

**ALASKA REGION RESEARCH VESSEL
(ARRV)
Preliminary Performance Assessment
June 2002**



Alaska Region Research Vessel



Model Tests

Ice Performance

- Masa Arctic Research Centre (MARC), Helsinki
- Attendees:
 - Robert Elsner, University of Alaska
 - Arno Keinonen, AKAC Inc.
 - Justin Morgan, The Glostén Associates

Resistance, Propulsion, and Seakeeping

- VTT, Helsinki
- Attendees:
 - Bruce Hutchison, The Glostén Associates



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Model Test Objectives

Performance Verification

- Ice Capability
- Full-scale Trials Prediction
- Seakeeping Assessment
- Maneuvering



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Status

- Ice – completed in April
- Resistance - completed mid-May
- Seakeeping - completed mid-May
- Maneuvering – completed last week
- Preliminary results in hand
- Expect final report end of month



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Model Test Program

Ice Tests

- Level ice resistance
- Turning in level ice
- Breaking out of channel
- Channel clearing
- Ridge tests



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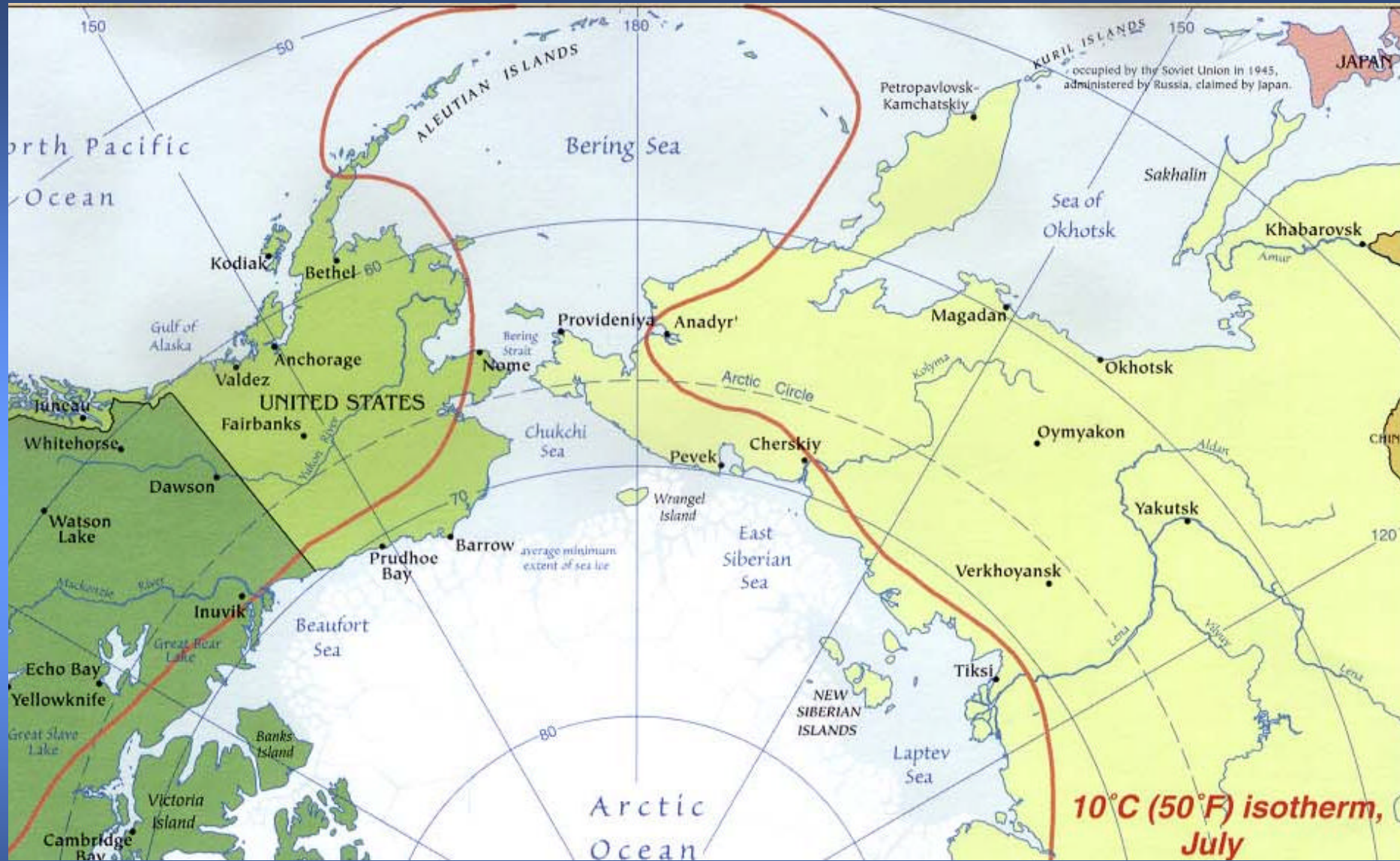
Ice Results

