Transport Canada Transports Canada

TP 12819

User Assistance Package

for the Implementation of

Canada's

Arctic Ice Regime Shipping System

(AIRSS)

May 1998

Cette publication est aussi disponible en français.

Canada

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This document supersedes all draft discussion versions that were made available before publication of this document.

First Edition: May, 1998

User Comments and Suggestions

One of the main purposes of this publication is to solicit feedback. The Ice Regime System was introduced outside the existing Zone / Date shipping control system to provide flexibility and safety in Arctic Navigation. Further implementation will be based on feedback and consultation with all interested parties. A transitional period has been allowed to ensure that users are familiar with the new system.

Comments, suggestions, and details of operating experience are all of great value and should be forwarded to:

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Foreword

The Ice Regime System is based on using the Master's expertise to match the structural capability of the vessel against the prevailing ice conditions.

This publication provides ship's officers with relevant information to facilitate an introduction of the Arctic Ice Regime Shipping System which applies when vessels intend to navigate outside Canada's current Zone / Date System. Vessels operating in Arctic waters are encouraged to use the system for the purpose of safe navigation.

Regional Director, Marine
Prairie & Northern Region
Transport Canada

Record of Amendments

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1.0 INTRODUCTION

1.1 Purpose

The *User Assistance Package* presents all the important components of the *Arctic Ice Regime Shipping System* for Canadian Arctic waters, and explains how the system can be used by mariners to increase safety and efficiency. It does this by:

a) providing a **video** that introduces the Ice Regime System, and some very basic ice recognition skills,

b) offering an Ice Regime **software** program that lets the operator calculate the ship's **Ice Numeral** for each ice regime, and automatically creates both the ***Ice Regime Routing Message*** and the ***After Action Report*** to make the system as easy as possible to use,

(The diskettes are at the back, and some notes are found on page 40)

c) linking the *Arctic Ice Regime Shipping System (AIRSS) Standards* and the applicable regulations for Navigation Officers and Ice Navigators in understandable terminology and,

d) identifying **reference material** that will enable Navigation Officers to access a variety of information products linked to the Ice Regime System concept.

Reading and following this publication is not a substitute for training as an Ice Navigator or Master. However, it is intended to provide useful reminders to experienced operators, and guidance to others on how to prepare for Arctic voyages where ice will be encountered.

1.2 Applied Principles

- The *Arctic Ice Regime Shipping System* is intended to provide greater flexibility for the operation of vessels in the Arctic, by permitting ships to navigate outside of the current Zone / Date System when ice conditions are suitable. It is based upon a simple calculation which indicates whether or not a given set of ice conditions can be expected to be safe for a particular vessel.

- A wide range of ice navigation parameters including: visibility, vessel speed, manoeuvrability, the availability of an icebreaker escort and the knowledge and experience of the crew must be considered in applying the Ice Regime System.

- The Master or Ice Navigator of an Arctic-going vessel will have primary responsibility for applying the Ice Regime System.
- Pollution Prevention Officers retain their power to direct any vessel clear of areas in which there is deemed to be a significant risk of structural damage leading to pollution. Ice regime information will be a useful tool in making their assessments.

1.3 Information Sources

The *Arctic Shipping Pollution Prevention Regulations* (ASPPR) have been revised to allow operators increased flexibility and the ability to improve their efficiency. An aspect of this process is an increased emphasis on the responsibility of the mariner to ensure the safety of the ship. To help mariners understand how to operate safely in the unique Arctic environment, Transport Canada is developing a training course and other aids which supplement existing material. This publication, the video and the software form the *User Assistance Package*, which is an important information source. Additional documentation has been listed in Section 8.2.

1.4 The *Arctic Shipping Pollution Prevention Regulations* (ASPPR)

Navigation in waters under Canadian jurisdiction north of 60° North Latitude is governed by the *Arctic Shipping Pollution Prevention Regulations* (ASPPR), made under *the Arctic Waters Pollution Prevention Act* (AWPPA). The regulations include requirements for hull construction, equipment, crew training and qualifications, and operating procedures. Complete copies of the Regulations, and of the Act, are available from Canadian Government Publishing for a nominal fee (see Section 8.2) or through Transport Canada's Home Page at: **www.tc.gc.ca**

The regulations were first promulgated in 1972, and experience over their first 20 years of use has led to substantial revisions in many areas. The process itself has been driven a desire to operate ships with greater flexibility than sometimes allowed by the rigid, Zone / Date System. Transport Canada has responded by making the regulatory changes apply at first to only outside of the Zone / Date System. This publication has been developed in part to describe and explain the system and to highlight some of the changes.

A major change is the move from controlling access to different geographic areas of the Arctic on the basis of calendar dates (the Zone / Date System), to controlling access on the basis of actual ice conditions, and how these compare to the structural strength of the ship (the Ice Regime System). This is explained in detail in Section 2; while the structural classifications used in the system are outlined on page 6.

1.5 The Master Maintains Responsibility

It is the responsibility of the Master to ensure the safety of the vessel. This includes avoiding areas with ice regimes beyond the ship's capabilities, and operating at speeds that could cause unsafe collisions with concentrations of dangerous ice. Utilizing the Ice Regime System provides a useful framework for operational decisions.

"There is nothing in the regulations which takes precedence over, or otherwise detracts from the Master's ultimate responsibility for the ship's safety."

V.M. Santos-Pedro, CMAC Meeting, April 96, Montréal

2.0 THE ZONE / DATE SYSTEM

2.1 Why Introduce an Ice Regime System?

Since the introduction of the *Arctic Shipping Pollution Prevention Regulations*, ships of different class or type have their access to the Arctic governed by the Zone / Date System. The Arctic is divided into 16 zones, where Zone 1 is generally considered to have the most demanding conditions, and Zone 16 the least.

Access to each zone was established, based on historical data related to the probable ice conditions at different times of the year. The least capable ships would never be permitted access to the most stringent zones, while the most capable would never be denied access. For other combinations of ship and zone, allowable operating windows were defined; hence the system is often referred to as the Zone / Date System. Both the access dates and the zones for 'Arctic Class' ships and 'Type' ship classes are clearly shown together on the following pages.

Although simple and predictable, this system has one major drawback - ice conditions vary significantly from year to year. So in a severe year, an inexperienced operator might attempt a voyage well beyond the capabilities of the ship. In a light ice year, the rigidity of the regulatory system may prevent ships from transiting areas which could be completely free of ice. The *Arctic Ice Regime Shipping System* (AIRSS) developed through the joint work of government and industry, is a more flexible and safe system.

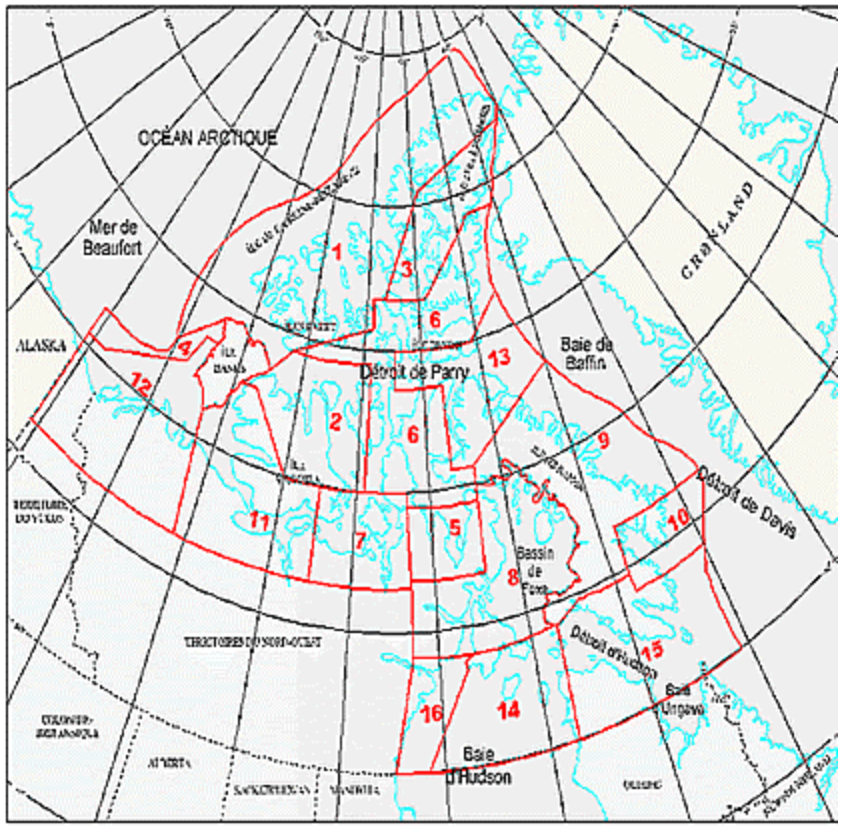
2.2 Using the Zone / Date Table - Arctic Class vs CAC Vessels

As mentioned earlier, the AIRSS has been introduced through a transitional period, during which it can be used to extend the operating areas/seasons when ice conditions permit *outside* of the Zone / Date System. Ships may however continue to use the *Dates of Entry* Table for basic passage planning to learn when the lighter ice conditions may occur. The Ice Regime System is to be used when making access decisions outside of the established dates.

Since the Zone / Date Table only uses the existing Arctic Class and Type designations, owners of CAC ships are prompted to use the Ice Regime System outside of the normal Zone / Date System. CAC ships could, if they choose, also use the Table 1 of the *Equivalent Standards For The Construction Of Arctic Class Ships,* TP 12260 to find their equivalent Arctic Class which would allow them to use the Zone / Date System. Arctic Class ships however, do not have a choice because the table is not reciprocal. Thus those shipowners are encouraged to apply for a CAC equivalency to allow them to utilize the Ice Regime System.

Following the transitional period, it is proposed that the AIRSS could completely replace the Zone / Date System, but this will only be done through the consultation process. User feedback during the transition period coupled with operational experience will allow fine-tuning of the system. All operators are strongly encouraged to provide comments and their suggestions for improvements, as outlined at the beginning of this publication.

