



Considerations when planning for Multi-Ship Ice Management Operations in Polar Waters

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ARCTIC MARINE SOLUTIONS AB

- Founded 2012 – focused on Arctic operations
- Team of experts from Polar operations
 - Logistics, Icebreaking, IT-solutions, meteorology
- Clients are shipowners, energy companies, scientific organisations, Government agencies
- Promoting responsible operations
 - The voluntary *Arctic Marine Best Practice Declaration* in 2012 lead to the creation of this forum
 - IMO Polar Code final outcome influenced by effort with Swedish MFA and Swedish Polar Research Secretariat conference in London March 2014, which resulted in the link between ice conditions/ice class and POLARIS system.



ARCOP 2022



- ArcOP is an international scientific expedition
 - August –September 2022
 - Scientific expedition to the Lomonosov ridge at 81N 140E.
 - Drilling for 900 m core-sediments in 800 m of water.
- Arctic Marine Solutions is, via Swedish Polar Research Secretariat, responsible for *Fleet and Ice Management* during the ArcOP expedition.
- *“Keeping a drilling vessel stationary in drifting pack-ice for an extended period of time”*
- *What were the basic considerations during selection of the fleet for ArcOP?*





IODP Expedition 377 ArcOP Overview



Bathymetry: GEBCO Compilation Group (2021) GEBCO 2021 Grid
(doi:10.5285/a29c5465-b138-234d-e053-6c86abc040b9)



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POLAR CODE

POLAR CODE CHAPTERS

EXPLANATION AND SUBMISSIONS

Part IA: Safety Measures

Chapter 1: General

Chapter 2: Polar Water Operation Manual

Chapter 3: Ship structure

Chapter 4: Subdivision and stability

Chapter 5: Watertight and weathertight integrity

Chapter 6: Machinery installations

Chapter 7: Fire safety/Protection

Chapter 8: Life saving appliances and arrangements

Chapter 9: Safety of navigation

Chapter 10: Communication

Chapter 11: Voyage planning

Chapter 12: Manning and training

Part IIA: Pollution Prevention Measures

Chapter 1: Prevention of Pollution by Oil

Chapter 2: Control of pollution by noxious liquid substances in bulk

Chapter 4: Prevention of pollution by sewage from ships

Chapter 5: Prevention of pollution by garbage from ships

Part IB

Additional Guidance Regarding the Provisions of the Introduction and Part I-A

Part IIB

Additional Guidance Regarding the Provisions of the Introduction and Part II-A



ARCOP IN PERSPECTIVE



ARCTIC AREAS

- 1 ACEX
- 2 NE Greenland
- 3 East Siberian
- 4 Beaufort
- 5 Laptev
- 6 Kara
- 7 N Barents
- 8 Pechora
- 9 Chukchi
- 10 Baffin Bay

Not as severe ice as ACEX 2004 but 20-25 days on site vs 8 days

ARCTIC AREAS

	Location*	Ice Type	Thickness	Drift	Icebergs	Window	Ice Class	Severity**	Comment
1	ACEX 2004	MYI	2.5-3.5 m	<0.6 kts	No	Aug	PC 1-2	5	88.5 N 145 E- core drilling on Lomonosov Ridge
2	NE Greenland	FYI+MYI	1.5-3.5 m	<0.7 kts	Some, mostly grounded	Aug Oct	PC 1-2	4-5	Up to 50% MYI. Frequent eddies.
3	East Siberian	FYI+MYI	1.0-2.5 m	<0.6 kts	No	Aug Sep	PC 1-3	4	MYI = Ugly Old Ice. Remote.
4	Beaufort (Canadian)	FYI+MYI	1.5-2.5 m	<0.8 kts	No	Aug Oct	PC 2-3	4	Area opens up for work prior to opening for access. Well researched regarding ice. Often high drift speeds.
5	Laptev (mid)	FYI+MYI	1.0-2.5 m	<0.5 kts	Potential	Aug Oct	PC 2--3	3-4	Large Polyniyas in June. Area opens before access routes do. Heavy ice class to get in. Potential for relatively long open water season inside.
6	Kara (mid)	FYI + low concentration MIY in North	1.0-2.0 m	<0.5 kts	Yes	Aug Oct	PC 3-4	3	Mixed bag of FYI, possibly MYI, and icebergs. High variability geographically
7	N Barents	FYI with MIY intrusions	1.0 m	<0.5 kts	Potential	May Nov	PC 2-4	2	High variability
8	Pechora	FYI	0.7-1.2 m	<0.6 kts	No	Jul Nov	PC 4-7	2	Open water Summer. Heavy FYI Winter. Shallow water with ice drift direction changes. Production year-round today.
9	Chukchi	FYI + potential MYI intrusions	0.5-2.0 m	<0.6 kts	No	Jul Nov	PC 1-6	2	Relatively benign ice, but potential MYI can be Ugly Old Ice
10	Baffin Bay	FYI + icebergs	1.0-1.5 m	<0.5 kts	Yes!	Jun Oct	PC 4-6	1-2	Icebergs are frequent
11	Sakhalin	FYI only	0.5-1.5 m	<0.7 kts	No	Jan Dec	PC 5-7	1	Operations year-round with icebreaking PSVs . Stable ice-drift.

