New Generation Polar Research Vessel Project Initiated

ISOPE 2004

Toulon, France

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Presented by

Richard Voelker

U.S. Maritime Administration

Presentation Outline

- Introduction
- Initial Requirements for New Vessel
- Project Results
  - Technical Studies
  - Mission Sensitivity Studies
- Preliminary Project Schedule
- Some Current Issues
- Tracking Project Progress

Introduction

Purpose of Project

Assess and possibly implement the leasing of a new vessel in 2012 to replace the existing icebreaking research vessel NATHANIEL B. PALMER

National Science Foundation (NSF)

- Is an independent U.S. Government agency
- Invests over $5.6 billion each year in about 20,000 research and education projects in science and engineering
- One of the programs is the United States Antarctic Program

NSF's Office of Polar Programs

- Supports basic research in a wide range of scientific disciplines in both the Arctic and Antarctic
- Additionally, provides logistics, operational and laboratory support both shore side and in the marine environment
- Current marine activities in the Antarctic are provided by two vessels:
  - NATHANIEL B. PALMER
  - LAURENCE M. GOULD

NATHANIEL B. PALMER - 1992 to present

LAURENCE M. GOULD - 1997 to present

U.S. Antarctic Research Vessel HERO - 1968 to 1984

U.S. Department of Transportation Maritime Administration (MARAD)

- Memorandum of Agreement between NSF and MARAD
- MARAD to provide technical support including naval architecture and marine engineering services, technical management, acquisition support, construction oversight and acceptance tests and trials for the new vessel

Initial Requirements for New Vessel

Science Requirements

- Bottom mapping during icebreaking
- Geotechnical drilling capability
- Enhanced towing of nets and instruments in ice
- Moon pool (completely enclosed) to deploy
  - Autonomous Underwater Vehicle (AUV)/Remotely Operated Vehicle (ROV)
  - Diving
  - Conductivity, Temperature, Depth (CTD) rosette
  - Ocean-Bottom Seismograph (OBS)
- Accommodation for 50 scientists
- Provision for a helicopter deck and hangar
- Traditional set of A-frames, winches, cranes
- Inter-deck science/cargo elevator

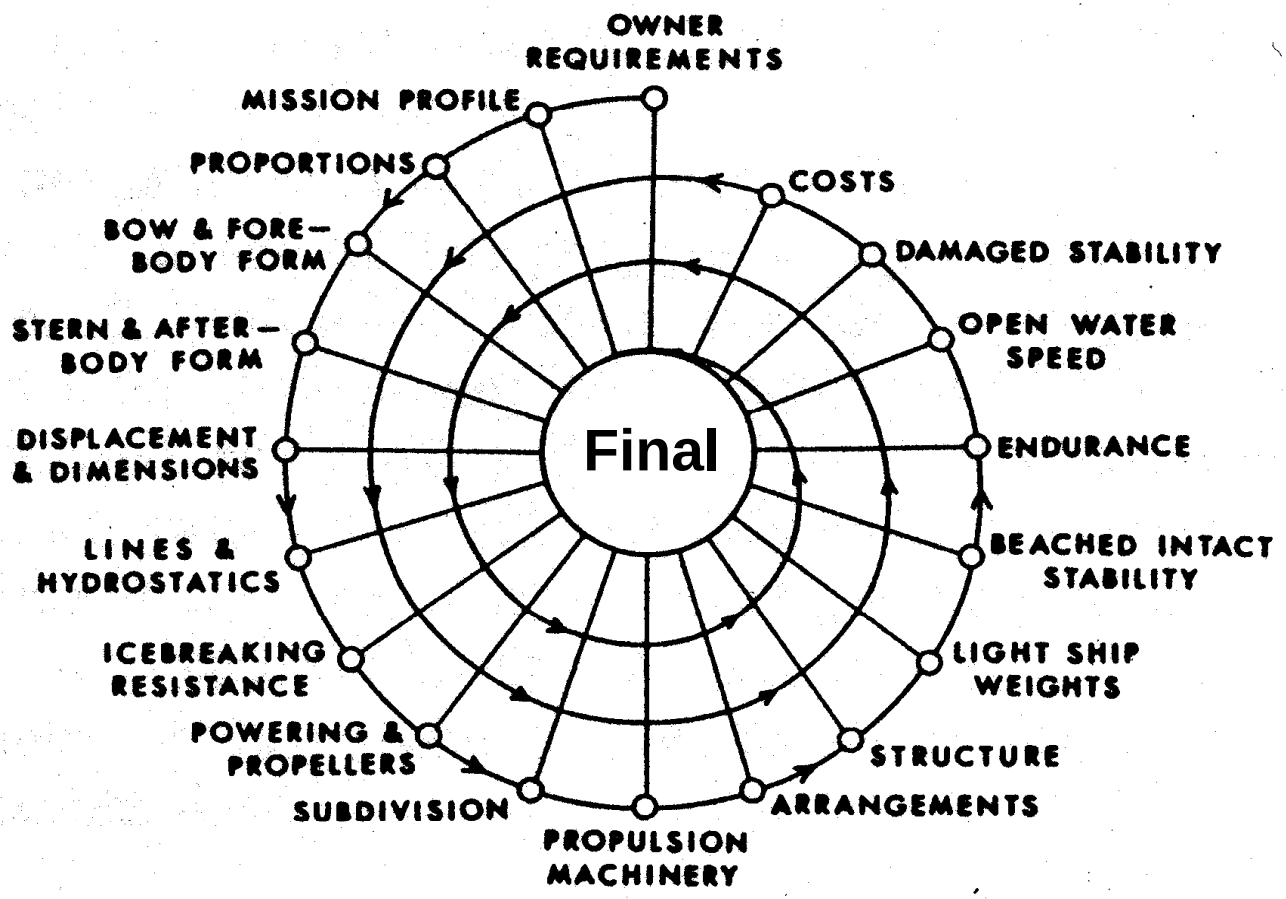
Operational Requirements

- Enhanced level icebreaking @ 3 knots -- 1.4m
- Capable of independent operation in multiyear ice
- Suitable for operations in both polar regions
- Excellent seakeeping capability
- Endurance at 12 knots -- 80 days/20,000 miles
- Comply with new International Maritime Organization (IMO) Guidelines for Arctic Vessels [effectively a double hull vessel]
- Improve ship's self-generated noise signature for better scientific acoustic sensor performance
- Reduce exhaust emissions from diesel engines and incinerator
- Clear view aft from starboard pilot house control station

