



POLARIS Update: A perspective on developments

Rob Hindley, Head of Machinery & Structural Design
3rd Arctic Shipping Best Practices Information Forum
London, 03 June 2019



Overview of this presentation

- Brief background to Aker Arctic
- Objective for today's presentation
- POLARIS
 - ◆ where did it come from
 - ◆ what is it
 - ◆ what can it become
- Some proposals from improvements
- Conclusions



Aker Arctic

Ship Design

- Transport studies
- Conceptual development
- CFD and FEM modelling
- Simulations
- Basic design engineering

Field Research

- Ice conditions
- Ice properties
- Environmental studies
- Design basis development

Arctic Engineering

- Feasibility studies
- Pre-FEED engineering
- Offshore conceptual planning
- Simulations

Testing in Model and Fullscale

- Ships
- Structures
- Offloading operations
- Rescue and evacuation



Aker Arctic

The Ice Technology Partner

Objective of today's presentation

*To present the current status of
POLARIS and to offer some opinions
on updating the system*



POLARIS – where did it come from?

IACS

IMO Polar Code: Update on IACS Informal Working Group Operational Limitations

James Bond
Rob Hindley
November 2014

Safer and Cleaner Shipping



IACS

Context

MSC93: Agreement that limitations for operating in ice to be included on the Certificate

MSC93 proposed initial guidance on limitations for operating in ice: MSC93/WP.7/Add1, Para 10:

in order to include the operational limitations in ice in the certificate, the group included a guidance in square brackets in part I-B of the draft Code, which will need to be further developed in conjunction with section 1.5 of part I-A, before the adoption of the Code (see part I-B, Additional guidance to chapter 1, Limiting ice capabilities for the Polar Ship Certificate). **In this context, the group noted that the observer from IACS stated that IACS would be willing to undertake further work on the guidance with the intention to submit a document to MSC 94. The group also noted that some interested delegations would cooperate with IACS on this necessary and urgent work.**

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Participants and structure of informal group

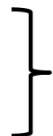
Develop Technical Content



Develop Proposal



Review and Validate



Technical Group

Informal CG

Technical Group: IACS, Canada, Denmark, Finland, Russia, Sweden

Informal Correspondence Group: email group consisting of volunteer members from MSC93 WG

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POLARIS: Way Forward


POLARIS presents a risk assessment tool for assessing operational limitations

- Links ice class and actual ice conditions
- Provides a framework for further enhancements
- Proposal offered for discussion at MSC94
- IACS continues to undertake validation work
- Feedback welcomed

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POLARIS – background, where to find it

- POLARIS is contained within MSC.1/Circ.1519
- Background sits in INF paper submitted to MSC.94 (INF.13) *“Technical Background to POLARIS”*
- Technical Paper (ATC) *“Evaluating Risk and Determining Operational Limitations for Ships in Ice”* (Bond, Hindley, Kendrick, Kämäräinen, Kuulila)



OTC-29143-MS

Evaluating Risk and Determining Operational Limitations for Ships in Ice

J. Bond, ABS; R. Hindley, Aker Arctic Technology Inc.; A. Kendrick, VARD; J. Kämäräinen and L. Kuulila, Finnish Transport Safety Agency

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Abstract

The IMO's International Code for Ships Operating in Polar Waters (Polar Code) entered in to force on 1 January 2017 and provides, for the first time, an international regulatory framework for ships operating in Polar waters. In addition to technical regulations, the Polar Code requires that the Polar Ship Certificate should reference a methodology to assess operational capabilities and limitations in ice: essentially setting operational limitations for the specific ship navigating in Polar waters. The Polar Operational Limit Assessment Risk Indexing System (POLARIS) has been developed as an acceptable methodology for providing guidance on the operational limitations in ice of ships assigned different ice classes and has been directly referenced by the IMO in the Polar Code. The system was developed as a collaborative effort, drawing on operational and regulatory experience from industry and national administrations with experience in setting navigational limitations for ice covered waters. This paper presents the technical background behind the system and supporting information on its practical use both as a voyage planning tool and as real-time guidance on assessing ice regimes ahead of the ship. Validation of the system in the context of other existing regulatory requirements is discussed. The limitations of the system are explored and commentary and proposals are provided on recommended future enhancements.

