

Design of the CCG Polar Icebreaker



Arctic Passion Seminar
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Background

Budget 2008 allocated funding for the acquisition of Canada's first Polar Icebreaker, *CCGS John G. Diefenbaker*, as the center-piece of Canada's Northern Strategy.

The Polar Icebreaker Project is following a two-step procurement strategy of design then build:

- Project is currently in the *Design Stage* of the *Project Definition Phase* following a competitive solicitation for Design Services (STX Canada Marine and Aker Arctic).
- For the *Project Implementation Phase*, production engineering and vessel construction will be procured through Canada's National Shipbuilding Procurement Strategy (Vancouver Shipyards Ltd).

The Polar Icebreaker is currently scheduled to be delivered to replace *CCGS Louis S. St-Laurent* after she decommissions in 2017.

Canada's second heavy icebreaker *CCGS Terry Fox* is presently scheduled for decommissioning in 2020.

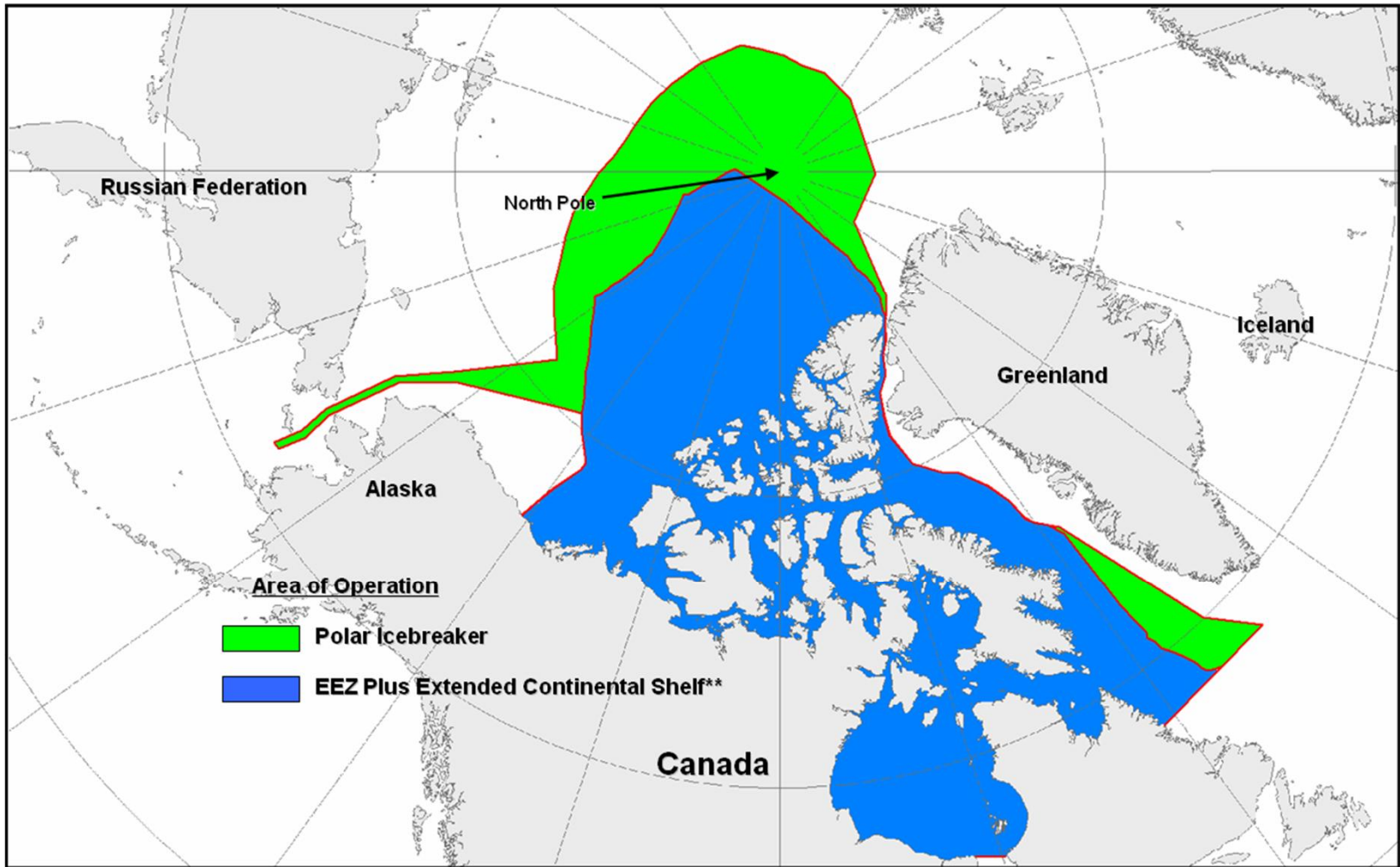


Mission Profile

- Unrestricted autonomous operations in Canadian Arctic and adjacent waters for nine months of the year.
- Typically available for operations for Apr/May through Dec/Jan but will be capable of safely over-wintering in high Arctic waters.
