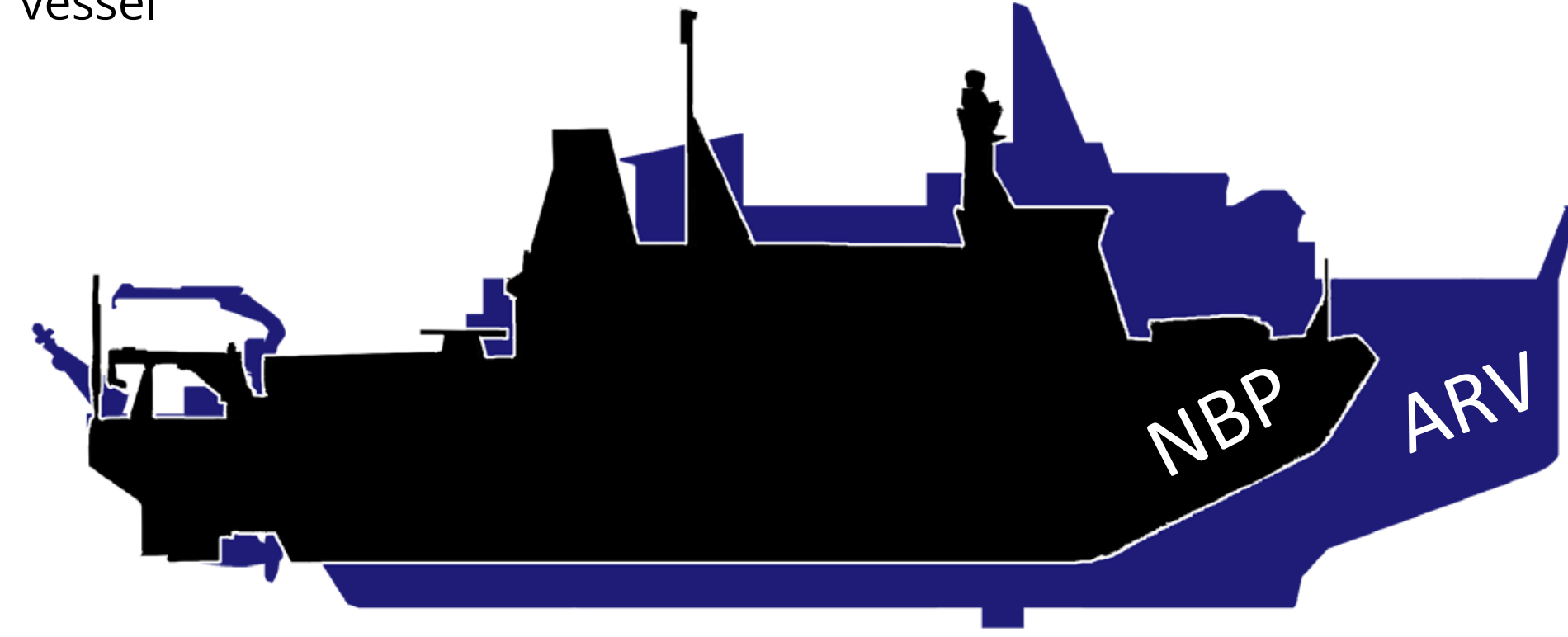


United States Antarctic Program Antarctic Research Vessel (ARV) Project

Overview

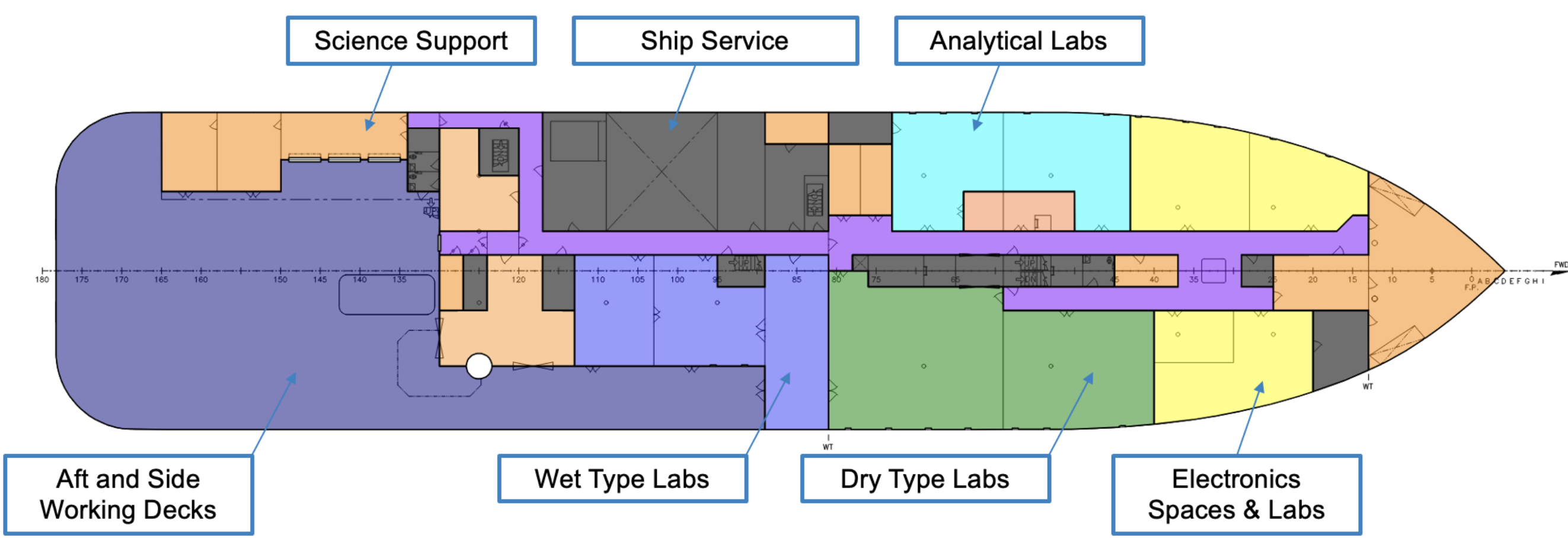
The United States Antarctic Program (USAP) is managed through the U.S. National Science Foundation (NSF) Office of Polar Programs (OPP). The USAP operates two research vessels that support NSF's extensive Antarctic marine research program. The R/VIB *Nathaniel B. Palmer* (NBP) is the primary research vessel for the USAP, operating on average of 275 days a year in support of science. The NBP, leased by NSF, was delivered in 1992 and will reach the end of its planned service life of approximately 40 years in 2032.

