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AWI

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG




PS II
Projekt
POLARSTERN II

Polarstern: Running an ageing research icebreaker and first Polarstern II newbuilding insights

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HELMHOLTZ



Key Facts - Shipping

- Family business, founded in 1824
- Offices in Rostock, Hamburg, Bremerhaven, Tokyo and Manila
- The current fleet comprises 27 ships, including car carriers (PCTCs), LPG/ammonia tankers, container and research vessels
- 75 employees in the shore organization and approx. 750 seafarers on the ships (including 135 German seafarers)
- Active in research shipping since 1996
- Certified according to ISO 9001, ISO 14001, ISO 50001, OHSAS 18001 and TMSA (Tanker

Management Self Assessment)

Research Vessels



Polarstern: Profile

Polarstern Working Load

42 years and 4 months service for science and support

14.000 international users

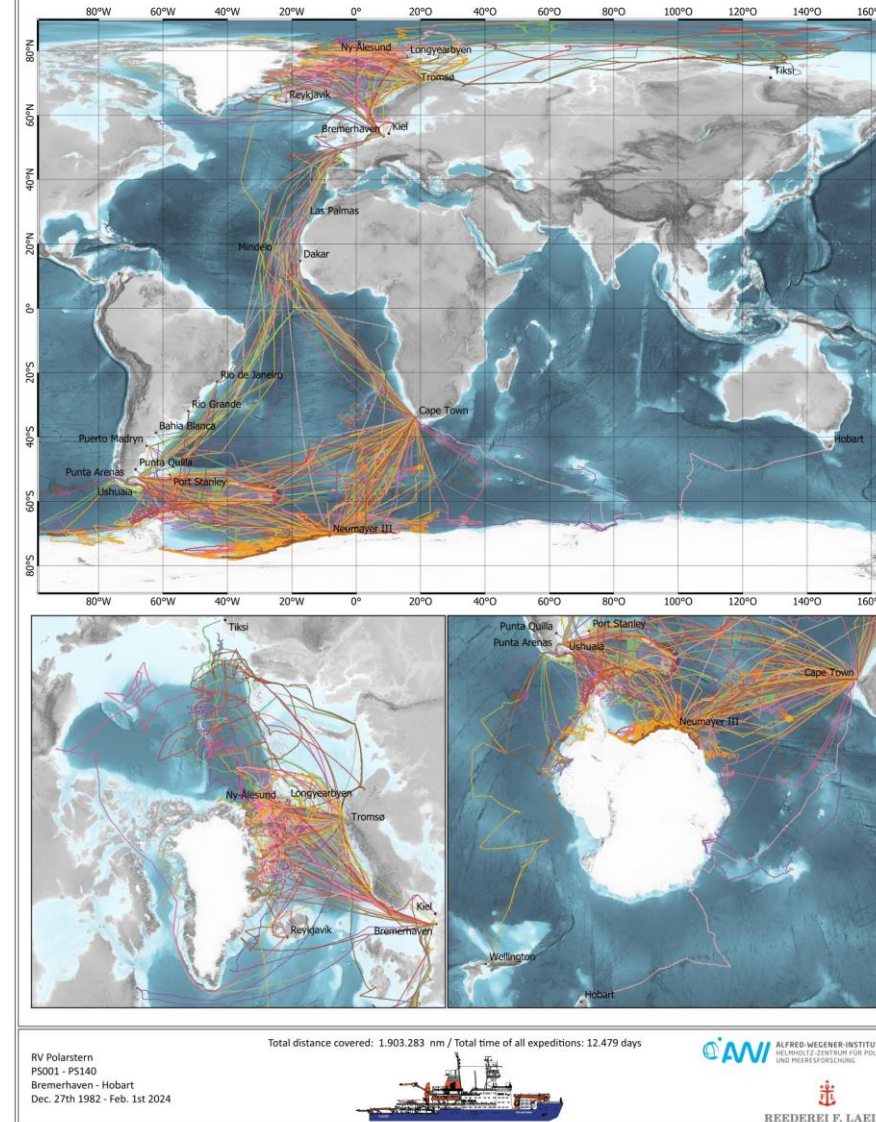
Nautical miles up to date 1.959.900

(150 nm/day at sea + station work, since 1982)

- 14 % days in port and shipyard
- 20 % cruising in open water
- 25 % station work in open water or light ice cover
- 1 % stops and supply at bases
- **25 % cruising in ice and ice breaking**
- **15 % very heavy ice breaking**
- **+ additional winter and drift experiments**
- ➔ **17 years of ice breaking**
- ➔ **with 7 years of heavy ice breaking**
- ➔ **+ + overwintering and ice drift**