Project Results

Technical Studies
Mission Sensitivity Studies

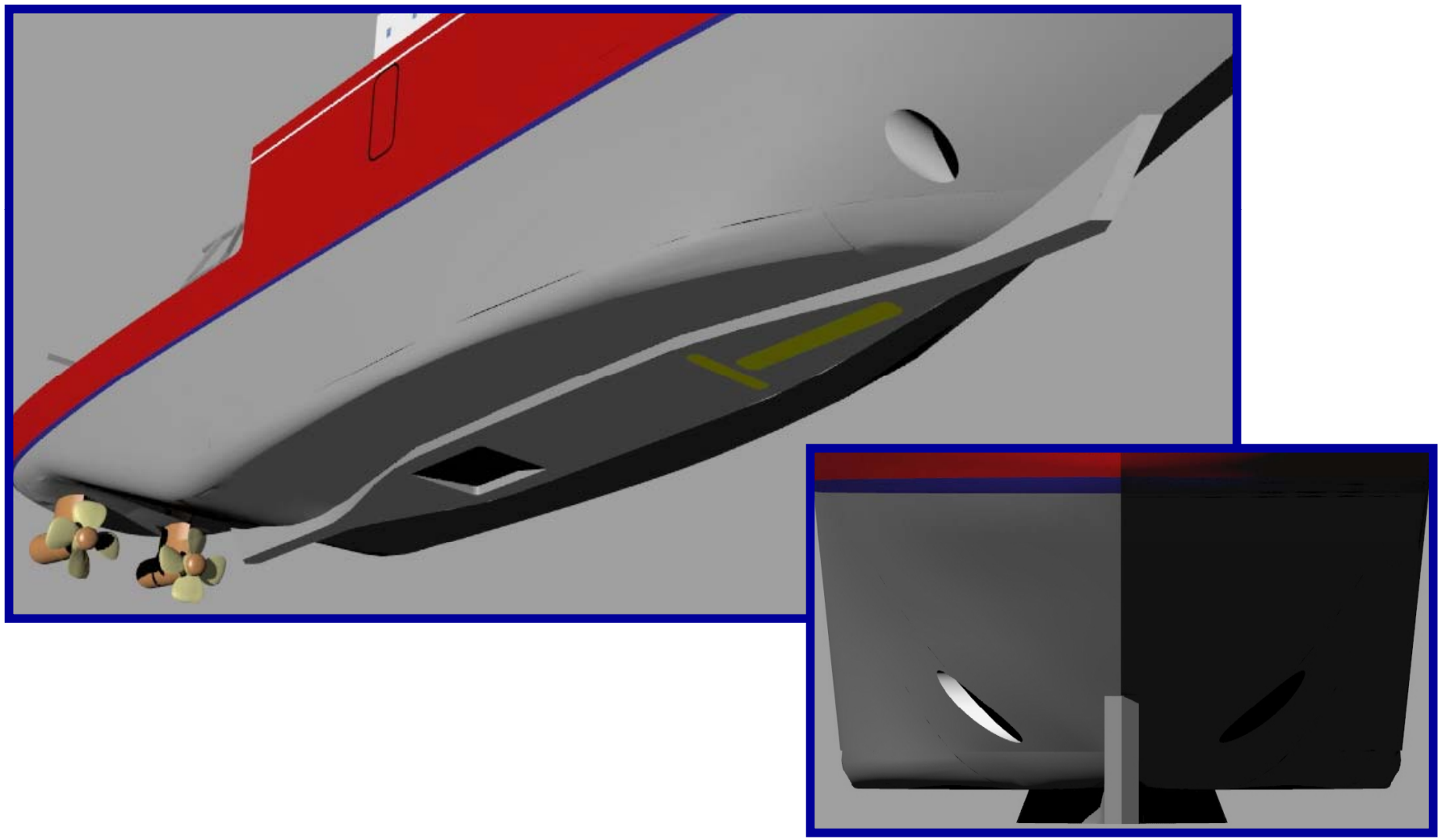
Naval Architecture and Marine Engineering Studies



Principal Characteristics

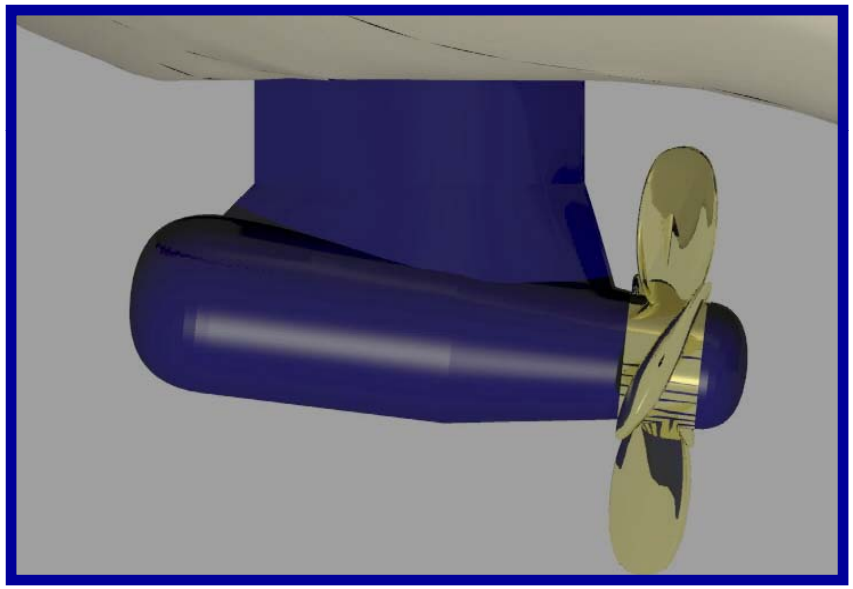
LOA	**115 m**	**Draft**	**9 m**
LWL	**104 m**	**Displacement**	**11,200 LT**
Beam	**23 m**	**Shaft horsepower**	**16,700 kW**

