure you understand each other.

- Open the fill valve at the truck fill point.
- Authorize the truck driver to start pumping**.**
- During the pumping stage, walk the line to determine if there are any leaks in the filling system under pressure.
- Be in constant communication with the truck driver either visually or by radio at all times.
- Ensure that the tank is filled not more than 18" from the tank top to allow for volume expansion, or until the high level alarm is sounded if the tank is so equipped.
- Signal the truck driver to stop pumping.
- Shut off the truck fill point valve and the tank fill valve.
- Ensure that the EC-00000xxx number of your fuel system is recorded on the fuel delivery slip.
- Sign the fuel delivery slip for the fuel received and obtain a copy.
- Remove the static line.
- Empty the drip tray and clean it out.

- Dip the fuel and record (closing).
- Close the gauging hatch.
- Carry out the final inspection of the tank and the fuel pipe line. Ensure the proper valves are open and closed.

9.6 Proper Inventory Reconciliation

New EC regulations for Petroleum Products and Allied Petroleum Products Storage Systems dictates that the owner of an aboveground storage tank system or the owner's designated representative shall ensure that the product level in an aboveground storage tank containing fuels is measured and reconciled at least weekly in conformance with Sentence 5.2.2(1). The storage tank inventory control measurements shall be reconciled by comparing product measurements with dispenser meter readings, shipments, deliveries, and internal transfers. The computation of any gain or loss of product shall be recorded and included with a monthly summary of cumulative losses or gains of product.
The authority having jurisdiction shall be notified immediately in conformance with Section 5.9 when a leak or discharge is indicated by any one of the following:

- any unexplained loss of 1.0% or more of throughput in one month from an aboveground storage tank as indicated by the recording and reconciliation of inventory records done in conformance with Sentence 5.2.2(1)
- inventory reconciliations showing 4 or more consecutive weeks of unexplained product losses; and
- inventory reconciliation showing an unexplained loss in one calendar month.

Besides the compliance with EC regulations, PPD has internal requirements to reconcile the fuel inventory on regular basis so a formal inventory reconciliation program is in place. Every single tank is physically dipped at the end of each month by PPD's contractors and Tank Gauge Reports, TGR, are sent to PPD HQ every month. PPD staff reconciles the sales and verify them from TGRs. If substantial variance is found tanks are re-dipped. A significant product loss points towards an undiscovered leak or spill. On the basis of inventory reconciliation, investigations are launched to identify the source of product loss.

9.7 Record Keeping

Under the new Environment Canada regulations PPD is required to keep records of the design and installation of tank system for the life of the system. These must include a record establishing that the system was installed by an approved installer or installation was supervised by a professional engineer as well as a set of 'as-built' drawings bearing the stamp and signature of professional engineer. Records of tank inspections (API-653, leak detection), operation and maintenance and record of permanent removal of the system from service are also to be kept for at least five

years. PPD complies with this EC requirement and maintains these records at the tank farm as well as at PPD HQ.

9.7.1 Preventative Maintenance

Preventative maintenance goes a long way in avoiding the accidents at the fuel storage facility. PPD has established a preventative maintenance program to keep the fuel tanks and other accessories in good working condition. PPD's fuel delivery contractors are obligated to perform monthly visual inspection on the tank farm and submit a monthly check list. Fuel transfer pumps, overfill protection systems, corrosion prevention systems, fuel cabinets and electrical installations are all inspected regularly to identify the potential maintenance issues so that they could be tackled proactively. PPD also keeps the record of all the maintenance work done on the tank farm.

9.7.2 Ongoing Leak Detection and Monitoring

In field–erected aboveground storage tanks and horizontal shop–fabricated storage tanks, the floor rests on the ground. Regardless of whether an impermeable barrier lies beneath the floor of the tank, the term "leak detection" is used to describe a system of pipes (usually perforated) located under the floor of the storage tank. These perforated pipes transmit any leakage to the tank perimeter where the product can be observed or detected. API-650 Standard provides a number of excellent details and specifications for this type of leak detection.

Leak detection terms are complicated for underground piping. To be consistent with the CCME– EPC–61E "Environmental Code of Practice for Underground Storage Tank Systems containing Petroleum Products and Allied Petroleum Products" and to specify the required performance level or type of leak detection, the terms level 1, level 2, level 3 or level 4 are attached to the term leak detection. A precision leak test should also be discussed. Since leaks from aboveground piping can be easily observed so sophisticated leak detection systems are not required.

Level 1, Leak Detection: Leak detection capable of detecting leaks of less than 0.38 L/h with a probability of detection of 0.95 and a probability of false alarm of 0.05. Pressure testing of piping will often meet level 1 performance. An alternate method of level 1 leak detection is to add tracer compounds periodically to the petroleum product and then sense for the tracer. Precision leak detection is considered a level 1 response as well. Although statistical inventory analysis might qualify as level 1 leak detection, it would not qualify as a precision leak test because the data is typically acquired over a period of 30 days.

Level 2, Leak Detection: Level 2 leak detection means a device or method that is capable of detecting a leak of 0.76 L/h with a probability of detection of 0.95 and a

probability of false alarm of 0.05. If the pipe is larger than 75 mm in diameter, secondary containment is not required (although it is recommended). In some cases a line–leak detector may work. However, in large–diameter pipe and/or with long pipe runs (for example, an airport hydrant system), line–leak detectors are not suitable. In these situations, level 2 leak detection is required. There are several types of level 2 leak detection. Some are only suitable for underground storage tank systems with underground piping and an accurate product flow meter or dispenser (typically retail service stations).

Statistical inventory reconciliation is a level 1 or level 2 leak detection method are suitable for underground storage tanks and piping, but it is not suitable for use with underground piping connected to an aboveground storage tank. Groundwater monitoring or vapour monitoring are types of level 2 leak detection that may be suitable for larger diameter piping. Product vapour pressure and subsurface conditions (soil type, depth to groundwater) are significant factors in determining whether one of these types of leak detection is suitable for a particular site. Leak detection methods that provide level 1 performance would of course be considered satisfactory level 2, leak detection.

Level 3, Leak Detection: The Level 3 leak detection means a device or method used in pressure piping that operates whenever the submersible pump starts up. It is capable of detecting a leak of 12 L/h with a probability of detection of 0.95 and a probability of false alarm of 0.05. Here provided by line–leak detectors that are located on the primary pipe. Product passes through the line–leak detector.

These devices sense a change in petroleum product pressure when a submersible pump starts up. Line–leak detectors are normally used at retail service stations and card locks that have submersible pumps and constantly pressurized piping. These devices are capable of quickly detecting large leaks (approximately 12 L/h). Some line–leak detectors are also capable of detecting small leaks as in level 1 or level 2, leak detection. Line– leak detectors are not available for pipe greater than 100 mm in diameter.

Level 4, Leak Detection: Level 4 leak detection means a device or method that is capable of detecting a leak with a probability of detection of 0.95 and a probability of false alarm of 0.05: before the monitoring sump or interstitial space fills to 50% of its capacity by volume, or before 600 L has leaked, whichever comes first.

Underground piping of 75 mm in diameter or less must have secondary containment, typically in the form of double–walled piping. With double–walled piping, the secondary or outer pipe typically drains to a sump where a level 4 leak detection device (a product or water sensor) detects the petroleum product or water. Probes may also be located in the interstitial space between the primary and secondary piping. When the leak–detection device is not an electrical device (such as a

monitoring well or statistical inventory reconciliation), electrical interlocks may not be possible. Even with the present mechanical type of line–leak detectors, a line leak within a submersible pump system can result in large volumes of product being pumped into the ground. Leaks from submersible pump systems have been the cause of some of the largest environmental and safety incidents. Where line–leak detectors are used, they shall not be bypassed when problems are encountered when dispensing the product. Line–leak detector means a device used in pressure piping systems to detect a leak in the piping.

Prior to implementation of new EC regulations on the Tank Systems for Petroleum Products and Allied Petroleum Products in Jun 2008, there was no leak monitoring or leak detection mandatory requirement. Under these new regulations PPD's tank systems have specific requirements for leak detection and monitoring which must be in place by June 12, 2010. In Arviat, all tanks are either double walled or have secondary containment. However, leak detection requirements are still applied to this facility. PPD's fuel delivery contractor conducts a monthly visual inspection for leak detection.

9.7.3 Tank Farm Design and Spill Containment

In Arviat, the tank farm is fully lined and bermed. It is capable of containing the largest possible spill within the lined areas. A large enough spill catchment basin was also constructed as an integral part of the tank farm to contain largest possible spill on the facility.

The design of tank farm provides natural slope towards the spill basin and directs the flow of fuel and water towards the basin. During spring thaw, basin presents the scene of a big pool full of water. Water has to be pumped out of the basin every year. Years must have affected the strength of liner but there is no evidence of substantial damage to liner integrity otherwise water would have not been standing there. There might have been a number of spills on the facility since the time of its construction and the subsoil has been facilitating the migration of fuel to the spill basin so it is expected to have high water/fuel conduciveness and porosity. Any spill within the lined area is expected to migrate to the catchment basin due to tank farm design.

9.8 Preparedness to Combat Emergency

Under the obligations of the *Environmental Emergency Regulations*, Petroleum Products Division of Government of Nunavut is demonstrating its preparedness to deal with potential incidents by:

- Identifying potential risk
- Documenting alternative scenarios and potential consequences
- Developing environmental emergency plans to mitigate the risks

- Training personnel to apply the environmental emergency plans
- Reviewing and practicing the incident preventative strategies regularly

While developing the Environmental Emergency Plan, PPD involved the key stakeholders to enhance the level of preparedness. The local fuel delivery contractor is the first responder to any emergency on the tank farm, therefore their inputs were incorporated into the plan. PPD as a regulatee has identified and ensured adequate capabilities and resources do exist to enable staff of local fuel delivery to safely respond to full range of potential emergencies. During the preparedness planning, PPD did recognize that depending on the significance and possible escalating of particular events, the facility's capability and resources to effectively respond may be inadequate. In such instances PPD has directed the fuel contractor to obtain the required sources and equipment through arrangements and mutual aid agreements with other community stakeholders.

PPD prepares itself to identify the gaps and tries to fill them by upgrading the equipment, expanding the emergency response staff and by increasing the communications between community stakeholders and public safety agencies. PPD's preparedness sets out to identify all activities essential to ensuring a high degree of readiness for a prompt and effective response to an environmental emergency. GN/PPD arranges drills and exercises as well as effective training for key personnel in and around the fuel tank farm to provide the means of testing the facility's resources and equipment and also raise awareness.

PPD's fuel delivery contractor keeps heavy equipment and has been advised to regularly maintain and test the equipment to ensure they are readily available. An inventory of equipment currently available on and off the site along with the quantity, location, description, intended use and capabilities are retained and accessible to responders. PPD intends to review this emergency plan regularly to ensure that changes within the facility are integrated into the plan. By implementing effective prevention measures, preparing personnel and implementing an environmental emergency plan, PPD and contractors can determine the necessary level of preparedness for each situation.

9.8.1 Spill Response Supplies

Environment Canada requires PPD to list the type and location of equipment that would be used in emergency scenarios such as shovels, spill kits and fire extinguishers. If only a small amount of equipment is needed then a simple text description of the locations may be sufficient. If the emergency plan requires a large quantity of onsite equipment, it may be easier to provide locations using a diagram or map of the site/area. Spill kits are kept in the Arviat operator shelter. The fuel delivery

contractor will provide hand tools, a light vehicle, and a back how should the need arise for the emergency response team.

Figure 9.5: Absorbing pads being applied on spilled products

9.8.2 Heavy Equipment

In Arviat, PPD's fuel delivery contractor is not a local construction contractor. Therefore a different contractor who keeps all kinds of heavy equipment (e.g. loader, bulldozer, dump truck, back hoe, excavator, etc.) would have to be found. The Hamlet has its own machinery which could be borrowed if fuel contractor's equipment proved deficient.

9.8.3 Spill Response Team Readiness

PPD has advised all fuel delivery contractors to form their Emergency Response Teams comprising of the people living within the community and could be available when a need arises. It is the fuel delivery contractor's duty to keep Personal Protective Equipment ready all the times (e.g. Nomex coveralls, Gloves, Steel toe boots, Goggles, Hard hat).

9.8.4 Fire Extinguishers

Four fire extinguishers are made available at different places within the tank farm fenced area whereas one is in the operator shelter. As a part of equipment inspection and testing program PPD ensures that all the fire extinguishers are kept in good working conditions. The inspection and testing date and time are documented and maintained at the location of the equipment as well as at PPD HQ. From time to time representatives of Fire Marshal visit the fuel storage facilities. They do inspections on these fire extinguishers and inform PPD if they are not properly maintained.

9.8.5 Provision of Corrosion Prevention Mechanisms

Maintaining the integrity of metallic structures is helpful in preventing emergency situations. Depending upon the structure to be protected, different corrosion protection techniques are employed;

1. Cathodic protection

Cathodic protection or cathodically protected means a method of preventing or reducing corrosion of a metal surface by making the metal a cathode using either an impressed direct current or attaching sacrificial anodes.

- Sacrificial anode systems
- Impressed current systems

2. Corrosion resistant coating

All the tanks and aboveground piping are coated with weather resistant paints. In some communities jet tanks are epoxy lined internally to prevent corrosion. Under the latest EC regulations, maintenance checks on the operation of cathodic protection systems shall be conducted in conformance with: API RP 651, "Cathodic Protection of Aboveground Petroleum Storage Tanks". Cathodic protection measurements conducted in conformance with Article 5.5.1 shall be considered satisfactory if:

- the measured surface potential for underground piping is equal to or greater than 850 mV negative using a copper/copper sulphate reference electrode; and
- the measured surface potential for the aboveground storage tank meets the criteria of a corrosion expert.

If corrosion protection monitoring conducted in conformance with EC requirements indicates inadequate protection, corrective measures shall be taken within 180 days to ensure that the measured surface potential conforms to the requirements.

9.8.6 Warning and Safety Signage

Petroleum storage tanks should be labeled on at least one side (preferably both) with the name of the product stored in the tank (gas, diesel). The words “Flammable - Keep Fire and Flame away”, and “No Smoking - Ignition Off” should also appear on the tank and near the dispensing area. These warning signs should be visible when refueling.

All the tanks at Arviat tank farm have been identified with Environment Canada under three identification numbers, which have all displayed on the respective tanks. Each tank has been labeled with tank number and product type. The tank farm is a secured and locked facility. For the safety of the contractor staff and general public,

signs such as “No Trespassing”, “Watch your step”, “Slippery when wet” are also placed at the appropriate places.

9.8.7 Securing the Valves and Joints

Valves and joints are potential sources of fuel leak, therefore they should be inspected regularly. PPD’s fuel delivery contractor at Arviat has been provided with locks and chains to keep all the valves locked when they are not opened. Flex connectors are also checked and replaced when needed. Resupply connections at the shore manifold are also kept locked and secured.

9.8.8 Arrangements for Marine Resupply

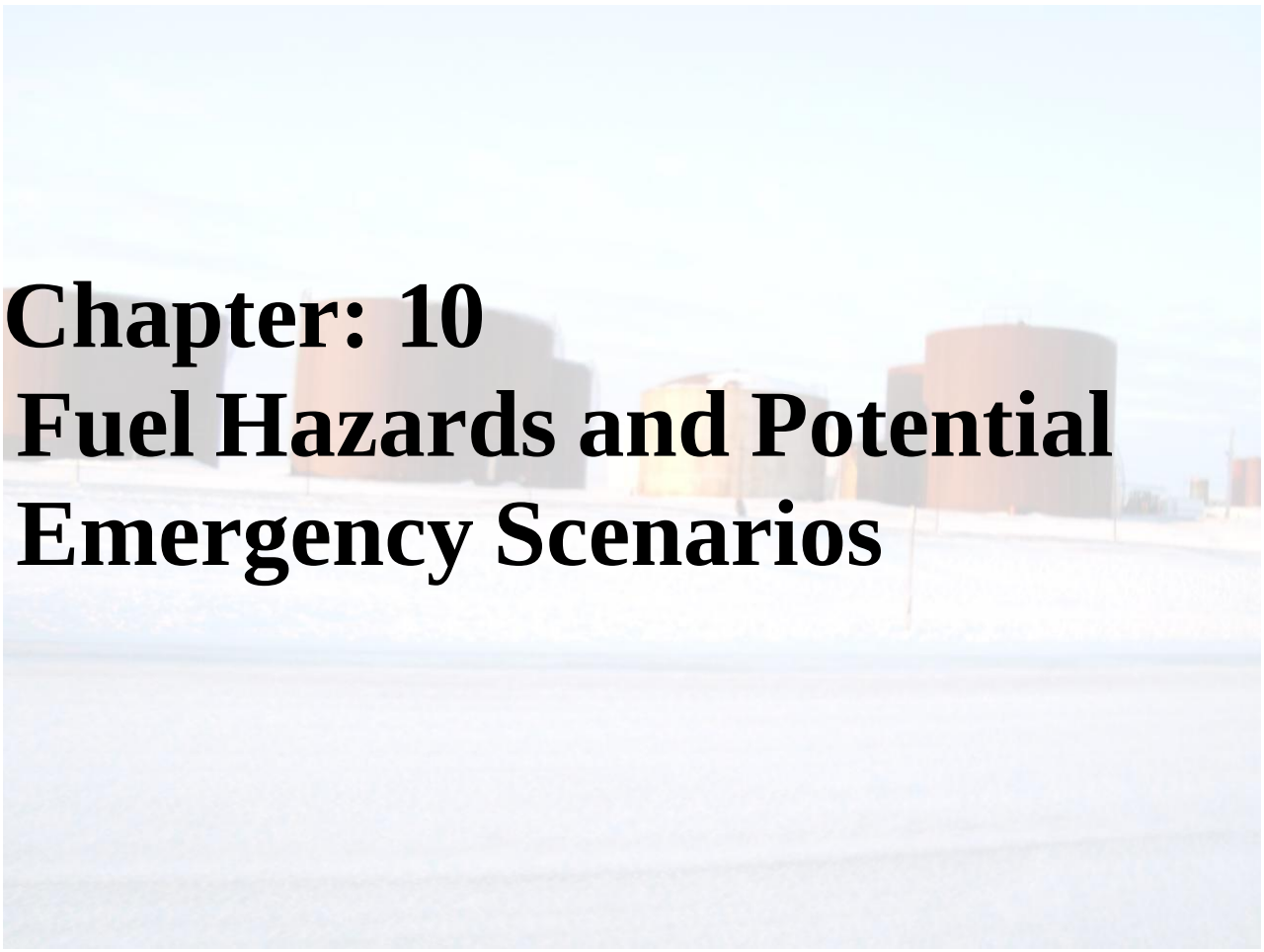
Annual fuel resupply is the biggest routine event of PPD’s operation. To manage and safely offloading the fuel require lot of experience and attention. In Arviat, once the tanker is ashore resupply takes 3-4 days, depending on weather conditions. Before starting resupply, all the spill response supplies are kept handy and necessary equipment is tested to ensure their operability. Mooring and vessel anchorage is properly done before off-loading the fuel.

9.8.9 Product Transfer Area

Under new EC regulations, all fuel storage tanks were to be upgraded to have a product transfer area designed to contain spill by June 12, 2008. The product transfer area is the place where product is transferred from one system to another. E.g. sea vessel to resupply line, shore manifold, truck fill area close to fuel dispenser and around the gas bars. PPD has provided lined and bermed transfer areas to contain the possible spill while transferring the product.

At the tank farm, transfer areas are properly constructed close to the diesel and gasoline dispensers. These areas have been extended to at least three meters- the distance between the fueling vehicle and fuel tank. Hoses and nozzles are main equipment used in these areas. The transfer areas are likely to have a leak or spill due to equipment failure, human error and corrosion. We have mitigated the dangerous effects of spill by running a preventative maintenance program and keeping inventories of the spill response supplies on the hand. A lined and cemented transfer area has also been provided at the shore manifold. The capacity of area has been ensured to hold enough fuel before measures to stop the release can be taken.