- Quantitative results, conservative
 - 2.5 ft level ice Achieved 2.56 ft
 - 7 ft ridges (sail height) Achieved 7 ft
- Qualitative results
 - Maintains maneuverability close to limiting ice thickness.
 - Clear wake for scientific deployment
 - Independent operability in Bering Sea
 - Extended season north of Bering Strait



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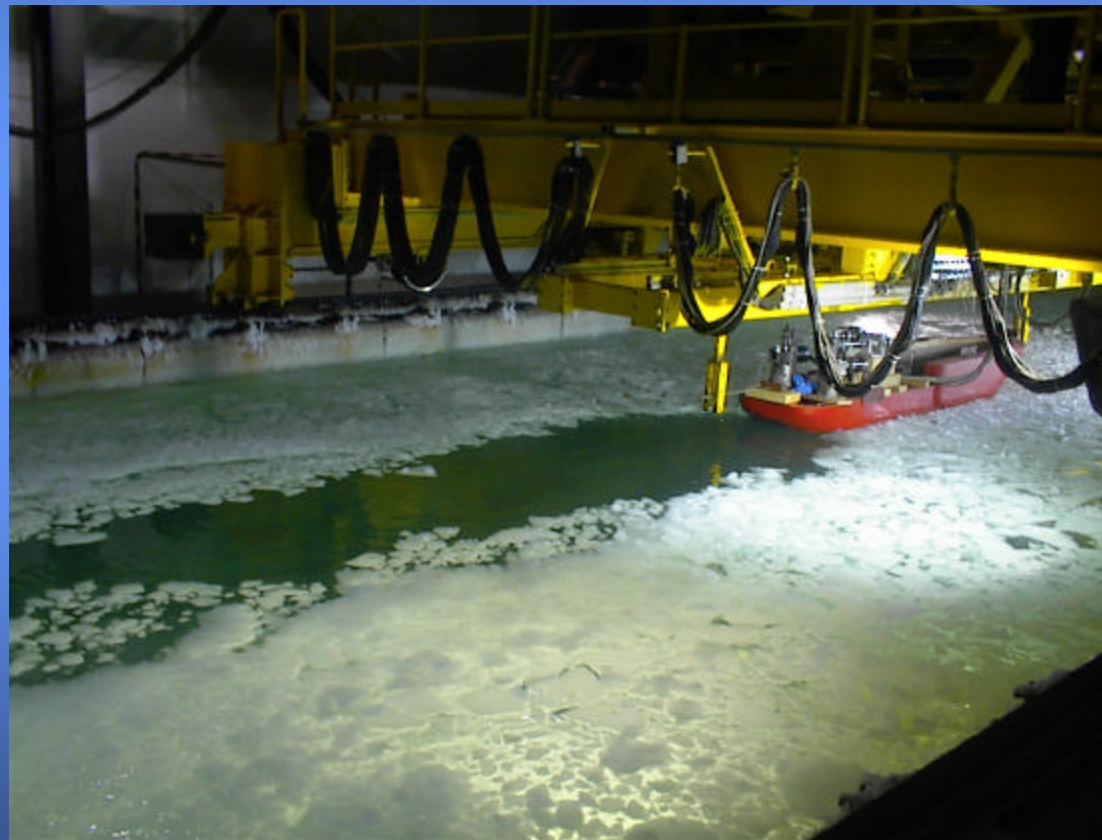
Alaska Region Research Vessel