View of Box Keel



View of Starboard Side

Podded Propulsion System Currently Preferred



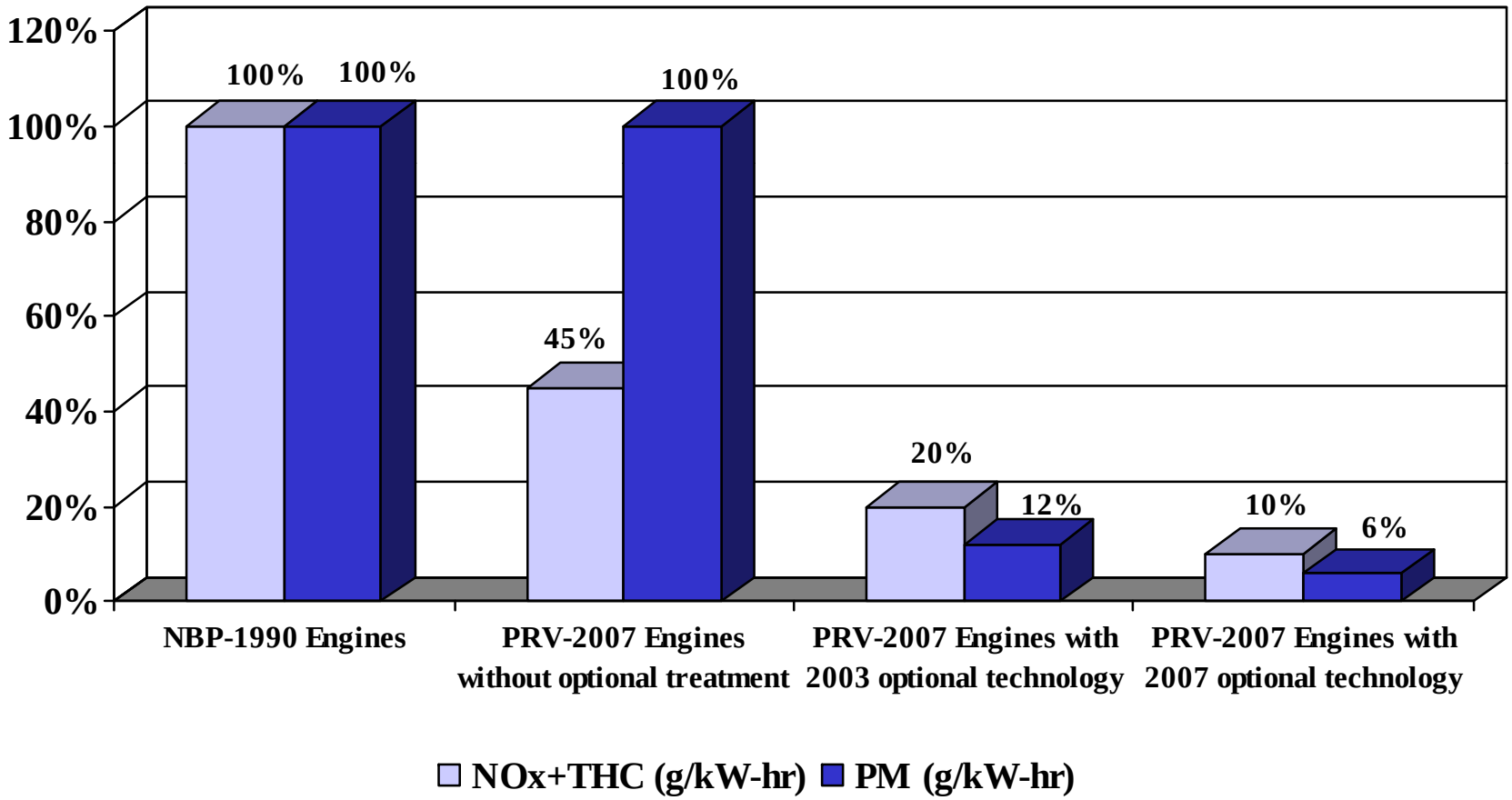
- Direct drive diesels are hard to fit into a ship with a large moon pool – electric plant provides flexibility
- Diesel generators can be “floated” on isolation mounts for low noise/vibration
- Twin azimuthal propulsors give greater maneuverability in ice and open water station keeping

Diesel Engine Exhaust Emissions

Goal: 90 Percent Lower Rate of Diesel Exhaust Emissions Compared to Existing Research Vessels

Emission Estimates for Various Engine Configurations	NOx + THC (g/kW-hr)	PM (g/kW-hr)
NBP-1990 engines	20	0.50
PRV-2007 engines without optional treatment	9	0.50
PRV-2007 engines with 2003 optional technology	4	0.06
PRV-2007 engines with 2007 optional technology	2	0.03