Figure 9.6: Shore manifold, two bollards for ship anchorage are ready to be installed (on the right)



Chapter: 10
Fuel Hazards and Potential Emergency Scenarios

10.1 Natural Hazards

Like all businesses and infrastructures, PPD's operation and fuel storage facility is susceptible to natural hazards. The time table for these phenomena is mostly unpredictable. Despite tremendous scientific developments and technological advancements the onset pattern and to how reduce the severity of natural events is still beyond the control of mankind. On the other hand, now we are well equipped with knowledge and machinery to contest these unforeseeable and controllable incidents. With proper planning and lesson learnt from our past experiences we can develop a better risk mitigation strategy to safeguard people and the environment from the detrimental effects of these disasters. Being on the open tundra tank farm is vulnerable to severe weather condition like heavy snow fall, blizzards and tornadoes. High winds have the potential to distort tank structure, especially when they are under construction.

Drought, fog and earthquake have their own consequences. To transfer the risk associated with these natural events, all GN owned tank farms, including the one at Arviat, are insured for their replacement in case some or all storage capacity is depleted due to damage caused by natural catastrophes. The GN/PPD renews the insurance policy every year, however the resulting environmental damage is not insured. The GN/PPD, as a responsible party, does due diligence to repair such damage when need arises. PPD, local fuel delivery contractor, GN Emergency Preparedness Services and community stakeholders develop a collective combat approach and stand by each other to mitigate the damages. Some of the common hazards have been thought of and their probability and impact along with risk management strategy has been tabulated in attached risk matrix.

Natural Hazards				
Hazard	**Probability**	**Impact**	**Risk Score**	**Risk Management Strategy**
Drought	2	1	2	Weather watch/Warinings
Land Fire	1	10	10	Execute Muncipal Energy Management Plans
Fog	6	1	6	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training
Blizzards	5	2	10	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training
Heavy Snow	3	1	3	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training
Thunder Storms	1	2	2	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training
Hail Storms	1	2	2	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training 4-Buy Insurance
Lighting Stomrs	1.5	1	1.5	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training 4-Buy Insurance
Tornadoes	1	10	10	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training 4-Buy Insurance
Extreme Heat	1	8	8	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training 4-Buy Insurance 5-Stress safe work places
Extreme Cold	8	1	8	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training 4-Buy Insurance 5-Stress safe work places
Earthquakes	0.5	10	5	Passive risk acceptance
Landslides/ Mudslides	0.5	8	4	Passive risk acceptance
Floods	2	5	10	1-Weather watch/ Warnings 2-Use communication systems 3-Driver Training 4-Buy Insurance

Table 10.1: Risk matrix for natural hazards

All fuel related emergency situations are linked one way or the other to unwanted and uncontrolled release of fuel to its environment. These incidents have potential to cause danger to human life or health and harm the physical environment. This plan has been developed to deal with the emergency related to all the petroleum products PPD stores and sells in the community of Arviat (i.e. diesel, gasoline and jet A-1). Since the petroleum products share their physical and chemical properties and hence the injurious effects on the human beings and their physical environment so this single Environmental Emergency Plan can work for them.

10.2 Toxic Nature of Fuel

All hydrocarbon gas category members contain primarily hydrocarbons (i.e., alkanes and alkenes). When inorganic components are present they consist of asphyxiate gases such as hydrogen. Unlike other petroleum product categories (e.g. gasoline, diesel fuel, lubricating oils, etc.), the constituents of hydrocarbon gases can be evaluated for hazard individually, and the results of the constituent evaluation can then be used to predict the screening level hazards of the Category members. The constituents used to evaluate the hazards of Hydrocarbon Gases Category members are:

- Hydrocarbon Gases Benzene,
- 1,3-Butadiene,
- C1 – C4 Hydrocarbons,
- C5 – C6 Hydrocarbons o Asphyxiate Gases,
- Carbon dioxide,
- Hydrogen gas, and
- Nitrogen gas.

The screening level health hazards associated with Petroleum Hydrocarbon Gases have been characterized by the constituents of each petroleum hydrocarbon gas. Each specific gas constituent could be adjusted in the respective petroleum hydrocarbon gas. This adjustment for the dilution of each component in a petroleum hydrocarbon gas represents the calculated concentration of the petroleum hydrocarbon gas required to reach the toxicity value. In many cases, there is more than one potentially toxic constituent in a petroleum hydrocarbon gas. In those cases, the constituent that is most toxic for a particular endpoint in an individual petroleum hydrocarbon stream is used to characterize the endpoint hazard for that stream.

The hazard potential for each mammalian endpoint for each petroleum hydrocarbon gases is dependent upon each petroleum hydrocarbon gas constituent endpoint toxicity values and the relative concentration of the constituent present in that gas. It should also be noted that for an individual petroleum hydrocarbon gas, the constituent characterizing toxicity may be different for different mammalian endpoints, again, being dependent upon the concentration of the different constituents in each, distinct petroleum hydrocarbon.

Hydrocarbon based fuel affects the nervous system ranging from a headache to death. The kidney and liver could also be damaged by fuel vapours. Aspiration into lungs can cause severe lungs damage leading to pulmonary edema and bronchial pneumonia. Exposure to petroleum hydrocarbons by skin contact may aggravate dermatitis. Prolonged or repeated inhalation exposure to high concentration could cause liver tumors. Benzene, an essential component of hydrocarbon fuels, is known

for its carcinogenic nature. High vapour content or liquid concentration can irritate eyes. If swallowed may cause nausea, irritation, vomiting, diarrhea and depression.

10.3 Fuel Related Emergencies

There could be many different ways constituting unintentional release of fuel into the environment. In Arviat all three products are transferred from tank farm to customers by fuel delivery trucks; everyday aircrafts are refueled by truck, diesel is transferred to NPC facility on regular basis by truck. Almost daily a few truckloads of home heating diesel are supplied to customers by truck. Considering the scale of truck filling requirements from the tank farm it is highly likely that fuel overflows while truck filling.

Overfill protection is being provided on each truck but failure of the system and human error can cause an overflow. The best strategy is to put all the overflow preventative measures in place and stay prepared to deal with the overflow. Adequate inventory of spill response supplies are maintained at the tank farm. An EC approved fuel transfer area can also limit the damage to environment in case of spill. Right now none of the eight vertical tanks on the new tank farm have overfill protection so an extra care needs to be taken while refilling these tanks through marine resupply.

A variety of incidents can initiate a fire on the tank farm. PPD recommends safe and approved practices for tank cleaning, fuel transferring, tank dipping and regular maintenance to avoid such incidents. Necessary training is also arranged to mitigate the chances of any mishaps. Staff from PPD HQ and from PPD regional office visits each community twice a year to ensure the integrity and worthiness of the overall infrastructure. The probability and impact of some fuel related emergencies are tabulated below along with their risk management strategy.

Fuel Related Emergencies				
Hazard	**Probability**	**Impact**	**Risk Score**	**Risk Management Strategy**
Fuel Truck Overfill	5	5	25	1-Overfill system 2-Trained truck driver 3-EC approved fuel transfer area 4-Readiness to implement Environmental Emergency Response Plan
Continuous Leak	2	4	8	1-Developing preventative maintenace program 2-Ensuring secondary containment 3-Exercising routine visual inspection 4-Readiness to implement Environmental Emergency Response Plan
Tank Overill	5	7	35	1-Overfill alarm sysems 2-Trained operator 3-EC approved fuel transfer area 4-Readiness to implement Environmental Emergency Response Plan
Fire	5	8	40	1-Readiness to implement facility and gas station evacuation plan 2-Trained personne 3-Ongoing coordination with local fire department 4-Readiness to implement Environmental Emergency Response Plan
Fuel Spill	4	6	24	1-Availability of spill response supplies 2-Trained personnel 3-Ongoing coordination with community stakeholders 4-Readiness to implement Environmental Emergency Plan

Table 10.2: Common fuel related incidents causing emergency

10.3.1 Persistent Fuel Leak

The entry of fuel to air, soil and water has long lasting effects. If the storage and transportation of fuel is not properly monitored a leak can go unnoticed for an extended period of time. A small leak may not go beyond the lined area but it could be a source of fuel loss while polluting the local atmosphere. Air with high concentration of hydrocarbon vapours is not fit for breathing. Also, a continuous small fuel leak can create an ignitable air mixture in the vicinity of the source, which in turn can result in a fire or explosion on the availability of ignition sources. Under the new EC regulations, leaking storage tank systems must be withdrawn from service immediately. Environment Canada has also made leak detection mandatory. The initial test has been described on all single-walled underground piping and aboveground piping without secondary containment. A permanent leak detection and monitoring program has been recommended. As an ongoing tank farm inspection program, the local fuel delivery contractor makes a thorough visual inspection on tanks, valves and piping and submits a furnished inspection checklist to PPD on monthly basis.

10.3.2 Fire or Explosion at the Tank Farm

Fire or explosion is an incident that could occur at the tank farm with most devastating effects; it will not only damage the environment but also destroy the property. There could be more than one reason for the fire to start. Most likely the facility is built on permafrost. Under the influence of global warming subsoil can get unstable resulting into the collapse of facility causing the spill and hence the fire. Changes in the earth crust have potential to destabilize the tank foundation but geographically Arviat is not known to be close to any earth crust fault which otherwise could give rise to earth quake or so. Unsafe tank cleaning practices and maintenance by untrained personnel using unapproved tools and equipment may initiate a fire or cause explosion. An ignited fuel vapours may result in a major fire in the dike area around the tank as well as a fire at the surface level of the tank.

Figure 10.1: Pipe Leak

Figure 10.2: Fire

The best rule to avoid the fire is not to let Fire Triangle complete, fuel vapours, and air and ignition source. Fuel vapour concentration should be monitored and controlled within safe limits on the facility. We cannot control the air. Many things can act as an ignition source such as smoking, using equipment those are not intrinsically explosion proof and instant static charge etc. In case of fire, emergency could be three dimensional:

- To control the fire
- To mobilize the medical efforts to deal with the medical emergency
- To address the shortage of fuel

In case of a large fire incident, emergencies will be dealt with by the collective efforts of PPD and locals who might have firefighting training. PPD holds the responsibility to provide technical support on how fuel initiated fire could be controlled and what safety precautions need to be taken to avoid fire/fuel related causalities. However, other community stakeholders will have to contribute to emergency efforts for the development of an effective and practicable Emergency Response Plan.

10.3.3 Fuel Spill

The greatest concern with a tank is the possibility of an overflow spill. There is a potential for large spills and if a tank keeps overflowing unnoticed or if a line ruptures or becomes disconnected.

10.3.4 Effect on Aquatic Life

All the three petroleum products have many toxic effects on aquatic life. The entry of PHCs could result in potential acute toxicity to some form of aquatic life. Oil coating of birds, sea otters or other aquatic life which come in direct contact with the spilled oil is another potential short term hazard. In the short term spilled oil tends to float on the surface. Water uses threatened by spills include recreation, fisheries, industrial, and irrigation. The spill product could combine with black oil and can cause mortality of marine fish.

10.3.5 Groundwater Contamination

Any addition of undesirable substances to groundwater caused by human activities is considered to be contamination. It has often been assumed that contaminants left on or under the ground will stay there. Groundwater often spreads the effects of spills far beyond the site of the original contamination. Groundwater contamination is extremely difficult, and sometimes impossible, to clean up.

Nationwide leaks of petroleum products have been increasing over the last two decades because underground steel tanks installed in large numbers in the 1950s and 1960s have become corroded and are leaking now. Although PPD does not have any underground fuel storage, common leaks and spills can pollute the groundwater if not contained properly.

Groundwater dissolves many different compounds and most of these substances have the potential to contaminate large quantities of water. Potential long-term hazards of the some of the lighter, more volatile, water-soluble aromatic compounds in petroleum products can include the contamination of groundwater. For example, one liter of gasoline can contaminate 1, 000, 000 liters of groundwater. This problem is particularly severe in the Atlantic and Arctic regions where there is a high usage of groundwater. In many cases, the problem is noticed long after the aquifer is contaminated, for example, when consumers start tasting or smelling gasoline. Most chronic effects are associated with the exposure of aromatic (Benzene, Toluene, Ethyl benzene, Xylenes) compounds of petroleum hydrocarbons.

10.3.6 Soil Contamination

The entry of petroleum products into the soil impairs its usefulness. Therefore a Canada Wide standard has been developed to categorize the soil contamination. Soil contamination commonly occurs when petroleum storage and handling systems leak and fuel spills contaminate surrounding soils, or when repeated overfills, surface spillage and housekeeping losses result in a contaminated area. When this occurs, the soil acts as an on-going source of contamination which may need to be remediated to prevent it from continuing to be a source of pollution. For the purposes of this emergency plan, refined petroleum hydrocarbons includes any mixture of hydrocarbons that is or could be used as a combustible fuel and includes gasoline and diesel fuel. One of the most practical ways for treating petroleum contaminated soils is by some form of land surface treatment whereby petroleum contaminated soils are applied onto the soil surface and periodically turned over or tilled to aerate the contaminated soils to enhance the volatilization and biodegradation processes. To facilitate prompt remediation of the soils, they must be spread thinly and ploughed regularly.

Tilling the soils promotes volatilization (evaporation) of the lighter portions while the remaining compounds are immobilized within the soil mass and breakdown biologically. Naturally occurring soil micro-organisms such as bacteria and fungi combine with sunlight, oxygen and moisture to biodegrade (breakdown biologically) the petroleum products. Soils which have been successfully remediated are acceptable for reuse, either as intermediate or final cover at municipal waste disposal sites.

10.4 Sabotage and Vandalism

All the PPD's fuel storage facilities are fully fenced and locked. Local fuel delivery contractors keep the keys. Only authorized personnel have access to the interior of the facilities. Unauthorized trespassing is always possible especially when the facility could not be guarded round the clock. Like natural events, sabotage and vandalism is also unpredictable but our vigilant and watchful behavior can reduce the chances of such incidents. The sooner the damage caused by these incidents is noticed/discovered, the better the remedy and recovery possible. This again stresses on regular facility inspection.

Figure10.3: Sabotage

10.5 Fuel Truck Flipping

Fuel trucks are always on the road making deliveries. All of the roads in Arviat are not paved. Snow and weather make them rough and treacherous, therefore fuel truck flipping is an imaginable incident. Properly dealing with a fuel spill resulting from a turning over a truck, should also be part of PPD's emergency plan. Some fuel absorbing pads and rolls are recommended to be carried on all the trucks. The fuel truck driver should be trained to adequately respond to the situation.

10.6 Fuel Quality Related Emergencies

PPD understands that fuel quality related issues have little to do with environmental emergencies but they have the potential to disrupt PPD's operation. The fuel supplied by marine resupply could go off specs necessitating its temporary storage or transfer to slop tanks. Quality related issues render the fuel unusable causing fuel shortage within the community so fuel will have to be air lifted in on emergency basis. All the situations could constitute an emergency scenario that requires pre-planning.

10.7 Marine Fuel Resupply Goes Wrong

The Arviat fuel storage facility is replenished at least once a year by sea borne fuel tanker. The vessels are fairly large with multimillion liters capacity of fuel. They need to be properly secured before fuel offloading could be started. In Arviat, proper mooring and shore bollards are available for tanker anchorage. Blizzards are frequent in Arviat so they can interrupt the oil transfer operations with potential risk of fuel spill into the water. In the event of spill, Transport Canada and Canadian Coast Guards are to be informed. The spill cleanup is the joint responsibility of PPD with marine carrier and local fuel delivery contractor. PPD will ask for assistance from the Canadian Coast Guard, if the incident involves a fuel discharge of more than 100 liters at the PPD shore manifold.

Figure 10.4: Shore manifold

Figure 10.5: Resupply underway

Fuel Delivery Contractor: Woodward
Address: Woodward Group of Companies , PO Box 300, Station C
Happy Valley- Goose Bay, NL A0P 1C0
Contact Number: 709 896 2421
Name of the Vessel (Oil Tanker): Nanny

10.8 Types of Vessels Unloaded at the OHF

- Oil Tanker – 19-20 Million Liters Cargo Capacity.
- Fuel Off-loads between July and October.
- Distance Vessel to Shore Manifold – 1 Km.
- Floater Hose – Between 800 and 1,000 m. in length, 4 in. diameter, 6,488 to 8,110 liters volume.
- Hose pumping rate – 75,000 liters/hr.
- Potential size of pollutant – 12,500 liters.
- Category of Oil Handling Facility is Level One.

Figure 10.6: One of the ships used to haul fuel to PPD Oil Handling Facilities.

The maximum oil transfer rate from vessel to fuel storage tanks in Arviat tank farm is 75 m^3 /hour. This will rate the Arviat tank farm a **"Level One Facility".**

10.8.1 Tides and Currents

- Tides are 3 to 4.5 meters.
- Currents move southward.
- Tidal streams – 2 knots on ebb, 5 knots on flood.

10.8.2 Environmental Sensitivities

- Polar Bear den areas inland – safety of responders & wildlife issues.
- Polar Bears roam coastal areas until freeze-up.
- Fall (September) migration route for beluga whales.

10.8.3 Maximum Most Probable Case Scenario

- Potential amount of Pollutant released – 12,500 liters.
- On-scene weather July – Wind N @ 5 Km/hr. Temp. +20C.
- On-scene weather August – Wind NW @ 15 Km/Hr. Temp. +10 C.

10.8.4 Staff for Monitoring

- There are 2 shore patrol officers and 4 ship operators on duty.
- There are 2 boat patrol officers checking the hose-line.

10.8.5 Notifications of Incident Commander

- The 24 Hour Spill Line is notified at 1-867-920-8130.
- CCG Sarnia is notified at 1-800-265-0237.
- PPD Headquarters is notified at 1-867-645-8400.

10.8.6 Initial Response Actions of Shore and Ship Operations

- A shore patrol officer smelt diesel or saw a leak and notified the ship to cease pumping.
- The ship stopped pumping for source control, within two minutes.
- Evacuate Personnel, if required within five minutes.
- Acknowledge notification process as completed within ten minutes.
- Control measures initiated within one half hour.
- Local Government, Hamlet and Private Contractors are dispatched to the scene within one hour.
- Response to this incident likely to terminate from 1 to 3 days.
- Clean-up may extend to one month depending on effectiveness of initial response.

10.8.7 Containment Strategies of Shore and Ship Operations

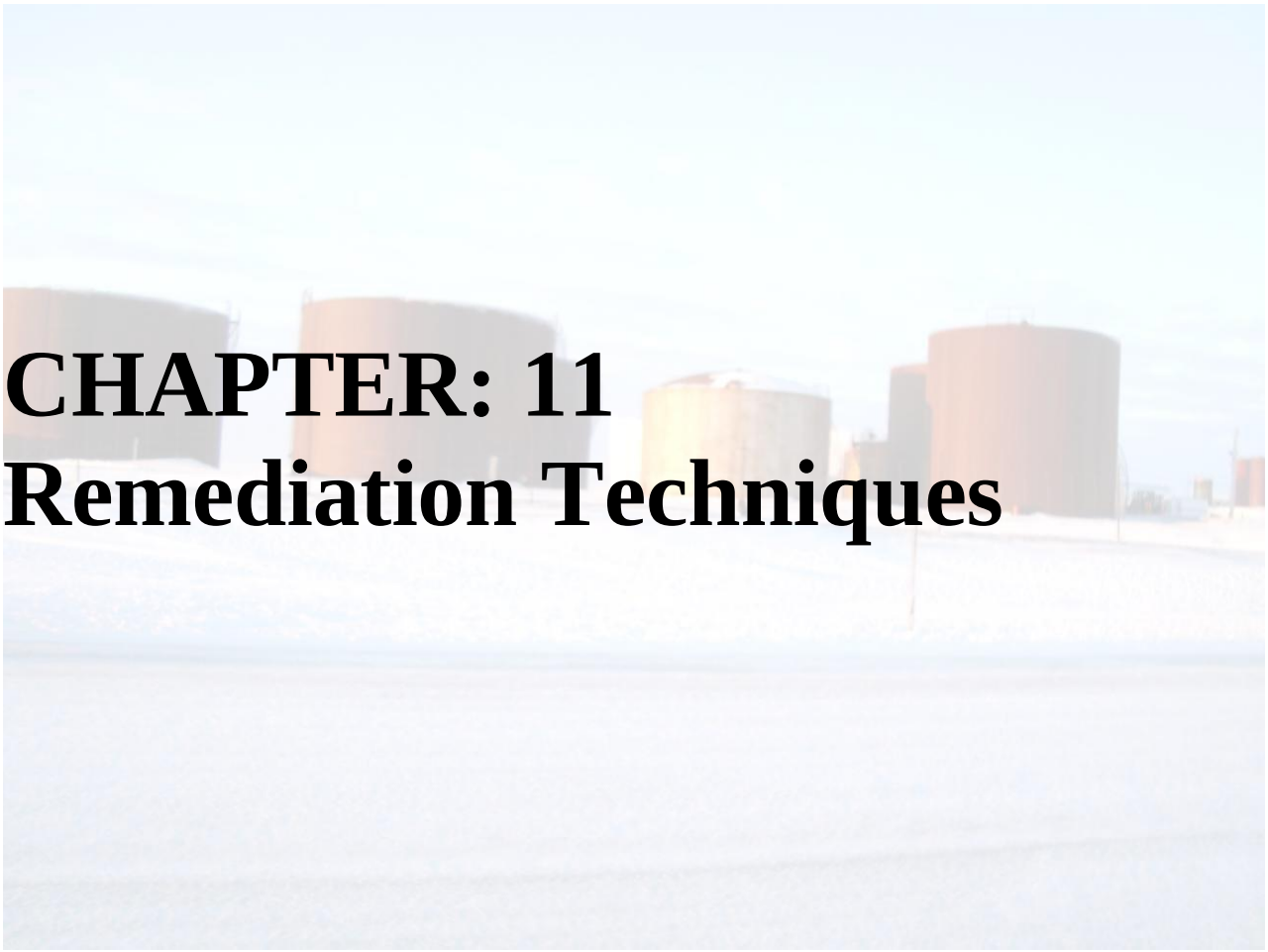
- Deploy containment equipment from the ship and the Sea Cans on shore to the spill site within one half hour.
- The containment equipment will prevent product from reaching the open waters of Hudson Bay by containment booming around the problem area. Boom failure is likely due to changing tides.
- Expect tidal flat clean-up.
- Shoreline protection is recommended.