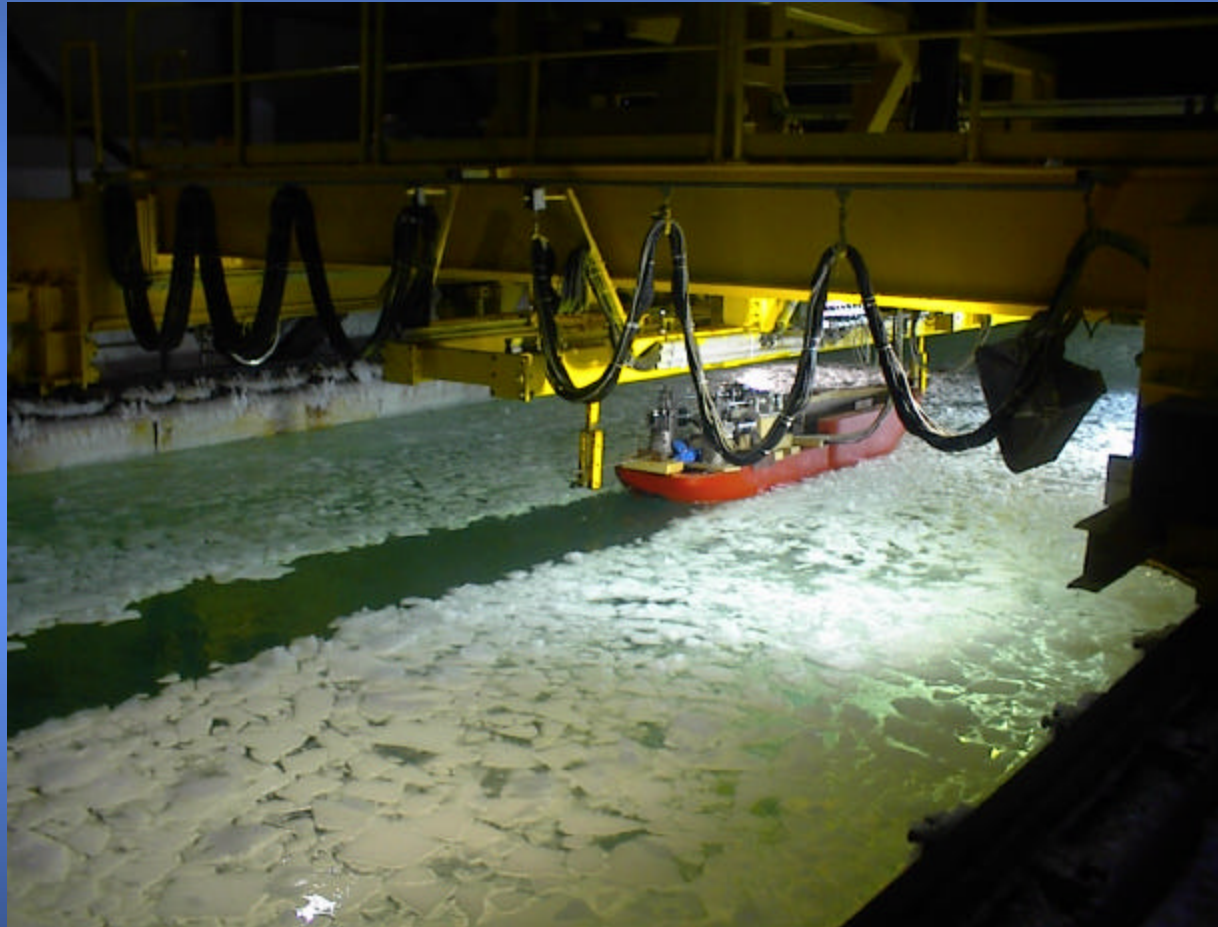
Clear Wake – 0.9m ice



Clear wake – Azipods @ 60°



Clear wake – Azipods @30°



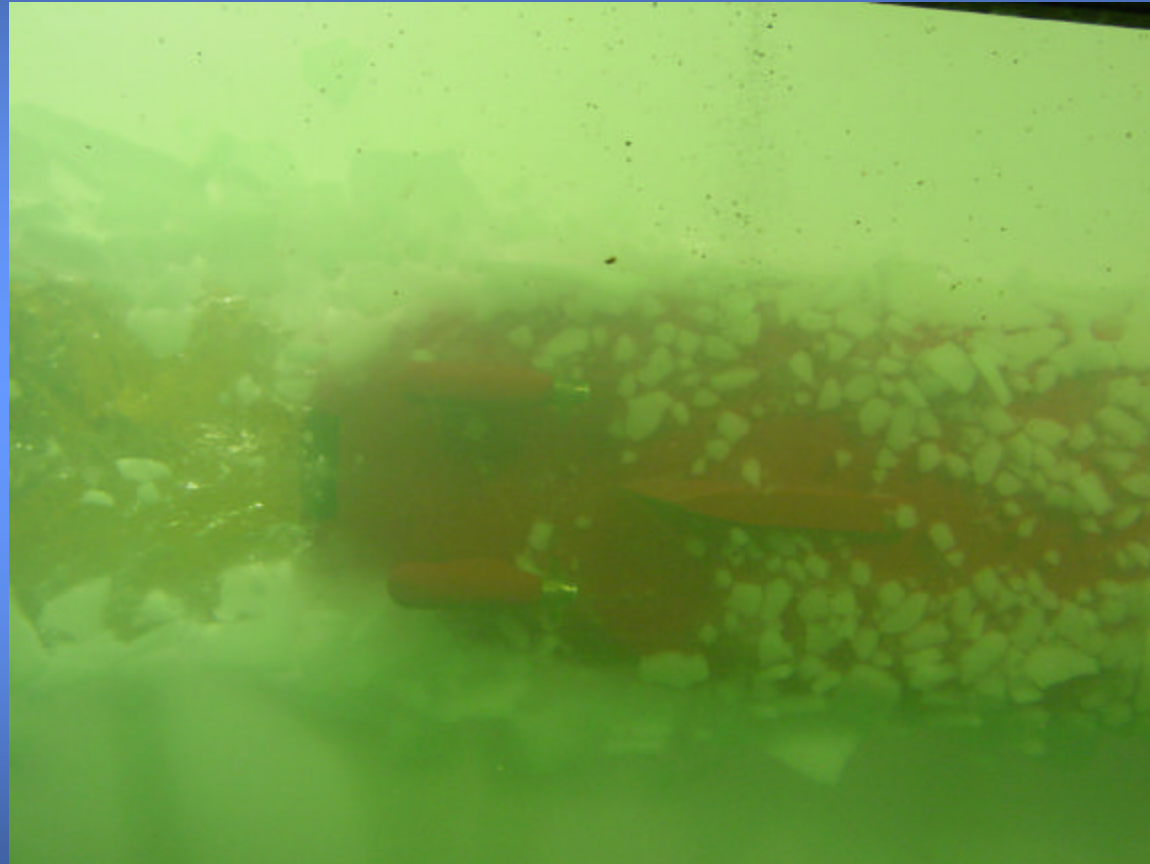
Clear wake – Azipods @0°



Icebreaking Pattern



Icebreaking Pattern



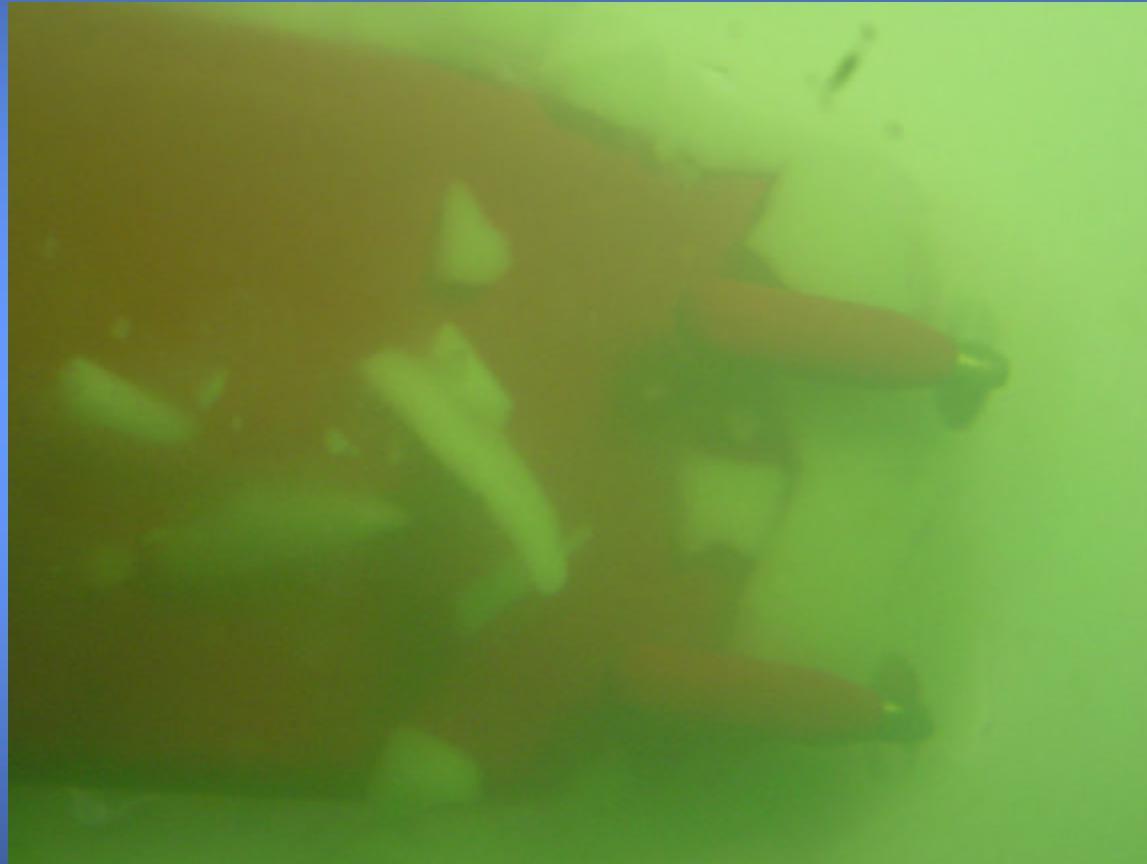