OPP has been developing the NBP-replacement, the Antarctic Research Vessel (ARV), since 2015, but the project has advanced significantly over the preceding two years of effort, culminating in a vessel



that will have an endurance of 90 days unrefueled, be able to accommodate at least 55 researchers and technical personnel and be rated as a Polar Class (PC) 3 vessel, capable of independently operating in ice up to 1.4m thick with an additional 30cm of snow at a continuous three knots.

Main Deck Features

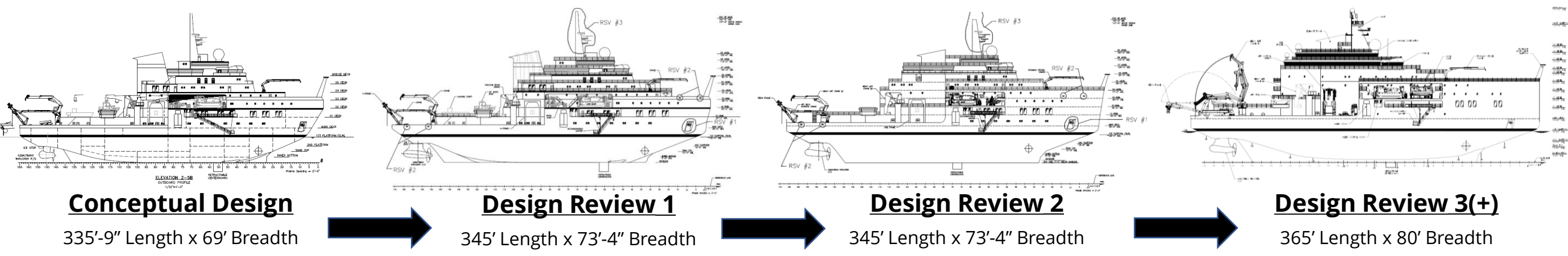


Science Driven Main Deck

- Continuous longitudinal passageway, linking interior lab spaces to working weather decks
- Lab spaces grouped by functionality