- Primary purpose to deliver Federal Programs in the Arctic; Coast Guard flagship and vital instrument of Government policy.
- Supported Programs addressed by “Modular Mission Payload” approach; multi-tasked, inter-operable and adaptive.
- 270 days logistical endurance will provide 3-season operation; driven predominantly by regulatory maintenance requirements.
- Organic aviation capability of 2 x medium lift IFR helicopters plus ability to land and refuel large DND maritime helicopter.



Area of Operation



Design Ice Criteria

Icebreaking Criteria:

- Maximum Ice conditions:
 $h_{ice} = 2.5\text{m}$ with 30 cm snow / $\sigma = 500\text{ kPa}$ / $v_{ship} = 3\text{ kts}$ / 100% MCR
- Manoeuvring/endurance conditions:
 $h_{ice} = 2.2\text{m}$ with 30cm snow / $\sigma = 500\text{ kPa}$ / 85% MCR
- Ice breaking endurance of 25 days minimum at full power

CHC studies

- Phase One – First Year Ice Analysis
- Phase Two – Ice Concentrations and Floe Size
- Phase Three – Multi-year Ice Analysis / Deformed Ice Analysis
- Pressurized Ice Numerical Simulations

Analysis feeds subsequent activities:

- Validation of Design criteria and operational requirements
- Design cost trade-off studies and decisions
- Ice class determination work
- Voyage simulations to validate design work for compliance to operational requirements
- Model scale design validation testing
- Full scale performance trials



