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

James Bond
Rob Hindley

09 October 2014
Objective of this presentation

The objective of this presentation is...

... to describe the development and key elements of a system for determining ice operational limitations
Content of this presentation

Context
Participants and structure of the informal group
Terms of Reference: Purpose of the task, Scope
Key concepts
Approach for developing operational limitations
Examples
Way forward
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.
Participants and structure of informal group

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

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

Develop Technical Content

Develop Proposal

Review and Validate
Identified Work Scope

- 100% ice coverage of one ice type, as presented at MSC93 is very rare in practice
- How will administrations and operators implement it?
- Current wording of ice classes does not provide sufficient information
Goal of Technical Group:

Develop a decision making system that can be used for voyage planning and "on the bridge" that uses the actual ice conditions, ice class and operational mode.

Polar Operational Limit Assessment Risk Indexing System (POLARIS)

INPUT → RISK LEVEL → OPERATION

- Actual ice conditions
- Ice class of ship
- Icebreaker escort or independent

Don’t operate
More Cautious operation
Operate

Safer and Cleaner Shipping
Key Concepts: Approach for updating limitations

- MSC93 Limitations Concept / Table
  - Initial Level ice (100% concentration) limit
  - Consolidated Level ice (100% concentration) limit
  - Level ice (100% concentration) limit with adjusted ice type terminology

- Partial Ice Concentration Approach
  - Summer (decayed ice) Approach
  - Escorted Operation Approach

- Updated Limitations System (POLARIS)

Safer and Cleaner Shipping
Key Concepts: Consolidation of existing experience

Technical group’s experience with ice class rules and ship operations in ice overlaid on initial MSC93 proposal

- Canada experience: Canadian Arctic Classes (CAC), Type Classes
- Denmark experience: Baltic (FSICR) Classes in Arctic conditions
- Finland / Sweden experience: Baltic (FSICR) Classes
- Russia experience: RMRS Arctic (Arc) Categories, RMRS Ice Categories

Consolidated Level ice (100% concentration) limit

IACS Polar Classes Technical Background
Key Concepts: Consolidation of existing experience
Key Concepts: Partial Ice Concentration Approach

- Assigns a graded level of risk to ice types for each ice class
- Based on Canadian AIRSS approach
### Key Concepts: Partial Ice Concentration Approach

Increasing ice thickness (severity)

<table>
<thead>
<tr>
<th>POLAR SHIP CATEGORY</th>
<th>ICE CLASS</th>
<th>ICE FREE</th>
<th>NEW ICE 0-10 cm</th>
<th>GREY ICE 10-15 cm</th>
<th>GREY WHITE ICE 15-30 cm</th>
<th>THIN FIRST YEAR 1ST STAGE 30-50 cm</th>
<th>THIN FIRST YEAR 2ND STAGE 50-70 cm</th>
<th>MEDIUM FIRST YEAR 1ST STAGE 70-95 cm</th>
<th>MEDIUM FIRST YEAR 2ND STAGE 95-120 cm</th>
<th>THICK FIRST YEAR 120-200 cm</th>
<th>THICK FIRST YEAR 2ND STAGE 200-250 cm</th>
<th>SECOND YEAR 250-300 cm</th>
<th>LIGHT MULTI YEAR 300-350 cm</th>
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</table>
Key Concepts: Decayed Ice Approach (Summer Season)

Adjustment of medium and thick first year ice to reflect ice decay and reduction in ice strength

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Safer and Cleaner Shipping
Key Concepts: Escorted in ice operation

- Correction of RIO value:
  - RIO result given a +10 “bonus”
  - Primarily based on input from Finland and Russia
- In addition, for “real time” use, the ice regime created by the icebreaker is to be assessed
- Looks complex, but simply reflects the actual reality that both Masters should be involved in the decision

- Canada AIRSS
- Escorted Operation Approach
- Russia experience: RMRS Arctic (Arc) Classes, RMRS Ice Classes
- Finland / Sweden experience: Baltic (FSICR) Classes

Safer and Cleaner Shipping
IACS

Key Concepts: Escorted in ice operation

• For Voyage planning, using ice charts:
  • Icebreaker uses ice chart data with POLARIS and calculates RIO based on its ice class
  • Escorted ship uses ice chart data with POLARIS and calculations RIO based on its ice class with a +10 bonus