10.8.8 Resource Personnel

- PPD Headquarters will hire local workers with qualifications required to assist in containment and clean-up.
- Local Contractors will be hired to assist in the clean-up within 6 hours of the initial response.

10.8.9 Resource Availability & Resource Procurement

- Equipment – absorbent material will be required for this size of spill.
- The Sea Cans have 1500 feet of 24 inch boom to contain the product in the water and the ship will provide any additional booming equipment.
- PPD Headquarters will procure Monetary Resources and Resource Personnel until the completion of the clean-up.



CHAPTER: 11
Remediation Techniques

11.1 Remediation Techniques

In cold regions like the Nunavut territory, oil and fuel spills are among the most extensive and environmentally damaging pollution problems constituting potential threats to human health and ecosystems. There is evidence that spills are more harmful in cold regions and that ecosystem recovery is slower than in warmer climates. In this environment the rate of natural attenuation is very slow and the rate of off-site migration is often relatively fast. The remediation of petroleum contaminated soils is much more expensive in polar and sub polar regions than in developed temperate regions.

Dig-and-haul and offsite treatment is particularly expensive, such treatment is also environmentally damaging because the soil that is removed is essentially destroyed, while the underlying permafrost can be degraded. Low-cost, on-site remediation alternatives have not been widely adopted in these regions, largely because problems such as remote access, high energy costs and environmental factors must be managed to achieve accelerated clean-up. Environmental factors include low temperatures, spatially and temporally-variable water distributions, low nutrients and soil heterogeneity. Soils with high water contents typically have low oxygen diffusivities and associated low oxygen levels which, when coupled with other limitations such as low temperatures and low nutrient availability, can reduce natural biodegradation to nearly negligible rates.

Few studies have evaluated the effects of increased aeration on hydrocarbon contaminant degradation in Arctic soils. Although their studies did not directly evaluate soil aeration, Reynolds et al. (1998) observed that longer hydrocarbon half-lives were associated with areas of a Fairbanks (Alaska, USA) land farm that tended to remain saturated for longer periods after rain, indicating that poor aeration may have limited bioremediation. Similarly Yeung et al. (1997) found that the half-life of crude oil in contaminated soil was reduced from 248 to 182 days by providing aeration to a bio-treatment cell in Alberta, Canada. Research quantifying the relationship between soil oxygen levels and hydrocarbon biodegradation in cold region soils is lacking. However, several studies (such as those cited above) indicate that rates of degradation may be increased by aerating oxygen limited soils. Research on biodegradation of naturally occurring organic material (NOM) in northern soils also demonstrates that degradation of these materials in wet environments is limited by lack of oxygen and can be accelerated by providing aeration.

Figure 11.1: Recovery Cycle

11.2 Land Containment

11.2.1 Trenches

Earth trenches are practical only under *summer* conditions. The trench must be dug to bedrock or impermeable ground. If water is present in the excavated trenches, it should be assumed that contamination could result and eventually be discharged into surface waters. A waterproof liner may be placed on the bottom and sides of the trench to prevent seepage. Shallow trenches placed down slope of the spill will be effective in trapping fuel from surface run-off and if care is taken from slightly below the surface. Trenches can be dug to divert the oil away from environmentally sensitive areas and streams. The material and equipment needed for trench construction are a backhoe, loader, dozer, shovels, picks and waterproof liners.

Figure 11.2 Trenching in sand, snow and ice

Sand and rocky ground conditions are common as well as snow and ice. In some ways these conditions are good because the spill will not penetrate rock or ice as readily. It is then a matter of steering the flow into a suitable position for easy recovery down slope. A natural depression down slope can be used for temporary containment along with a plastic liner.

Snow actually makes a very good sorbent, particularly when it is light and dry much like the snow that is prevalent above the tree line. The contained snow can then be disposed of with an approved and suitable oil-water separator. In some ways these conditions may hinder spill containment. Sand will allow fuel to filter through until it hits permafrost. The oil will then flow with the slope beneath the surface layers and make guiding the spill difficult. It is important not to let this happen, if at all possible.

Oil can also lower the freezing point of ice and snow. The slushy mix that results will flow as steady as syrup. The oil flow can also create its own trench and form tunnels that cannot be seen from the surface. It is important to know how much is flowing and the direction of flow to effectively steer and contain the spill. See the figure “Plywood Barriers” later in this chapter as they can be used for diverting a land spill below the snow surface.

11.2.2 Berms

A containment berm can be constructed of available materials such as earth, gravel, or snow. Use earth-moving equipment or manual labor to construct the berm. Form the materials into a horseshoe shape ahead of the flow of oil. Use plastic sheeting to line the walls of a soil berm to prevent oil penetration. Sandbags filled with sand or other heavy material also make excellent containment barriers.

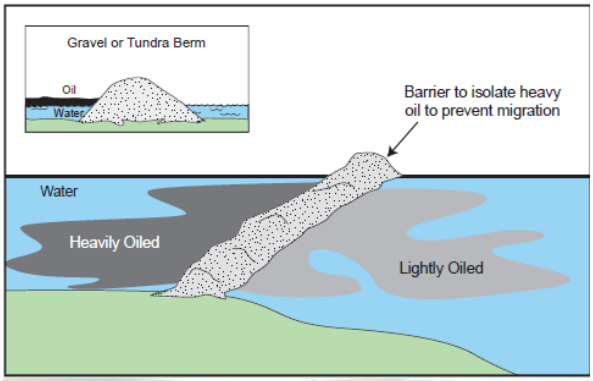


Figure 11.3: Containment Berms

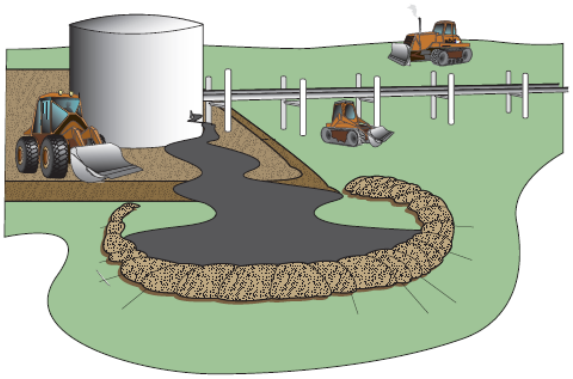


Figure 11.4: Containment Berms

11.2.3 Marsh and Tundra

Marshes and tundra are sensitive wetland habitats, where extra care must be taken to minimize damage when constructing and operating barriers. Excavation and other ground disturbances in these environments can cause more damage than the spill. Any activity that has the potential to push the contamination into the soft soils should be avoided. In some cases, it may be best to wait for cold weather to freeze the substrate before working on a tundra or marsh. In other cases, the Environmental Unit may recommend no clean-up activity at all, leaving the marsh/tundra to recovery naturally.

Travel across marshes and tundra with tracked vehicles, heavy equipment, and even foot traffic can seriously damage these sensitive habitats. Disturbance is greatly reduced by using sheets of plywood, outdoor carpet, or other similar material as a traveling surface and minimizing trips with equipment. Before excavating in marsh or tundra, check for the presence of groundwater or permafrost. Do not excavate into frost-laden (cemented) soils, since disruption of the permafrost could accelerate thermal erosion. The depth of the excavation is limited by the depth of the permafrost or the water table.

11.2.4 Dams

Earth or snow dams constructed across ditches may be used to contain a spill and stop its flow. A dam may be built with earth, wood, sandbags, and snow. The dam should be lined with plastic sheeting to make it impermeable to the spilled product. In the ***winter***, water may be sprayed on snow dams forming ice to make it impermeable. Care should be taken to ensure that the dam is large enough to contain the entire spill; insufficient capacity may result in overtopping failure. For ditches with flowing water or for small streams, it may be necessary to allow water flow to continue and to retain the lighter-than-water liquids. Water bypass dams may be constructed on small, slow flowing ditches or streams. An earth dam is built stopping the flow of water and oil in the ditch. Water is then allowed to continue down the ditch by piping water from below the level of the fuel.

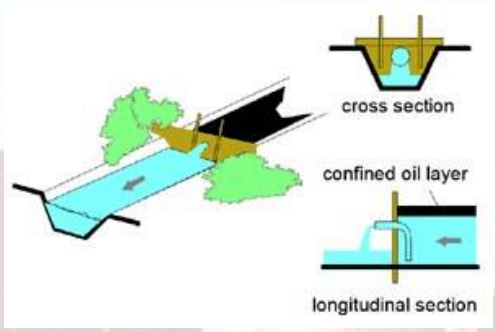


Figure 11.5: Containment Dams

11.2.5 Weirs

Weirs may be also used in ditches and at culverts. Materials commonly used such as plywood, lumber and sheet metal may be placed to completely or partially block culvert entrances. These barriers are effective on slow moving streams.

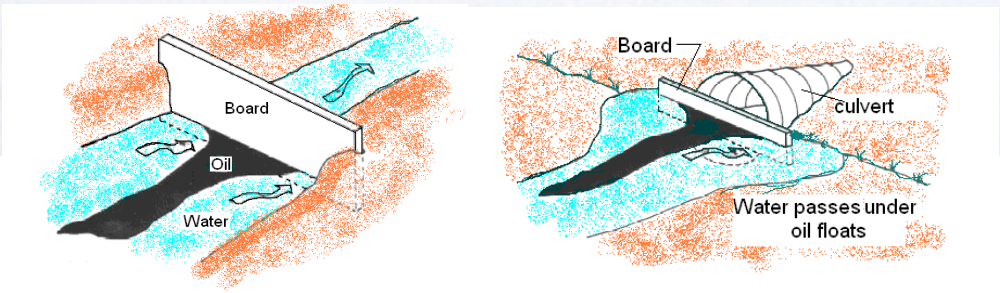


Figure 11.6: Containment Weirs

11.2.6 Water Containment

Water containment measures generally include the use of barriers or booms. Unless the entire flow of contaminated water can be stopped by damming, these methods are limited to the containment and recovery of materials that can be separated and

float on water. Certain materials such as gasoline or other volatile or flammable petroleum products have a high risk of fire or explosion. For these materials, containment and evaporation (without recovery) or burning may be a preferred approach.

11.2.7 Barriers – Snow Fence and Sorbent Barrier

Snow fence and sorbent barriers may be used in streams (less than 1 m deep) with soft beds into which stakes can be driven. This method is limited to *summer conditions*. A snow fence barrier is installed to span the width of the stream, anchored at both ends, and stakes are driven into the stream bottom at 1 to 2 m intervals. Straw bales or commercial sorbents are placed on the upstream side.

11.2.8 Barrier and Sorbent

Sorbent will float against the upstream side of the barrier but must be replaced before they sink. The barrier should be angled against the current for shore side collection. Multiple snow fence barriers can provide backup against potential losses from upstream barriers. Net or chicken wire barriers can be constructed in the same way. For stronger currents, these are more practical since water can flow through more easily.

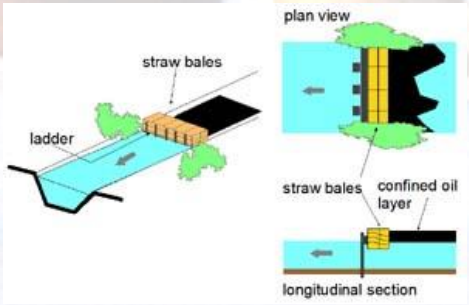


Figure 11.7: Containment Barriers

11.2.9 Booms

The general principles in using a boom are to contain a spill of floating liquid or debris, to deflect or divert material to a defined area so that it may be recovered, and to protect sensitive areas from contamination.

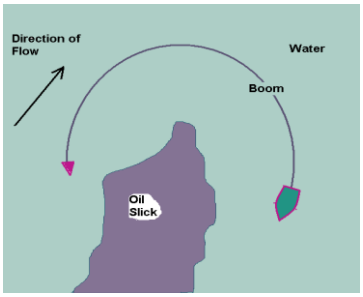


Figure 11.8 Boom Deployment

Boom deployment is important because the angle of the boom relative to how fast the water is moving affects how well the oil may be contained. The faster the stream, the more angled the boom. Several booms arranged in parallel may be necessary to contain all the fuel. These should be spaced to allow for fuel, which may escape the first boom, to float to the surface and be contained by the next boom. In addition, the use of several booms permits the removal of a boom for cleaning. Booms may be either commercially made or homemade.

Commercially made booms are designed to float and keep oil from escaping under the boom. Homemade booms may be constructed from logs, railroad ties, telephone or power poles, trees or lumber. These may be used to deflect floating material to shore or to keep floating material within a contained area. Individual sections are connected together by rope, chain or wire. A seal around the joints to prevent leakage can be made by wrapping with plastic sheets or burlap. Wooden or other floating booms can be used to contain the spilled fluid itself or the sorbent containing the fuel. They can also be used upstream of sorbent booms to improve the efficiency and longevity of the sorbent material. Inflated fire hose or Styrofoam can also be used as homemade booms.

11.2.10 Containment under Ice

Vertical barriers in ice such as plywood may be used to deflect oil under ice in slow moving deep waters. The ice must be strong enough to support the necessary personnel and equipment. Vertical barriers are put in place by cutting trenches in ice at an angle to current flow, inserting the plywood barriers and allowing them to freeze in place. The location of the oil slick may be monitored by drilling observation holes with an ice auger.

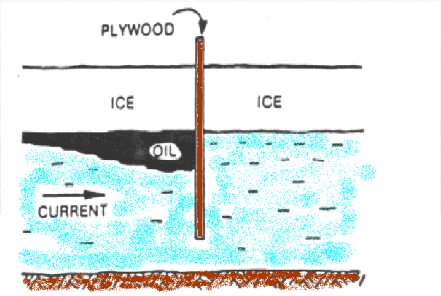


Figure 11.9: Containment Barriers

Ice slotting may be used in rivers or streams when current speeds are slow, less than0.5 m/second. A trench is cut into the ice using a chain saw or “ditchwitcher” machine at an angle to the current, to deflect and concentrate oil that passes through the area. Because of the thick ice encountered during the winter, cutting and removal of ice blocks is often difficult. Loaders or backhoes may be needed to lift blocks out

of the slot, or backhoes may be used to push blocks down. Oil, which accumulates in the ice slot, may be pumped out, absorbed or burned in place.

11.2.11 Angled Ice Slot

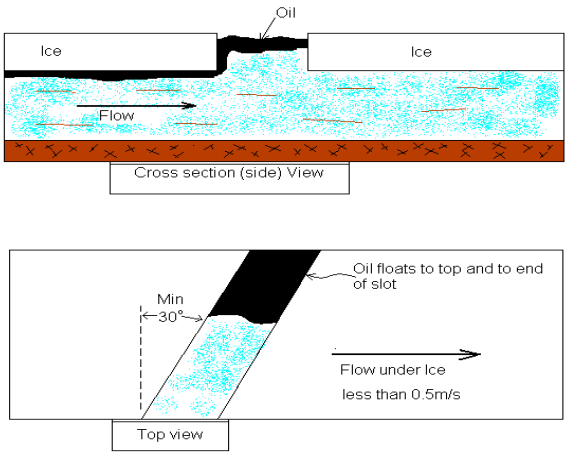


Figure 11.10: Oil on Ice

Sometimes it is best to do little, in three situations:

1. When oil is spilled in a sensitive environment, it is sometimes best to leave the clean-up to nature, as the activity itself may cause more damage.
2. Sometimes natural removal processes are faster or more effective than human efforts. For example, some storms can make shoreline conditions unsafe, but may also remove the oil quite effectively.
3. Areas such as the fiords and rocky coasts along the Canadian Arctic Archipelago are also best left, because the action of high-energy waves will break up the oil.

11.2.12 Weather Affects Response Activities

The response team depends on weather reports to provide information that is essential for tracking, containing and cleaning up a spill. The location of the accident, the season, the time of day, and the type of response actions planned will influence what information is useful. Decisions on which clean-up and containment methods to use depend on present and forecast weather conditions at the spill site. Meteorologists provide:

- forecasts of wind shifts and strengths;
- warnings of severe weather, such as high winds, blizzards and ice storms;
- information on wave heights, air and sea temperature, and air mass stability;
- forecasts of the icing potential, wind chill, fog, and visibility; and
- information on the presence and movement of ice flows.

11.2.13 Larger Scale Water Containment

In open water situations such as a bay or lake a slick may need to be isolated so as not to reach shore or to prevent spreading. A boat deployment of a boom may be necessary. The contained slick may be removed with a skimmer or with sorbents.

11.2.14 Barrel Containment

If liquid is leaking from a barrel, the leak may be stopped by plugging the leak or by rolling the barrel over so the hole is on top. A leak may be plugged with wooden wedges wrapped with a cloth, covered with heavy duty tape, or with an inner tube placed over the leak and tightened with a rod or stick. All of these methods are to be used as temporary seals only. The liquid needs to be transferred into a new barrel or storage tank to prevent further contamination.

11.3 Recovery

Fuel recovery methods generally include direct suction, mechanical removal and the use of sorbent material. Uses of sorbent pads serve the most common spill recoveries. A water spray mist may also be used to herd the fuel to an area for collection.

11.3.1 Direct Suction Equipment and Techniques

Direct suction methods include the use of vacuum trucks, portable pumps or shop vacuums. Vacuum or portable pumps can be used to directly recover materials from damaged containers or from thick slicks on water. Shop vacuums are suitable for small spills if a power source is available.
Commercial skimmers are available for attachment to vacuum hoses. These skimmers serve to “skim” floating product from the water surface while reducing the amount of water recovered. Suction screens may be required to prevent hose plugging by floating debris and to prevent pump damage. Care should also be taken to prevent the uptake of water in order to minimize the final volume of material which requires disposal and to prevent emulsification of oil and water. Once removed from the water body, however, water and oil can be separated using gravity separation. Valves on vacuum trucks can be used for water/oil separation or a drum separator may be readily constructed using a 45 gallon drum and hardware. Oil soaked sand may be separated by adding water to contained sand. Much of the oil will float to the surface of the water and can be separated more easily.

CAUTION: All containers used for the recovery of fuel must be grounded because of the potential for static-electricity build-up and fire.

11.3.2 Manual and Mechanical Recovery

Manual recovery by use of hand tools (cans, buckets, shovels, rakes) is an effective means of recovering fuel from small spills or from areas that are inaccessible to larger equipment. This is often the only method available, and in some cases preferred as it causes the least amount of damage to the area. Mechanical recovery using heavy construction equipment can be used in some cases for recovery and loading of material for disposal. Caution must be used when operating such equipment around a spill site. In some instances, more damage could be produced from the operation of the equipment than from the spilled fuel. Escaping petroleum vapours may also be present and pose the danger of explosion and fire.

