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Polar Code on Roger Revelle

The what, why, where, and how

What is the Polar Code?

The polar code is Chapter XIV - Safety measures for ships operating in polar waters in the International Convention for the Safety of Life at Sea (SOLAS).
The U.S.A ratified the code on Oct 7 1977 and the code entered into force on May 25 1980. All SOLAS vessels are to comply with the code.

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Why was the Polar Code developed?

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The Polar Code has been developed to supplement existing IMO instruments in order to increase the safety of ships' operation and mitigate the impact on the people and environment in the remote, vulnerable and potentially harsh polar waters.

Where is it applicable in Arctic waters?

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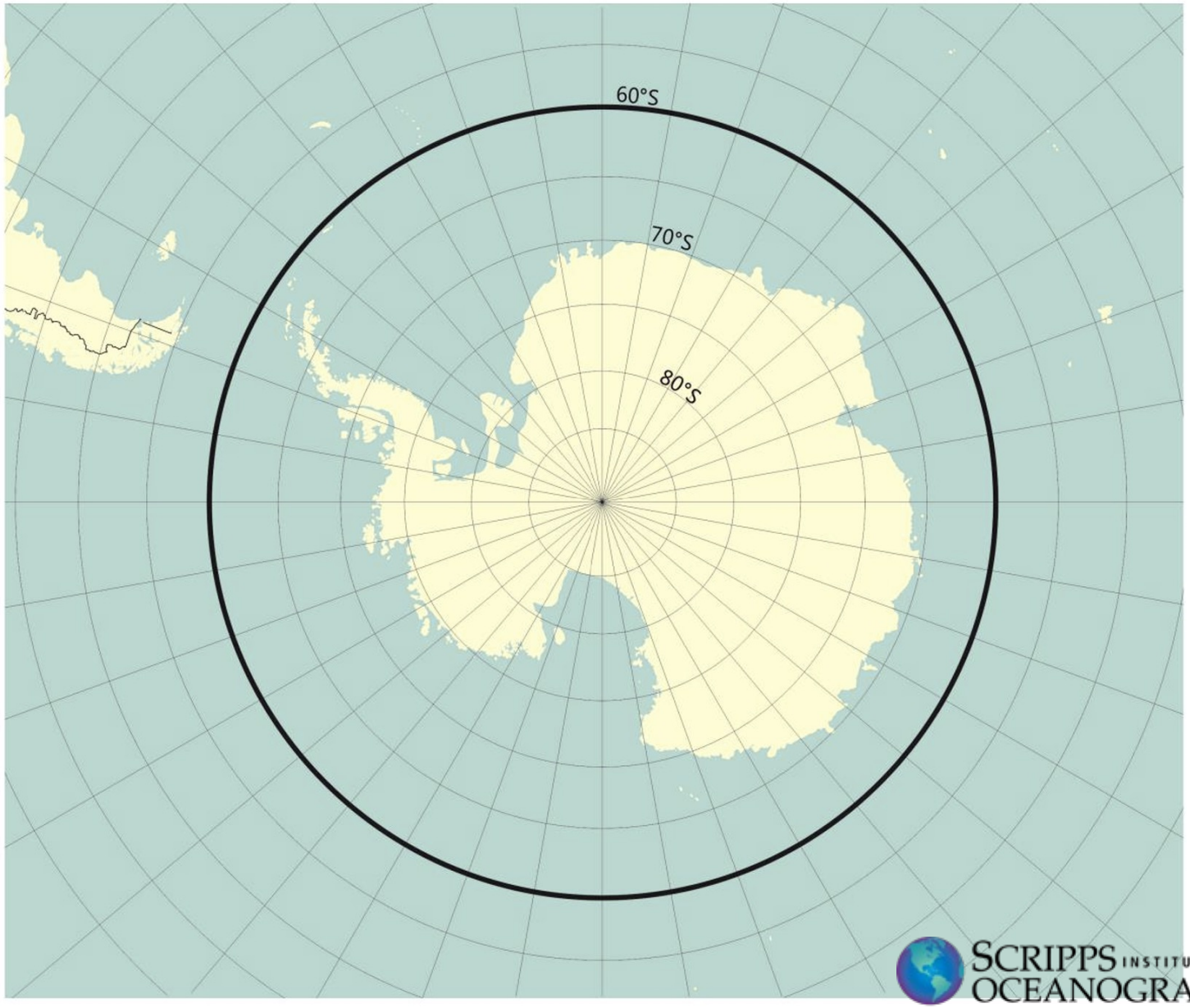
Where is it applicable in Antarctic waters?



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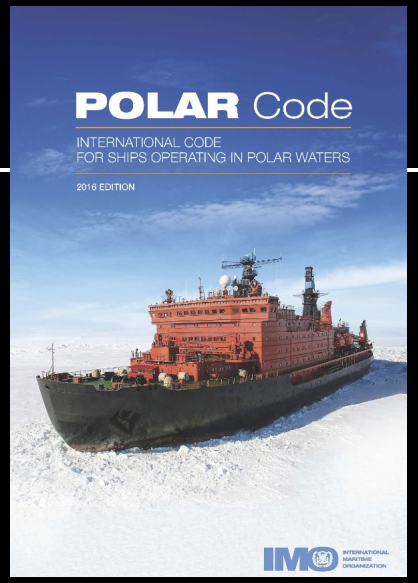
How is the Polar Code structured? (MEPC 68/21/Add.1 Annex 10