ZONES DE CONTRÔLE DE LA SÉCURITÉ DE LA NAVIGATION



Item	Category Zone 11	Zone 1 Zone 12	Zone 2 Zone 13	Zone 3 Zone 14	Zone 4 Zone 15	Zone 5 Zone 16	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10	
1.	**Arctic** All **Class 10** Year	All All Year Year	All All Year Year	All All Year Year	All All Year Year	All Year Year	All Year	All Year	All Year	All Year	All Year	All
2.	**Arctic** All **Class 8** Year	July 1 All to Year Oct. 15	All All Year Year	All All Year Year	All All Year Year	All Year Year	All Year	All Year	All Year	All Year	All Year	All
3.	**Arctic** All **Class 7** Year	Aug. 1 All to Year Sept. 30	Aug. 1 All to Year Nov. 30	July 1 All to Year Dec. 31	July 1 All to Year Dec. 15	July 1 to Year Dec. 15	All Year	All Year	All Year	All Year	All Year	All
4.	**Arctic** July 1 **Class 6** Year Mar. 31	Aug. 15 All to Year Sept. 15	Aug. 1 All to Year Oct. 31	July 15 All to Year Nov. 30	July 15 All to Year Nov. 30	Aug. 1 All to Oct. 15	July 15 to Feb. 28	July 1 to Mar. 31	July 1 to Mar. 31	All Year	All Year	to
5.	**Arctic** July 5 **Class 4** to Jan. 15	Aug. 15 June 1 to to Sept. 15 Jan. 31	Aug. 15 June 1 to to Oct. 15 Feb. 15	July 15 June 15 to to Oct. 31 Feb. 15	July 15 June 15 to to Nov. 15 Mar. 15	Aug. 15 June 1 to Sept. 30 Feb. 15	July 20 to Dec. 31	July 15 to Jan. 15	July 15 to Jan. 15	July 10 to Mar. 31	July 10 to Feb. 28	to
6.	**Arctic** July 5 **Class 3** to Dec. 15	Aug. 20 June 10 to to Sept. 15 Dec. 31	Aug. 20 June 10 to to Sept. 30 Dec. 31	July 25 June 20 to to Oct. 15 Jan. 10	July 20 June 20 to to Nov. 5 Jan. 31	Aug. 20 June 5 to Sept. 25 Jan. 10	Aug. 1 to Nov. 30	July 20 to Dec. 15	July 20 to Dec. 31	July 20 to Jan. 20	July 15 to Jan. 25	to
7.	**Arctic** July 10 **Class 2** to Nov. 20	No June 15 Entry to Dec. 5	No June 25 Entry to Nov. 22	Aug. 15 June 25 to to Sept. 30 Dec. 10	Aug. 1 June 25 to to Oct. 31 Dec. 20	No June 10 Entry Dec. 10	Aug. 15 to Nov. 20	Aug. 1 to Nov. 20	Aug. 1 to Nov. 30	Aug. 1 to Dec. 20	July 25 to Dec. 20	to
8.	**Arctic** July 15 **Class 1A** to Nov. 10	No July 1 Entry to Nov. 10	No July 15 Entry to Oct. 31	Aug. 20 July 1 to to Sept. 15 Nov. 30	Aug. 20 July 1 to to Sept. 30 Dec. 10	No June 20 Entry Nov. 30	Aug. 25 to Oct. 31	Aug. 10 to Nov. 5	Aug. 10 to Nov. 20	Aug. 10 to Dec. 10	Aug. 1 to Dec. 10	to
9.	**Arctic** July 15 **Class 1** to Oct. 20	No July 1 Entry to Oct. 31	No July 15 Entry to Oct. 15	No July 1 Entry to Nov. 30	No July 1 Entry to Nov. 30	No June 20 Entry Nov. 15	Aug. 25 to Sept. 30	Aug. 10 to Oct. 15	Aug. 10 to Oct. 31	Aug. 10 to Oct. 31	Aug. 1 to Oct. 31	to
10.	July 10 **Type A** to Oct. 31	No June 15 Entry to Nov. 10	No June 25 Entry to Oct. 22	Aug. 20 June 25 to to Sept. 10 Nov. 30	Aug. 20 June 25 to to Sept. 20 Dec. 5	No June 20 Entry Nov. 20	Aug. 15 to Oct. 15	Aug. 1 to Oct. 25	Aug. 1 to Nov. 10	Aug. 1 to Nov. 20	July 25 to Nov. 20	to
11.	July 15 **Type B** to Oct. 20	No July 1 Entry to Oct. 25	No July 15 Entry to Oct. 15	Aug. 20 July 1 to to Sept. 5 Nov. 30	Aug. 20 July 1 to to Sept. 15 Nov. 30	No June 20 Entry Nov. 10	Aug. 25 to Sept. 30	Aug. 10 to Oct. 15	Aug. 10 to Oct. 31	Aug. 10 to Oct. 31	Aug. 1 to Oct. 31	to
12.	July 15 **Type C** to Oct. 15	No July 1 Entry to Oct. 25	No July 15 Entry to Oct. 10	No July 1 Entry to Nov. 25	No July 1 Entry to Nov. 25	No June 20 Entry Nov. 10	Aug. 25 to Sept. 25	Aug. 10 to Oct. 10	Aug. 10 to Oct. 25	Aug. 10 to Oct. 25	Aug. 1 to Oct. 25	to
13.	July 15 **Type D** to Oct. 10	No July 1 Entry to Oct. 20	No July 30 Entry to Sept. 30	No July 10 Entry to Nov. 10	No July 5 Entry to Nov. 10	No July 1 Entry Oct. 31	No Entry	Aug. 10 to Oct. 5	Aug. 15 to Oct. 20	Aug. 15 to Oct. 20	Aug. 5 to Oct. 20	to
14.	July 15 **Type E** to Sept. 30	No July 1 Entry to Oct. 20	No Aug. 15 Entry to Sept. 20	No July 20 Entry to Oct. 31	No July 20 Entry to Nov. 5	No July 1 Entry Oct. 31	No Entry	Aug. 10 to Sept. 30	Aug. 20 to Oct. 20	Aug. 20 to Oct. 15	Aug. 10 to Oct. 20	to

Note: There are additional date restrictions contained in Section 6. of the *Arctic Shipping Pollution Prevention Regulations* for certain ships.

June, 1996

2.3 Structural Requirements

A new system now exists for determining how the most highly ice-strengthened vessels are classed by Transport Canada, Marine Safety. Four Canadian Arctic Categories (CAC) have now replaced the previous Arctic 1 - Arctic 10 Classes. Details of the new structural classifications are provided in the Transport Canada publication *Equivalent Standards For The Construction Of Arctic Class Ships* - TP 12260 (see Section 8.2); to summarize:

- CAC 1 is seen as an icebreaker which can operate anywhere in the Arctic and can proceed through Multi-Year ice continuously or by ramming according to the owner's performance requirements. A CAC 1 ship is capable of navigation in any ice regime found in the Canadian Arctic and unrestricted ramming of the heaviest ice features (except icebergs or similar ice formations) for the purpose of ice management.

- Class CAC 2 is seen as a commercial cargo carrying ship which can trade anywhere in the Arctic, but would take the easiest route. It could proceed through Multi-Year ice continuously or by ramming according to the owner's performance requirements. A CAC 2 ship is capable of navigation in any ice regime found in the Canadian Arctic and ramming of heavy ice feature restricted by its structural capability.

- Class CAC 3 is seen as commercial cargo carrying ship which can trade in the Arctic where ice regimes permit. It would proceed through Multi-Year ice only when it is unavoidable and would do so in a controlled manner usually by ramming. It would be unrestricted in Second and heavy First-Year ice.

- Class CAC 4 is seen as commercial cargo carrying ship which can trade in the Arctic where ice regimes permit. It would be capable of navigating in any thickness of First-Year ice found in the Canadian Arctic, including First-Year ridges. It would avoid Multi-Year ice and when this is not possible it would push or ram at very low speeds.

Vessels CAC 1, 2, 3, and 4 may also be considered suitable escorts, capable of escorting ships of lower classes.

Canada has developed structural standards for each of these classes. Ships built to polar standards of other Classification Societies and national authorities can apply for CAC equivalency on a case-by-case basis, as can owners of vessels previously classified under the existing Canadian system for Arctic Class vessels.

The approach that Canada took was to base: Type A, B, C, D, and E vessels on the Finnish-Swedish (Baltic) rules where 'Type A ships can operate in Thick First-Year ice and Type E ships are considered Open Water vessels with no ice strengthening. The Type designation will apply to most of ships working in the Arctic which are less structurally capable than CAC vessels, but have some level of ice strengthening over and above open water requirements.

The 'Type' ships have the capacity to work in First-Year ice of approximately the thicknesses and types shown below:

ASPPR Type Ships and their Approximate WMO Ice Conditions

ASPPR Type and their Ice Thickness Design		Corresponding Ice Construction
Type A	1.0 - 1.2 metres	Thick first-year ice.....(> 1.2 m)
Type B	0.7 - 0.8 metres	Second stage thin first-year...(0.5 - 0.7 m)
Type C	0.5 - 0.6 metres	First stage thin first-year .....(0.3 - 0.5 m)
Type D	0.3 - 0.4 metres	Grey-white Ice .....(0.15 - 0.3 m)
Type E	< 0.15 metres	Grey Ice.....(0.1 - 0.15 m)

2.4 Vessel Certification - Arctic Pollution Prevention Certificates

Ships that sail into Canada's Shipping Safety Control Zones with a valid *Arctic Pollution Prevention Certificate* comply with the Arctic Shipping Pollution Prevention Regulations. Vessels without the certificate, which is not mandatory, may be inspected for compliance. Thus all vessels are encouraged to have a valid Arctic Certificate issued prior to undertaking any voyage into the Shipping Safety Control Zones. The certificate may also be issued outside Canada by an approved Classification Society or within Canada waters by the Administration.

The Arctic Pollution Prevention Certificate indicates what the ice class of the vessel is at specific drafts. The ship's ice class (Type, Arctic Class or CAC) designation could now either be applied to the Zone / Date Table (previous pages) or directly in the case of a CAC ship to the Arctic Ice Regime Shipping System using the Table of Ice Multipliers (page11). Mariners intending to navigate in ice-covered waters should ensure they know the ice class or type of their ship, and have a good understanding of the combinations of ice conditions and operating procedures which are likely to be safe for the voyage.

Note: The specific details related to the Arctic Pollution Prevention Certificate can be found in Sections 12. to 18. of the *Arctic Shipping Pollution Prevention Regulations.*

2.5 Coast Guard Icebreakers and the AIRSS

Canadian Coast Guard (CCG) icebreakers like many other vessels have been built to a variety of structural standards. Government icebreakers are not classed under the Zone / Date System for operational purposes. In order to provide feedback, CCG ice-capable vessels are encouraged to perform Ice Numeral calculations and for this purpose structural equivalency may be determined. Arctic Pollution Prevention Certificates will not be issued to CCG ice-capable vessels as per current policy.

Icebreakers that are involved with an escort are however encouraged to utilize the AIRSS from the perspective of the commercial ship following them while looking at the icebreaker's track (Section 7.2.1) or for voyage planning.

3.0 THE *ARCTIC ICE REGIME SHIPPING SYSTEM* (AIRSS)

3.1 The Ice Regime System

The *Arctic Ice Regime Shipping System* involves comparing the actual ice conditions along a route to the structural capability of the ship. The basic definition of an ice regime is as follows:

> "An **ice regime** is composed of any mix or combination of ice types, including open water. An ice regime occurs as a region in navigable waters covered with generally consistent ice conditions; i.e. the distribution of ice types and concentrations does not change very much from point to point in this region." Page 23, TP 9981

Under this system, the decision to enter a given ice regime is based on the quantity of dangerous ice present, and the ability of the vessel to avoid the dangerous ice along the route to (and from) its destination.

Every ice type (including Open Water) has a numerical value which is dependent on the ice category (Class or Type) of the vessel. This number is the **Ice Multiplier (IM)**. The value of the Ice Multiplier reflects the level of danger that the ice type poses to the particular category of vessel.

3.2 Ice Numeral Calculations

For *any* ice regime, an **Ice Numeral (IN)** is the sum of the products of:

(a) the concentration in tenths of *each* Ice Type, and
(b) the Ice Multipliers relating to the Type or Class of the ship in question.

Equation: $IN = (C_a \times IM_a) + (C_b \times IM_b) + \ldots$

where: IN - Ice Numeral
C_a - concentration in tenths of ice type "a"
IM_a - Ice Multiplier for ice type "a" (refer to the *Ice Multiplier Table* on either page 11 or page 5 in the AIRSS Standards)

The term(s) on the right hand side of the equation (a, b, c, etc.) are repeated for as many Ice Types and each of their respective concentrations that may be present, including Open Water. Ice Numerals can be calculated from ice conditions as shown in the Canadian Ice Service's, *MANICE* / WMO ice "eggs" or data obtained from other sources.

The Ice Numeral is therefore unique to the particular ice regime and ship operating within its boundaries. To use the system, the master or ice navigator needs to identify the ice types and concentrations along the route - information sources are also outlined in Section 4.0.

Note: While doing any Ice Numeral calculation remember that every regime is composed of an aggregate $10/10^{th}$'s concentration of various ice types. As an example, if an ice "egg" shows a total concentration of $6/10^{th}$'s, remember that the other $4/10^{th}$'s is Open Water and should be accounted for in the IN calculation. (Examples are on page 15)

3.3. Linking the Canadian Ice Service Charts to the 'Ice Multipliers'

The principal concept upon which the Ice Regime System has been developed is that:

> "Every ice type (including open water) has a numerical value which is dependent on the ice category of the vessel. This number is called an **Ice Multiplier** (IM). The value of the Ice Multiplier reflects the level of risk or operational constraint that the particular ice type poses to each category of vessel." (TP 12259, Page 7)

The Canadian Ice Service's products, in particular their *Tactical*, *Daily* and *Weekly Ice Analysis Charts* can be used for geographically defining "Ice Regimes" together with actual visual observations. Their ice Codings, or descriptions comply with the World Meteorological Organization (WMO) nomenclature. While using the *Arctic Ice Regime Shipping System,* a mariner can use an ice analysis chart to calculate an **Ice Numeral** based upon the ice types, as shown by the codes within the ice ovals or ice "eggs".

The complete WMO coding, from *MANICE* (Pages 3-6) has been included below, explaining how the codes from within the ice eggs relate to the Ice Regime System. The following table combines the *MANICE* material with the Ice Multiplier Table from the AIRSS Standards to clarify how ice chart information can be used to define an ice regime.

