Kiggavik Project
Final Environmental Impact Statement

Tier 3 Technical Appendix 2J:
Marine Transportation

September 2014

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Attachments

Acronyms

AIS ... Automatic Identification System
ARPA ... Automated Radar Plotting Aid
ATB ... Articulated Tug with Barge
COSEWIC ... Committee on the Status of Endangered Wildlife in Canada
DGPS ... Differential Global Positioning System
DWT ... Dead Weight Tonnage
EA ... Environmental Assessment
EIS ... Environmental Impact Statement
IMO ... International Maritime Organization
IQ ... Inuit Qaujimajatuqangit
ISO ... International Organization for Standardization
LAA ... Local Assessment Area
MARPOL ... International Convention for the Prevention of Pollution From Ships
MMO ... Marine Mammal Observer
MSP ... Marine Shipping Plan
NIRB ... Nunavut Impact Review Board
NLCA ... Nunavut Land Claims Agreement
OHF ... Oil Handling Facility
OPEP ... Oil Pollution Emergency Plan
RAA ... Regional Assessment Area
SARA ... *Species at Risk Act*
Solas ... International Convention for the Safety of Life at Sea
SOPEP ... Shipboard Oil Pollution Emergency Plan
TEU ... Twenty-foot Equivalent Unit
VEC ... Valued Environmental Component

1 Introduction

1.1 Overview

The objective of this report is to provide information on marine transportation associated with the Kiggavik Project. The Project is located approximately 75 kilometres (km) west of the community of Baker Lake, Nunavut, which is west of Chesterfield Inlet and Hudson Bay (Figure 1.1-1). The Kiggavik Project includes four open pit mines and one underground mine. The Main Zone, Centre Zone and East Zone pits are located at the Kiggavik site and the Andrew Lake pit and End Grid underground mine are located about 15 km to the southwest at the Sissons site. A dock site and cargo storage facility is proposed to be built at Baker Lake to receive supplies.

Projection: NAD 1983 UTM Zone 14N
Creator: CDC
Date: 8/21/2014 Scale: 1:16,000,000
File:
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, Geological Survey of Canada, AREVA Resources Canada Inc.*

FIGURE 1.1-1
GENERAL LOCATION OF PROPOSED KIGGAVIK PROJECT IN CANADA

ENVIRONMENTAL IMPACT STATEMENT
APPENDIX 2J - MARINE TRANSPORTATION

Kiggavik Project

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1.2 Regulatory Regime and Conventions

The marine component will operate in compliance with the following regulations and maritime conventions:

- *Canada Shipping Act*, 2001,
- *Arctic Waters Pollution Prevention Act*, 1985
- Arctic Shipping Pollution Prevention Regulations, 2006*,*
- *Canada Oceans Act*, 1996,
- International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78):
    - Annex I (Mineral oils),
    - Annex II (Noxious Liquid Substances carried in bulk),
    - Annex III (Harmful substances carried in packaged forms),
    - Annex IV (Sewage), Annex V (Garbage),
    - Annex VI (Air Pollution),
- International Convention for the Safety of Life at Sea, 1974 (SOLAS 74) and associated amendments,
- *Transportation of Dangerous Goods Act*, 1992,
- *Marine Liability Act,* 2001,
- *Navigation Protection Act,* 1985, and
- Nunavut *Environmental Protection Act*, 1999.

Canada is a signatory to the International Maritime Organization (IMO), MARPOL and SOLAS and, as such, Canadian regulations are a reflection of these International Conventions and protocols. The Canadian regulations offer exemptions from some of the International regulations and this also applies to implementation schedules for certain provisions affecting Canadian registered vessels operating in Canadian waters only. Vessels used for the Kiggavik Project will be required to comply with all International and Canadian marine regulations.

1.3 Organization

This Marine Transportation plan is organized as follows:

- Section 2 summarizes Arctic marine transportation;
- Section 3 describes the Marine Shipping Plan;
- Section 4 presents the proposed Baker Lake dock and storage facility;
- Section 5 reviews the content of key management plans; and,
- Section 6 discusses other environmental considerations.

2 Arctic Marine Transportation

2.1 Background

The shipping requirements to support the Kiggavik mine are substantial. The materials and equipment needed for the construction of the mine are not available in the Regional Assessment Area (RAA). The consumables needed for the day-to-day operation of the mine are also not available in the RAA. There are no alternative shipping methods available to support the construction and operation of the proposed Project. The existing fleet of vessels which has traditionally provided shipping services to the Kivalliq region will need to be expanded to meet the increased shipping volume requirements. New vessels will be more efficient and will meet stringent new environmental regulations limiting exhaust emissions, sewage treatment and waste management. Barges and tankers carrying fuel will be of double hull construction designed to prevent oil spills as a result of a grounding or other impact. The new articulated tug-barge (ATB) design will provide safe and reliable marine transportation of materials through the Chesterfield Narrows to Baker Lake. A modern marine dock and cargo handling facility will reduce accidents and damage to cargo, lower cargo loading time, and increase efficiency of shipping Project supplies. Further detail on shipping season, routes, vessels and navigation are discussed in Section 3, Marine Shipping Plan.

2.2 Spatial and Temporal Boundaries

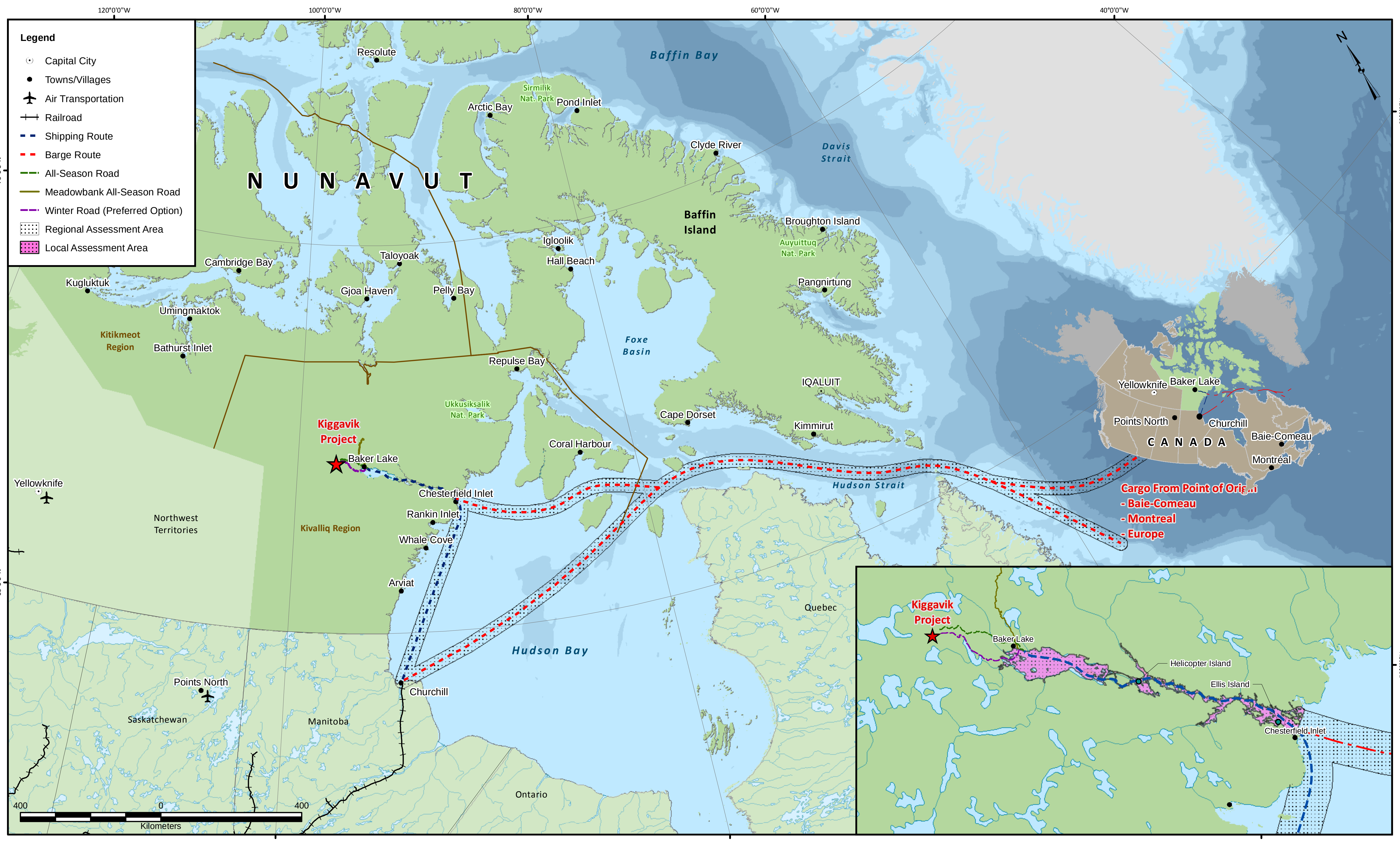
2.2.1 Spatial Boundaries

As indicated in Volume 7 Marine Environment, Section 4.5, the Project footprint for the marine assessment is defined as the shipping route used by the vessels transiting from the entrance to Chesterfield Inlet from Hudson Bay, through Chesterfield Narrows to the dock facility on the north shore of Baker Lake.

The local assessment area (LAA) is defined as marine waters of Chesterfield Inlet and the adjacent coastal and offshore regions at the mouth of Chesterfield Inlet where measureable environmental effects from Project-related marine vessel traffic are most likely to occur. This area includes portions of the shipping route where marine vessels will be transiting to and from the main shipping routes in Hudson Bay (see Figure 2.2-1).

The regional assessment area (RAA) of the Project extends beyond the LAA to encompass the shipping route in Hudson Bay between Churchill and Chesterfield Inlet, and the shipping route through Hudson Bay and Hudson Strait to the extent of Nunavut Territorial waters (Figure 2.2-1). The RAA encompasses the zone where Project vessels are likely to have a measureable effect on the marine environment, and have the potential to act cumulatively with marine activities of other projects. The boundaries of the RAA were developed using a 20 km buffer around the proposed shipping and barge routes.

This buffer represents the conservative zone of influence, which is based on the maximum area where marine animals could sense and respond to sounds from vessel activities. It also encompasses the considerably smaller zone of influence that is associated with the potential for vessel collisions with marine mammals. Further information on the assessment of Project shipping with the marine environment is detailed in Volume 7.



Projection: NAD 1983 UTM Zone 14N
Creator: CDC Revised: TL
Date: 07/22/2014 Scale: 1:10,000,000
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 2.2-1
KIGGAVIK PROJECT TRANSPORTATION ROUTES

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File: Q:\SHEQ\GIS\KIGGAVIK\2014\EIS\Volume 2 - Project Description\Volume 2 - Tier 3\Appendix 2J -Marine Transportaion\MXD\Figure 2.2-1 Kiggavik Project Transportation Routes.mxd

2.2.2 Temporal Boundaries

The temporal boundaries are defined based on the timing and duration of potential environmental effects of marine transportation associated with the Project. The Marine Environment assessment (Volume 7) covers the period of all major Project phases including construction, operation and final closure during which marine activities and transportation will occur. While the expected life of the Project is influenced by available ore reserves and the production rate, the operational life of the Project is estimated to be 14 years given current resources. However, as there are up to 25 years of tailings storage capacity in the TMFs, the assessment assumes 25 years of operations and associated marine transport. While the number, frequency and timing of vessel movements may differ among these Project phases, the types of environmental effects that may arise as a result of vessel movements are similar.

2.3 Mitigation

As outlined in Technical Appendix 2T, AREVA's Environmental Protection Framework provides an integrated approach to facility design, mitigation, and environmental assessment, and outlines how the outcomes of these processes are integrated into facility construction, operation and decommissioning. Furthermore, the Environmental Protection Framework outlines how the results of monitoring and follow-up programs are incorporated into evaluation processes which facilitate the identification of continual improvement initiatives and adaptive management requirements, when necessary.

As part of the environmental assessment process, mitigation measures are incorporated into the Project to avoid and minimize potential adverse environmental effects. Mitigation measures consist of industry best technologies and practices and incorporate the learning based experiences of other development projects. Mitigation measures can generally be classified as mitigation by design, and mitigation by management, as outlined below.

2.3.1 Mitigation by Design

Many facility design features have been adopted to mitigate potential environmental and health effects and ensure worker safety. The main marine transport mitigation measures by design outlined in this plan include:

- All vessels will be operated in accordance with Canadian *Acts* and regulations as well as International conventions.
- Marine transport of supplies will only occur during the open water season to reduce environmental effects of ice breaking on Baker Lake and in Chesterfield Narrows.

- Selecting appropriate vessels with capabilities for operating safely within the confined waters of Chesterfield Narrows. Alternatively, barges may be designed specifically to meet Project needs in order to improve safety through maneuverability as well as improve cargo capacity.
- The open water shipping season has been conservatively assessed and includes a 35% contingency to account for unknowns such as late deliveries, weather delays, mechanical breakdowns, and scheduling conflicts during the cumulative peak annual sealift to Baker Lake.

2.3.2 Mitigation by Management

Many management practices mitigate potential environmental and health effects and promote safety. This often includes the development, use, enforcement, and revision of procedures and work instructions. The main mitigation measures by management outlined in this plan include:

- No ballast water exchange will occur within the RAA. In the event ballast water must be discharged for safety reasons, it will be tested prior to release.
- As per regulations, no vessel bilge water will be discharged into Arctic waters. Bilge water will be retained on board for discharge at an appropriate reception facility.

2.3.3 Monitoring

Results from the monitoring of facilities and operations will be evaluated against predicted performance, a process it identify design and management improvement opportunities, and adaptive management needs. The main monitoring activities outlined in this plan include:

- A local marine mammal observer (MMO) will be present as vessels transit in Chesterfield Narrows to observe and record marine mammal sightings and any disturbances caused by the vessel or any incidents such as marine mammal – vessel collisions.

3 Marine Shipping Plan

The main components of the Marine Shipping Plan (MSP) for the Kiggavik Project are outlined here. The MSP will require revision at the time of licensing in order to provide further detail with respect to vessel type and dock site configuration. Procedures and safety protocols from the selected marine shipping contractor will also be incorporated at that time. The responsibility for the marine transportation component to AREVA's Baker Lake dock facility will remain with the shipping company. AREVA is committed to selecting contractors that comply with all regulations and employ quality management systems. Careful consideration has been given to conservatively assess the potential environmental effects from all proposed marine transportation options. Potential effects due to marine transport including interaction with marine wildlife are assessed in Volume 7 Marine Environment.

Revision of the MSP will be conducted once a shipping contractor has been selected. At Project licensing, a revised MSP will be provided.

3.1 Background

The community of Baker Lake and Agnico–Eagle's Meadowbank mine currently receive supplies during the annual sealift which takes place during the open water season (i.e., typically July to October). Dry cargo and fuel are loaded onto ships or barges in southern ports and are then transported to Chesterfield Inlet via the Hudson Strait and Hudson Bay. A section of the passage between Chesterfield Inlet and Baker Lake known as Chesterfield Narrows (herein referred to as the Narrows) is relatively shallow, which limits the size of vessels travelling through this area. Most ocean-going vessels are too deep drafted to travel through the Narrows; therefore, cargo is lightered onto barges or shallow draft vessels east of the Narrows for transport to Baker Lake.

3.2 Open Water Season

No ice breaking activity is planned for the Kiggavik sealift. The Marine Shipping Plan is scheduled around open water operations only. The average thickness attained by level shore fast ice at Baker Lake is 221 cm (87 in) with a record maximum thickness of 248 cm (98 in) measured in 1969. Breakup usually begins about mid-June with the lake becoming clear of ice by the last week of July. Freeze up usually begins about mid-October with a complete ice cover forming before the end of the month. Two to three weeks variation in breakup and freeze up can occur.

The MSP has been based on a conservative operating season estimate of 60 days, commencing on August 1 and completing on October 1. Seasonal access to the port has been conservatively assessed as 78 high tides available to transit the Narrows. Traditional knowledge and the experience of shipping companies working in the area indicates that the operating season may be more accurately predicted as being from mid-July to mid-October. Marine shipping operations are scheduled for the open water season only, however, all vessels will have an Ice Class designation meeting *Arctic Waters Pollution Prevention Act* (AWPPA)(1985) regulations for operating mid-July to the end of October in Zones 14, 15, and 16 which includes the Hudson strait, Hudson Bay, and Chesterfield Inlet to Baker Lake. All vessels designed to carry fuel will be of double hull construction.

