A New Generation Polar Research Vessel

Impact of an Ice-Diminishing Arctic on Naval and Maritime Operations

Washington, DC July 10-12, 2007

Presentation Outline

- Background
- Science and Operational Requirements
- Results from Technical Studies
  - Research Vessel Features
  - Mission Sensitivity Studies
- Project Schedule
- Some Closing Thoughts

Background

U.S. Research Capable Icebreakers

(Operational and Planned)

Geographic Area	Vessel Ownership	Primary Mission	Icebreaking Capability
Arctic	UNOLS (ARRV) USCG (Healy)	Science Multi-mission	0.8 m (2.5 ft) 1.4 m (4.5 ft)
High Arctic	USCG	Multi-mission	1.8 m (6 ft)
Antarctica	Commercial (Lease to National Science Foundation)	Science	0.9 - 1.4m (3 - 4.5 ft)

This presentation will show the conceptual design of a dedicated research vessel with icebreaking capability for use in the Antarctic, but Arctic capable.

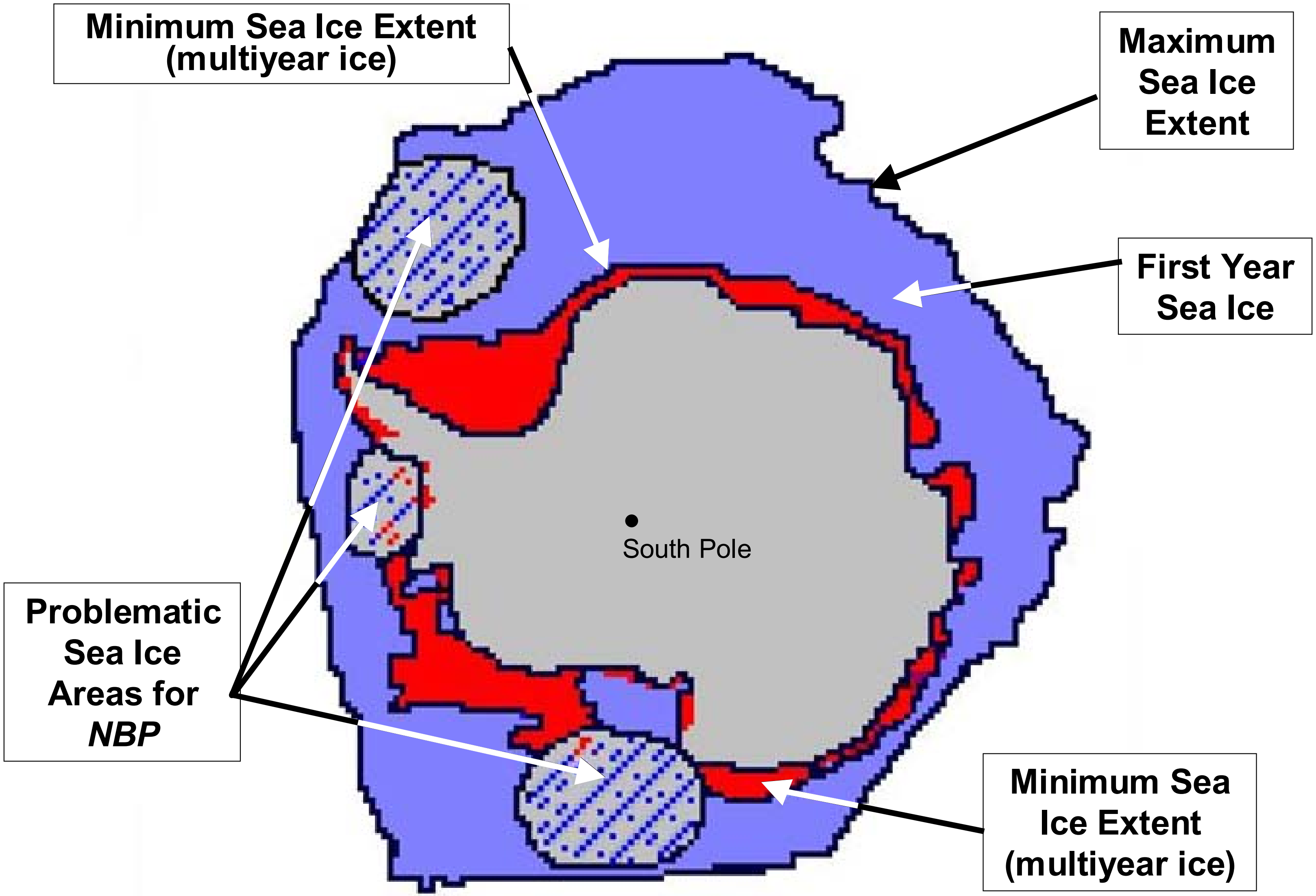
Science and Operational Requirements

NATHANIEL B. PALMER - 1992 to present

Critical New Research Requirements

- Enhanced icebreaking capabilities 1.4m (4.5 ft) at 3 kts
- Increased endurance to 80 days and 20,000 miles at 12kts
- Increased accommodations for 50
- Moon pool for geotechnical drilling - provides access to the water column through a controlled interface (no ice, limited surge, and turbulence)
- Ability to tow nets and research instrumentation from the stern during icebreaking
- Acoustically quiet
- Hull form designed for the installation of bottom mounted sensing instruments and operation during icebreaking

ANTARCTICA



Minimum Sea Ice Extent
(multiyear ice)
Maximum
Sea Ice
Extent
First Year
Sea Ice
South Pole
Problematic
Sea Ice
Areas for
NBP
Minimum Sea
Ice Extent
(multiyear ice)

Additional Science and Operational Requirements

- Capability to conduct autonomous underwater vehicle remotely operated vehicle (AUV/ROV) operations
- Jumbo piston coring (JPC) capacity for 50 m
- Compliance with International Maritime Organization (IMO) guidelines for Arctic vessels
- Reduced air emission from diesel engines and incinerator and other features for a “greener” ship
- Provision for a helicopter flight deck and hangar
- Space for 6 portable lab containers
- Aloft, enclosed platform for science observations
- Inter-deck elevator and wide passage way on main deck