11.3.3 Bio-Sparging (scattering)

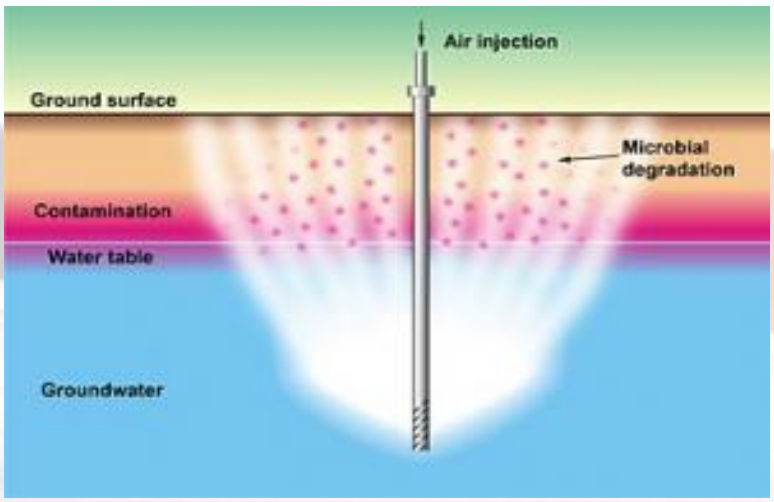


Figure 11.11: Bio-Sparging

Bio-sparging is an in situ remediation technology that uses indigenous microorganisms to biodegrade organic constituents in the saturated zone. In bio-sparging, air (or oxygen) and nutrients (if needed) are injected into the saturated zone to increase the biological activity of the indigenous microorganisms.

Bio-sparging can be used to reduce concentrations of petroleum constituents that are dissolved in groundwater, adsorbed to soil below the water table, and within the capillary fringe.

11.3.4 Bio-Ventilation

Bio-venting is an in-situ remediation technology that uses microorganisms to biodegrade organic constituents adsorbed in the groundwater. Bio-venting enhances the activity of indigenous bacteria and simulates the natural in situ biodegradation of hydrocarbons by inducing air or oxygen flow into the unsaturated zone and, if

necessary, by adding nutrients. During bio-venting, oxygen may be supplied through direct air injection into residual contamination in soil.

Bio-venting primarily assists in the degradation of adsorbed fuel residuals, but also assists in the degradation of volatile organic compounds (VOCs) as vapors move slowly through biologically active soil.

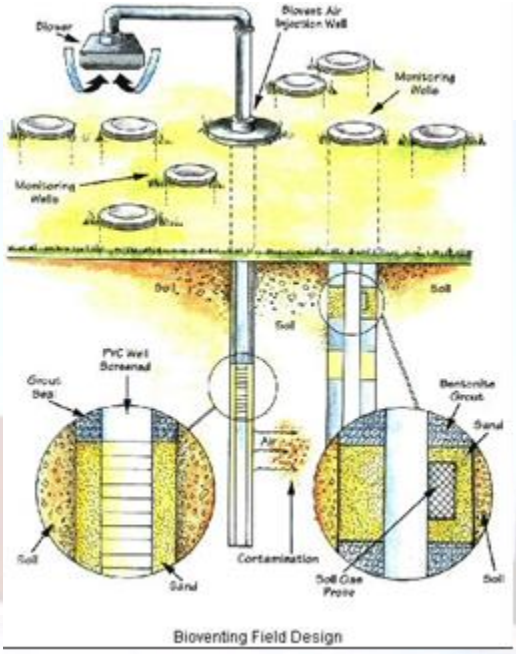


Figure 11.12: Bio-Ventilation

11.3.5 Sorbent Material

Sorbents are insoluble materials or mixtures of materials used to recover liquids through the mechanism of *ab*sorption, or *ad*sorption, or both. *Ab*sorbents are materials that pick up and retain liquid distributed throughout its molecular structure causing the solid to swell (50 percent or more). The absorbent must be at least 70 percent insoluble in excess fluid. *Ad*sorbents are insoluble materials that are coated by a liquid on its surface, including pores and capillaries, without the solid swelling more than 50 percent in excess liquid. To be useful in combating oil spills, sorbents need to be both oleophilic (oil-attracting) and hydrophobic (water-repellent). Although they may be used as the sole cleanup method in small spills, sorbents are most often used to remove final traces of oil, or in areas that cannot be reached by skimmers.

Sorbent materials used to recover oil must be disposed of in accordance with approved local, state, and federal regulations. Any oil that is removed from sorbent

materials must also be properly disposed of or recycled. Sorbents can be divided into three basic categories: natural organic, natural inorganic, and synthetic.

Natural inorganic sorbents consist of clay, perlite, vermiculite, glass wool, sand, or volcanic ash. They can adsorb from 4 to 20 times their weight in oil.

Inorganic sorbents, like organic sorbents, are inexpensive and readily available in large quantities. These types of sorbents are not used on the water's surface.
Synthetic sorbents include man-made materials that are similar to plastics, such as polyurethane, polyethylene, and polypropylene and are designed to adsorb liquids onto their surfaces. Other synthetic sorbents include cross-linked polymers and rubber materials, which absorb liquids into their solid structure, causing the sorbent material to swell. Most synthetic sorbents can absorb up 70 times their own weight in oil.

The characteristics of both sorbents and oil types must be considered when choosing sorbents for cleaning up oil spills:

- ***Rate of absorption*** -- The absorption of oil is faster with lighter oil products. Once absorbed the oil cannot be re-released. Effective with light hydrocarbons (e.g., gasoline, diesel fuel, benzene).
- ***Rate of adsorption*** -- The thicker oils adhere to the surface of the adsorbent more effectively.
- ***Oil retention*** -- The weight of recovered oil can cause a sorbent structure to sag and deform, and when it is lifted out of the water, it can release oil that is trapped in its pores. Lighter, less viscous oil is lost through the pores more easily than are heavier, more viscous oils during recovery of adsorbent materials causing secondary contamination.
- ***Ease of application*** -- Sorbents may be applied to spills manually or mechanically, using blowers or fans. Many natural organic sorbents that exist as loose materials, such as clay and vermiculite, are dusty, difficult to apply in windy conditions, and potentially hazardous if inhaled.

11.3.5.1 Sorbent Capacity

Sorbent capacity can be listed by the amount of weight it will absorb in relation to itself ("Absorbs 12 times its weight.") or by its liquid capacity ("Absorbs 8 gallons."). For example, if a boom weighs one pound and absorbs 12 times its weight, it will absorb 12 pounds of fluid. However, since all liquids don't weigh the same per gallon, the weight capacity of the sorbent actually varies from liquid to liquid. So perhaps a more accurate way to assess sorbent capacity is by how many gallons it will absorb, or its liquid capacity. This amount will remain fairly static,

regardless of the fluid weight. A boom that's four feet long and three inches in diameter will typically absorb 1 to 1¼ gallons of liquid. A pad that measures 16" x 20" and is 3/16" thick will absorb 28–32 fluid ounces. (Both of these examples are for polypropylene sorbents. Other materials may have different sorbent capacities.)

11.3.6 Underground Wells

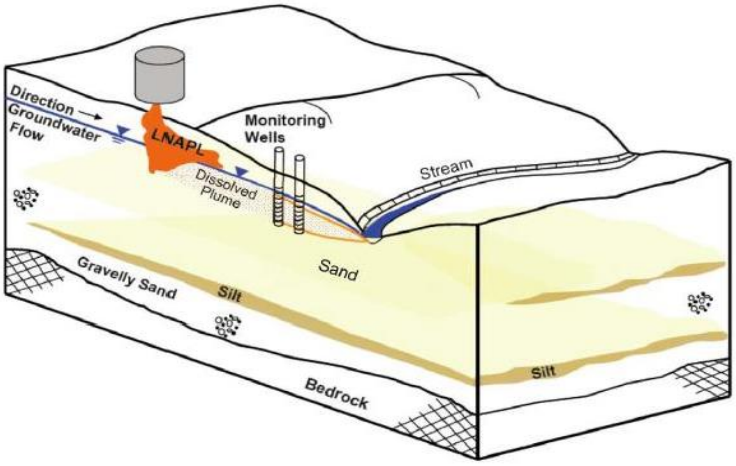


Figure 11.13 : Monitoring Wells

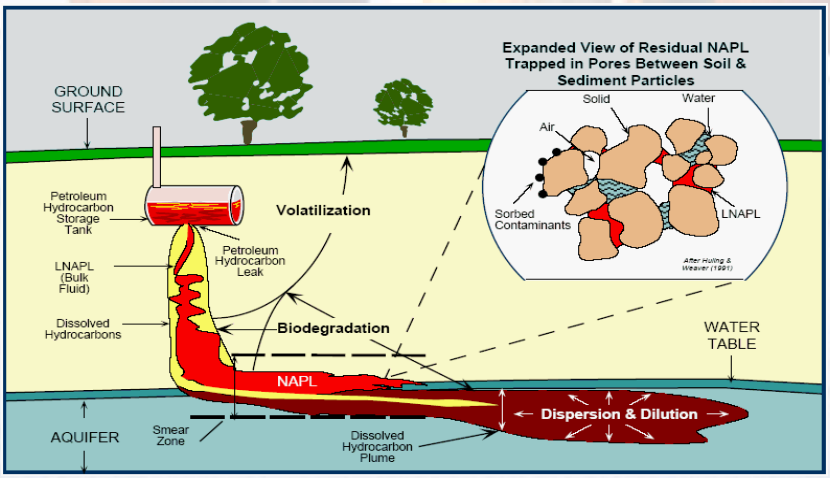


Figure 11.14: NAPL Migration

Light Non-Aqueous Phase Liquids LNAPL such as gasoline and diesel fuel etc.

Monitoring-wells are often drilled for the purpose of collecting ground water samples for analysis. These wells, which are usually six inches or fewer in diameter, can also be used to remove hydrocarbons from the contaminant plume within a groundwater aquifer by using a belt style oil skimmer. Belt oil skimmers, which are simple in design, are commonly used to remove oil and other floating hydrocarbon contaminants from industrial water systems.

A monitoring-well oil skimmer remediates various oils, ranging from light fuel oils such as petrol, light diesel or kerosene to heavy products such as No. 6 oil, creosote and coal tar. It consists of a continuously moving belt that runs on a pulley system driven by an electric motor. The belt material has a strong affinity for hydrocarbon liquids and for shedding water. The belt, which can have a vertical drop of 100+ feet, is lowered into the monitoring well past the LNAPL/water interface. As the belt moves through this interface it picks up liquid hydrocarbon contaminant, which is removed and collected at ground level as the belt passes through a wiper mechanism. To the extent that DNAPL hydrocarbons settle at the bottom of a monitoring well, and the lower pulley of the belt skimmer reaches them, these contaminants can also be removed by a monitoring-well oil skimmer.

Typically, belt skimmers remove very little water with the contaminant, so simple weir type separators can be used to collect any remaining hydrocarbon liquid, which often makes the water suitable for its return to the aquifer. Because the small electric motor uses little electricity, it can be powered from solar panels or a wind turbine, making the system self-sufficient and eliminating the cost of running electricity to a remote location

At sites where contaminated soil is in contact with ground water, or ground water contamination appears likely, a ground water contamination assessment is necessary. The objectives of the assessment are to determine whether ground water is, or likely to be, impacted with petroleum contamination and whether the impacted hydrogeologic unit is considered an aquifer. Ground water samples from temporary monitoring wells are taken and analyzed for the appropriate parameters to determine the concentration of hydrocarbons. Based on the results of geophysical and soil vapour surveys, monitoring wells and piezometers are placed in strategic positions, and representative ground-water samples are collected and analyzed. The objective of a ground-water monitoring program is to identify, interpret and track the movement of a contaminant plume so that a comprehensive remediation program can be implemented if deemed necessary.

Note: In the text, the term "monitoring wells" refers to both "wells" and "piezometer stand-pipes".

11.3.6.1 Monitoring Well Location

The monitoring well location is a function of the site's **flow conditions and the distribution of contaminant source(s)**. The best location for wells is determined by utilizing site screening methods which would identify and delineate the general extent and location of contamination. Once contamination "hot spots" have been identified, wells may then be confidently placed to obtain representative results. The wells are then used to develop a 3-Dimensional geological and hydrological model

of the site. The number of wells required for a monitoring program is entirely site dependent, but a minimum of 3 is needed, and can range up to 200 or more wells for a 20 hectare site. **At least 1 well should be installed upstream of the contamination to provide baseline water quality information for the site.** Linear alignment of wells should be avoided unless they are along an identified bedrock fracture. Since comprehensive groundwater remediation is dependent on removal of contamination from the **vadose zone** (the water suspended in the soils above the water table), well location should enable monitoring of this zone to determine its level of contamination.

11.3.6.2 Sampling Quality Assurance And Quality Control

Sample collection is often the greatest source of error in groundwater monitoring data. Therefore, a proper Quality Assurance/Quality Control (QA/QC) program should be established in order to ensure that data obtained are **accurate and representative** of actual groundwater conditions. **Quality Control** is the set of procedures used to measure and correct, when necessary, data quality. **Quality Assurance** is the set of procedures used to provide documentary assurance of the proper application of the methodologies used in the sampling program and the laboratory analysis before any field investigations commence. Following should be considered before proceeding for sampling:

- Sampling locations (use a map).
- Sample collection methods.
- Equipment used, and methods for calibration, maintenance and decontamination procedures.
- Use of quality control samples.
- Type, number, and size of sample containers to be used.
- Sample volumes to be collected.
- The sampling order (least to most contaminated).
- Preservation instructions.
- Procedures for minimizing sample aeration and air contact (oxygen may affect the sample).
- Documentation requirements for well sampling records and sample log records.
- Procedures for maintaining chain of custody records.
- Plans for storage and transportation of samples.

11.4 Storage of Contaminated Material

Contaminated material can cause health and safety concerns if not disposed of properly. Contaminated material should be stored in a safe place before being

disposed to an appropriate location. Storage of the contaminated material is required due to the following reasons:

- If a suitable location for disposal cannot be found
- If climatic conditions do not permit disposal at the time of cleanup
- If the selection of a disposal option requires further assessment or
- If transportation to a disposal/destruction facility is dependent on the availability of a suitable transportation vehicle.

Storage options generally consist of containers, barrels, drums, tanks or lined landfarms. The specific type of storage needed is dependent on the volume of recovered material, the degree of contamination with water and soil, the properties of the spill material, and the duration of storage required.

11.4.1 Vehicle Storage

Vehicles suited for the storage of recovered fuel are tank trucks, vacuum trucks, dump trucks, flatbed trucks, trailer or sled-mounted tanks, and transport trailers.
Tank trucks may be used to separate oil and water by emptying the water from the bottom of the tank. Tank trucks typically have capacities ranging from 7.8 to 24.6 m^3, while vacuum trucks typically hold 3.8 to 17.0 m^3. Flatbed trucks and transport trailers are suitable for carrying 45-gallon drums and barrels.

11.4.2 Open-Topped Tanks

Open-topped tanks such as plastic lined swimming pools may be quickly assembled on firm, level ground. The capacities range from 1 to 20 m^3. They may be fed by several hoses at once and can store liquids and solid debris. These should be used only for short-term storage when storing fuel.

11.4.3 Drums and Barrels

Tanks, drums and barrels, which are available in all communities, may be used for temporary storage of fuel.

11.5 Disposal of Contaminated Material

Disposal or destruction of recovered fuel is needed to eliminate the risk of further contamination from the recovered fuel. No decision, except under emergency conditions, should be made until approval has been obtained from appropriate government agencies. The 24-hour Spill Report Line should be used to initiate such requests and a follow-up report should describe the disposal method used.

11.5.1 Salvage and Recycle

Recovered diesel and lubricating oil may be reused directly as a low-grade heating fuel.

11.5.2 Fuel Burning

In some areas, burning of contaminated fuel may be a practical and acceptable disposal technique. Burning of fuel requires prior approval and advice from appropriate regulatory agencies. Fuel must not be ignited unless all personnel and equipment are a safe distance from the area. Fuel on frozen water bodies can be burned using mass burning techniques. The residue and oil not burned can then be scooped up using scrapers, dozers, dump trucks, and finally with brooms and shovels and loaded into trucks. Burning can also be considered when fuel penetration has been prevented because of frozen or compacted mineral soil or when the water table is at the surface. Residue can be removed the same way as on ice, but great care must be taken to protect area vegetation. The worst areas to consider burning is where islands of vegetation exist or where the surface has a moss cover into which the oil has penetrated to more than eight or ten centimeters.

11.6 Final Clean-Up and Restoration

Natural Assimilation (Biodegradation) and Re-vegetation Oil can be degraded naturally by micro-organisms under proper conditions of temperature and nutrients. Tilling the affected soil to increase the exposure of the soil organisms and oil to oxygen can also be beneficial. The utilization of natural assimilation to treat, in whole or in part, soils affected by spilled oils requires approval of government agencies.

11.6.1 Replacement of Soil

The grass on the upper layer of soil may have to be removed if these have been contaminated with oil or chemicals. When contaminated material is being removed, regulatory agencies should be contacted in regard to acceptable disposal sites. In some instances, it will be necessary to replace contaminated soil with clean soil. Sensitive areas in the tundra should be left untouched. Equipment for the removal of contaminated soil includes front-end loaders and small dozers.

11.6.2 Land Based Response

11.6.2.1 Scope and Purpose of Plan

This plan deals specifically with the preparation and response to a spill that could occur during the unloading of product from a fuel transport truck or holding tank while at the Facility. This Environmental Emergency Plan (EEP) is not intended to replace or supersede Emergency Response Plans currently in place, but to provide specific guidance on procedures, training and response for local land spills. This plan will demonstrate the Facility has an effective response capability. This plan is meant to be a working document for use by the Facility. The fundamental basis for planning will be established utilizing the development of a scenario for the class of product handled at the Facility.

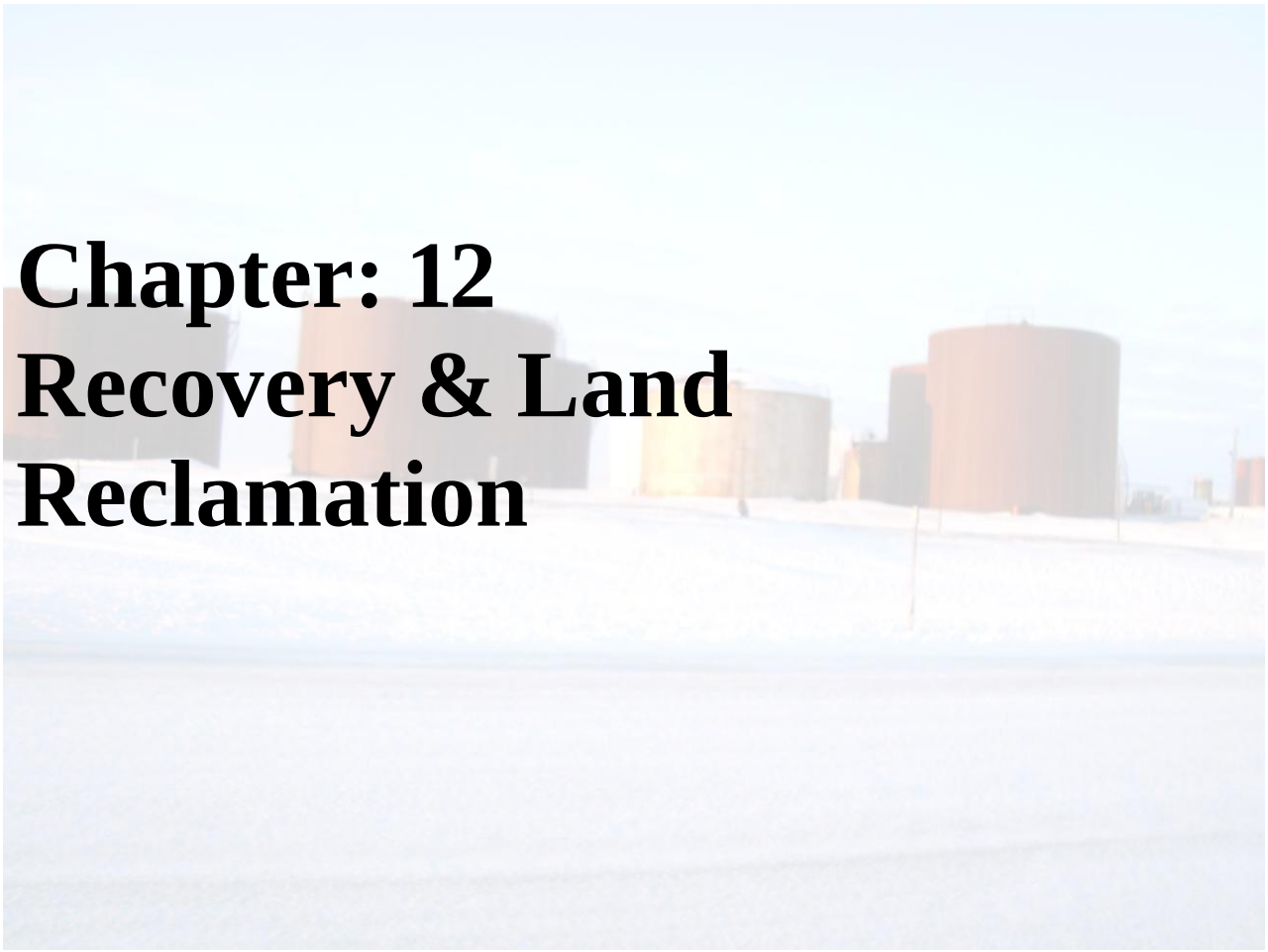
11.6.2.2 Background

The Facility handles Distillate. The Facility personnel are familiar with the hazards associated with the products they are handling and have on hand, the appropriate material Data safety sheets.

