Feasibility-level Design of New Generation Polar Research Vessel (PRV)

May 1, 2003

Introductory Remarks

- NSF long-term objectives
- NSF near-term objectives
- Role of Maritime Administration

Presentation Overview

- Some project management issues
- Project overview
- Visit to Baltic icebreakers and AWI
- Feasibility-level design begins

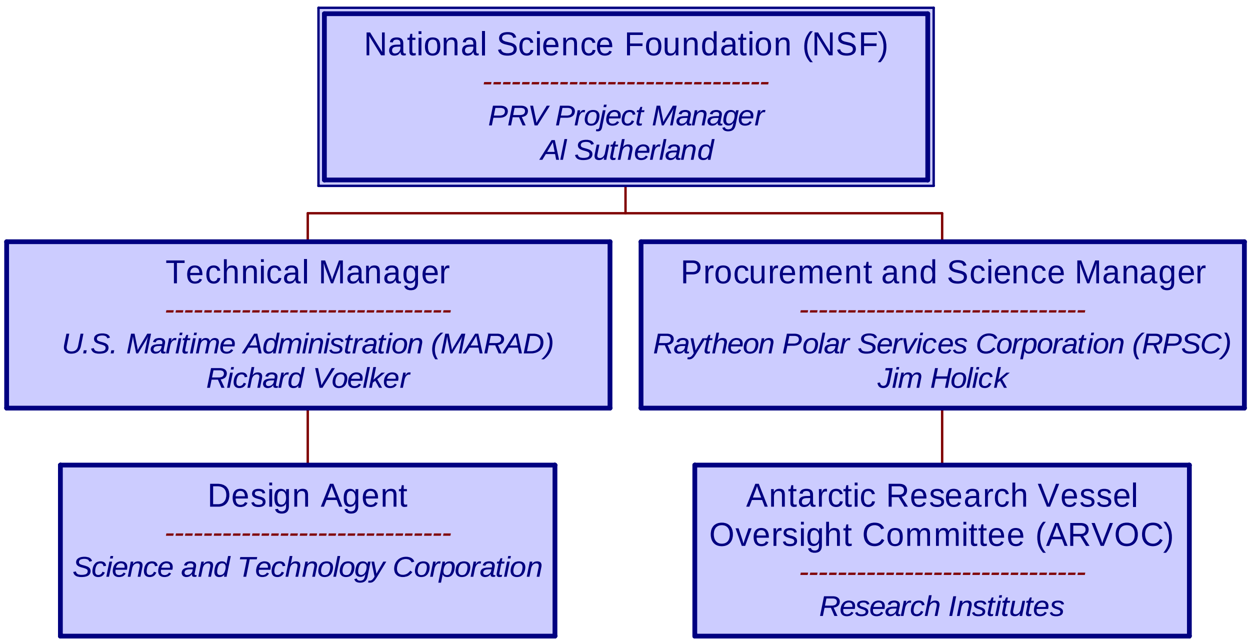
Management Issues

How the PRV procurement activity is different from the NBP

NBP procurement had limited design guidance in the RFP technical specifications and bidders were to submit competing designs at all levels of detail including science spaces.

This PRV procurement will contain significantly more details in the specification, including guidance drawings that reflect the preferences of the science community.

Project Organization for Polar Research Vessel (PRV)



Possible long-term perspective

- NSF
  - Directs project activities
- MARAD
  - Provides technical and shipbuilding expertise
  - Develops vessel conceptual design and cost
  - Supports RPSC in procurement activities
- RPSC
  - Manages the procurement process
  - Signs contract for vessel charter
  - Accepts delivery of vessel

Communication between scientists and designers

- Web page for this project is under development by RPSC
  - Monthly newsletter describing project activities prepared by MARAD with RPSC
  - Science and operational requirements
  - PRV technical specification for the vessel
    - Format suitable for review and comment
    - Specification changes can be made on an on-going basis, but access is limited to make revisions
  - Links to other sites, including NBP specifications
  - At completion of current design effort, results on web

PRV
Home Page

(under
development)