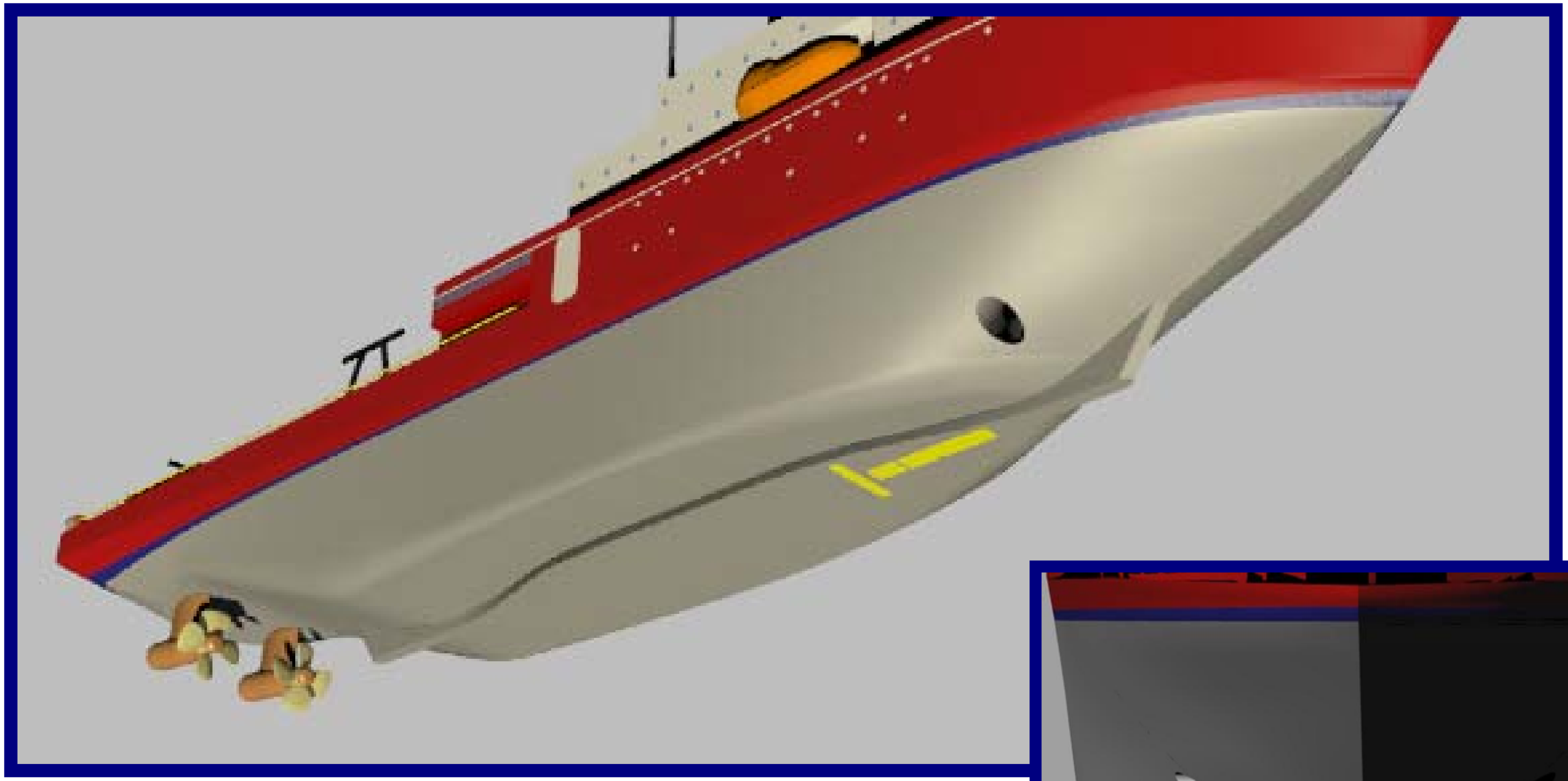
Desired Operating Profile

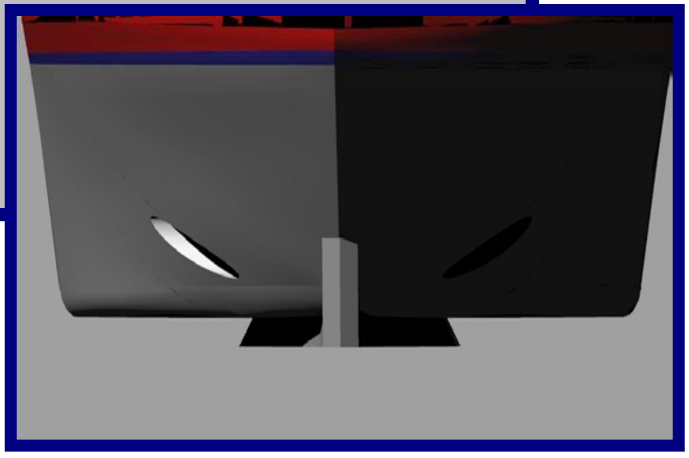
	Days
Science operations away from port and in-transit	265
In-port preparations for science operations	35
Repairs and maintenance	65
Total days	365