11.6.2.3 Preparation

Prior to fuel transfer at the Facility, the staff will do the following:

- Make sure access to the storage tanks is readily accessible;
- Inventory the environmental emergency equipment; and
- Make ready environmental emergency equipment.



Chapter: 12
Recovery & Land Reclamation

12.1 Introduction

In this Environmental Emergency Plan, recovery refers to the reinstatement of any part of the environment damaged by or during the emergency. Recovery affects both the operating entity itself and the surrounding community. The issue of recovery is best managed through discussion between all involved parties to assess the damage and agree on a restoration plan. The level of environmental restoration is determined by many factors such as size, persistence and toxicity of a release. Therefore recovery of an area to its natural state is not always possible. Thus restoration plans are situation specific and would need to be defined in terms of acceptability to affected stakeholders. Recovery from an environmental emergency involves activities and programs designed to return the place and its surrounding environment to a safe and acceptable condition.

The general objective of the recovery portion of an environmental emergency plan should be to provide sufficient direction to reduce impacts to the environment and to minimize the recovery time from a particular incident. The purpose of guidelines in this part of the plan is to prepare PPD, its fuel delivery contractor and public authorities to initiate recovery processes as soon as possible, striving for a rapid recovery from environmental damage and a quick return to normal facility operations. Those leading the recovery process must be appropriately trained and well aware that rapid response without assessing the risks associated with the recovery efforts can lead to increased damage and longer recovery times for the environment. Depending upon the nature of the incident, the business resumption process can either begin during response or can be initiated in stages until normal operations are restored.

Planning for the recovery phase during the prevention, preparedness and response process will improve recovery time and reduce impact to the environment. The actual recovery time depends upon many factors such as the extent of damage, availability and commitment of response personnel, resources and finances. PPD realizes the importance of establishing a pre-planned capability to recover and undertake swift damage assessments, because the longer it takes to recover, the higher the ultimate cost. PPD and its fuel delivery contractor will take the following steps to damage assessment in a recovery situation:

- Determine the extent of damage and appropriate communication to all relevant parties,
- Develop a system to bring in the proper resources, including people, at the right time,
- Work with outside resources to support recovery, and
- Organize community resources necessary for people recovering from an emergency situation.

This includes the restoration of normal operations following a disruptive event, particularly where critical services are concerned. This also includes the long-term resumption of full operating capacity and evaluating the response process.

- Has a damage assessment been conducted?
- Have the legal issues been identified and addressed?
- Has a recovery team been assembled?
- Have priorities been sent for the restoration of services?

12.2 Post Emergency Response Review

The effectiveness of emergency response should be evaluated so that so that we can improve our response and learn from the past. After an emergency or an emergency exercise, a review and debriefing will be scheduled as soon as possible after the event (within 14 days). All parties that responded to or which were involved in the emergency shall be requested to attend. The review will be documented including any action items. A separate debriefing will be held with PPD employees after the emergency or emergency exercise to communicate the findings of the emergency review. Lesson learnt would be documented to improve on emergency response.

12.3 Maintenance of Damaged Equipment

Most of the accidents inflict damage to infrastructure rendering them unserviceable. If the structural integrity of a pipe, tank or truck tank is impaired, then a leak occurs. Damaged components affect the overall performance of the systems. A fire at the facility can result in the distortion of the tank shape and twisting of the roof. The fuel delivery contractor and PPD may not have the in-house required expertise to do a proper inspection and assessment on any damaged structure. Therefore the services of a professional consultant may have to be procured.

If a fuel pipe bursts, its replacement is essential; if valves and joints leak they should be repaired. Gas and diesel dispensing cabinets, dispenser buildings, and operator shelters are some other structures that could be damaged in an accident at the tank farm. Repairing of all these components will have to be done before facility is reopened for the regular PPD's operation.

12.4 Environmental Site Assessment

In Arviat all the tank farm and dispensing areas are fully lined. The spill catchment basin is also lined so the release of spill within the facility would be considered contained. If it crosses the boundaries, then PPD will have to ensure a formal site assessment study done to delineate the contamination out of the berm. The GN has a standing agreement with some consulting companies who have been doing ESA

studies on GN's facilities. The tank farm is close to the Bay so a massive spill can contaminate the water there. To rule out the possibility of fuel reaching the water body, a formal site assessment study will be recommended. PPD will hire an environment consulting company to undertake ESA investigations aimed at the following objectives:

- To visually delineate the extent of observable liquid petroleum hydrocarbons (LPH) on the surface of snow / ice on and surrounding area,
- To delineate the lateral and vertical extents of petroleum hydrocarbon impacts in the soil as a result of fuel release,
- To delineate the extent of PHC impacts in groundwater / surface water (if possible) as a result of this spill incident, and
- To provide recommendations to minimize the environmental damage of the release.

12.5 Soil Remediation

In Nunavut and across Canada, contaminated sites can pose a threat to human health, safety and the environment. Petroleum hydrocarbon contamination in soil is a concern for several reasons. To differing degrees, petroleum hydrocarbons are toxic to plants and animals, and are mobile and persistent in the environment. Petroleum hydrocarbons can also pose a fire or explosion hazard and can create aesthetic problems such as offensive odours and tastes. In some cases the concern may also be financial, because of the loss of property value and the cost of remediating the property.

The Department of Environment (DOE) within the Government of Nunavut (GN) has developed their own environmental guideline for contaminated site remediation. The intent of this Guideline is to help effectively manage contaminated sites. It helps to provide a consistent approach by describing the process used to manage (e.g. identify, assess, plan and remediate) contaminated or potentially contaminated sites on Commissioner's Land, including private land within municipalities, and by providing soil remediation criteria for petroleum hydrocarbons and other contaminants. The Environmental Protection Act (EPA) gives the Government of Nunavut authority to take measures to ensure the preservation, protection and enhancement of the environment, with the goal of long-term sustainability and stewardship. Section 2.2 of the EPA provides the Minister of Environment with authority to develop, coordinate, and administer this guideline. The Department of Environment is the key territorial agency concerning the management of contaminated sites on Commissioner's Land. In Nunavut however, Indian and Northern Affairs Canada (INAC) retains responsibility for the management of inland waters, including surface water and groundwater. If contaminated water is encountered, INAC should immediately be consulted. Petroleum products are

complex mixtures of hydrocarbons whose environmental fate depends primarily on the specific chemical and physical properties of their individual components. The relatively lighter, more volatile, mobile and water soluble compounds in fuels tend to fairly quickly evaporate into the atmosphere or migrate to groundwater.

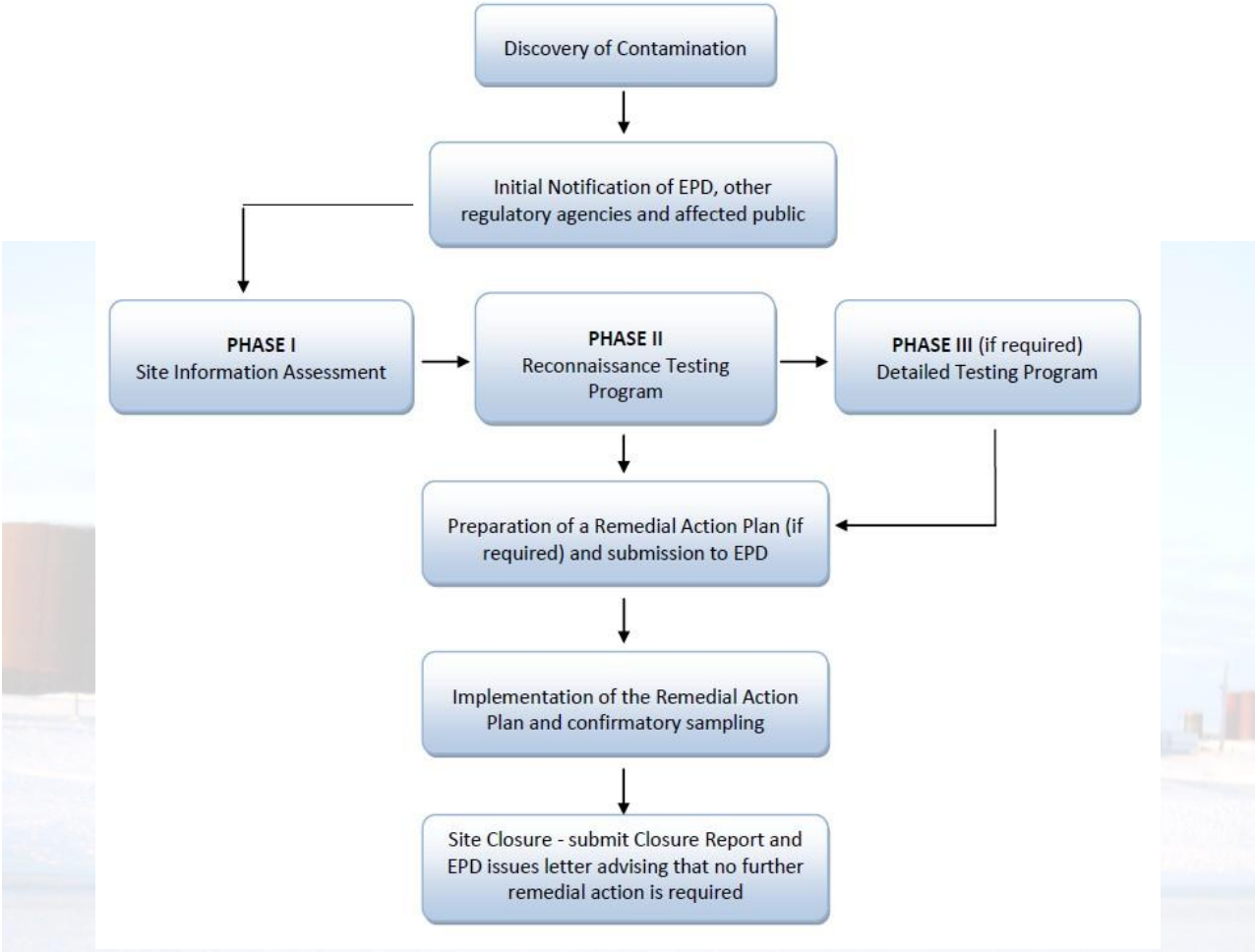


Figure 12.1: Contaminated Site management process

When exposed to oxygen and sunlight most of these lighter compounds tend to break down relatively quickly. However in groundwater, many of these compounds tend to be more persistent than in surface water. The compounds of petroleum products which tend to be somewhat more persistent and more bound to solid particles include the PAHs, alkyl PAHs and alkyl benzenes. Higher concentrations of heavier PAHs tend to be in adjacent contaminated soils than in ground water. Cleaning up groundwater without cleaning up soil contamination will usually result in a rebound of higher concentrations of these compounds portioning from contaminated soils into groundwater. Natural attenuation of these components by bioremediation lessens the degree of soil contamination with time. The primary degradative fate process for petroleum hydrocarbons in soil is biodegradation. While volatization is expected to be the dominant fate process for lighter components from soil surfaces, biodegradation becomes increasingly dominant as the soil depth increases. Some components of these fuels also migrate through the soil to groundwater.

12.5.1 Remediation Criteria for Petroleum Hydrocarbons

The term 'Petroleum Hydrocarbons' (PHC), describes a mixture of organic compounds found in and derived from oil, bitumen and coal. Petroleum products typically contain thousands of compounds in varying proportions, composed predominantly of carbon and hydrogen, with minor amounts of nitrogen, sulphur and oxygen.

The properties of PHC contamination in soils varies with the soil type, petroleum source and composition, degree of processing (crude, blended or refined) and the extent of weathering caused by exposure to the environment. Such factors complicate the assessment of the human health, safety and environmental risks associated with PHC contamination. This complicated assessment of risk makes it necessary to evaluate PHC as four fractions: F1, F2, F3, and F4. PHCs are subdivided according to specified ranges of equivalent carbon number (ECN). Each fraction is, in turn, made of sub fractions. These sub fractions are described according to their relevant physical and chemical properties and toxicological characteristics. These divisions between the fractions have been established in consideration of analytical factors, physical and chemical properties, the expected relevance to biological response in soils and the ability to utilize the definitions and associated properties.

Fraction 1 (F1)
The range of ECN is from C6 to C10. It includes gasoline and represents the volatile fraction of most hydrocarbon mixtures. The F1 fraction consists of aromatic sub fractions in the range C8 to C10, as well as aliphatic sub fractions in the ranges of C6 to C8 and >C8 to C10. The fraction is generally considered to be high in mobility, volatility and solubility

Fraction 2 (F2)
The range of ECN is from > C10 to C16. It includes kerosene, jet fuel and light fuel oils (No. 2 fuel oil, Arctic diesel) and represents the semi-volatile fraction of petroleum hydrocarbons. The F2 fraction is comprised of aromatics and aliphatic sub fractions in the ranges >C10 to C12 and >C12 to C16.

Fraction 3 (F3)
The range of ECN from >C16 to C34 and includes medium fuel oils (No. 4 fuel oil, Bunker B), heavy fuels oils (Bunker C) and lubricating and motor oils. It is comprised of both aromatics and aliphatics in the ranges >C16 to C21 and >C21 to C34.

Fraction 4 (F4)

The range of ECN is from > C34 to C50+. PHC within this range often make up a significant proportion of crude oils. The fraction is generally considered to be of low mobility, volatility and solubility.

Tier 1 and Tier 2 remediation criteria are prescribed for coarse-grained and fine-grained soils. As a result, sufficient textural information needs to be obtained through environmental site assessments to permit classification of the soils as either coarse or fine.

These classifications are defined as follows:

Fine-grained soil

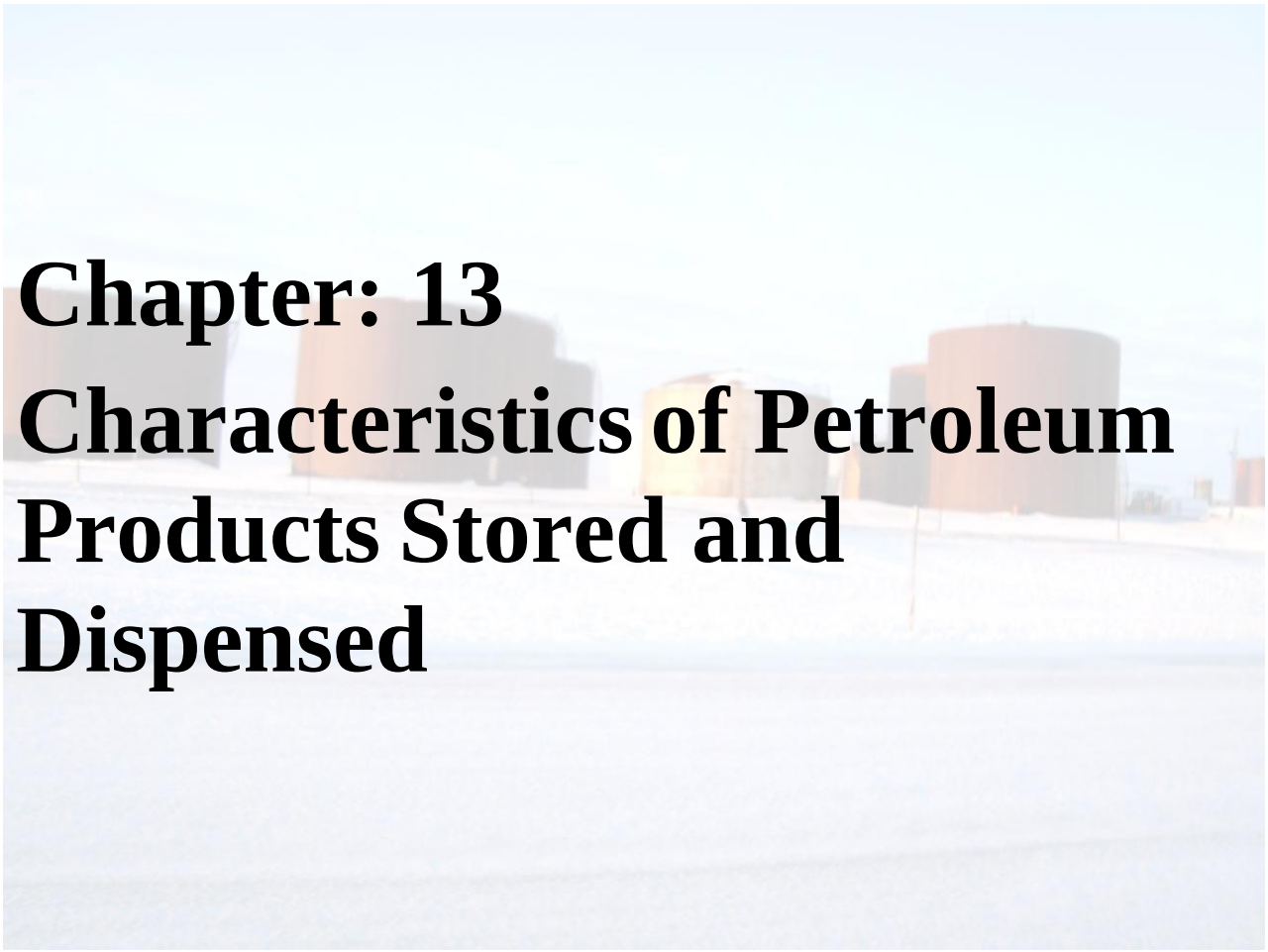
Soil having a medium grain size of <75 µm, as defined by the American Society for Testing and Materials, and includes silts and clays.

Course-grained soil

Soil having a median grain size of >75 µm as defined by the American Society for Testing and Materials, and includes sands and gravels.