Credit: NSF

Design Evolution

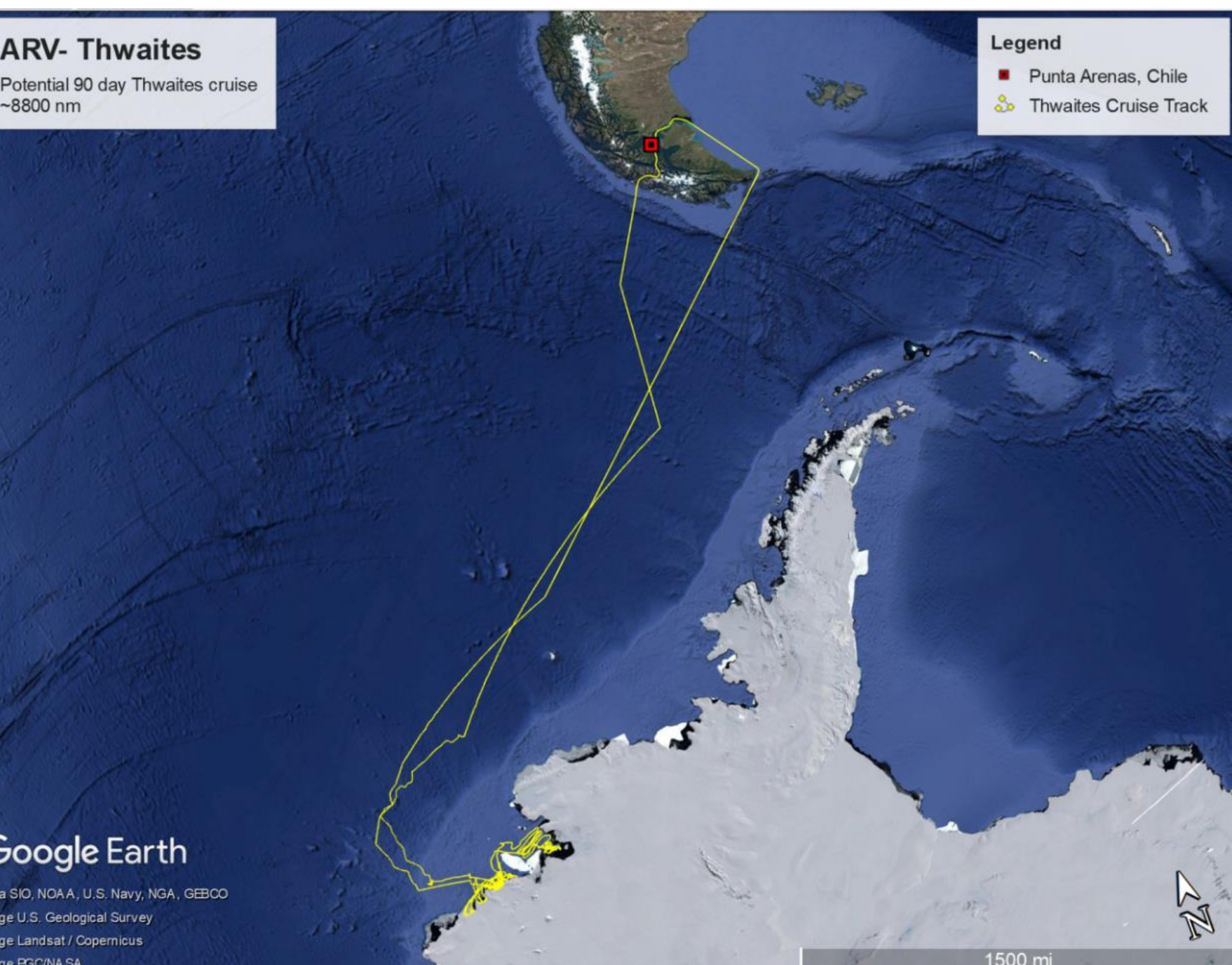


Preliminary Design Review

- 365' (111m) Length x 80' (24m) Breadth
- Meets All KPPs
- Main Deck Lab Arrangement with Workflow Focus
- Science Operations Center (SOC)
- 20 Lab Van Capacity
- Aft/Side Working Deck for 50m Core
- Box Keel