Coding for Sea Ice Stages of Development

Description	Thickness	Code	Ice Regime System Comments
Bergy Water, Brash & New Ice	<10 cm	1	Consider it 'Open Water'
Nilas, Ice Rind	<10 cm	2	Consider it 'Open Water'
Young Ice	10 - 30 cm	3	May appear on Tactical Ice Charts, but never on Daily or Weekly Charts
Grey Ice	10 - 15 cm	4	
Grey-White Ice	15 - 30 cm	5	
First-Year Ice	≥30 cm	6	May appear on Tactical Ice Charts, but never on Daily or Weekly Charts. (If seen, must assume it's 4• ice.)
Thin First-Year Ice	30 - 70 cm	7	The Code "7" must be considered to be Thin First-Year Second Stage. (This will only affect Type C ships.)
First Stage Thin First-Year	30 - 50 cm	8	Only used in the Baltic Sea.
Second Stage Thin First-Year	50 - 70 cm	9	Only used in the Baltic Sea.
Medium First-Year Ice	70 - 120 cm	1•	
Thick First-Year Ice	>120 cm	4•	
Old Ice		7•	A "7•" must be considered to be Multi-Year Ice until September 30th.
Second-Year Ice		8•	Will only appear on ice charts 01 October to the 31st of December
Multi-Year Ice		9•	Will only appear on ice charts 01 October to the 31st of December
Ice of land origin		Δ•	N/A to Ice Numerals
Undetermined or unknown		X	N/A to Ice Numerals

Ice Multiplier Table

Ice Multiplier Table

CIS / WMO Ice Codes	Ice Types	Thickness	Ice Multipliers for each Ship Category						
			Type E	Type D	Type C	Type B	Type A	CAC 4	CAC 3
7• or 9•	Old / Multi-Year Ice		-4	-4	-4	-4	-4	-3	-1
8•	Second-Year Ice		-4	-4	-4	-4	-3	-2	1
6 or 4•	Thick First-Year Ice	> 120 cm	-3	-3	-3	-2	-1	1	2
1•	Medium First-Year Ice	70-120 cm	-2	-2	-2	-1	1	2	2
7	Thin First-Year Ice	30-70 cm	-1	-1	-1	1	2	2	2
9	Thin First-Year Ice - 2nd Stage	50-70 cm							
8	Thin First-Year Ice - 1st Stage	30-50 cm	-1	-1	1	1	2	2	2
3 or 5	Grey-White Ice	15-30 cm	-1	1	1	1	2	2	2
4	Grey Ice	10-15 cm	1	2	2	2	2	2	2
2	Nilas, Ice Rind	< 10 cm	2	2	2	2	2	2	2
1	New Ice	< 10 cm	"	"	"	"	"	"	"
	Brash (ice fragments < 2 m across)		"	"	"	"	"	"	"
=Δ	Bergy Water		"	"	"	"	"	"	"
||||	Open Water		"	"	"	"	"	"	"

Decayed Ice: For the following ice types: MY, SY, TFY, and MFY that are Decayed, add **+1** to the Ice Multiplier.

Ridged Ice: For ice floes that are over 3/10ths 'Ridged' and in an overall ice concentration that is greater than 6/10ths, **subtract 1** from the Ice Multiplier.

Ice Codes: **7•**, **6** & **3** are additional Ice Codes, of a more general nature. Code **7•** represents Old Ice, which is used until Sept. 30th. Code **6** is First Year Ice, and **3** represents Young Ice, both of which may only appear on Tactical Ice Charts and rarely on the *Daily Ice Analysis* or *Weekly Regional Ice Charts*. These three Ice Codes are used when the resolution of digital images or data sets does not distinguish the exact ice thickness. For example; an Ice Type **6** would mean that there could be Ice Types: **4•**, **1•**, **9**, **8** or **7** present in that location in any combination / mixture.

8 and **9** are not used in Canada, (originated in the Baltic Sea) except if ice thickness measurements have been taken. These two rows have been primarily kept on the Table to facilitate an international Ice Regime System in future years.

7 is a popular code that has a thickness of up to 70 cm and must be considered equivalent to Thin First-Year Ice, 2nd Stage as a safety measure.

8• and **9•** shall normally appear on ice charts only from 01 October to 31 December.

CAC **1** / CAC **2**: The two highest ship categories, CAC **1** & CAC **2**, are designed for unrestricted navigation in the Canadian Arctic.

*Another version of this table can be found in TP 12259.

3.4 Ice Features and Other Factors that Affect Ice Multipliers

3.4.1 Decayed Ice

Currently there is no WMO or *MANICE* definition of Decayed Ice, however for the purpose of the Ice Regime System, the definition that is in place states:

> *"Decayed ice: means*
> *(a) Multi-Year ice,*
> *(b) Second-Year ice,*
> *(c) Thick First-Year ice, or*
> *(d) Medium First-Year ice*
> *which has thaw holes formed or is Rotten ice.*[1]*"*

In the past Decayed Ice, because of its difficulty in satellite detection, didn't appear on any ice chart, other than *Tactical Ice Charts* that were based upon visual observations. Currently there is research being conducted in this area and during the summer of 1999 Decayed Ice *will* appear on *Daily Ice Analysis Charts* and a formal definition is being developed internationally for insertion into the WMO nomenclature.

For Decayed Ice +1 *may* be added to that ice type's Ice Multiplier. As an example, if a Type B ship encounters decayed Thick First-Year ice, the Ice Multiplier changes from -2 to -1.

3.4.2 Ridged Ice

Where the total ice concentration in a particular regime is 6/10th's or greater, and at least 3/10th's of the area of an ice type (other than Brash Ice[2]) is deformed by Ridges, Rubble or Hummocking, the Ice Multiplier for that ice type, shall be decreased by 1. The basis for this numeric adjustment is that ridged ice is thicker. If, as an example a Type E ship finds a regime with Ridged Thin First-Year ice, the Ice Multiplier changes from -1 to -2.

3.4.3 Brash Ice

As a result of research obtained during validation studies, loose Brash Ice (not Jammed Brash Barrier or Agglomerated Brash) has been given the same weighting as Open Water i.e. a +2 Ice Multiplier. Within the concept of the Ice Regime System, this form of ice is intended to account for the ice predominately found in well defined icebreaker tracks and because the Ice Regime System is based on *safety* and not *performance*, it is possible to have a positive Ice Numeral, while surrounded by Brash and not be able to move.

3.4.4 Trace of Old Ice

On occasion, traces of ice may be reported in ice forecasts or indicated on the left side (outside) of an ice egg. A trace means less than 1/10th ice concentration (*MANICE*, Page 3-5) and is *not* required to form part of the Ice Numeral calculation process. If a trace of Old Ice is encountered within a regime, extra caution should be exercised when navigating due to the risk that this form of ice creates. As an illustration of a trace of Multi-Year ice, an Ice Numeral is calculated in Example 3 on page 16.

1. Page 2 of *Arctic Ice Regime Shipping System (AIRSS) Standards*, June 1996, TP12259
2. *Experience With The Proposed Ice Regime Shipping Control System*, Oct. 90, TP 10612

3.4.5 Strips & Patches

A common notation found on Canadian Ice Service ice charts is the symbol placed either in the top or bottom of an ice egg or if the floe sizes are significant, connecting two eggs indicating Strips & Patches. When using the Ice Regime System, the ice within the Strips or Patches actually forms smaller *regimes* and they should be treated as such. From a tactical Ice Navigator's perspective, this type of regime would have to be visually assessed to see if it is possible to transit the area without encountering a negative Ice Numeral. If the orientation of the ice within the regime generally parallels the ship's base course there should be little difficulty. However, if these features lie across the intended track, depending upon their extent, a transit of this ice regime may not be possible. Particular care may be required in planning a route through this regime. Below is a realistic example:

3/10ths total ice concentration in strips and patches of 9+/10ths concentration. In the strips or patches there will be 6/10ths Old ice in vast floes and 4/10ths thick First-year ice in big floes. These sizes are significant and warrant the uses of two ovals.

A Strips and Patches Example

For more information on Strips and Patches, pages 3-8 and 3-19 of *MANICE* should be consulted.

3.4.6 Floe Size

The Ice Numeral calculation does not account for floe size[1]. Depending upon a ship's size and manoeuvrability, an experienced mariner may know that it is easier to pick a route and safe speed in an ice regime composed of Small Ice Floes (20-100 m) and Very Open / Open Pack ice (1/10th to 6/10th's) concentrations, compared to a regime with larger floes that may offer a similar Ice Numeral. At this time there is no direct way of quantifying this relationship numerically[2] within the Ice Regime System.

3.4.7 CAC 1 and CAC 2 Ships

The two highest ship categories, CAC 1 and CAC 2, are designed to withstand impacts with all Ice Types, and therefore have been excluded from the Ice Multiplier (IM) Table.

(TP 12259, Page 4 and TP 9981, Page 25)

1. *Proposed CASPPR 1990 Ice Regime Shipping Control System Seminar / Workshop*, June 90
2. *Implementation Meeting On The Ice Regime System - Summary Minutes*, September 94

3.4.8 Safe Speed

The ship's speed is a critical aspect of safe ice navigation. At this time speed has not been numerically incorporated as part of the aggregate Ice Numeral calculations within the *Arctic Ice Regime Shipping System*, but it must be an important consideration for a mariner operating with due caution in ice-infested waters.

A vessel navigating in a regime composed of either Bergy Water or a trace of Old Ice could have an Ice Numeral that is +18 to +20. This high, positive number could create a false sense of security and in turn, create a high risk transit.[1] In many ice regimes to which entry is permitted, mariners must be aware that the vessel's operating speed should cautiously be selected to avoid damaging impacts with dangerous ice, preferably by avoiding it altogether. A ship operated conservatively at low speed will run little risk, while another operated at a higher speed through inexperience could be at significant risk.

Safe speed is a function of the crew's ability to incorporate: the ship's capability, weather, visibility, radar information, ice pressure and the availability and or lack of other navigational or ice information.

This Type D Bulk Carrier was Damaged in Hudson Strait

3.4.9 Ship Under Escort

When under the escort of another vessel, the Master of the escorted ship when calculating the Ice Numeral can take into consideration the track ahead, together with the prevailing conditions in assessing the ice regime for the ship. Section 7.2 contains more information about following in the track of an icebreaker.

1. *Implementation Meeting On The Ice Regime System - Summary Minutes*, September 94

3.4.10 Ice Chart Symbols - Chart Scale

While reading a *Daily Ice Analysis Chart* or a *Weekly Regional Ice Chart* produced by the Canadian Ice Service, a mariner will never encounter the following notations: Snow cover, Ridging, Compacting, Pressure, Cracks, Leads, Shear lines, Puddling, or possibly Stages of melting (See 3.4.1). The reason for this lack of information on ice charts is linked to the physical size of the ice charts and the ability to place data on a chart and still make it legible after being transmitted by radio facsimile. The air reconnaissance aircraft, Can Ice 3 is permitted more latitude, due to its tactical nature. The 1:1,000,000 chart scale used to report the ice and visual observations allow the crew to use the full range of the *MANICE* symbols.

Mariners should know that the Canadian Ice Service of Environment Canada now has the ability to tailor Ice Analysis Charts to an individual ship's operational area or geographic region in varying degrees of detail. An array of possibilities exist now that Radarsat is in full operation. For more information refer to Section 4.5.

3.5 Examples: Ice Regimes and their Ice Numeral Calculations

In this User Assistance Package two slightly Ice Multiplier Tables are provided to permit the calculation of Ice Numerals. The version on page 11 provides explanatory notes that link the Ice Codes to the Ice Types. The second table is the plasticized version that is larger in scale and designed to be left on the chart table. Either of these tables allows the user to look at an ice egg and quickly calculate Ice Numerals.

The following examples are of *realistic* Ice Numeral calculations based on ice "eggs" from *Daily Ice Analysis Charts* or in the case of Example 4, a *Tactical Ice Reconnaissance Chart*. For each case, two different ships were used to illustrate how the Ice Numerals fluctuate for the same ice with structurally different vessels.

Example 1

Ice Egg

8

1 7

7 4•

4 3

Interpretation:

This mid-summer's Ice Regime consists of 8/10th's total ice concentration of which: 1/10th is Old ice and 7/10th's Thick First-Year ice. While doing the calculation remember to incorporate the 2/10th's of Open Water.