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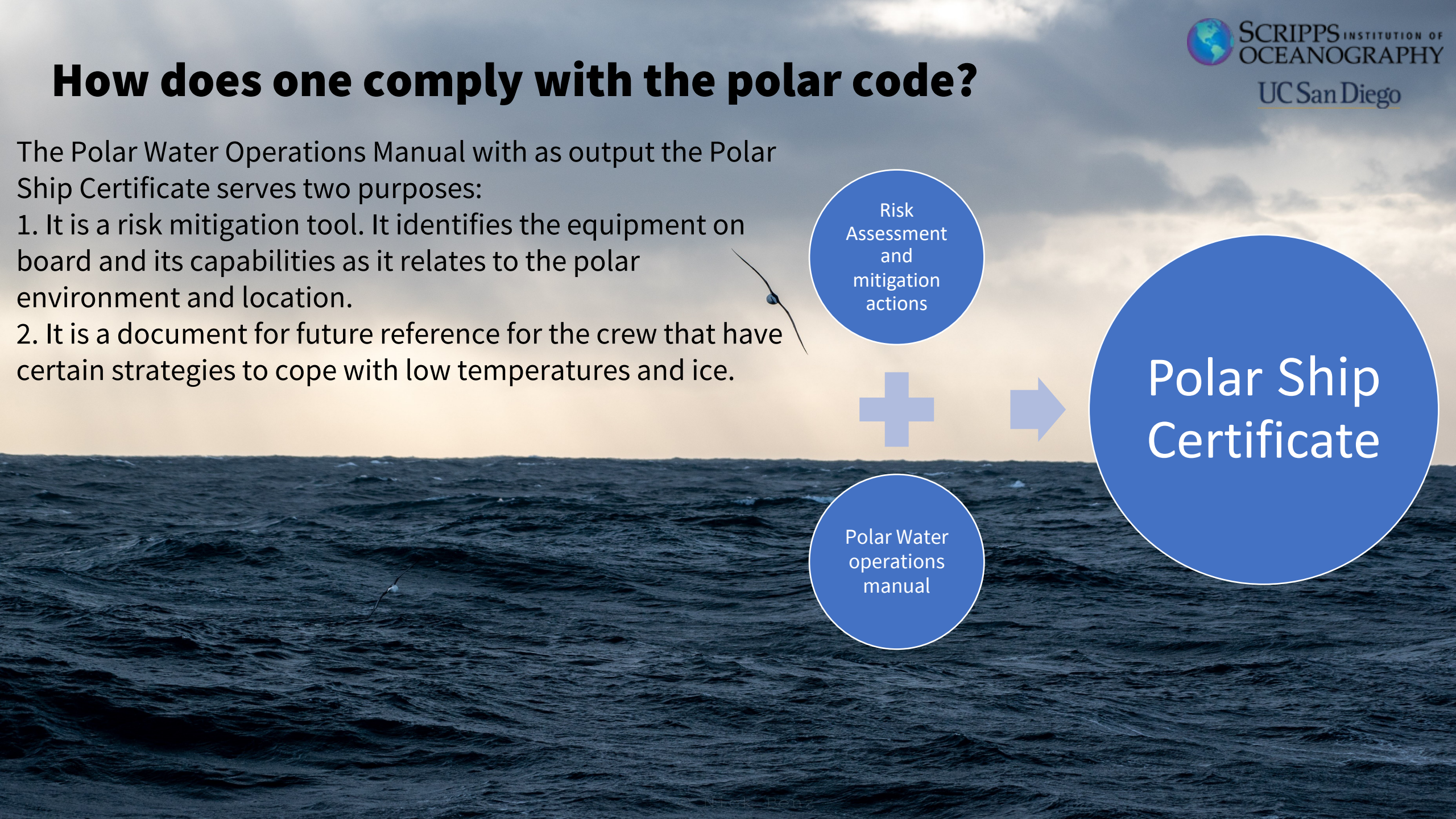
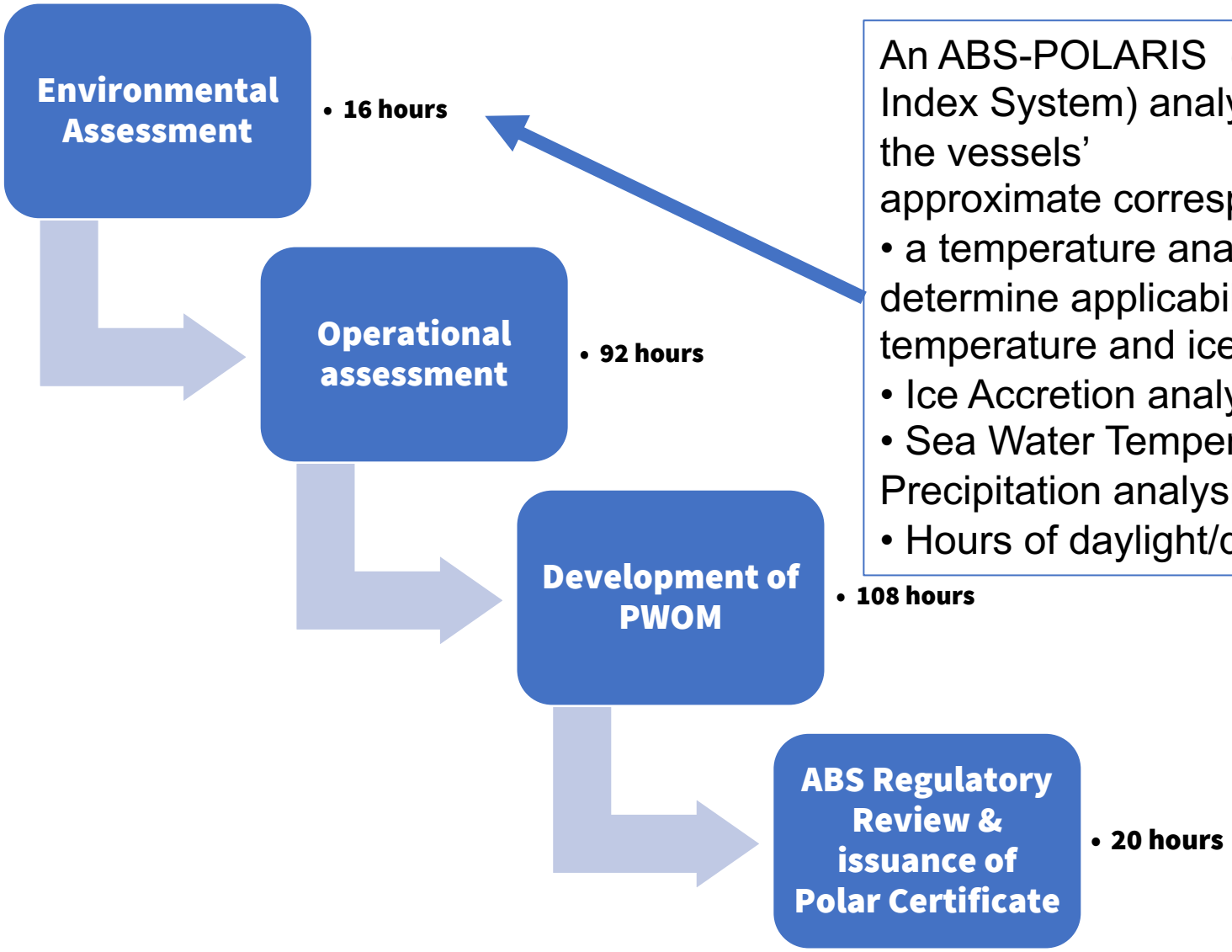
How does one comply with the polar code?

The Polar Water Operations Manual with as output the Polar Ship Certificate serves two purposes:

1. It is a risk mitigation tool. It identifies the equipment on board and its capabilities as it relates to the polar environment and location.
2. It is a document for future reference for the crew that have certain strategies to cope with low temperatures and ice.