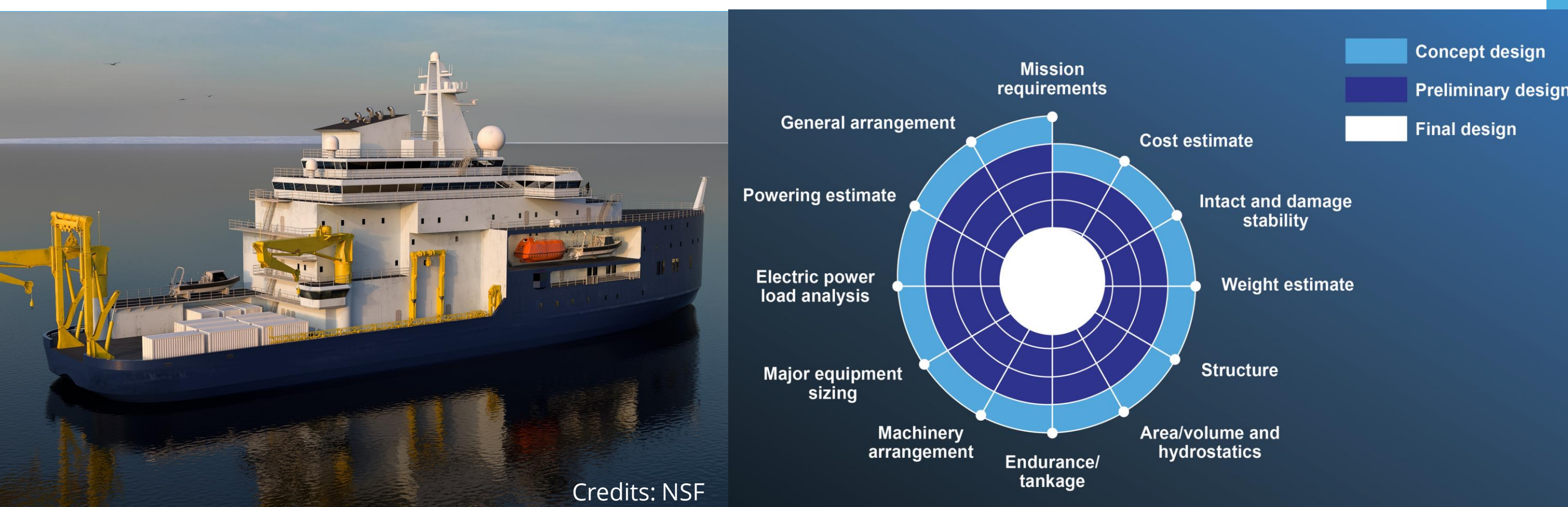
Credit: NSF

Design Reference Mission (DRM) - Thwaites/Pine Island Bay



A conceptual science expedition for the ARV was developed to facilitate the design process. This design reference mission (DRM) is based on historic Antarctic research expeditions and potential future missions. It anticipates the expanded ARV performance and support capabilities beyond the incumbent vessels and includes activities reflecting the ARV program's three primary key performance parameters.

Operational Mode	Fair Weather Duration (Days)		
	Southern Ocean	Amundsen Embayment	Amundsen Sea
Open water transit	10	0	0
Acoustically quiet transit	0	17.5	0
Icebreaking	2	9	0
On Station	0	32	0
On Station, DP	0	11.5	0
Deployment	0	4	0
In Port	1	0	0
Ice Transit	0	3	1
Totals (91-day total mission duration)	13	77	1



Credits: NSF



Key Performance Parameters (KPPs)

- Polar Class 3 (PC3); 4.5' (1.4m) ice + 12"(30cm) snow at 3 kts
- 90-day endurance
- 55-science & technical personnel