• For real-time on bridge operation:
  • As above, and...
  • Escorted ship visually assesses ice regime made by icebreaker track with POLARIS and calculates RIO based on its ice class

Safer and Cleaner Shipping
Key Concepts: Expressing risk level as an operational decision

- Assessment of limitations – Risk Index Outcome (RIO)
  - Basic calculation procedure
  - Sum of \( (\text{Ice Concentrations (C)} \times \text{Risk Values (RV)}) \)
  - \( \text{RIO} = (C_1 \times RV_1) + (C_2 \times RV_2) + (C_3 \times RV_3) + (C_4 \times RV_4) \)
  - \( C_1 \ldots C_4 \) - concentrations of ice types within ice regime (maximum of four from Egg Code)
  - \( RV_1 \ldots RV_4 \) – corresponding risk index values

- Risk Values (RV) are a function of ship ice class, season of operation, and operations state (independent operation or icebreaker escort)
### POLARIS: Evaluation Criteria (Independent Operations)

<table>
<thead>
<tr>
<th>$\text{RIO}_{\text{SHIP}}$</th>
<th>Category A &amp; B (PC1 – PC7)</th>
<th>Category C (below PC7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{RIO} \geq 0$</td>
<td>Operation Permitted</td>
<td>Operation Permitted</td>
</tr>
<tr>
<td>$-10 \leq \text{RIO} &lt; 0$</td>
<td>Limited Speed Operation Permitted (See Table 1.3)</td>
<td>Operation Not Permitted</td>
</tr>
<tr>
<td>$\text{RIO} &lt; -10$</td>
<td>Operation Not Permitted</td>
<td>Operation Not Permitted</td>
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</tbody>
</table>
POLARIS in practice

• What it is:
  • A risk assessment tool:
    • For use on-board in real time on the bridge (a guide to help the master relate the ship’s structural safety level with the ice he sees
    • For use in voyage planning on board and ashore
    • Guidance for linking ship strength and safe operations in actual ice conditions

• What it is not:
  • Not intended to replace Master’s judgement
POLARIS in practice…onboard

- Master assesses ice conditions
- Master calculates RIO
- Use ice charts for planning, use actual conditions seen from the bridge in real time
POLARIS in practice...onboard

- PC7 ship, independently operating in winter time, the master only uses this information

<table>
<thead>
<tr>
<th>Category</th>
<th>Ice Class</th>
<th>Ice Free</th>
<th>New Ice</th>
<th>Grey Ice</th>
<th>Grey White Ice</th>
<th>Thin First Year Ice, 1st Stage</th>
<th>Thin First Year Ice, 2nd Stage</th>
<th>Medium First Year Ice</th>
<th>Medium First Year Ice 2nd Stage</th>
<th>Thick First Year Ice</th>
<th>Second Year Ice</th>
<th>Light Multi-Year Ice</th>
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<th>$RIO_{SHIP}$</th>
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</tr>
<tr>
<td>$RIO &lt; -10$</td>
<td>Operation Not Permitted</td>
<td>Operation Not Permitted</td>
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</tbody>
</table>
POLARIS: RIO Calculation example (from Ice Chart Data)

RIO = (C_1 \times RV_1) + (C_2 \times RV_2) + (C_3 \times RV_3) + (C_4 \times RV_4)

- **Ice Class PC7**
  
  \[ RIO = (8 \times 1) + (2 \times -1) = +6 \]
  
  RIO is positive = “GO“

- **Ice Class IB**
  
  \[ RIO = (8 \times -1) + (2 \times -3) = -14 \]
  
  RIO is negative = “NO GO“

- **S_A** = Thin first year ice (30 – 70 cm)
- **S_B** = Medium first year ice (70 – 120 cm)
POLARIS RIO Calculation: Example (actual ice conditions = ice regime)

- 4/10\(^{th}\) thick first year ice (#4·)
- 1/10\(^{th}\) second year ice (#8·)
- 1/10\(^{th}\) multi-year ice (#9·)
- 4/10\(^{th}\) ice free
- Ice Class PC7

RIO = (4 \times -2) + (1 \times -3) + (1 \times -3) + (4 \times 3) = -2

RIO is negative, but >-10

“GO with SLOW Speed Limitation“
Table 1.3 Marginal capability speed limitations

<table>
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<tr>
<th>Ship Category (ice class)</th>
<th>Independent Operation</th>
<th>Escorted Operation</th>
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<td>A (PC1 – PC2)</td>
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<td>A (PC3 – PC5)</td>
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<td>B (PC6 – PC7)</td>
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<tr>
<td>C (IA Super - IA)</td>
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<tr>
<td>C (below IA)</td>
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- Acknowledges that there is not a finite point when the ship cannot operate
- Based on IACS ice class rule formulations
Why are IA and IAS in Category C?