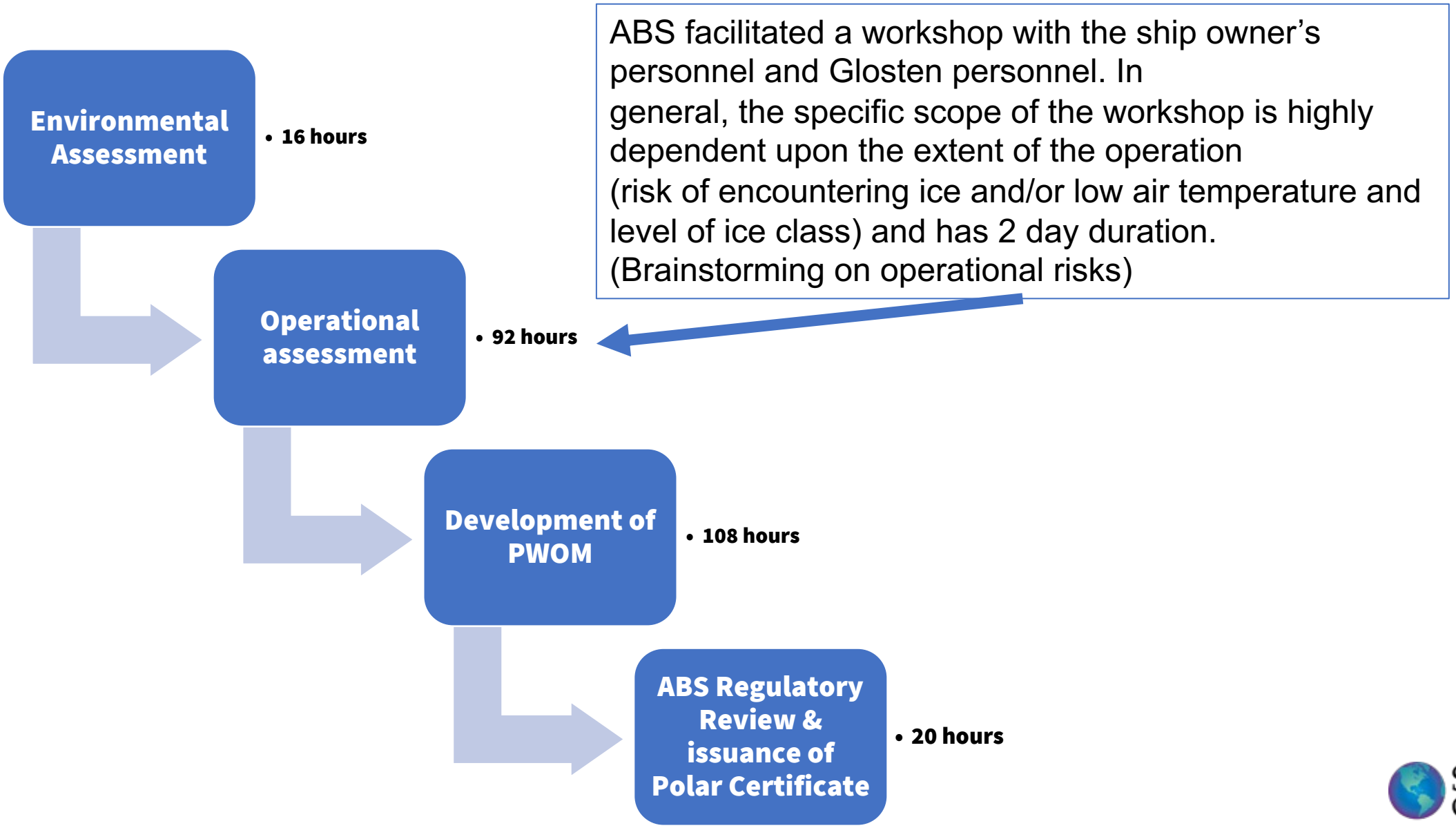


The Sequence of work



An ABS-POLARIS (Polar Operational Limit Assessment Risk Index System) analysis for ice operational limitations based on the vessels'
approximate correspondence ice class (Ice Class IC);
• a temperature analysis for temperature limitations2 and determine applicability of low
temperature and ice accretion requirements.
• Ice Accretion analysis
• Sea Water Temperature analysis
Precipitation analysis
• Hours of daylight/darkness analysis

The Sequence of work



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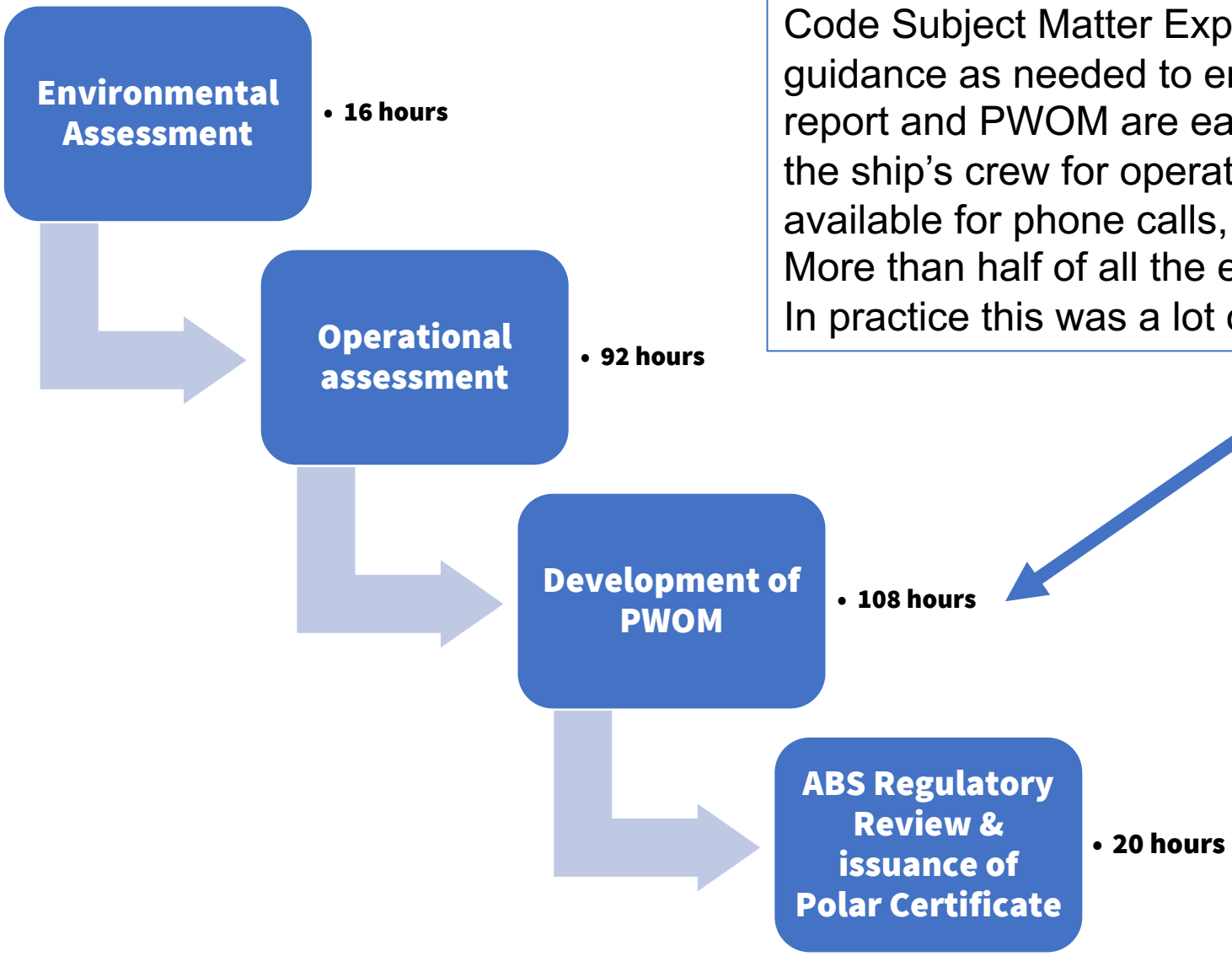
The Sequence of work



To write the PWOM. An ABS Polar Code Subject Matter Expert (SME) will be available to offer guidance as needed to ensure the operational assessment report and PWOM are easily reviewed while also being useful for the ship's crew for operations to polar waters. The SME will be available for phone calls, online meetings, emails, etc.
More than half of all the effort is for the creation of this manual. In practice this was a lot of joint editing with Glosten and SIO.