Around half of its life span ice breaking

Polarstern Expeditions



Polarstern: Profile

Time table Polarstern	year	age
Start of service	1982	
RFL in operation	1996	
1998-2001 mid life conversion	1998	
Originally expected end of service	2012	30
	2014	32
	2018	36
	2020	38
	2025	43
DNV(last?) class approval	2027	45
double acting season with PS II (?)	2030	48
End of service ?	2031	49



PS II: National scientific advisory board recommends an replacement

PS II: Start of 1st tender
RFL as consultant and nominated as operating company

PS II: 1. expected start of service

PS II: Start of 2nd tender

PS II: Contract for newbuild with tkms, Germany

PSII : Expected start of service

Polarstern: preventive and exceptional maintenance (examples)

Hull

paint and coating fully renewed

intense rewelding of the hull

Propulsion

reconditioning of fin stabilizers

reconditioning of propeller blades

reconditioning of bow and sternthruster

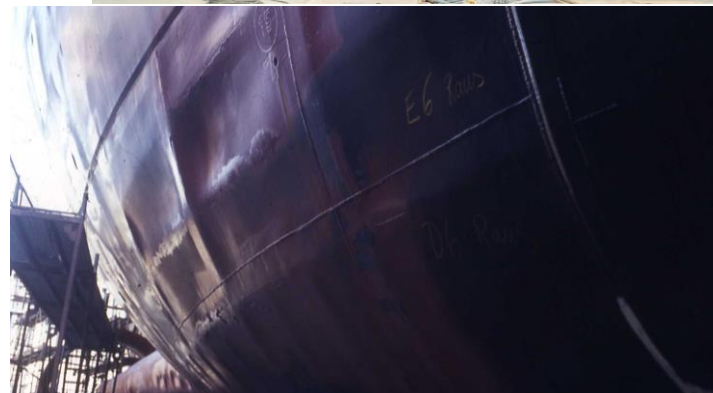
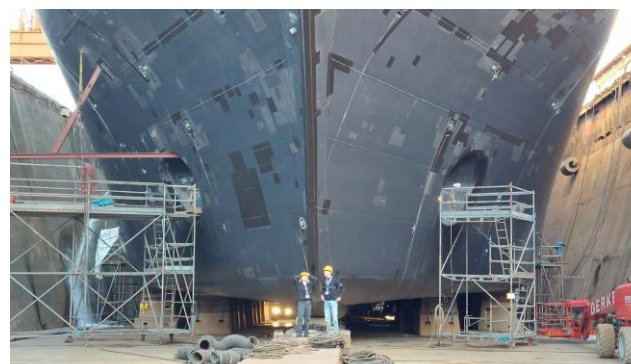
reconditioning of shaft seals

bunker tanks coating renewal

ballast tank coating renewal

renewal of pipes that go trough tanks

renewal of cylinder heads



Polarstern: preventive and exceptional maintenance (examples)

Electric

complete rebuild the two shaft generators

change of all major electric ships cables, also engine room

General

new life rafts and new davits

intensive steel renewal working deck

overhaul of both slide booms, completely deattached

overhaul of all other lifting gears and winches

Two main cranes renewed

bridge renewed

cabin floor, bath rooms, and superstruture steel decks

kitchen fully renewed



Great efforts are required to keep such a heavily used vessel fully operational,
finally the new Polarstern is in sight.



1982 Newbuilding



2025 (..... + 5 years): fully operational

Signing of Building Contract (Wismar): Feb. 18th 2025

- First ideas and recommendation to replace Polarstern by national science advisory board in 2012.
- 1st EU wide tender started 2015, aborted 02/2020.
- 2nd EU wide tender started 6/22, **completed 12/24**
 - Fixed price contract, value: 1,185 bn €
 - New mission equipment (ROV, AUV, 2 helicopters, drones etc.) included - part of the vessels permanent scientific facilities.
- Kickoff technical team: Week 4, January 2025



Project Organization



**Federal Ministry of Research,
Technology and Space**



Federal Ministry
of Research, Technology
and Space

Project Advisors:

Bansbach-Econum

Administrative Support:

Project Management Jülich (PtJ)

reporting



funding

AWI Project Team PSII

Project Directorate
Quality Management
Controlling, Risk/Change Management
Purchasing



Project Office Shipbuilding

Scientific-Technical Advisory Group
Other AWI capacities on demand

External Experts

SDC/Mareval
Reederei Laeisz
Castringius
PwC

*Shipbuilding
Ship Operator
Legal
Controlling
Legal, BA*

Reporting,
invoicing



Contract / order changes /
technical supervision /
owner approvals / advisory
/ remuneration