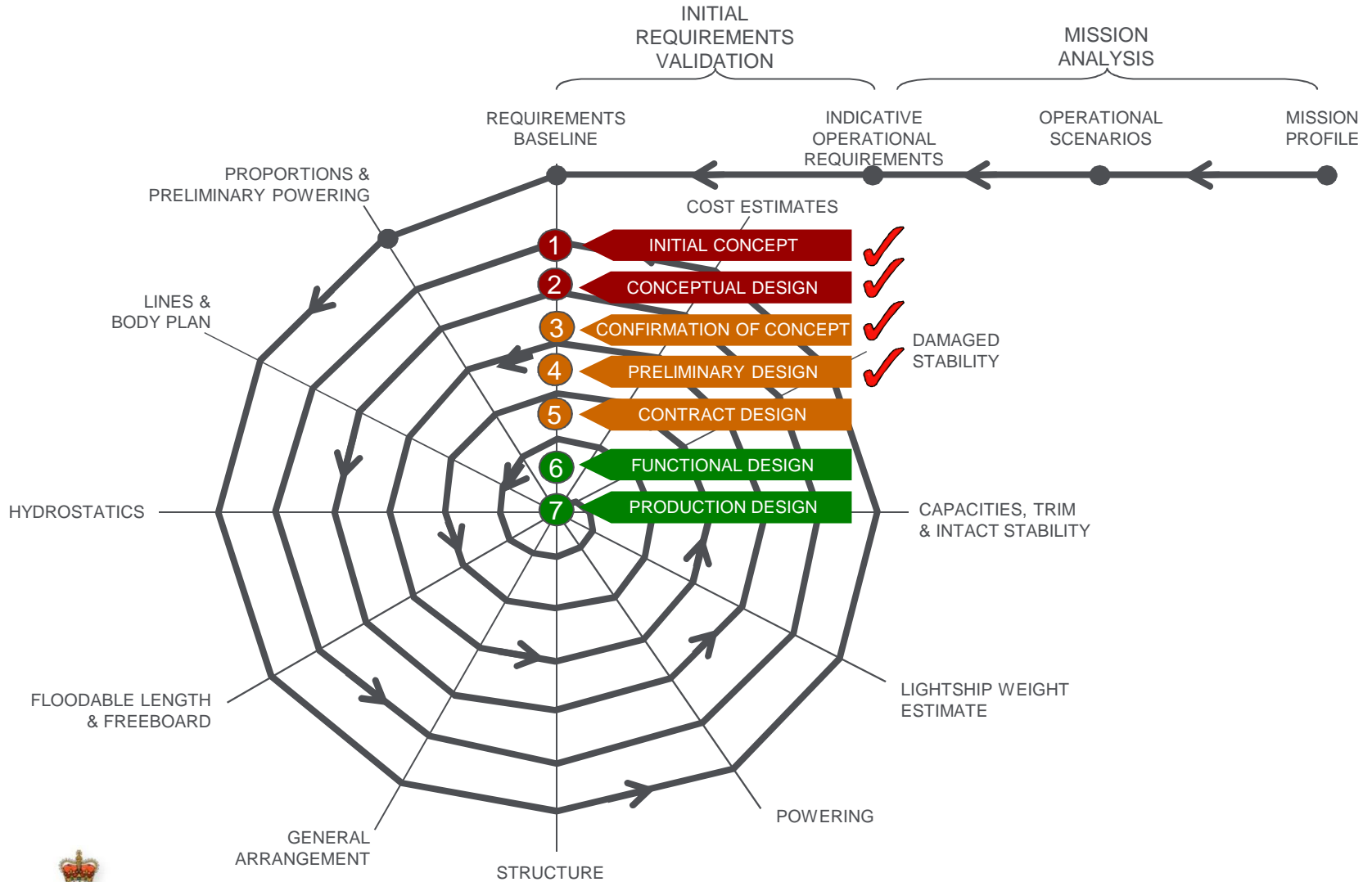
Operational Flexibility and Adaptability

Modular Mission Payload Approach

- Multi-purpose icebreaker.
- Flexibility and inter-operability.
- Adaptable to future program demand.
- Much more than just containerisation.
- Multi-purpose spaces and reconfigurable systems / equipment.
- Ability to reconfigure while underway.
- Interface specification to be developed.