Introduction

Operators have often been faced with uncertainty when determining the safety level of their ships in ice. Classification society rules provide various ice classes which set a certain strengthening requirement for the ship's hull and propulsion machinery to mitigate ice impacts. However, relating the ice class and the often-nominal ice thickness associated with it to actual ice conditions during navigation is problematic. Historically then the art of operating safely in ice has relied on practical knowledge and comparisons of successful and unsuccessful experiences. Article 234 of UNCLOS (UN,1982) allows coastal states to enforce regulations for the prevention of marine pollution in their exclusive economic zone (EEZ) in particular where the presence of sea ice may cause exceptional hazards to navigation. Several coastal administrations have initiated traffic operational limitations and restrictions for ships operating in their territorial waters during the ice season, often using the ships ice class as a reference. The development of the mandatory International Code for Ships Operating in Polar Waters (Polar Code) (IMO, 2015) prompted

POLARIS – what it is

- Core of POLARIS is a set of Risk Index Values for each WMO ice type and each ice class
- These are used to evaluate the risk of a ship operating in a certain ice regime

Increasing ice thickness (severity) →

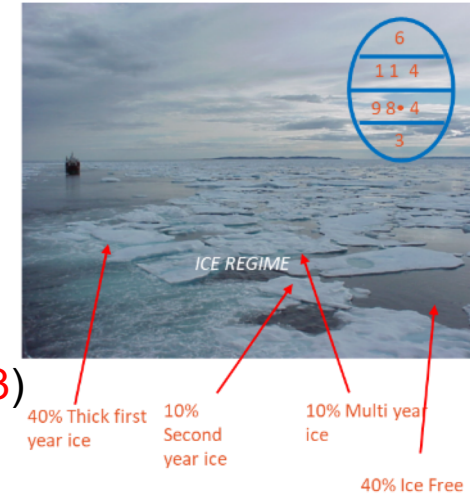
Increasing ice class ↑

| | RISK INDEX VALUES (RIVs) for each Ice Type | | | | | | | | | | | |
|--------------|--|---------|----------|----------------|---------------------------|---------------------------|-------------------|-----------------------------|------------------|-------------|------------|------------------|
| | ICE FREE | NEW ICE | GREY ICE | GREY WHITE ICE | THIN FIRST YEAR 1ST STAGE | THIN FIRST YEAR 2ND STAGE | MEDIUM FIRST YEAR | MEDIUM FIRST YEAR 2ND STAGE | THICK FIRST YEAR | SECOND YEAR | MULTI YEAR | HEAVY MULTI YEAR |
| PC 1 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| PC 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| PC 3 | 3 | 3 | 3 | 3 | | 2 | 2 | 2 | 2 | 2 | 1 | 0 |
| PC 4 | 3 | 3 | 3 | 3 | | | 2 | 2 | 1 | 0 | -1 | -2 |
| PC 5 | 3 | 3 | 3 | 3 | 2 | | | 1 | 0 | -1 | -2 | -2 |
| PC 6 | 3 | 2 | 2 | 2 | 2 | 1 | | 0 | -1 | -2 | -3 | -3 |
| PC 7 | 3 | 2 | 2 | 2 | 1 | 1 | | | -2 | -3 | -3 | -3 |
| IAS | 3 | 2 | 2 | 2 | 2 | 1 | 0 | | | -3 | -4 | -4 |
| IA | 3 | 2 | 2 | 2 | 1 | 0 | -1 | -2 | | -4 | -5 | -5 |
| IB | 3 | 2 | 2 | 1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -6 |
| IC | 3 | 2 | 1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 | -8 |
| No Ice Class | 3 | 1 | 0 | -1 | -2 | -3 | -4 | -5 | -6 | -7 | -8 | -8 |