Ice Numeral calculations:

Type **A** ship: (1 x **-4**) + (7 x **-1**) + (2 x **2** for open water) = **-7** [A *Negative* Regime]

CAC **4** ship: (1 x **-4**) + (7 x **+1**) + (2 x **2** for open water) = **+7** [A *Positive* Regime]

or If this regime happened to be **Ridged**:

With **Ridged** thick first-year ice the Ice Numeral calculations are:

3

Type **A** ship: (1 x **-4**) + (7 x **-2**) + (2 x **2** for open water) = **-14** [A *Negative* Regime]

CAC **4** ship: (1 x **-4**) + (7 x **0**) + (2 x **2** for open water) = **0** [A *Positive* Regime]

Example 2

Ice Egg **Interpretation:**

6 This July 9th Ice Regime consists of 6/10th's total concentration of ice of which:

1 4 1 1/10th is Old ice, 4/10th's is Thick First-Year and 1/10th of Medium First-Year ice.

7 4 1•

6 3 3 Ice Numeral Calculations:

Type **E** ship: (1 x **-4**) + (4 x **-3**) + (1 x **-2**) + (4 x **+2** for open water) = **-10** [A '*Negative*' Regime]

Type **A** ship: (1 x **-4**) + (4 x **-1**) + (1 x **+1**) + (4 x **+2** for open water) = **+1** [A '*Positive*' Regime]

or If this regime happened to be **Decayed** based upon data on an ice chart:

5 With **Decayed** ice (all Ice Types) the Ice Numeral calculations are:

Type **E** ship: (1 x **-3**) + (4 x **-2**) + (1 x **-1**) + (4 x **+2** for open water) = **-4** [A *Negative* Regime]

Type **A** ship: (1 x **-3**) + (4 x **0**) + (1 x **+2**) + (4 x **+2** for open water) = **+7** [A *Positive* Regime]

Example 3

Ice Egg **Interpretation:**

9+ This Nov. 11th Ice Regime consists of 9/10th's plus total concentration[1] of ice in which:

7 3 there is a trace of Multi-Year ice, 7/10th's Thin First-Year and 3/10th's of Grey-White ice.

9• 7 5 (Note: A trace of Multi-Year or Old ice creates a high risk transit.)

6 5 Ice Numeral Calculations:

CAC **4** ship: (7 x **2**) + (3 x **2**) = **+20** [A *Positive* Regime] (Traces of ice are not factored in

Type **C** ship: (7 x **-1**) + (3 x **1**) = **-4** [A *Negative* Regime] the calculation, i.e. under 1/10th)

Example 4

Ice Egg **Interpretation:**

9+ This data that has been interpreted from remote sensing imagery (Radar / NOAA etc.)

3 4 3 indicates that this regime of 9/10th's plus[1] ice, consists of: 3/10th's Old ice, 4/10th's

7• 6 3 of First-Year (considered thick) and 3/10th's of Young ice (considered Grey-White).

5 4 X

Ice Numeral calculations:

Type **B** ship: (3 x **-4**) + (4 x **-2**) + (3 x **+1**) = **-17** [A *Negative* Regime]

CAC **3** ship: (3 x **-1**) + (4 x **+2**) + (3 x **+2**) = **+11** [A *Positive* Regime]

1. "Total ice concentrations of 9/10th's plus (9+) are considered 10/10th's for the purposes of Ice Numeral calculations". (*ASPPR Ice Regime Project - Case Studies of the IN Concept*, TP 8890 page 5)

4.0 REPORTING

4.1 Documentation and Vessel Reporting Procedures

The purpose of this section is to briefly describe and clarify the vessel reporting procedures required for a ship approaching, within, or departing the Arctic Canada Traffic Zone (NORDREG). In its most basic form there are three different categories of reporting procedures:

A) General, NORDREG Reporting:

Entering the Zone / 1600 UTC Report / Exiting the Zone / etc.

The publication, *Notices To Mariners 1 to 46, Annual Edition* (Ref. 4) contains a section (Notices to Mariners # C26) that describes in detail, the type and exact content of all NORDREG messages.

B) Coast Guard Icebreaker Escort:

Prior to an icebreaker escort, the vessel requesting assistance may be required to send a brief message to the icebreaker containing general information needed to asses the following (escorted) ship's capabilities. The content of this message may be found in Section 2.7.2 of the publication, *Ice Navigation In Canadian Waters*. (Section 8.3, 3.)

It is not within the scope of this document to describe NORDREG or icebreaker messages because their content is covered in Section 8.2, References 3 and 4.

C) Arctic Ice Regime Shipping System Messages:

Whenever the Ice Regime System is used for voyages outside of the existing Zone/Date System, there will be a requirement for ships to submit the following two messages:

a) **Ice Regime Routing Message**

b) **After Action Report**

(This reporting system will be used during the transitional implementation phase and reviewed or modified as considered necessary before full implementation of the Ice Regime System. It should also be noted that reporting is part of the feedback program.)

Sections 6(3) and 6(3.1) of the *Arctic Shipping Pollution Prevention Regulations* and the *Arctic Ice Regime Shipping System Standards* both describe in detail the regulatory requirements of both the *Ice Regime Routing Message* and *the After Action Report*. A primary role of the *User Assistance Package* is to describe all the aspects of *what is required* to comply with *both* the Regulations and the Standards.

- All of these reports constitute part of radio traffic that can be sent free of charge, through any Marine Communications and Traffic Services (MCTS) Centre.

(*Radio Aids To Marine Navigation*)

4.2 Ice Regime Routing Message

For a ship wishing to operate outside the calendar dates of the Zone/Date System, an *Ice Regime Routing Message* must be sent to the Regional Ice Operations Superintendent at NORDREG containing the following information:

To: Regional Ice Operations Superintendent
NORDREG Canada ..... Facsimile: (867) 979 - 4236

ICE REGIME ROUTING MESSAGE

a) the ship's name,
b) the ship's call sign and IMO number
c) the ice strengthening of the ship (Type / CAC / Arctic Class / etc.),
d) the date and UTC time,
e) the ship's current position, course and speed*****,
f) the anticipated destination,
g) the intended route,
h) a listing of the ice regimes and their associated Ice Numerals,
i) the source(s) of ice information,
j) any other pertinent information / comments
k) the name of any escorting vessel, and
l) the name(s) of the Ice Navigator(s) on board

Master

***** Course & Speed are not required by the *ASPPR* but they are by the *AIRSS Standards*. Providing this information will offer an indication of the vessel's current status in the ice prior to applying the Ice Regime System and can be analysed later for future requirements.

This message is intended to be brief and may only be sent once per voyage. However if the vessel's route includes regimes with apparent negative Ice Numerals, it is required that additional information be included explaining the voyage plan (eg. expected changes in ice conditions and / or other considerations). For those that wish to use the Arctic Ice Regime Shipping System software, the Ice Regime Routing Message can easily be created. (Refer to Section 8.4.)

Later, during the voyage, if there are any changes or amendments to the ship's original Ice Regime Routing Message, those changes should be attached to NORDREG's regular *1600 UTC Report*.

4.3 After Action Report

An *After Action Report* must be submitted to Transport Canada (either in writing, by facsimile, or digitally using the Ice Regime Software) within 30 days of departing NORDREG waters for all voyages where the *Arctic Ice Regime Shipping System* was utilized *outside* the Zone / Date System.

The report can be quite brief and for those who have used the Ice Regime Software during the voyage, this report can be generated automatically. In cases where the voyage has involved difficulties or unexpected occurrences, it will be valuable to include any information which the Master considers significant. This information could be useful for the future development of the system and for the overall safety of navigation in the Arctic.

To: Regional Director, Marine
Prairie & Northern Region
Transport Canada (AMNS)
Place de Ville, Tower C
330 Sparks Street, 14th Floor
Ottawa, Ontario, K1A 0N5

Telephone: (613) 991 - 6004
Facsimile: (613) 991 - 4818
E-mail Wolfer@tc.gc.ca

AFTER ACTION REPORT

a) the ship's name,

b) the ice strengthening of the ship (Type / CAC / Arctic Class / etc.),

c) a description of the actual route, including the: ice regimes encountered, transit speeds and the Ice Numerals for each,

d) copies of the ice information used,

e) escort information, if applicable
   1) duration of the escort,
   2) the ice regime under escort, and,
   3) the characteristics of the track,

f) weather conditions and visibility, and

g) any other important information.

Master

4.3.1 Ice Charts or Imagery

To fulfill the requirements of d) above "copies of the ice information used", it is suggested that copies of ice analysis charts or imagery that were used on the voyage be attached to the *After Action Report* and to make reporting easier for Ship's Officers, the vessel's courses could be drawn over the ice charts along with brief notations that describe the regimes or conditions of concern. This could, in essence save a lot of time and text writing.

Duplicates of ice reconnaissance or satellite imagery is not required for submission due to its high cost, however photocopies of the data, if relevant to the report should be included.

4.4 General Reporting Guidelines:

1) Under Section 6(3) of the ASPPR,

   "...no ship that carries oil in a quantity in excess of 453 m3 may navigate... outside the... [the Zone / Date System]... unless... the master of the ship receives an acknowledgment of the [Ice Regime Routing] message sent... from the Canadian Coast Guard [NORDREG] before entering..."

   In other words... if a ship is to apply the Ice Regime System outside of the existing Zone / Date System, there will be a requirement to not only submit an *Ice Regime Routing Message*, but also the vessel must wait for NORDREG to acknowledge the routing message. NORDREG does not grant permission, rather they check that the request appears reasonable, and if not, request additional information or clarification.

2) Item 'g)' in the *Ice Regime Routing Message*, the intended route may be described either as a series of Way Points or in a descriptive text format - whichever is easier. As an example the text could be: ranges & bearings, latitudes & longitudes, A/C to 322°T, steam for 23', 8' North of Bylot Is., intend to stay to the East of a -6 regime, etc. While submitting the *Ice Regime Routing Message,* several items could in fact be covered with a facsimiled copy of an ice chart with courses plotted and the Ice Numerals written in the appropriate regimes.

3) To assist mariners with the *Ice Regime Routing Message* a fill-in-the-boxes template has been provided on page 27 in the AIRSS Standards (last page). It is designed to be photocopied, filled in and then facsimiled.

4) If there is any information that may have an impact on the Standards it should be submitted in the *After Action Report*, to authenticate any proposed future changes.

5) Part of the *User Assistance Package* is a software package developed called the Arctic Ice Regime Shipping System Software that may be of assistance in applying the Ice Regime System. The software itself, has been designed to encourage logging all the ice regimes encountered, icebreaker escort periods and even offers both a pre-designed *Ice Regime Routing Message* and an *After Action Report*. If the software is used correctly, the reports (printed or on diskette) will meet all of Transport Canada's regulatory reporting requirements.

6) The *Ice Observation Log* on the following page may also assist with recording ice information and could form part of the submission for the *After Action Report*.

7) After the transitional period (several seasons) is terminated, and if the Ice Regime System is fully implemented, the *After Action Reports* would be required "only by exception[1]", which means if the voyage was uneventful and only positive Ice Numerals were encountered this report may not be required.

1 V.M. Santos-Pedro, CMAC Meeting, Montréal ,April 96.

4.5 Pollution Prevention Officers

Pollution Prevention Officers (PPO's) are authorized by law to exercise specific powers described in the AWPPA of 1972. The *Arctic Ice Regime Shipping System* does not change this laws' application. Under Section 15(4) of the *AWPPA*, a PPO has the authority to direct a ship clear of any area at any time.

Powers in relation to ships:

15. (4) A pollution prevention officer may

(a) board any ship that is within a shipping safety control zone and conduct such inspections thereof as will enable the officer to determine whether the ship complies with standards prescribed by any regulations made under section 12 that are applicable to it within that shipping safety control zone;

(b) **order any ship that is in or near a shipping safety control zone to proceed outside the zone** in such manner as the officer may direct, to remain outside the zone or to anchor in a place selected by the officer, if

(i) the officer suspects, on reasonable grounds, that the ship fails to comply with standards prescribed by any regulations made under section 12 that are or would be applicable to it within that shipping safety control zone,

(ii) the ship is within the shipping safety control zone or is about to enter the zone in contravention of a regulation made under paragraph 12(1)(b) or (c), or

(iii) the officer is satisfied, by reason of weather, visibility, **ice or sea conditions**, the condition of the ship or its equipment or the nature or condition of its cargo, that such an **order is justified in the interests of safety**; and

(c) where the officer is informed that a substantial quantity of waste has been deposited in the arctic waters or has entered the arctic waters or where, on reasonable grounds, the officer is satisfied that a grave and imminent danger of substantial deposit of waste in the arctic waters exists,

(i) order all ships within a specified area of the arctic waters to report their positions to the officer, and

(ii) order any ship to take part in the clean-up of the waste or in any action to control or contain the waste.

PPO’s will take into account the ice regime information provided by ships’ Masters and from other sources that monitor marine traffic and ice conditions. This will be used to help ensure that no vessels are operating at risk of structural damage which could lead to pollution.