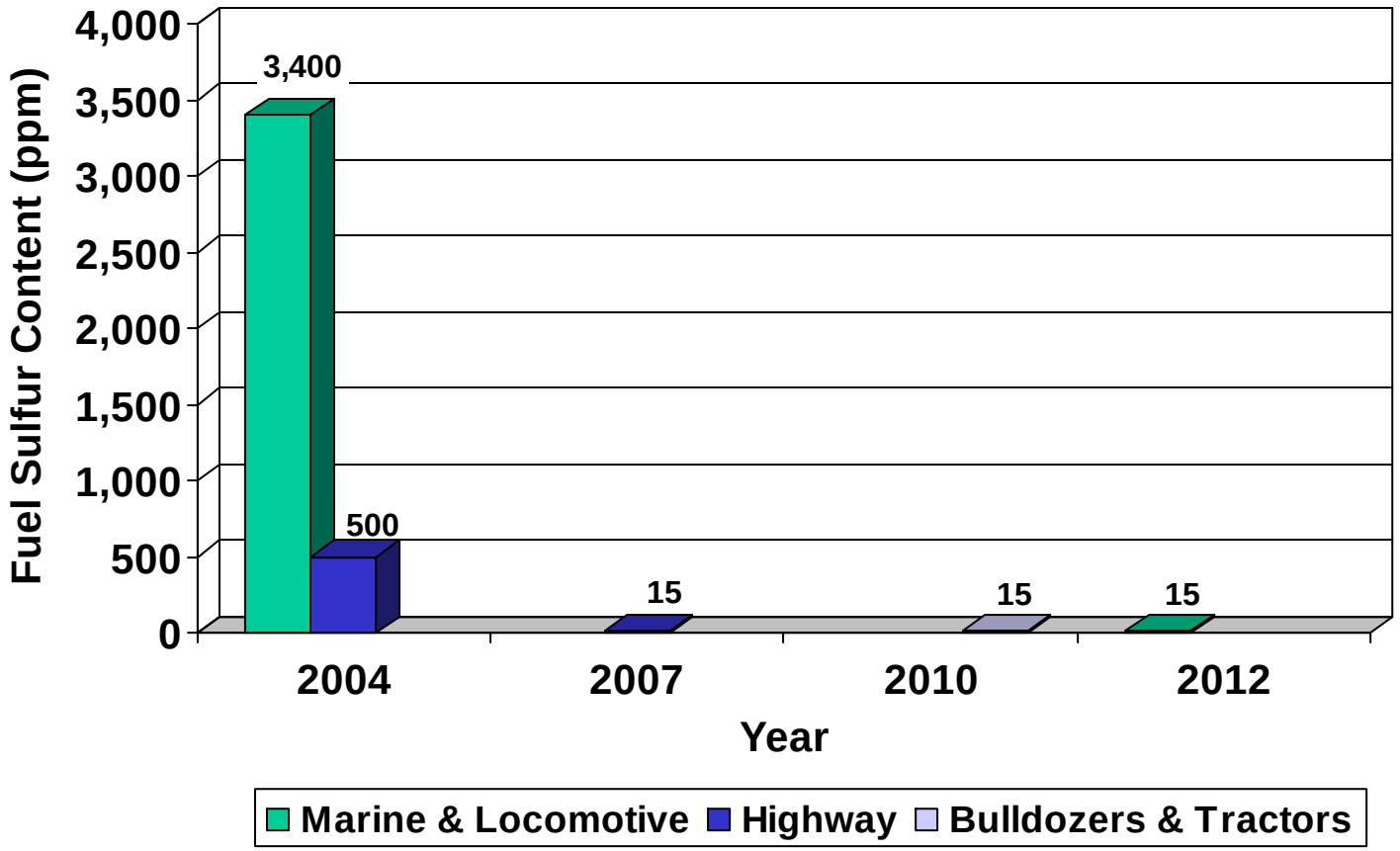
Emission Reduction per Horsepower



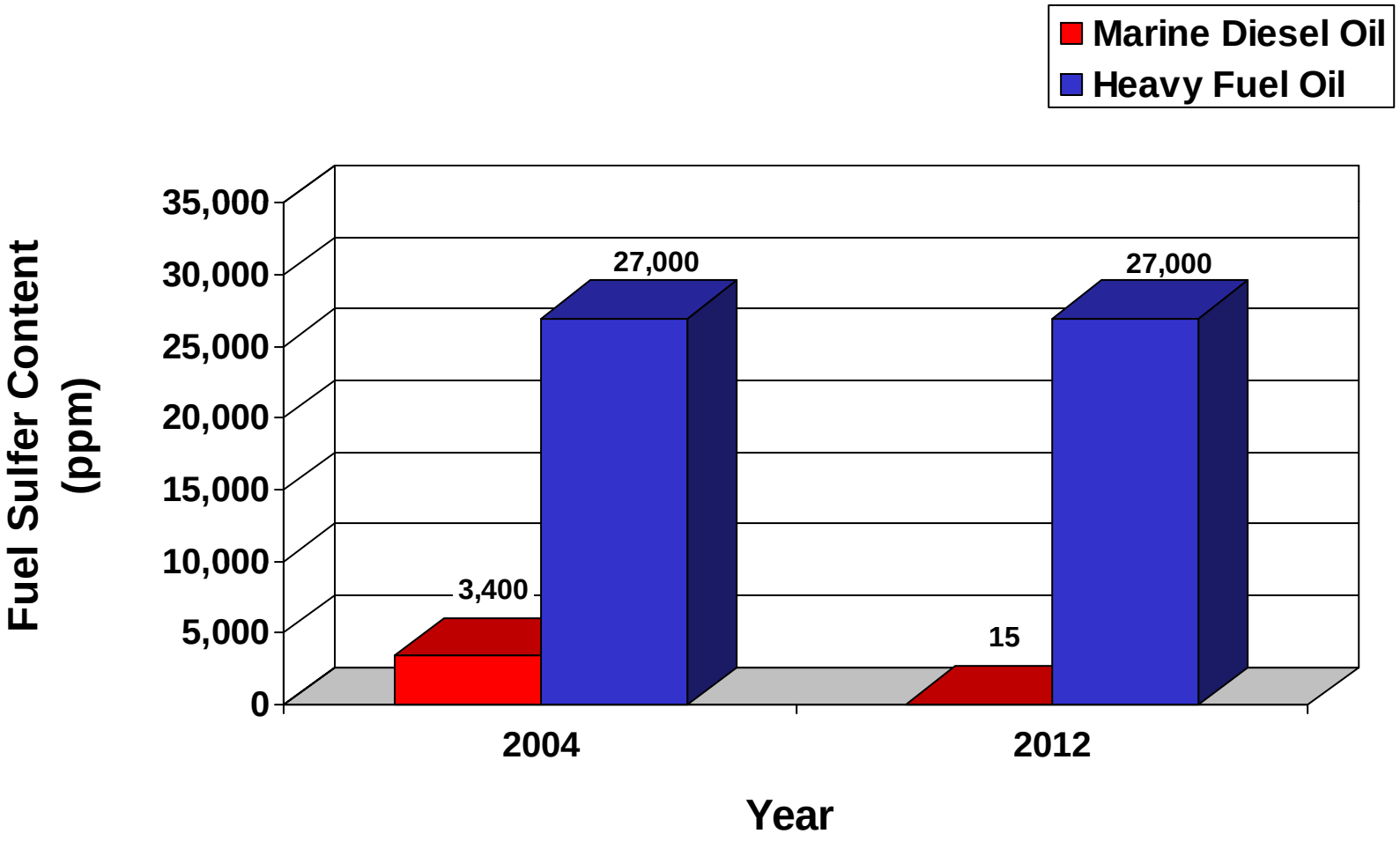
To achieve the 2007 goal -- there is a need to reduce the quantity of sulfur in diesel fuel oil.