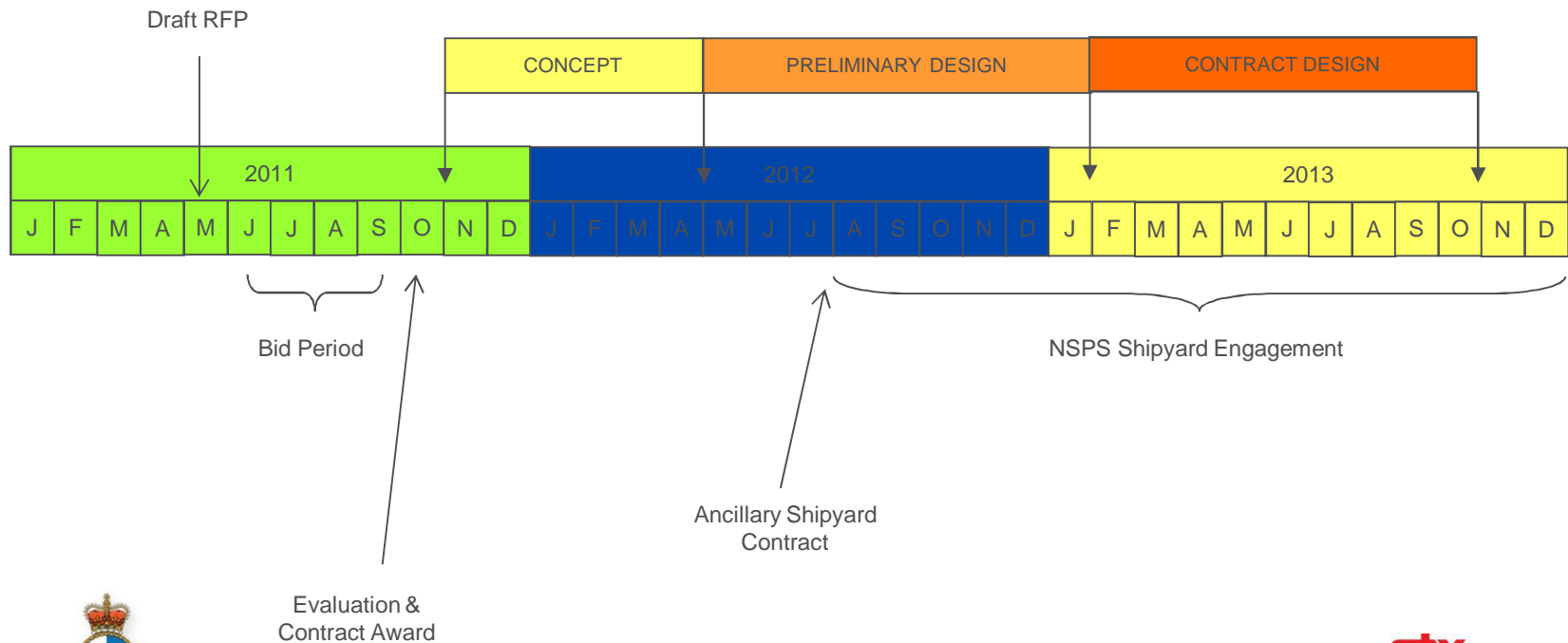


CCG Polar Icebreaker Design Process



Polar Icebreaker Design Schedule

- STXM is currently developing the Contract Design
- All design information in this presentation is Preliminary and may change as the design is further developed



Preliminary Design

Notional Vessel Particulars:

- IACS UR PC2 (Icebreaker)
- Length approximately 149m
- Beam approximately 28m
- Draught 10.5m
- Displacement approximately 23,700 tonnes
- Fully integrated diesel electric system
- Installed power of 42 MW
- 18 knots max / 12 knots cruise / 3 knots ice
- Full power endurance of at least 25 days
- Complement of 60 crew / 40 msn personnel
- 270 days logistical endurance
- 2 x medium lift helicopters



Vessel Overview: Principal Particulars

Principal Particulars

Length Overall (LOA)	149.3 m
Breadth (B)	28.0 m
Depth (D)	13.5 m
Design Draught (T)	10.5 m
Weight (Design)	
Displacement	23,700 MT
Complement	
Core Crew	60 persons
Program Pers	40 persons

Classification

Lloyd's Register +100A1 Icebreaker, Ice Class PC2, IBS, DP(AM), UMS, CCS, ICC, PSMR, IFP, Winterization: H(-35), A(-40)

Safety Regime

Transport Canada according to IMO Special Purpose Ship Code



Vessel Overview: Operation / Performance

Ship Operation

Max Service Speed	>18 kts
Economic Cruise Speed	12 kts
Program/Science Operations	0-6 kts