Access to the Specification

Raytheon Polar Services Company

Employment | About RPS | About NSF | News & Info | Conference | Procurement

United States Antarctic Program

Home

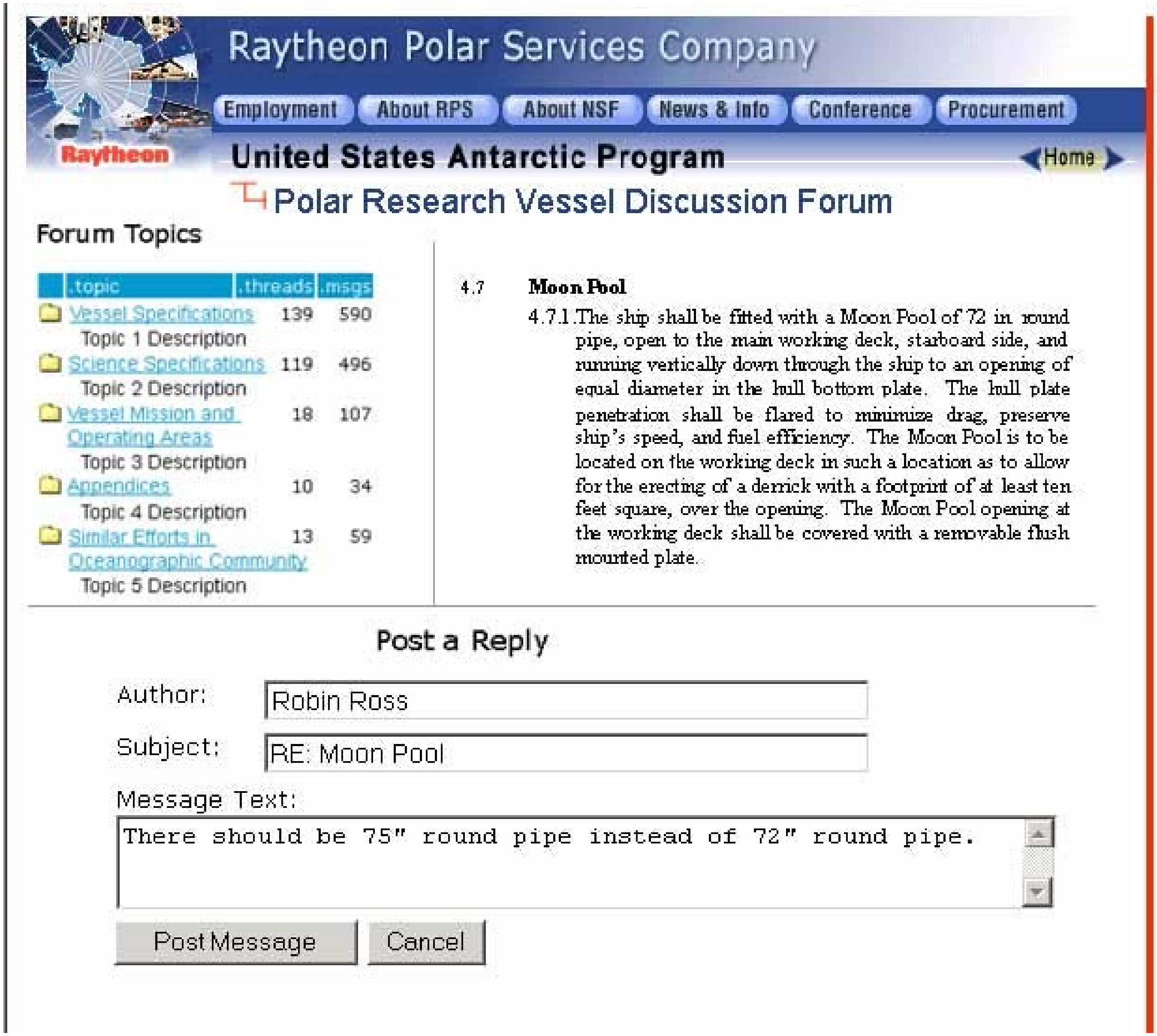
Polar Research Vessel Discussion Forum

Forum Topics

.topic	.threads	.msgs
Vessel Specifications Topic 1 Description	139	590
Science Specifications Topic 2 Description	119	496
Vessel Mission and Operating Areas Topic 3 Description	18	107
Appendices Topic 4 Description	10	34
Similar Efforts in Oceanographic Community Topic 5 Description	13	59