Ridges Ahead



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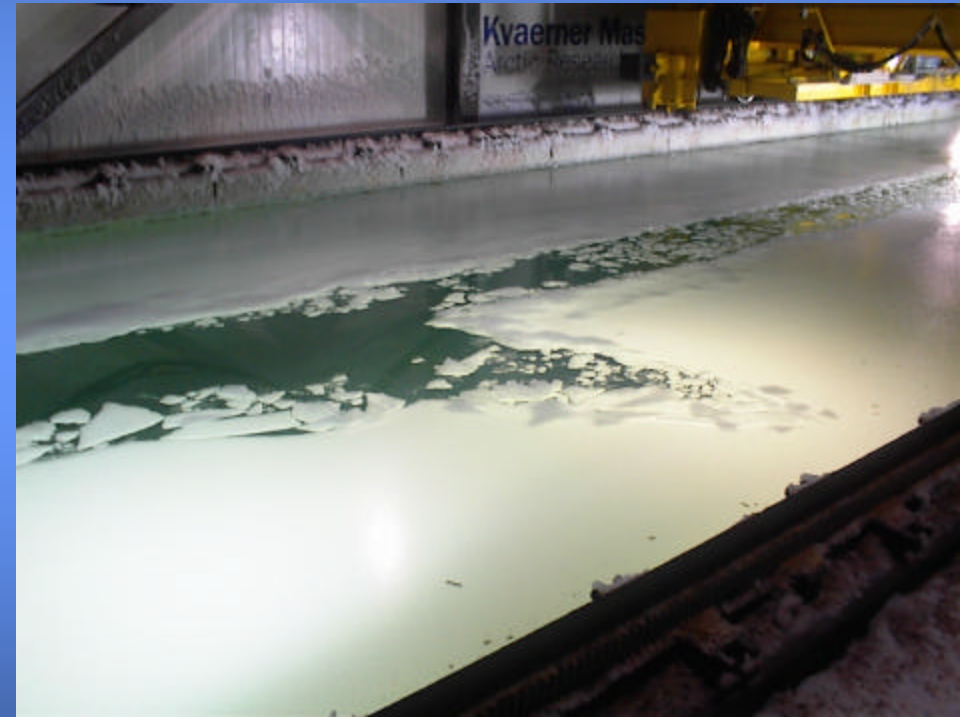
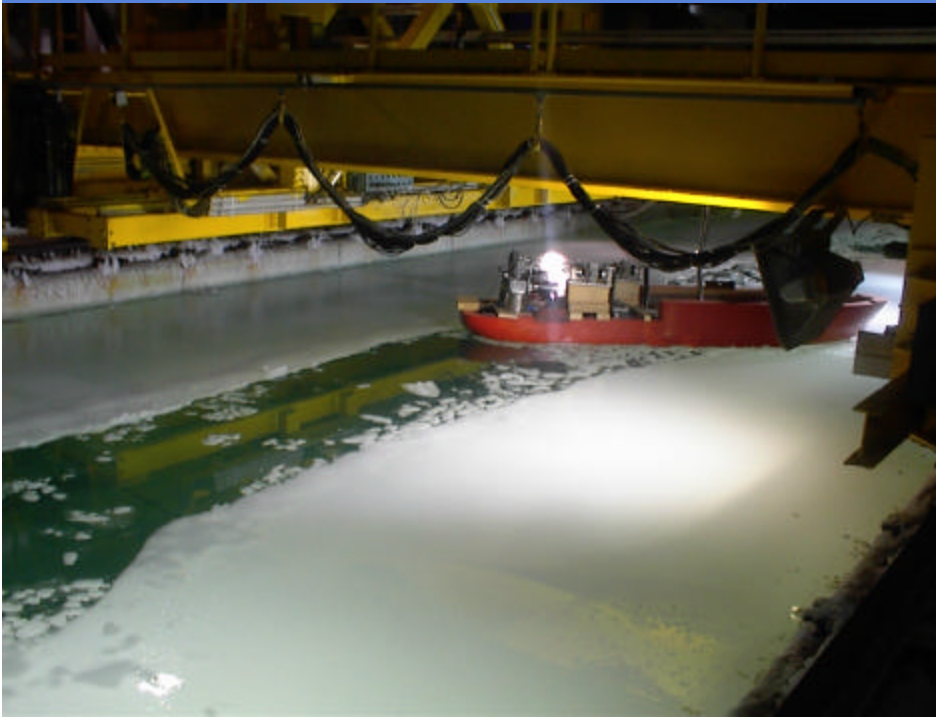
Ridge Astern



Ridge Astern



Turning Ahead



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Turning Ahead



Turning Astern



Resistance Program

Resistance

- Towed model (13:1 scale)
- Result → Full-scale resistance estimate

Propulsion

- Self-propelled model (13:1 scale)
- Result → Full-scale trials prediction (power)
- Wake survey → data for quiet propeller design