Land Use	Exposure Pathway	Fine-Grained Soils				Coarse Grained Soils			
		F1	F2	F3	F4	F1	F2	F3	F4
Agricultural	Direct Contact w/Soil(DC)	12000	6800	15000	21000	12000	6800	15000	21000
	Vapour Inhalation-basement (VI)	710	3600	NA	NA	40	190	NA	NA
	Vapour Inhalation-slab-on-grade (VI)	610	3100	NA	NA	30	150	NA	NA
	Ecological Soil Contact (ESC)	210	150	1300	5600	210	150	300	2800
	Protection of Portable GW (GW-P)	170	230	NA	NA	240	320	NA	NA
	Protection of GW for Aquatic Life (GW-A)	RES	RES	NA	NA	970	380		
	Protection of GW for Livestock (GW-L)	4200	10000	NA	NA	5300	14000	NA	NA
	Management Level	800	1000	3500	10000	700	1000	2500	10000
	Governing Objective	**176**	**156**	**1366**	**5666**	**36**	**156**	**366**	**2866**
	Governing Pathway	**GW-P**	**ESC**	**ESC**	**ESC**	**VI**	**VI**	**ESC**	**ESC**
Residential	Direct Contact w/Soil(DC)	12000	6800	15000	21000	12000	6800	15000	21000
	Vapour Inhalation-basement (VI)	710	3600	NA	NA	40	190	NA	NA
	Vapour Inhalation-slab-on-grade (VI)	610	3100	NA	NA	30	150	NA	NA
	Ecological Soil Contact (ESC)	210	150	1300	5600	210	150	300	2800
	Protection of Portable GW (GW-P)	170	230	NA	NA	240	320	NA	NA
	Protection of GW for Aquatic Life (GW-A)	RES	RES	NA	NA	970	380	NA	NA
	Management Level	800	1000	3500	10000	700	1000	2500	10000
	Governing Objective	**176**	**156**	**1366**	**5666**	**36**	**156**	**366**	**2866**
	Governing Pathway	**GW-P**	**ESC**	**ESC**	**ESC**	**VI**	**VI**	**ESC**	**ESC**
Commercial	Direct Contact w/Soil(DC)	19000	10000	23000	RES	19000	10000	23000	RES
	Vapour Inhalation (VI)	4600	23000	NA	NA	320	1700	NA	NA
	Ecological Soil Contact (ESC)	320	260	2500	6600	320	260	1700	3300
	Protection of Portable GW (GW-P)	170	230	NA	NA	240	320	NA	NA
	Protection of GW for Aquatic Life (GW-A)	RES	RES	NA	NA	970	380	NA	NA
	Offsite Migration (OM)	NA	NA	19000	RES	NA	NA	4300	RES
	Management Level	800	1000	5000	10000	700	1000	3500	10000
	Governing Objective	**176**	**236**	**2566**	**6666**	**246**	**266**	**1766**	**3366**
	Governing Pathway	**GW-P**	**GW-P**	**ESC**	**ESC**	**GW-P**	**ESC**	**ESC**	**ESC**
Industrial	Direct Contact w/Soil(DC)	RES	RES	RES	RES	RES	RES	RES	RES
	Vapour Inhalation (VI)	4600	23000	NA	NA	320	1700	NA	NA
	Ecological Soil Contact (ESC)	320	260	2500	6600	320	260	1700	3300
	Protection of Portable GW (GW-P)	170	230	NA	NA	240	320	NA	NA
	Protection of GW for Aquatic Life (GW-A)	RES	RES	NA	NA	970	380	NA	NA
	Offsite Migration (OM)	NA	NA	19000	RES	NA	NA	4300	RES
	Management Level	800	1000	5000	10000	700	1000	3500	10000
	Governing Objective	**176**	**236**	**2566**	**6666**	**246**	**266**	**1766**	**3366**
	Governing Pathway	**GW-P**	**GW-P**	**ESC**	**ESC**	**GW-P**	**ESC**	**ESC**	**ESC**

Table 12.1: Remediation criteria



Chapter: 13
Characteristics of Petroleum Products Stored and Dispensed

Developing a plan to deal with potential emergencies requires a comprehensive knowledge of the physical properties and characteristics of the petroleum products involved, including Diesel and Gasoline.

13.1 Diesel Fuel

Ultra-low sulfur diesel (ULSD) is a standard for defining diesel fuel with substantially lowered sulfur contents. PPD sells ULSD in all communities of Nunavut including Arviat. Generally diesel is used in all kinds of diesel engines but in Nunavut the product is also used as home heating fuel, motor fuel, and fuel for power generation etc. Bulk fuel storage tanks are replenished usually once a year during the summer months. Diesel is mostly distributed to customers by trucking. In some communities modern RDR diesel dispensers are used for filling vehicles.

Figure 13.1: A modern RDR diesel dispenser

Figure 13.2: USLD sample

13.1.1 Physical Properties of USLD

The physical properties of diesel could be summarized as below.

Form:	Liquid		
Appearance:	Clear, straw coloured		
Odour:	Characteristic petroleum (kerosene) odour		
Flash point-typical:	38°C minimum for diesel, 52°C minimum for #2 Diesel		
Auto ignition temperature:	257°C (495°F)		
Thermal decomposition:	No decomposition if stored and applied as directed		
Lower explosive limit:	0.6 % (V)	Upper:	4.7% (V)
pH:	Not applicable		
Freezing point:	No data available		
Boiling point:	154-372°C (310°-702°F)		
Vapour pressure:	<2 mm Hg at 20°C		
Density:	0.86g/cm^3		
Water solubility:	Negligible		
Viscosity, dynamic:	1.7-40mPa.s at 37.8°C (100°F)		

ULSD is produced from the fractional distillation of crude oil between 200°C (392°F) and 350°C (662°F) at atmospheric pressure, resulting in a mixture of carbon chains that typically contain between 8 and 21 carbon atoms per molecule. As of 2012, the density of petroleum diesel is about 0.832 kg/l, about 86.1% of the fuel mass is carbon, and when burned, it offers a net heating value of 43.1 MJ/kg as opposed to 43.2 MJ/kg for gasoline. However, due to the higher density, diesel offers a higher volumetric energy density at 35.86 MJ/L (128 700 BTU/US gal) vs. 32.18 MJ/L (115 500 BTU/US gal) for gasoline, some 11% higher, which should be considered when comparing the fuel efficiency by volume.

The CO_2 emissions from diesel are 73.25 g/MJ, just slightly lower than for gasoline at 73.38 g/MJ. Diesel is generally simpler to refine from petroleum than gasoline, and contains hydrocarbons having a boiling point in the range of 180-360°C (360-680°F). Because of recent changes in fuel quality regulations, additional refining is required to remove sulfur, which contributes to a sometimes higher cost.

13.1.2 Chemistry of ULSD

Petroleum-derived diesel is composed of about 75% saturated hydrocarbons (primarily paraffin including straight chain, branch chain and cyclo paraffin),and 25% aromatic hydrocarbons (including naphthalenes and alkyl benzenes). The average chemical formula for common diesel fuel is $C_{12}H_{23}$, ranging approximately from $C_{10}H_{20}$ to $C_{15}H_{28}$. Actually ULSD is a mixture of following hydrocarbons fractions :

Component	CAS-No.	Weight
Fuels, diesel,No.2 Gasoil- unspecified	68476-34-6	100%
Nonane	111-84-2	0-5%
Naphthalene	91-20-3	0-1%
1,2,4-Trimethylbenzene	95-63-6	0-2%
Xylene	1330-20-7	0-2%
Sulfur	7704-34-9	15ppm maximum

Table 13.1: Composition of ULSD

Figure 13.3: Diesel is immiscible with water

Microbes such as algae can cause some quality and environmental issues when let grow in a fuel tank. Algae need light to live and grow. As there is no sunlight in a closed fuel tank, no algae can survive, but some microbes can survive and feed on the diesel fuel. These microbes form a colony that lives at the interface of fuel and water. They grow quite fast in warmer temperatures. They can even grow in cold weather when fuel tank heaters are installed. Parts of the colony can break off and clog the fuel lines and fuel filters and may result into pipe burst contaminating the environment.

13.1.3 Diesel Related Environmental Concerns

Accidental release of diesel to the atmosphere is hazardous and could pose a threat to air quality and cause contamination of land and nearby water bodies. A disadvantage of diesel as a vehicle fuel in cold climates, compared to gasoline or other petroleum-derived fuels, is that its viscosity increases quickly as the fuel's temperature decreases, turning into a non-flowing gel at temperatures as high as - 19°C (-2.2°F) or -15°C (5°F), which cannot be pumped by regular fuel pumps. Special low-temperature diesel contains additives to keep it in a more liquid state at lower temperatures, but starting a diesel engine in very cold weather may still pose considerable difficulties. Diesel-powered vehicles generally have a better fuel economy than equivalent gasoline engines and produce less greenhouse gas emission. Their greater economy is due to the higher energy per-litre content of diesel fuel and the intrinsic efficiency of the diesel engine. While petro diesel's higher density results in higher greenhouse gas emissions per litre compared to gasoline, the 20–40% better fuel economy achieved by modern diesel-ignited automobiles offsets the higher per-litre emissions of greenhouse gases and a diesel-powered vehicle emits 10-20 percent less greenhouse gas than comparable gasoline vehicles.

In the past, diesel fuel contained higher quantities of sulfur. North American Emission Standards and preferential taxation have forced oil refineries to dramatically reduce the level of sulfur in diesel fuels. Canadian diesel fuel typically also has a lower octane number (a measure of ignition quality) than European diesel, resulting in worse cold weather performance and some increase in emissions.

Petro diesel spilled on a road will stay there until washed away by sufficiently heavy rain, whereas gasoline will quickly evaporate. After the light fractions have evaporated, a greasy slick is left on the road which can destabilize moving vehicles.

Diesel spills severely reduce tire grip and traction, and have been implicated in many accidents. The loss of traction is similar to that encountered on black ice. High levels of sulfur in diesel are harmful for the environment because they prevent the use of catalytic diesel particulate filters to control diesel particulate emissions, as well as more advanced technologies, such as nitrogen oxide (NO_X) adsorbers (still under development), to reduce emissions. Moreover, sulfur in the fuel is oxidized during combustion, producing sulfur dioxide and sulfur trioxide, that in presence of water;

rapidly convert to sulfuric acid, one of the chemical processes that result in acid rain. However, the process for lowering sulfur also reduces the lubricity of the fuel, meaning that additives must be put into the fuel to help lubricate engines.

13.2 Gasoline

Gasoline is a toxic, translucent, petroleum-derived liquid that is primarily used as a fuel in internal combustion engines. It consists mostly of organic compounds obtained by the fractional distillation of petroleum, enhanced with a variety of additives. Gasoline is more volatile than diesel oil, Jet-A, or kerosene, not only because of the base constituents, but also because of additives. Volatility is often controlled by blending with butane, which boils at -0.5°C. The volatility of gasoline is determined by the Reid vapor pressure (RVP) test. The desired volatility depends on the ambient temperature. In hot weather, gasoline components of higher molecular weight and thus lower volatility are used. In hot weather, excessive volatility results in what is known as "vapor lock", where combustion fails to occur, because the liquid fuel has changed to a gaseous fuel in the fuel lines, rendering the fuel pump ineffective and starving the engine of fuel. This effect mainly applies to camshaft-driven (engine mounted) fuel pumps which lack a fuel return line. Vehicles with fuel injection require the fuel to be pressurized, to within a set range. Because camshaft speed is nearly zero before the engine is started, an electric pump is used. It is located in the fuel tank so the fuel may also cool the high-pressure pump. Pressure regulation is achieved by returning unused fuel to the tank. Therefore, vapor lock is almost never a problem in a vehicle with fuel injection.

Gasoline vapours are injurious to human health and are carcinogen in nature so there are certain regulations to control its emission. In Canada, volatility is regulated in large cities to reduce the emission of unburned hydrocarbons by the use of so-called reformulated gasoline that is less prone to evaporation. Modern automobiles are also equipped with an evaporative emissions control system (called an EVAP system in automotive jargon), which collects evaporated fuel from the fuel tank in a charcoal-filled canister while the engine is stopped, and then releases the collected vapors into the engine intake for burning when the engine is running (usually only after it has reached normal operating temperature). The evaporative emissions control system also includes a sealed gas cap to prevent vapors from escaping via the fuel filler tube.

Figure 13.4: Gasoline sample

13.2.1 Toxic Ingredients of Gasoline

Gasoline contains the following toxic chemicals subject to reporting requirements of section 313 of Emergency Planning a Community Right-To-Know Act.

Ingredient Name (CAS Number)	Concentration WT. Percent
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline
Ethyl benzene (100-41-4	<3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1, 2, 4 Trimethylbenzene (95-63-3)	<6
Xylene, mixed isomers (1330-20-7)	1-15

Ingredient name CAS number	Concentration –Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i), perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

13.2.2 Combustible and Physical Properties of Gasoline

Flammable Properties:

Flash point:	-45°F (-43°C)
Auto ignition temperature:	Highly variable;>530°F (>280°C)
OSHA/NFPA Flammability Class;	1A (Flammable Liquid)
Lower Explosive Limit (%):	1.4%
Upper Explosive Limit (%):	7.6%

Odour-A strong, characteristic aromatic hydrocarbon odour. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odour and is detectable at a lower concentration then non-oxygenated gasoline.

Odour Threshold	Odour Detection	Odour Recognition
Non-oxygenated gasoline:	0.5-0.6ppm	0.8-1.1ppm
Gasoline with 15% MTBE:	0.2-0.3ppm	0.4-0.7ppm
Gasoline with 15% TAME:	0.1ppm	0.2pm

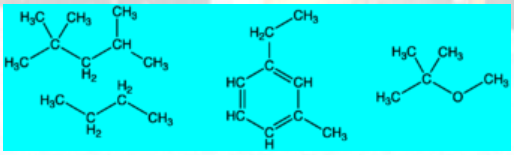
Basic Physical Properties

Boiling Range:	85 to 437°F (39-200°C)
Vapour pressure:	6.4-15 RVP @ 100°F (38°C) (275-475mm Hg @ 68°F (20°C)
Vapour Density (air=1):	AP 3 to 4
Specific Gravity (H^2O+1):	0.70-0.78
Evaporation Rate:	10-11 (n-butyl acetate=1)
Percent Volatiles:	100%

Solubility (H^2O):	Non-oxygenated gasoline-negligible (<0.1%@77°F). Gasoline with 15% MTBE-Slight (0.1-3%@77°F); ethanol is readily soluble in water

Combustibility of gasoline is measured in terms of its octane rating which is determined relative to a mixture of 2,2,4-trimethylpentane (an isomer of octane) and n-heptane. There are different conventions for expressing octane ratings, so a fuel may have several different octane ratings based on the measure used.

The octane rating became important as the military sought higher output for aircraft engines in the late 1930s and the 1940s. A higher octane rating allows a higher compression ratio, and thus higher temperatures and pressures, which translate to higher power output. Some scientists even predicted that a nation with a good supply of high octane gasoline would have the advantage in air power. The specific gravity (or relative density) of gasoline ranges from 0.71–0.77 (719.7 kg/m3 ; 0.026 lbs./in3; 6.073 lbs./US gal; 7.29 lbs./imp gal), higher densities having a greater volume of aromatics. Gasoline floats on water; water cannot generally be used to extinguish a gasoline fire, unless used in a fine mist. Gasoline is produced in oil refineries. Material that is separated from crude oil via distillation, called virgin or straight-run gasoline, does not meet the required specifications for modern engines (in particular octane rating; see below), but will form part of the blend.



Some of the main components of gasoline: isooctane, butane, an aromatic compound, and the octane enhancer MTBE. The bulk of a typical gasoline consists of hydrocarbons with between 4 and 12 carbon atoms per molecule (commonly referred to as C4-C12). The various refinery streams blended to make gasoline have different characteristics. Some important streams are:

- Straight-run gasoline is distilled directly from crude oil. Once the leading source of fuel, its low octane rating required lead additives. It is low in aromatics (depending on the grade of crude oil), containing some naphthenes (cycloalkanes) and no olefins. About 0-20% of gasoline is derived from this material, in part because the supply of this fraction is insufficient and its RON is too low.
- Reformate, produced in a catalytic reformer with a high octane rating and high aromatic content, and very low olefins (alkenes). Most of the benzene, toluene, and xylene (the so-called BTX) are more valuable as chemical feed stocks and are thus removed to some extent.

- Cat cracked gasoline or cat cracked naphtha, produced from a catalytic cracker, with a moderate octane rating, high olefins (alkene) content, and moderate aromatics level.
- Hydrocrackate (heavy, mid, and light) produced from a hydrocracker, with medium to low octane rating and moderate aromatic levels.
- Alkylate is produced in an alkylation unit, involving the addition of isobutane to alkenes giving branched chains but low aromatics.
- Isomerate is obtained by isomerising low octane straight run gasoline to isoparafins (like isooctane).

The terms above are the jargon used in the oil industry but terminology varies. Overall, a typical gasoline is predominantly a mixture of paraffins (alkanes), naphthenes (cycloalkanes), and olefins (alkenes).The actual ratio depends on the oil refinery that makes the gasoline, as not all refineries have the same set of processing units; crude oil feed used by the refinery; the grade of gasoline, in particular, the octane rating.

Figure13.5: Burning of gasoline produce large quantities of soot

13.2.3 Gasoline Storage

Good quality gasoline should be stable almost indefinitely if stored properly. Such storage should be in an airtight container, to prevent oxidation or water vapors mixing, and at a stable cool temperature, to reduce the chance of the container leaking. When gasoline is not stored correctly, gums and solids may accumulate resulting in "stale fuel". The presence of these degradation products in fuel tank, lines, and carburetor or fuel injection components, make it harder to start the engine. Upon the resumption of regular vehicle usage, though, the buildups should eventually be cleaned up by the flow of fresh petrol. Users have been advised to keep gasoline containers and tanks more than half full and properly capped to reduce air exposure, to avoid storage at high temperatures, to run an engine for ten minutes to circulate the stabilizer through all components prior to storage, and to run the engine at intervals to purge stale fuel from the carburetor.

13.2.4 Energy Value of Gasoline

Gasoline contains about 35 MJ/L (9.7 kW·h/L, 132 MJ/US gal, 36.6 kWh/US gal) (Higher heating value) or 13 kWh/kg. Gasoline blends differ, and therefore actual energy content varies according to the season to season and producer by up to 4% more or less than the average. The lower energy content (per litre) of LPG in comparison to gasoline is mainly due to its lower density. Energy content per kilogram is higher than for gasoline (higher hydrogen to carbon ratio). Currently many countries set limits on gasoline aromatics in general, benzene in particular, and olefin (alkene) content. Such regulations led to increasing preference for high octane pure paraffin (alkane) components, such as alkylate, and is forcing refineries to add processing units to reduce benzene content.

Gasoline can also contain other organic compounds, such as organic ethers (deliberately added), plus small levels of contaminants, in particular organic sulfur compounds, but these are usually removed at the refinery. Gasolines are also treated with metal deactivators, which are compounds that sequester (deactivate) metal salts that otherwise accelerate the formation of gummy residues. The metal impurities might arise from the engine itself or as contaminants in the fuel. Gasoline, as delivered at the pump, also contains additives to reduce internal engine carbon buildups, improve combustion, and to allow easier starting in cold climates.