For conservative planning purposes, the first loaded vessel will arrive at the entrance to Chesterfield Inlet on August 1. The lightering of dry cargo or fuel will commence on arrival and will continue until the cargo has been delivered or October 1. If the season commences earlier, then the first vessel will arrive in Chesterfield Inlet to take advantage of the open water. The purpose of precautionary planning is to provide a contingency for unknown occurrences so that the Kiggavik sealift will be completed well before freeze up. Environment Canada Canadian Ice Service provides Seasonal Summary reports for North American Arctic Waters available on their website (EC 2014). Spring and summer ice conditions are compiled annually that provide an indication of the average open water season in Chesterfield Inlet over the past ten years. In 2011, the lowest ice coverage over Canadian Arctic waters since 1968 was observed. The conclusion drawn from these reports is that an extended operating season from mid-July to mid-October is likely to occur in future years.

Residents have commented that water levels in Baker Lake have gone down over the years and there are areas now that are dry and channels we use to boat through that we cannot anymore (EN-RB OH Nov 2010) and that it was dry where so much water was before, however, it is unlikely the water level will drop below what there needs to be for transport (EN-RB OH Nov 2012). Navigation course lines running East and West down the center of Baker Lake and along the North shore have substantial water depth in the order of 50 m and therefore will not be affected by a reduction of water depth. Water depths with abrupt drop offs near the North shore in the vicinity of the potential dock-site are also substantial and will not be adversely affected by reduced water depth. Studies on global warming predict an increase in ocean water levels. The water way from Hudson Bay and Chesterfield inlet is tidal and therefore should remain unchanged in the short term and may increase in depth in the long term. The most significant change which appears to have occurred since 1990 is the early breakup of the winter ice and the later onset of freeze up in the fall. This is supported by IQ which indicates freeze-up is later now than in the past but not as much change for break-up (IQ-WCCR 2011). The ice free season is generally increasing in length and global warming will promote the continuation of this trend which has a positive effect on marine shipping access. Residents of Baker Lake and ship operators also report stronger and less predictable wind conditions on Baker Lake. Winds from the southerly direction can hamper loading and unloading operations at dock-sites on the north shore of Baker Lake. The negative effect brought on by the high winds is offset by the positive effect of the increase in season length.

The MSP has applied this traditional knowledge to establish a safety buffer when setting targets for ice free operation. Information on climatic conditions which have an adverse effect on shipping such as observed changes in wind forces and predominant wind directions on Baker Lake and changes in ice breakup patterns and timing, as well as comments on the later arrival of freeze-up, were incorporated. This information was used to include a significant number of non-navigational days which were factored into the MSP.

3.3 Project Shipping Requirements

3.3.1 Summary

All vessels that will operate in the waters of Chesterfield Narrows will be designed with double redundancy on critical equipment such as propulsion, steering, essential navigation, and electrical power supply. The MSP will include a marine traffic management program in order to coordinate and regulate the movement of all marine operators working in the LAA in accordance with Transport Canada requirements and guidelines. The marine traffic management program will be developed in consultation with Transport Canada, Baker Lake Community Interests, Baker Lake Commercial Interests, and Marine Shipping Companies operating in the LAA. The MSP is based on good marine practices and has been developed following consultation with reputable marine shipping companies who have a longstanding reputation for providing safe and reliable service in the LAA and RAA.

3.3.2 Dry Cargo and Fuel

The annual cargo requirement to support the Kiggavik Project is estimated to include approximately 55,300 tonnes (t) of diesel fuel and 91,000 tonnes of dry cargo during peak operations. The majority of dry cargo will be shipped in twenty-foot equivalent unit (TEU) marine shipping containers. Fuel will be shipped using double hull tankers suitably sized to safely transit the narrow passage into Baker Lake.

There are a number of primary proposed segments of marine transport to be considered:

- Marine shipment of fuel and dry cargo via ocean-going vessels through Hudson Strait to Chesterfield Inlet. The cargo would then be lightered into barges or smaller self-propelled vessels in Chesterfield Inlet and delivered to the final destination in Baker Lake.
- Marine shipment via ocean-going tug/barges directly from southern ports to Baker Lake.
- Marine shipment via ocean-going vessels through Hudson Strait and Hudson Bay to Churchill. The cargo would be transshipped from Churchill to Baker Lake via tug and barge. A rail link connecting to major southern railways is also available for shipping fuel and dry cargo to Churchill.

The Hamlet of Baker Lake and the Agnico-Eagle mine currently receive supplies during the annual sealift which takes place in the open water season from August to October. Dry cargo and fuel are loaded onto ships or barges in southern ports and are then transported to Chesterfield Inlet. A section of the passage between Chesterfield Inlet and Baker Lake known as Chesterfield Narrows (the Narrows) is relatively shallow and is subject to strong currents which limit the size and timing of vessels passing this area. Most ocean going vessels are too deep drafted to pass the Narrows, therefore cargo is lightered onto barges or small shallow draft vessels east of the Narrows for transportation to Baker Lake.

Agnico Eagle has constructed a 60 million litre (ML) tank farm in Baker Lake. The proposed Kiggavik Kiggavik Project docksite will include a tank farm of 70 ML capacity and a container handling facility sized for approximately 5,000 TEUs. The cumulative cargo requirements for the Hamlet of Baker Lake, Agnico-Eagle Meadowbank mine, and the proposed Kiggavik mine would approximately double the volume of cargo currently being shipped into Baker Lake. Efficient cargo handling facilities will be required at Baker Lake in order to accommodate the increased volume of cargo. A conceptual breakdown of the number of barge trips from Chesterfield Inlet to AREVA's Baker Lake Dock Facility is presented in Table 3.3-1.

The estimated amount of dry cargo to be transported during the construction phase is anticipated to be similar to the operations phase for the Kiggavik Project even though the estimated tonnage is significantly less. The reason for this is due to the anticipated transport of non-uniform sized cargo (e.g., heavy equipment, custom-designed components for mining, milling, and other infrastructure) that does not fit into a standard shipping container. This type of cargo generally occupies more space on vessels than bulk products that fit into shipping containers, and also tend to take longer to load and offload. As such, the number of trips required per year during the construction phase was conservatively estimated to be higher than otherwise required for the noted cargo tonnage. The estimated maximum number of barge return trips per day/week/month does not take into consideration unknown circumstances, such as weather delays or equipment malfunctions.

Table 3.3-1 Marine Transport from Chesterfield Inlet to AREVA's Baker Lake Dock Facility

Marine Transport from Chesterfield Inlet to AREVA's Baker Lake Dock Facility									
Mine Phase	**Assumed Tug/Barge Arrangement**	**Transport Item**	**Estimated Amount (tonnes) Per Year**	**Number of Trips Required Per Year**	**Estimated Number of Days to Complete Return Trips Per Shipping Season**	**Estimated Maximum Number of Trips per Month**	**Estimated Maximum Number of Trips per Week**	**Estimated Maximum Number of Trips per Day**	**Comments**
Construction	2 x 5000 DWT Barges & 2 tugs	Dry Cargo	53,000	18	38 - 49	10	3	<1	1 trip every 2 days for number of trips per day.
		Fuel	33,000	7	11 -14	7	3	<1	1 trip every 2 days for number of trips per day.
Operations	2 x 5000 DWT Barges & 2 tugs	Dry Cargo	91,000	19	39 - 50	12	4	<1	1 trip every 2 days for number of trips per day.
		Fuel	55,300	12	21 - 28	12	3	<1	1 trip every 2 days for number of trips per day.
Final Closure	1 x 5000 DWT Barge & 1 tug	Dry Cargo	4,000	1	2	1	<1	<1	Only 1 trip required.
		Fuel	1,000	1	2	1	<1	<1	Only 1 trip required.

A number of natural factors affect the amount of cargo that can be transported by sea lift to Baker Lake. The length of the open water shipping season is conservatively assumed to be 60 days. Navigation at the Chesterfield Narrows is assumed to be at high tide slack water only with two barge loads passing the Narrows on each tide. Navigation through Chesterfield Narrows is assumed to be during daylight hours only. This translates to 90 high tides at the Narrows that correspond with daylight navigation for a 60-day open water shipping season. Marine operators have reported losing an average of seven days per season due to weather issues including high winds and other limiting factors such as poor visibility. For conservatism, a total of fourteen high tides are assumed to be lost leaving a total of 76 available high tides during daylight available to transit the Narrows.

3.3.3 Current Marine Traffic

A conceptual breakdown of the current level of vessel traffic through the Narrows, as well as in Hudson Strait and Hudson Bay, including the expected level of increase in vessel traffic associated with the Kiggavik Project and reasonably foreseeable projects in the region are presented in Tables 3.3-2 to 3.3-4. Each table identifies the current and anticipated level of vessel traffic in comparison to the different phases of the Kiggavik Project. The Hudson Strait and Hudson Bay traffic includes marine traffic for the Port of Churchill, the Kivalliq Region Sealift, and the west coast of Baffin Island. Estimates for future mines that may have a reasonable opportunity for development have been included.

Vessel traffic estimates for the operating phase of the Meadowbank Mine are based on the actual cargo volumes delivered in 2012. Traffic estimates to and from the Port of Churchill, the Kivalliq Region Sealift, and Baker Lake have been extrapolated from actual marine traffic records for 2012 provided by Transport Canada. Marine traffic for the Baffinland Mary River mine has been based on estimates provided in the Baffinland Iron Ore Corp. Environmental Impact Statement. Traffic estimates are based on estimated maximum volumes delivered to the Steensby Port for the construction phase and operational phase for the mine. Marine Traffic estimates for the proposed Agnico-Eagle Meliadine mine and other new hypothetical mines (shown as Hypothetical Mine A and B) have been based on traffic volumes for the Meadowbank mine and are included for conservative planning purposes. Marine traffic for the Kiggavik mine is based on the largest annual estimated cargo volume for each phase of the Project. Different sized vessels may be used to transport dry cargo and fuel for the various shipping programs that currently occur, as well as shipping programs that may occur in the reasonably foreseeable future. As such, this will influence the number of return trips presented in Tables 3.3-2 to 3.3-4.

Table 3.3-2 Anticipated Vessel Traffic through Hudson Strait and Chesterfield Inlet during the Kiggavik Project – Construction Phase

Major Cargo Recipient	Dry Cargo (tonnes)	Fuel (tonnes)	Dry Cargo Return Trips	Fuel Cargo Return Trips
Passage via Chesterfield Inlet				
Hamlet of Baker Lake	7,000 (Est.)	9,000	2	2
Agnico Eagle Meadowbank	38,000	60,000	8	12
Jet fuel Baker lake		4,000		1
Kiggavik Project	53,000	33,000	18	7
Total for Chesterfield Inlet to Baker Lake	**98,000**	**106,000**	**28**	**22**
Increase in barge shipping from Chesterfield Inlet to Baker Lake due to the Kiggavik Project – Construction Phase			**18**	**7**
Passage via Hudson Strait				
Hamlet of Baker Lake	7,000	9,000	1	1
Jet Fuel for Baker Lake Incl. above		4,000		1
Agnico Eagle Meadowbank	38,000	60,000	3	4
Port of Churchill commercial traffic	400,000	-	12	-
Other including Kivalliq Sealift	70,000	70,000	6	4
Baffinland Mary's River Sealift	206,000	100,000	13	6
Kiggavik Project	53,000	33,000	6	2
Total ocean going vessels passing via Hudson Strait and/or Hudson Bay	**774,000**	**276,000**	**41**	**18**
Increase in ocean-going shipping passing via Hudson Strait due to the Kiggavik Project – Construction Phase			**6**	**2**

Assumptions:

- Agnico–Eagle's Meadowbank mine is anticipated to remain operational until 2017; therefore, full operation sealift traffic volumes are included.
- Vessel traffic associated with the community of Baker Lake, the Port of Churchill, and the Kivalliq sealift will remain constant.
- Baffinland's Mary River mine will be approved and constructed concurrently with the Kiggavik mine.

Table 3.3-3 Anticipated Vessel Traffic on Hudson Strait and Chesterfield Inlet during the Kiggavik Project – Operations Phase

Major Cargo Recipient	Dry Cargo (Tonnes)	Fuel (tonnes)	Dry Cargo Return Trips	Fuel Cargo Return Trips
Passage via Chesterfield Inlet				
Hamlet of Baker Lake	7,000	9,000	2	2
Jet fuel Baker lake		4,000		1
Decommission Meadowbank Mine	4,000	1,000	1	1
New Hypothetical Mine A near Baker Lake	38,000	60,000	8	12
Kiggavik Project	91,000	55,300	19	12
Total for Chesterfield Inlet to Baker Lake	**140,000**	**129,300**	**30**	**28**
Increase in barge traffic from Chesterfield Inlet to Baker Lake due to the Kiggavik Project – Operations Phase			**19**	**12**
Passage via Hudson Strait				
One Hypothetical Mine A near Baker Lake	38,000	60,000	3	4
Hamlet of Baker Lake	7,000	9,000	1	1
Jet Fuel for Baker Lake Incl. above		4,000		1
Decommission Meadowbank Mine	4,000	1,000	1	1
Agnico-Eagle Meliadine Rankin	38,000	60,000	3	4
Port of Churchill commercial traffic	400,000	-	12	-
Other including Kivalliq Sealift	70,000	70,000	6	4
Baffinland Mary River Sealift	106,000	15,000	7	1
Baffinland Mary River Ore shipments occurring during Sealift	5,100,000	-	34	-
Kiggavik Project	91,000	55,300	7	4
Total ocean going vessels passing via Hudson Strait	**5,854,000**	**274,300**	**74**	**20**
Increase in ocean-going shipping passing via Hudson Strait due to the Kiggavik Project - Operations Phase			**7**	**4**

Assumptions

- Agnico–Eagle's Meadowbank mine will be in the decommissioning phase during this time period. Assume vessel traffic to facilitate decommissioning activities to be the same as what is anticipated for the Kiggavik Project.
- Vessel traffic associated with the community of Baker Lake, the Port of Churchill, and the Kivalliq Sealift will remain constant.
- Baffinland's Mary River mine will be operational concurrently with Kiggavik.
- Reasonable to expect Agnico–Eagle's Meliadine mine near Rankin Inlet will be operational. Operation cargo figures for the Meadowbank mine have been used. The addition of this mine does not increase the traffic through the Narrows.
- One additional mine (i.e., Hypothetical Mine A) will be approved and constructed near Baker Lake assumed to be equal to the Meadowbank mine. Cargo will be delivered through the Narrows.
- Fuel cargo transported through the Narrows will be carried in ATB double hull barges. Diesel fuel for the Baffinland's Mary River mine will be carried in ore carriers on their return trip to the Steensby port therefore only a minor increase in tanker traffic is expected during the annual sealift.

Table 3.3-4 Anticipated Vessel Traffic on Hudson Strait and Chesterfield Inlet During the Kiggavik Project – Final Closure Phase

Major Cargo Recipient	Dry Cargo (Tonnes)	Fuel (tonnes)	Dry Cargo barges/vessels	Tank Barges Vessels
Passage via Chesterfield Inlet				
Hamlet of Baker Lake	7,000	9,000	2	2
Jet fuel Baker lake		4,000		1
Hypothetical Mine A near Baker Lake	38,000	60,000	8	12
Hypothetical mine B near Baker Lake	38,000	60,000	8	12
Kiggavik Project final closure	4,000	1,000	1	1
Total for Chesterfield Inlet to Baker Lake	**87,000**	**134,000**	**19**	**28**
Increase in Barge Traffic from Chesterfield Inlet to Baker Lake due to the Kiggavik Project – Final Closure Phase			**1**	**1**
Passage via Hudson Strait				
Hypothetical Mine B near Baker Lake	38,000	60,000	3	4
Hypothetical Mine A near Baker Lake	38,000	60,000	3	4
Hamlet of Baker Lake	7,000	9,000	1	1
Jet Fuel for Baker Lake		4,000		1
Agnico–Eagle's Meliadine mine – Final Closure	4,000	1,000	1	1
Churchill commercial traffic	400,000	-	12	-
Other including Kivalliq Sealift	70,000	70,000	6	4
Baffinland's Mary River Sealift	106,000	15,000	7	1
Baffinland's Mary River Ore shipments during Sealift	5,100,000	-	34	-
Kiggavik Project	4,000	1,000	1	1
Total ocean-going vessels passing via Hudson Strait	**5,767,000**	**220,000**	**68**	**17**
Increase in ocean-going shipping passing via Hudson Strait due to the Kiggavik Project – Final Closure Phase			**1**	**1**

Assumptions:

- Vessel traffic associated with the community of Baker Lake, the Port of Churchill, and the Kivalliq sealift will remain constant.
- Baffinland's Mary River mine will be operational concurrently during the Kiggavik Project's Final Closure Phase.
- Anticipate Agnico–Eagle's Meliadine Mine near Rankin Inlet to be in a Final Closure Phase.
- Hypothetical Mine A and B near Baker Lake will be open.
- Fuel cargo for transport through the Narrows will be carried in ATB double hull barges.