- Different risk levels for all ice classes
- IA and PC7 are not the same strength level
- PC6, PC7 assumed to comply with tank protection
- POLARIS has facility to upgrade a ship if equivalency can be demonstrated
POLARIS in regulations

- Policy decision – IACS have only presented a technical system and have not proposed the mechanism for implementing as guidance or otherwise

- POLARIS can be used as part of Risk Assessment procedures for voyage planning

- POLARIS can be used to assist in selecting the appropriate ship (or ice class) for specific areas, using historical ice data

- Ice Class and assigned Risk Index forms the basis of limitations in POLARIS

- Risk Index may be assigned to existing ships based on equivalency
POLARIS in regulations

• Policy decision – setting limitations for existing ships:
  • Technical assessment should be demonstrate structural equivalency: this sets the level of risk
  • Guidance on determining equivalency in Part IB includes consideration for service (existing) experience
  • There may be the need to assign bespoke Risk Values for ships that lie “between” ice classes
POLARIS: Example in a non-Uniform Ice Regime

- Winter ice type
- 1/10\(^{th}\) Medium first year ice (2\(^{nd}\) stage)
- 4/10\(^{th}\) Thick first year ice
- 5/10\(^{th}\) Ice free

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Safer and Cleaner Shipping
POLARIS: Example in a non-Uniform Ice Regime

- Winter ice type
- 8/10\textsuperscript{th} Thick first year ice
- 1/10\textsuperscript{th} Multi-year ice
- 1/10\textsuperscript{th} Ice free
POLARIS: Example in a non-Uniform Ice Regime

- Winter ice type
- 7/10\(^{th}\) Thick first year ice
- 2/10\(^{th}\) Multi-year ice
- 1/10\(^{th}\) Ice free

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Safer and Cleaner Shipping
Example Arctic ice chart for single day (31 October 2013)

- RIOs calculated for non-ice classed ship
- Summer RVs
- Ice chart zone boundaries

Ice data source
POLARIS: An operations / planning tool

• Considering a voyage through the Northwest Passage at the time of year that historically coincides with minimum ice extent (10-29 Sep 2014)
• Two ice charts used (CIS Canadian Arctic – East & West) plot overlays the minimum RIOs from each of three specific days (Sept 15, 22 and 29)
• Ship ice class = Baltic 1A
• NO GO!
POLARIS: An operations / planning tool

- Consider the same voyage and the same ice charts
- Change ship to ice class = PC 4
- GO! - slow speed (cautious operations) for part of the trip

Ice Class PC4 POLARIS Summer Minimum RIOs for 9/10-29
POLARIS: Comparison to AIRSS

- Consider a ship with **no ice class** (red and also yellow = no go)
- Arctic between 10-15 October

FEDNAV courtesy Mr Tim Keen (6 year average data)

POLARIS (10 year average data)

Ice Class NO POLARIS Summer Average RIOs for 10/15-31

**Safer and Cleaner Shipping**
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
Example from Ice Chart

- Beaufort Sea
- 8/10th thin first year ice (#7)
- 2/10th medium first year ice (#1·)
First meeting of Technical Group agreed purpose:

The purpose of the Technical Work for the small technical content group is to develop guidance, based on the existing content in Part B, which can be used by the administration and Masters to identify limitations and to ensure the guidance suitably aligns with the content of the Polar Ship Certificate.
### POLARIS: Example of Uniform Ice Regime

- **10/10ths Coverage**
- **Winter ice**
- **Single ice type**

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**Risk Index Outcomes - 10/10ths Coverage, Single Ice Type, Winter Ice**

**Safer and Cleaner Shipping**
**POLARIS: Example of Uniform Ice Regime**

- 10/10ths Coverage
- Summer ice
- Single ice type

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Risk Index Outcomes - 5/10ths Coverage, Single Ice Type, Summer Ice

Safer and Cleaner Shipping