Unless the PPO has a valid and justifiable reason in the interest of safety to doubt that the vessel’s operations risk harming the environment, the powers of control over it will not be invoked.

ICE OBSERVATION LOG

Ship’s Name: Arctic Voyage 199_ Ice Strengthening
(Type / CAC / Arctic Class / etc.)

Voyage From: ________________ To: ________________ Page ____ of ____

Date	Time UTC	Latitude	Longitude	Ship's Head	Ship's Speed	Total Conc. in x/th's	x/th's MY / Old Code 9• or 7•	x/th's SY Code 8•	x/th's TFY Code 6 or 4•	x/th's MFY Code 1•	x/th's FY Code 7	x/th's GW Code 3 or 5	x/th's G Code 4	Open Water Codes 2,1,|	Vis	Comments	Obs. Init.
		° ' N	° ' W	°T													
		° ' N	° ' W	°T													
		° ' N	° ' W	°T													
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1) A *“D”* following a concentration indicates that the ice is ‘Decayed’. (Increase the Ice Multiplier by +1)

2) A *“R”* following a concentration of 6/10th’s or greater indicates that the ice cover is heavily (over 3/10th’s) ‘Ridged’. (Decrease the Ice Multiplier by -1)

3) Ice Numerals (IN) can be calculated and included in the ‘comments’ section.

4) Visibility is reported in Nautical Miles.

5) While under escort, observers should report the ice concentrations of the icebreaker’s track and indicate the quantity of ‘Brash Ice’ in with the ‘Open Water’.

To assist with the research process, surrounding ice conditions outside of the icebreaker’s track should be recorded.

6) Unusual ice conditions should be photographed, and referred to by: time, date and location for later analysis.

5.0 ICE INFORMATION

5.1 Ice Information is Part of Marine Safety

> "To conduct a sea voyage safely and efficiently, a mariner must have a well-founded understanding of the operating environment. This is especially true for navigation in ice. It is the responsibility of all mariners to ensure that before entering ice-covered waters, adequate ice information is available to support the voyage from beginning to end." (*Ice Navigation In Canadian Waters,* TP 5064E, Page 120)

All voyages into the Canadian Arctic, at any time of the year have the potential to encounter floating sea ice. Early season voyages (June / July) will encounter sea ice that is only beginning to deteriorate and can be expected to be at or near its maximum winter strength. Mid-season voyages (September) can expect to encounter decaying First-Year ice, and quantities of Multi-Year ice that are still very strong. Late season voyages (October) will encounter New Ice, which is a general term that describes recently formed ice, as large bodies of water may become ice-covered very quickly. This is also the time of year where existing floes of ice will start coagulating and growing thicker. It must therefore be emphasized that prior to departing for the Arctic and during Arctic voyages that navigational personnel must be aware of the present and forecasted ice conditions for the area in which they intend to operate.

The **Canadian Ice Service**, which is a branch of the Atmospheric Environment Service of Environment Canada, is the principle provider of ice information products and services for all Canadian waters.

5.2 Categories of Ice Information Products

The following paragraphs place a variety of the Canadian Ice Service's products in an operational context by sub-dividing them into six principal categories on the basis of **time scale** and **geographic scope**. Some of these products or services may change over the next couple of years, however the intent of this section is explain how a voyage may be supported with the various levels of ice information.

- **Tactical Ice Information** - This is *Current* Ice Observations from a wide range of sources including: visual (ship / helicopter), aircraft (a Dash 7, CFR / Can Ice 3 with Side Looking Airborne Radar / visual capability) and remote sensing data from satellites. When CFR flies, it produces three levels of data (radar imagery, tactical charts at 1:1,000,000 and verbal consultation) which can be accessed depending on the ship's equipment. The resolution on the aircraft imagery can be from 40 to 400 metres, influenced by the horizontal distance off the flight track. The primary satellites used are the National Oceanographic and Atmospheric Administration (NOAA) satellites and RADARSAT. The NOAA satellite has a resolution of 1.1 kilometres, but the imagery *is* affected by cloud and darkness. RADARSAT has a Synthetic Aperture Radar (SAR) sensor on board. The SAR imagery used for ice analysis has a resolution of between 50 and 100 metres and the radar return has the additional benefit of being unaffected by cloud.

- **Strategic Ice Information** - This will consist of narrative Ice Bulletins and the *Daily Ice Analysis Charts*. The primary purpose of these products is to provide vessel routing assistance. The *Daily Ice Analysis Chart* is not intended to be a tactical navigation tool because it lacks the accuracy to provide floe-by-floe plotting. However, in its 1:2,000,000 scale it will guide mariners to areas where more favourable ice conditions can be found. It is worth noting that if there are no Coast Guard ships within the geographic boundaries of a particular *Daily Ice Analysis Chart*, that chart may not be produced on that particular day. Also if there is only one Coast Guard vessel within the boundaries, only the pertinent sections of the chart may be completed in detail. The above items are available at a nominal cost. For a slightly higher cost, special charts can be produced specifically for each commercial vessel.

    - **Short Term Planning** - Regular forecasts are not available. Special forecasts for any period can be produced on request. Another Ice Service product that falls within this category is the *Weekly Regional Ice Analysis Chart.* For these charts Canada's Arctic is divided into three, vast 1:4,000,000 scale regions. The chart contains descriptions of floe sizes, ice types, concentrations, and air temperatures compared to the mean temperatures over the past seven day period. The primary purpose of this product is for climatology, however most mariners find it an ideal planning tool.

        - **Medium Range Planning** - *30 Day Extended Forecasts* are produced twice a month (on the 1st & 15th) and describes expected ice conditions for the whole Arctic in one publication that is sub-divided into three areas: *Hudson Bay & Approaches*, *Eastern Arctic,* and the *Western Arctic* forecasts. A number of marine operators find this item a valuable component in voyage planning especially when they are considering applying *the Arctic Ice Regime Shipping System* outside of the Zone / Date System. If conditions appear lighter than the mean values, the season of operation in that part of the Arctic may actually be extended.

            - **Long Range Planning** - A *Seasonal Outlook* is produced by the Canadian Ice Service in early June, which describes the expected ice conditions for the Arctic summer, and after the completion of the summer season, they also produce a *Seasonal Summary* which is designed to assist marine operators in writing their own summer shipping reports.

                - **Climatological** - There are a number of publications produced to supplement the long range forecasts and form a climatological foundation including the annual *Arctic Winter Ice Analysis and SAR Imagery*, more commonly known as the *Ice Atlas* which is based upon satellite and aerial reconnaissance of Canada's Arctic in January.

For more detailed information regarding these products refer to the Canadian Ice Service's *Catalogue of Ice Information Products and Services* or call 1 (800) 767 - 2885.

5.3 *Radio Aids To Marine Navigation*

Information of how to obtain High Frequency (HF) radio facsimiles of ice charts, direct tactical reconnaissance charts in 1:000,000 scale, and text broadcast of the *Ice Bulletin* (describes the ice edge and gives *Ice Warnings* if required) may be obtained from the following pages in the publication *Radio Aids To Marine Navigation* . (To obtain either of these publications see the List of Reference Material in Section 8.2)

Volume: *Atlantic and Great Lakes* - April 1996

Page 2-5 **Iqaluit** (VFF), disseminates a complete package of weather and ice information for the Eastern Arctic. Text products are sent over HF radiotelephony and VHF in the local area and ice charts are sent by HF facsimile. In the summer of 1999, the Arctic's first NAVTEXT transmitter may be installed here.

Resolute, Killinek and Coral Harbour are now remotely controlled by Iqaluit (VFF), and any services requested in those areas should be addressed to "Iqaluit Coast Guard Radio". Text products are sent over HF radiotelephony, and VHF in the local area with ice charts are sent by HF facsimile.

Page 2-48 **Churchill** is now remotely operated from **Thunder Bay** "VBA" and is only operational during the navigation season.

Page 2-59 **Iqaluit** (VFF) HF Radio Facsimile Schedule for all the: *Daily Ice Analysis Charts, Weather Surface Analysis & Weather Prognosis* charts.

Page 2-60 This section describes airborne facsimile transmissions of observed ice conditions from the **ice reconnaissance aircraft**. (UTC Times & HF Radio Frequencies) The actual 'Flight Schedule' for the Ice Service's Dash-7 (Can Ice 3) CFR, ice reconnaissance aircraft is transmitted everyday to all Canadian Coast Guard icebreakers and the Ice Operations Office in Iqaluit (NORDREG) outlining its' flight plan for the next three days. In addition to this daily message, Environment Canada also distributes a very general two week schedule for CFR every Monday. On flight days the aircraft can be contacted through ***M***SAT at: 1 (600) 701 - 6359. For additional information please contact NORDREG.

Note: Due to the geographic location of NORDREG / Ice Office, and its proximity to the Van Allen atmospheric belts, the received facsimilies on board a ship may not always be clear.

Volume: *'Pacific'* - April 1996

Page 3-4 **Inuvik** (VFA) transmits the *Daily Ice Analysis Charts* for *Waterway to St. Roch Basin* and also *Beaufort Sea* / Alaskan Coast. A unique feature with this radio station is that they have a little more latitude with their radio frequencies, such that they occasionally transmit charts over the CW 4 MHz frequency instead of the advertised 8 MHz to offer ships (depending upon their position) clearer ice charts. If a mariner wishes to obtain ice charts for other areas, they will be broadcast upon request. Inuvik Coast Guard Radio only transmits the *Ice Bulletins* upon request.

Page 3-13 Airborne facsimile transmissions of observed ice conditions from ice reconnaissance aircraft. (The UTC Times & HF Radio Frequencies)

Page 3-14 **Iqaluit** (VFF) & **Resolute** (VFR) HF Radio Facsimile Schedule for the: *Daily Ice Analysis Charts*, *Weather Surface Analysis & Weather Prognosis.*

Comparison: Level Of Ship Communications vs. Degree Of Ice Information Obtainable

Ice Information 'Available'	Basic Commercial Ships with: - VHF & HF Radios - Radio Facsimile Machine	Standard Commercial Ships with: - VHF & HF Radios - Radio Facsimile Machine - INMARSAT	Standard Commercial Ships with: - VHF & HF Radios - Radio Facsimile Machine - INMARSAT - Telephone Facsimile Machine	Sophisticated Commercial Ships with: - VHF & HF Radios - Radio Facsimile Machine - INMARSAT - MSAT - Telephone Facsimile Machine - Modem + Bridge Computer (the BBS) - APT	Very Sophisticated Commercial Ship with: - VHF & HF Radios - Radio Fax Machine - INMARSAT / MSAT - Telephone Facsimile Machine - Modem + Bridge Computer (the BBS) - Internet Access - Dir. Aerial Downlink - ICE-NAV / ICE-VUE - HRPT
Tactical Information					
The Ship's Current Visual Observations	✓	✓	✓	✓	✓
The Ship's Radars	✓	✓	✓	✓	✓
Airborne Radar Direct Downlink					Very Specialized HRPT
Aircraft / Helo. Visual Observations	HF	HF	HF	HF	HF
Coast Guard Icebreaker Local Knowledge	HF	HF	HF	Radios / Phone	Radios / Phone
Satellite / Radar Imagery				BBS APT	BBS HRPT
Tactical Ice Charts 1:000,000 Scale			T-Fax	T-Fax	T-Fax HRPT
Strategic Information					
Daily Ice Analysis Charts	R-Fax	R-Fax	R-Fax T-Fax DIS	R-Fax T-Fax DIS BBS	R-Fax T-Fax DIS BBS HRPT
Short Term Planning					
Weekly Regional Ice Analysis Charts			T-Fax DIS	T-Fax DIS BBS	T-Fax DIS BBS
Ice Outlook	HF	HF	HF T-Fax DIS	HF T-Fax DIS BBS	HF T-Fax DIS BBS
Med. Range Planning					
30 Day Extended Forecasts			T-Fax DIS	T-Fax BBS DIS	T-Fax BBS DIS
Long Range Planning					
Seasonal Outlook & Seasonal Summary					
Climatological					
Annual 'Ice Atlas'					
Climatology Notes					

Methods: **HF** VHF or HF Marine Radio Voice Communication **BBS** Canadian Ice Service's Bulletin Board Service
R-Fax HF Radio Facsimile via C.G. Radio or NORDREG **T-Fax** Telephone Facsimile via INMARSAT or ***MSAT***
DIS Can. Ice Service's Dial-In / Fax-back Service Enfotec's 'Ice-Nav' or the Ice Service's 'Ice-Vue'
Internet E-Mail **APT** Auto. Picture Transmission (eg. Wx. NOAA with 4km Resolution - $10-15K)
Canada Post Mail **HRPT** High Resolution Picture Trans. (For NOAA AVHRR imagery direct from the satellite - $150k)

5.4 *MSAT*® - A Regional Satellite System that *can* Deliver Ice Information

Early in 1996 a new telecommunications network, called ***M****SAT*, was commercially introduced. ***M****SAT* is a Canadian-owned satellite-based network targeted primarily towards mobile users operating in rural and remote areas. Currently the initial services include: voice (telephone), 4.8 kbps data, facsimile, dispatch radio, electronic mail and voice mail.