Results from Technical Studies

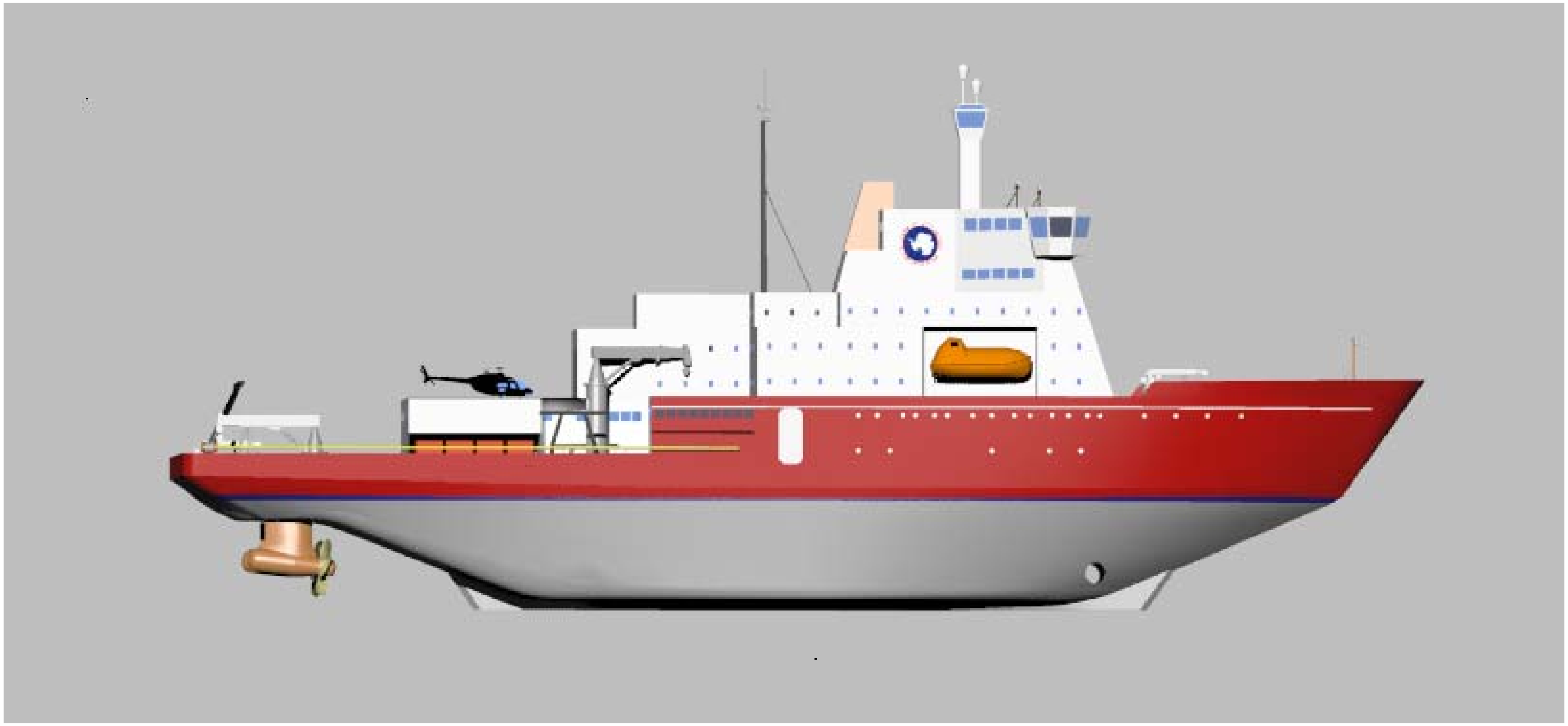
Above water features of PRV

Underwater view of PRV box keel with bottom mapping sensors

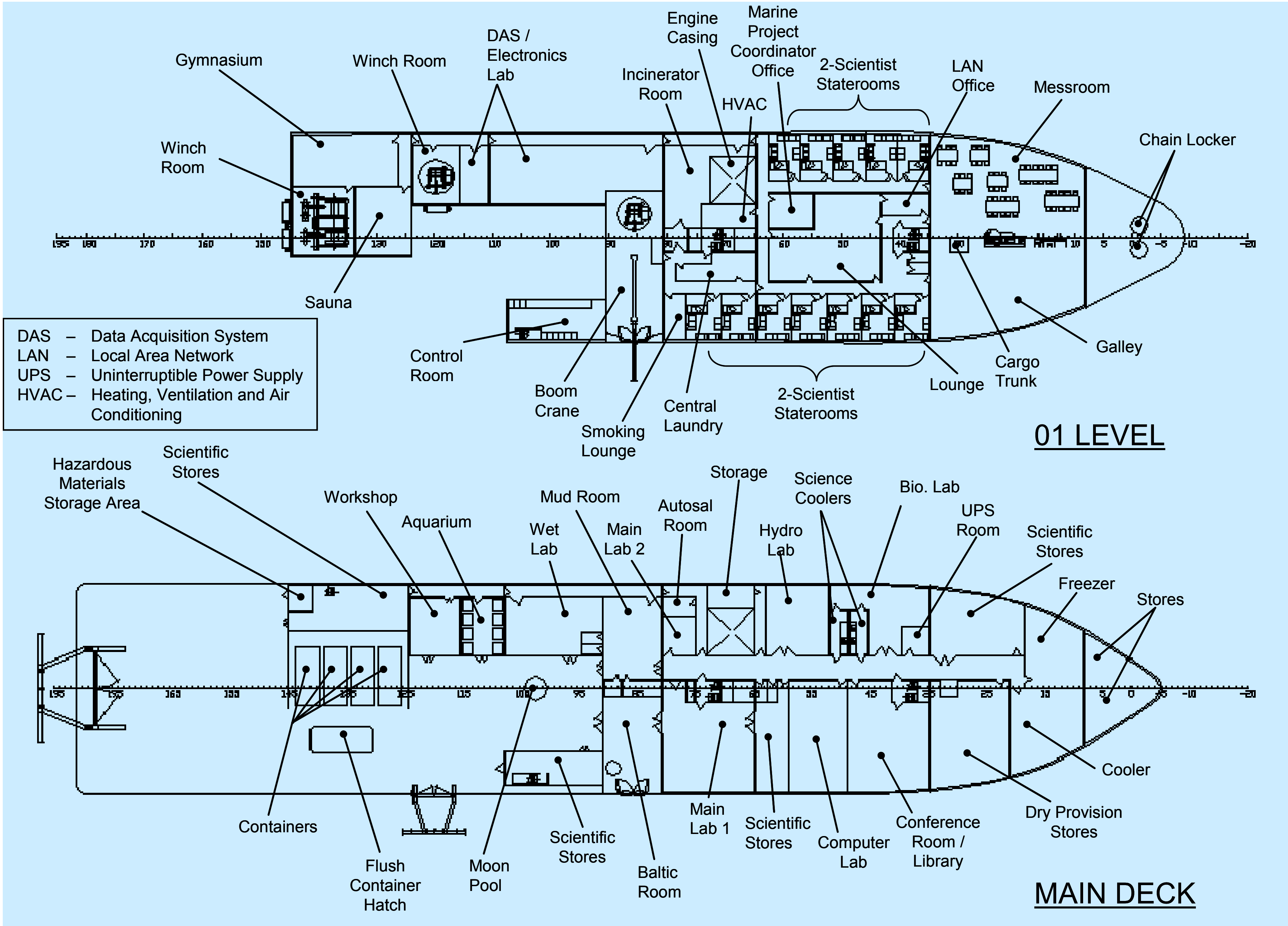




Principal Characteristics



LOA	**120.2 m**	**Draft**	**10.2 m**
LWL	**108.3 m**	**Displacement**	**13,900 MT**
Beam	**22.3 m**	**Shaft Power**	**15,000 kW**



Gymnasium
Winch Room
DAS / Electronics Lab
Engine Casing
Marine Project Coordinator Office
Incinerator Room
HVAC
2-Scientist Staterooms
LAN Office
Messroom
Chain Locker
Winch Room
Sauna
DAS – Data Acquisition System
LAN – Local Area Network
UPS – Uninterruptible Power Supply
HVAC – Heating, Ventilation and Air Conditioning
Control Room
Boom Crane
Smoking Lounge
Central Laundry
2-Scientist Staterooms
Lounge
Cargo Trunk
Galley
01 LEVEL
Hazardous Materials Storage Area
Scientific Stores
Workshop
Aquarium
Wet Lab
Mud Room
Main Lab 2
Autosal Room
Storage
Hydro Lab
Science Coolers
Bio. Lab
UPS Room
Scientific Stores
Freezer
Stores
Containers
Flush Container Hatch
Moon Pool
Scientific Stores
Baltic Room
Main Lab 1
Scientific Stores
Computer Lab
Conference Room / Library
Dry Provision Stores
Cooler
MAIN DECK