Shipyard

Engineering, Purchasing, Management



Engineering



Classification (Hamburg)



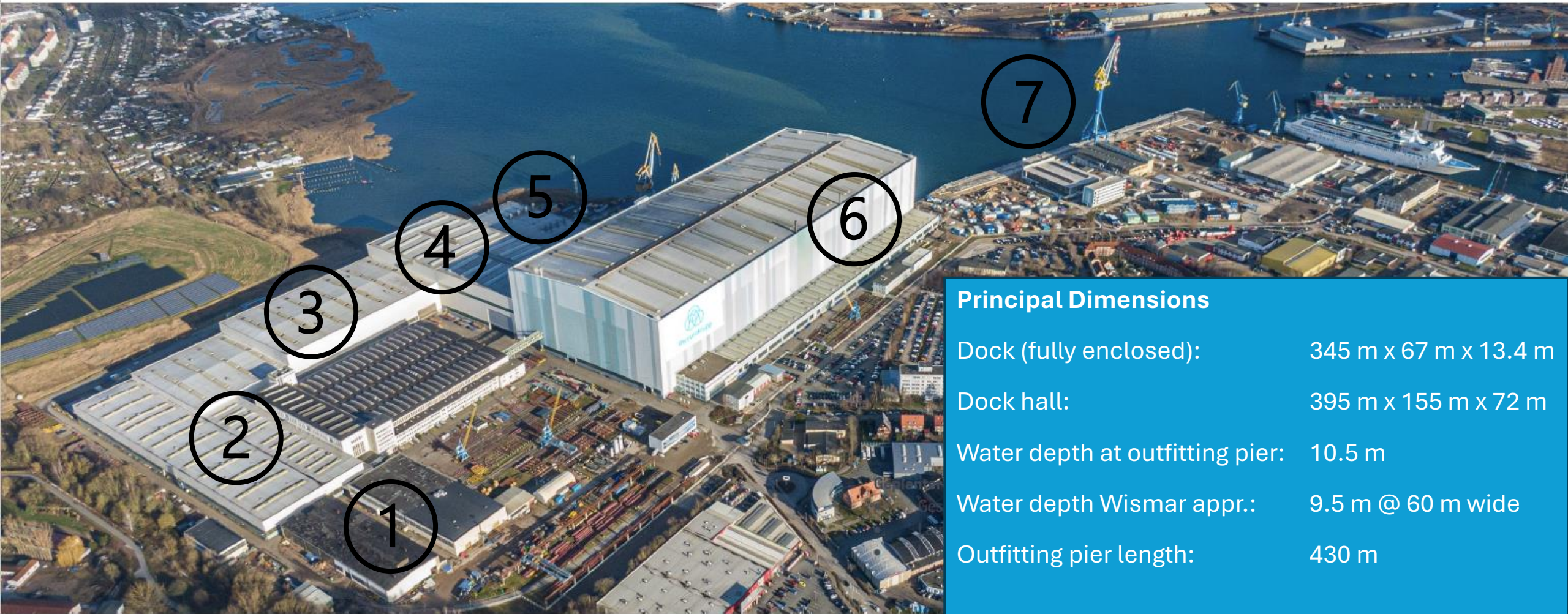
**Ship Model Basin
incl. Ice Tank trials**