Ship Performance

Range

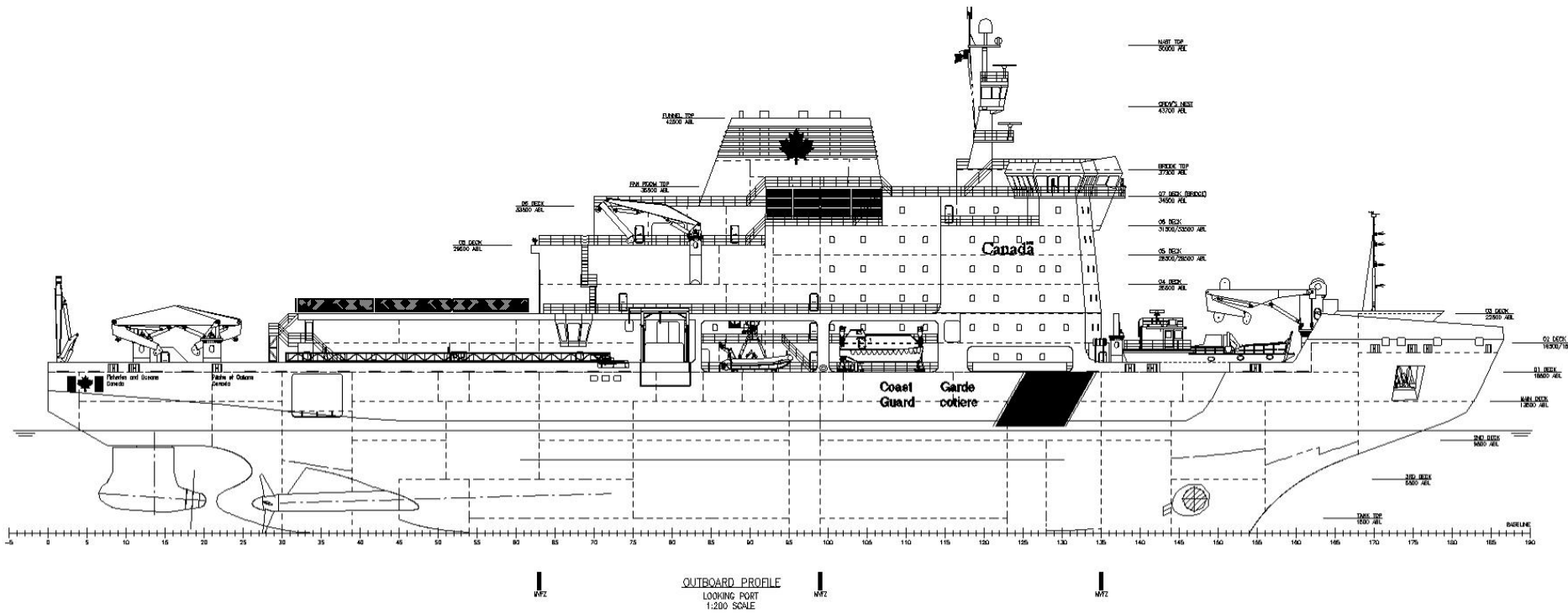
In 2.2 m ice @ 3 kts (exclusive of reserve) days	25 - 30
@ 12 knots in SS3	~28600 nm
Icebreaking in 2.5 m ice w/ 30cm snow	> 3 kts