Credit: NSF

Model Testing

Powering

- Model tests demonstrated that the installed 19 MW power is adequate power to maintain required speeds.
 - Ahead - 3 knots in 4.5 ft thick ice, with 1.0 ft thick snow cover
 - Ahead - 7 knots 3.0 ft thick ice with 1.0 ft thick snow cover
 - Astern - 3 knots in 4.5 ft thick ice, with 1.0 ft thick snow cover
 - Astern - 4.5 knots 3.0 ft thick ice with 1.0 ft thick snow cover

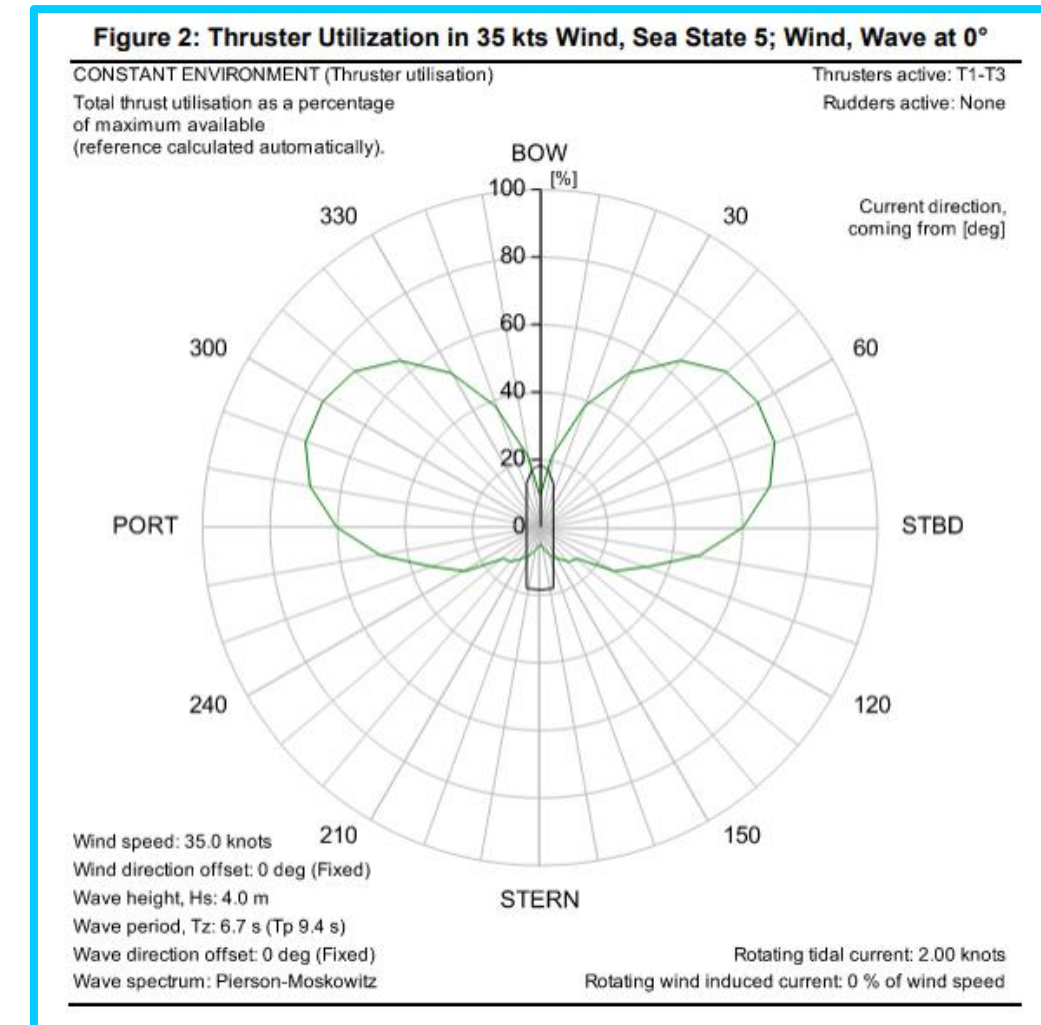
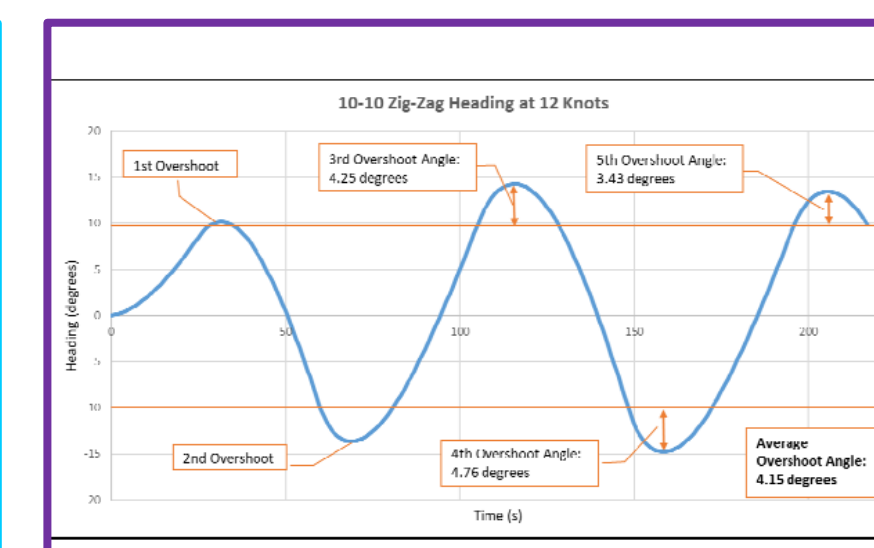
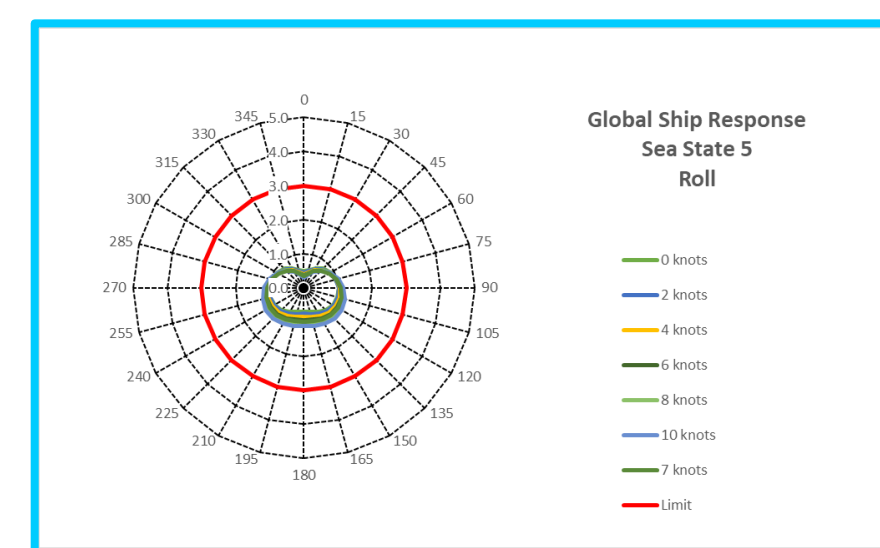
Maneuvering