Increased Risk

POLARIS: Concept in one slide

| | RISK INDEX VALUES (RIVs) for each Ice Type | | | | | | | | | | | |
|------|--|---------|----------|----------------|---------------------------|---------------------------|--------------------|------------------------------|------------------|-------------|------------|------------------|
| | ICE FREE | NEW ICE | GREY ICE | GREY WHITE ICE | THIN FIRST YEAR 1ST STAGE | THIN FIRST YEAR 2ND STAGE | MEDIU M FIRST YEAR | MEDIU M FIRST YEAR 2ND STAGE | THICK FIRST YEAR | SECOND YEAR | MULTI YEAR | HEAVY MULTI YEAR |
| PC 7 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | -1 | -2 | -3 | -3 | -3 |



RIV's assigned for ice class PC7:

$$\text{RIO} = (4 \times 3) + (4 \times -2) + (1 \times -3) + (1 \times -3)$$

40% ice free + 40% thick first Yr + 10% Second Yr + 10% Multi Yr

$$\text{RIO} = -2$$

Outcome for PC7 ship in
this ice regime =
Elevated operational risk

| <i>RIO_{SHIP}</i> | <i>Ice classes PC1-PC7</i> |
|---------------------------|--|
| $\text{RIO} \geq 0$ | Normal operation |
| $-10 \leq \text{RIO} < 0$ | Elevated operational risk* |
| $\text{RIO} < -10$ | Operation subject to special consideration** |

A deadline to work to: January 2021

GUIDANCE ON METHODOLOGIES FOR ASSESSING OPERATIONAL CAPABILITIES AND LIMITATIONS IN ICE

1 The Maritime Safety Committee, at its ninety-fourth session (17 to 21 November 2014), adopted the new chapter XIV of SOLAS and the International Code for Ships Operating in Polar Waters (Polar Code), by resolutions MSC.386(94) and MSC.385(94), respectively. In accordance with the Polar Code, new and existing ships operating in polar waters shall have on board a valid Polar Ship Certificate establishing operational limitations, including limitations related to ship structural ice capabilities.

2 The Polar Code also requires that information on ship-specific capabilities and limitations in relation to the assessment required under section 1.5 of the Polar Code be included in the Polar Water Operational Manual (PWOM).

3 The annexed guidance addresses the development of methodologies for the assessment of operational limitations in ice which may be referenced on the Polar Ship Certificate and which may form part of information on ship-specific capabilities and limitations included in the PWOM.

4 This guidance has been issued as "interim guidance" in order to gain experience in its use. It should be reviewed four years after the entry into force of the Polar Code in order to make any necessary amendments based on experience gained.

5 In the meantime, Member States and international organizations are invited to report on their experience with the use of the guidance to the Maritime Safety Committee under the agenda item "Any other business".

6 Member States are invited to bring the annexed guidance to the attention of all parties concerned.

POLARIS – what it can become (?)

- Industry standard for evaluating safety levels / risks in ice
- A reference for regulators, administrations and others interested in safety risks (insurers)
- A living system which responds to industry needs and technology developments
- A tool to assist in ice navigator training
- A support tool for company seasonal voyage planning
- A support tool for selecting a new ship's ice class



Some areas for improvement

- RIV updates
- Glacial Ice
- Icebreaker Escort
- Linear dependency on ice concentration
- Low speed limit
- Propeller strength?

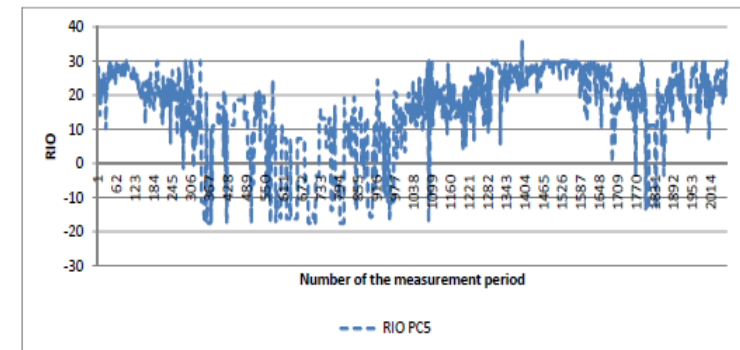
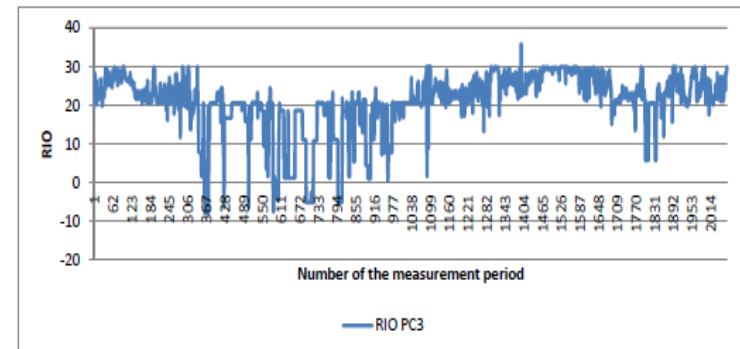
... feedback is needed!