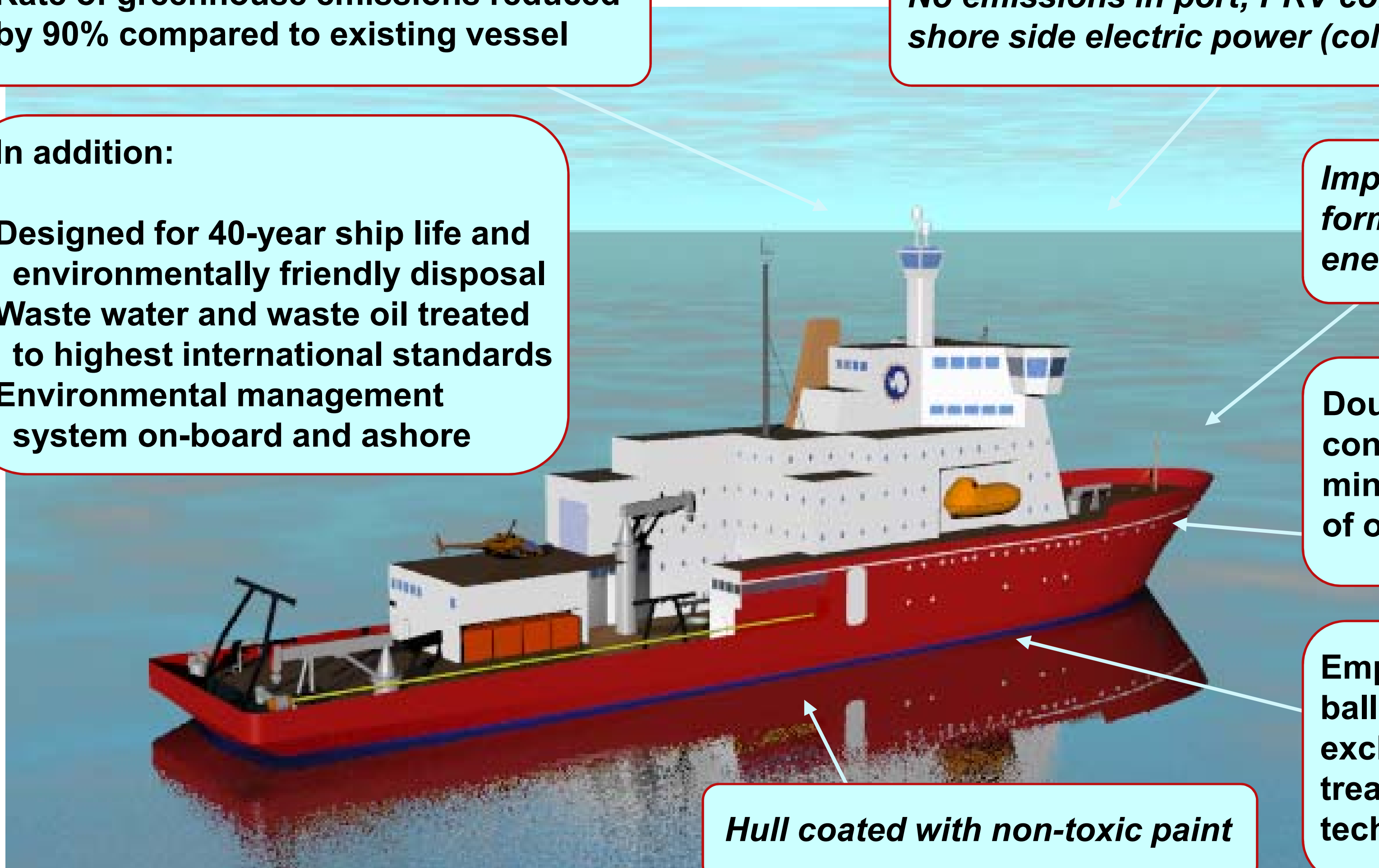
Some Environmental Features Incorporated in the PRV

Rate of greenhouse emissions reduced by 90% compared to existing vessel

No emissions in port; PRV connects to shore side electric power (cold ironing)

In addition:

Designed for 40-year ship life and environmentally friendly disposal
Waste water and waste oil treated to highest international standards
Environmental management system on-board and ashore



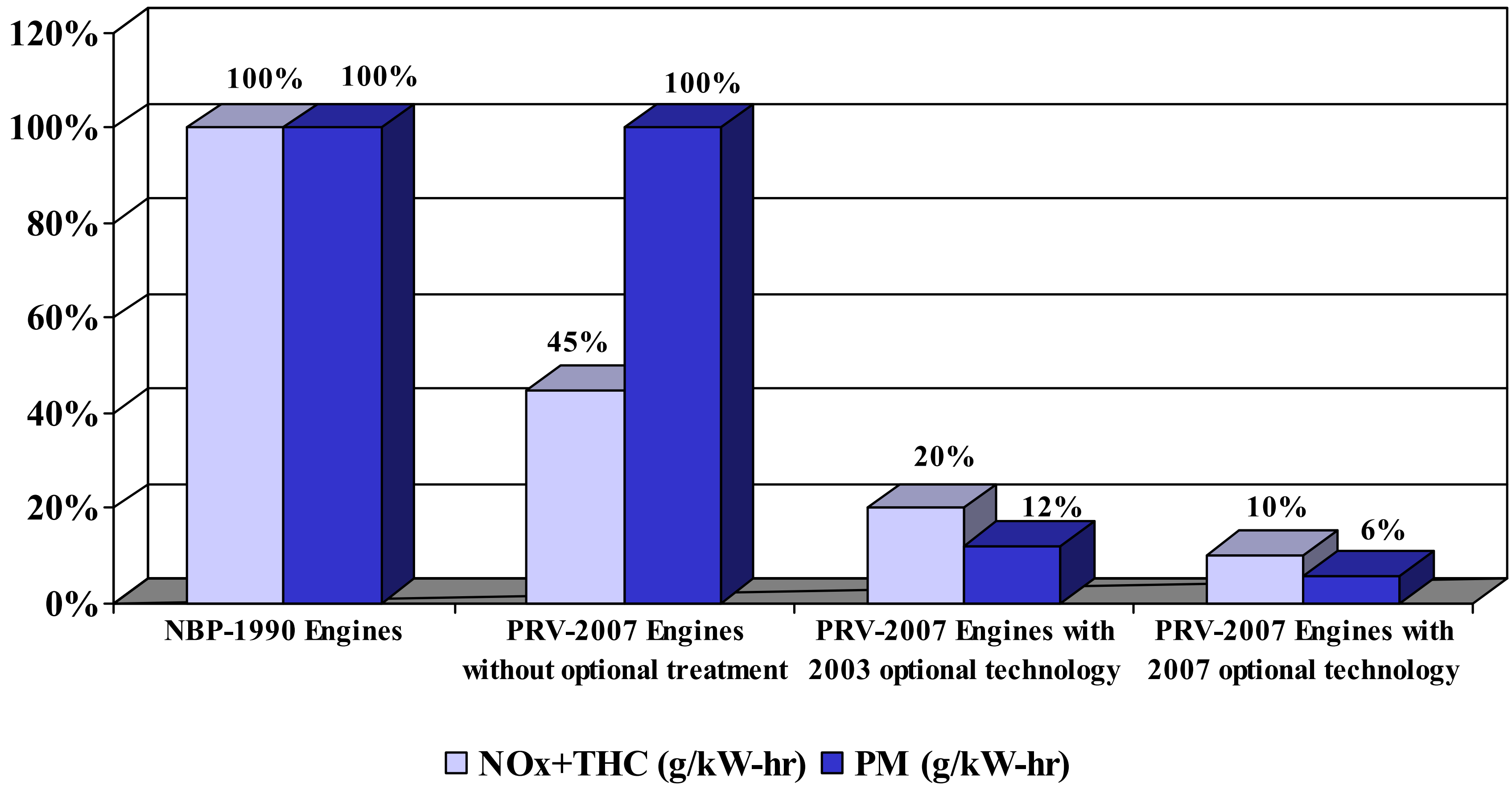
Improved hull form reduces energy by 20%