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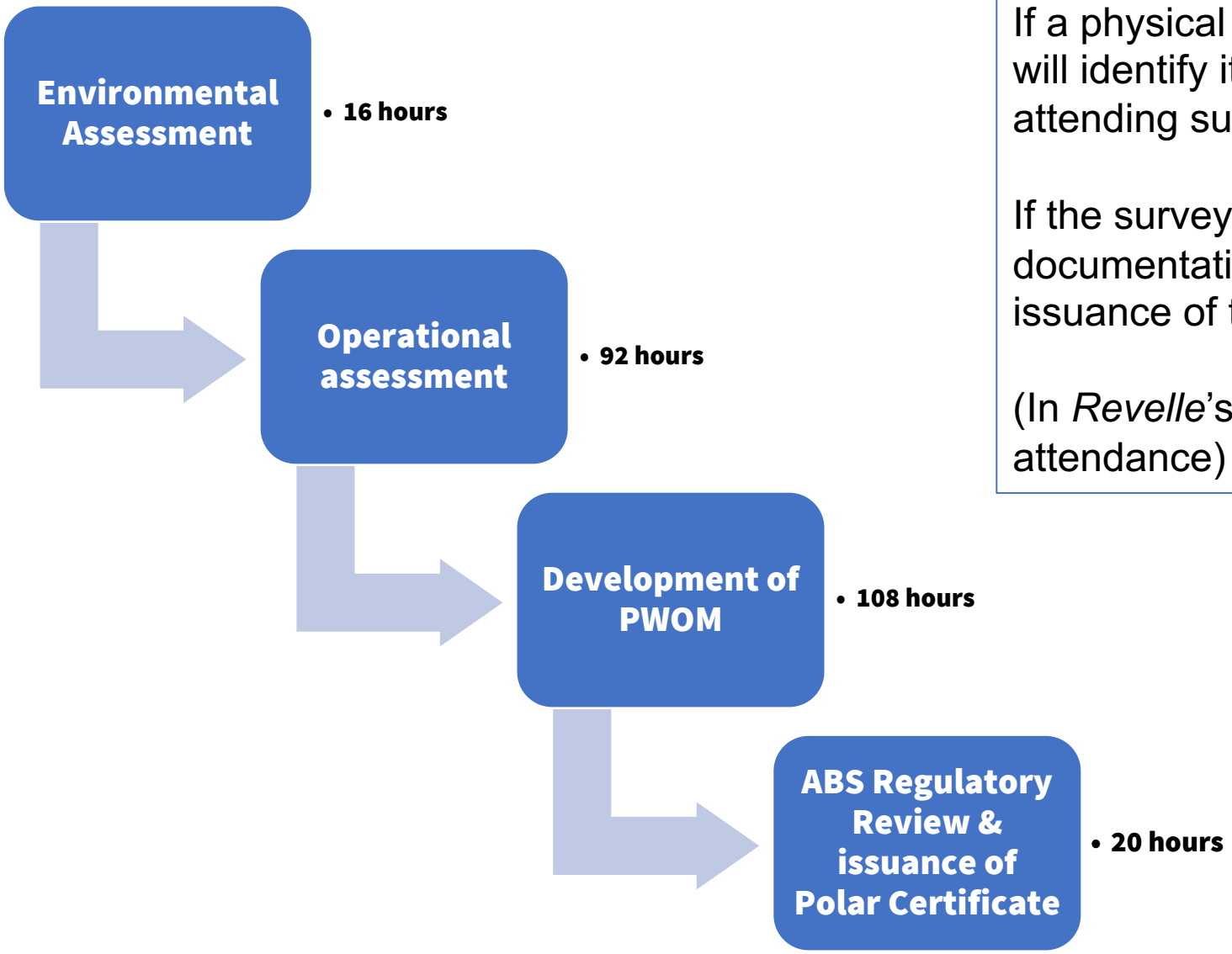
The Sequence of work



If a physical survey is required, the Engineering Review will identify items to be verified by the attending surveyor.

If the survey is not required, the engineering documentation review may lead to issuance of the Polar Ship Certificate (PSC).

(In *Revelle*'s case there was one final verification attendance)

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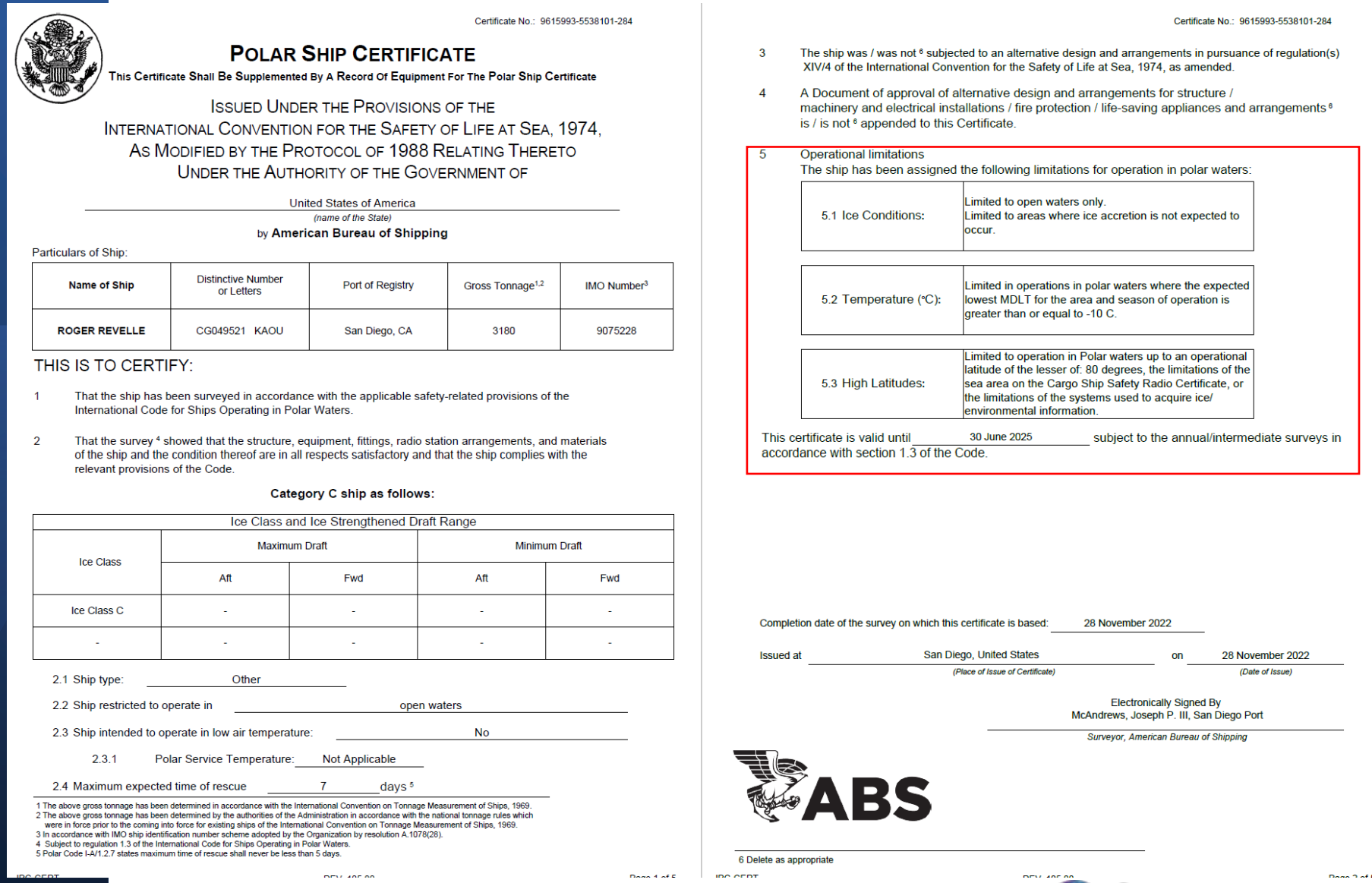
How did the Roger Revelle satisfy the requirements?

The limitations depend on the complexity of risk mitigation: We tailored the polar ship certificate to our needs to avoid excessive work and cost:

- Limited to open waters only (= ice concentrations of less than 1/10th)
- Limitation to the lesser of 80° (Purposely no North or South hemisphere defined)
- Air temperature limitation



Certificate No.: 9615993-5538101-284

POLAR SHIP CERTIFICATE

This Certificate Shall Be Supplemented By A Record Of Equipment For The Polar Ship Certificate

ISSUED UNDER THE PROVISIONS OF THE
INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974,
AS MODIFIED BY THE PROTOCOL OF 1988 RELATING THERETO
UNDER THE AUTHORITY OF THE GOVERNMENT OF

United States of America
(name of the State)

by **American Bureau of Shipping**

Particulars of Ship:

Name of Ship	Distinctive Number or Letters	Port of Registry	Gross Tonnage[1,2]	IMO Number[3]
ROGER REVELLE	CG049521 KAOU	San Diego, CA	3180	9075228

THIS IS TO CERTIFY:

1 That the ship has been surveyed in accordance with the applicable safety-related provisions of the International Code for Ships Operating in Polar Waters.