Previous data gathering (feedback) exercises

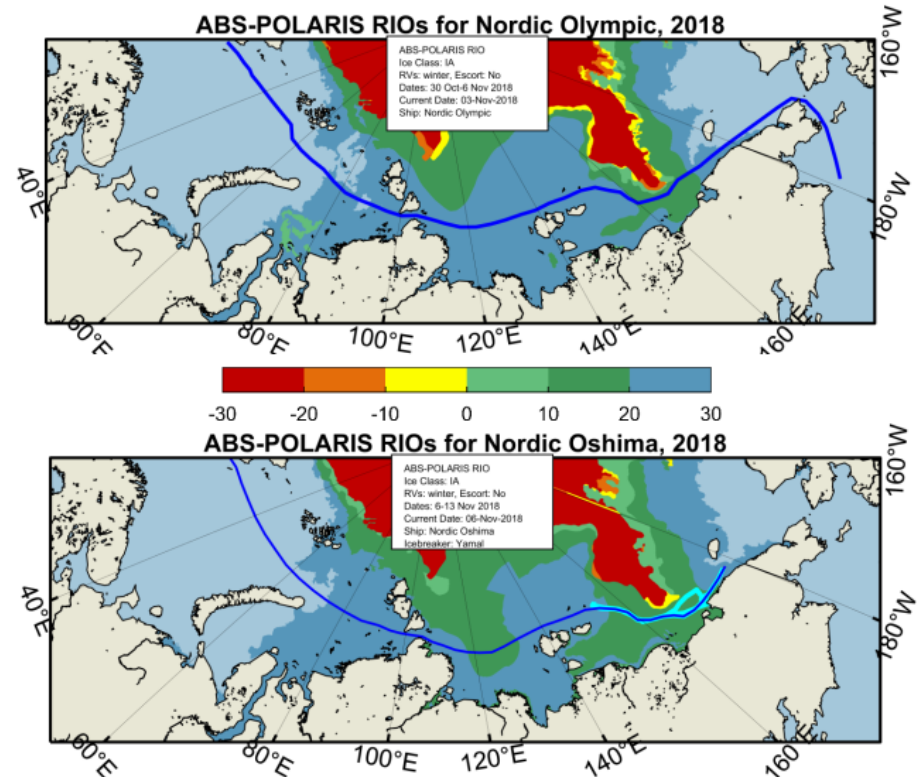
- Separate work by Kujala et. Al (2015) at Aalto University in "Analysis of a suitable ice class of ship hull for Antarctic operations"
- Compared RIO determined from recorded ice conditions (thickness / concentration) with stress levels recorded by an Ice Load Monitoring System on the SA Agulhas II

A?



ABS POLARIS: 2018 Transits

- Plots
 - AIS track for the YAMAL is shown on the images
 - RIOs are for no escort
- NORDIC OLYMPIC
 - On NSR from 23 Oct thru 2 Nov
 - There was definitely a path through that did not require escort
- NORDIC OSHIMA
 - On NSR from 29 Oct thru 6 Nov
 - Definite path through that did not require escort is evident



- Courtesy of ABS!