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 2012



Mission Sensitivity Studies

Construction Cost Sensitivity of Added PRV Mission Capabilities

BASELINE CAPABILITY (*NATHANIEL B. PALMER* CAPABILITIES PLUS ELECTRIC PODDED PROPULSION)

- AFT WORKING DECK
- 1.2 M ICEBREAKING
- SCIENCE WORKSHOP
- WINCHES
- CRANES
- 37 SCIENTISTS ACCOMMODATIONS
- 60-DAY ENDURANCE
- LABORATORIES
- WORKBOAT
- SONARS & ACOUSTICAL SYSTEMS
- VAN STORAGE
- HELICOPTER DECK AND STORAGE

→ = 100.0%

\+ ARCTIC GUIDELINES (Double Hull) & IMPROVED HULL FORM = 106.4%

\+ SUPERIOR ACOUSTICAL FEATURES = baseline

\+ BOTTOM MAPPING DURING ICEBREAKING WITH BOX KEEL = 97.7%

\+ GEOTECHNICAL DRILLING = 103.7%

\+ ICEBREAKING 4/4.5 FT = 139.5% / 158.2%

\+ 80-DAY ENDURANCE = 106.5%

\+ AUV/ROV OPERATIONS THROUGH MOON POOL = 103.4%

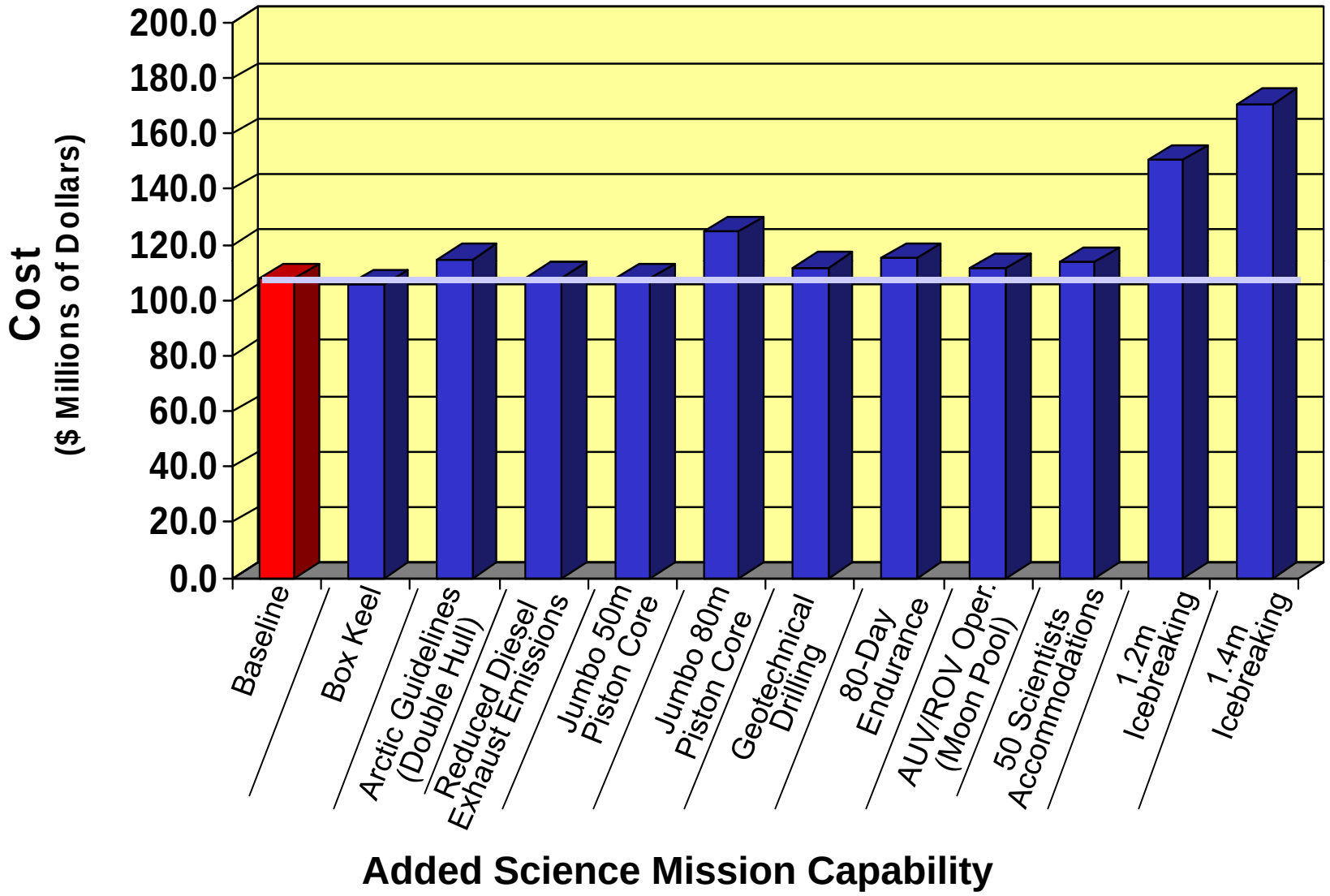
\+ REDUCED DIESEL EXHAUST EMISSIONS = 100.3%