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Propulsion Results

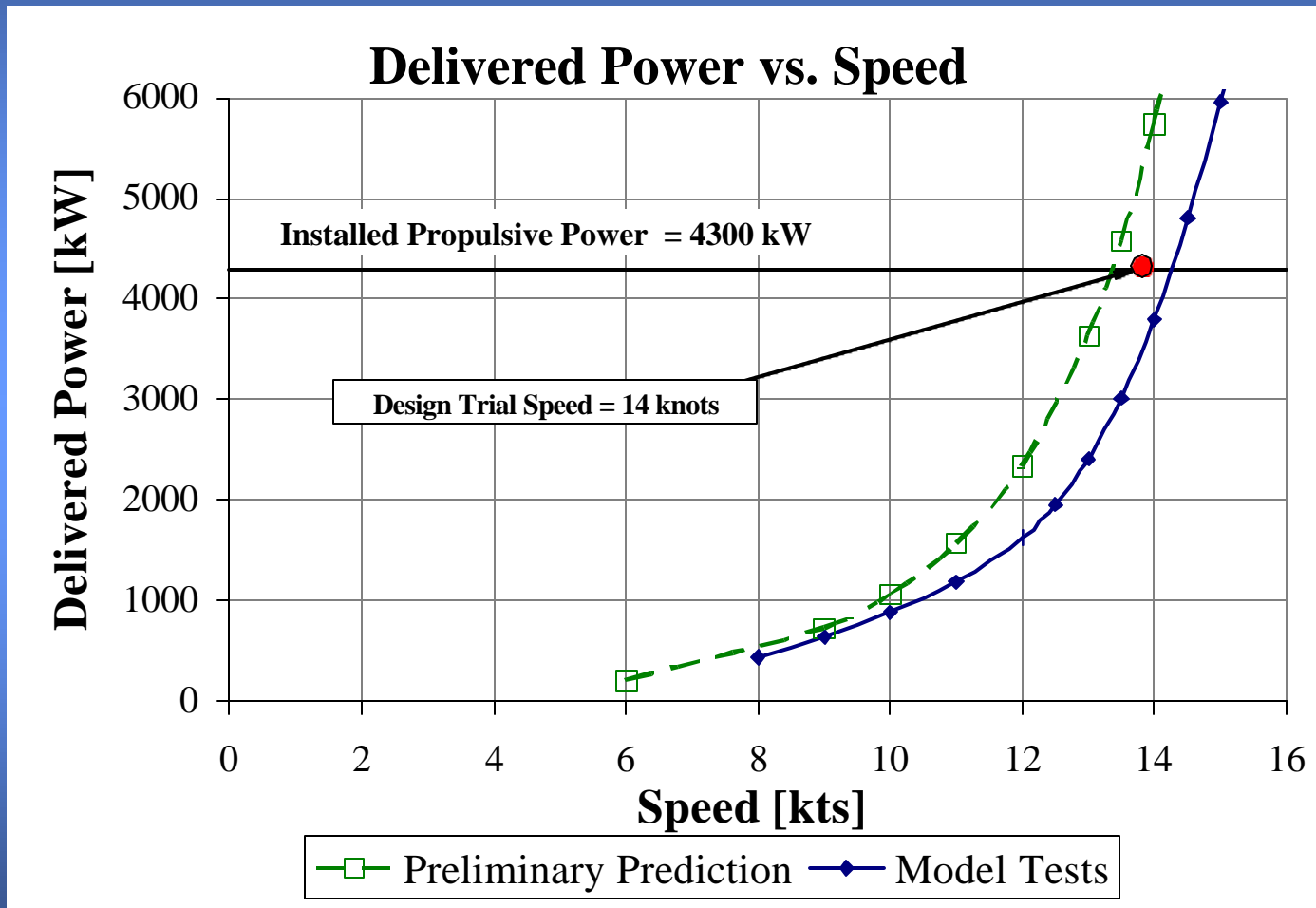
- Trial speed 14 knots Achieved 14+ kts
- Installed power of 4300 kW adequate
- Bollard thrust ~480 kN