tkMS shipyard Wismar - location



tkMS shipyard Wismar – production line



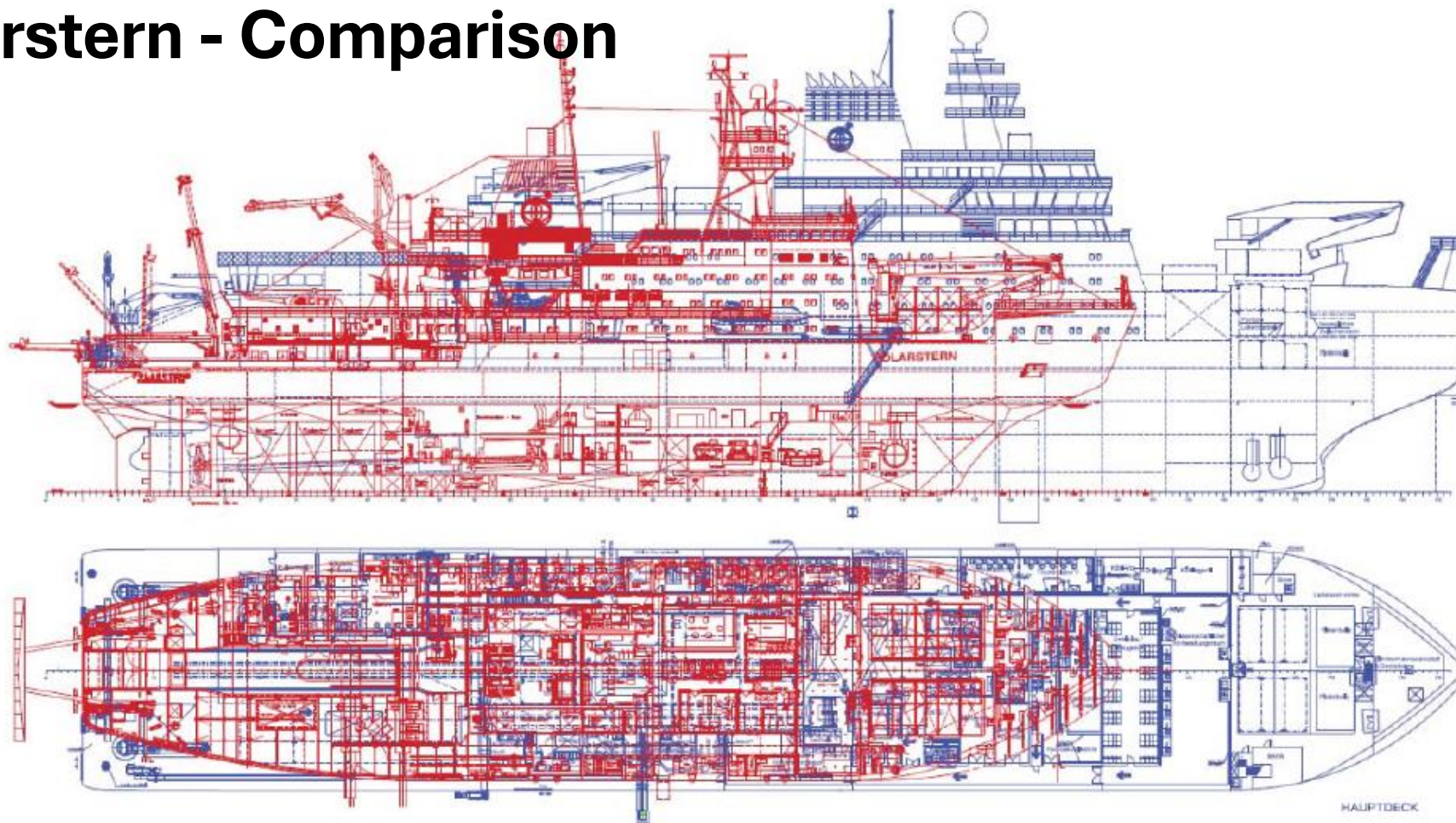
Principal Dimensions

Dock (fully enclosed):	345 m x 67 m x 13.4 m
Dock hall:	395 m x 155 m x 72 m
Water depth at outfitting pier:	10.5 m
Water depth Wismar appr.:	9.5 m @ 60 m wide
Outfitting pier length:	430 m

Imagine in a few years from now ...