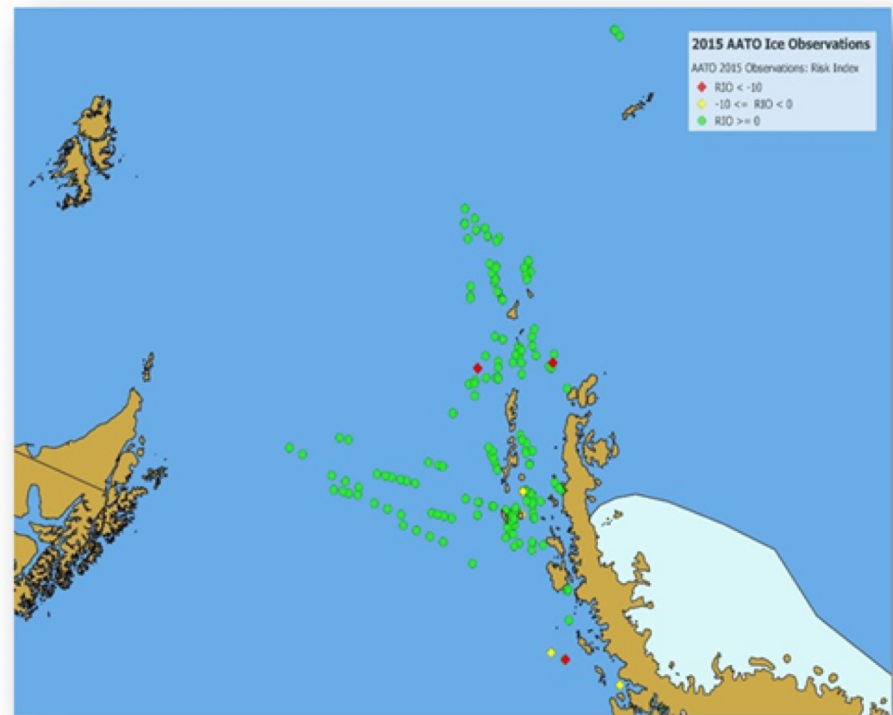
Previous data gathering (feedback) exercises

■ Trialling of POLARIS in the Antarctic:

Prior to finalisation of POLARIS IAATO volunteered to trial the system in the Antarctic

- ◆ Feedback on system
- ◆ Gather ice condition data
- ◆ 25 voyages, 10 ships

■ Two follow-up seasons



Examples of log books used:

- Developed under IACS
- Reports gathered by LR
- Data processed by VARD Marine

IACS

POLARIS
Polar Operational Limit Assessment Risk Indexing System

ICE CONDITIONS LOG BOOK

SHIP'S NAME:

Revision 0.9

IACS POLARIS Ice Condition Reporting Log Book

Form A This form is to be completed once for every voyage.

General Particulars

| | |
|------------|----------------------|
| Ship Name | <input type="text"/> |
| Call Sign | <input type="text"/> |
| IMO Number | <input type="text"/> |
| Ship Type | <input type="text"/> |
| Ice Class | <input type="text"/> |

Supplementary comments on the ship's characteristics, if applicable
(e.g. number of seasons ship has operated on route):


Voyage Plan

Description of itinerary (to include port of departure and planned intermediate calling points as applicable):

Authorisation

| | |
|---------------|----------------------|
| Name | <input type="text"/> |
| Rank/Position | <input type="text"/> |

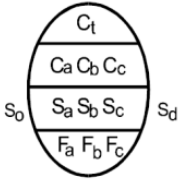
Log book content – introductory text



IACS POLARIS Ice Condition Reporting Log Book

Annex – Guidance on ice types and concentrations

Floe sizes & Ice types



C_t Total concentration of ice in area, reported in tenths

C_a C_b C_c Partial concentration in tenths of thickest (C_a), second thickest (C_b) and third thickest (C_c) ice types with C_a, C_b, C_c 1/10 or more. If only one thickness type is present, C_a equals C_t and the second level is left blank.


S_a S_b S_c Stage of development (age) of ice concentration reported by C_a, C_b, C_c.

F_a F_b F_c predominant form of ice (Floe size) corresponding to S_a, S_b and S_c.