2 That the survey [4] showed that the structure, equipment, fittings, radio station arrangements, and materials of the ship and the condition thereof are in all respects satisfactory and that the ship complies with the relevant provisions of the Code.

Category C ship as follows:

Ice Class and Ice Strengthened Draft Range				
Ice Class	Maximum Draft		Minimum Draft	
	Aft	Fwd	Aft	Fwd
Ice Class C	-	-	-	-
-	-	-	-	-

2.1 Ship type: Other

2.2 Ship restricted to operate in open waters

2.3 Ship intended to operate in low air temperature: No

2.3.1 Polar Service Temperature: Not Applicable

2.4 Maximum expected time of rescue 7 days [5]

1 The above gross tonnage has been determined in accordance with the International Convention on Tonnage Measurement of Ships, 1969.
2 The above gross tonnage has been determined by the authorities of the Administration in accordance with the national tonnage rules which were in force prior to the coming into force for existing ships of the International Convention on Tonnage Measurement of Ships, 1969.
3 In accordance with IMO ship identification number scheme adopted by the Organization by resolution A.1078(28).
4 Subject to regulation 1.3 of the International Code for Ships Operating in Polar Waters.
5 Polar Code I-A/1.2.7 states maximum time of rescue shall never be less than 5 days.

IPC CERT REV. 105-20 Page 1 of 5

Certificate No.: 9615993-5538101-284

3 The ship was / was not [6] subjected to an alternative design and arrangements in pursuance of regulation(s) XIV/4 of the International Convention for the Safety of Life at Sea, 1974, as amended.

4 A Document of approval of alternative design and arrangements for structure / machinery and electrical installations / fire protection / life-saving appliances and arrangements [6] is / is not [6] appended to this Certificate.

5 Operational limitations
The ship has been assigned the following limitations for operation in polar waters:

5.1 Ice Conditions:	Limited to open waters only. Limited to areas where ice accretion is not expected to occur.
5.2 Temperature (°C):	Limited in operations in polar waters where the expected lowest MDLT for the area and season of operation is greater than or equal to -10 C.
5.3 High Latitudes:	Limited to operation in Polar waters up to an operational latitude of the lesser of: 80 degrees, the limitations of the sea area on the Cargo Ship Safety Radio Certificate, or the limitations of the systems used to acquire ice/ environmental information.

This certificate is valid until 30 June 2025 subject to the annual/intermediate surveys in accordance with section 1.3 of the Code.

Completion date of the survey on which this certificate is based: 28 November 2022

Issued at San Diego, United States *(Place of Issue of Certificate)* on 28 November 2022 *(Date of Issue)*

Electronically Signed By
McAndrews, Joseph P. III, San Diego Port
Surveyor, American Bureau of Shipping

ABS

6 Delete as appropriate

IPC CERT REV. 105-20 Page 2 of 5

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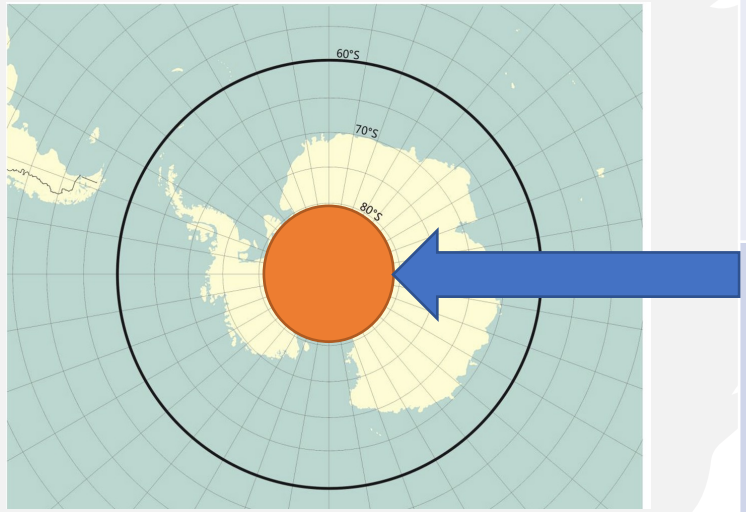
What are our operational limitations based on?



Issue	Limitation	Reason	Notes
5.1 Ice conditions	Limited to open waters [<10% Ice] and no ice accretion	Training requirements: we have not trained our crew as per the polar code requirements	The vessel was not close enough to warrant the expense.
5.2 Air temperature	Limited to -10°C	The Revelle has a design service temperature of 0°F (-17.8°C) and carries no winterization notations.	This temperature limitation, as well as the limitations of Ice Class C, were considered during the assessment of environmental hazards (ABS 2022b).
5.3 80 latitude limitation	80 degrees.	No GNSS compass on board	For our purposes this was a perfect concession as 80 degrees south is 90% land, and far away from our stations.

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Training Requirements

	TANKERS	PASSENGER SHIPS	OTHER SHIPS
In ice-free waters	None	None	None
In open waters (ice concentration less than 1/10)	Certificate in Basic Training for master, chief mate and officers in charge of a navigational watch	Certificate in Basic Training for master, chief mate and officers in charge of a navigational watch	None
In other ice-covered waters (ice concentration more than 1/10)	Certificate in Advanced Training for master and chief mate Certificate in Basic Training for officers in charge of a navigational watch	Certificate in Advanced Training for master and chief mate Certificate in Basic Training for officers in charge of a navigational watch	Certificate in Advanced Training for master and chief mate Certificate in Basic Training for officers in charge of a navigational watch

Source: https://www.dnv.com/maritime/polar/index.html

Certificate in Basic Training

for ships operating in polar waters

Complete an approved basic training course
Meet the standard of competence in the STCW Code, § A-V/4, paragraph 1

Certificate in Advanced Training

for ships operating in polar waters

Meet the requirements for a Certificate in Basic Training
Complete approved seagoing service
- on board a ship operating in polar waters or equivalent seagoing service,
- in the deck department at the management level or while performing watchkeeping duties in an operational level, and
- for a period of at least 2 months in total during the preceding 5 years

Complete an approved advanced training course
Meet the standard of competence in the STCW Code, § A-V/4, paragraph 2