- Break out from a cleared channel, ahead and astern, in both ice thicknesses.
- Breaking through ridges with keel depths of 23' and 37.7'
 - Slight loss of speed in the shallower ridge depth
 - Two ramming attempts in the deeper ridge



Credits: NSF

Seakeeping & Maneuvering



Seakeeping meeting all P-SPEC Requirements

- The 100% Operability for Sea States 4 & 5
- 54% Operability for Sea State 6
- Zero speed operability within +/- 45 degrees of best heading for Sea States 4 through 6.
- 100% Safe Operation - Operability for Sea State 7 and 8

Maneuvering meeting all P-SPEC Requirements

- Tactical turning diameter
- IMO 10-10 zig-zag at 5 speeds
- Directional stability

Dynamic Positioning meeting all P-SPEC Requirements

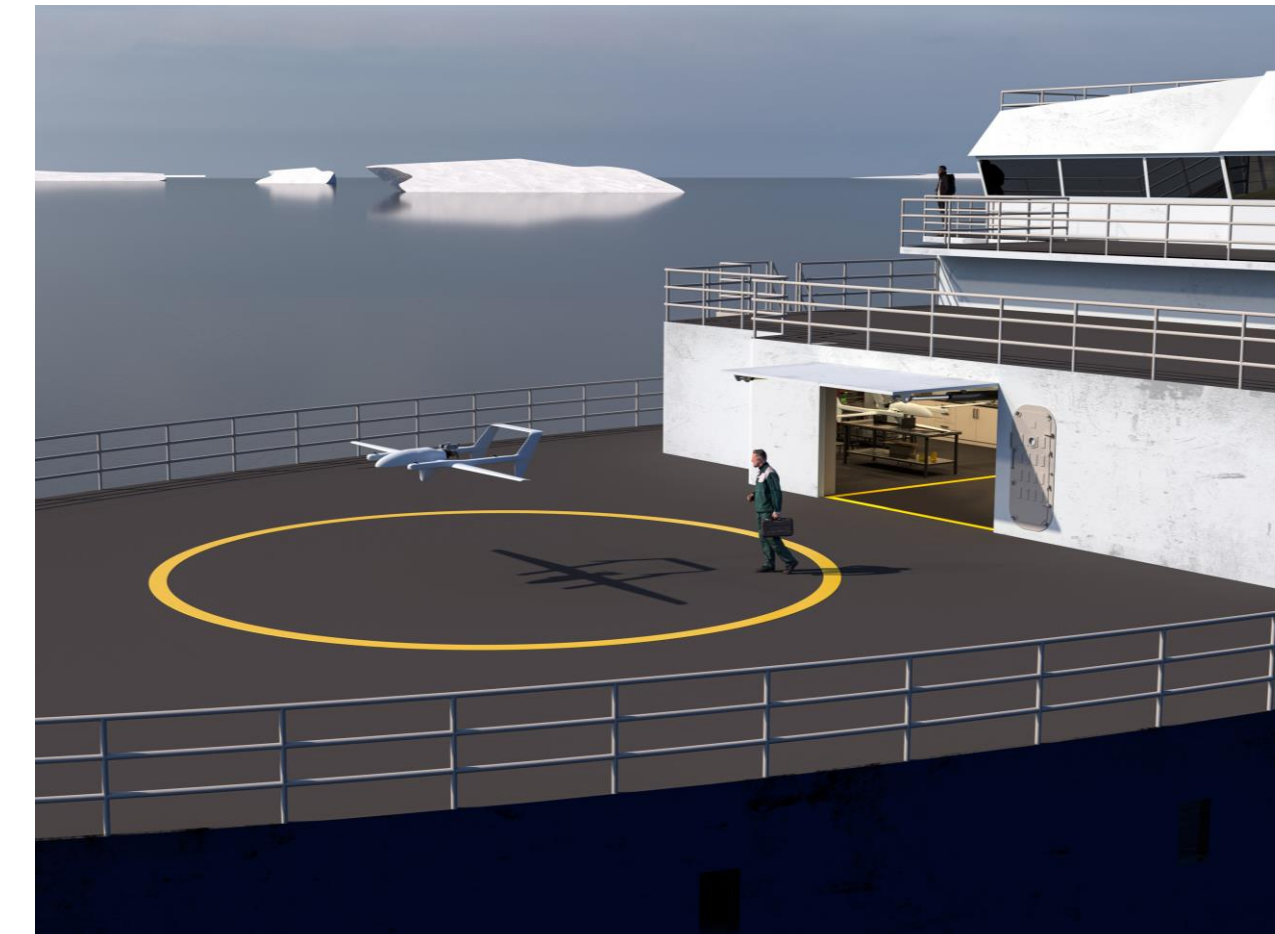
Target Watch Circles = 16.4 feet in Sea State 4
66 feet in Sea State 5

The system is capable of holding station in wind and wave headings of 0 and 180 degrees at all current headings of 0 to 360 degrees.

The system is also capable of maintaining station, at all current headings, in seas up to 10 degrees off the bow and 20 degrees off the stern. Additional estimates evaluating reduced bow thruster utilization to minimize to radiated and structure borne noise levels.