\+ GREATER LENGTH FOR 80 M JUMBO PISTON CORING = 115.5%

\+ 50 SCIENTISTS ACCOMMODATIONS = 105.1%

\+ IMPROVED TOWING OF NETS AND INSTRUMENTATION = baseline

Sensitivity Studies

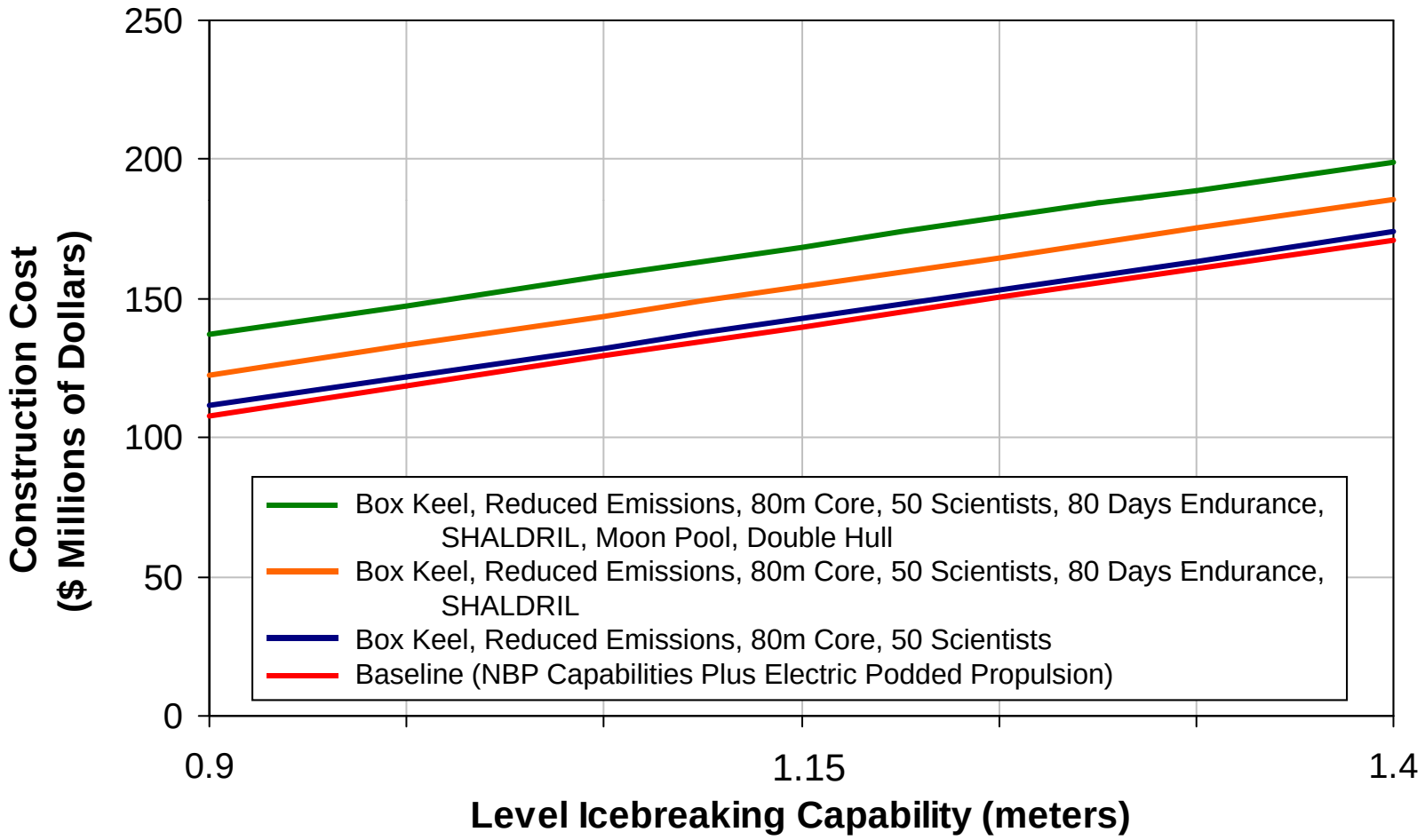


Selected Mission Options with 1.2m Icebreaking

	Level icebreaking	Box keel	Reduced diesel emissions	Length for 50 m jumbo piston core	50 science accommodations	80 days endurance	SHALDRIL capable	Expanded moon pool	Double hull	Length for 80 m jumbo piston core	Cost ($M)	% of baseline cost	% of .9 m baseline cost
baseline	1.2 m	○	○	○	○	○	○	○	○	○	150.6	100%	140%
	1.2 m	●	●	●	○	○	○	○	○	○	147.0	98%	136%
	1.2 m	●	●	●	●	○	○	○	○	○	152.5	101%	141%
	1.2 m	●	●	●	○	●	○	○	○	○	155.7	103%	144%
	1.2 m	●	●	●	○	○	●	○	○	○	150.4	100%	139%
	1.2 m	●	●	●	○	○	○	●	○	○	152.5	101%	141%
	1.2 m	●	●	●	○	○	○	○	●	○	154.5	103%	143%
	1.2 m	●	●	●	●	●	○	○	○	○	161.3	107%	149%
	1.2 m	●	●	●	●	●	●	○	○	○	164.8	109%	153%
	1.2 m	●	●	●	●	●	●	●	○	○	170.1	113%	158%
	1.2 m	●	●	●	●	●	●	●	●	○	178.9	119%	166%
	1.2 m	●	●	●	●	●	●	●	●	●	178.9	119%	166%