Double hull construction minimizes risk of oil spill

Employs latest ballast water exchange and treatment technology

Hull coated with non-toxic paint

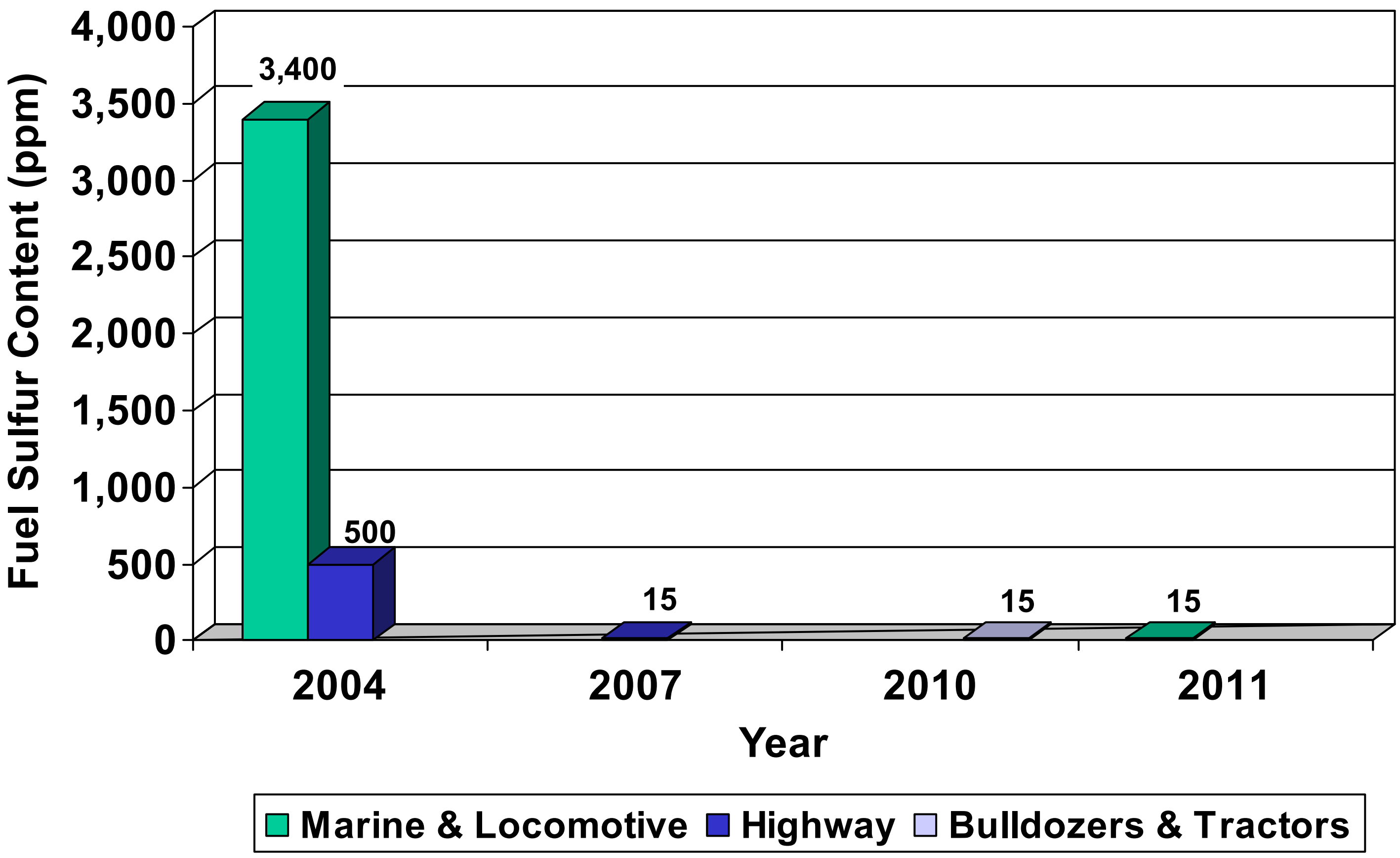
Emission Reduction per Horsepower



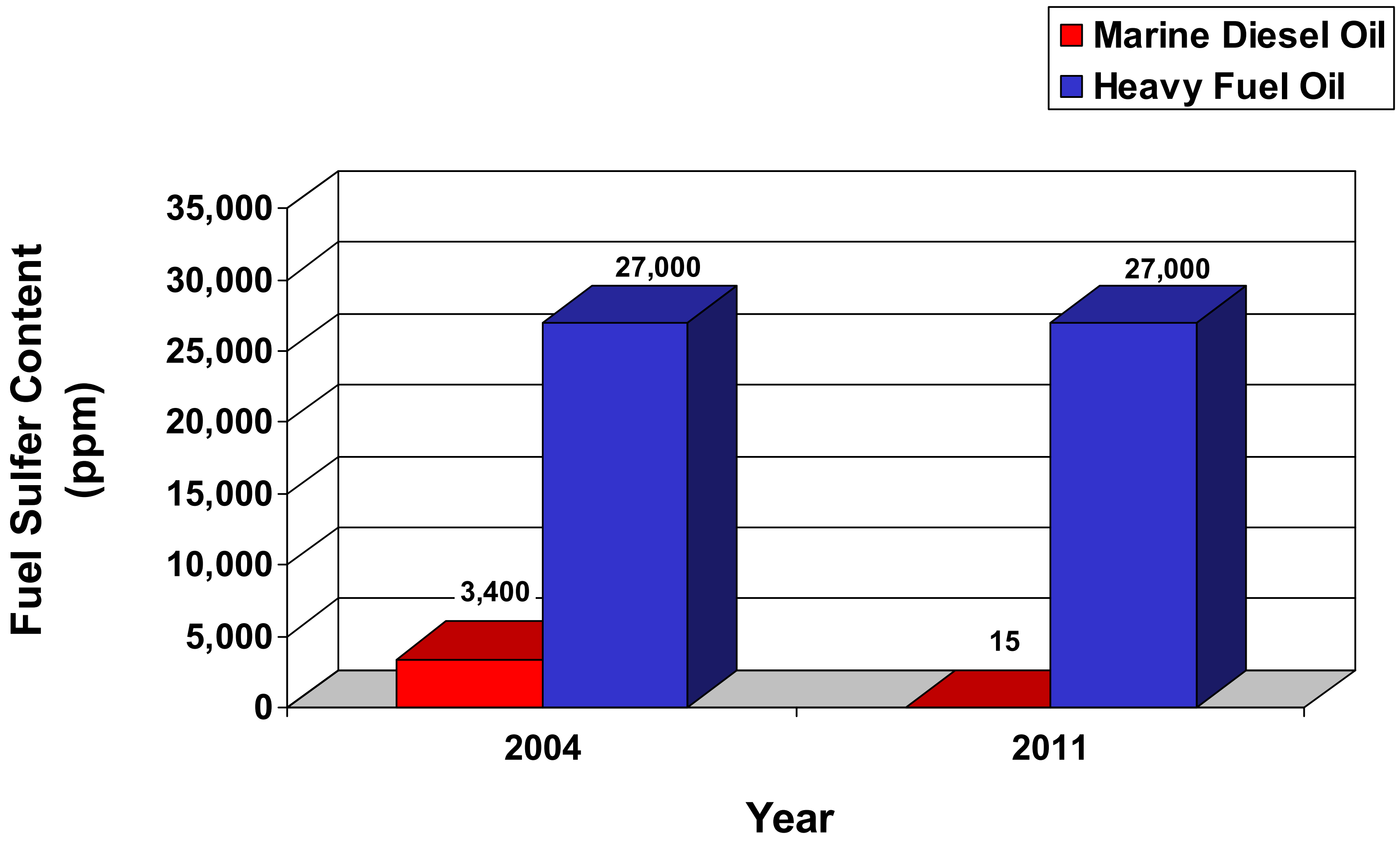
To achieve the emission goal -- there is a need to reduce the quantity of sulfur in diesel fuel oil.