TABLE OF CONTENTS

Method for sending a comment to the vessel designers and others



E-mail addresses of project team

Al Sutherland	NSF	alsuther@nsf.gov
Jim Holick	RPSC	jim.holick@usap.gov
Paul Olsgaard	RPSC	paul.olsgaard@usap.gov
Skip Owen	RPSC	harold.owen@usap.gov
Dick Voelker	MARAD	richard.voelker@marad.dot.gov
Jim St. John	STC	jstjohn7@earthlink.com
Alex Iyerusalimskiy	STC	alexiyer@earthlink.com
David Karnes	STC	dkarnes7@earthlink.com

Project Overview

Some of the initial PRV requirements

- Acoustic profiling including bottom mapping during icebreaking
- Towing of nets and instruments from the stern during icebreaking
- Conduct of AUV/ROV operations from a moon pool
- Geotechnical drilling through a moon pool
- Acoustically quiet
- Comply with IMO guidelines for Arctic vessels
- Accommodations for 50 scientists
- 80-day endurance
- Reduced air emissions from diesels and incinerator
- Enhanced icebreaking capability (5 ft and operations in MY ice)

Current Statement of Work

- Translate an initial set of science and operational requirements into design criteria taking into account the experience gained by U.S. and foreign vessels engaged in polar research
- Conduct a number of special studies to properly understand the full implications of these requirements
- Perform a feasibility-level ship design in sufficient detail to arrive at a ship size, general arrangement drawings and a vessel cost estimate
- Deliverables include a copies of special studies, vessel plans and characteristics, technical specifications, cost estimate and design history

Special Technical Studies

- Towing in ice (seismics and nets), recommend a hull form and propulsion system that improves towing in ice
- Bathymetry in ice, recommend a hull form and appendages that improves ice management and reduces bubble sweep down over acoustic windows
- Geotechnical drilling, recommend a hull form, propulsion/thruster and drilling arrangement for shallow water drilling in landfast ice and open water
- Establish requirements for moon pool to deploy and recover ROVs and AUVs in ice and consider CTD /rosette deployment and diving operations through the moon pool
- Evaluate an increase in icebreaking capability and evaluate one or more propulsion concepts to satisfy mission requirements
- Examine compliance with new IMO requirements for Arctic vessels including provision for no pollutants carried directly against the outer shell
- Investigate and recommend an approach to improve the ship's self-generated noise to enhance scientific acoustic sensor performance
- Analyze and recommend an approach on methods to reduce emissions from diesel engines and the incinerator

Project Milestones

(Feasibility-level design study)

- Project started on March 11, 2003
- End of April
  - Trip report on visit to Baltic icebreakers
  - Outline of select sections of the vessel technical specification
  - Presentation of work to ARVOC
- End of May
  - Interim report on special design studies
  - Meet with RPSC and geotechnical drilling contractor and AUV/ROV operator
- End of June
  - Final report on special design studies
  - Draft of the design arrangement and hull form
- End of July
  - Design history, technical specification, drawings and cost estimate
  - A presentation is planned after July

Visit to Baltic icebreakers and AWI

March 2003

- Finnish Maritime Administration and their icebreaker BOTNICA
- Swedish Maritime Administration and their icebreaker ODEN
- Alfred Wegener Institute for Polar and Marine Studies (POLARSTERN)

Purpose of the trip

To gain insight into the design and operational experience of some of the innovative icebreakers with advanced hull forms, propulsion systems and specialized capabilities. This included ice shedding bow forms, podded propulsion units, moon pools, box keel for bottom mapping and the like.