* Typical offshore licence location

** Operating difficulty ranking 1-5



ICE CONDITIONS

Planning for conditions that may occur during operation. Some sources used:

- Ice coverage - AMSRE-E (University of Bremen)
- Ice thickness – Polar Portal (DMI)
- Ice drift – proprietary method hindcasting using ECMWF data

and most importantly

- Experience from Arctic voyages (in area and similar areas) with the ODEN and other vessels.



DEMAND ON OPERATION

Drilling vessel:

- Moon-pool
- Drilling rig fitted or possible to fit
- Able keep position in managed ice
- Sufficient ice class – if protected by Ice Management icebreakers – to be safe in managed ice
- POB capacity for drilling/science team



DEMAND ON OPERATION

Ice Management vessels:

- Ability to efficiently manage Multi-Year-Ice
 - Power
 - Strength
 - Manoeuvrability
- At least one unit to be *heavier* than ODEN (ODEN = reference object for us)



~~ACEX 2004~~ ARCOP 2022

Ice Management
ODEN

Coring vessel
~~VIDAR VIKING~~
DINA POLARIS

Ice Management
~~SOVIETSKIY SOYUZ~~
VIKTOR CHERNOMYRDIN



VIKTOR CHERNOMYRDIN
Icebreaker 25 MW
Delivered 2020



DINA POLARIS
Ice class 1A
Delivered 2017



ODEN
Icebreaker 18 MW
Delivered 1989

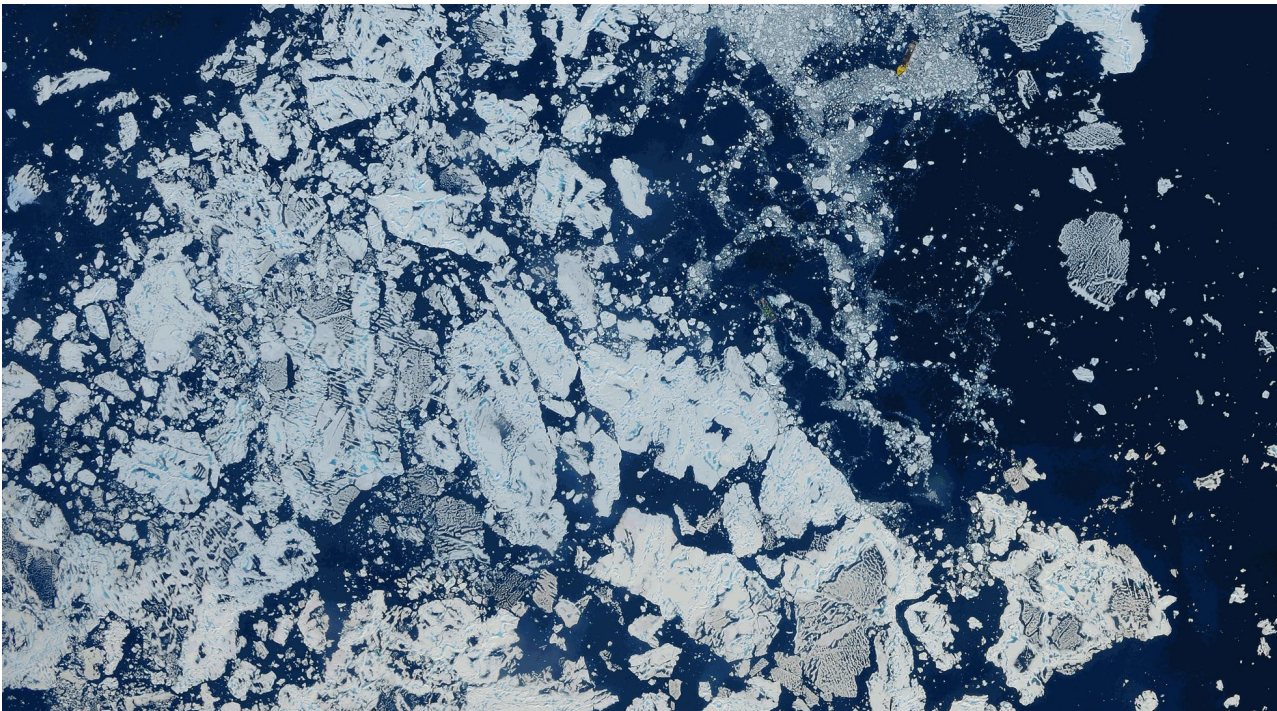
OPERATION WITH 1A ICE CLASS POSSIBLE?