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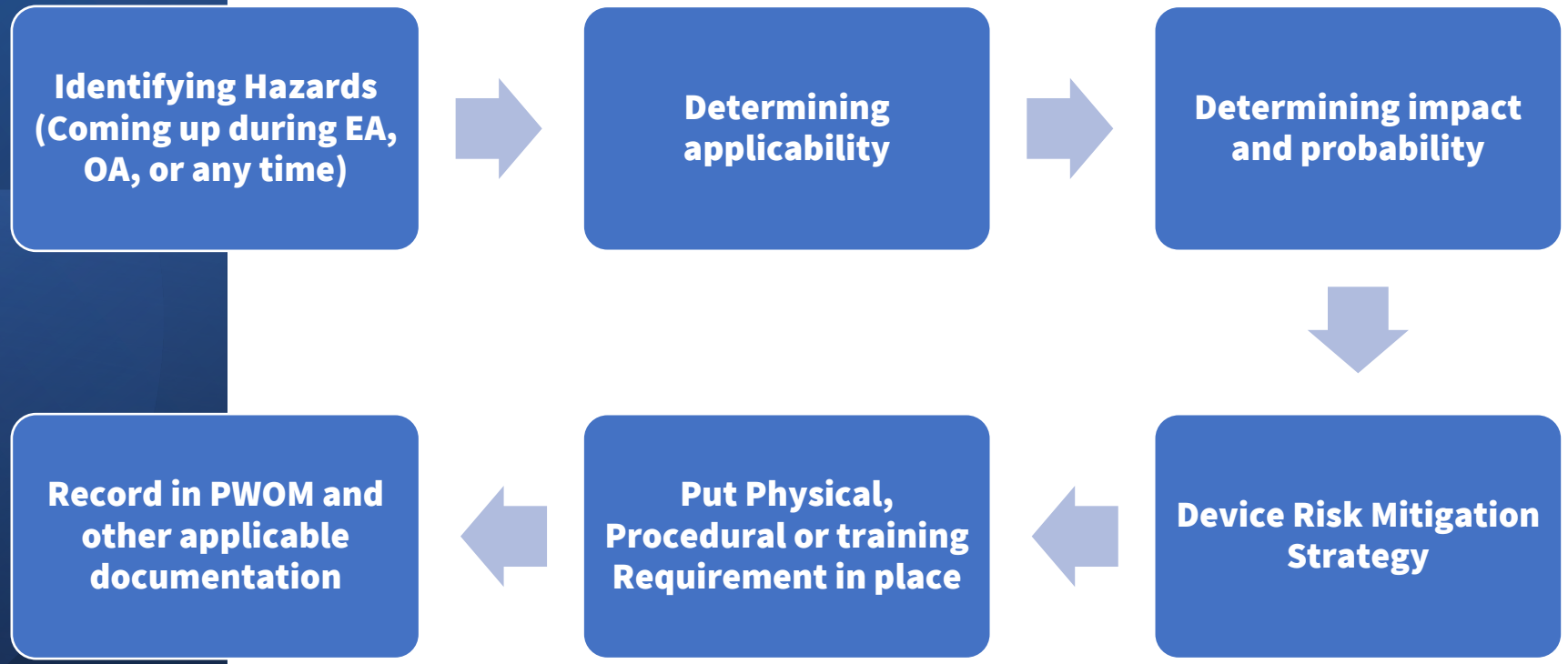
Risk Mitigation



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Risk Mitigation in action

While taking inventory of all ship's equipment through the lens of seeking out compatibility with extreme temperatures and remoteness of the vessel, we found a couple of risks, such as our AFFF for example, and the quantity of calories and water available for abandoning ship situations.

Table 6: R/V *Roger Revelle* – Temperature Capabilities

System	Rated Temperature [°C]	Information Source
Life Saving appliances (lifeboats, launching appliances, etc.)	Viking liferafts model 25DK+ "Can be deployed at temperatures as low as -30˚C"	myviking.viking-life.com
Liferaft inflation system	-30˚C (same as raft)	myviking.viking-life.com
Liferaft hydrostatic release	Rated to -30˚C	cmhammer.com
Firemain	SIO please provide	SIO please provide
Ship Service Generators	SIO please provide	SIO please provide
AFFF Foam extinguishers	**Lowest usable temp +2˚C**	Ansul product sheet
CO_2 fire extinguishers	Rated to -30˚C	Placard on extinguisher
GMDSS radio VHF8900s	Rated to -15˚C	Operators Manual
Radars antenna unit	Rated to -25˚C	Operators Manual
EPIRB	Rated to -20˚C	Operators Manual
EPIRB hydrostatic release	Rated to -30˚C	cmhammar.com
VHF liferaft aircraft radio	Rated to -10˚C	Operators Manual
Vessel's Hull structures	Rated to -17˚C (0˚F)	NAVSEA 1986

	Persons		Days	Water	Kcal	SubTotal Water	Subtotal Calories
Available in rafts							
Raft 1	25	capacity		1.5	2420	37.5	60491
Raft 2	25	capacity		1.5	2420	37.5	60491
Raft 3	25	capacity		1.5	2420	37.5	60491
Raft 4	25	capacity		1.5	2420	37.5	60491
Raft 5	25	capacity		1.5	2420	37.5	60491
Raft 6	25	capacity		1.5	2420	37.5	60491
Raft 7	25	capacity		1.5	2420	37.5	60491
Raft 8	25	capacity		1.5	2420	37.5	60491
					Totals in Rafts	**300**	**483929**
Required as per MSC							
	59	persons	7	2.0	1195	826	493535
					Total Required	826	493535
					Add needed	**526**	**9606**

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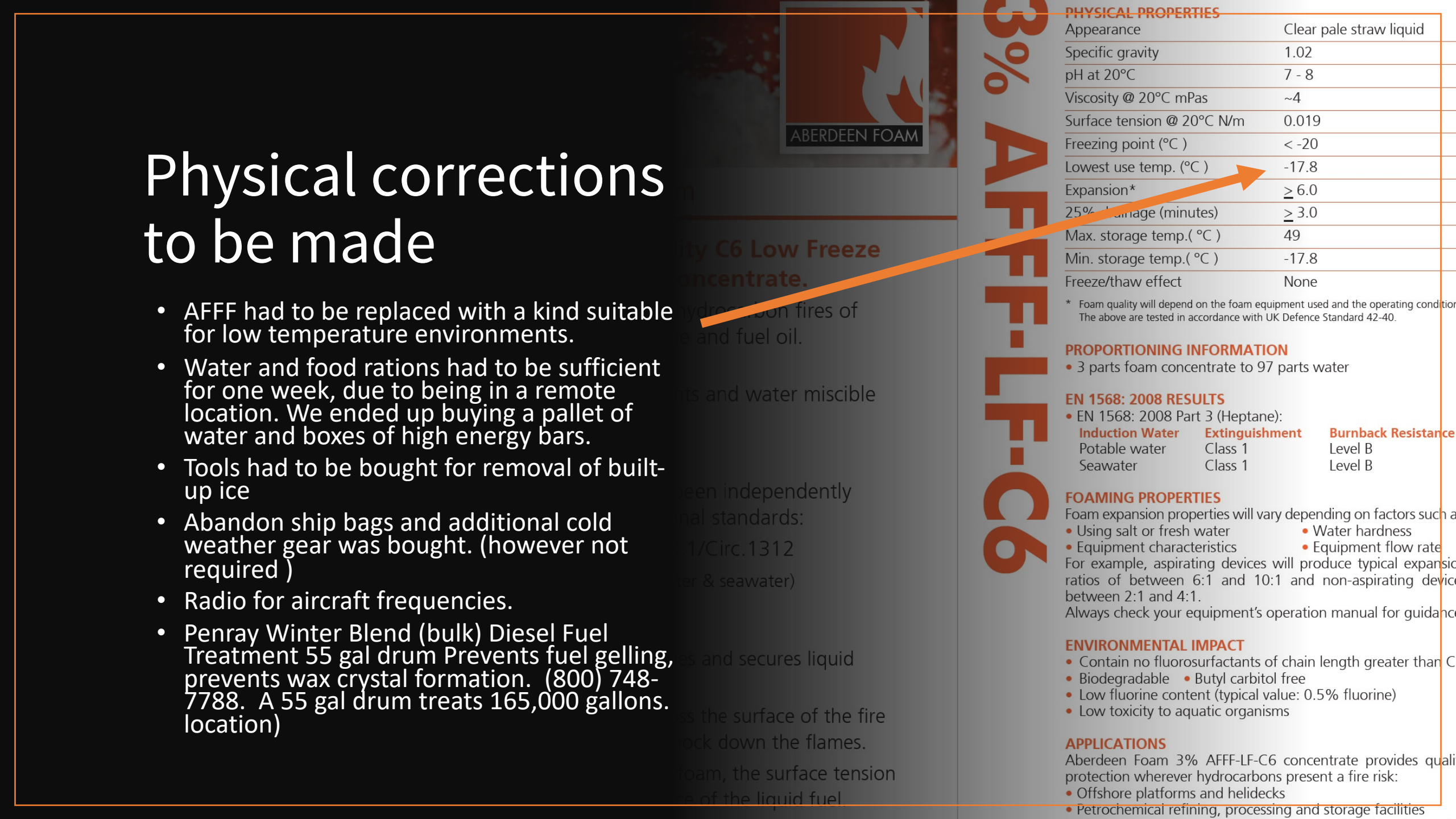
Physical corrections to be made

- AFFF had to be replaced with a kind suitable for low temperature environments.
- Water and food rations had to be sufficient for one week, due to being in a remote location. We ended up buying a pallet of water and boxes of high energy bars.
- Tools had to be bought for removal of built-up ice
- Abandon ship bags and additional cold weather gear was bought. (however not required)
- Radio for aircraft frequencies.
- Penray Winter Blend (bulk) Diesel Fuel Treatment 55 gal drum Prevents fuel gelling, prevents wax crystal formation. (800) 748-7788. A 55 gal drum treats 165,000 gallons. location)



Procedural changes

Ice accretion rounds

Portable radio management

Keeping sludge tank empty

Avoiding critical operations

In short: Good Sea(wo)manship!