S_o S_d Development stage (age) of remaining ice types. S_o if reported is a trace of ice type thicker/older than S_a. S_d is thinner ice type which is reported when there are four or more ice thickness types.

| F _a F _b F _c | S _a S _b S _c |
|--|--|
| Form of ice (width) | Stages of Development (thickness cm) |
| 0 Pancake | 1 New - < 10 |
| 1 Brash | 2 Nilas - < 10 |
| 2 Ice Cakes - < 20 m | 3 Young - 10 - 30 |
| 3 Small floe - 20 - 100 m | 4 Grey - 10 - 15 |
| 4 Medium floe - 100 - 500 m | 5 Grey-white - 15 - 30 |
| 5 Big Floe - 500 - 2000 m | 6 First-year - > 30 |
| 6 Vast Floe - 2 - 10 km | 7 Thin First-year - White - 30 - 70 |
| 7 Giant Floe > 10 km | 1. Medium First-year - 70 - 120 |
| 8 Fast Ice | 4. Thick First-year - > 120 |
| 9 Icebergs | 7. Old |
| X No Form | 8. Second Year no |
| C Ice is in strips with concentration C | 9. Multi-year icebergs defined ranges |

Note: All ages to the left of " " are decoded from the table as having " "



IACS POLARIS Ice Condition Reporting Log Book

Purpose

The purpose of this log book is to record ice conditions encountered by vessels transiting in the Arctic and Antarctic. The data gather will be used to validate the POLARIS (Polar Operational Limit Assessment Risk Indexing System) decision making tool that is currently being considered at the IMO.

The intent is to encourage ship operators to provide "ground truth" data on their operations in ice so that POLARIS suitably reflects the actual ice conditions being encountered. The intent of this reporting is not to undermine operator's decisions. The data gathered will be filtered and collated so that individual cases will not be made available externally.

Authorship

This log book has been developed by IACS (International Association of Classification Societies) to validate POLARIS which originated from an IACS initiative. Comments and queries may be directed to Rob Hindley, Lead-Specialist Arctic Technology at Lloyd's Register (rob.hindley@lr.org).

Format & Instructions for use

This log book consists of three Forms:

Form A is a ship specific reporting form which includes general information on the ships characteristics. This form need only be completed once.

Form B is a condition specific reporting form. This form is to be used to record ice conditions encountered by the ship, as seen from the vessel's bridge. Form B should be completed by the officer of the watch or their designate. As a guide it is recommended that a Form B is completed:

- A minimum of once every watch (even when no ice conditions are present)
- When entering ice
- When operating in ice and the ice conditions ahead of the ship change sufficiently for the officer of the watch to consider altering course or changing speed

However in order to reduce additional burden on the watch keeper reporting of the most significant ice conditions / events by the judgement of the OOW is encouraged above all else.

Each time a Form B is completed a photograph of the ice conditions as seen from the bridge should be made and suitably cross-referenced to the Form B. Each time a Form B is completed and an ice chart is available a copy of the ice chart should be attached to the Form B.

Form C is a feedback form. This form need only be completed once, is optional and provides an opportunity to comment on challenges with recording / reporting of ice conditions during the voyage and on use of this log book.

Regular log – per hour (or when conditions change)

IACS

POLARIS Ice Condition Reporting Log Book

Form B Page 1 of 2

To be completed when tactical ice operational decisions are made

| | | | |
|--------------------|--|----------------------|--|
| Ship Name | | | |
| Observation ID # | | Digital photo / ID # | |
| Date | | Latitude | |
| Time (& Time Zone) | | Longitude | |

Operational Conditions

| | |
|--------------------|--|
| Activity/Operation | |
| Vessel Speed | |
| Visibility | |

Ice Conditions

[Remember % cover must add up to 100. Include open water]

Floe size

[tick one applicable]

Brash ☐ / Small ☐

Medium ☐ / Big ☐

Vast ☐ / Giant ☐

Roughness / Ridges

[tick one applicable]

None ☐ / Low ☐

Medium ☐ / High ☐

Ice Pressure

[tick one applicable]