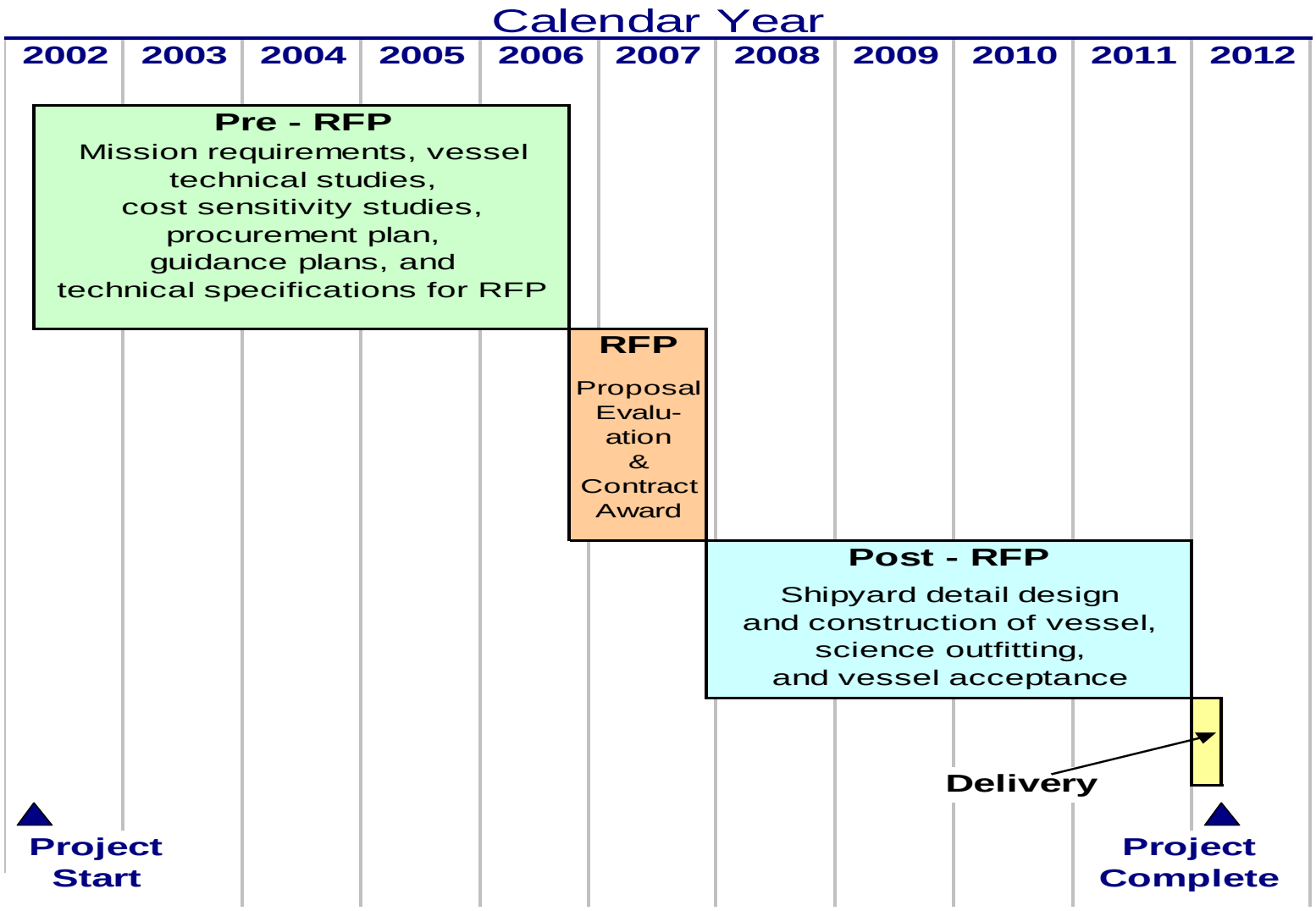
○ = feature not selected ● = feature selected

Construction Cost for Selected Mission Capabilities



Preliminary Project Schedule

Timeline of Major Project Activities



Some Current Issues

Some Current Issues

Procurement

- Evaluate “Lease” versus “Buy” Alternative
- Assess competitiveness and risks associated with different types of vessel procurements (performance based/design based/other technical specifications)