Conservative estimates were used when calculating the volume of cargo which could pass safely through the Narrows and a total peak cumulative requirement for the annual sealift into Baker Lake is conservatively estimated to be less than 300,000 tonnes (Table 3.3-3). At peak operations, the Kiggavik annual cargo requirement can be transported through the Chesterfield Narrows on 31 tides using 5,000 t barges (Table 3.3-1 and Table 3.3-3). Although the Agnico-Eagle Meadowbank mine is expected to be in a decommissioning phase at the time of peak operational marine transport for the Kiggavik Project, for conservative planning Hypothectical Mine A (Table 3.3-3) assumes that a new mine opens in the Baker Lake region replacing Meadowbank transportation with identical cargo requirements. As such, estimated other concurrent mine transportation is estimated to require 22 tides utilizing 5,000 t barges (Table 3.3-3). The annual transportation requirement for fuel and dry cargo for the hamlet of Baker Lake is assumed to be conservatively high at approximately 20,000 t which would require an additional 5 tides. Therefore, at peak operations, the cumulative annual sealift can be transported on 58 tides of the conservatively estimated 76 tides during the open water season.

This total cargo requirement can be transported through the Chesterfield Narrows using 5,000 tonne barges based on two barge transits per tide; one barge in a loaded condition transiting towards Baker Lake from Chesterfield Inlet and one barge transiting into Chesterfield Inlet from Baker Lake with a backload of empty containers. Therefore the waterway has the capacity to handle the anticipated cumulative traffic including an approximate 35% contingency to account for unknowns such as weather delays, mechanical breakdowns, and scheduling conflicts. The use of 7,500 tonne barges was also evaluated which provides an opportunity to further increase the efficiency of marine transport without compromising safety. A discussion on the viability of using 7,500 DWT barges is discussed in Section 3.5.4. AREVA will contract with marine shipping companies to provide modern, efficient vessels for the Baker Lake sealift (see Section 3.5).

3.4 Shipping Routes

The current shipping route through Hudson Strait provides access for resupply for a number of communities along the coast of Hudson Bay, industrial activities (e.g., Meadowbank Mine, Meliadine Mine), and the import and export of goods and supplies from the Port of Churchill which has been operating since 1931 (Port of Churchill, 2012). Community re-supply involves a variety of vessel types including tankers, general cargo, container ships, and tug/barge combinations. As with community re-supply vessels, Project-related shipping will follow established shipping routes through Hudson Strait and west across northern Hudson Bay to Chesterfield Inlet or directly southwest to the Port of Churchill.

The final shipping route selected for transporting supplies associated with the Kiggavik Project will be determined during the licensing stage. Other details that influence the final shipping route (e.g., selection of the shipping company, the shipping ports capabilities to handle the amount and type of cargo to be transported) will play an important role in the final shipping route selected. As the final shipping route has not been determined at this time, the potential environmental effects of each route needs to be considered independently within the context of the mitigations outlined (see Volume 7 Marine Environment, Section 10 for a summary of mitigation measures) so that the shipping options remain available at the time of licensing.

The shipping route illustrated in Figure 2.1-1 leaves the Davis Strait (1,000 – >3,000 m depth) and enters Hudson Strait, travelling along the middle of the Strait (200 to 499 m depth), and entering northern Hudson Bay. Depths in northern Hudson Bay are <200 m deep throughout most of the Bay. The shipping route from Chesterfield Inlet south to Churchill is in waters <200 m deep.

Major marine shipping routes and course scale bathymetry for these routes are provided by Transport Canada (TC, 2012). Figure 4.5-1 in Volume 7 Marine Environment shows the shipping routes for the Kiggavik Project, as well as the available bathymetry through Hudson Strait and the west coast of Hudson Bay, along Chesterfield Inlet to Baker Lake. The bathymetry of Chesterfield Inlet is provided in Technical Appendix 7A, Figure 5.1-1. Marine Charts 5002, 5620, 5621, 5622, 5623, 5624, 5625 and 5626 are provided in this report as Attachment A.

3.4.1 Ice

Ship routing will be conducted so that ships will be operating in largely open water ice conditions, in accordance with the Arctic Ice Regime Shipping System (AIRSS), for the type of vessels and the planned operating season for the Project. While localized patches of partial ice cover (e.g., pieces of first year or multi-year ice) may be encountered during the defined open water shipping season, the vessel courses would be selected to maximize travel through open water and to avoid ice floes and utilize areas of low sea ice concentrations.

As a result, interactions between wildlife, which might use these localized patches of ice (e.g., seals or walrus for temporary haul-out, birds for resting), and project vessels are expected to be infrequent. Human travel on such ice cover is unlikely.

3.4.2 Marine Habitat

Through engagement with local communities regarding proposed shipping routes, further information was requested for certain areas of the shipping routes through Hudson Strait and potential effects on marine life (EN-CH HTO Jan 2014[1]). IQ indicates "*there is a small island off the north coast of Coates Island called 'island covered by walrus'*" (IQ-CHJ 2011) and *"areas used to hunt walrus included a series of small islands off the mouth of Dawson Inlet, including Walrus Island"* (IQ-Riewe 1992).

Figure 2.1-1 shows the shipping route proposed with the 20 km RAA shown. This 20 km assessment area is the limit of where project vessels may potentially affect the marine environment. The distance between Walrus Island and Coats Island is 42 km. Vessels will remain in deep water midway between these islands in order to maintain a minimum 20 km distance from Walrus Island if the safety of the vessel is not compromised in doing so.

The proposed shipping route through Hudson Strait will pass near the Coats Island Key Marine Habitat Site for migratory birds at Cape Pembroke (Site 26 in Mallory and Fontaine, 2004). This includes an offshore area within a 30 km radius of the site. AREVA is committed to avoiding shipping disturbance in this habitat and as such will ensure routes near this site maintain a minimum 30 km distance from Cape Pembroke.

3.4.3 Shipping Scenarios

The following marine shipping routes have been considered for delivering dry cargo from southern ports to Baker Lake:

- Wherever possible, dry cargo will be transported in 20-foot marine shipping containers (TEU's). Dry cargo may be carried on general cargo vessels fitted with unloading cranes direct to an anchorage at Helicopter Island which is located east of the Narrows. Refer to Marine Chart 5624 in Attachment A. Cargo will be lightered from cargo ships onto barges to be delivered to the AREVA's dock site in Baker Lake.
- Dry cargo may be loaded on ocean-going barges in southern ports and delivered directly to Baker Lake.
- Dry cargo may be loaded on large container ships in southern ports and delivered direct to the port of Churchill. The containers will be loaded on barges in Churchill and delivered directly to AREVA's dock site (Currently no infrastructure currently exists for container handling and storage at the port of Churchill).
- Dry cargo may be delivered to Churchill by rail then loaded on barges for delivery to AREVA's dock site.

[1] Aiviit HTO Board of Directors are requesting for the coordinates when vessels will travel by Walrus and Coats Island from Montreal or from somewhere down there when they traveling that route close to Walrus and Coats Island. They are wondering if the vessel will travel too close to those two island and worried that the marine mammals will be disturb by big vessels traveling too close to the islands. Can you provide Aiviit HTO coordinates from the two islands please.

The following marine shipping routes have been considered for delivering fuel from southern ports to Baker Lake:

- Fuel may be carried in ocean-going double hull tankers to an anchorage near Ellis Island which is located at the eastern end of Chesterfield Inlet, Refer to Marine Chart 5621 in Attachment A. Fuel will be transferred to double bottom barges for delivery to AREVA's fuel tank farm at Baker Lake.
- Fuel may be carried in ocean-going double hull tankers to the Churchill tank farm. Fuel will be loaded from the tank farm into double hull barges for delivery direct to Baker Lake.
- Areva has considered shipping routes with load ports in Rotterdam, Houston, Halifax, and Montreal. Only diesel fuel meeting Grade DF-A-(Arctic) specifications will be loaded.

Attachment A includes the marine charts which show general vessel course routes.

3.5 Vessels

The shipping plan is scheduled around open water operations only. No ice breaking activity, as defined by the use of an ice breaker prior to spring breakup or after fall freeze up, is planned. As a precautionary measure, all vessels will have an ice class meeting Arctic Waters Pollution Prevention regulations for operating mid-July to the end of October in Zones 14, 15, and 16 which includes the Hudson Straight, Hudson Bay, Chesterfield Inlet and Baker Lake.

The final selection and design of the types of vessels to be used for the Project will be based on a multitude of factors such as route selection, depth of passage, cargo requirements, seasonal/navigational restrictions, logistics, and operational requirements, among others. All vessels will conform and be operated in accordance with the regulations outlined in Section 1.2.

Various sizes of dry cargo ships, tugs, barges and tankers have been studied and proposed for the Kiggavik project. In the case of fuel barges and tugs, these will have to be designed and built. Dry cargo ships, tankers, tugs and barges will be designed, built and operated in accordance with Classification requirements of a society belonging to the International Association of Classification Societies (IACS), such as Lloyds Register of Shipping, Det Norske Veritas, Bureau Veritas, American Bureau of Shipping, NK, or others.

Oceangoing geared cargo vessels are too deep drafted to pass through the Narrows, therefore, the cargo will be unloaded onto barges at an anchorage east of the Narrows for the final journey to AREVA's Baker Lake dock facility. Oceangoing geared cargo vessels are typically equipped with two cargo cranes rated for a maximum lift of 180 tonnes each. The cranes are used for loading and offloading shipping containers or other dry cargo onto barges. The majority of dry cargo will be securely packed in 20-foot ISO marine shipping containers. Empty shipping containers will be loaded onto barges at AREVA's Baker Lake Dock Site Facility for transport back to the oceangoing geared cargo vessels for transport to southern ports as back haul cargo.

Fuel cargo vessels would anchor at Ellis Island near Chesterfield Inlet. Fuel would be lightered from the tanker to a double hull tank barge and shuttled to Baker Lake. The tankers and dry cargo vessels arriving from southern ports will have sufficient marine fuel onboard to make the return voyage south. Cargo vessels arriving from southern ports will also carry sufficient marine fuel to resupply the tugboats.

The following marine shipping scenarios have been proposed for future development.

3.5.1 Arctic Grade Diesel Fuel Shipment

Ocean-going, double hull tanker vessels considered for shipment of the estimated 55,300 tonnes of fuel include:

- Ice Class 30,000 DWT double hull tankers
- Ice Class 30,000 DWT Handy size double hull tankers
- Ice Class 18,300 DWT double hull tankers

Various tug and tanker barge configurations have been assessed to support the shipment of fuel to AREVA's Baker Lake dock site and are outlined in Section 3.5.3.

The following scenarios outline potential shipping logistics for the shipment of fuel for the Project:

Fuel Scenario 1:

Two 30,000 deadweight tonnage (DWT) Ice Class, double hull tankers arrive consecutively anchored near Ellis Island at the easterly end of Chesterfield Inlet. Fuel is lightered into tank barges for shipment to Baker Lake. Time taken to deliver fuel cargo to Baker Lake after the tankers have arrived at Ellis Island is approximately 14 to 23 days, depending on the tug/barge combination.

Fuel Scenario 2:

Two 30,000 DWT Ice Class, Handy Size double hull tankers (Figure 3.5-1) arrive consecutively at Churchill and transfer fuel into the Churchill tank farm, as capacity permits. Barges take on fuel from the Churchill tank farm and shuttle fuel directly to Baker Lake. Time taken for the barges to deliver fuel to Baker Lake from Churchill is approximately 26 to 39 days, depending on the tug/barge combination.

Fuel Scenario 3:

Three 18,300 DWT, Ice Class, double hull tankers (Figure 3.5-2) arrive consecutively and anchor near Ellis Island. Fuel is lightered into tank barges for shipment to Baker Lake. This scenario includes one additional 5,000 DWT barge load from Churchill to meet the peak fuel volume requirement. The time taken to deliver fuel cargo to Baker Lake after the tankers have arrived at Ellis Island is 17 to 28 days, depending on the tug/barge combination.

Fuel Scenario 4:

Fuel is delivered by rail from Edmonton to Churchill. An articulated tug and barge (ATB) fuel tanker combination (Figure 3.5-3) load fuel at Churchill and deliver fuel directly to Baker Lake. The time taken to deliver fuel cargo from Churchill to Baker Lake is 26 to 53 days, depending on the tug/barge combination.

Figure 3.5-1 Typical Handy Size Tanker

Figure 3.5-2 Example of a 18,300 DWT Tanker

Figure 3.5-3 Example of an Articulated Tug Barge (ATB) Fuel Tanker

3.5.2 Dry Cargo Shipment

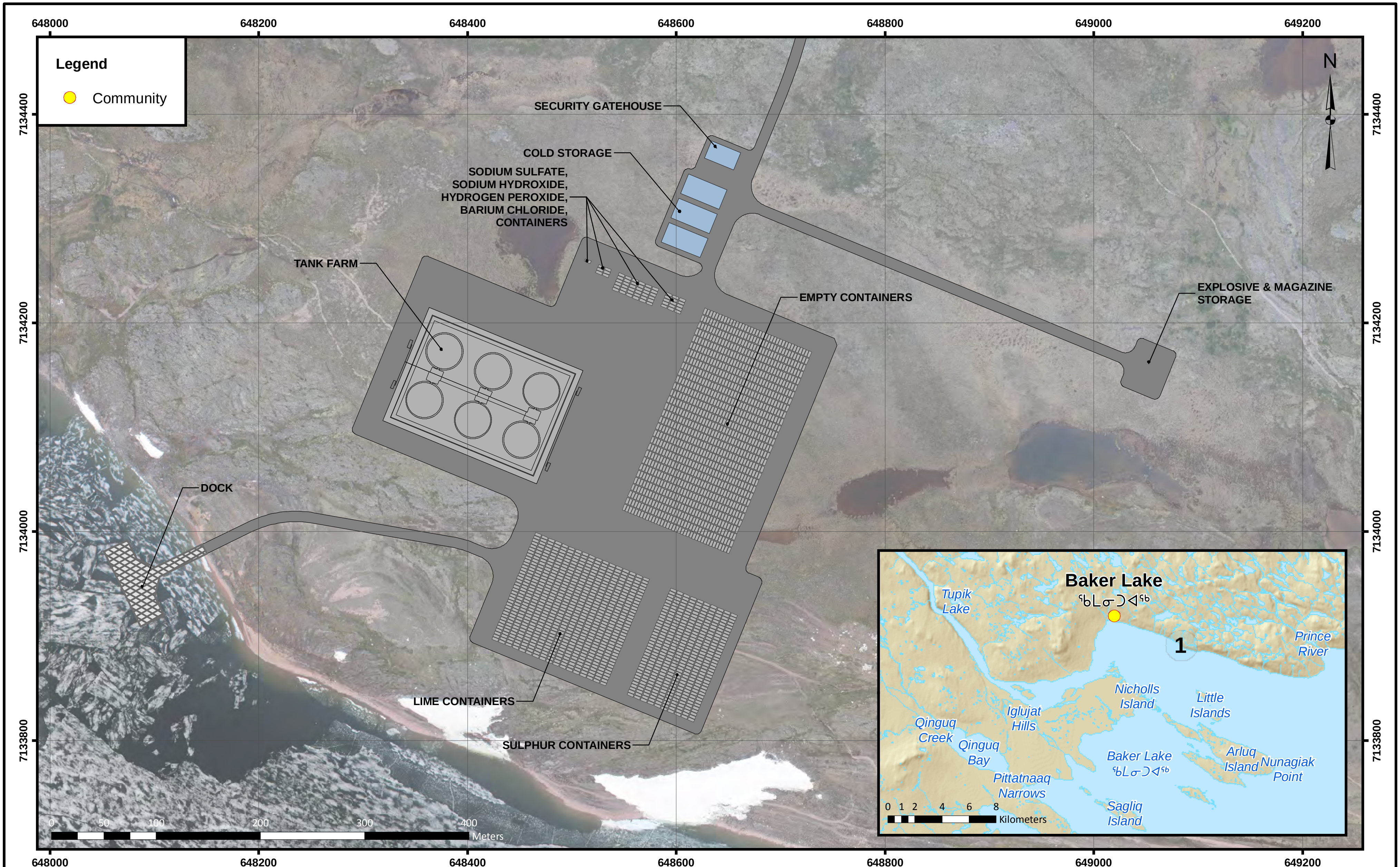
Ocean-going geared cargo vessels are typically equipped with two cargo cranes rated for a maximum lift of 180 tonnes each. The cranes are used for loading and offloading shipping containers or other dry cargo onto barges. The majority of dry cargo will be securely packed in 20-foot ISO marine shipping containers that represent one TEU. Empty shipping containers will be transported by barge from AREVA's Baker Lake dock facility back to the geared cargo vessels for transport to southern ports as backhaul cargo.