Sulfur inhibits the use of NO_x and particulate matter emission reduction equipment (such as catalysts and filters) which are needed to meet U.S. Environmental Protection Agency regulations for air quality.

The Future of Ultra-Low Sulfur Diesel Fuel in the U.S.



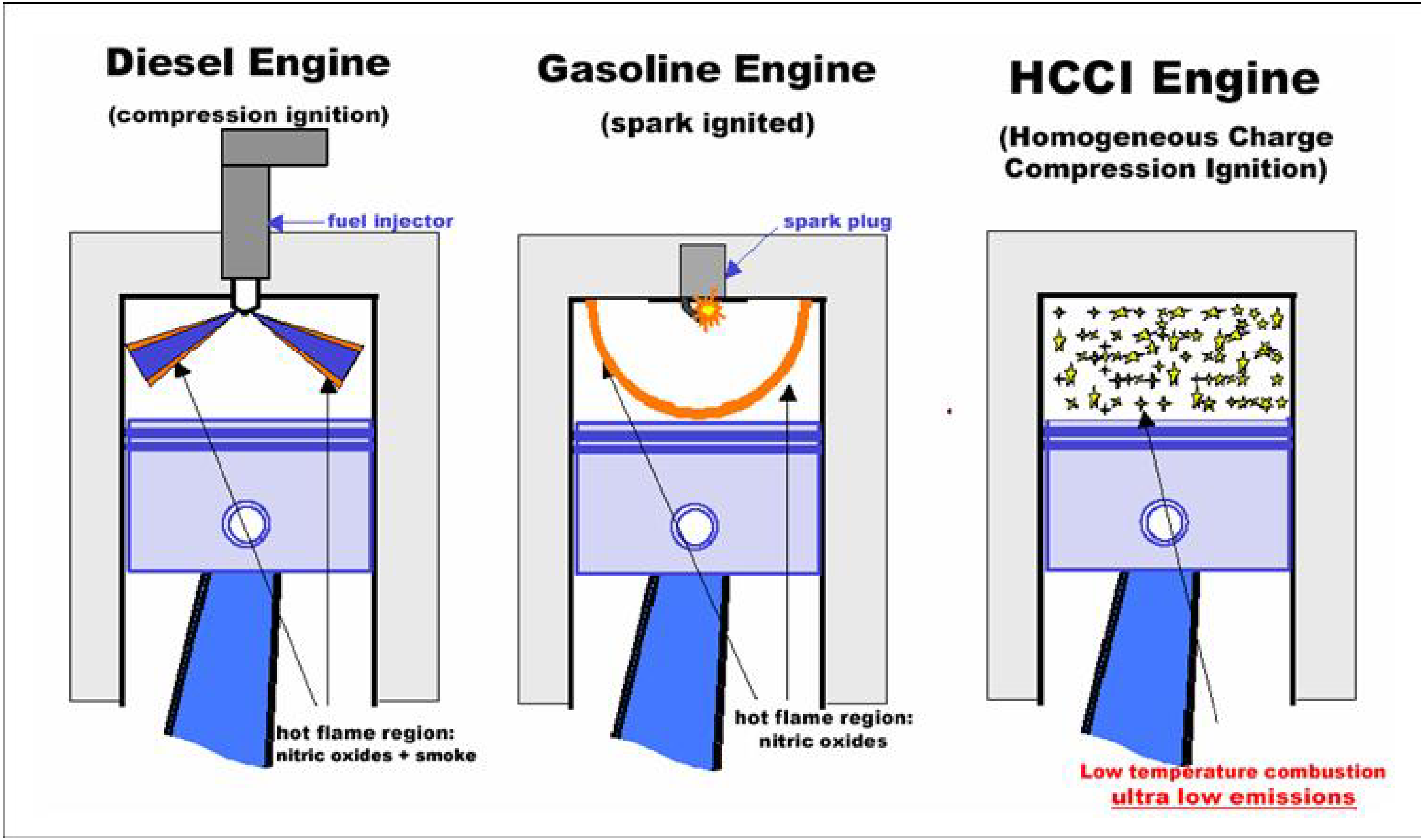
U.S. Marine Fuel Oil Sulfur Levels in 2004 and 2011



Next Generation Diesel Engine ???