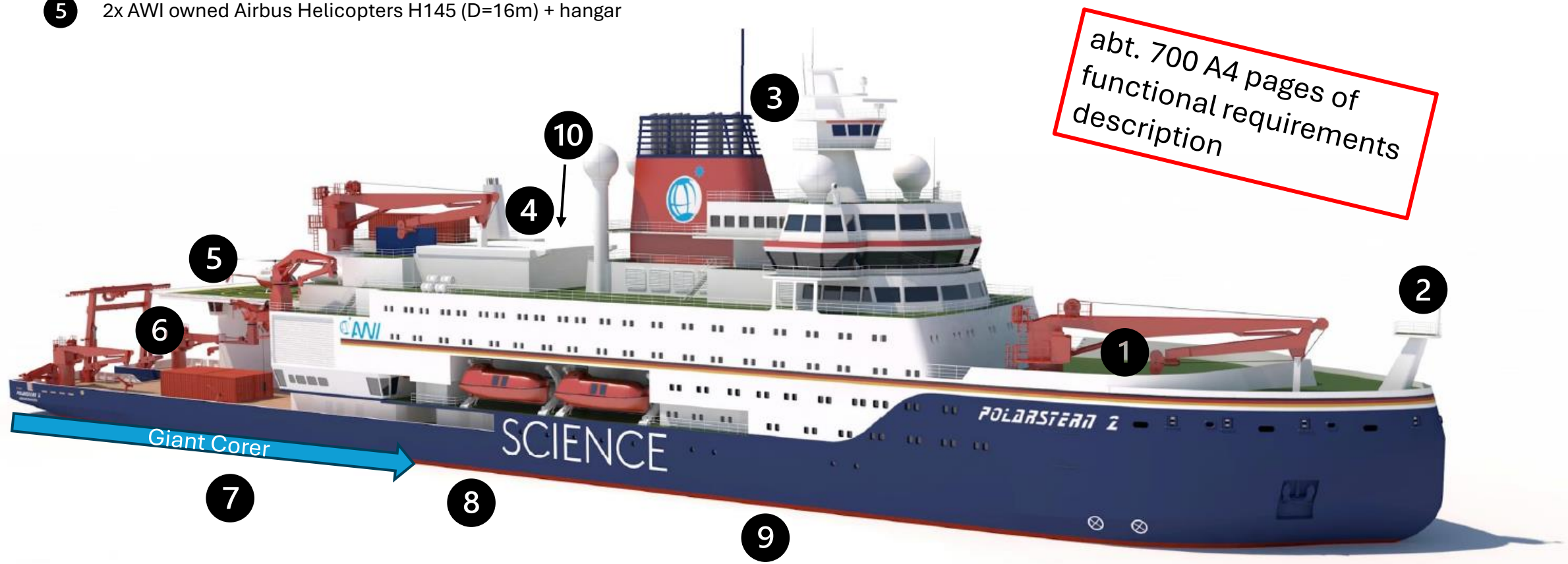
Polarstern - Comparison



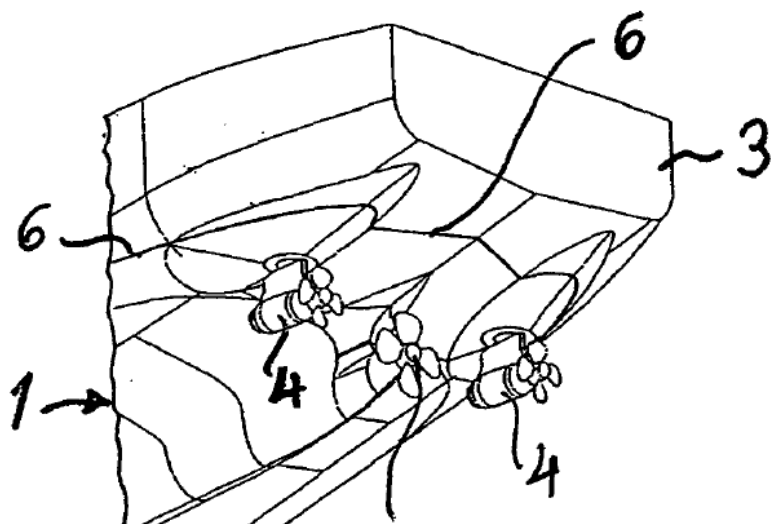
	Polarstern (1982)	Polarstern (2030)
Dimensions	LOA: 117,91 m; Beam: 25,00 m; max. Draft: 11,21	LOA: 159,80 m; Beam: 27,30 m; max. Draft: 11,1 m
GT	12.614	ca. 26.700
Future reserves	Draft: 20 cm	Draft: 20 cm; Stability: +20 cm on GM limit curve

Polarstern – Features (rendering 12/2024)

- 1 4 6 1.000 mt payload (abt. 80x TEU storage, reefers, laboratories)
- 2 4hrs emission free operation, using 12+ MWh battery pack
- 3 TIER III -30%, DPF: PN -95% / sooth -90%; ICES 209; CAC3
- 5 2x AWI owned Airbus Helicopters H145 (D=16m) + hangar
- 6 new robotic systems such as ROVs, AUVs, UAVs operated by an AWI group
- 8 Scientific hangar: moonpool (6,4 x 4,8 m); drill rig ready, wet well connection
- 9 Drop keel inkl. flank array preparation, small moonpool



Polarstern - Propulsion



- Use of **3 screw propulsion** patent (EP 2 167 374 B1) (Aker Arctic)
- **PC2; Icebreaking:** 1,8m (500 kPa) + 20% snow cover at 3kn (last ice regions)
- Redundant propulsion and steering concept (**PSMRL***)
- **Ice milling** operation astern
- **DP(0) System** operational limits: current 1,5 kn, 22 kn wind, Hsig = 5m
- **Estimated propulsion power:**
 - Azimutpropeller: abt. 9 MW per unit (pulling type)
 - Centerline propeller: abt. 10,5 MW
 - Bowthrusters: abt. 2 MW per unit
- **Total installed power:** abt. 34 MW
- **Battery pack:** abt. 12+ MWh (zero emission / peak shaving / spinning reserve)
- **Diesel-Electric propulsion:** 2x dual fuel + 2x single fuel gensets
- **MeOH tank capacity:** 2.200 m³ / abt. 5.100 nm