Ocean-going vessels considered for shipment of the estimated 91,000 tonnes of cargo include:

- 660 TEU geared cargo ships
- 1,000 TEU non-geared container ships

Various tug and barge configurations have been assessed to support the shipment of cargo to AREVA's Baker Lake dock site and are outlined in Section 3.5.3.

All loaded barges that arrive at AREVA's Baker Lake Dock Site Facility will be tied alongside a large spud barge floating dock which will serve as the loading and unloading point (Figure 3.5-4). The four corners of the spud barge will be secured to the lake bottom with steel pillars (spuds) which can be raised or lowered. The inboard side of the barge may also be secured to land with cables. A second floating dock will be used to connect the spud barge to the shore. A ramp will be connected from the dock to the shore. The dock areas (including barges) will be well lit for reduced visibility operations. A mobile dock crane specifically configured for handling containers will be situated on the floating dock. The crane will use a container spreader which will connect and disconnect the containers from the barge. The crane spreader will be fitted with a guide system to locate the shipping container spreaders so the connection process can be achieved safely and efficiently. The container crane will be sized to handle all weights of containers at a rate that matches the load rate of the cargo ship cranes. The container crane will remove the shipping containers from the barge and land them on the dock, where a top loading container stacker will load them directly onto shuttle trucks. The trucks will transfer the shipping containers to the lay down area ashore where top loading stackers will be used to stack the loaded shipping containers. The lay down area will be well lit for operations in reduced visibility conditions.



Projection: NAD 1983 UTM Zone 14N
Creator: CDC Revised: TL
Date: 09/01/2011 Scale: 1:5,000
Data Sources: *Areva Resources Canada Inc.*

FIGURE 3.5-4
BAKER LAKE DOCK AND STORAGE FACILITY LAYOUT

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 2: PROJECT DESCRIPTION
TECHNICAL APPENDIX 2J: MARINE TRANSPORTATION

Kiggavik Project
AREVA

File: Q:\SHEQ\GIS\KIGGAVIK\2014\EIS\Volume 2 - Project Description\Volume 2 - Tier 3\Appendix 2J -Marine Transportaion\MXD\Figure 3.5-4 baker_lake_port_facility_layout.mxd

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5

The cranes and other shipping container handling equipment used at AREVA's Baker Lake Dock Site Facility will be inspected and maintained in accordance with Nunavut's Occupational Health and Safety Regulations requirements. A spill contingency plan covering dry and liquid cargo products will be in place. Spill containment and recovery supplies and equipment will be staged at the Dock Site Facility. Personnel operating AREVA's Dock Site Facility will have spill response training, and the Kiggavik Emergency Response Team (ERT) will be on-call to assist with any containment and recovery efforts.

Cargo Scenario 1:

660 TEU geared cargo vessels (Figure 3.5-5) will make various trips from southern ports to a lightering position at Helicopter Island near the entrance to the Chesterfield Narrows. Shuttle barges will load remaining cargo in a southern port and mobilize to Baker Lake for any remaining cargo. Time taken to deliver cargo after arriving in Chesterfield Inlet varies between 22 days to 33 days depending on the type of Tug/Barges used.

Cargo Scenario 2:

Three 1,000 TEU non-geared cargo vessels (Figure 3.5-6) will transit from southern ports to the port of Churchill (Figure 3.5-7) where cargo will be lightered to 250 to 375 TEU barges that will then transport cargo directly from Churchill to Baker Lake. Time taken to deliver cargo from Churchill to Baker Lake varies between 22 days to 63 days depending on the type of Tug/Barges used.

Cargo Scenario 3:

Large ocean-going tugs and barges mobilize directly to Baker Lake from southern ports with capacity for 700 or 1,050 TEUs. Any remaining TEUs would be shipped to Churchill by rail then loaded onto barges in Churchill and shipped directly to Baker Lake. Time taken to deliver cargo after arriving in Churchill/Chesterfield Inlet varies between 29 days to 63 days depending on the type of tug/barge arrangement.

Figure 3.5-5 Example of a Geared Cargo Vessel

Figure 3.5-6 Example of a Non-geared Cargo Vessel

Figure 3.5-7 Port of Churchill

3.5.3 Tug-Barge Variations

Various tug - barge arrangements have been studied for the proposed Kiggavik Project. New tugs and barges for the Kiggavik project will be designed and built in collaboration with a reputable Canadian shipping company once a decision has been made to proceed towards licencing of the Project. Priority will be given to tug barge arrangements which provide the best maneuverability for safe and efficient operation. Tug barge arrangements must be capable of delivering the entire dry cargo and fuel cargo requirements within a 60 day open water window. The following tug barge arrangements have been studied.

- 4 new 7,500 DWT ATB double hull barges and 2 new/modified 4,500 hp tugs
- 2 new 7,500 DWT and 2 new 5,000 DWT ATB double hull barges and 2 new/modified 4,500 hp tugs
- 4 new 5,000 DWT ATB double hull barges and 2 new/modified 3,500 hp tugs
- 4 new 5,000 DWT double hull barges and 2 existing 3,500 hp standard tugs

Figure 3.5-8 Example of ATB Tug in Notch of Barge

An articulated tug and barge arrangement, shown in Figure 3.5-8, provides exceptional maneuverability, as the forward portion of the tug fits into a deep notch in the stern of the barge. The tug is connected to the barge by a mechanical connection which gives the tug/barge unit ship-like maneuverability and performance. The bow of the barge is ship-shaped. The barge can be fitted with a bow thruster which further enhances maneuverability.

The barges proposed may all be dual purpose, capable of carrying fuel or dry cargo or they may be a combination of dual purpose and dry bulk barges. The final selection and design of the types of vessels to be used for the Project will be based on a multitude of factors such as route selection, depth of passage (draft), cargo requirements, seasonal/navigational restrictions, logistics, and operational requirements, among others. All vessels will conform and be operated in accordance with the regulations outlined in this document. Information and detailed design specifications will be provided for review at the time of Project licensing.

3.5.4 Draft

AREVA has studied alternate methods of delivering the fuel and dry cargo requirements for the Kiggavik Project through the Chesterfield Narrows. Standard Tug Barges (STBs) and Articulating Tug Barges (ATBs) of 5,000 DWT and 7,500 DWT have been considered. ATB double hull tank barges and general cargo barges are widely used to transport fuel and dry cargo in coastal regions of the United States, and to a lesser degree, on the west coast of Canada.

To put the 7,500 DWT tug/barge arrangement into perspective, a comparison was made between what is currently being used to transport fuel through Chesterfield Inlet (i.e., the shuttle tanker MT "Nanny") and a tug/barge arrangement that is similar to what was studied for the Kiggavik Project (i.e., the 7,800 DWT deck barge "Niagara Spirit" which currently operates in the St. Lawrence Seaway) to demonstrate the viability of using this type and size of barge in Chesterfield Inlet (Table 3.5-1).

Table 3.5-1 Comparison between a Tug/Barge Arrangement and the Current Vessel Activity for Transporting Cargo and Fuel through Chesterfield Inlet.

Description	Barge Niagara Spirit	Shuttle Tanker MT Nanny
Length	99 m (120m with tug in notch)	116 m
Breadth	23.8 m	19 m
Depth	5.8 m	10.1 m
Design Draft	4.27 m	7.8 m
DWT @ design draft	7,800 tonnes @ 4.27 m	9,176 tonnes
DWT at Narrows Draft 4.6 m	7,800 tonnes	Est. 3,500 tonnes @ 4.6 m draft
Rudder(s)	Two High Lift	Single rudder
Propeller(s)	Two Controllable Pitch in Nozzles	Single Controllable Pitch
Main propulsion engine(s)	Two diesel engines	Single diesel engine
Propulsion Power	4,500 bhp (Tug)	5,225 bhp

The draft of a ship's hull is the vertical distance between the waterline and the bottom of the keel and determines the minimum depth of water a ship can safely navigate. For planning purposes, Table 3.5-1 indicates the maximum draft for a vessel travelling through the Chesterfield Narrows at high tide should be approximately 4.65 m which would provide an under keel clearance of 0.75 m (based on current water level; this value will vary depending on seasonal tide levels).

One of the main factors for a vessel to navigate safely through Chesterfield Narrows is the design of the vessel. As shown in Table 3.5-1, the “Niagara Spirit” has a design draft of 4.27 m. The draft for a vessel to safely navigate through the Chesterfield Narrows at high tide is currently 4.65 m. The MT “Nanny” has a DWT capacity of 9,176 tonnes at its design draft of 7.8 m, however only a portion of its full cargo capacity (approximately 3,500 tonnes) can be loaded onto the vessel to maintain its draft at a depth which will permit safe passage through the Narrows.

The maneuverability as well as the cargo carrying characteristics of a 7,500 DWT ATB barge are considered to be superior to standard barges and what is currently being used to transport cargo and fuel through the Chesterfield Narrows for the following reasons:

- The 7,500 DWT ATB barges will be specifically designed to carry the desired cargo capacity with an under keel clearance margin of safety for transiting the Chesterfield Narrows. For example, the typical 7,800 DWT barge shown in Table 3.5-1 has an under keel clearance of 1.1 m at its full load capacity when transiting the Chesterfield Narrows at high tide.
- The ATB barge will have approximately the same length and width of the currently used shuttle tanker; however, the depth of the barge will be considerably less.
- The tug will likely be fitted with twin controllable pitch propellers and twin high lift rudders which will make it highly maneuverable.
- No cables or wires are anticipated for connecting the tug to the barge. The tug’s bow will fit into a notch in the stern of the barge and will be attached to the barge with a connecting system. This connection allows the tug and the barge to maneuver as a single unit with maneuvering characteristics similar to that of a ship with twin propellers and twin rudders.
- The ATB connection system is designed so that the tug will operate at its designed draft at all times, independent of what the barge draft may be.
- The tug will likely have double redundancy with two main propulsion engines, two steering gears and twin rudders.
- The ATB connection permits pushing in a wide range of sea conditions which would include all sea conditions found in Chesterfield Inlet and Baker Lake.
- The ATB connection permits unmatched maneuverability at sea and in port.
- The superior cargo carrying capacity of the ATB barge coupled with a reduced draft will result in fewer trips through the Chesterfield Narrows.

These highly maneuverable ATB units will carry the designed cargo DWT through the Chesterfield Narrows by maintaining course in the deepest part of the channel which will enhance safety without sacrificing cargo capacity.

3.6 Navigation

The Shipping Management Plan will contain operating procedures to deal with contingencies for events peculiar to the RAA and LAA. The plan calls for operation in the open water season only with a 30 day contingency for variations in start in season opening and end of season freeze up. The assumed open water season for the shipping plan is 60 days; recent experience indicates that an open water season of approximately 90 days might occur. Barges and tugs will be capable of navigating in reduced draft situations caused by lower water levels. A 35% contingency is available to cover possible delays in transiting Chesterfield Narrows due to low water levels or inclement weather. The ATBs will be highly maneuverable and capable of handling low water levels and changes in current patterns. Navigation in restricted areas will be in daylight hours only with good visibility. Under keel clearance guidelines will be established by the shipping company for all restricted draft areas. These guidelines will be will closely monitored.

Traffic in the Chesterfield Inlet and particularly in the Narrows will be coordinated and managed to enhance safety. For instance, it is proposed that passage at the Narrows be one-way traffic on each high tide, with a maximum of two cargo barges/vessels transiting on each high tide. The operation would be single tug single barge only (i.e., no tandem or double towing will be carried out in restricted navigation areas.

Masters of Tugs will be responsible for the safe navigation of their tug as well as the barge they are towing or pushing. When the barge is secured to the dock site a shore supervisor will take charge of the barge. When a barge is laid alongside a dry cargo vessel or tanker for lightering purposes a trained loading supervisor will take charge of the barge. Masters of tankers and dry cargo vessels will be responsible for their vessels at all times while operating in the RAA. A marine traffic controller (MTC) will provide useful traffic information to all vessel Masters in the RAA. The MTC will insure that tug-barges do not encounter one another in passing situations at difficult navigation areas such as Chesterfield Narrows.

Tugs will be equipped with the latest generation of navigation aids including electronic charting system (ECDIC) with AIS interface and radar overlay, Differential Global Positioning Systems, Automatic Identification System (AIS), Type X band radar with Automated Radar Plotting Aid (ARPA), Type S band radar with ARPA. Communications equipment on Tugs and other vessels will use the latest satellite based technology. Standard VHF, UHF and SSB communication equipment will also be used. AREVA will require all vessel operators to have double redundant radio equipment capable of communicating and coordinating with NORDREG and the Canadian Coast Guard.

Kivalliq community members have expressed concern over the safety of marine transportation in Chesterfield Inlet. Mitigation measures have been developed to address community concerns. Example comments from engagement and IQ are provided below:

- Who will monitor speed? Will you hire and train locals? (EN-AR KWB Oct 2013)
- The area between Chesterfield Inlet and Baker Lake (290 miles) has already claimed some ships over the years and there are many critical areas along the way. Concerned over how the barges will get through. (EN-CI NIRB May 2010)
- The route to Baker Lake has shallow areas. Will there be emergency response? (EN-AR KWB Oct 2013)
- This is a hard environment for spills. How will you look after that? (EN-CH OH Oct 2012)

The following measures will be implemented to ensure safe navigation conditions:

- Persons with local knowledge acting as Marine Mammal Observers (MMOs) onboard vessels will be a valuable source of information for ship Masters regarding weather and water flow anomalies along the shipping routes. Ship navigators will be trained using marine simulators and residents of the LAA and RAA with local knowledge of the areas with navigational hazards will be consulted when setting up simulator programs for the shipping routes.
- Navigation in restricted areas such as the Chesterfield Narrows will be restricted to high tide, daylight navigation with good visibility. Detailed passage plans will be used by all navigators.
- The dry cargo ships, tankers and tugs will be equipped with a complete electronic navigation package for navigation in restricted waters.
- Vessels transiting difficult navigation sections on Chesterfield inlet will have dual redundancy for all critical navigation and communication equipment.
- All tankers and fuel barges will be constructed with a double hull. Contact as a result of groundings will greatly reduce the probability of a pollution incident.
- Tugs and barges will be highly maneuverable and will be designed for reduced draft operation.
- A vessel traffic management system will be in place to organize the vessel traffic flow for all operators thus avoiding situations where collisions or groundings might occur.
- The Emergency Spill Response Plan (ESRP) will be designed to address oil spills which are beyond the capacity of the individual vessel to mitigate.

Further information on spill contingency planning is provided in Section 5.5. Information on AREVA's Emergency Response Plan is provided in Volume 10 Accidents and Malfunctions.