Propulsion

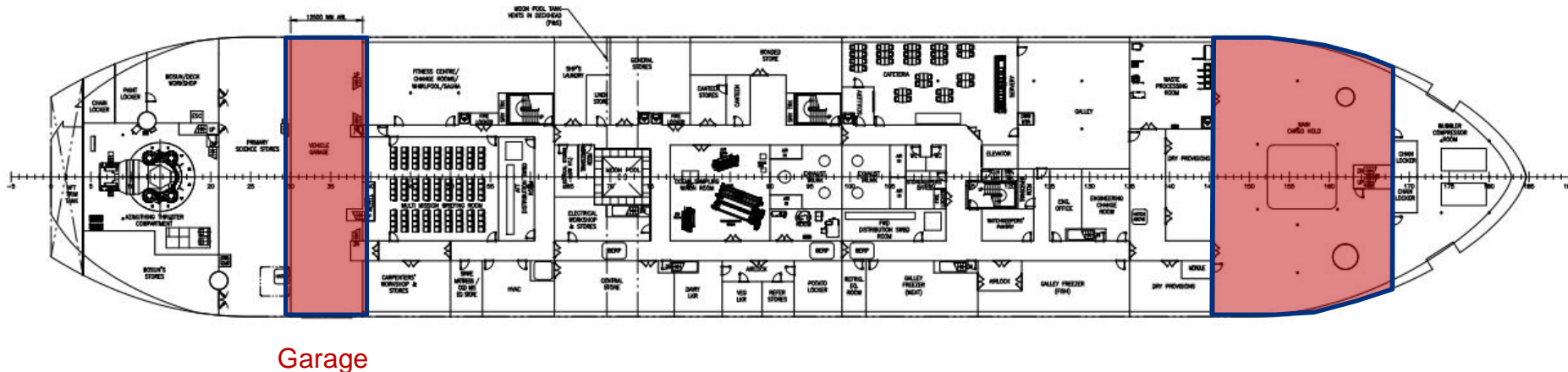
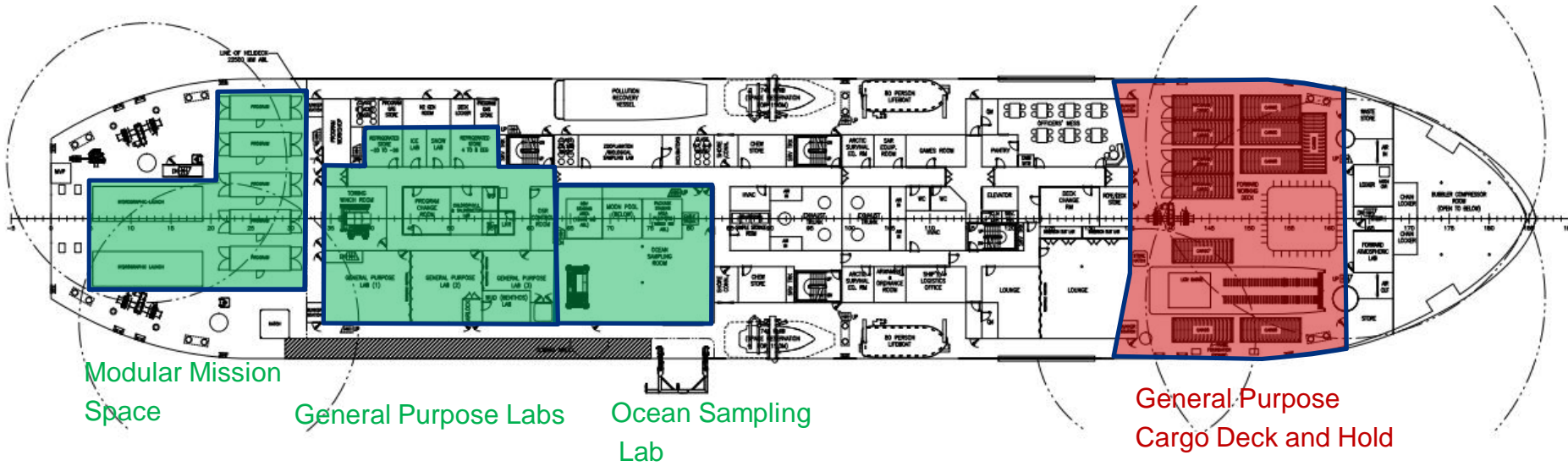
Prime mover power	3 x 8 MW, 2 x 9 MW
Shaft power	3 x 12 MW