13.2.5 Safety & Environmental Issues Related to Gasoline

Energy is obtained from the combustion of gasoline, the conversion of a hydrocarbon to carbon dioxide and water. The combustion of octane follows this reaction:

$$2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$$

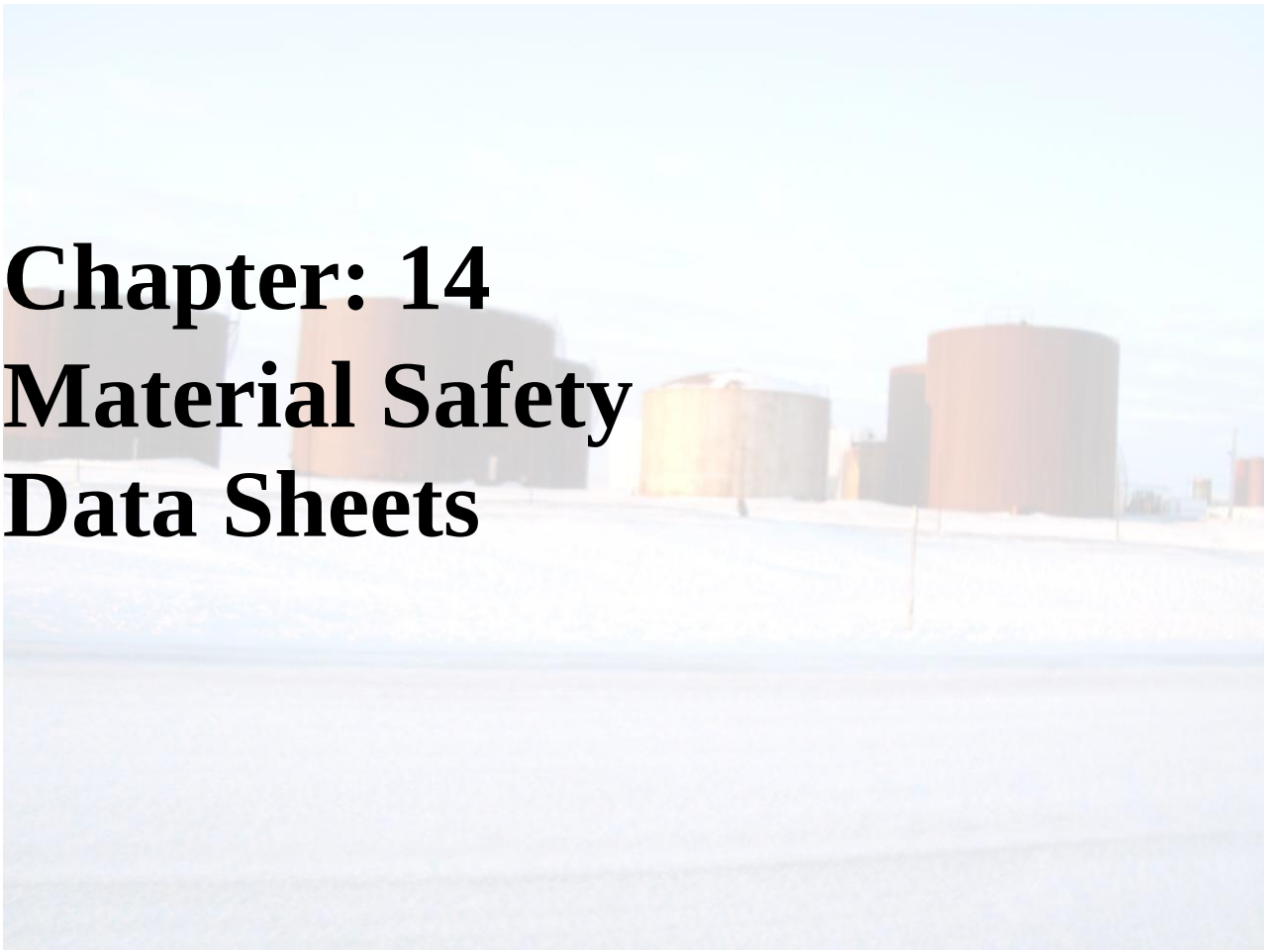
Combustion of one US gallon of gasoline produces about 19.4 pounds (8.8 kg) of carbon dioxide (converts to 2.33 kg/litre), a greenhouse gas. Gasoline is one of the hazardous substances and is regulated in United States and Canada by the Occupational Safety and Health Administration. The material safety data sheet for unleaded gasoline shows at least 15 hazardous chemicals occurring in various amounts, including benzene (up to 5% by volume), toluene (up to 35% by volume), naphthalene (up to 1% by volume), tri-methyl benzene (up to 7% by volume), methyl tert-butyl ether (MTBE) (up to 18% by volume, in some provinces) and about ten others. Benzene and many anti knocking additives are carcinogenic.

The chief risks of such leaks come not from vehicles, but from gasoline delivery truck accidents and leaks from storage tanks. Because of this risk, most storage tanks now have extensive measures in place to detect and prevent any such leaks, such as sacrificial anodes.

The main concern with gasoline on the environment, aside from the complications of its extraction and refining, are the potential effect on the climate. Unburned gasoline and evaporation from the tank, when in the atmosphere, react in sunlight to produce photochemical smog. Addition of ethanol increases the volatility of gasoline, potentially worsening the problem. Gasoline, when used in high-compression internal combustion engines, has a tendency to auto ignite (detonate) causing damaging "engine knocking" (also called "pinging" or "pinking") noise. The discovery that lead additives modified this behavior led to the widespread adoption of additives use in the 1920s and therefore more powerful, higher compression engines.

The most popular additive was tetra-ethyl lead. With the discovery of the extent of environmental and health damage caused by the lead, however, and the incompatibility of lead with catalytic converters found on virtually all newly sold automobiles since 1975, this practice began to wane (encouraged by many governments introducing differential tax rates) in the 1980s. In North America, where lead had been blended with gasoline (primarily to boost octane levels) since the early 1920s, standards to phase out leaded gasoline were first implemented in 1973. Most countries have phased out leaded fuel now. Different additives have replaced the lead compounds.

The most popular additives include aromatic hydrocarbons, ethers and alcohol (usually ethanol or methanol). Like other alkanes, gasoline burns in a limited range of its vapor phase and, coupled with its volatility, this makes leaks highly dangerous when sources of ignition are present. Gasoline has a lower explosion limit of 1.4% by volume and an upper explosion limit of 7.6%. If the concentration is below 1.4% the air- gasoline mixture is too lean and will not ignite. If the concentration is above 7.6% the mixture is too rich and also will not ignite. However, gasoline vapor rapidly mixes and spreads with air, making unconstrained gasoline quickly flammable. Many accidents involve gasoline being used in an attempt to light bonfires; rather than helping the material on the bonfire to burn, some of the gasoline vaporizes quickly after being poured and mixes with the surrounding air, so when the fire is lit a moment later, the vapor surrounding the bonfire instantly ignites in a large fireball, engulfing the unwary user. The vapor is also heavier than air and tends to collect in garage inspection pits.



Chapter: 14
Material Safety Data Sheets

MATERIAL SAFETY DATA SHEETS (MSDS) are provided for each petroleum product. These MSDS documents are included as information packages in this plan.

For Copy of (M)SDS: Internet: www.petro-canada.ca/msds
Canada-wide: telephone: 1-800-668-0220; fax: 1-800-837-1227
For Product Safety Information: (905) 804-4752

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

PLEASE BE PREPARED TO USE THE MSDS FOR THE PRODUCT SPILLED.

14.1MSDS for Diesel (Information from petro-canada.ca) Material Safety Data Sheet

DIESEL FUEL

1. Product and company identification

Product Name: DIESEL FUEL

Synonym: Seasonal Diesel, #1 Diesel, #2 Heating Oil, #1 Heating Oil, D50, D60, P40, P50, Arctic Diesel, Farm Diesel, Marine Diesel, Low Sulphur Diesel, LSD, Ultra Low Sulphur Diesel ULSD, Mining Diesel, Naval Distillate, Dyed Diesel, Marked Diesel, Coloured Diesel, Furnace special, Biodiesel blend, B1, B2, B5, Diesel Low Cloud (LC).

Code: W104, W293

Material Uses: Diesel fuels are distillate fuels suitable for use in high and medium speed internal Combustion engines of the compression ignition type. Mining diesels, marine diesels, MDO and naval distillates may have a higher flash point requirement.

Manufacturer: PETRO-CANADA
P.O. Box 2844
150 –6th Avenue South-West
Calgary, Alberta

T2P 3E3

In case of emergency: Petro-Canada: 403-296-3000
Canutec Transportation: 613-996-6666
Poison Control Centre: Consult local telephone directory for emergency number(s).

2. Hazards identification

Physical State: Bright oily liquid
Odour: Mild petroleum oil like.

WHMIS (Canada):

Class B-3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F)
Class D-2A: Material causing other toxic effects (Very toxic)
Class D-2B: Material causing other toxic effects (Toxic)

OSHA/HCS status: This material is considered hazardous by the OSHA Hazard Communication Standard.

Emergency overview: WARNING!
COMBUSTIBLE LIQUID AND VAPOUR. CAUSES EYE AND SKIN IRRITATION.
Combustible liquid. Severely irritating to the skin. Irritating to eyes. Keep away from heat, sparks and flame. Do not get in eyes. Avoid breathing vapour or mist. Avoid contact with skin and clothing. Use only with adequate ventilation. Wash thoroughly after handling.

Routes of entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Potential acute health effects

Inhalation: Inhalation of this product may cause respiratory tract irritation and Central Nervous System (CNS) depression, symptoms of which may include; weakness, dizziness, slurred speech, drowsiness, unconsciousness and in case of severe overexposure; coma and death.

Ingestion: Ingestion of this product may cause gastro-intestinal irritation. Aspiration of this product may result in severe irritation or burns to the respiratory tract.

Skin/Eyes: Severely irritating to the skin. Irritating to eyes.

Potential chronic health effects

Chronic effects: No known significant effects or critical hazards.

Carcinogenicity: Diesel engine exhaust particulate is probably carcinogenic to humans (IARC Group 2A).

Mutagenicity: No known significant effects or critical hazards.

Teratogenicity: No known significant effects or critical hazards.

Developmental effects: No known significant effects or critical hazards.

Fertility effects: No known significant effects or critical hazards.

Medical conditions aggravated by overexposure: Avoid prolonged or repeated skin contact to diesel fuels which can lead to dermal irritation and may be associated with an increased risk of skin cancer.

See toxicological information (Section 11)

3. Composition/information or ingredients

Name	CAS number	%
Hydro-treated Renewable Diesel/ fuels, diesel/Fuel Oil No.1/ Fuel Oil No. 2	64742-81-0/ 68334-30-5/ 8008-20-6/ 68476-30-2	95-100
Alkanes, C10-20 Branched and linear (R100)	958771-01-1	10-20
Fatty acids methyl esters	61788-61-2/ 67784-80-9 73891-99-3	0-5

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. First-aid measures

Eye contact: Check for and remove and contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.

Skin contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash skin thoroughly with soap and water or use recognized skin cleanser. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation: Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion: Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of first aiders: No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth to mouth resuscitation.

Notes to physician: No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

5. Fire-fighting measures

Flammability of the product: Combustible liquid

Extinguishing media

Suitable: Use dry chemical, CO2, water spray (fog) or foam.

Unsuitable: Do not use water jet.

Special exposure hazards: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No actions shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Products of combustion: Carbon oxides (CO, CO2), nitrogen oxides (NOx), sulfur oxides (SOx), sulfur compounds (H2S), smoke and irritating vapours as products of incomplete combustion.

Special protective equipment for fire-fighters: Fire-fighters wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in a positive pressure mode.

Special remarks on fire hazards: Flammable in presence of open flame, spark, and heat. Vapours are heavier than air and may travel considerable distance to sources of ignition and flash back. This product can accumulate static charge and ignite.

Special remarks on explosion hazard: Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Runoff to sewer may create fire or explosion hazard.

6. Accidental release measures

Personal precautions: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spill material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapour or mist. Provide adequate ventilation. Wear appropriate personal protective equipment (see Section 8).

Environmental precautions: Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods for cleaning up:

Small spills: Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water soluble. Alternatively, or if water insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

Large spills: Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with noncombustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.
Contaminated absorbent material may pose the same hazard as the spilt product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7. Handling and storage

Handling: Put on appropriate personal protective equipment (see section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing vapour or mist. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage: Store in accordance with local regulations store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready to use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental containment. Ensure the storage containers are grounded/ bonded.

8. Exposure controls/personal protection

Ingredient	Exposure limits
Fuels, diesel	**ACGIH TLV (United States). Absorbed through skin,** TWA: 100mg/m3, (inhalable fraction and vapour)8 hour(s)
Fuel oil No. 2	**ACGIH TLV (United States). Absorbed through skin.** TWA: 100mg/m3, (inhalable fraction and vapour) 8 hour(s)
Hydro-treated Renewable Diesel	**ACGIH TLV (United States). Absorbed through skin.** TWA: 200mg/m3, (inhalable fraction and vapour) 8
Fuel oil No. 1	**ACGIH TLV (United States). Absorbed through skin.** TWA: 200mg/m3, (inhalable fraction and vapour) 8

Consult local authorities for acceptable exposure limits.

Recommended monitoring procedures: If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Hygiene measures: Wash hands, forearms, and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal protection

Respiratory: Use a properly fitted, air purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended:

organic vapour cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited. Use a positive-pressure, air-supplied respirator if there is any potential for uncontrolled release, exposure levels are unknown, or any other circumstance where air-purifying respirators may not provide adequate protection.

Hands: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Recommended: nitrile, neoprene, polyvinyl alcohol (PVA), Viton®. Consult your PPE provider for breakthrough times and the specific glove that is best for you based on your use patterns. It should be realized that eventually any materials regardless of their imperviousness, will get permeated by chemicals. Therefore, protective gloves should be regularly checked for wear and tear. At the first signs of hardening and cracks, they should be changed.

Eyes: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to process equipment will be necessary to reduce emissions to acceptable levels.

9. Physical and chemical properties

Physical state:	Bright oily liquid
Flash point:	Diesel fuel and other distillate fuels: Closed cup: ≥40°C (≥104°F) Marine Diesel/MDO/Naval Distillate: Closed cup: ≥60°C (≥140°F) Mining Diesel: Closed cup: ≥52°C (≥126°F)
Auto-ignition temperature:	225°C (437°F)
Flammable limits:	Lower: 0.7% Upper: 6%
Colour:	Clear to yellow (This product may be dyed red for taxation purposes)
Odour:	Mild petroleum oil like.
Odour threshold:	Not available
pH:	Not available
Boiling/condensation point:	150 to 371°C (302 to 699.8°F)
Melting/freezing point:	Not available
Relative density:	0.80 to 0.88 kg/L @ 15°C (59°F)
Vapour pressure:	1kPa (7.5 mm Hg) @ 20°C (68°F)
Vapour density:	4.5 [Air=1]
Volatility:	Not available
Evaporation rate:	Not available
Viscosity:	Diesel fuel: 1.3-4.1 cSt @ 40°C (104°F) Marine Diesel Fuel: 1.3-4.4 cSt @40°C (104°F)
Pour point:	Not available
Solubility:	Insoluble in cold water, soluble in non-polar hydrocarbon solvents.

10. Stability and reactivity

Chemical stability:	The product is stable.
Hazardous polymerization:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Materials to avoid:	Reactive with oxidizing agents and acids.

Hazardous decomposition products: May release COx, NOx, H2S, smoke and irritating vapours when heated to decomposition.

11. Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Fuels, diesel	LD50 Dermal	Mouse	24500mg/kg	---
	LD50 Oral	Rat	7500mg/kg	---
Fuel oil No. 2	LD50 Oral	Rat	12000mg/kg	---
Fuel oil No. 1	LD50 Dermal	Rabbit	>2000mg/kg	---
	LD50 Oral	Rat	>5000mg/kg	---
	LC50 Inhalation	Rat	>5000mg/m3	4 hours Vapour
Hydrotreated Renewable Diesel	LD50 Dermal	Rabbit	>2000mg/kg	---
	LD50 Oral	Rat	>5000mg/kg	---
	LC50 Inhalation	Rat	>5200mg/m3	4 hours Vapour

Conclusion/Summary: Not available

Chronic toxicity:

Conclusion/Summary: Not available

Irritation/Corrosion

Conclusion/Summary: Not available

Sensitizer

Conclusion/Summary: Not available

Carcinogenicity

Conclusion/Summary: Diesel engine exhaust particulate is probably carcinogenic to humans (IARC Group 2A).

Classification

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
Fuels, diesel	A3	3	---	---	---	---
Fuel oil No. 1	A3	3	---	---	---	---
Fuel oil No. 2	A3	3	---	---	---	---
Hydrotreated Renewable Diesel	A3	3	---	---	---	---

Mutagenicity

Conclusion/Summary Not available

Teratogenicity

Conclusion/Summary Not available

Reproductive toxicity

Conclusion/Summary Not available

12. Ecological information

Environmental effects: No known significant effects or critical hazards.

Aquatic ecotoxicity

Conclusion/Summary: Not available

Biodegradability

Conclusion/Summary: Not available

13. Disposal considerations

Waste Disposal: The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose of surplus and non-recyclable products via a licensed disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapour from product residues may create highly flammable or explosive atmosphere inside the container. Do not cut, weld, grind used containers unless they have been cleaned

thoroughly internally. Avoid dispersal of split material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations. Refer to Section 7: Handling and Storage and Section 8: Exposure Controls/Personal Protection for additional handling information and protection of employees

14. Transport information

Regulatory Information	UN Number	Proper shipping Name	Class	PG*	Label	Additional Information
TDG Classification	UN1202	DIESEL FUEL	3	III		----
DOT Classification	Not Available	Not Available	Not Available	----	----	----

PG*: Packing group

15. Regulatory Information

United States

HCS Classification: Combustible liquid
Irritating material

Canada: Class B-3: Combustible liquid with a flash point between 37.8°C (100°F) and 93.3°C (200°F)
Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

International regulations

Canada inventory: All components are listed or exempted.
United States inventory (TSCA 8b): All components are listed or exempted.
Europe inventory: All components are listed or exempted.

16. Other information

Label requirements: COMBUSTIBLE LIQUID AND VAPOUR. CAUSES EYE AND SKIN IRRITATION.

Hazardous Material Information System:

Health	**2**
Flammability	**2**
Physical hazards	**0**
Personal protection	**H**

National Fire Protection Association (USA):

References: Available upon request.
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Date of Printing: **6/28/2013.**
Date of issue: 28 June 2013
Date of previous issue: 6/28/2013
Responsible name: Sécurité de produit – KKB

- Indicates information that has changed from the previous version.

For Copy of (M)SDS: Internet: www.petro-canada.ca/msds
Canada-wide: telephone: 1-800-668-0220; fax: 1-800-837-1227

14.2MSDS for Gasoline, (Information from petro-canada.ca) Material Safety Data Sheet

GASOLINE, UNLEADED

1. Product and company identification

Product Name: GASOLINE, UNLEADED

Synonym: Regular, Unleaded Gasoline (US Grade), Mid-Grade, Plus, Super, WinterGas, SummerGas, Supreme, SuperClean WinterGas, RegularClean, PlusClean, Premium, marked or dyed gasoline, TQRUL, transitional quality regular unleaded, BOB, Blendstock for Oxygenate Blending

Code: W102E, SAP: 102 to 117

Material Uses: Unleaded gasoline is used in spark ignition engines including motor vehicles, inboard and outboard boat motors, small engines such as chain saws and lawn mowers, and recreational vehicles.

Manufacturer: PETRO-CANADA
P.O. Box 2844
150 –6th Avenue South-West
Calgary, Alberta
T2P 3E3

In case of emergency: Petro-Canada: 403-296-3000
Canutec Transportation: 613-996-6666
Poison Control Centre: Consult local telephone directory for emergency number(s).

2. Hazards identification

Physical State: Clear liquid

Odour: Gasoline.

WHMIS (Canada):

Class B-2: Flammable liquid
Class D-2A: Material causing other toxic effects (Very toxic)
Class D-2B: Material causing other toxic effects (Toxic)

OSHA/HCS status: This material is considered hazardous by the OSHA Hazard Communication Standard. (29 CFR 1910. 1200)

Emergency overview: WARNING!
FLAMMABLE LIQUID AND VAPOUR. CAUSES RESPIRATORY TRACT, EYE AND SKIN IRRITATION. CANCER HAZARD – CONTAINS MATERIAL WHICH CAN CAUSE CANCER. CONTAINS MATERIAL WHICH CAN CAUSE HERITABLE GENETIC EFFECTS.

Flammable liquid. Irritating to eyes, respiratory system and skin. Keep away from heat, sparks and flame. Avoid exposure – obtain special instructions before use. Do not breathe vapour or mist. Avoid contact with eyes, skin and clothing. Contains material which can cause cancer. Risk of cancer depends on duration and level of exposure. Contains material which can cause heritable genetic effects. Use only with adequate ventilation. Keep container tightly closed and sealed until ready to use. Wash thoroughly after handling.

Routes of entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Potential acute health effects

Inhalation: Inhalation of this product may cause respiratory tract irritation and Central Nervous System (CNS) depression, symptoms of which may include; weakness, dizziness, slurred speech, drowsiness, unconsciousness and in case of severe overexposure; coma and death.

Ingestion: Ingestion of this product may cause gastro-intestinal irritation. Aspiration of this product may result in severe irritation or burns to the respiratory tract. Ingestion of this product may cause respiratory tract irritation and Central Nervous System (CNS) depression, symptoms of which may include; weakness, dizziness, slurred speech, drowsiness, unconsciousness and in case of severe overexposure; coma and death.

Skin/Eyes: Irritating to the skin. Irritating to eyes.

Potential chronic health effects

Chronic effects: This product contains an ingredient or ingredients, which have been shown to cause chronic toxic effects. Repeated or prolonged exposure to the substance can produce blood disorders.

Carcinogenicity: Contains material which can cause cancer. Risk of cancer depends on duration and level on exposure.

Mutagenicity: Contains material which can cause heritable genetic effects.

Teratogenicity: No known significant effects or critical hazards.

Developmental effects: No known significant effects or critical hazards.

Fertility effects: No known significant effects or critical hazards.

Medical conditions aggravated by overexposure:

Repeated or prolonged contact with spray or mist may produce chronic eye irritation and severe skin irritation. Repeated skin exposure can produce local skin destruction or dermatitis.