Polarstern - Propulsion



Polarstern - Winterisation

✠ 100 A1 Research Vessel, Helideck, *IWS, Ice Class PC2, Winterisation **H(-48°C) D(-48°C) S(C)**, ECO
 ✠ LMC, UMS, BWTS, DP(AM), LFPF(GF, ML), PSMRL*, CAC3, ShipRight(IHM, SCM), SPS(140)



MOSAiC Expedition (2020); Drift Experiment

Endurance

normal	90 days
Drift experiment	5 months
Emergency Survival (Citadell)	7 months
Evacuation to ice / land	7 days

Winterization Topics

Deck machinery	Ice accretion and removal
Survival Equipment	Heating (deck/access ways)
Lifting Appliances	Exposed piping, wires, vents
Materials used	FMEA
PWOM	

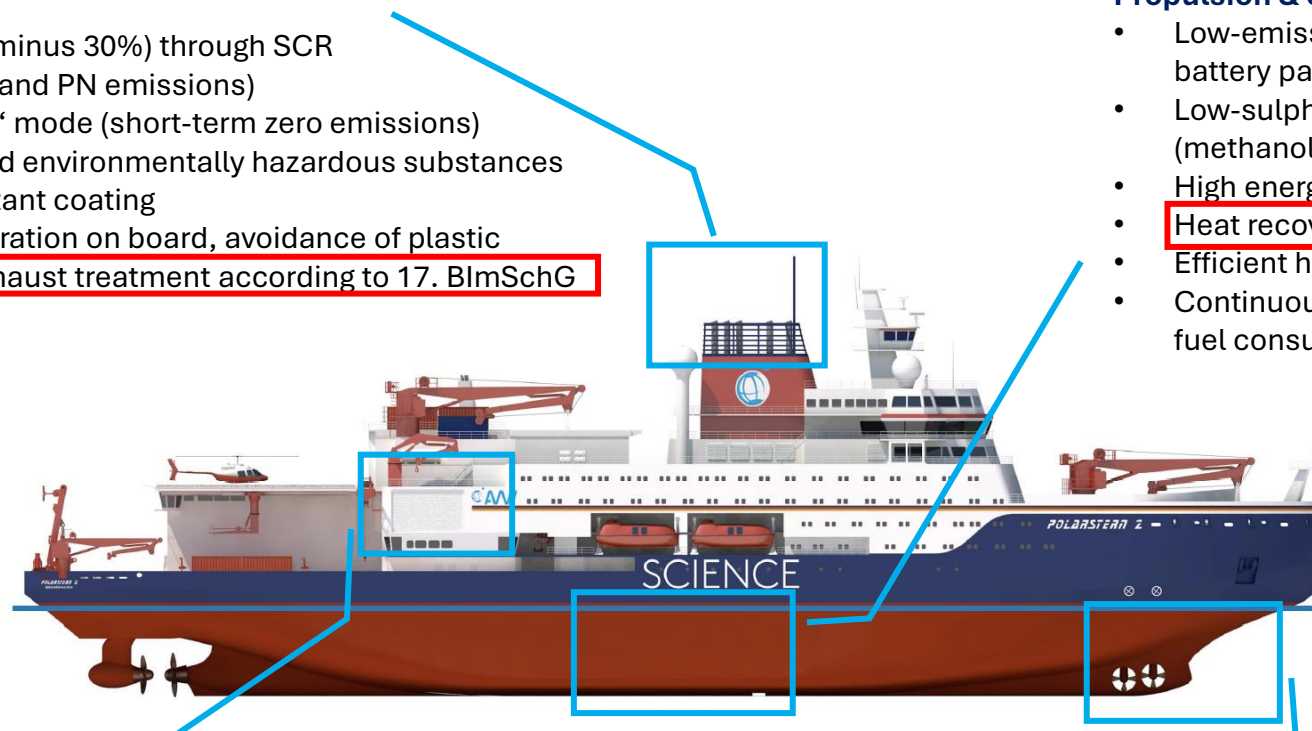
Polarstern – Sustainability

Emission reduction:

- NOx reduction (Tier III minus 30%) through SCR
- Particle filters (low PM and PN emissions)
- Temporary „clean ship“ mode (short-term zero emissions)
- Reduction of health and environmentally hazardous substances
- Modern abrasion resistant coating
- Waste treatment: separation on board, avoidance of plastic
- Waste incineration: exhaust treatment according to 17. BImSchG

Propulsion & energy supply:

- Low-emission hybrid propulsion concept (diesel electric / battery pack)
- Low-sulphur fuels plus additional use of alternative fuels (methanol)
- High energy efficiency
- Heat recovery from exhaust gas / HT / LT(?)
- Efficient heating, ventilation and air conditioning (HVAC)
- Continuous monitoring & collection of parameters such as fuel consumption using digital tools