M*SAT* Mobile Communicators are compact, with antennas approximately 20 centimetres high and 20 centimetres in diameter and have been specifically developed for marine applications. The equipment and service costs are significantly lower than those charged by international mobile satellite service providers and due to the satellite's optimal geostationary position over the equator, excellent coverage is available over the Arctic, the Caribbean and 200 nautical miles off the east and west coasts of North America.

The ***M****SAT* equipment successfully used from Halifax en route to Resolute, Cambridge Bay and Tuktoyaktuk during an evaluation of the satellite's coverage in the 1996 shipping season. ***M****SAT* provided a reliable, efficient and inexpensive method for the reception of ice information in the form of verbal consultation, the paper facsimile generation of ice charts, and electronic mail of text descriptions of ice conditions from the Canadian Ice Service to the ship. The only weak link has been the dissemination of large graphics files such as SLAR or RADARSAT imagery because they are just too big to be sent through the current 4.8 kbps data processors.

M*SAT* Network upgrades being introduced will include packet-switched communications for applications such as vessel tracking using Global Positioning System technologies. Preliminary testing is underway for a high speed data service between 19.2 and 56 kbps.

For further information regarding ***M****SAT*, contact TMI Communications at 1 (800) 216 - 6728 or their service providers:

Glentel Inc.....1 (800) 811 - 0833
Infosat Telecommunications ..... 1 (800) 871 - 3011 / 207 - 5759
NMI Mobility.....1 (867) 393 - 7662

The CCGS Louis S. St. Laurent testing the ***M***SAT system near Resolute in 1996.

5.5 Ice Questions?

If there are **any** questions regarding ice, or the Canadian Ice Service's products there are several principle avenues available for obtaining more information:

Consultation

If there is a requirement for a verbal description of ice conditions *anywhere* in the Canadian Arctic, or questions concerning a particular ice product produced by the **Canadian Ice Service**, they are available for consultation on a **fee** basis by phone (through INMARSAT / ***M****SAT*) at **1 (800) 767 - 2885** from 0730 - 1730 EST (1130 - 2130 GMT). This option may prove to be particularly valuable when a vessel is out of HF range from a Marine Communications and Traffic Services Centre.

Or

NORDREG Operations may also be called at anytime (24 Hours) during the summer shipping season through INMARSAT / ***M****SAT* or by phone at **(867) 979 - 5727** or by facsimile at (867) 979 - 4236.

The NORDREG office staffs a **Regional Ice Operations Superintendent** that can offer information on ice conditions, specific ice routing assistance, aids to navigation, and Icebreaker support when considered necessary.

Phone: ..... (867) 979 - 5200
Facsimile: ..... (867) 979 - 2613
E-mail: .....iceyfb@nunanet.com

Additional information regarding the role of NORDREG may be obtained by reading *Notices To Mariners 1-46 Annual Edition* No's 6 & 26, and several pages of the *Radio Aids To Navigation (Atlantic & Great Lakes)* annual publication. Outside of the shipping season the function of NORDREG is carried out by the St. John's MCTS Centre which may be contacted by phone at (709) 772 - 2106.

The Canadian Ice Service, Environment Canada

The Canadian Ice Service can be contacted at the following address:

Canadian Ice Service
Client Service
373 Sussex Drive, E - 3
Ottawa, Ontario
Canada
K1A 0H3

Telephone: ..... 1 (800) 767 - 2885 / (613) 996 - 1550
Facsimile:..... (613) 947 - 9160

INMARSAT / ***M****SAT* Phone: ..... (613) 996 - 1550
INMARSAT / ***M****SAT* Facsimile:.....(613) 947 - 9160

Note: With INMARSAT, the numbers to dial before the area code may vary by ship.

E-Mail: .....Cis.Client@ec.gc.ca
URL: ..... http://www.cis.ec.gc.ca

6.0 THE ICE NAVIGATOR

Since the *Arctic Shipping Pollution Prevention Regulations* (ASPPR) were developed in the 1970's there has *always* been a definition for an "Ice Navigator" and a requirement for them to be aboard tankers or other ships at certain periods when using the Zone / Date System. When the regulations were recently amended to introduce the *AIRSS*, it also included more stringent qualifications and experience an 'Ice Navigator'. The term Ice Navigator is not new, but the role of the Ice Navigator has become more prominent including the requirement to have an Ice Navigator aboard *any ship* that intends to take advantage of the flexibility offered by the Ice Regime System.

6.1 Qualifications and Requirements for an Ice Navigator

The qualifications and requirements for an Ice Navigator are stated in Section 26 of the *ASPPR* which is reproduced below for reference:

Ice Navigator

26. **(1)** No tanker shall navigate within any zone without the aid of an ice navigator who is qualified in accordance with subsection (3).

(2) No ship other than a tanker shall navigate in any zone set out in the heading to each of Columns II to XVII of Schedule VIII

(a) where the words "No Entry" are shown in that column of item 14, and

(b) where a period of time is shown in that Column of item 14, except during that period of time, without the aid of an ice navigator who is qualified in accordance with subsection (3).

(3) The ice navigator on a ship shall

(a) be qualified to act as master or person in charge of the deck watch in accordance with regulations made pursuant to the *Canada Shipping Act*; and

(b) have served on a ship in the capacity of master, or person in charge of the deck watch for a total period of at least 50 days, of which 30 days must have been served in Arctic waters while the ship was in ice conditions that required the ship to be assisted by an icebreaker or to make manoeuvres to avoid concentrations of ice that might have endangered the ship.

(4) Despite subsections (1) and (2), a tanker or ship referred to in those subsections may navigate in a zone without the aid of an ice navigator during any part of the transit in open water.

(5) For the purposes of subsection (4), "open water" has the meaning assigned to that term in the *Arctic Ice Regime Shipping System* (AIRSS) *Standards* (TP 12259), published by Marine Safety, Transport Canada, in June 1996, as amended from time to time.

There is work in progress to develop an endorsement / certification process for Ice Navigators (who may not necessarily be the Master of the ship). In the interim, personnel will be assessed using the criteria above. It is the responsibility of the shipowner to ensure that qualified persons be on board for the intended voyage.

6.2 When is an Ice Navigator Required?

Section 26 of the *ASPPR* lists the circumstances under which an Ice Navigator *must* be aboard, however it is always recommended to have an experienced person guiding the ship when there is the potential for encountering sea ice. To summarize and illustrate:

A) An Ice Navigator **is required**:

i) on all tankers (when carrying oil as cargo) at all times that the tanker is in a Shipping Safety Control Zone,

ii) when any ship, over 100 gross tons is navigating outside the dates set out in row 14 of Schedule VIII in the *ASPPR* (the Type E dates from Zone / Date Table), and

iii) while using the Arctic Ice Regime Shipping System.

B) An Ice Navigator **is not required**:

iv) during any part of a ship's transit (including oil tankers) while the vessel is in open water [*ASPPR*, Section 26 (4)],

v) when a ship other than a tanker is navigating under the Zone / Date System, in zones 7 to 16, within the dates listed in row 14 of Schedule VIII in the *ASPPR* (the Type E dates from Zone / Date Table), and

vi) outside Canada's Shipping Safety Control Zones.

Example: Entry of a Type B Ship into Zone 15

This is an example of how the Dates of Entry Table applies to a **Type B** ship.

Note: The bullets below indicate how the table could be interpreted relevant to the Zone / Date System and the Arctic Ice Regime Shipping System.

Item	Category	Zone 14	Zone 15	Zone 16
10.	**Type A**	June 25 to Nov. 30	June 25 to Dec. 5	June 20 to Nov. 20
11.	**Type B**	July 1 to Nov. 30	July 1 to Nov. 30	June 20 to Nov. 10
12.	**Type C**	July 1 to Nov. 25	July 1 to Nov. 25	June 20 to Nov. 10
13.	**Type D**	July 10 to Nov. 10	July 5 to Nov. 10	July 1 to Oct. 31
14.	**Type E**	July 20 to Oct. 31	July 20 to Nov. 5	July 1 to Oct. 31

(Extract from the - *Shipping Safety Control Zones - Dates of Entry)*

- The Type B ship in this example, that is not a tanker, can be in Zone 15 anytime between July 20th and Nov. 5th without having an Ice Navigator on board. (the Type E dates)
- A Type B ship, can be in Zone 15 from July 1st to November 30th if there is an Ice Navigator on board.
- A Type B ship can be in zone 15 prior to July 1st and after November 30th (i.e. outside the Zone / Dates) if all of the following conditions are complied with:
    i) there is an Ice Navigator on board,
    ii) the vessel is using the Arctic Ice Regime Shipping System,
    iii) the ship transmits an *Ice Regime Routing Message* that illustrates positive Ice Numerals along its route,
    iv) the ship receives an acknowledgement from NORDREG related to the *Ice Regime Routing Message*, and
    v) the ship intends to complete an *After Action Report*.

7.0 VESSEL OPERATIONS

7.1 Tactical Navigation - Encountering Negative Ice Numerals

At certain points in a voyage, it may be essential to transit local areas where the regime has a negative Ice Numeral for the ship. This should not form part of a voyage plan.

While using the Ice Regime System, intentional entry into a negative ice regime outside the Zone/Date limits is prohibited.

Examples of this situation may develop when the ship has been following a voyage plan that was based on either ice information in which the resolution of the data used to compile the chart is larger than the local floe sizes or simply old ice information. Another consideration is that by the very definition of an *"Ice Regime"*, there could be several regimes at the tactical level that may not appear on ice charts due to the scale and detail required to indicate every ice regime down to the vessel's level. Another scenario may find the ship unable to avoid deteriorating conditions during the later part of the season when the ice is likely to grow rather than dissipate.

When the Master or Ice Navigator find themselves in any of the above situations they may consider:

a) selecting another route,
b) obtaining more recent and / or higher quality ice information,
c) waiting for improved weather or ice conditions, or
d) requesting the assistance of an icebreaker by calling NORDERG.

NORDREG, will be able to provide additional information to assist in these circumstances and will have up-to-date knowledge of the positions of icebreakers. As a reminder, comments related to such situations *must* be incorporated into the *After Action Report* when operating outside of the Zone / Dates.

7.2 Escorted Operations

When ice conditions prevent, or significantly impede a ship's operations, it may be desirable or necessary to work together with another vessel of similar capability, or to be escorted by one of greater capability. Escorted operations are specifically allowed for in the Ice Regime System, and must be considered on an individual basis while planning routes and defining local ice regimes. Under some circumstances a suitable escort can be effective in easing the ice conditions along the route (for example, breaking large pieces of dangerous ice or assisting vessels to manoeuvre around them). However, if the escort's broken track is too narrow, if the ice is under pressure, or if there are various other circumstances, the effectiveness of an escort can be severely limited.

The ice regime that has been modified by the suitable escort should be the basis for the decision on whether to proceed.

The Masters of both the escort and the escorted ship must work closely. **The icebreaker will decide whether it is safe to break a track, but the Master of the escorted ship must continue to evaluate the conditions in order to decide whether it is safe to follow, and at what speed**. Communications and operating procedures must be established before *any* escort operation starts and maintained throughout. There may also be the requirement for an Escort Message (Section 4.0, Part B) to be sent to the icebreaker. In the publication, *Ice Navigation In Canadian Waters* (Section 2.7.2), there is information on the recommended procedures for icebreaker escort operations.

Issues to consider regarding the escort operation:

- the width of the broken track, in comparison with the following ship's beam,
- the size, thickness, and strength of the ice pieces left in the track,
- the likelihood of pressure conditions, which may cause the track to close rapidly.