3.6.1 Pilotage

Pilots will be responsible for guiding ships through hazardous and congested waterways. They are expert shiphandlers who have detailed knowledge of waterways. Pilots are required to engage in extensive training and be experienced with different types of vessels and docking facilities. Pilotage is compulsory in the St. Lawrence River between Montreal and Escoumins, Quebec with pilotage provided by the Laurentian Pilotage Authority. There is also compulsory pilotage within the Port of Churchill, Manitoba, and is managed by the Great Lakes Pilotage Authority. It is also understood that there is currently only one pilot stationed at the port of Churchill. Pilotage is governed by the Pilotage Act, the Great Lakes Pilotage Regulations, and the General Pilotage Regulations. AREVA will ensure the selected marine shipping contractor(s) adhere to all applicable shipping Acts and regulations pertaining to navigation along the proposed shipping routes.

While AREVA has no current plans to train pilots, AREVA will work together with the shipping company selected for the Kiggavik Project, the Port of Churchill, Manitoba and Great Lake Pilotage Authority to ensure there will be a sufficiently trained number of pilots to safely navigate ships in and out of the port, and will support personnel to be trained in accordance with the Great Lakes Pilotage Regulations (C.R.C., c. 1266) and the requirements listed under Applicant for Pilot Certificate – After Dec 31, 2012.

In addition, AREVA and the shipping company will provide shipping plans and hold discussions with the appropriate authorities to confirm sufficient pilot capacity prior to any construction activity related to the Project. While there are no finalized shipping plans created yet for the Kiggavik Project, AREVA will ensure that the Great Lake Pilotage Regulations (C.R.C., c. 1266), in particular, Section 4, Compulsory Pilotage are met. If AREVA chooses to use a tug or barge that is not piloted, then it will require the shipping company to follow those requirements listed in the Great Lake Pilotage Regulations, Compulsory Pilotage, Tugs, Section 4.3. A complete and comprehensive plan to ensure there will be sufficient pilots for the Kiggavik Project will be provided at the time of licensing (Technical Appendix 1D).

3.6.2 Navigation Hazards

Existing sea based navigational aids are limited to manual visual aids. The use of modern electronic positioning verification equipment such as Laser Fan beam and Radius electronic targets will be considered to assist with navigation. Tugs will be equipped with the latest generation of navigation aids including Automatic Identification System (AIS), electronic charting system (ECDIC) with AIS interface and radar overlay, Differential Global Positioning Systems, Type X band radar with Automated Radar Plotting Aid (ARPA), Type S band radar with ARPA as noted in Section 3.6. Communications equipment on Tugs and other vessels will use the latest satellite based technology and be double redundant.

The Iqaluit Marine Traffic Centre provides weather reports, navigation warnings, and ice reports. Navigation in the Hudson Strait and Hudson Bay is not challenging during the open water season. Marine navigation in the Chesterfield inlet presents several challenges. The following comments on various sections of Chesterfield Inlet provide a description of navigation hazards that will be encountered.

Ellis Island to Helicopter Island

The maximum range of large tides in this stretch is between 5.2 m (17 ft) at Ellis Island to 2.3 m (8 ft) at Helicopter Island. Outflow currents of 3 to 4 knots and up to 5 knots on the ebb are experienced. These strong tidal streams and cross currents can set a vessel across the channel. The currents are particularly strong in Deer Island Channel (Reference Marine Chart 5621) and in the vicinity of Skua Reef (Reference Marine Chart 5621). Vessels will time their arrival at these areas to coincide with a reduced current flow. Vessels navigating in opposite directions would time their arrival to avoid passing at these locations. The ebb tidal stream which reaches a maximum rate at low water runs for 8 hours, the flood for 4 hours. The shores of the inlet consist mostly of rocky slopes rising gently from the water to elevations seldom exceeding 162 feet (50 m) and covered with moss, lichens and dwarf shrubs. Islands and headlands generally blend into the back ground and are difficult to distinguish – there are few prominent features useful for navigation. Beacon ranges are established in the most confined water ways consisting of lattice towers with fluorescent-orange day marks. Navigational buoys, beacons and range lights do not exist. Water depths range from > 70 m to 17 m. Vessels navigating this section will use ARPA radars, GPS, Electronic Charts and visual aids to maintain courses. Detailed voyage plans are essential for safe navigation.

Helicopter Island to Chesterfield Narrows

The maximum range of large tides in this stretch is 2.3 m (8 ft). Currents up to 4 knots are estimated. Between Schooner Harbor and Eddy Point, situated 1 mile east of Chesterfield Narrows, channel depths are mostly over 20 m (11 fathoms). Between Eddy Point and Chesterfield Narrows, depths are 7 to 9 m (23 to 30 ft). A depth of 3m (10 ft) can be carried through the narrows and vessels drawing up to 4.6 m (15 ft) have passed through the narrows safely at high water levels. Vessels navigating this section will use ARPA radars, GPS, Electronic Charts and visual aids to maintain courses. Detailed voyage plans are essential for safe navigation. Vessels will time their arrival at these areas to coincide with high tide slack water. A vessel traffic management system will be required to coordinate vessel movements through this area to insure that vessels do not meet in these areas.

Chesterfield Narrows

The height of the tide and the strength of the tidal currents in Chesterfield Narrows may be appreciably influenced by the water level in and subsequent outflow from Baker Lake. The lake varies by 0.6 to 0.9 m (2 to 3 ft) from the high levels in late June and early July to the lower levels in September and October. The tidal information given below is for summer conditions. The ranges of mean tides and large tides at Chesterfield Narrows have been measured to be 2.4 and 2.7 m (8 and 9 ft), respectively. High water at Norton Island, 2 miles east of the narrows, follows high water at Churchill by ½ to 1 hour. High water at Chesterfield Narrows might then be expected to begin 1 to 1½ hours after high water at Churchill.

Tidal currents flow westward for the 3 to 4 hours of flood and can reach rates up to approximately 4 knots. Flood flow is preceded and followed by ½ hour periods of slack water. The eastward ebb flow lasts 8 hours, reaching maximum rates at low water. Ebb flows up to 8 knots have been reported. The tidal effect at the east end of Baker Lake, north of the narrows, is negligible. The navigation channel through the Narrows is narrow and demands two tug & barge course alterations of greater than 30 degrees. Passage through Chesterfield Narrows is possible only at high water slack during day light hours in good visibility. Given a chart datum depth of 3.0 m (10 ft) and a mean tide height of 2.4 m (8 ft) the maximum available summer water depth is 5.4 m (17.7 ft). Assuming an under keel clearance of 0.75 m (2.5 ft) the maximum fresh water draft for tug & barge is 4.65 m (15.25 ft). Traffic in the Chesterfield Inlet and particularly in the Narrows will be coordinated and managed to enhance safety. For instance, it is proposed that as a precautionary measure passage at the Narrows is one-way traffic on each high tide, with a maximum of two cargo barges/vessels transiting on each high tide. The operation would be single tug, single barge only (i.e., no tandem or double towing will be carried out in restricted navigation areas.

Chesterfield Narrows to Baker Lake

Baker Lake is a fresh water lake extending westward for 50 miles from Chesterfield Narrows to the mouth of the Thelon River, near which the Hamlet of Baker Lake is located. The northern two-thirds of Baker Lake is a comparatively deep basin; the southern one-third appears to be shallow and strewn with shoals. Depths west of Christopher Island along the “track usually followed” range generally between 20 and 40 fathoms (37 & 73 m), reducing to less than 10 fathoms (18.3 m) about 3 miles east of the Hamlet.

4 Baker Lake Dock Site and Storage Facility

4.1 Dock Site Location

The Baker Lake dock site will be designed and constructed to receive barges, offload goods, and store goods prior to transport by road to the Kiggavik site. Since one of the Project options includes a winter road only, the current design considers storage of all goods required for one year of operation.

A number of options for the location and design of the dock facility have been considered. The review of these options are discussed in detail in Technical Appendix 2A, Alternatives Assessment. Bathymetric information for the dock site options are included in Technical Appendix 5C, Aquatics Baseline.

Figure 4.1-1 and Marine Chart 5626 show the existing Agnico-Eagle Meadowbank dock site (AE, Position N64º 18' 14" – W95º 57' 9") and AREVA potential sites. The following potential dock site locations have been identified:

- Dock site 1 (Position N64º 17' 60" – W95º 56' 21")
- Dock site 2 (Position N64º 17' 23" – W95º 51' 49")

The preferred location of the dock facility is identified as Site 1 (Figure 4.1-1). This site is preferred due to its potential for synergy with Agnico-Eagle Meadowbank operations, proximity to the community of Baker Lake, and location on the north shore. Topography is such that the site is suitable for a dock while storage structures can be placed at sufficient elevation to accommodate changes in water level.

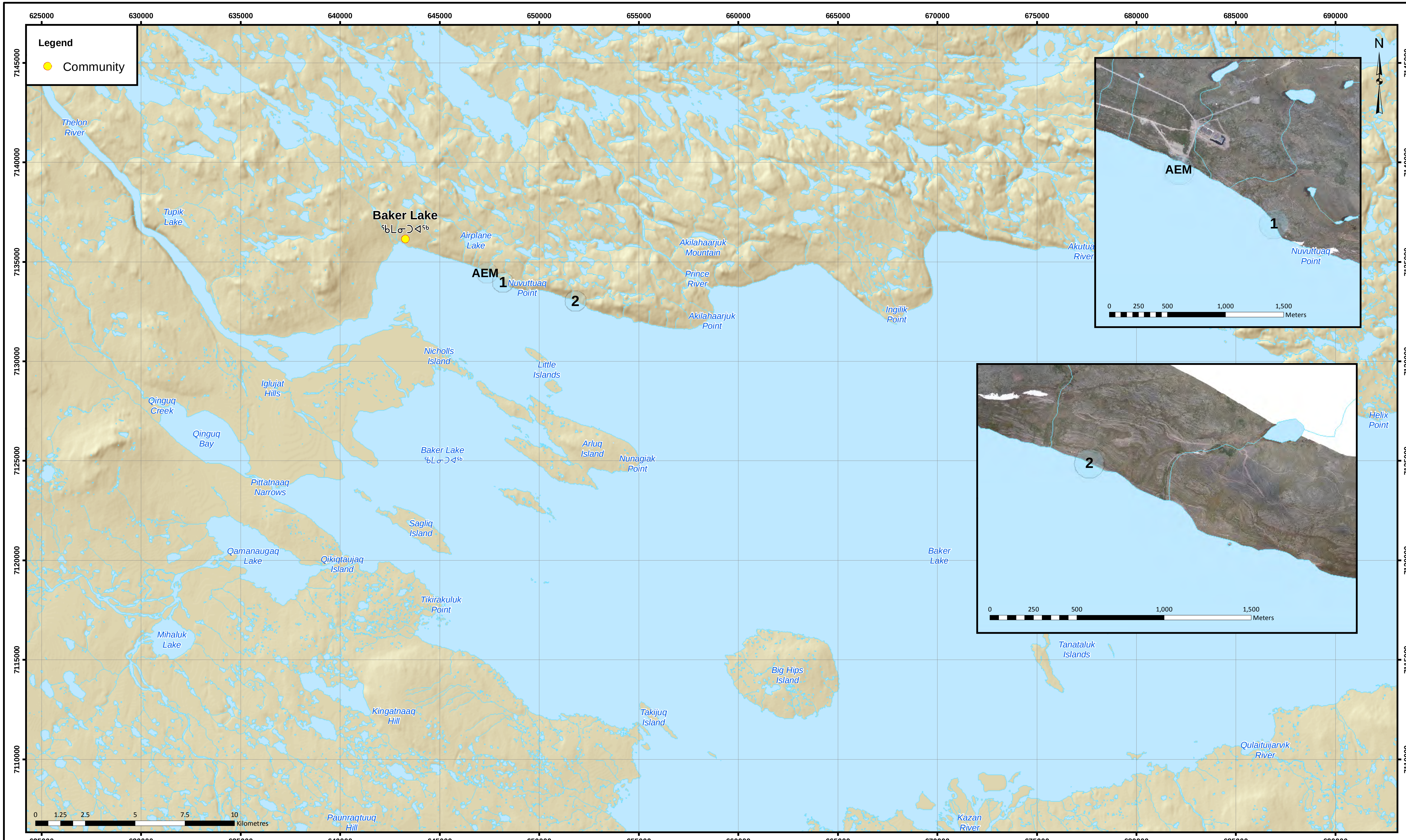
Consistent with the successful logistics approach used by Agnico-Eagle and applying conservative principles, the dock will consist of a floating spud barge placed from the shore out to sufficient depth to permit barge-docking. No dredging of the lake bottom is anticipated. The dock is constructed by placing minimal clean fill along the shoreline, floating the barge into place and anchoring the barge using steel piles driven into the lake bottom. The barge retains vertical mobility along the steel piles such that changes in water levels and ice formation are accommodated. The spud barge is further secured using steel cabling anchored to the shore. The spud barge can remain in place during winter, be disconnected and shipped south at the end of the shipping season, or be pulled onto shore.

Given that the proposed dock installation would be similar to the current Agnico-Eagle Meadowbank wharf installation with floating barges, fill required for access to the barges will have a very limited footprint on the overall dock site and can be easily monitored, maintained, repaired and decommissioned. This design is anticipated to be relatively unaffected by changing water levels, ice shifting, and spring thaw.

Sea containers and loose goods will be off-loaded using a crane and mobile equipment for transfer to the storage yard prior to loading trucks for transport to Kiggavik. The storage yard will include a small office area, outdoor laydown area, a cold storage building and possibly a heated storage building. A section of road to connect the dock facility to the existing road network will be required. A mobile generator will be installed to provide power to the dock facility. Wireless communications will be used to reduce infrastructure requirements.

Security will include placarding of all hazardous goods storage areas. During periods when materials are stored at the site, regular inspections by trained personnel will be conducted to ensure containment. The site will be restricted at all times to authorized personnel with appropriate training. No security fence is anticipated at this time.

The primary use of the dock will be to handle the Kiggavik annual cargo requirements. When the dock is not in use the unloading facilities may be used for other cargo purposes at the discretion of AREVA. Anticipated uses include off-loading of community re-supply or Agnico-Eagle barges as back-up to the existing off-loading sites.



Projection: NAD 1983 UTM Zone 14N
Creator: CDC Revised: TL
Date: 09/01/2011 Scale: 1:175,000
Data Sources: *Natural Resources Canada, Geobase®, Nation Topographic Database, AREVA Resources Canada Inc.*

FIGURE 4.1-1
BAKER LAKE DOCK SITE OPTIONS

ENVIRONMENTAL IMPACT STATEMENT
VOLUME 2: PROJECT DESCRIPTION
TECHNICAL APPENDIX 2J: MARINE TRANSPORTATION

Kiggavik Project
AREVA

AREVA Resources Canada Inc - P.O. Box 9204 - 817 - 45th Street West - Saskatoon, SK - S7K 3X5

File: Q:\SHEQ\GIS\KIGGAVIK\2014\EIS\Volume 2 - Project Description\Volume 2 - Tier 3\Appendix 2J -Marine Transportaion\MXD\Figure 4.1-1 Baker Lake Dock Site Options.mxd

4.2 Fuel Offloading at OHF

Fuel will be loaded at terminals in Montreal, Rotterdam, or New York then transported to Ellis Island anchorage at the east end of Chesterfield Inlet using oceangoing Ice Class double hull tankers. The ocean going tankers will anchor at Ellis Island and lighter their cargoes into double hull barges. Procedures conforming to Transport Canada Guidelines TP10783E will be used for fuel lightering. The barges will lie alongside and tie up to the tanker during this process. Floating Yokohama type fenders will be used between the barges and the tanker. The double hull barges will also deliver the fuel direct to Baker Lake from southern ports. Double hull tankers may also deliver fuel to the tank farm in Churchill.

A containment boom will be placed between the tanker and the bow and stern of the barge as a precautionary measure to contain any fuel should a spill occur. A work boat and a barge containing oil spill equipment will be stationed at Ellis Island during all fuel transfers. A containment boom which will encircle the entire length of the tanker and barge will be available onsite, ready to be deployed if necessary.

A fuel off-loading system will be constructed to pump fuel from the barges to a 70 ML fuel tank farm located at the AREVA Baker Lake dock and storage facility. The off-loading system will include secondary containment and redundancy as required by the Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum and Allied Petroleum Products (CCME 2003). A preliminary spill contingency plan is included in Technical Appendix 10B.