- At operation site - Safe Speed:
 - Finnish/Swedish Ice Class 1A = proceeding in a broken channel of 1 m First-Year-Ice (with hardness like northern Baltic wintertime) at 5 knots.
 - Typical ice-drift at ArcOP >1 knot.
- In/out of operation site:
 - Two large icebreakers in formation
 - Slow speed
 - Best part of the year



ESTIMATE OF MANAGED ICE

Ice-floe size diameter	Thickness / Type	Percentage of each size
1.5 – 5 m	1.0 m FYI	30%
5 – 10 m	1.5 m FYI	25%
10 - 20 m	1.5 m FYI	20%
20 – 30 m	1.5 m FYI	20%
30 – 50 m	2.5 m MYI	5 %



Max drift speed:
1.4 knots

Typical ice drift speed:
0.2-1.0 knots



POLARIS – CALCULATION –

Ice-floe size diameter	Thickness / Type	Percentage of each size
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5 – 10 m	1.5 m FYI	25%
10 - 20 m	1.5 m FYI	20%
20 – 30 m	1.5 m FYI	20%
30 – 50 m	2.5 m MYI	5 %

- 70% ice coverage + 90% ice coverage

“The RIO is determined by a summation of the RIVs for each ice type present in the ice regime multiplied by its concentration (expressed in tenths):

$$RIO = (C1 \times RIV1) + (C2 \times RIV2) + (C3 \times RIV3) + \dots (Cn \times RIVn)$$

Where C1...Cn are the concentrations (in tenths) of ice types within the ice regime; and RIV1...RIVn are the corresponding Risk Index Values for each ice type.”

- Assuming 95% FYI and 5% MYI
 - 70% concentration = 66.5% FYI + 3.5% MYI
 - 90% concentration = 85.5% FYI + 4.5% MYI
- (Speed – not relevant for calculation)
- Decaying Thick FYI for 1A vessel = RIV -2
- Decaying MYI for 1A vessel = RIV -5

$$(0.665 \times -2) + (0.035 \times -5) = -6.3 \text{ RIO (70\% concentration)}$$

$$(0.855 \times -2) + (0.045 \times -5) = -6.1 \text{ RIO (90\% concentration)}$$



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MSC.1/Circ.1519
6 June 2016

GUIDANCE ON METHODOLOGIES FOR ASSESSING OPERATIONAL CAPABILITIES
AND LIMITATIONS IN ICE



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RIO -6.1 = Elevated Risk

1.4 Elevated Operational Risk

1.4.1 Ships operating in an elevated risk ice regime, based on the RIO outcome, should limit the speed to the values indicated in table 1.2. Operational measures may also include, provision of additional watch keeping or use of icebreaker support. When the speed reduction may impair the ship manoeuvrability, the operation should be avoided.

Table 1.2 Recommended speed limits for elevated risk operations

Ice Class	Recommended Speed Limit
PC1	11 knots
PC2	8 knots
PC3-PC5	5 knots
Below PC5	3 knots



Operation allowed according to POLARIS, as risks are mitigated:

- Ice drift at ArcOP operation site > 1 knot
- Protection of 2 x Polar Class icebreakers – both in operation and transit
- (Experienced Ice Management team)



BUT CAN VESSEL STAY IN POSITION?



The simulation shown in this video was created by Arctic Integrated Solutions (ArcIso) for Arctic Marine Solutions (AMS). It shows the Dina Polaris in 90% concentration broken ice.

OTHER CONSIDERATIONS

- We find the web-portal really helpful when dealing with shipowners and other parties in adhering to the Polar Code requirements.
- A pre-planning exercise can never guarantee the outcome under the actual operating conditions.
- Therefore, *Manning and Training*, to ensure best navigational and safety requirements are in place is essential.



THANK YOU

This time next year we will be happy to share our experience at both the Forum and at PAME.

Questions?