7.2.1 Calculating an Ice Numeral Behind an Escort

The track of an escort and surrounding conditions should be treated as a separate Ice Regime, while the Ice Numeral calculation process remains the same. The ice in the track must be assessed for thickness (age / ice type), concentrations and floe size. If the actual floes are under 2 m in diameter, consider it 'Brash' with an Ice Multiplier equivalent to Open Water, i.e. +2. When adding up the 10th's of Brash and Open Water, a positive regime is possible, but it is not necessarily indicative of a safety factor.

Extreme caution must be exercised when working in an Icebreaker's track because of the confined aspect of the track. Ice floes, although small could be several metres thick and have no place to go other than being pushed ahead in the track, under the ice sheet or forcibly wedged between the ship's side and the ice edge.

Maintain a watch for the use of either the icebreaker's red Escort Warning Lights or the aft facing Zet Horn.

7.3 Early Season Voyage

An early season voyage can be described as a voyage where the vessel intends to enter the Canadian Arctic prior to the main onset of melt and expects to actively break ice to reach its destination. Depending on the area, early season voyages are those in May, June, or early July.

Prior to departure, a vessel planning an early season voyage may contact the Canadian Ice Service to receive a copy of the *Seasonal Outlook*, and the *Thirty Day Forecast* (see Section 4.5 in this document for addresses and phone numbers). As the vessel proceeds towards the Canadian Arctic, the noted HF facsimile frequency should be monitored in order to receive the most recent *Daily Ice Analysis* charts or *Ice Edge* charts.

(Refer to *Radio Aids To Marine Navigation*)

When the vessel is approximately 24 hours away from the Shipping Safety Control Zones, the vessel is to send an *Ice Regime Routing Message* to NORDREG (Section 4.2). NORDREG will reply with a message that acknowledges that the vessel will be entering the Arctic Canada Traffic Zone, and it may also contain a recommended route for the vessel.

Once the vessel is north of 60°N latitude reporting to NORDREG should continue in the form of the daily 1600 UTC Reports. HF facsimile broadcasts and radio transmissions of ice forecasts should continued to be monitored to receive the latest ice information.

On early season voyages, a vessel may wish to enter a zone outside the Zone / Date System. Entry could be possible under the Ice Regime System if there is an indication of positive Ice Numerals. In this case it will be necessary for the vessel to have on board an Ice Navigator. An *Ice Regime Routing Message* must be sent to NORDREG via the nearest Marine Communications and Traffic Services Centre and following the voyage an *After Action Report* (as described earlier in Section 5.2) must be submitted. It should be remembered that during the transition period **the *After Action Report* is always required whenever the Ice Regime System is used** even though only positive Ice Numerals may have been encountered.

During an early season voyage, conditions will generally be improving due to the longer days and the sea ice undergoing its decay process. Thus, although delays in transit on an early season voyage may be undesirable, detouring or waiting for conditions to improve may be the safest and most efficient option.

7.4 Late Season Voyage

Late season voyages (late October-November) deserve special attention because of the certainty that ice conditions will worsen during the voyage, and the possibility that they will deteriorate rapidly. Severe, late season storms can cause pressure events and move large quantities of Multi-Year ice from high latitudes into the shipping channels. An example of this phenomenon is the redistribution of Multi-Year ice from the Kane Basin / Smith Sound to along the western shore of Baffin Bay, including the formation of a North / South barrier of ice that may block the entrance to Lancaster Sound.

Prior to departure, a vessel planning a late season voyage may contact the Canadian Ice Service to receive a copy of the *Seasonal Outlook*, and *the Thirty Day Forecast* (Section 5.5). As the ship heads toward the Arctic, the appropriate HF facsimile frequency should be monitored in order to receive the most recent *Daily Ice Analysis* charts or *Ice Edge* charts.

(Refer to *Radio Aids To Marine Navigation*)

When the vessel is approximately 24 hours away from the Shipping Safety Control Zones, the vessel is to send an *Ice Regime Routing Message* to NORDREG (Section 4.2). NORDREG will reply with a message that acknowledges that the vessel will be entering the Arctic Canada Traffic Zone, and it may also contain a recommended route for the vessel. On late season voyages this communication with NORDREG is very important considering that the availability of Icebreaker support may be crucial if ice conditions deteriorate rapidly.

Contact may also be made on HF with other ships or icebreakers in the area as these ships may be able to provide additional ice information or support if required.

With these voyages, a vessel may wish to enter a zone outside the Zone / Date System and entry is permitted under the *Arctic Ice Regime Shipping System* provided that several conditions are met. The ship will be required to have an Ice Navigator on board (see Section 7.2), submit an *Ice Regime Routing Message* that illustrates positive ice regimes ahead of the vessel, and provide an *After Action Report* 30 days after departing NORDREG's waters. Assistance in these areas may be found by contacting NORDREG via the nearest Marine Communications and Traffic Services Centre.

In most cases a Coast Guard icebreaker is on standby for ships operating in the Arctic late in the season.

7.5 Tug and Barge Operations

The *AIRSS Standards* (TP 12259) do not fully address several aspects of towing operations such as the reduced icebreaking capability of a vessel engaged in towing, the increased potential for collision between tug and tow and the constraints imposed on the route by the size and manoeuvrability of the tow relative to the characteristics of the tug[1].

Unlike the simple Ice Numeral calculation required for a single ship to enter an ice regime, when a tug and tow combination are about to enter a regime there must be some consideration made for the hull strength or Ice Class of both the tug and each component of the tow. From a structural perspective the set of Ice Multipliers selected should correspond to the lightest structure / ice class in the towing operation and the towmaster should make frequent inspections to check for evidence of damage during the tow. Prior to entering the ice, some of the factors to consider should be:

- the quality (date / resolution / source) of the ice information available,
- the reduced icebreaking capability of the tug while engaged in towing[1],
- the method of towing[1] (close-couple or conventional),
- the beam and displacement differences between the tug and tow[1],
- the floe sizes of the ice[1] and indication of pressure, and
- the effectiveness of the ice escort[1], if any.

Tug and barge operations and other tows in the Arctic require particular care. Directional control may be difficult, while the speed of both the towing ship and its tow can change almost instantly, thus increasing the risk of collisions with ice floes. Selection of appropriate tow lengths and speeds therefore requires experience, understanding, and caution.

M/V TERRY FOX Towing the ARCTIC KIGGIAC, 1991 Photo: B. Cowper

1 Draft - *Operational Review of the Arctic Ice Regime Shipping System standards for Tug and Tow Operations*, Pages 1 & 2, March 1997

7.6 Crew and Equipment

Any ship planning to enter the Arctic should have an adequate crew, and the equipment should be suited to the voyage and the environmental conditions which will be encountered. The prevention of damage to the hull and propulsion machinery by ice requires navigation with due caution, as described earlier. Mariners should also be aware that vibration during icebreaking can put high stresses on equipment, causing breakdowns or malfunctions. Hull vibrations can also have deleterious effects on personnel. Any ship making a maiden voyage into Arctic waters may have unexpected problems, and should have contingency plans to cover repairs or delays.

Natural phenomena can make it difficult to get good performance from communications or navigation equipment. The most common of these problems are the speed (especially the East/West component) and damping of the gyros, magnetic variation, ionospheric disturbances that may affect radio transmissions, and obtaining an unobstructed view of an INMARSAT satellite above 73°North.

Navigating in the Arctic can be very demanding and tiring. If an operator plans to navigate for prolonged or difficult periods of ice navigation while using the Arctic Ice Regime Shipping System it may consider it prudent to assign sufficient Ice Navigators[1].

Few Arctic ports and terminals have comparable facilities to those found in Southern areas. The crew and equipment carried should therefore be adequate in numbers and training to handle any challenges which may arise. Masters should ensure that they are fully aware of the shore facilities available when making their voyage plans.

For voyages involving an oil transfer to or from the ship, specific requirements for crew and equipment may apply depending on the transfer location. Details are given in *Arctic Waters Oil Transfer Guidelines,* TP 10783. (See the List of Reference Material in Section 8.2 for information on obtaining a copy.)

Other important equipment items to consider are those involving safety and emergency response. Masters should be aware that voyages at any time of year may encounter difficult conditions, and those in winter months can involve extremely low temperatures. Standard safety equipment may not function properly under these conditions, or may not be adequate to ensure protection.

Transport Canada has developed a *Cold Weather Marine Survival Guide*, TP 11690, and a *Marine Survival Handbook for Cold Regions*, TP11969. These provide details and a summary, respectively, of practical advice on cold weather survival in a marine environment. Masters planning Arctic voyages should be familiar with these publications, and should ensure that copies are made available to be read by personnel on board.

1. On the topic of Ice Navigation being demanding and tiring, the following research and development report addresses this issue: *Hours of Work and Rest of Canadian Ice Navigators on board Foreign Registered Vessels in Arctic Waters*, Page 17, Section 4.2.5, March 1998, TP 13207 E

8.0 CONTACTS & REFERENCES

8.1 Contacts / Inquiries

Transport Canada

Transport Canada should be contacted for questions pertaining to: the *Arctic Ice Regime Shipping System*, the *User Assistance Package*, the AIRSS Standards, regulatory issues or any issue related to marine safety. Regarding the Ice Regime System, the After Action Report shall be shall be sent to this address. The office is open during normal business hours, however during the summer months there is a Stand-By Duty Officer that may be reached via NORDREG if required.

Prairie & Northern Region, Marine
Transport Canada (AMNS)
Place de Ville, Tower C — Telephone: (613) 991 - 6004
330 Sparks Street, 14th Floor — Facsimile: (613) 991 - 4818
Ottawa, Ontario, K1A 0N5 — E-mail: Wolfer@tc.gc.ca

Arctic Canada Traffic System (NORDREG Canada)

While in Canada's Arctic, NORDREG may be contacted for: ice information, ice routing and icebreaker assistance. Regarding the Ice Regime System, NORDREG shall be sent *the Ice Regime Routing Message*. During the summer shipping season this office is staffed 24 hours a day. (More information may be found in the Annual Edition, Notices To Mariners, No. 6 & 26.)

NORDREG Canada — Telephone: (867) 979 - 5724
P.O. Box: 189 — Facsimile: (867) 979 - 4236 or
Iqaluit, N.W.T. — (867) 979 - 4264
X0A 0H0 — Radiogram: NORDREG CANADA

Outside of the summer shipping season the function of NORDREG is carried out by the St. John's MCTS Centre which may be contacted by phone at (709) 772 - 2106.

Canadian Ice Service, Environment Canada

Regarding ice conditions *anywhere* in the Arctic, or questions concerning a particular ice product produced by the Canadian Ice Service, they are available for consultation by phone from 0730 - 1730 EST (1130 - 2130 GMT). (See Section 5.5 of this publication for there complete address and methods of communication.)

8.1.1 Roles of Agencies

In the *Arctic Ice Regime Shipping Standards* - TP 12259 (Tab 9) there are several pages that describe the roles and authorities of the following:

All of these agencies have an important function within the context of the *Arctic Ice Regime Shipping System*.

8.2 List of Reference Material

1. *MANICE, Manual of Standard Procedures for Observing and Reporting Ice Conditions*, Eighth Edition, Canadian Ice Service, Atmospheric Environment Service, Downsview, Ontario. April 1994.
   Available from: Environment Canada, Canadian Ice Service ATTN: Client Service
   373 Sussex Drive, E-3, Ottawa, Ontario, K1A 0H3

2. *Radio Aids to Marine Navigation (Atlantic and Great Lakes*) or *(Pacific*) Canadian Coast Guard, Annual Edition 1998.
   From: Hydrographic Chart Distribution Office ⌈ Ottawa, Ont. Phone: (613) 998 - 4931 ⌊ Sidney, B.C. Phone: (250) 656 - 8358
   Atlantic and Great Lakes ....Catalogue # T51-4/1998E.....ISBN 0-660-17428-6
   Pacific .....Catalogue # T51-5/1998E.....ISBN 0-660-17429-4

3. *Ice Navigation in Canadian Waters - 1992 Edition,* Canadian Coast Guard. TP 5064 E
   Available from: Canada Communications Group - Publishing, Ottawa, Ontario, K1A 0S9
   Catalogue # T31-73/1992E or F ISBN 0-660-14787-4
   The cost is $24.95 per copy and a third edition could be published in the fall of 1998.