Aviation Deck/Hangar

Design includes an aviation deck focused on expanded use of unoccupied aerial vehicles (UAVs). Deck will also be able to support the landing of a single light helicopter.



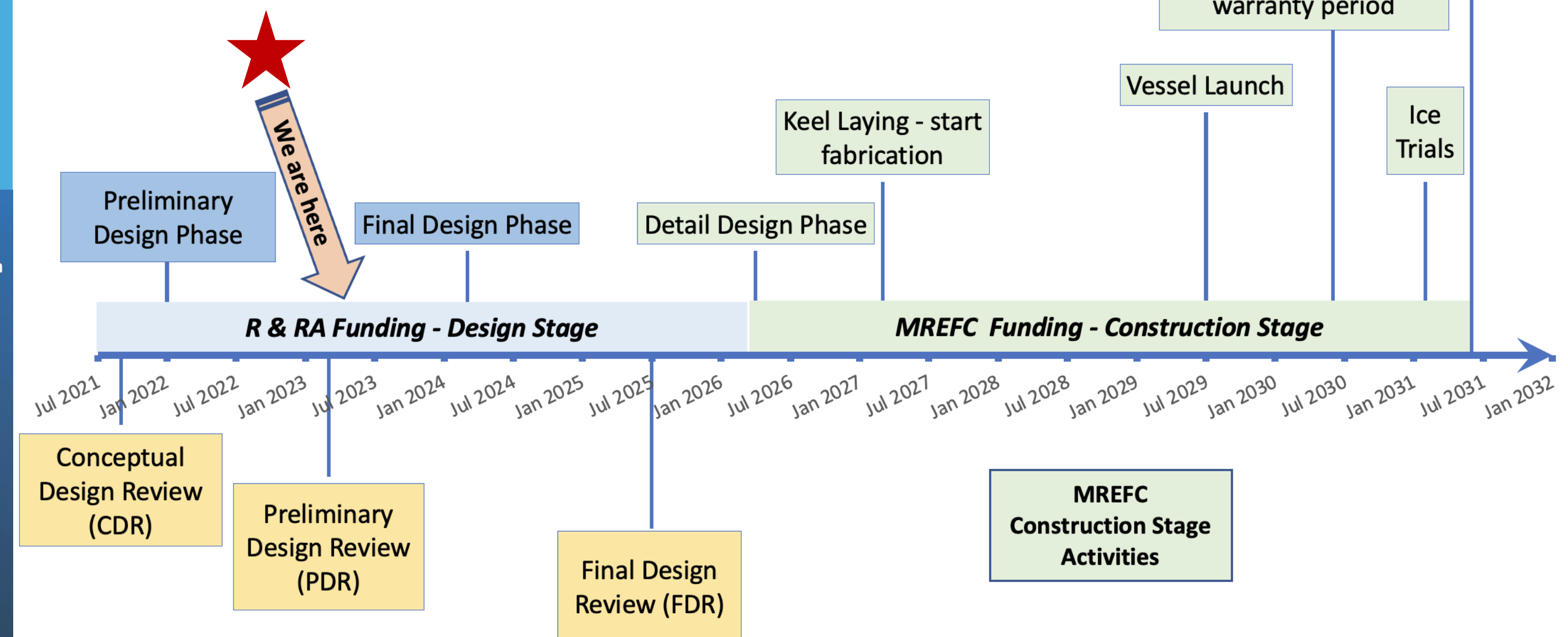
"Green" Ship Features

- FULL UTILIZATION OF WASTE HEAT
- ELIMINATION OF OZONE-DEPLETING SUBSTANCES
- SEWAGE TREATMENT PLANT
- 83% LESS WATER USAGE AND WASTEWATER DISCHARGE
- IMPROVED HYDRODYNAMICS
- ENERGY EFFICIENT HOTEL SYSTEMS
- FLUID WASTE STREAMS TREATED PRIOR TO OVERBOARDING

Credit: NSF

End Warranty - Final Acceptance and Begin Science

ARV Delivered to NSF - Transition to Ops Phase: outfitting, trials, science system verification, & warranty period



Tim McGovern, NSF ARV Program Manager
tmcgover@nsf.gov

Mike Prince, NSF ARV Project Manager
jprince@nsf.gov