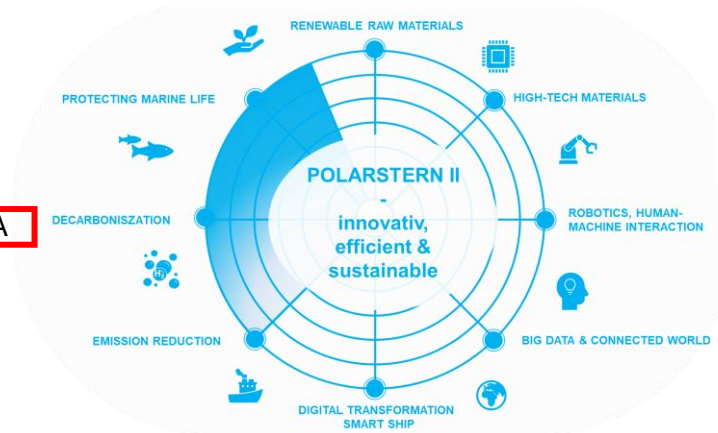


Sustainable construction:

- Requirement to use sustainable / renewable raw materials (interior construction)
- Reduction of CO2 emissions during steel construction by using green electricity
- High HSE & environmental management standards
- Establishment of Product Carbon Footprint (PCF) + LCA
- Stringent sustainability standards in purchasing specs. defined.

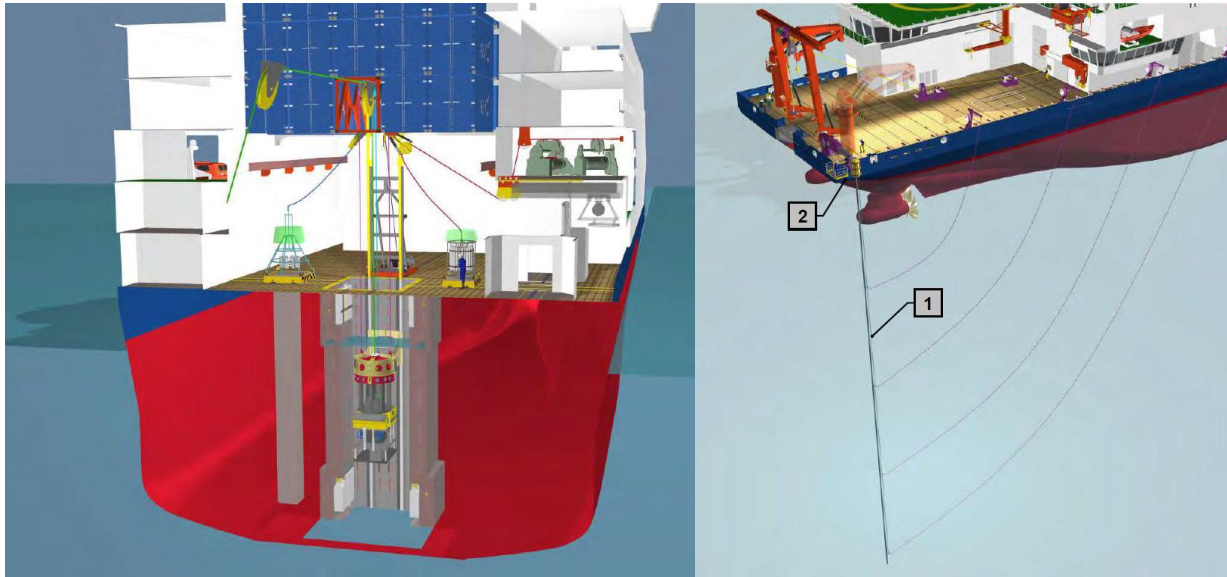
Design:

- Underwater radiated noise: compliance with ICES 209
- On board noise and vibration: compliance with CAC3
- Optimized hull design (Ice breaking / bubble sweepdown)
- Accessibility and cabin for partially disabled persons



Good for me.
Good for the environment.