See toxicological information (section 11)

3. Composition/information or ingredients

Name	CAS number	%
Gasoline	86290-81-5	85-100
Ethanol	64-17-5	0.1-1
Benzene	71-43-2	0.5-1.5
Toluene	108-88-3	15-40*

*Montreal: may vary from 3-40%

*Edmonton: may vary from 1-5%

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. First-aid measures

Eye contact: Check for and remove and contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.

Skin contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash skin thoroughly with soap and water or use recognized skin cleanser. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation: Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion: Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of first aiders: No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

Notes to physician: No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

5. Fire-fighting measures

Flammability of the product: Flammable liquid (NFPA).

Extinguishing media

Suitable: Use dry chemical, CO2, water spray (fog) or foam.

Unsuitable: Do not use water jet.

Special exposure hazards: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No actions shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Products of combustion: Carbon oxides (CO, CO2), nitrogen oxides (NOx), polynuclear aromatic hydrocarbons, phenols, aldehydes, ketones, smoke and irritating vapours as product of incomplete combustion.

Special protective equipment for fire-fighters: Fire-fighters wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in a positive pressure mode.

Special remarks on fire hazards: Extremely flammable in presence of open flame, spark, shocks, and heat. Vapours are heavier than air and may travel considerable distance to sources of ignition and flash back. Rapid escape of vapour may generate static charge causing ignition. May accumulate in confined spaces.

Special remarks on explosion hazard: Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Containers may explode in heat of fire. Vapours may form explosive mixtures with air.

6. Accidental release measures

Personal precautions: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spill material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapour or mist. Provide adequate ventilation. Wear appropriate Respirator when ventilation is inadequate. Put on personal protective equipment (see Section 8).

Environmental precautions: Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods for cleaning up:

Small spills: Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water soluble or absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof and explosive-proof equipment. Dispose of via a licensed waste disposal contractor.

Large spills: Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with noncombustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product.

Note: see section 1 for emergency contact information and section 13 for waste disposal.

7. Handling and storage

Handling: Put on appropriate personal protective equipment (see section 8).
Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. Do not ingest. Avoid contact with eyes, skin and clothing. Avoid breathing vapour or mist. Use only with adequate ventilation.
Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage: Store in accordance with local regulations. Store in a segregated and approved areas. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready to use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental containment. Ensure the storage containers are grounded/ bonded.

8. Exposure controls/personal protection

Ingredient	Exposure limits
Gasoline	**ACGIH TLV (United States)**. TWA: 300 ppm 8 hour(s). STEL: 500 ppm 15 minutes(s)
Ethanol	**ACGIH TLV (United States).** STEL: 1000 ppm 15 minute(s)
Benzene	**ACGIH TLV (United States).** TWA: 0.5 ppm 8 hour(s) STEL; 2.5 ppm 15 minute(s)
Toluene	**ACGIH TLV (United States).** TWA: 20 ppm 8 hour(s)

Consult local authorities for acceptable exposure limits.

Recommended monitoring procedures: If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Hygiene measures: Wash hands, forearms, and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal protection

Respiratory:	Use a properly fitted, air purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Recommended: A NIOSH-approved air-purifying respirator with an organic vapour cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited. Use a positive-pressure, air-supplied respirator if there is any potential for uncontrolled release, exposure levels are unknown, or any other circumstance where air-purifying respirators may not provide adequate protection.
Hands:	Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Recommended: polyvinyl alcohol (PVA), Viton. Consult your PPE provider for breakthrough times and the specific glove that is best for you based on your use patterns. It should be realized that eventually any materials regardless of their imperviousness, will get permeated by chemicals. Therefore, protective gloves should be regularly checked for wear and tear. At the first signs of hardening and cracks, they should be changed.
Eyes:	Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.
Skin:	Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Environmental exposure controls:	Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to process equipment will be necessary to reduce emissions to acceptable levels.

9. Physical and chemical properties

Physical state:	Clear liquid
Flash point:	Closed cup: -50 to -38°C (-58 to -36.4°F) [Tagliabue]
Auto-ignition temperature:	257°C (494.6°F) (NFPA)
Flammable limits:	Lower: 1.3% Upper: 7.6%
Colour:	Clear to slightly yellow or green, undyed liquid. May be dyed red for taxation purposes
Odour:	Gasoline
Odour threshold:	Not available
pH:	Not available
Boiling/condensation point:	25 to 220°C (77 to 428°F) (ASTM D86)
Melting/freezing point:	Not available
Relative density:	0.685 to 0.8 kg/L @ 15°C (59°F)
Vapour pressure:	<107kPa (<802.5 mm Hg) @ 37.8°C (100°F)
Vapour density:	3 to 4 [Air=1] (NFPA)
Volatility:	Not available
Evaporation rate:	Not available
Viscosity:	Not available
Pour point :	Not available
Solubility :	Hydrocarbon components virtually insoluble in water. Soluble in alcohol, ether, chloroform and benzene. Dissolves fats, oils and natural resins.

10. Stability and reactivity

Chemical stability:	The product is stable.
Hazardous polymerization:	Under normal conditions of storage and use, hazardous polymerization will not occur.
Materials to avoid:	Reactive with oxidizing agents, acids and interhalogens.

Hazardous decomposition products: May release COx, NOx, phenols, polycyclic aromatic hydrocarbons, aldehydes, ketones, smoke and irritating vapours when heated to decomposition.

11. Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Gasoline	LD50 Dermal	Rabbit	>5000mg/kg	----
	LD50 Oral	Rat	13600mg/kg	----
Ethanol	LD50 Dermal	Rabbit	>15800mg/kg	----
	LD50 Oral	Mouse	3450 mg/kg	----
	LC50 Inhalation Vapour	Rat	8850 mg/m3	4 hours
Benzene	LD50 Dermal	Rabbit	>8240mg/kg	----
	LD50 Oral	Rat	930mg/kg	----
	LC50 Inhalation Vapour	Rat	13228 ppm	4 hours
Toluene	LD50 Dermal	Rabbit	12125mg/kg	----
	LD50 Oral	Rat	636mg/kg	----
	LC50 Inhalation Vapour	Rat	7585mg/m3	4 hours

Conclusion/Summary: Not available

Chronic toxicity:

Conclusion/Summary: Not available

Irritation/Corrosion

Conclusion/Summary: Not available

Sensitizer

Conclusion/Summary: Not available

Carcinogenicity

Conclusion/Summary: Not available

Classification

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
Gasoline	A3	3B	---	---	---	---
Ethanol	A3	---	---	---	---	---
Benzene	A1	1	A	+	Proven	+
Toluene	A4	3	D	---	---	---

Mutagenicity

Conclusion/Summary Not available

Teratogenicity

Conclusion/Summary There is wealth of information about the teratogenic hazards of toluene in the literature; however, based upon professional judgment regarding the body of evidence, WHMIS classification as a teratogen is not warranted.

Reproductive toxicity

Conclusion/Summary Not available

12. Ecological information

Environmental effects: No known significant effects or critical hazards.

Aquatic ecotoxicity

Conclusion/Summary: Not available

Biodegradability

Conclusion/Summary: Not available

13. Disposal considerations

Waste Disposal: The generation of waste should be avoided or minimized wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose the surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the

requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of split material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations. Refer to Section 7: Handling and Storage and Section 8: Exposure Controls/Personal Protection for additional handling information and protection of employees

14. Transport information

Regulatory Information	UN Number	Proper shipping Name	Class	PG*	Label	Additional Information
TDG Classification	UN1203	Gasoline	3	III		----
DOT Classification	Not Available	Not Available	Not Available	----	----	----

PG*: Packing group

15. Regulatory Information

United States

HCS Classification: Flammable liquid
Irritating material
Carcinogen

Canada: Class B-2: Flammable liquid

WHMIS (Canada) Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

International regulations

Canada inventory: All components are listed or exempted.
United States inventory (TSCA 8b): All components are listed or exempted.
Europe inventory: All components are listed or exempted.

16. Other information

Label requirements: FLAMMABLE LIQUID AND VAPOUR. CAUSES RESPIRATORY TRACT, EYE AND SKIN IRRITATION. CANCER HAZARD- CONTAINS MATERIAL WHICH CAN CAUSE CANCER. CONTAINS MATERIAL WHICH CAN CAUSE HERITABLE GENETIC EFFECTS.

Hazardous Material Information System:

Health	**2**
Flammability	**3**
Physical hazards	**0**
Personal protection	**H**

National Fire Protection Association (USA):

References: Available upon request.
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Responsible name: Product Safety - RS

- Indicates information that has changed from the previous version.

For Copy of (M)SDS: Internet: www.petro-canada.ca/msds

Canada-wide: telephone: 1-800-668-0220; fax: 1-800-837-1227
For Product Safety Information: (905) 804-4752

14.3 MSDS for Naphtha, (Information from petro-canada.ca) Material Safety Data Sheet

NAPHTHA (SWEET)

1. Product and company identification

Product Name: NAPHTHA (SWEET)

Synonym: Light Naphtha, Heavy Naphtha, Reformer feed, Platformer feed, Hydrodesulfurized Naphtha, Hydrotreated Naphtha.

Code: W344

Material Uses: Light and heavy naphthas are intermediate refinery products used as feedstocks to platformer units for the production of high octane motor gasoline blending components.

Manufacturer: PETRO-CANADA
P.O. Box 2844
150 –6th Avenue South-West
Calgary, Alberta
T2P 3E3

In case of emergency: Petro-Canada: 403-296-3000
Canutec Transportation: 613-996-6666
Poison Control Centre: Consult local telephone directory for emergency number(s).

2. Hazards identification

Physical State: Liquid
Odour: Gasoline like.

WHMIS (Canada):

Class B-2: Flammable liquid
Class D-2A: Material causing other toxic effects (Very toxic)
Class D-2B: Material causing other toxic effects (Toxic)

OSHA/HCS status: This material is considered hazardous by the OSHA Hazard Communication Standard. (29 CFR 1910. 1200)

Emergency overview: WARNING!
FLAMMABLE LIQUID AND VAPOUR. CAUSES EYE AND SKIN IRRITATION. CANCER HAZARD – CONTAINS MATERIAL WHICH CAN CAUSE CANCER. POSSIBLE BIRTH DEFECT HAZARD- CONTAINS MATERIAL WHICH MAY CAUSE BIRTH DEFECTS, BASED IN ANIMAL DATA. CONTAINS MATERIAL WHICH MAY CAUSE HERITABLE GENETIC EFFECTS.
Flammable liquid. Irritating to eyes and skin. Keep away from heat, sparks and flame. Avoid exposure – obtain special instructions before use. Do not breathe vapour or mist. Avoid contact with eyes, skin and clothing. Contains material which can cause cancer. Risk of cancer depends on duration and level of exposure. Contains material which can cause heritable genetic effects. Contains material which may cause birth defects, based on animal data. Avoid exposure during

pregnancy. Use only with adequate ventilation. Keep container tightly closed and sealed until ready to use. Wash thoroughly after handling.

Routes of entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Potential acute health effects

Inhalation: Inhalation of this product may cause respiratory tract irritation and Central Nervous System (CNS) depression, symptoms of which may include; weakness, dizziness, slurred speech, drowsiness, unconsciousness and in case of severe overexposure; coma and death.

Ingestion: Ingestion of this product may cause gastro-intestinal irritation. Aspiration of this product may result in severe irritation or burns to the respiratory tract.

Skin/Eyes: Irritating to the skin. Irritating to eyes.

Potential chronic health effects

Chronic effects: This product contains an ingredient or ingredients, which have been shown to cause chronic toxic effects. Repeated or prolonged exposure to the substance can produce blood disorders.

Carcinogenicity: Contains material which can cause cancer. Risk of cancer depends on duration and level on exposure.

Mutagenicity: Contains material which may cause heritable genetic effects.

Teratogenicity: Contains material which may cause birth defects, based on animal data..

Developmental effects: No known significant effects or critical hazards.

Fertility effects: No known significant effects or critical hazards.

Medical conditions aggravated by overexposure: Repeated skin exposure can produce local skin destruction or dermatitis.

See toxicological information (section 11)

3. Composition/information or ingredients

Name	CAS number	%
Complex mixture of aliphatic and aromatic hydrocarbons (C4-C12)	64741-69-1 64741-42-0 64741-41-9 64741-46-4 64741-78-2	85-100
Toluene	108-88-3	3 - 7
Xylene	1330-20-7	3 - 6
Benzene	71-43-2	1 – 2

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

4. First-aid measures

Eye contact: Check for and remove and contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.

Skin contact: In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash skin thoroughly with soap and water or use recognized skin cleanser. Wash clothing before reuse. Clean shoes thoroughly before reuse. Get medical attention immediately.

Inhalation: Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Ingestion: Wash out mouth with water. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Protection of first aiders: No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

Notes to physician: No specific treatment. Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

5. Fire-fighting measures

Flammability of the product: Flammable

Extinguishing media

Suitable: Use dry chemical, CO2, water spray (fog) or foam.

Unsuitable: Do not use water jet.

Special exposure hazards: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No actions shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Products of combustion: Carbon oxides (CO, CO2), reactive hydrocarbons, aldehydes, ketones, smoke and irritating vapours as product of incomplete combustion.

Special protective equipment for fire-fighters: Fire-fighters wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in a positive pressure mode.

Special remarks on fire hazards: Flammable in presence of open flame, spark, shocks, and heat. Vapours are heavier than air and may travel considerable distance to sources of ignition and flash back. May accumulate in confined spaces. Rapid escape of vapour may generate static charge causing ignition.

Special remarks on explosion hazard: Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

6. Accidental release measures

Personal precautions: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spill material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapour or mist. Provide adequate ventilation. Wear appropriate Respirator when ventilation is inadequate. Put on personal protective equipment (see Section 8).

Environmental precautions: Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods for cleaning up:

Small spills: Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water soluble. Alternatively, or if water insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof and explosive-proof equipment. Dispose of via a licensed waste disposal contractor.

Large spills: Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with noncombustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see section 13). Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product. Note: see section 1 for emergency contact information and section 13 for waste disposal.

7. Handling and storage

Handling: Put on appropriate personal protective equipment (see section 8). Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. Avoid exposure- obtain special instructions before use. Avoid exposure during pregnancy. Do not get in eyes, or on skin and clothing. Do not ingest. Avoid breathing vapour or mist. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use non-sparking tools. Take precautionary measures against electrostatic discharges. To avoid fire or explosion, dissipate static electricity during transfer by earthing and bonding containers and equipment before transferring material. Empty containers retain product residue and can be hazardous. Do not reuse container.

Storage: Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials.

Keep container tightly closed and sealed until ready to use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental containment. Ensure the storage containers are grounded/ bonded.

8. Exposure controls/personal protection

Ingredient	Exposure limits
Toluene	**ACGIH TLV (United States)**. TWA: 20 ppm 8 hour(s).
Xylene	**ACGIH TLV (United States).** TWA: 100 ppm 8 hour(s) STEL: 150 ppm 8 hours(s)
Benzene	**ACGIH TLV (United States). Absorbed though skin** TWA: 0.5 ppm 8 hour(s) STEL: 2.5 ppm 15 minute(s)

Consult local authorities for acceptable exposure limits.

Recommended monitoring procedures: If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Engineering measures: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Hygiene measures: Wash hands, forearms, and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal protection

Respiratory: Use a properly fitted, air purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator

selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
Recommended: organic vapour cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air-purifying respirators is limited.

Hands: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Recommended: polyvinyl alcohol (PVA), Viton®.

Eyes: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.

Skin: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Environmental exposure controls: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to process equipment will be necessary to reduce emissions to acceptable levels.

9. Physical and chemical properties

Physical state:	Liquid
Flash point:	Closed cup: <-18°C (<-0.4°F)
Auto-ignition temperature:	288°C (550.4°F)
Flammable limits:	Lower: 1% Upper: 7.5%
Colour:	Yellowish to clear
Odour:	Gasoline like
Odour threshold:	Not available
pH:	Not available
Boiling/condensation point:	Montreal: IBP >60°C (140°F) Edmonton: IBP >65°C (149°F) IBP (for LN) = 102°C (215°F)
Melting/freezing point:	Not available
Relative density:	0.7 to 0.75
Vapour pressure:	14 - 20kPa 105-150 mm Hg) @ 37.8°C (100.4°F)
Vapour density:	Not available
Volatility:	Not available
Evaporation rate:	Not available
Viscosity:	Not available
Pour point:	Not available
Solubility:	Hydrocarbon components virtually insoluble in water. Soluble in alcohol, ether, chloroform and benzene.

10. Stability and reactivity

Chemical stability: The product is stable.

Hazardous polymerization: Under normal conditions of storage and use, hazardous polymerization will not occur.

Materials to avoid: Reactive with oxidizing agents, acids and interhalogens.

Hazardous decomposition products: May release COx, reactive hydrocarbons, aldehydes, ketones, smoke and irritating vapours when heated to decomposition.

11. Toxicological information

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Toluene	LD50 Dermal	Rabbit	12125mg/kg	----
	LD50 Oral	Rat	636mg/kg	----
	LC50 Inhalation	Rat	7585 ppm	4 hours Vapour
Xylene	LD50 Dermal	Rabbit	>1700mg/kg	----
	LD50 Oral	Rat	4300 mg/kg	----
	LC50 Inhalation	Rat	5000 ppm	4 hours Vapour
Benzene	LD50 Dermal	Rabbit	>9400mg/kg	----
	LD50 Oral	Rat	930mg/kg	----
	LC50 Inhalation	Rat	13200 ppm	4 hours Vapour

Conclusion/Summary: Not available

Chronic toxicity:

Conclusion/Summary: Not available

Irritation/Corrosion

Conclusion/Summary: Not available

Sensitizer

Conclusion/Summary: Not available

Carcinogenicity

Conclusion/Summary: Not available

Classification

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
Toluene	A4	3	D	---	---	---
Xylene	A4	3	D	---	---	---
Benzene	A1	1	A	+	Proven	+

Conclusion/Summary Not available

Teratogenicity

Conclusion/Summary Not available

Reproductive toxicity

Conclusion/Summary Not available

12. Ecological information

Environmental effects: No known significant effects or critical hazards.

Aquatic ecotoxicity

Conclusion/Summary: Not available

Biodegradability

Conclusion/Summary: Not available

13. Disposal considerations

Waste Disposal: The generation of waste should be avoided or minimized wherever possible. Significant quantities of waste product residues should not be disposed of via the foul sewer but processed in a suitable effluent treatment plant. Dispose the surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed. Empty containers or liners may retain some product residues. Vapour from product residues may create a highly flammable or explosive atmosphere inside the container. Avoid dispersal of split material and runoff and contact with soil, waterways, drains and sewers.

Disposal should be in accordance with applicable regional, national and local laws and regulations. Refer to Section 7: HANDLING AND STORAGE and Section 8: EXPOSURE CONTROL/PERSONAL PROTECTION for additional handling information and protection of employees.

14. Transport information

Regulatory Information	UN Number	Proper shipping Name	Class	PG*	Label	Additional Information
TDG Classification	UN1268	PETROLEUM DISTILLATES, N.O.S.	3	II		----
DOT Classification	Not Available	Not Available	Not Available	----	----	----

PG*: Packing group

15. Regulatory Information

United States

HCS Classification: Flammable liquid
Irritating material
Carcinogen

Canada: Class B-2: Flammable liquid

WHMIS (Canada) Class D-2A: Material causing other toxic effects (Very toxic).
Class D-2B: Material causing other toxic effects (Toxic).

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

International regulations

Canada inventory: All components are listed or exempted.
United States inventory (TSCA 8b): All components are listed or exempted.
Europe inventory: All components are listed or exempted.

16. Other information

Label requirements: FLAMMABLE LIQUID AND VAPOUR. CAUSES EYE AND SKIN IRRITATION. CANCER HAZARD- CONTAINS MATERIAL WHICH CAN CAUSE CANCER. POSSIBLE BIRTH DEFECTS HAZARDS- CONTAINS MATERIAL WHICH MAY CAUSE BIRTH DEFECTS, BASED ON ANIMAL DATA. CONTAINS MATERIAL WHICH CAN CAUSE HERITABLE GENETIC EFFECTS.

Hazardous Material Information System:

Health	**2**
Flammability	**4**
Physical hazards	**0**
Personal protection	**H**

National Fire Protection Association (USA):

References: Available upon request.
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