4. *Notices to* Mariners , 1 to 46, Annual Edition 1998
   Available from: Canada Communications Group - Publishing, Ottawa, Ontario, K1A 0S9
   Catalogue # T51-5/1996E ISBN 0-660-15931-7

5. *Guidelines for the Operation of Tankers and Barges in Canadian Arctic Waters (Interim),* Transport Canada, Sept. 1993, Revised April 1997. TP 11663E

6. *Marine Survival Handbook for Cold Regions*, Canadian Coast Guard. TP 11969E

7 *Cold Weather Marine Survival Guide,* Transport Canada, Nov. 1992, Revised August 1997, TP 11690

8. *Arctic Waters Oil Transfer Guidelines*, Transport Canada, June 1994, Revised April 1997. TP 10783E

9. *Proposals for the Revision of the Arctic Shipping Pollution Prevention Regulations*, Transport Canada, December 1989. TP 9981

10. Equivalent *Standards for the Construction of Arctic Class Ships*, Transport Canada, 1996. TP 12260E

11. *ASPPR Sub - Committee On Training And Certification, March 30/31, 1993 Meeting and Recommendations*, TP 12530

    Publications: 5 to 11 are available from:
    Prairie & Northern Region, Marine - AMNS
    Transport Canada, Place de Ville
    330 Sparks Street, 14th Floor
    Ottawa, Ontario, K1A 0N5

12. Canadian Government Publishing - The source for copies of regulations and government publications (2, 3 & 4 above) which cost a nominal fee. Contact them at: Phone: (819) 956 - 4800 / Fax: (819) 994 - 1998 / Internet: HTTP://Publications.pwgsc.gc.ca

8.3 Additional Material Available to the Ice Navigator

8.3.1 Arctic Ice Regime Shipping System - Video

A video has been produced by Transport Canada with the intent of training both foreign and Canadian mariners regarding:

A) How to recognize the basic ice types,

B) How to apply the Arctic Ice Regime Shipping System, and

C) An explanation of the transition from the Zone / Date System to the *Arctic Ice Regime Shipping System* (AIRSS).

The video is available free of charge in either English or French and in any of the following formats: PAL, NTSC or SECAM. The video forms a component of the *User Assistance Package*, but is also distributed individually from Transport Canada.

8.3.2 *Ice Navigation In Canadian Waters*

In Schedule 6 of the *Charts and Nautical Publications Regulations* there is requirement that *Ice Navigation In Canadian Waters* be aboard any ship that will be "making a voyage during which ice may be encountered". The 1992 revised edition of *Ice Navigation In Canadian Waters* provides a wealth of knowledge pertinent to navigation in ice and every Navigation Officer should be thoroughly familiar with its' content.

The following sections are relevant to ice information:

a) Sections: 1.7 to 1.10.3 (pages: 11 - 16) describing the role of NORDREG, Coast Guard Ice Offices and Environment Canada in providing ice information to mariners,

b) Section: 2.5.2, on page 118 gives a description of INMARSAT's limitations, and

c) Section: 2.7 (pages: 120 - 124) gives a good overview of the various forms of ice information, followed by a description of ice chart features.

The 1992 revised edition has been reprinted during the summer of 1996 to meet commercial demand and in the summer of 1998 the publication will be revised again. The third edition should be available through the Canada Communications Group by the spring of 1999.

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Passage Planning:

Unlike route planning for open water voyages, the primary concern in route planning for Arctic voyages is ice avoidance. Although ice capable ships may be inclined to select a shorter distance route which crosses through some ice, the shortest route can easily result in the longest transit time where sea-ice is concerned.

The *Sailing Directions - Arctic Canada, Volumes I, II, and III* also provide a lot of information that can be useful for passage planning and should be consulted on a regular basis and on all occasions when transiting new routes.

8.4 Arctic Ice Regime Shipping System Software

The Arctic Ice Regime Shipping System Software is contained on four diskettes at the back of this publication. There are several strong attributes that Transport Canada has built into the software and they are:

1) the software automatically generates (see Section 8.4.5) both reports:
   a) the *Ice Regime Routing Message*, and
   b) the *After Action Report*.

2) the software is completely bilingual for both English and French operators,

3) after entering some tombstone data for your ship, and the ice concentrations in each ice regime the software will do the Ice Numeral calculation, and

4) there is an ability to record all the voyage data and if the data is submitted Transport Canada with the After Action Report, the data from your ship as well as those from other vessels would provide support for any future changes to the Ice Regime System.

If you have suggestions for modifications that would improve the software, feel free to contact Transport Canada at the address provided at the beginning of this publication.

8.4.1 Bilingual Use of the Software

The software has been designed in a completely bilingual format and during the loading process individuals will be prompted to open either: the English (**AIRSS**) program, the French (**SRGNA**) program, or either **AIRSS Help** / **SRGNA Aide** files. The unique structure of the software allows both English and French operators to use the same software, thus accumulating ice regime data in a common file.

To switch from one language to another, the software must first be shut down and then restarted in the other language. The concept behind this design supports Navigation Officers that work in different languages and at the change of the watch the program would be closed and the data saved before the next watch commences.

8.4.2 System Requirements

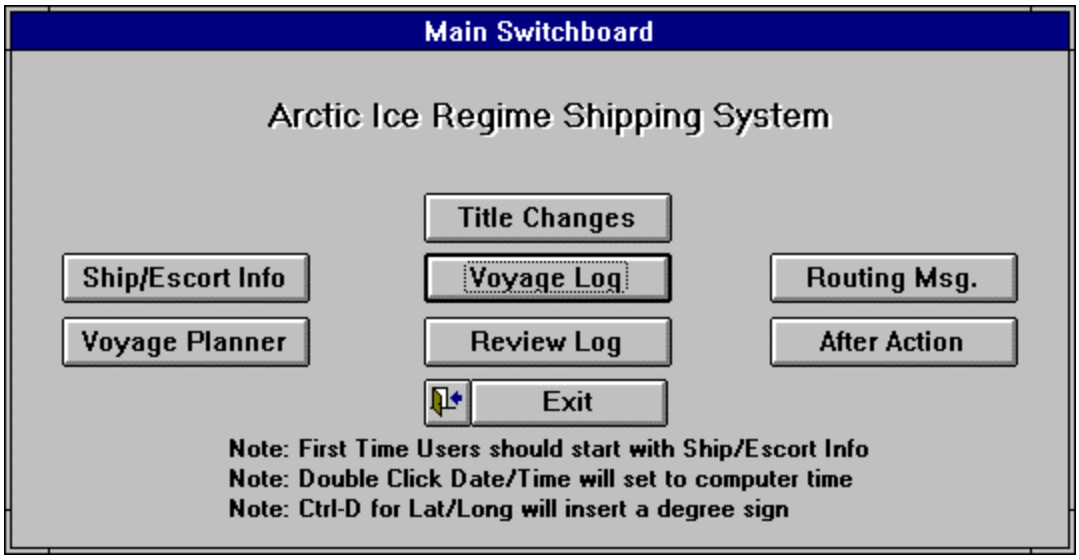
- 486 or Pentium® processor-based personal computer
- Microsoft Windows 3.1, Windows 3.11, Windows NT 3.51, Windows 95 or Windows NT 4.0
- 16 MB of RAM for optimal performance

8.4.3 Software Installation

To install the AIRSS Software for Microsoft Windows systems:

1) Start Microsoft Windows and insert diskette 1/4 in drive A.
2) a) For Windows **3.1**, Windows **3.11** or Windows **NT 3.51**
   In the Windows Program Manager, choose **File** then **Run**.
   b) For Windows **95** or Windows **NT 4.0**
   From the **Start** menu button, select **Run**
3) In the Command Line box, type **a:\setup** and then select the **OK** button.
5) Follow the instructions on your screen. The setup leads you through the installation process, insert the succeeding setup disks. When the process is complete, the software is automatically placed in the Program Menu under the title "T.C. AIRSS Software". The software is now loaded.
5) When you go to use the software for the first time a Dialogue Box will appear asking "Where is Airssdat.MDB?" Click with your left mouse button **airssdat.mdb** in the big box on the left side. Click **OK**. With this step you are telling the computer where to find the data base and this box will not appear again.

8.4.4 Software Program Sections



Ship / Escort Info..... This is the FIRST section a new user should go to. This form contains the tombstone information describing the vessel, crew and escort, and it is used continually throughout the rest of the program.

Voyage Planner..... This form is for route planning, and is used to store data for use with the Ice Regime Routing Message section of the program.

Voyage Log ..... This form is used for logging ice observation while the ship is underway and in ice. The data from this form is used for generating an After Action Report.

Review Log..... This form is for review and editing of the logged ice observations saved from the Voyage Log section.

Routing Message ..... This form is used to generate an Ice Regime Routing Message (hard copy or computer file) for NORDREG.

After Action..... This form is used to generate an After Action Report (hard copy or computer file) for Transport Canada.

Title Changes..... While filling out the tombstone data in the 'Ship/Escort Info' section, there is a block called 'Officer Information' and if you clicked the left list button there will be a long list of 'Titles' to select from for each individual. However, if you have a 'Title' that is different from the designed list, this part of the program allows you to add or edit from the existing titles. This button also the operator to insert an equivalent French translation of the new English Title to permit the software to keep all the data coordinated while running in either language.

8.4.5 Generating Reports

The tombstone data entered when you were in the **Ship / Escort Planner** section will be routed in the software to the Ice Regime Routing Message and the After Action Report pages. To insert the data into the:

a) Ice Regime Routing Message go to the **Load Route** button and select all the components of the route that will form the body of the message.

b) After Action Report go to the **Load Logs** button and select the regimes that the ship has sailed in that are to be placed in the report.

After either message has been constructed, choose the 🖫 **Save Info** button. From here it is just like any other computer program in that you just create a file name an select a place to store the files. This will also be the time to copy the report(s) to a diskette to be placed in the mail.

8.4.6 Software Notes

- Pressing Ctrl-D while the cursor is in a Latitude or Longitude text box will insert a degree sign.

- Double clicking most time/date fields will reset the item to the current computer time, therefore if the computer clock is set to UTC you can easily set the date/time information to the current UTC. You can set the computer clock in the CMOS by (typically) pressing the 'Delete' key when your computer is first turned on (booted).

  CAUTION - Only change the CMOS time and/or date values - don't change any other settings if you are unsure of the result.

- Double clicking on purple-sunken fields on the Ship/Escort form will allow you to edit the fields. White-sunken fields can be normally edited.

- Raised fields can not be edited.

- Records on the Review Log (Review/Edit) must be unlocked before editing.

8.5 Canadian Ice Service's *Arctic Ice Information Manual*

In association with the *User Assistance Package*, the Canadian Ice Service of Environment Canada has created an *Arctic Ice Information Manual* that explains what types of ice information products are available, how to get them to a ship and their cost. This 1½" binder will be available upon request from the Canadian Ice Service. Each section of the *Arctic Ice Information Manual* is briefly described below:

8.5.1 *MANICE* (Manual of Standard Procedures for Observing & Reporting Ice Conditions)

MANICE is the authoritative publication that completely describes, in detail the procedures of the Atmospheric Environment Service for observing, recording and reporting all ice conditions which includes: Sea, Lake, River Ice and Ice of Land Origin - Icebergs. It describes all the procedures, coding, terminology and symbology that are compatible with the World Meteorological Organization's (WMO) nomenclature. The primary benefit of this publication to mariners lies within Chapters One and Three. The first chapter contains a complete list of ice terminology, and the third chapter, starting in section 3.4, describes how the "Egg Code" is structured and after reading the next few pages *any* ice chart or product can be easily read no matter how complex the chart may appear. (This publication is available individually from the address given in the List of Reference Material on page 38.)

8.5.2 Canadian Ice Service - Brochure

This four page document explains the role of the Canadian Ice Service which is to promote safe and efficient marine operations through accurate and timely ice information.

8.5.3 Catalogue of Ice Information Products and Services

The catalogue contains the details of the ice information products & services available from the Canadian Ice Service. It will answer questions regarding availability, resolution, and distribution (BBS, Fax, Mail...).

8.5.4 Client Service - Price and Products List

The Price and Product List is just states what types of ice information products are available and how much they cost.

8.5.5 BBS User's Guide / Dial-In Service

This manual explains how mariners, either ashore or at sea can obtain a wide variety of Canadian Ice Service products through either: the Bulletin Board Service or "BBS", the "Fax Back" system or the Internet / World Wide Web Home Page.

8.5.6 *MSAT* Telephone Service

This small section contains a number of commercially prepared fliers that describes the *MSAT* equipment and the variety of services available.

8.5.7 Canadian Arctic Ice Climatology Notes

This document offers an understanding of seasonal ice distribution patterns in the Arctic and the interrelationship between meteorological and oceanographic factors.

- Temperature
- Wind
- Bathymetry
- Currents
- Ice Thickness
- Variations