The participants with Capt. Anders Backman aboard ODEN

Icebreaking operations aboard BOTNICA and ODEN were observed in the Gulf of Bothnia

BOTNICA – Operating in a broken ice channel

BOTNICA ship model with derrick

BOTNICA principal characteristics

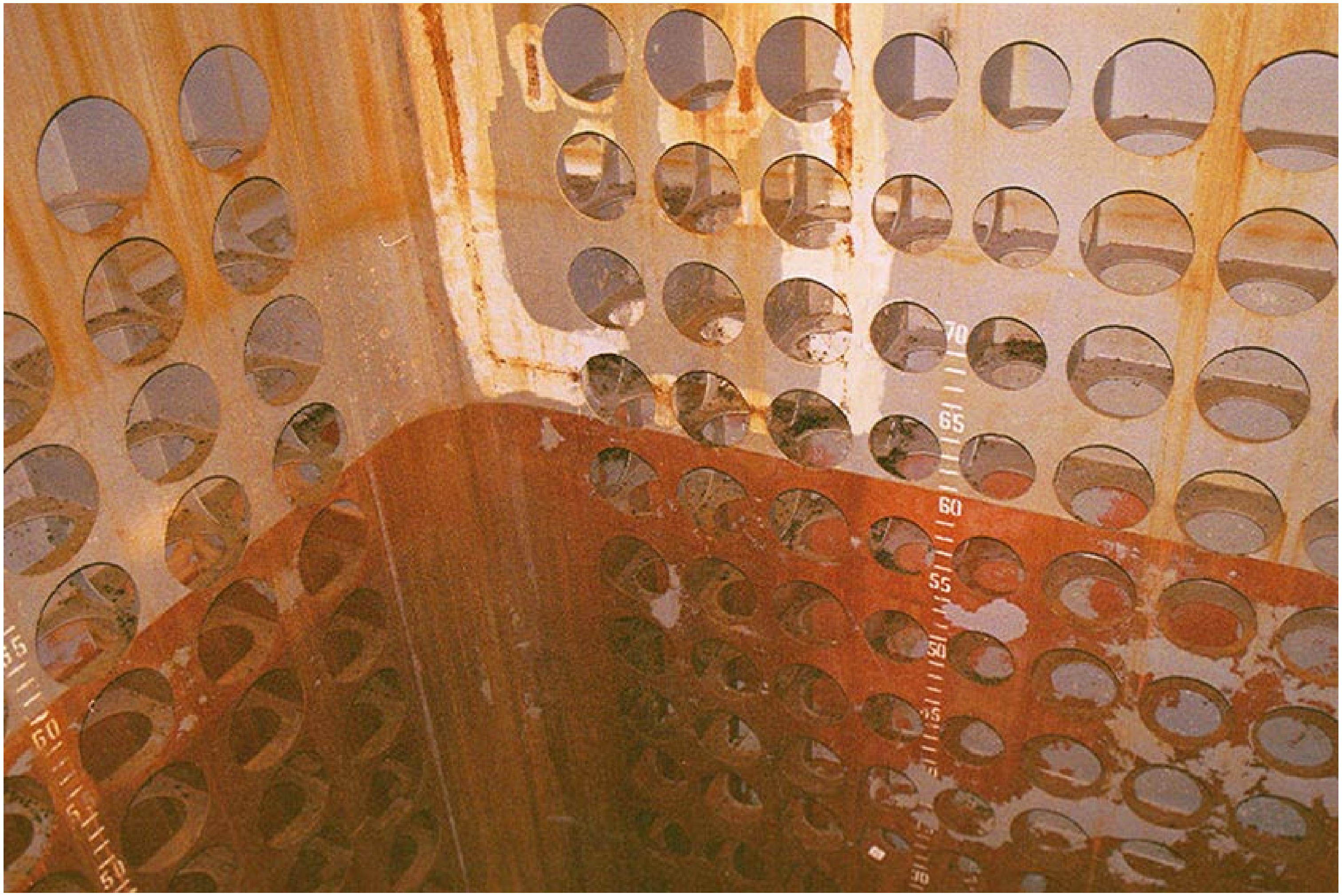
Length over all	317 ft
Beam	78.7 ft
Draft	25.6 ft
Displacement	7,300 tons
SHP	13,500
Crew	21
Berths	72