Homogeneous Charge Compression Engine (HCCI)

- Economical – 25 percent fuel reduction
- Ultra low emissions – near zero
  - Oxides of Nitrogen (NOx)
  - Particulate Matter (PM)
- Operate on gasoline, diesel fuel, alternative fuel
- Has marine application
- "May be" commercialized in light-duty passenger vehicles by 2010



Combustion occurs simultaneously throughout the cylinder volume rather than a flame front.

It is not here yet !

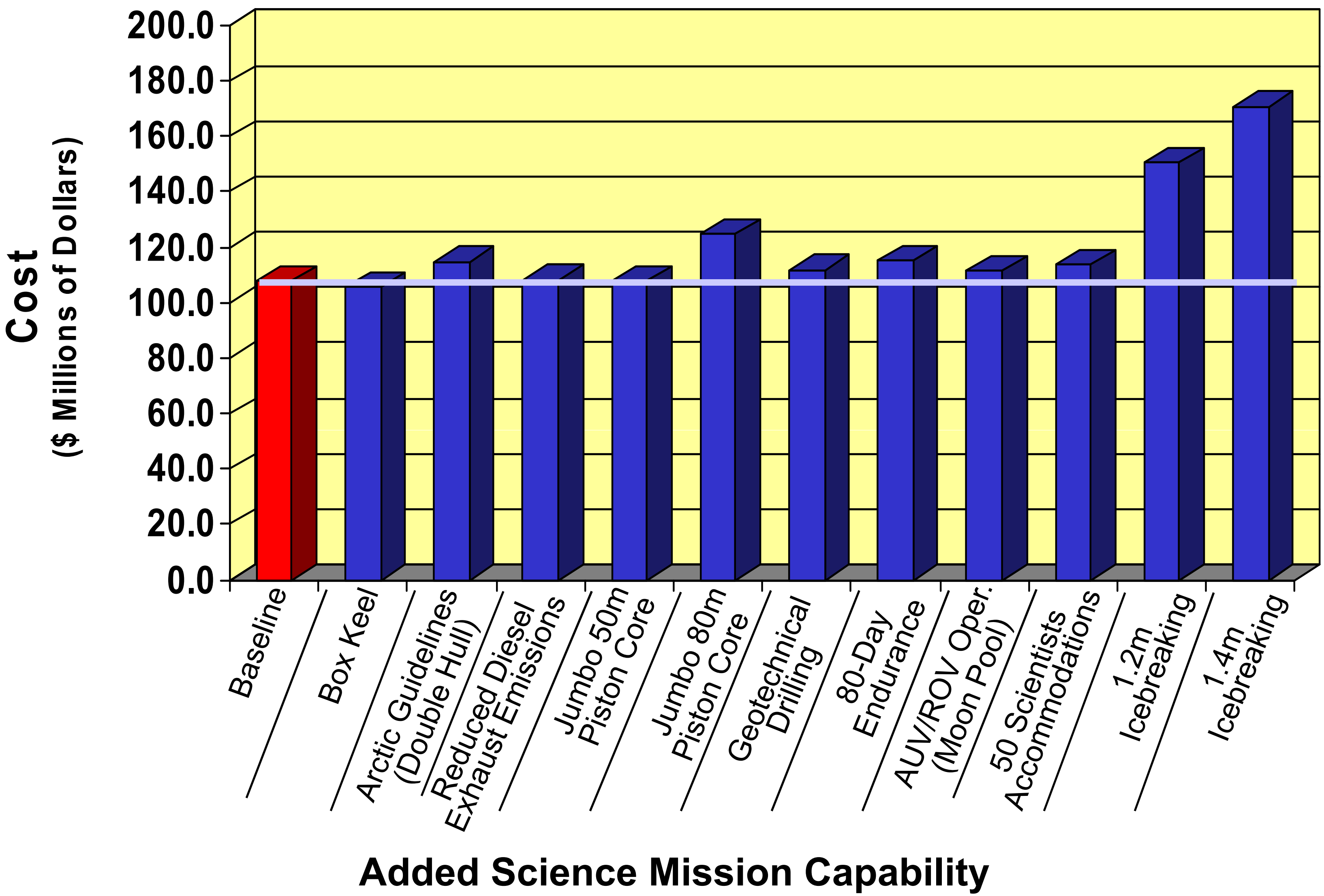
Research is still on-going in such areas as

Controlling ignition timing over a wide range of speeds and loads.
Limiting the rate of combustion heat release at high-load operation.
Providing smooth operation through rapid transients.

Major engine manufacturers are conducting HCCI research and EPA funding some aspects.