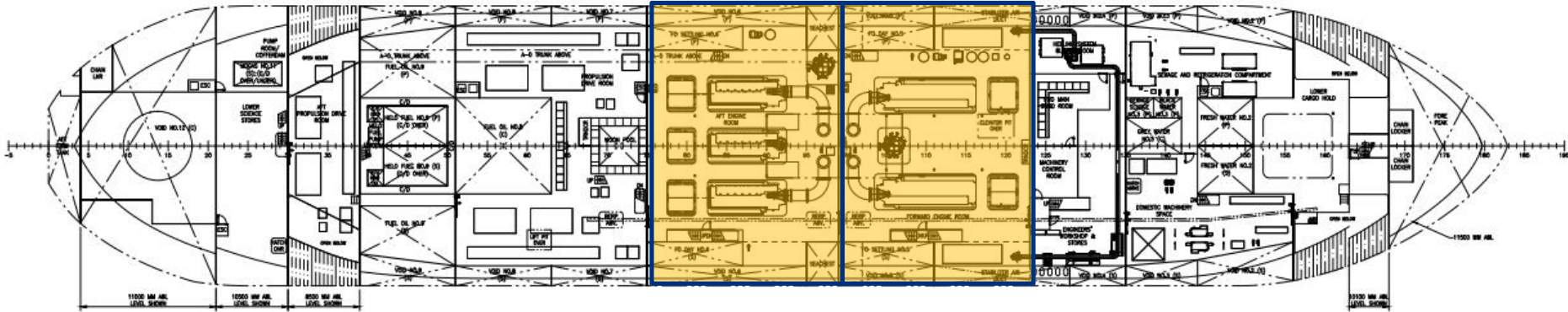
General Arrangement



General Arrangement

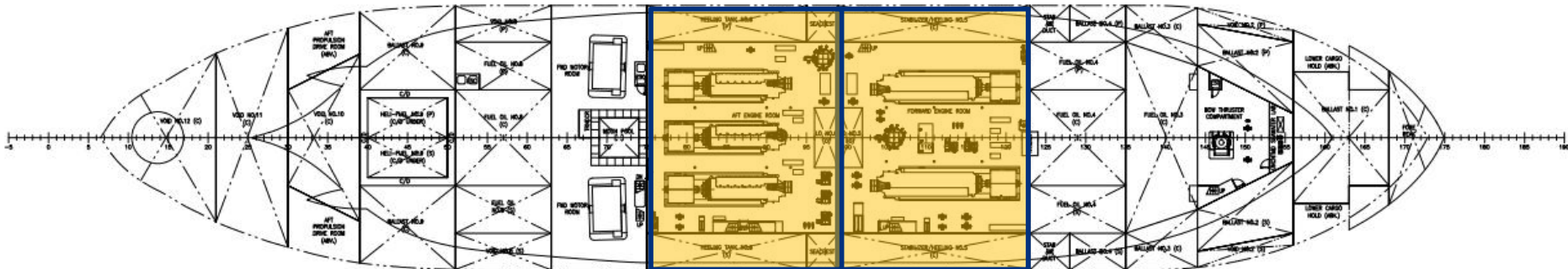


General Arrangement



Aft Machinery Space

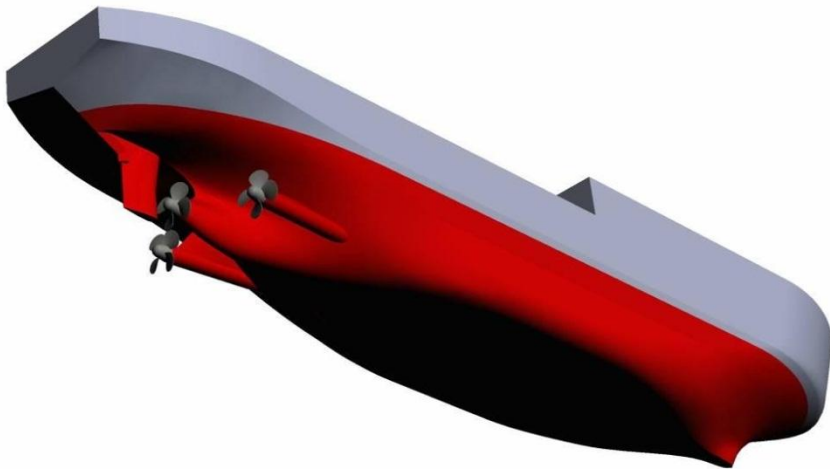
Forward Machinery Space



Propulsion Configurations

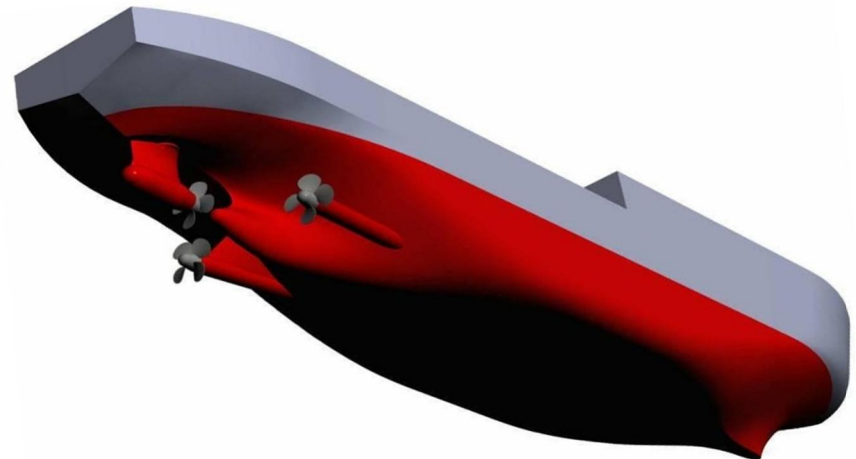
Integrated Diesel-Electric Propulsion System with AC-AC Variable Frequency

Three shafts & C/L rudder



- Traditional arrangement for Polar Icebreakers
- Proven arrangement for Canadian Arctic operations yet still susceptible to damage
- Meets most technical and operational requirements but challenged in some areas
- Marginally less capital cost