BOTNICA is approximately 10 percent larger than NBP

BOTNICA - moon pool cover

BOTNICA's 20ft by 20ft moon pool

BOTNICA - inside the moon pool



BOTNICA

View of broken ice behind the icebreaker in thin, stable ice cover

BOTNICA - View aft of broken ice channel

BOTNICA - view inside cabin

BOTNICA - showing electrical and electronic outlets and telephone at desk

BOTNICA - Cabin window

(Hard plastic covers recessed window, shades and curtains)

Aboard BOTNICA
Name card holder outside each cabin

BOTNICA

Sign shown at each deck in the stairwell

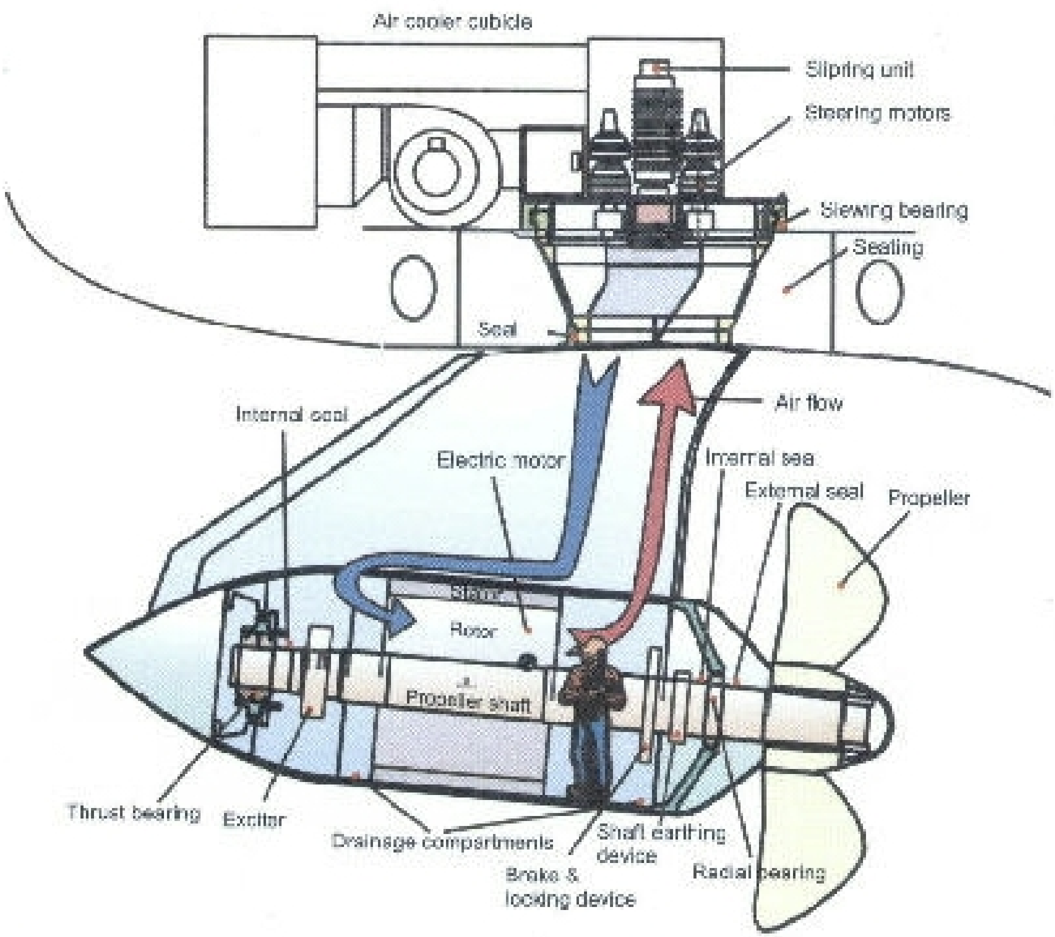
BOTNICA - looking aft at pilot house

BOTNICA - Starboard bridge wing

BOTNICA - view of center of pilot house

OTSO - Bridge

Podded propulsion unit



BOTNICA - top view of Azipod

BOTNICA - Mess deck

BOTNICA’s conical bow at waterline

(hull structural vibration occurred during all icebreaking operations due to insufficient stiffness of the hull at this waterline, but at a deeper draft at summer open water operation, the vibration ceases)

A Sign Aboard BOTNICA -

Have you had a toxic gift recently?