None ☐ / Light ☐

Medium ☐ / Intense ☐

| Ice Type | | % cover |
|---|---------------|---------|
| [enter % of each ice type in right column] | | |
| Open Water | | |
| New Ice | | |
| Grey Ice | (10-15cm) | |
| Grey-White Ice | (15/30cm) | |
| Thin First Year Ice (1 st Stage) | (30-50cm) | |
| Thin First Year Ice (2 nd Stage) | (50-70cm) | |
| Medium First year Ice (1 st Stage) | (70-100cm) | |
| Medium First year Ice (2 nd Stage) | (100cm-120cm) | |
| Thick First year Ice | (120-200cm) | |
| Second Year Ice | (200- 300cm) | |
| Old/Multi-year Ice | (>300cm) | |
| Old/Multi-year Ice ("ugly MY") | (> 300cm) | |
| TOTAL | | 100 |

Revision 1.0

FORM B

Page 1 of 2

IACS

POLARIS Ice Condition Reporting Log Book

Form B Page 2 of 2

Identification and presence of glacial ice

| | |
|---|---|
| Glacial Ice present? | Yes <input type="checkbox"/> / No <input type="checkbox"/> |
| How is glacial ice identified? [tick applicable] | Historic knowledge of area <input type="checkbox"/> / Visually from Bridge <input type="checkbox"/> / Other means <input type="checkbox"/> (please specify): <div></div> |
| Type of glacial ice [tick all applicable] | Trace <input type="checkbox"/> / Bergy Bit <input type="checkbox"/> / Iceberg <input type="checkbox"/> |

Comments from the Officer of the Watch

How would you describe progress made in this ice regime? [tick applicable]

Easy ☐ / Steady, but cautious ☐ / Challenging ☐ / Difficult ☐

Did you alter your mode of operation with this ice regime?

Yes ☐ / No ☐ If yes, how?

Reduction in speed ☐ Speed reduced to knots

Manoeuvre around ice floes ☐

Other ☐ If so, specify:

General Comments

Please make any further general comments on the ice conditions below:

Experience of personnel completing Form B

Please describe experience of personnel for ice navigation (seasons, areas etc.):

| | |
|---------------|--|
| Name | |
| Rank/Position | |

Revision 1.0

FORM B

Page 2 of 2

Voyage log and feedback

IACS

POLARIS Ice Condition Reporting Log Book

Form C This form is to be completed once for every voyage or season.

Comments on assessing ice conditions

Comments on using this Log Book

Other comments / recommendations

Experience of personnel completing Form C

| | |
|---|--|
| Please describe experience of ice navigation (seasons, areas etc.): | |
| | |
| Name | |
| Rank/Position | |

Status of POLARIS updates

- No work is being done by IACS on updating POLARIS
- Technical team who worked on it are dispersed
- Limited work being done in academia to investigate POLARIS's validity
- ***This*** is the forum for feedback:
 - ◆ Could we (ASBPIF) develop standard logbooks and reporting?
 - ◆ Could the web portal be used to collect the logbooks / data?
 - ◆ Could we (ASBPIF) embark on a small amount of work to process the data so that it could be used by others to develop updates to POLARIS?



ASBPIF as a means to cooperate – some thoughts

- An opportunity for joint industry-administration cooperation to report ice conditions and POLARIS outcomes
- Could some agreement be made between the Arctic States for this?
- What is industry willing to contribute?
- Ideally:
 - ◆ Technical team or working group established to do this and to report to ASBPIF
 - ◆ Preparation of log books and reporting approach to be agreed
 - ◆ Reporting of log books uploaded to ASBPIF web portal
 - ◆ Data made available on the portal (in some kind of redacted format?)

Final Message

- MSC1.Circ.1519 is interim guidance, we should be working now to get updates ready for 2021 (2022?)
- Updates will be dependent on:
 - ◆ Sharing of practical operational data between operators and administrations
 - ◆ Collection of data on operations, ice conditions and damages
 - ◆ Dedicated trials and measurements
 - ◆ Systematic recording and reporting to the IMO
 - ◆ Cooperation!





Aker Arctic

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