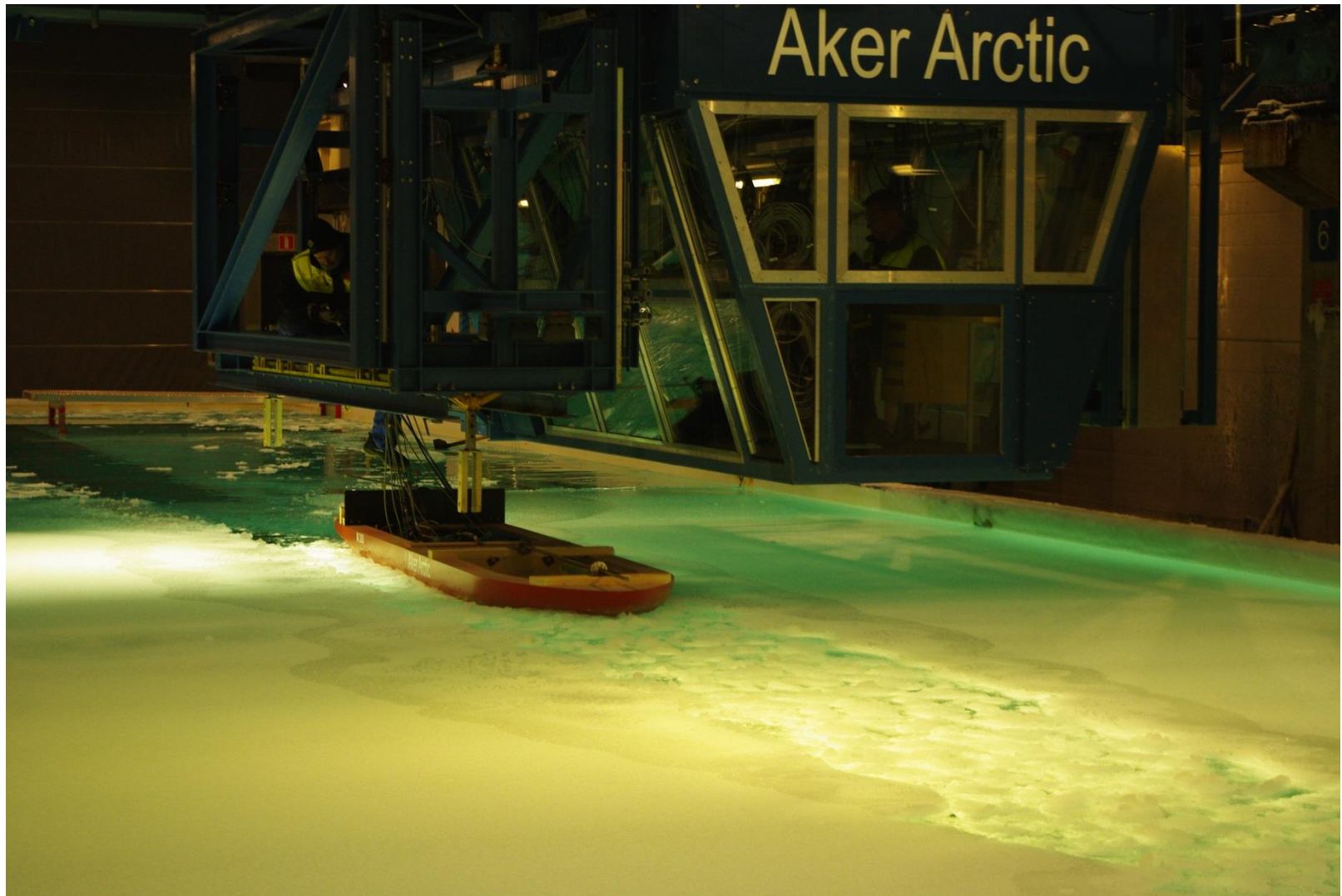
Two wing shafts & C/L Pod



- Popular approach for ice classed vessels over the last 10-15 years
- Proven in Arctic first year ice, limited data for operations in multi-year ice
- Major advantages in manoeuvrability and station-keeping



Model Tests



Current Preliminary Design



Current Preliminary Design



Thank you for your attention.