Steel piping will lead down to the loading dock from the diesel fuel tank farm (Figure 3.5-4). The size of the piping will be sufficient to maintain a flow rate of 500 cu. m per hour, approximately. The discharge hose will be a marine grade bunker hose rated at 17 bar. The discharge hose(s) will be connected to the fuel receiving manifold on the dock using a dry break coupling(s). A powered hose reel and hose crane will be fitted on the barge. All connection points will be protected with save-alls. The dock area will be well lit as required for work being conducted under low light conditions. A ready use pollution kit will be stored on the dock. A containment boom will be deployed between the dock and the barge hull during fuel transfers as a precaution to contain any fuel that may accidentally spill.

The oil handling facility (OHF) at the dock site will be constructed and operated in accordance with Transport Canada Arctic Waters Oil Transfer Guidelines TP 10783E and Oil Handling Facility Guidelines TP 12402E. The OHF supervisors will be trained in accordance with Transport Canada Supervisor of Oil Transfer Operation course TP 12402 or equivalent. A team of trained personnel will be in charge of the barge discharge equipment. Fire-fighting equipment will be fitted on the dock as well as on each barge as required by Transport Canada. For more information refer to spill contingency information at the dock site in Technical Appendix 10B.

4.2.1 Loading and Offloading Procedures

Pre-Transfer Procedures for Lightering Fuel from Tankers to Barges and from Barges to Storage Facilities Ashore

- Inform Prairie and Northern Region, Marine, via NORDREG, or the nearest CCG Radio Station of the intended nature and duration of transfer, 48 hours prior to the start of transfer operations, or as practicable, in sufficient time that would allow a Pollution Prevention Officer to arrive at the site and witness the transfer;
- Inform local authorities as appropriate;
- Where local traffic warrants and if the transfer location is outside "port" facilities areas, broadcast navigational warnings on VHF before starting, announcing the name(s) of vessel(s), the geographic location, the nature and expected duration, and requesting a wide berth;
- Cancel the warning when transfer operations are complete and secured;
- In all transfers, each party has the right to suspend operations at any time, if they decide it is necessary;
- Conduct a pre-transfer conference between Supervisors of Oil Transfer Operations in Arctic Waters (North of 60°00’N) of Supplier and Recipient vessels/facilities to:
    - inform each party involved of the dimensions of the other's key facilities, such as manifold/fuelling station location, maximum and minimum draught, barge/ship length, fendering arrangements, shore manifold connections, and jetty/shore characteristics such as tides, bollards, mooring and positioning aids, hidden hazards;
    - Inform all participating personnel of their duties and responsibilities during the transfer, and ensure they are used versed in emergency procedures, and know the oil spill contingency plan to be followed in the event of an incident;
- Ensure engines, steering, thrusters, and maneuvering controls, are tested and remain on stand by during transfer;
- Unless vessels are in open water, clear of land and traffic routes, with no ice present, ensure they are secured alongside or anchored, with due consideration for prevailing and expected wind, weather, ice, and tide conditions;
- Ensure that moorings (including shore moorings) are adequate to allow for draught and tidal changes during transfer;
- Suspend all operations that could cause ignition hazards around deck tank vent areas, such as:
    - welding and other hot work,
    - use of portable electrical apparatus, particularly extension cords,
    - use of portable combustion engine driven equipment,
    - other operations which could cause ignition hazards;
- Ensure all cargo manifold valves and/or fuelling connections which will not be used in the current transfer are isolated and blanked;
- Ensure sea valves in cargo pump rooms are closed and sealed;

- Ensure valves which will be used for the transfer, are free of ice or other obstructions, and are easy to operate through their full range;
- Ensure all deck scuppers are plugged to contain any oil spilled, and that freeing ports and other open areas where spillage could go overboard are closed;
- Ensure absorbent material is readily available at the flexible hose connections on deck and other predictable minor spill locations;
- Ensure containers, or drip trays of suitable size are placed under tank vents, manifolds, fuelling connections, or other locations where adequate permanent containment arrangements are not fitted;
- Ensure accommodation deck doors, deadlights or shutters, ports, and vents are closed;
- Ensure flame arrestors or gauze screens and pressure/vacuum relief valves (PVR) are checked;
- Ensure no helicopter landings or takeoffs occur during transfer operations;
- Ensure vessel air conditioning systems are on recirculation mode;
- Ensure vessels hoist the appropriate signals by day and night; and
- Ensure that all valves and pipelines required for the current transfer are open, and that all other valves and pipelines in connected systems are closed and secured. Ensure this is double checked by the assigned crew members and the Transfer Supervisor/Cargo Officer.
- Check for a valid hose certificate, confirming that the hose has been satisfactorily inspected during the past 12 months, according to the Oil Pollution Prevention Regulations;
- Check individual hose test markings or tags;
- Define who will supply the transfer hose and establish hose configuration -- diameter, total hose length, coupling type and number, operating pressure of hose and couplings, type of terminal flange (size/class, etc.);
- Define hose purging method between products, and after final transfer;
- Examine "O" rings and joints in couplings and replace any damaged seals or gaskets;
- Inspect hose-to-coupling clamps visually to ensure good condition and security and repair or replace any damaged clamps, where possible, or use spare hose lengths;
- Check that an insulating flange or coupling is in place;
- Secure hose coupling clips with safety wire;
- Ensure lifting and restraining arrangements are suitable for the type and dimensions of hose used, and that the apparatus will prevent hose damage due to ship movement in swells or draught changes;
- Ensure the hose is suitably supported throughout the hand-over, and during the transfer, to avoid damage and prevent kinks;
- When transferring sea hose ashore, ensure the hose is free from chafing, or pinching between ice floes or rocks;
- Use hose strain relief system with long floating hose transfers to prevent strain on the hose string from winds, tides, and ice;

- Examine the completely installed hose string carefully and repair or replace any damaged hoses, flanges or joints, before starting the transfer;
- Minimize the number of couplings by using longer hose lengths; and
- In ship to shore transfers use a suitable boat to send the hose ashore.

Transfer Procedures

- Complete the pre-transfer check list;
- Have a responsible person, with an operational radio set on the correct channel/frequency, near the cargo/transfer pump start/stop control throughout the transfer;
- Start pumping at a previously agreed slow rate, while rechecking hose string for leaks;
- Ensure the product is going to the correct recipient tank;
- Maintain the normal pumping rate, as agreed with the other party, until topping off is required;
- Examine the hose string regularly during transfer and watch for signs of undue strain, bulging, and other evidence of real or potential leaks;
- For floating hose, patrol the string, check the water in the area for leakage signs, and look for coupling problems, or snags on ice floes;
- Check both Supplier and Recipient tanks regularly for both content level and product, and investigate any anomalies, suspending the transfer if necessary;
- Keep a constant check on the pumping pressure and immediately investigate any pressure variations of an unexpected nature;
- Make regular visual checks of the water immediately surrounding the vessel(s) and transfer area;
- Reduce transfer rate, when Recipient tanks are nearly full, for topping off; and
- Use an automatic stop device which will shut down the pump when the flow rate or back pressure exceeds a pre-set level.

Emergency Procedures

If any of the following conditions occur, the transfer should be stopped immediately:

- Lost communications;
- Loss of ability to monitor hose to shore;
- Sign of spillage, or damage to hoses and couplings;
- Any detection of accumulated gases;
- Major increase in wind and/or swells;
- When an electrical storm is present or predicted;
- Sever deterioration in ice or visibility conditions;
- Helicopter landings or take offs; and

- Any other situation deemed dangerous by the transfer supervisor;

Post Transfer Procedures

When the transfer has been completed, the following procedures should be followed:

- Purge the hose by previously agreed method (see II - Recommendation for Purging), and shut all manifold and tank valves; when purging ensure that no air will be introduced to the tanks at the shore facility;
- Sound all tanks, (after waiting for settling, if necessary), and confirm with both parties that quantities of fuel/cargo have been properly transferred;
- Stow hoses securely for sea passage;
- Complete transfer checklists;
- Ensure the ship's and facility's Oil Books and Checklists are signed, kept up to date, and retained for examination by a Pollution Prevention Officer or other authorized official, (by prior arrangement with Prairie and Northern Region, Marine, organizations may use their existing checklists for recording transfer preparation conditions, provided all major aspects are covered in those checklists);
- Forward the transfer particulars checklist or a post-season summary of operations and quantities, for statistical records and prevention guidelines improvement purposes, to Prairie and Northern Region, Marine by the calendar year-end.

5 Review of Key Management Plans

5.1 Shipping Management Plan

The Shipping Management Plan (SMP) will ensure that all equipment and operating procedures conforms to the requirements of the Canada Shipping Act, The Arctic Waters Pollution Prevention Act, Canada Oceans Act, 1997, MARPOL 73/78 Annex I (Mineral oils), Annex II (Noxious Liquid Substances carried in bulk), Annex III (Harmful substances carried in packaged forms), Annex IV (Sewage), Annex V (Garbage) and Annex VI (Air Pollution). Solas 74 with amendments.

Lessons learned from previous marine operations in the LAA and RAA will be incorporated into the SMP and documented site specific operating procedures will be incorporated into the SMP. Adherence to approved procedures will be verified by annual audits. The marine equipment used on the Kiggavik project will be selected on the basis of best value meeting rigorous task performance criteria for: reliability, safety and capability of meeting stringent environmental standards. The Marine Shipping Company selected for the Kiggavik Project will have a proven history of excellent performance in Arctic Transportation. The Marine Shipping Company will be required to carry third party Liability Insurance.

The SMP will include protocols for the transportation of dangerous goods into Baker Lake. Documented procedures following Transport Canada guidelines outlined in TP 10783E will be used for all vessel to vessel and vessel to shore fuel transfers. A supervisor trained and experienced in marine fuel transfers will supervise fuel transfers. The specification for diesel fuel will meet the Canadian General Standards Board (CGSB) or equivalent standards for grade Diesel Fuel – Arctic (DF-A) (also referred to as arctic diesel). The SMP will also include specific protocols for the marine transportation of diesel fuel into Baker Lake. All diesel fuel will be carried in tankers and/or barges which have been constructed with a double hull. A watertight void space will be constructed around the perimeter of the cargo tanks therefore insuring that the cargo does not come in contact with the vessel's outside steel shell. Should the vessel run aground or otherwise breach the outer shell, no cargo fuel will spill from the cargo tanks into the surrounding water.

All foreign ships entering Canadian waters are required by Canadian law to the Ballast Water Control and Management Regulations of the *Canada Shipping Act 2001*, designed to prevent foreign ballast water and sediments from being released. The SMP will include a ballast water management plan which meets the Ballast Water Control and Management Regulations (SOR/2006 – 129) of the *Canada Shipping Act*. Regulations include mandatory exchange of foreign ballast water at least 200 nautical miles from shore and in water depths greater than 2000 m. Vessels transiting from southern ports or outside the RAA will arrive in a loaded condition, therefore minimal ballast water will be carried on the vessels when they arrive. The intake of ballast water (should it be required) will be conducted in deep water at the mouth of Chesterfield Inlet and in accordance with the *Canada Shipping Act,* 2001 and regulations.

Bilge water accumulates from seawater that may seep or flow into the vessel from various points in the structure, and may become contaminated with oil and other substances from machinery. All marine vessels will comply with the *Arctic Shipping Pollution Prevention Act,* 1985 and the Arctic Waters Pollution Prevention Regulations, 2006, which include provisions that prohibit the release of oily bilge water into Arctic waters. All bilge water generated on board vessels will be retained for discharge at a licensed reception facility.

The SMP will include onboard waste management policies and guidelines for handling solid waste, sewage and other domestic waste generated by vessels. All vessels will be fitted with sewage treatment plants that meet Marpol 73/78 Annex IV requirements. All vessels will be required to implement a garbage management plan that meets Marpol 73/78 Annex V requirements. The plan will maximize recycling of solid materials and minimizes the use of incinerators. Baker Lake and Chesterfield Inlet will be treated as special areas as defined by Annex V meaning no garbage of any kind will be discharged.

The SMP will address smuggling prevention as part of the Vessel Security. All manned vessels will be certified in accordance with the Canadian Ship Security Regulations (SOR/2004 – 144). An International Ship Security Certificate will be required for all SOLAS vessels. All cargo will be manifested and accounted for when loaded and unloaded at the origin, transfer and final delivery port. A Ship Security Plan will be required by all SOLAS and non SOLAS vessels. The marine Shipping Company will be required to enforce a zero Alcohol and Drug Policy.

The SMP will ensure that all vessels have a documented, approved SOPEP which include contingency plans for accidental spills of fuel and chemicals, extreme weather conditions and malfunctions during shipping operations, with reporting action procedures. All vessels involved in the carriage of fuel and chemicals will have an approved SOPEP. The SOPEP will contain all information and operational instructions as required by the Guidelines for the Development of the Shipboard Marine Pollution Emergency Plan. A plan outline is provided in Section 5.4 and a detailed plan will be developed later in conjunction with the selected shipping companies prior to Project licensing.

5.2 Occupational Health and Safety Plan

AREVA will ensure that the marine shipping company has a Health, Safety and Environmental Protection Plan which includes the following elements:

1. Health Policy that recognizes interaction with the Nunavut Medical Health system, Safety Policy, Environmental Protection Policy, Drug & Alcohol Policy, and Healthy Workplace Policies.

2. The HSE System Manuals, which describe the Shipping company's Policies, System-level Procedures and Work Instructions;
3. A defined and documented organizational structure, with clear levels of responsibility and authority and lines of communication between shore-based and shipboard personnel;
4. Appointment of a Designated Person/Management Representative with specific responsibilities for all HSE System matters;
5. Documented procedures for the control of HSE System Documents and Records;
6. Programs through which Top Management ensures that the importance of meeting regulatory and AREVA's requirements is communicated throughout the organization;
7. Periodical establishment of measurable HSE objectives and performance review against these objectives;
8. A System for integrating quality, health, wellness and safety into daily processes as well as maintaining the integrity of the HSE system when changes take place;
9. Procedures for carrying out periodical Shore side Management and Master's Reviews of the HSE System;
10. A system to ensure that:
    a) All personnel performing work that affects safety, environmental protection or service quality are competent on the basis of education, training, skills and experience, fully conversant with the HSE System, and aware of the importance of their activities and their impact on the company's HSE objectives;
    b) All vessels are manned with properly certified, experienced, trained and medically fit seafarers, in accordance with international and national regulations. Special training will be provided to all seafarers and dock workers for the handling and transportation of Uranium concentrate;
    c) All new personnel and those transferred to new assignments are provided with proper familiarization with their duties;
    d) All vessel personnel are capable of communicating effectively with each other;
    e) Additional training in support of the HSE System to deal with situations unique to the LAA; and, RAA.
11. Instructions and Procedures to ensure the safe and efficient operation of the vessels and protection of the environment in general with a particular focus on the RAA and LAA environment. The instructions will include documented voyage plans, loading plans, discharge plans and SOPEPs developed from sources such as Job Safety Analysis (JSA), Traditional Knowledge and Risk assessments of all critical marine activities;
12. Offshore and Onshore Safety Committees representation and regular conduct of Safety Meetings, which provide a forum for all personnel to work together in identifying and resolving Health, Wellness, Safety and Environmental hazards on board the vessels and ashore;
13. Emergency Response Plans, to identify and effectively respond to potential emergency situations, and a program of drills and exercises to test these plans;
14. A system for maintaining identification and traceability of the vessels' activities and products supplied to the vessels;

15. Procedures to ensure that all vessels are maintained and certified in accordance with all international and national rules and regulations and any additional requirements of the shipping company;
16. Procedures to exercise care with Areva owned products while under the Marine Shipping Company's control;
17. Procedures for calibrating, verifying, adjusting, identifying and protecting, monitoring and measuring devices which are critical to the safety of the ship, protection of the environment or service quality;
18. Documented procedures for reporting and analyzing accidents, incidents, illnesses, near misses and non-conformities, and controlling non-conforming products or services, for the purpose of developing and implementing preventive or corrective actions to prevent occurrence or recurrence. A system to communicate Lessons learned to all vessels ;
19. Specific methods through which HSE System processes and the shipping company's performance overall, are monitored and measured against specified objectives, relevant data analyzed, and corrective action is taken when deviations are observed; and,
20. A program for conducting Internal HSE System Audits and Inspections at planned intervals and procedures that govern the conduct of these audits.