Some observations from BOTNICA visit

- Moon pool primarily used for ROV operations, to date
- Moon pool bottom cover is of very rudimentary design
- Azipods provide excellent station keeping ability, maneuvering and reversing (more expensive than direct drive propulsion, some oil leakage)
- Prefer Intering (active)roll stabilization system vice passive roll tanks
- Double hull environmental protection
- 12 diesel engines (high-speed type) are excessive and selected based on initial cost only

Some observations from BOTNICA visit (contd.)

- Bridge is regarded by crew as best known to date. Visibility from starboard side control station is excellent
- Cabin layout of interest (desk arrangement, bathroom and ceiling height)
- Hull form is poor with “continuous” vibration aboard vessel during icebreaking and slamming in waves

Approaching ODEN - March 2003

ODEN - Ship model

ODEN principal characteristics

Length over all	353.7 ft
Beam	101.7 ft
Draft	26 ft
Displacement	11,900 tons
SHP	23,500
Crew	26
Berths	48

ODEN is approximately twice as large as NBP

ODEN - Onboard laboratory space

ODEN - Research laboratory in van

ODEN - Research laboratory in van

ODEN - Moon Pool

ODEN cabin

(Note that upper berth can be stowed)

ODEN - Office area adjacent to cabin

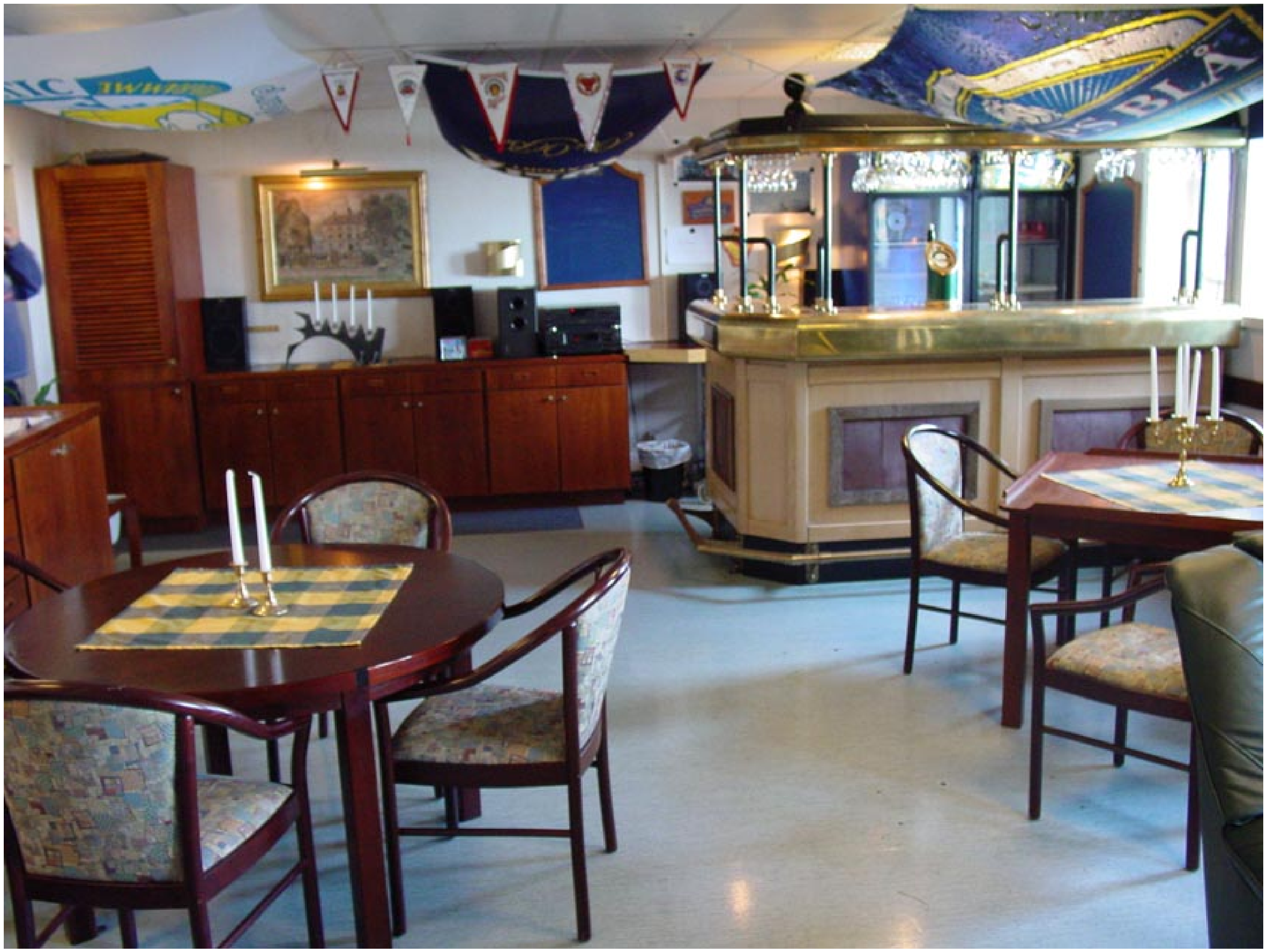
Elevator aboard Swedish icebreaker ODEN

Note: All Finnish icebreakers have elevators

ODEN - Ice conditions at bow while backing

ODEN - Broken ice looking aft

ODEN’s pub (a delightful place)



ODEN

Towing cargo vessel in notch

ODEN - View of bridge from aft

Some observations from ODEN visit

- Large vessel with excellent ahead propeller thrust and icebreaking ability in Baltic
- Flat bow directs broken ice under flat bottom of vessel
- Broken ice channel behind vessel similar to BOTNICA
- Flat bow form unsuitable for open water transit in waves
- Diesel direct drive to propellers similar to NBP (most cost-effective)
- Nice staterooms and cabins with fold-away upper bunk
- Vessel does not back well with reamers - primarily a one-direction vessel
- No intent of Swedish Maritime Administration to use this hull form again