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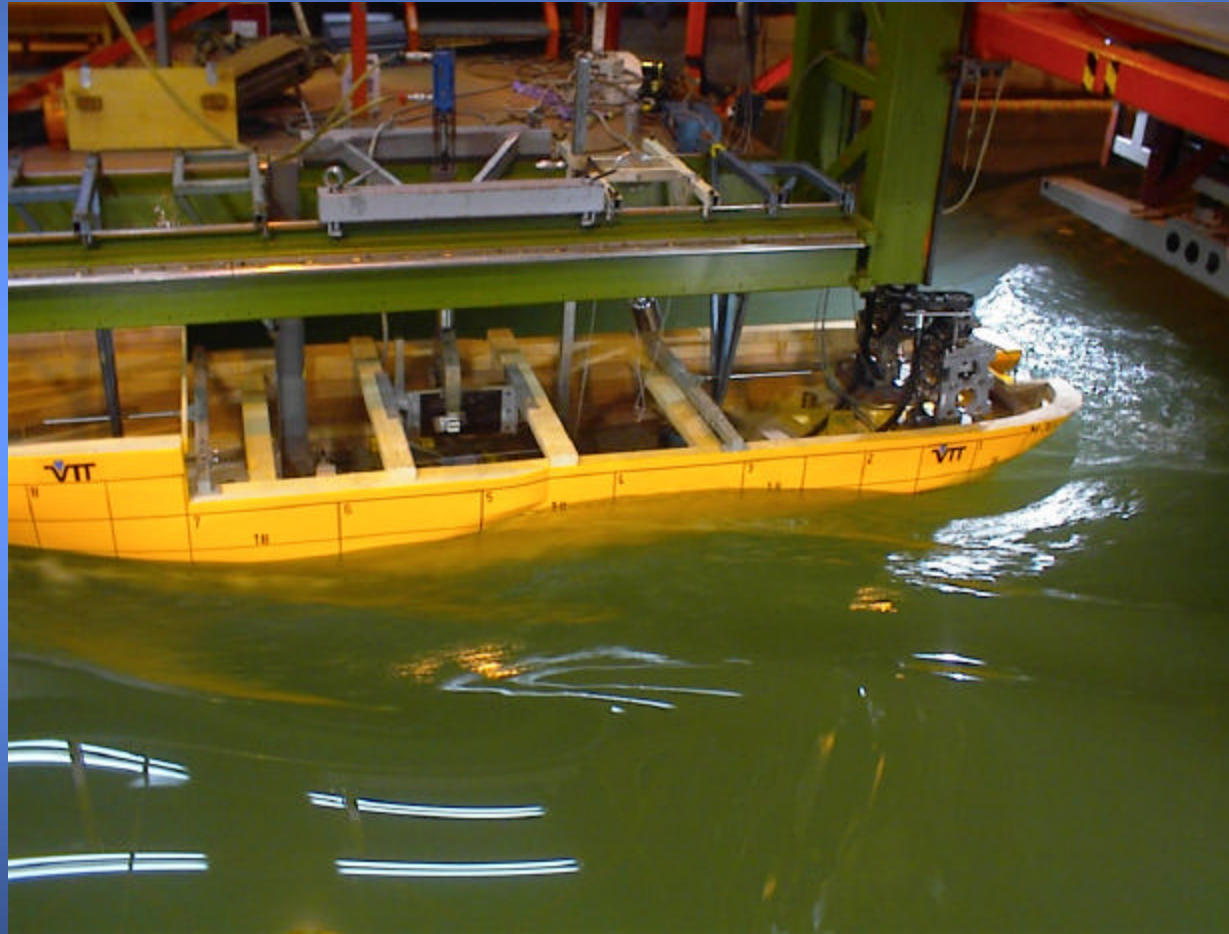
Full-Scale Trials Prediction