5.3 Oil Pollution Emergency Plan

The Oil Pollution Emergency Plan (OPEP) for the Oil Handling Facility (OHF) at the Baker Lake Dock Site will conform to the following Regulations:

- The Canada Shipping Act 2001 Part 8. Subsection 168 (applications north of 60º)
- The Canada Shipping Act Response Organizations and Oil Handling Facilities Regulations (SOR/95-405)
- The Oil Handling Facilities Standards, TP12402
- Northwest Territories, Nunavut Worker's Compensation Act
- Mine Health and Safety Act and Regulations (Nunavut)
- Canada Labour Code Part II

The OHF will consist of a tank farm with seven steel storage tanks. Each tank will be designed to carry 10 million litres (ML) of Ultra Low Sulphur Arctic Diesel. The tanks will be located within a berm designed to contain the capacity of the largest storage tank and 10 percent of the total capacity of all other storage tanks (i.e. 16 ML). A steel pipeline will be laid from the tank farm to a shore line manifold. A flexible marine floating discharge hose will be laid from the shore manifold to a selected anchorage point for double hull shuttle tankers and/or double hull barges. Rapid response Oil Pollution Spill kits will be placed at strategic locations including the discharge manifold on the vessel, the receiving manifold in the OHF, the discharge manifold at the truck filling station and the OHF Pump location.

The OPEP will be developed with consideration of the following main objectives:

- Maximizing the safety of the OHF's operating personnel
- Maximizing the safety of persons living near the OHF
- Safeguarding the integrity of the OHF
- Reducing the risk of fire and explosion
- Reducing the risk of an oil pollution incident
- Timely notification and reporting of an oil pollution incident
- Reducing the environmental impact of an oil pollution incident
- Responding to the cleanup in an effective manner after an oil pollution incident

The OPEP for the Baker Lake dock site will be finalized at the licensing stage when all necessary details such as vessel and barge type, site layout, and detailed design of the OHF will be available.

5.3.1 Training

The OPEP will contain a training plan for all OHF operating personnel. All personnel will be trained in the proper operation of OHF equipment. OHF operating procedures will be documented. All work carried out at the OHF will be managed by a formal work permit system. The opening and closing of fuel flow valves will be managed using a lock out - tag out system to improve security. The wearing of Personal Protection Equipment (PPE) will be mandatory. Specialized PPE will be worn by oil spill response teams. Oil spill response exercises with full equipment deployment will be carried out periodically based on realistic scenarios.

5.3.2 Spill Response Scenarios

The OPEP will describe measures to be taken in the event of a spill including emergency response team activation protocols, spill notification protocols, and containment and cleanup procedures. The OPEP will have human resources and sufficient materials and equipment located at or near the OHF to be completely self-sufficient to deal with a spill in the specified time frame as required by regulations. The OPEP will also include commercial arrangements with specialized Oil Spill Contractors which can be mobilized to assist in spill cleanup.

The OPEP will contain detailed Spill Response Scenarios prepared for:

- Spill risks from transfers to the OHF from vessels/barges
- Loading trucks at the OHF
- Spill risks from storage tanks and other containers
- Spill risks from OHF piping/pump systems

5.4 Shipboard Oil Pollution Emergency Plan

Requirements of National laws and regulations, as well as International Regulations and standards apply to the proposed marine shipping for the Kiggavik Project. The Shipboard Marine Pollution Emergency Plan will be written in accordance with the requirements of regulation 37 of Annex I and regulation 17 of Annex II of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and amended by Res.MEPC.78 (43).

The Shipboard Oil Pollution Emergency Plan (SOPEP) will contain all information and operational instructions as required by the Guidelines for the development of the Shipboard Marine Pollution Emergency Plan as developed by the Organization (IMO) and published under MEPC.85 (44) and MEPC.54 (32) amended by MEPC.86 (44). A plan outline is provided; detailed plans will be developed later in conjunction with the selected shipping companies prior to Project licensing.

The SOPEP will contain instructions to the Master with a list of Contacts for reporting a Marine Accident/Incident. The contact list will include the marine shipping company's Emergency Response team ashore, client contact (AREVA), regulatory agencies, third party Emergency Response organization and may include insurance contacts.

The SOPEP is designed as a ship-specific tool however it will also contain links to shore-based plans. The plan will allow an efficient co-ordination between the ship and the shore-based authorities/ organizations in mitigating the effects of any pollution incident. A shore based third party emergency response team with access to oil spill containment and clean up resources will be available to assist the ship's master.

The SOPEP will contain all information and operational instructions as required by the Guidelines for the Development of the Shipboard Marine Pollution Emergency Plan as developed by IMO and published under MEPC.85 (44) and MEPC.54 (32) amended by MEPC.86 (44).

The SOPEP for each vessel will contain the following instructions:

- Response Team Organizational Structure which will include, Master, designated Spill Officer, Spill Squad, and Repair Squad.
- Procedures for the crew to mitigate Fuel transfer incidents including: Transfer System Leak (Oil), System Leak (NLS), Tank Overflow (Oil), Tank Overflow (NLS), Suspected Fuel Tank or Hull Leak,
- Procedures for Crew to Mitigate Casualty Discharge from: Stranding, Grounding, Collisions, Fire and Explosion, Hull Failure, Excessive List, Dangerous Reactions of Cargo, Other Dangerous Cargo Release, Loss of Tank Environmental Control, Cargo Contamination Yielding a Hazardous Condition, Equipment Failure, Steering Gear

Failure, Main Engine Failure, Use of Anchors, Damage Stability, Emergency Ship – to – Ship Transfer, Emergency Towing and Hull Stress Considerations, Location of Salvage, Stability, Shipboard Mitigation Equipment and Stress Assessment information.
- Crew responsibilities for taking and recording samples of spilled product.
- Master's responsibility and instructions for reporting oil spills.
- An inventory of ready use spill response equipment to be kept onboard.
- An inventory of Spill Response equipment stored ashore on location.

A response plan for a large oil spill from a vessel in transit will be in place which will compliment and support the SOPEPs on individual vessels. The Emergency Spill Response Plan (ESRP) will be designed to address oil spills which are beyond the capacity of the individual vessel to mitigate. The ESRP will be organized along a similar format to a SOPEP however it will be designed to deal with a worst case scenario and will be capable of bringing larger shore based resources of personnel and equipment to mitigate the spill. The Management structure will include: Senior AREVA representative, Baker Lake Community liaison, Nunavut and Federal Government liaison, Marine Advisor, Oil Spill Response Team Lead, Information Liaison, and a Traditional Knowledge advisor. The plan will incorporate an initial response capability which is designed to mitigate worst case scenarios. A support plan to mobilize equipment and personnel stationed at strategic points in the LAA, RAA, and at other locations outside of the RAA.

5.5 Spill Contingency Plan

AREVA will ensure that trained spill response personnel and response equipment appropriate for the type of cargo and cargo operation is available at the OHF in Baker Lake and at the lightering location. In the event that a spill occurs while a vessel is discharging at the OHF, Transport Canada Marine Safety will be the governing body to ensure that procedures in the OPEP for the OHF and the SOPEP for the vessel are carried out as required by the *Canada Shipping Act*. The Canadian Coast Guard will monitor the spill response performance and may assume command of the operation if the response is not satisfactory. If a spill occurs at the OHF at times when a vessel is not loading or discharging; the governing body which monitors the spill response is Aboriginal Affairs and Northern Development Canada (AANDC).

The Onsite Coordinator is responsible for implementing the following procedures:

- Activate the Spill Response Plan. Call the 24-hour Oil Pollution Line, AANDC water resources, Transport Canada Marine Safety, and the Canadian Coast Guard to advise of the spill event.
- Assume authority over the spill scene and personnel involved.
- Evaluate the initial situation and assesses the magnitude of the spill.
- Develop an overall plan of action and communicate that plan to the appropriate regulatory authority.

- Collect photographic records of the spill event and cleanup efforts.
- Provide information and recommendations to AREVA Operations Manager regarding resource requirements (additional manpower, equipment, materials, etc.) to complete the cleanup effort.
- Mobilize personnel and equipment to implement the cleanup.
- The Onsite Coordinator shall be accessible to communicate with the Canadian Coast Guard-Transport Canada Marine Safety and AANDC during the spill response.
- Prepare an incident investigation and a root cause analysis for all spills.

The marine transportation spill contingency plan for the Kiggavik Project will include the following:

- AREVA Environmental Policy
- Scope of the Plan
- Response Organization
- Organization Chart with positions identified. In times of emergency all available human and material resources must be available to provide mutual assistance. The organization should include members from the local community, Emergency Response Organizations, and other mining and shipping companies working in the area.
- Bridging document to allocate responsibilities between AREVA and Shipping Company Emergency Response teams
- Internal and External Contacts including Regulatory bodies
- Media coordinator
- Onsite response Team
- Offsite (3rd Party) Response Organization
- Description of Response Team member's duties
- Weather reports
- Notification directives
- Define training requirements for all team members from team leads to first responders

Arctic Transportation and Logistics Plan

- Pre-arranged contracts for emergency shipment of equipment and personnel
- Transportation plan to be designed with consideration of arctic conditions

Spill Response Containment Plans

- Location of spill containment materials stored in LAA, RAA and other
- Inventory of spill containment material

Spill Response Clean-up Plans

- Location of spill clean-up materials in LAA, RAA and other
- Inventory of spill clean-up material

Emergency Response Exercise Plan

- Define frequency and extent of emergency response exercises
- Exercise review process
- Incident review process

Maintenance of Emergency Response Equipment

- Documented maintenance plan
- Responsibility organization chart
- Review process

Reference Material

- Marine charts
- Tide tables
- Maps showing locations of spill response materials and how to access them
- Names, contact numbers, and specifications of all vessels working in the RAA

5.5.1 Spill Response Training

All persons involved in the transfer of pollutants will receive spill response training commensurate with their level of responsibility. Spill response exercises will be carried out on a regular basis to practice spill response techniques and to improve spill response reaction time and organization. Spill kits will be carried on tugs, barges, tankers and dry cargo vessels in accordance with individual Shipboard Oil Pollution Emergency Plans. Additional spill kits will be available at the OHF, lightering positions, and at the dock site in Baker Lake. Spill kits positioned at the OHF and lightering sites will include containment booms of sufficient length to completely surround the largest tanker or barge. Oil recovery skimmers will be of sufficient capacity to recover oil quantities equal to the volume of one cargo tank within 48 hours. A contract will be arranged with a spill response organization with equipment and personnel to respond to a larger incident. Back up equipment and a plan to transport the equipment to a remote spill site will be available.

5.6 Accident/Incident Reporting

Accidents and incidents will be reported as required by AWPP regulations.

- All accidents, incidents and near misses involving marine operations will be reported on Accident- Incident forms and a follow up identification number will be assigned to each event.
- An event log will be maintained.
- Events will be investigated using Systematic Causal Analysis Techniques to determine root cause.
- The investigation of the event will not be considered closed until appropriate corrective action has been taken and the results of the investigation have been published within the shipping company fleet.
- Accident prevention will be the cornerstone of the Safety program and will be supported by a pro-active program to identify and correct potential hazards before an accident occurs.

5.7 Waste Management Plan

AREVA will require that vessel operators comply with the Vessel Pollution and Dangerous Chemical Regulations (SOR/2012-69) of the *Canada Shipping Act*, 2001. Vessels will require the following valid certification at a minimum:

- International Oil Pollution Prevention Certificates
- International Noxious Liquid Cargo Certificates (where applicable)
- International Sewage Pollution Prevention Certificates
- Garbage management plan
- International Air Pollution Prevention Certificates
- Anti-fouling Coating Compliance Certificate

As well, fuel bunker for vessels must be provided with a Bunker Delivery note specifying the sulfur content of the fuel.

Sewage

All manned vessels will have an approved Sewage Treatment Plant installed which meets MARPOL 73/78 Annex IV requirements. The LAA and RAA will be considered a special region where the discharge of raw sewage and grey water will not be allowed.

Sewage treatment plants will be designated as critical equipment with stringent preventative maintenance programs and suitable spare parts inventories. In the event of a malfunction of a treatment plant, the sewage/grey water will be retained onboard in holding tanks until the plant has been repaired. Sewage may be disposed of in the onboard incinerator.

Domestic Waste

Domestic waste will be kept to a minimum by adherence to a comprehensive recycling program. All recycled plastics, paper, metal and wood products will be segregated and loaded into containers and transported south as back haul cargo. Galley waste will be incinerated.

Ship-based domestic waste generated by ocean-going vessels amounts to approximately 50 kg per day. Approximately 50% of this waste consists of wood products which will be dealt with onboard by incineration.

Food waste is estimated to be 2.25 kg per person per day which amounts to 25 kg per day for a tug and 60 kg per day for a cargo ship or tanker. Food waste will be dealt with onboard by incineration.

Hazardous Waste

Used lubricating oil, hydraulic fluid, cleaning solvents, dirty fuel and oil recovered from Oily Water Separators are held onboard in waste oil tanks as regulated by International Oil Pollution Prevention (IOPP) regulations. All may be burned in a waste incinerator. Larger cargo vessels generally will have adequate storage capacity onboard which will allow them to dispose of the waste at approved facilities at southern ports. Smaller vessels, such as tugs, may load waste oil into marine liquid ISO containers and ship to southern ports as back haul cargo or may be able to burn waste oil in onboard incinerators. Waste which cannot be incinerated such as PCBs and plastics will be packaged and loaded into designated ISO containers for backhaul to southern ports where they will be recycled or disposed of at approved facilities.

The annual volume of waste fluids generated by tug boats is estimated to be approximately three cubic meters per tug/season based on 0.5% of annual fuel consumption. Large cargo vessels burning intermediate fuel oil (IFO) will generate 20 cubic meters of liquid waste per vessel based on 2% of IFO consumed. The waste oil generated by vessels will be disposed of in the vessel's incinerator or stored onboard in designated waste oils tanks and discharged ashore in southern ports at approved facilities. Oil may be loaded into 20 foot ISO oil containers for shipment to southern ports where the oil can be transferred to approved receiving facilities for disposal.

Incinerator

All marine incinerators will meet IMO MEPC.76(40) standards (IMO, 1997). They will be capable of handling solid waste, including domestic waste, oil waste and, in most cases, sewage. Modern marine incinerators operate at very high combustion temperatures in the range of 850º - 1200º C. Automatic combustion controls and rapid cooling of exhaust gasses maintain emissions within stringent limits of IMO shipboard incineration regulations.

Waste generated by tugs will be minimal and will consist of residual ash from incineration amounting to less than 10% of the total waste onboard. This residual ash will be sealed in heavy duty fabric containers loaded into a designated waste shipping container which when filled, or at the end of the season, will be shipped south as backhaul and disposed of at an approved receiving facility at a southern port. Waste generated from the recycling program will be loaded into a designated recycling container and shipped south as backhaul cargo and then turned over to an approved recycling depot at a southern port.

5.8 Ballast Water Management Plan

All vessels will comply with a Ballast Water management Plan that will be developed with the selected shipping contractor prior to Project licensing. There will be minimal ballast water carried onboard vessels arriving from outside the RAA as they will be transiting fully loaded, therefore,virtually no ballast water will be discharged into the waters of the RAA. All vessels will be required to have a Ballast Water Management Plan which conforms to the following Regulations:

- International Maritime Organization (IMO) Assembly Resolution A.868 (20);
- Guidelines for the control and management of ships ballast water to minimize the transfer of harmful aquatic organisms and pathogens
- International convention for the control and management of ships ballast water and sediments
- The *Canada Shipping Act* ballast water control and management regulations

Ballast water management procedures will vary from ship to ship depending on installed equipment and tank layout, however, all vessels will have a Ballast Water Management Plan that will contain the following information and best management practices:

1. SHIP PARTICULARS

2. BALLAST WATER MANAGEMENT PLAN

2.1 Introduction

2.2 Usage of the Plan

2.3 Crew training and Familiarization

3. BALLAST WATER ARRANGEMENT Drawings

3.1 Ballast System and Condition Arrangements

3.2 Ballast Pumps

3.3 Ballast Monitoring

4. BALLAST WATER SAMPLING POINTS

4.1 Purpose

4.2 Table of Sampling Points

5. BALLAST WATER PLANNING

5.1 When to Exchange Ballast Water

5.2 Uptake of Ballast Water in Harbor

5.3 Removing of Ballast Sediments

5.4 Exchange of Ballast Water in Open Sea

5.5 Reduced Discharge of Ballast Water in Harbor

6. SAFETY

6.1 Limitations

6.2 Potential Hazards Connected to Ballast Exchange in Open Sea.

6.3 Examples of Limitations due to Weather – Sequential Exchange.

7. BALLAST WATER EXCHANGE PROCEDURES

7.1 General

7.2 Exchange by Sequential Method

7.2.2 Proposed ballast exchange sequence

7.3 Flow through Method

7.3.1 General

7.3.2 Tanks for which the flow through method should be applied

7.3.3 Operating procedure

7.3.4 Calculated tank pressure and time consumption

8. BALLAST WATER REPORTING FORM

9. BALLAST WATER HANDLING LOG

Information regarding ballast water management and prevention of introducing non-indigenous species into Arctic waters is presented in Volume 7 Marine Environment, Section 4.3.