Enforcement

On *Roger Revelle*'s first port of call after the GEOTRACES cruise in Antarctic waters, port state control boarded the vessel in Punta Arenas, Chile.

ARMADA DE CHILE
DIRECCIÓN GENERAL DEL TERRITORIO MARÍTIMO Y DE MARINA MERCANTE

PORT STATE CONTROL INSPECTION REPORT

FORM B

Copy to: Master
Head Office
PSCO
If ship is detained copy to:
Flag State
R.O.

riz 537 – Valparaíso - CHILE
208613 – 2208641
e-Mail: psc@dgtm.cl

Latinamerican Agreement on Port State Control (Viña del Mar Agreement) 1992 and norandum of Understanding on Port State Control in the Asia-Pacific (Tokyo MOU) 1993

ɔGER REVELLE 6.IMO number 9075228 10.date of inspection 26.01.2023 11.place of inspection CLPUQ - Punta Arenas

Nature of deficiency	Conventions	Action(s) taken	Responsible RO	ISM Rel.
D DOCUMENTATION - SHIP CERTIFICATES/Cargo Ship Safety ıg exemption)/Record of equipment for the cargo ship safety equipment not duly marked (item 2.1)..	SOLAS ch. I STCW	16 - Rectify deficiency within 14 days 16		No

ontary evidence of mandatory
ım qualification requirements
dance with STCW chapter V an polar code for the Polar
water of master and officers
not available

Jose Ampuero L

Signature

AUTORIDAD MARITIMA PSC OFFICER 008 ARMADA DE CHILE

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We were issued one deficiency for not having the master chief and other Officers in charge to be certified in accordance with STCW chapter V and the polar code.

	TANKERS	PASSENGER SHIPS	OTHER SHIPS
In ice-free waters	None	None	None
In open waters (ice concentration less than 1/10)	Certificate in Basic Training for master, chief mate and officers in charge of a navigational watch	Certificate in Basic Training for master, chief mate and officers in charge of a navigational watch	None
In other ice-covered waters (ice concentration more than 1/10)	Certificate in Advanced Training for master and chief mate Certificate in Basic Training for officers in charge of a navigational watch	Certificate in Advanced Training for master and chief mate Certificate in Basic Training for officers in charge of a navigational watch	Certificate in Advanced Training for master and chief mate Certificate in Basic Training for officers in charge of a navigational watch

It was a mistake by the port state control officer; he assumed we were navigating in ice concentrations exceeding 10%. We called our ABS representative, and a local surveyor discussed the matter with port state control. The finding was then cleared.

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Questionnaire for the Polar Code Inspection Campaign

Ship's name	Roger Revelle
IMO No.	[illegible]
Date of Inspection	26/01/2023

QUESTIONS 1 TO 9 ANSWERED WITH A "NO" MUST BE ACCOMPANIED BY A RELEVANT DEFICIENCY ON THE REPORT OF INSPECTION.

No.	Questions	Yes	No	N/A	Detention
	Part 1 **Only relevant for ships which are certified**				
1*	Is the ship's Polar Ship Certificate valid? 01134 Part I-A, Regulation 1.3	✓			
2*	Is the Polar Water Operational Manual (PWOM) readily available on board? 01335 Part I-A, Regulation 2.1	✓			
3	Can exposed sections of the fire main be isolated and are the sections provided with means for draining of the sections? 07110** Part I-A, Regulation 7.3	✓			
4*	Are there means of receiving and displaying current information on ice conditions on board? 05110** Part A-1, regulation 9.3	✓			
	Part 2 **Only relevant for ships, which are certified and bounded for or operating regularly within polar waters**				
5	Are there measures on board to prevent ice accretion? 18426**/03103** Part I-A, Regulation 4.3	✓			
6*	Does the vessel carry proper lifesaving equipment onboard? 11102** Part I-A regulation 8.2.3.1	✓			
7*	Have the master, Chief mate and other officers in charge of a navigational watch, the required certificates in accordance with STCW, chapter V and the Polar Code for the polar waters the ship is certified to operate in? 01201** Part I-A, Regulation 12.3		X		
8	Is the ship's crew responsible for garbage management well aware of the additional requirements in the Polar Code that shall be met to prevent pollution by garbage from ships as additional requirements to MARPOL annex V, regulation 4? 14501** Part II-A, Chapter 5, Regulation 5.2	✓			
9	Is the ship's crew responsible for sewage discharge, well aware of the requirements if discharge of sewage in Polar waters should be considered? 14403** Part II-A, Chapter 4, regulation 4.2	✓			

NOTE
1 If "NO" is selected, for question marked on "*", the ship may be considered [illegible]

How was UCSG involved?

Minimal. The whole process was between ABS and us. (We did seek input)

SONNEL. Total Persons allowed: 59

ute Permitted And Conditions Of Operation:

---Oceans---

IN ACCORDANCE WITH 46 CFR 15.812, WHEN THE VESSEL IS UNDERWAY ON FEDERAL PILOTAGE WATERS OF THE UNITED STATES, THE VESSEL MUST BE UNDER THE DIRECTION AND CONTROL OF AN INDIVIDUAL QUALIFIED TO SERVE AS PILOT.

MMERSION SUITS ARE NOT REQUIRED WHEN THE VESSEL IS OPERATING IN THE ATLANTIC OCEAN BETWEEN 32 DEGREES NORTH A 32 DEGREES SOUTH LATITUDE OR ANY OTHER WATERS BETWEEN 35 DEGREES NORTH AND 35 DEGREES SOUTH LATITUDES.

EXT PAGE FOR ADDITIONAL CERTIFICATE INFORMATION***

spection for Certification having been completed at PORTLAND, OR, UNITED STATES, the Officer in Charge, Marine ar Columbia River certified the vessel, in all respects, is in conformity with the applicable vessel inspection laws s and regulations prescribed thereunder.