Visit to Alfred Wegener Institute for Polar and Marine Research

AWI's POLARSTERN

Who we met at AWI

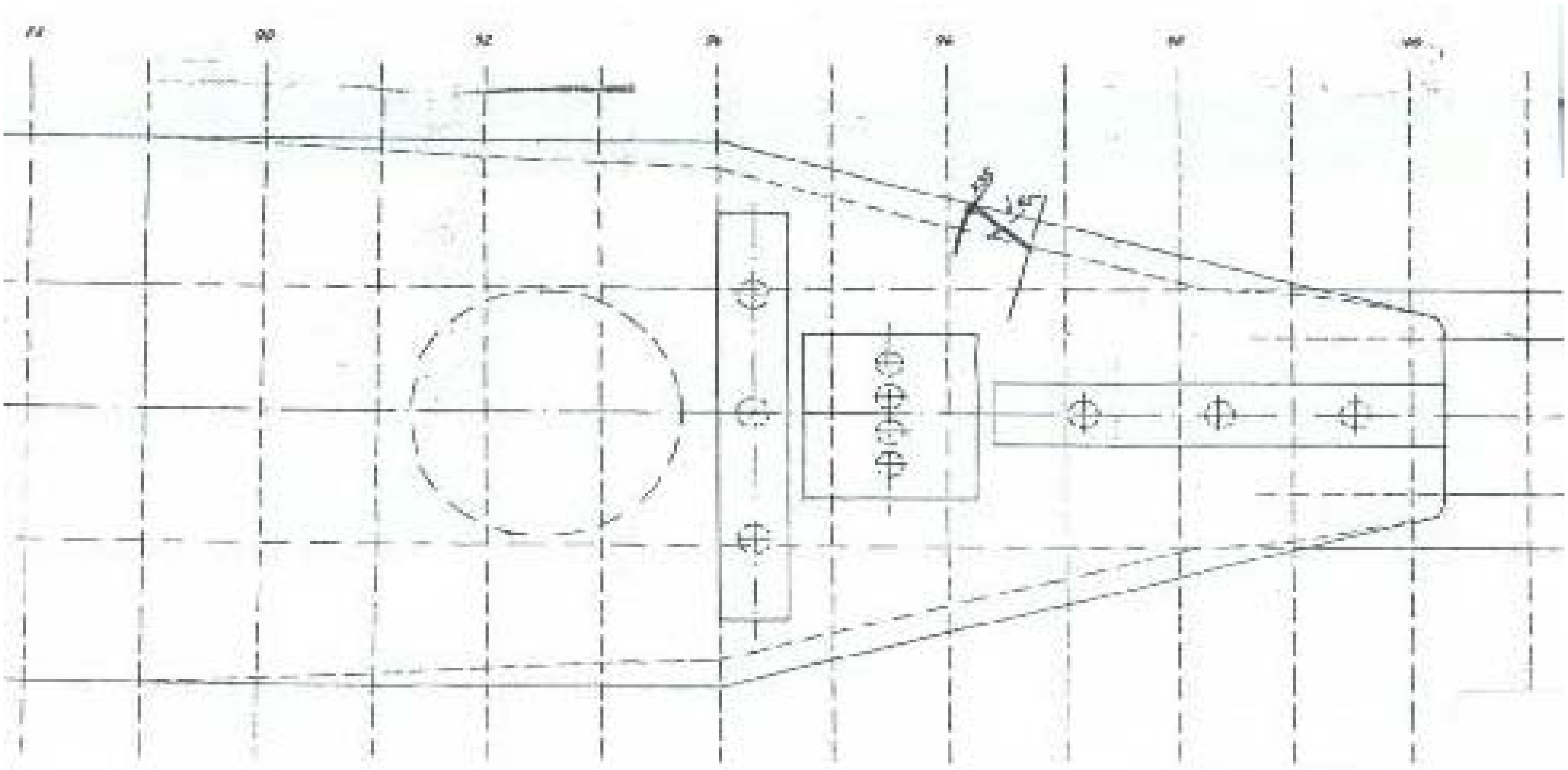
Dr. Eberhard Fahrbach	Scientific Program Manager
Dr. Hans Schenke	Hydroacoustics
Dr. Jorn Thiede	Director, AURORA BOREALIS
Dr. Martin Boche	Former Captain POLARSTERN now Logistics Manager
Dr. Saad El Naggar	Physicist, Dep. DirectorLogistics
Dr. Michael Klages	AUV/ROV Operations
Dr. Wilfried Jokat	Geophysical
Mr. Eberhard Wagner	Operator, Shipping Co. LAEISZ

Some Comments from AWI

- Use box keel to house all of their transducers
  - Avoids bubble sweepdown in front of transducers
  - Continuously conduct bottom mapping during icebreaking
  - Deep draft of POLARSTERN helps in pressure ridges transits
  - Recommend 1-meter deep box keel on research vessels
  - Will modify METEOR with box keel to avoid bubble sweep down
- Power of POLARSTERN insufficient to maintain speed in Arctic ice, dual ship operations preferred
- Believe all ships have the same broken ice pattern behind the vessel, regardless of bow form
- Stern ramp on the fantail aids geophysical operations

POLARSTERN box keel

(transducer in front, echo sounder center and receiver aft)



Some Comments from AWI (contd.)

- New Arctic drilling research vessel AURORA BOREALIS design is complete with two moon pools (4mx5m) and design will be available
- Believe all new research vessels should have AUV/ROV capability
- One helicopter is good for 10 miles away from the vessel; for greater distances use two
- Use of podded propulsion is unclear in terms of its affect on vessel acoustics and impact of electromagnetic radiation on other instrumentation
- Accommodations for 50 scientists is good
- POLARSTERN will continue to operate for next 15 years