5.9 Wildlife Mitigation and Monitoring

Mitigation measures will be employed to reduce the risk of Project-related vessel-mammal strikescollisions. These include establishing speed restrictions on vessels transiting specific portions of the assessment area where vessels are most likely to encounter marine mammals, use of best operating practices (i.e., avoidance of unnecessary acceleration, maintenance of a constant course), and the use of onboard marine mammal observers (MMOs) to monitor marine activity. (EN-CI NIRB May 2010[2]).

MMOs will be required to have marine emergency duties training in addition to training that they will require for marine mammal observations and reporting. The MMO will receive orientation training upon arrival onboard the vessel. The MMO will participate in marine drills such as fire and abandon ship drills. The MMO will also participate in the safety and environmental management program. A variety of strategies will be employed to reduce the potential of a Project related vessel-mammal collision occurring. Mitigation measures apply to all Project-related vessel types operating within the confined waters of Chesterfield Inlet, or operating in marine mammal habitat in the RAA that is deemed to be sensitive for migration, calving, or feeding. MMOs from local communities will be

[2] EN-CI NIRB May 2010: *I would like to see wildlife observers onboard the vessels*

present onboard tugs and vessels to monitor marine activities when transiting through the LAA. Mitigation measures to reduce the likelihood of vessel-mammal collisions are summarized as follows.

- IQ indicates, “If ships travel during the winter months, wildlife will be affected. Summer barging would have less of an impact on marine life.” (IQ-CHJ [2011]). Marine shipping is planned to occur only during the open water season.
- The area surrounding Churchill is important beluga whale habitat, and there are known concentrations of animals in this area during the open-water shipping season (IQ-CI02 [2009][3]; IQ-RIHT [2009])[4]. To reduce chances of a vessel-mammal collision, vessels will travel at a maximum speed of 8 to 10 knots when transiting this area at all times during the open-water season, unless otherwise required for safe navigation.
- Along established shipping routes in western Hudson Bay and Hudson Strait, vessel speeds will not exceed 13 knots, unless otherwise required for safe navigation, and are likely to be much less than this speed while transiting Chesterfield Inlet.
- Vessels will avoid unnecessary acceleration and maintain a constant course, whenever possible.
- Upon the advice of the onboard local MMO, vessels will halt if marine mammals appear to be herded by an approaching vessel within Chesterfield Inlet, unless conditions present a risk to vessel and human safety.

MMOs on vessels transiting through the LAA will record all marine mammal sightings, near misses, and incidents of vessel-mammal collisions. In the absence of monitors while transiting the RAA, incidents will be recorded by the maritime crew. Ship logs will record course adjustments to avoid sensitive habitat (i.e. near Coats Island), vessel speed and speed reductions in important areas (i.e. Port of Churchill). Further information regarding the responsibilities of the MMO and marine wildlife mitigation strategies are provided in Volume 7 Marine Environment.

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[3] IQ-CI02 [2009]: *Beluga Whale calve in an area between Arviat and Churchill.*

[4] IQ-RIHT 2009) *Hunters believe the best place to hunt beluga whale is close to Churchill in early July, when they are starting to migrate.*

6 Other Environmental Considerations

6.1 Air Quality

All vessels will be installed with engines meeting IMO Annex VI - Tier 1 exhaust gas emission limits. Vessels built after 2011 will meet Tier II exhaust gas emission limits. Tier III exhaust gas emission limits will come into effect in 2016. Tier 1 Sulfur content in marine fuel is also regulated by IMO Annex VI.

Tier	Effective Date	NOx Limit g/kwhr		
		n ≤ 130 kw	n ≥130 ≤ 2000 kw	n ≥ 2000 kw
I	2000	17.0	45.n-0.2	9.8
II	2011	14.4	44.n-0.23	7.7
III	2016	3.4	9.n-0.2	1.96
Note. n= engine power in kw				

The sulfur content in marine fuel is the main controlling factor in SOx emissions. The maximum sulfur content for marine fuel is limited to 1% as of 2010 and 0.1% in 2015.

Domestic waste will be disposed of in onboard marine incinerators which will comply with IMO MEPC.76(40). Modern marine incinerators operate at very high combustion temperatures in the range of 850º - 1200ºC. Automatic combustion controls and rapid cooling of exhaust gasses maintain emissions within stringent limits of IMO MEPC.76(40). Carbon monoxide in flue gas is limited to 200 mg/MJ. The incineration of domestic waste will have the least negative impact.

Vessel Masters will be encouraged to reduce fuel consumption by shutting down machinery that is not immediately required. Idling of propulsion engines is to be avoided whenever possible. Full power maneuvering is to be avoided wherever possible to reduce fuel consumption and minimize underwater noise. New tugs will be designed to meet current and future exhaust emission standards.

6.2 Noise and Vibration

All vessels have been constructed to meet allowable noise levels for persons working onboard. Hearing protection is provided for personnel as required. Full power maneuvering is to be avoided wherever possible to reduce propeller noise due to cavitation. Propeller designs will consider underwater noise reductions as well as efficiencies. Further information on minimizing underwater noise as a result of vessel operation is provided in Technical Appendix 7B.

6.3 Terrestrial Environment

The ocean- going tanker vessels that will be used to transport fuel will be of a size commonly referred to as handy size from 15,000 DWT up to 30,000 DWT. These vessels will proceed at a slow speed as they enter the eastern entrance to Chesterfield Inlet and proceed to an anchorage near Ellis Island. The inlet is 5 km wide at the narrowest point in this area. There will be no destructive wake generated by these ships.

Smaller dry cargo ships will proceed down the Chesterfield Inlet as far as helicopter Island where they will anchor and lighter there cargo onto barges for the last leg of the voyage to Baker Lake. Tank barges will transit from Ellis Island to Baker Lake. The vessels will be travelling at relatively slow speeds and the wake affects will be minimal.

The tug and barge operation will for the most part operate between Helicopter Island and the dock site east of the Baker lake village. The vessels will be travelling at a relatively low speed. On clearing the north channel at the entrance to Baker Lake, the tug and barge nearest distance to the north shore will be approximately 4.5 km from Ingilik point and Helix point. The affect of vessel wake on the shore will be minimal.

6.4 Hull Fouling

As of January 1, 2008, organotin compounds acting as biocides (eg. Tributyltin) cannot be applied to the outer hull of a ship. Only TBT free antifouling coatings will be used on project vessels. All vessels will carry an International Anti-Fouling System Certificate (IFAS) to document the state of compliance. The underwater hulls and sea inlets of all vessels will be coated with approved TBT free anti-fouling coatings. Sea bays and sea inlet chests will be treated with an approved biocide and flushed before entering the RAA as per regulations.

6.5 Transboundary Effects

The marine component of the Project will involve several different types of open water marine transport during construction and operations including:

- Dry cargo transport from southern ports to Chesterfield Inlet or Churchill through Hudson Strait using 3 to 6 cargo ships (3 to 6 round trips or 6 to 12 transits per year);

- Diesel fuel transport from southern ports to Chesterfield Inlet or Churchill through Hudson Strait using ice-class tankers (double hulled) (2-3 round trips per year; 4 to 6 transits);
- Dry cargo transport from southern ports to Chesterfield Inlet or Churchill through Hudson Strait using 5 articulated tugs/barge combinations (1 tug with two barges) (10 round trips or 20 transits per year through Hudson Strait);
- Dry cargo transport through western Hudson Bay using 5 articulated tugs/barge combinations (15 round trips or 31 transits per year) (one tug will overwinter in Churchill); and
- Dry cargo and fuel transport from Chesterfield Inlet to Baker Lake using articulated tugs/barge combinations (15-16 round trips or 31 transits per year). Barges would be custom-built for the project and would be dual purpose and double-hulled.

All tankers, cargo ships, tugs and barges will be chartered from a third party by AREVA. While the specific company has not yet been determined, it would likely be one of the existing marine transportation firms that currently supply the communities and other industry in the region. Operations of these vessels will be similar to that already in practice in Nunavut waters by these shipping companies.

The exact number of return trips for vessels traveling along Chesterfield Inlet will depend on the final size of the barge chosen (i.e., 5,000t vs. 7,500t) and the specific needs during construction and operations. Similarly, the exact number of return trips through Hudson Strait or transits to Churchill will depend on the size of vessel (i.e., 18,300 DWT vs. 30,000 DWT tankers; 660 TEU vs. 1,000 TEU cargo ships) and the specific needs during construction and operations. Fewer vessel trips will be required if larger vessels are used.

Vessels will only operate during the open water season. No ice breaking activity is planned to allow the shipping season to begin earlier in the spring or to extend the shipping season in the fall. The conservative shipping operating season in Baker Lake is 1 August to 1 October. This will mean that the first vessel of the season in Hudson Strait may arrive by mid-July and the last vessel will transit through in mid-October. Vessels will follow the Arctic Waters Pollution Prevention Act for operating during this period in Hudson Strait, Hudson Bay and Chesterfield Inlet. Based on the conservative shipping operational season, the average number of transits are summarized in Table 6.5-1.

Table 6.5-1 Summary of Vessel Transits

Vessel Type	Geographic Area	Minimum Length of Operating Season (d)	Maximum Number of Transits per Year	Average Transit Frequency (Days per Transit)[1]
Cargo Ship	Hudson Strait and Hudson Bay	93	12	7.8
Tanker	Hudson Strait and Hudson Bay	93	6	15.5
Tug/Barges	Hudson Strait	93	20	4.7
Tug/Barges	Western Hudson Bay	93	31	3.0
Tug/Barges	Chesterfield Inlet	61	31	2.0

1. Conservative (i.e., minimum) length of the Operating Season (days) for the geographic area divided by the maximum number of transits

In Hudson Strait, transits will occur on average every 4.7 to 15.5 days, depending on the vessel. If all vessels (cargo ships, tankers and tug and barge combinations) through Hudson Strait traveled independently, a transit would occur on average every 2.4 days. In western Hudson Bay, the average transit interval for the articulated tug and barge configurations will be three days. However, during marine operations, vessels are more likely to travel in convoys, such that the interval between transits would be longer.

Within Hudson Strait and Hudson Bay, all vessels will follow the major shipping routes recommended by Transport Canada. In the open water area of Hudson Bay and Hudson Strait, all vessels will comply with federal legislation and regulations pertaining to aspects such as safe operations, ballast water management, bilge management, transportation of dangerous goods, and emergency response preparedness.

As noted in the assessment of project and cumulative environmental effects on the marine Environment (Volume 7 Marine Environment), the potential for effects such as behavioural changes associated with underwater noise, avoidance of vessels and vessel strikes is greatest in the confined channels along Chesterfield Inlet. As noted in Table 6.5-1, the average frequency of vessel transits is the highest for the several geographic areas considered in the FEIS (one transit every two days on average). Accordingly, the assessment of effects on marine biota was most detailed for this geographic area. AREVA also has committed to a suite of mitigation measures to minimize effects on marine fish, birds and mammals (e.g., marine environmental observers, safety zones for wildlife around a vessel; specialized vessel operating procedures when marine wildlife are encountered including reduced speeds or full stop of vessel).

Sea-going vessels will cross from the exclusive Economic Zone for Canada (and possibly international waters) into Nunavut during in-bound transits and out of Nunavut into Canadian and possibly international waters on outbound transits. Some cargo ships and articulated tug/barge combinations will cross between Nunavut and the Province of Manitoba (i.e., the Port of Churchill). Such transits are required to successfully construct and operate the Kiggavik Project.

Given that vessel operations within Hudson Bay and through Hudson Strait are transboundary, there will be transboundary effects primarily relating to:

- Air emissions from vessels
- Underwater noise from the vessels and vessel movements resulting in temporary avoidance and potential energetic stress in marine fish and marine mammals within the zone of esonification
- Surface noise from the vessels, vessel presence and vessel movements resulting in sensory disturbance and potential energetic stress in marine birds
- Potential for vessel –marine mammal collisions
- Potential for accidental spills of fuel due to a collision or malfunction

While vessel emissions will occur, these emissions will be transitory and will not result in significant adverse effects on air quality. In addition, as per federal requirements, vessels will be required to use lower sulphur content fuels when operating within Canadian Waters.

Specifically, vessels will be required to meet the MARPOL Annex VI amendment regarding use of low sulphur fuel, as well as ongoing actions respecting the North American Emission Control Areas. Given these requirements, by 2015, sulphur in fuel will be 0.1%, which is a reduction of 96% from current fuel sulphur content. This reduction will dramatically reduce sulphur dioxide emissions and have a beneficial effect by also reducing particulate matter emissions.

Effects of underwater noise, surface noise and other sensory stimuli on marine biota are predicted to be transitory and of short duration (i.e., during the passing of a vessel, an animal in a single location will only be subject to the stimuli for a period of tens of minutes depending on the vessel speed), and restricted to an area within the immediate vicinity of the vessel. As is discussed in more detail in the environmental assessment for the marine environment (Volume 1, Section 8.4.2; Volume 7 Marine Environment), project effects and cumulative effects on marine fish and marine mammals are predicted to be not significant.

Marine birds were not assessed in detail as effects on marine birds were predicted to be not significant (Volume 7 Marine Environment, Section 4.3.1). In addition, AREVA committed to mitigation measures for marine birds that are proven and effective (i.e., route selection, reduced vessel speeds in Chesterfield Inlet, shielding of lighting).

It is recognized that shipping traffic is increasing in the Eastern Arctic, particularly in areas such as Hudson Strait. Existing vessel traffic associated with the Port of Churchill, community resupply in Nunavut, Manitoba and Quebec and mining projects such as the Meadowbank Mine already use Hudson Strait as the main shipping route into and out of Hudson Bay. Proposed projects such as this Project, the Baffinland Mine and the Meliadine Mine will further increase vessel traffic in Hudson Strait. To address potential conflicts between shipping traffic and environmentally sensitive areas, particularly for marine birds and marine mammals, AREVA is prepared to work with federal agencies, Nunavut, shipping companies and other marine transportation users to identify preferred shipping routes and seasonal timing constraints to minimize shipping effects on these environmentally sensitive areas. Operational changes such as vessel speed reductions may also be useful in reducing the potential for vessel – marine mammal collisions, as well as underwater noise.

Transboundary effects could also occur in the event of a marine accident or malfunction, particularly if a collision or grounding led to a release of diesel fuel or bunker oil. The consequences of a fuel spill on the biophysical and human environment could range from inconsequential to severe depending on a number of factors, including:

- type of incident
- type and volume of materials released
- location of the incident and proximity to environmentally-sensitive areas, harvesting areas, coastal campsites or settlements
- time of year
- physical conditions at the time of the spill (e.g., wave regime, currents)
- type, timing and success of emergency response measures, including containment and removal
- type and effectiveness of clean-up and recovery activities

While the consequences of a spill could potentially be severe, the risk of these types of incidents is moderate to low. The potential risk associated with a range of marine accidents and malfunctions was summarized in Volume 1, Section 10, and was discussed in detail in both Tier 2 and Tier 3 reports (for additional information see Volume 10 - Accidents and Malfunctions and Technical Appendix 10A - Transportation Risk Assessment).

The marine risk assessment identified several moderate risk activities that are considered acceptable with stringent controls. Stringent protocols, emergency response capability, preventative measures such as double-hulled fuel barges and tankers, appropriate personal protective equipment, and pre-installed anchor systems will be employed to mitigate these risks for the Project.

In addition, all vessels would comply with federal legislation and regulations with respect to emergency response planning, preparedness and ship-board emergency response equipment. AREVA will also provide a revised Emergency Response Plan (Technical Appendix 10C) prior to the start of construction of the Project.

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Attachment A Marine Charts