Polarstern - Main Deck (wip)

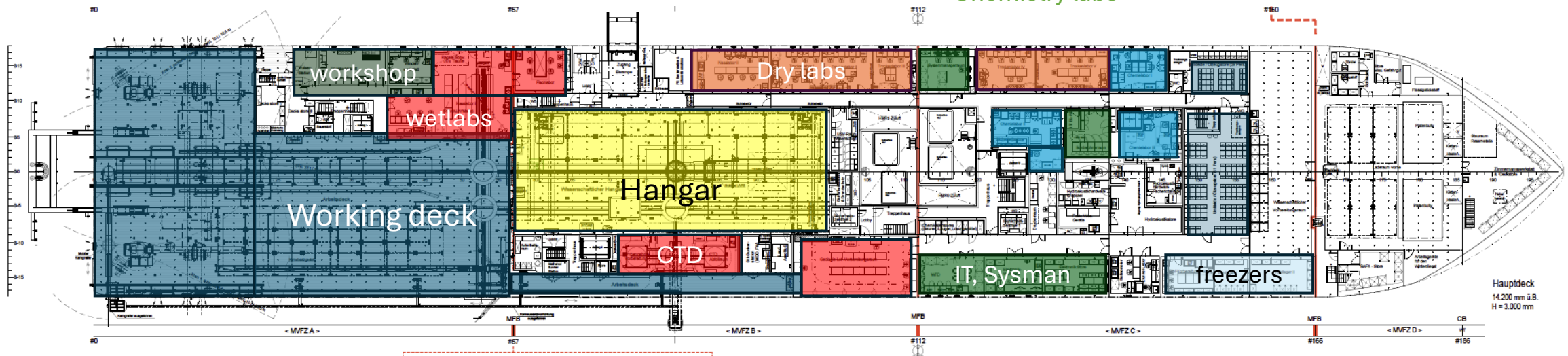


Working Profiles covered:

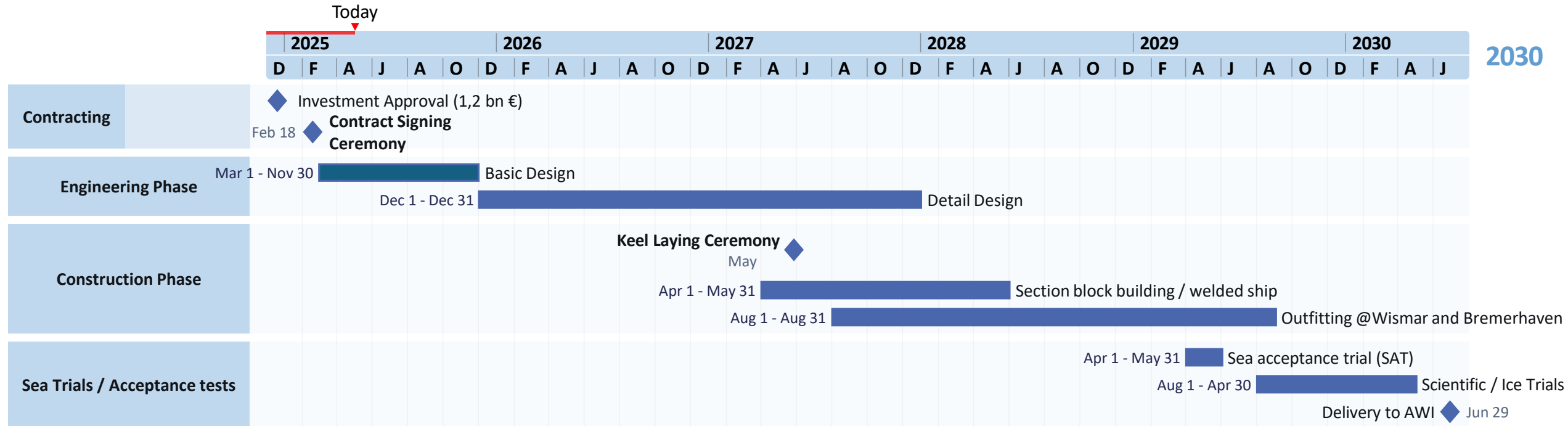
1. CTD over STB side
2. CTD/ROV/MUC via moonpool
3. Moorings deployment and recovery
4. Box Corer (30m)
5. Giant Corer WHOI (60 m)
6. Open Water 2D seismic survey
7. 3D seismic survey
8. 2D seismic survey in ice covered waters
9. Fisheries: trawling
10. Fisheries: Agassiz trawl
11. ROV deployment via A frame
12. AUV deployment via mobile platform
13. Deployment MARUM MeBo
14. Surface and under-Ice Trawl (SUIT)
15. Ocean Floor Observation System (OFOS)
16. Deployment TOP Awi
17. Deployment Bottom Lander
18. Deployment AUVs astern
19. Installation of mobile drilling platform

Chemistry labs

Lockerrooms



Polarstern - Construction and Building Timeline



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FORSCHUNGSSCHIFF

POLARSTERN 2



Bundesministerium
für Bildung
und Forschung



thyssenkrupp



Polarstern – Neumeyer III supply (antarctica)