Science

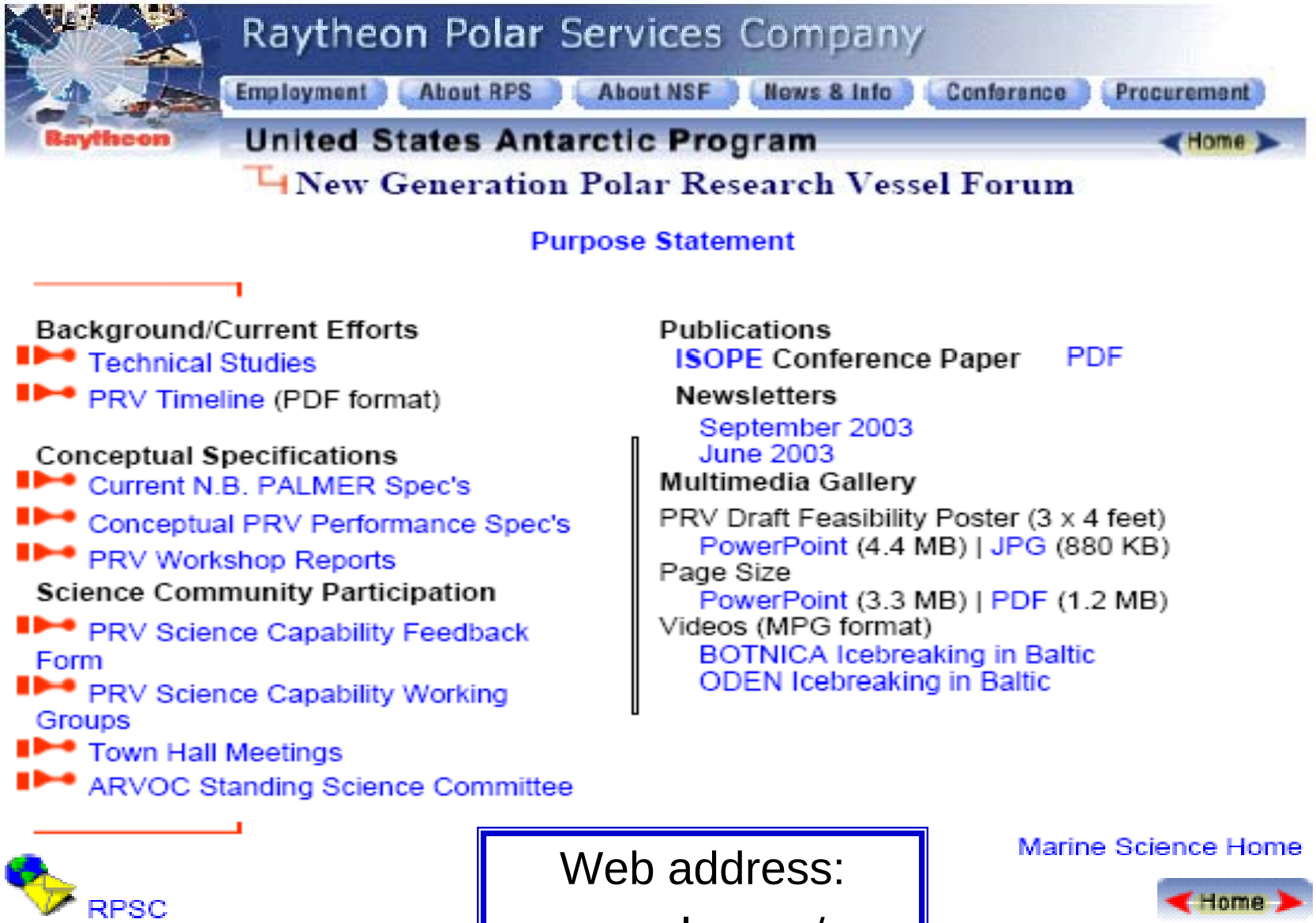
- Define national needs and opportunities to use suitable international platforms for future science missions
- Specify acceptable acoustic criteria

Vessel

- Validate the suitability of podded propulsion systems (electro-magnetic interference and noise)
- Determine level of acoustic treatment
- Examine methods to reduce emissions from the incinerator (oily waste, paper, food, plastic, other waste)

Tracking Project Progress

Project Web Page



Web address:

www.polar.org/prv

Project Newsletter

U.S. Department of Transportation
Maritime Administration
Office of Shipbuilding and Marine Technology

New Generation
Polar Research Vessel

Issue 1 — June 2003

Introduction

This is the first newsletter of a series that is designed to keep our readers informed of recent and pending events and project activities related to the design of a new polar research vessel.

This issue contains articles on the beginning stages of the design, the design team's visit to Scandinavian icebreakers, and the current status of the program.

For your convenience, acronyms are identified on page 6.

Your comments on the newsletter are welcomed.

This issue:

Design Studies Begin for New Polar Research Vessel for NSF

The National Science Foundation (NSF) has initiated a program to assess, and possibly implement, the leasing of a Polar Research Vessel (PRV) to support science in the Antarctic as a replacement for the *NATHANIEL B. PALMER*. As part of that effort, the NSF established a Memorandum of Agreement (MOA) with the Maritime Administration (MARAD), under which various aspects of technical support related to the design of the vessel will be provided. The first task, now in progress, is to conduct feasibility-level design studies for a new research vessel.

This effort includes the development of vessel design criteria from a set of science and operational requirements

(Continued on page 2)

Visit to Scandinavian Icebreakers

In mid-March 2003, the Polar Research Vessel design team visited the Finnish Maritime Administration and its icebreaker *BOTNICA* as well as the Swedish icebreaker *ODEN*. The purpose of the trip was to gain insight into the design and operation of some of the innovative icebreakers in the Baltic. The icebreakers have advanced hull forms, propulsion systems, and specialized capabilities. These include ice shedding bow

(Continued on page 2)

Some members of the Polar Research Vessel design team observing icebreaking operations aboard the Swedish icebreaker ODEN in the Gulf of Bothnia, March 2003. Left to right: Paul Chigogard, SPSC; Al Sutherland, NSF/OPP; Alex Iyerusalimsky, STC; Jim St. John, STC; Captain Anders Backman, Swedish Maritime Administration; and Dick Voelker, MARAD.

U.S. Department of Transportation
Maritime Administration
Office of Shipbuilding and Marine Technology

New Generation
Polar Research Vessel

Issue 2 — September 2003

Highlights

This, our second Newsletter, focuses on some of the results of the initial design studies including a description of scientific features, principal characteristics, and an artist's rendition of the PRV. Dr. Robin Rose, Chair of the Antarctic Research Vessel Oversight Committee (ARVOC), has also prepared an article on their role in the PRV design and procurement effort.

For your convenience, acronyms are identified on page 8.

As always, your comments on the Newsletter are welcomed.

This issue:

PRV Design Unveiled

The initial design of the Polar Research Vessel (PRV) was presented at the Antarctic Research Vessel Oversight Committee's (ARVOC's) meeting on July 31 and August 1 at the Monterey Bay Aquarium Research Institute (MBARI) in Moss Landing, California.

The presentation included an overview of the design process, a review of current scientific and operational requirements, results from eight special technical studies, and the PRV design including cost estimates.

At the conclusion of the meeting, MBARI provided a description of their operational experience with Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs) and also provided a timely visit aboard their research vessels *ZEPHYR* and *WESTERN FLYER*.

Artist Rendition of Polar Research Vessel (PRV)

E-mail address: richard.voelker@marad.dot.gov

Questions