Annual/Periodic/Re-Inspection

Zone	A/P/R	Signature
	A	MUNOZ JOSEPH
	P	MUNOZ JOSEPH

This Amended certificate issued by:

R. NEGRON, CAPTAIN, USCG, BY DIRECTION

Officer in Charge, Marine Inspection

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Costs

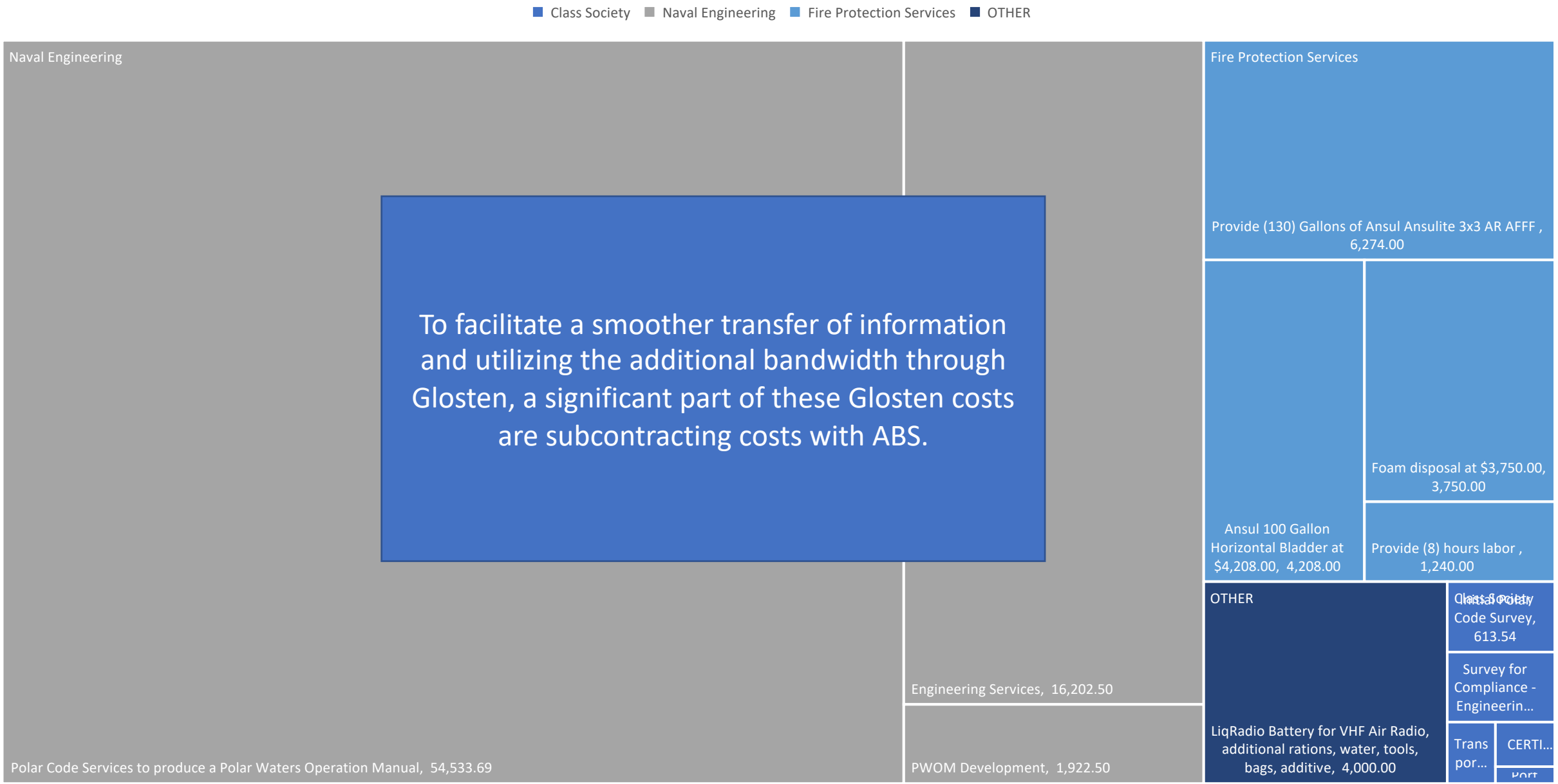
$90,297.83 -

~$100,000

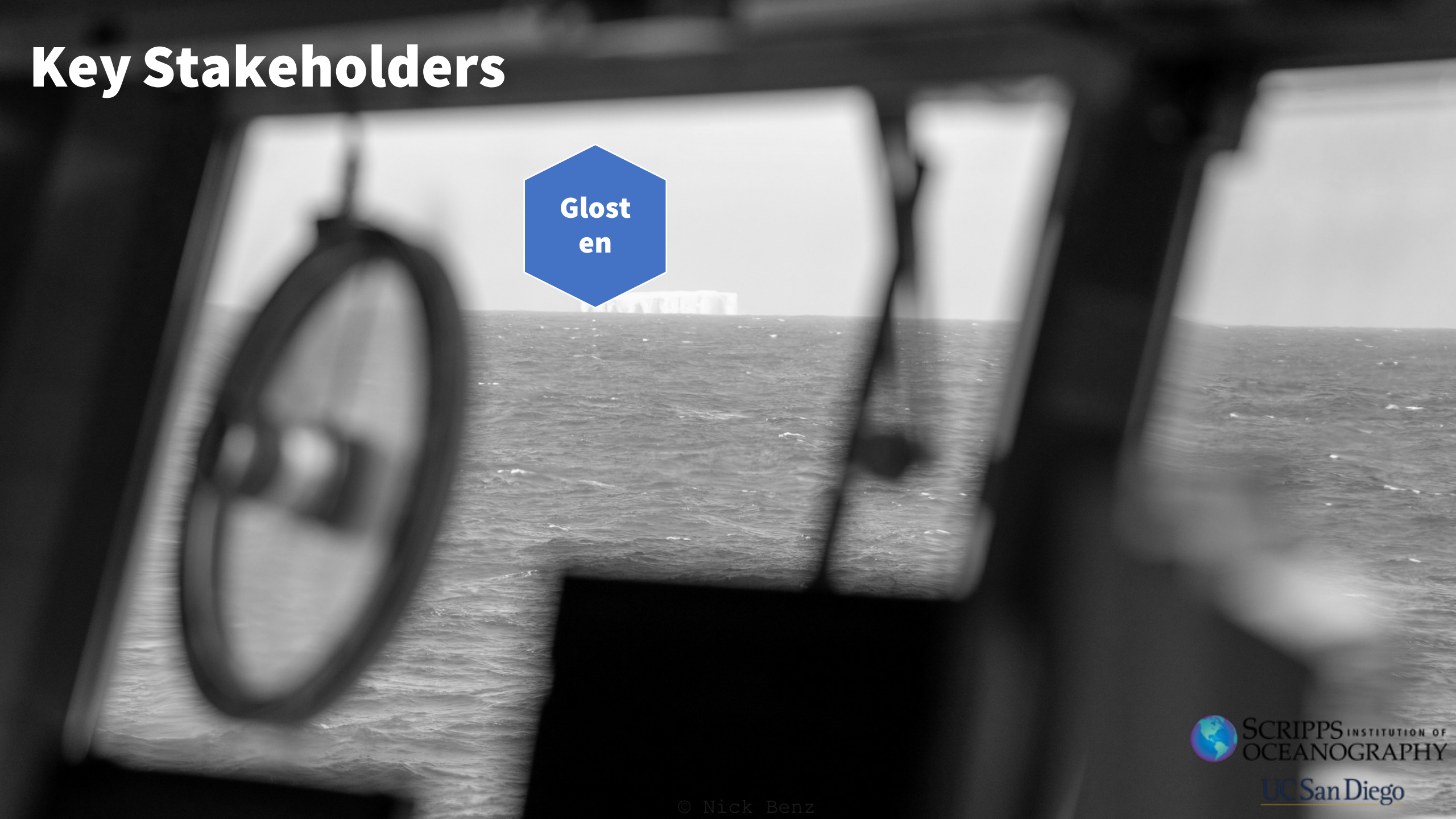
Material costs: 20%

Manhours in Design : 80%

Polar Code Certificate Cost Breakdown



Key Stakeholders



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Thank you for your attention, and a thank you to our funding agencies!

Credits:

- **Pictures taken by ResTech Nicholas Benz**
  nbenz@ucsd.edu

- **Slide 15 and 22 contain screenshots derived from DNV**
  https://www.dnv.com/maritime/polar/index.html

Questions?