Results from Mission Sensitivity Studies

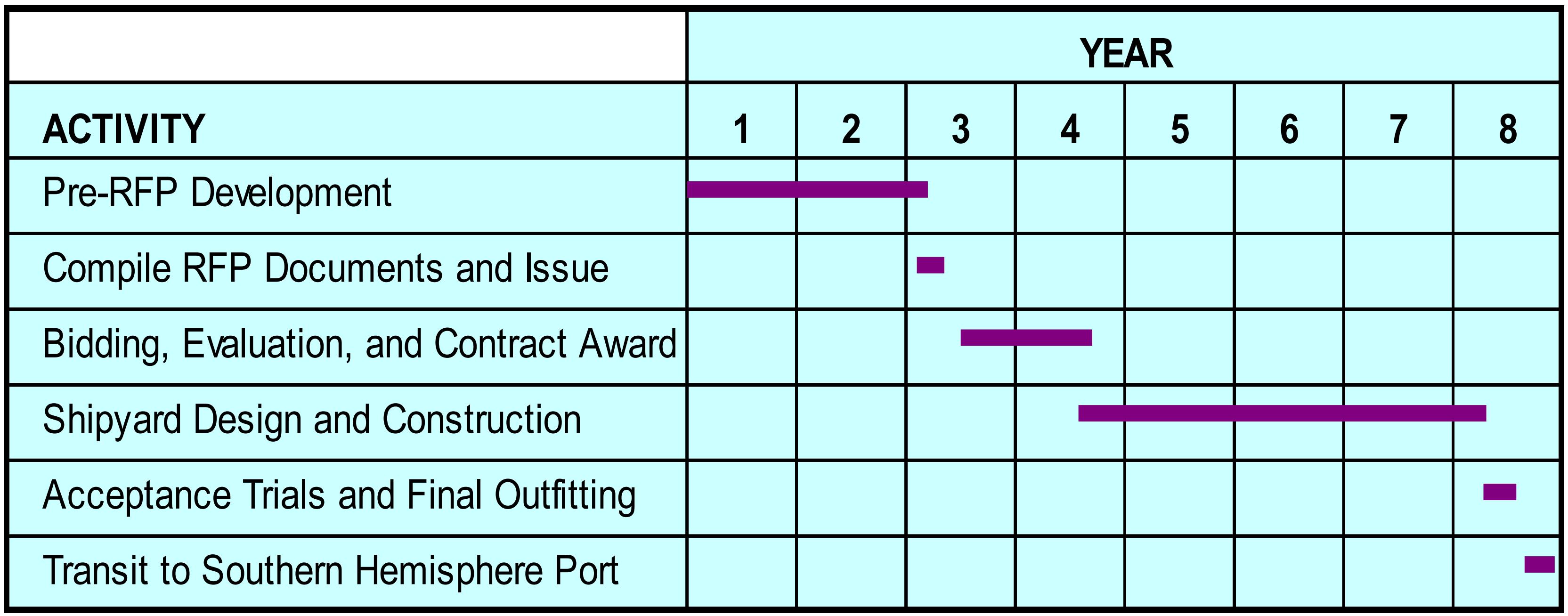
Sensitivity Studies



Project Schedule

Project Timeline

(Vessel lease)



Icebreaking Research Ship Duration from Inception to Delivery

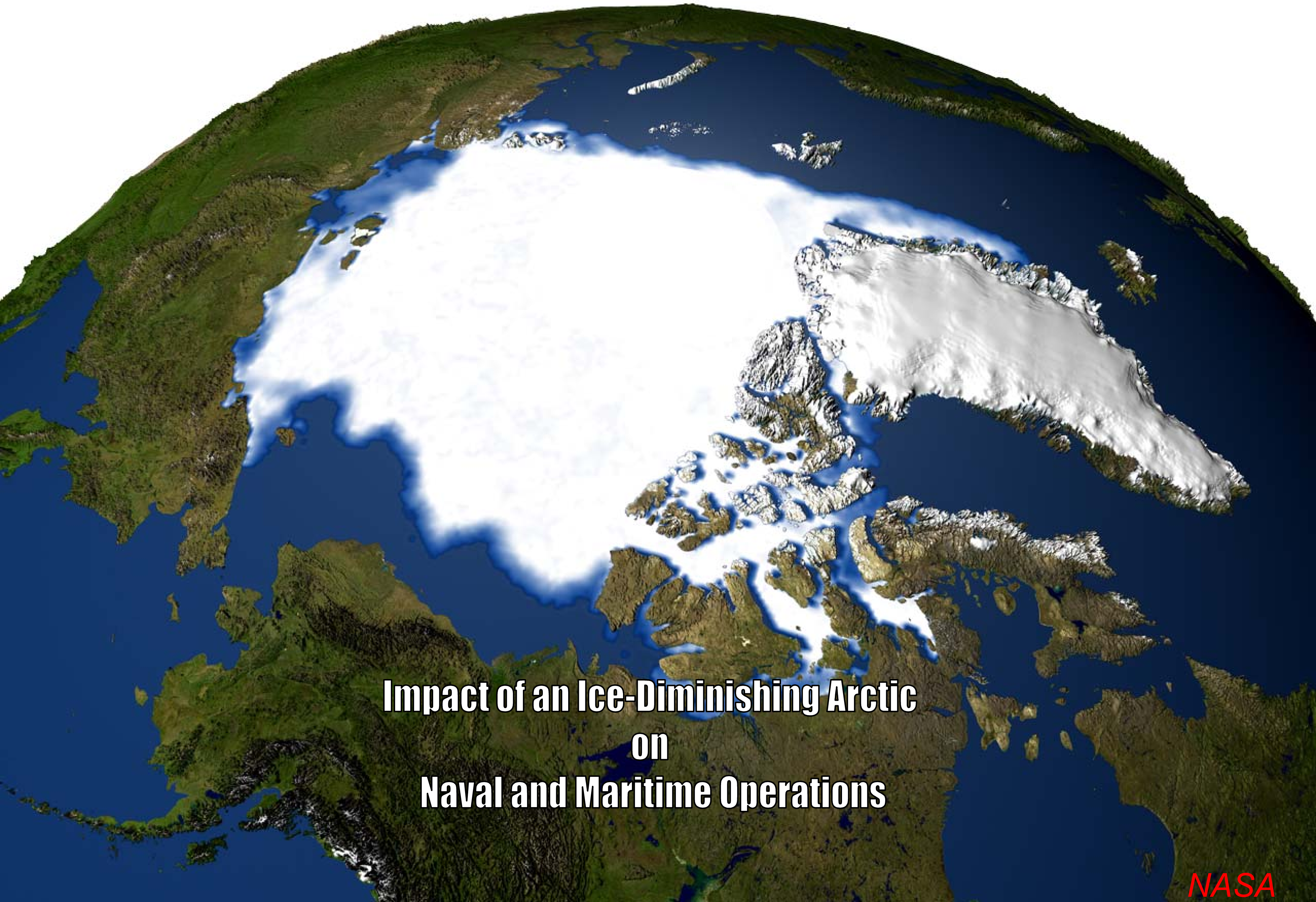
Ship	Years
Arctic (ARRV) Ownership UNOLS	17
High Arctic (replacement for POLAR Class) Ownership USCG	15
Antarctic Ownership Commercial (lease to NSF)	11
NATHANIEL B. PALMER (lease)	6 (5)

Estimated Schedule for New U.S. Research Vessel Deliveries

Arctic (ARRV) Ownership UNOLS	2011 to 2013
High Arctic (replacement for POLAR Class) Ownership USCG	2022 to 2024
Antarctic Ownership Commercial (lease to NSF)	2015 to 2017

Alaska Region Research Vessel

LOA	**72 m**	**Scientist berths**	**26**
Beam	**16 m**	**Endurance**	**45 days**
Draft	**5.5 m**	**Icebreaking**	**0.76 m**


Impact of an Ice-Diminishing Arctic
on
Naval and Maritime Operations
NASA

Some Closing Thoughts

Features to Consider in the Next Generation Polar Icebreaker

Design and build for:

- 40 year ship life
- Set the standard for protecting the environment
  - Green icebreakers
- High skill level of personnel (ice piloting and ice navigation are the most critical skills)

A Vision of the Future

The year is 2040
and climate change continues with the disappearance of Arctic ice

The latest U.S. research icebreaker is observed off Point Barrow, Alaska.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U.S. COAST GUARD