14 knots



14 knots



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14 knots



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14 knots



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12 knots



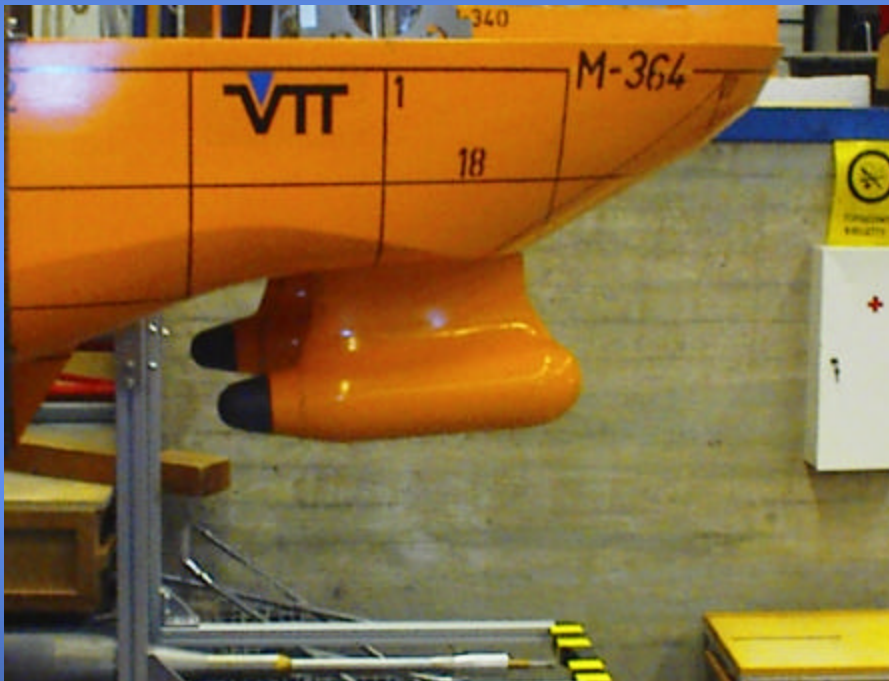
10 knots



Model Propeller



Model Azipods



Model Test Program

Seakeeping

- Self-propelled model (20:1)
- Ship Motion Program (SMP) Benchmark
 - Accelerations
 - Relative motion
 - Added resistance in waves
 - Response Amplitude Operators

Seakeeping Results

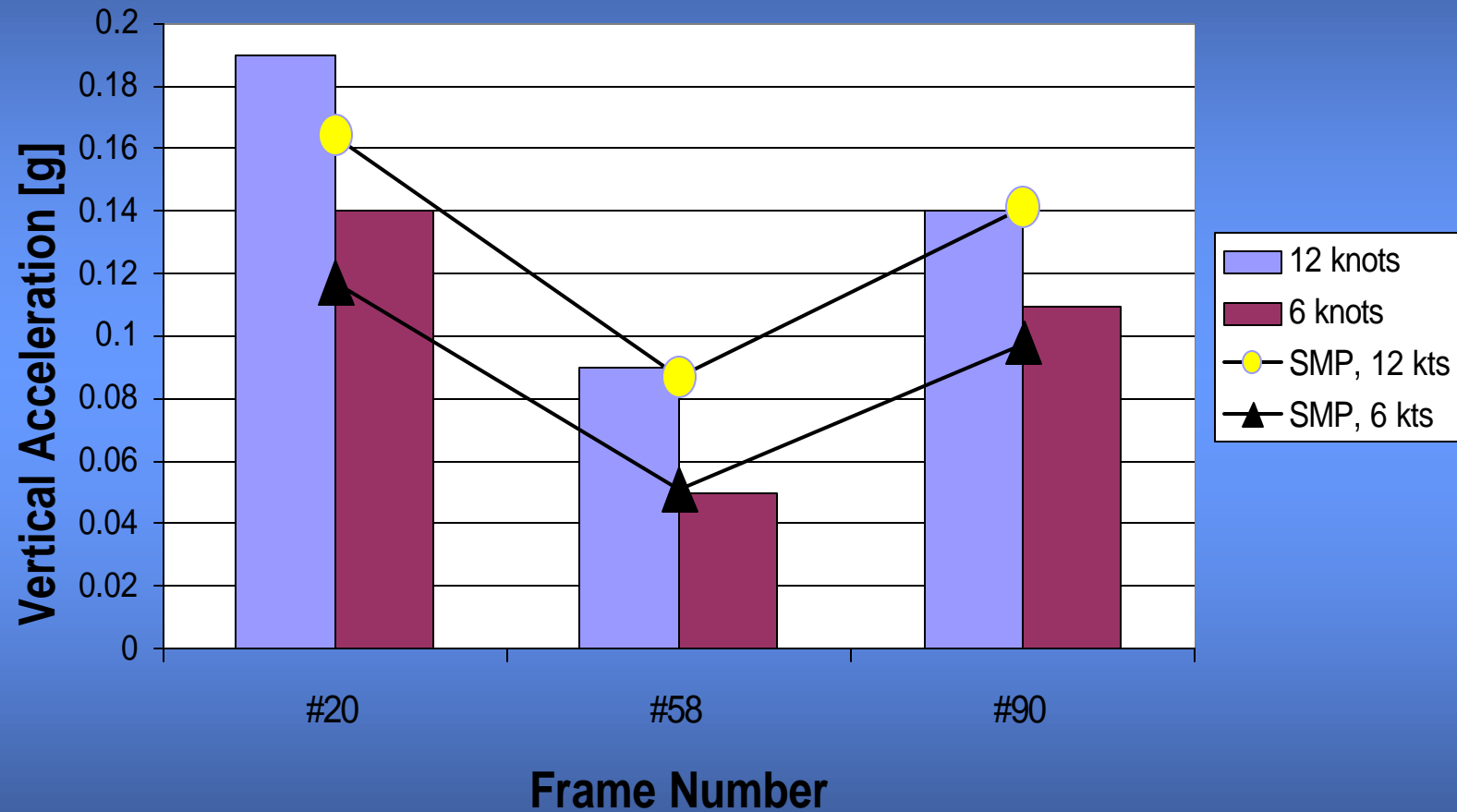
- Seakindly
- Dry
- Low relative motions on working deck
- SMP predictions validated
- Operational in SS 5



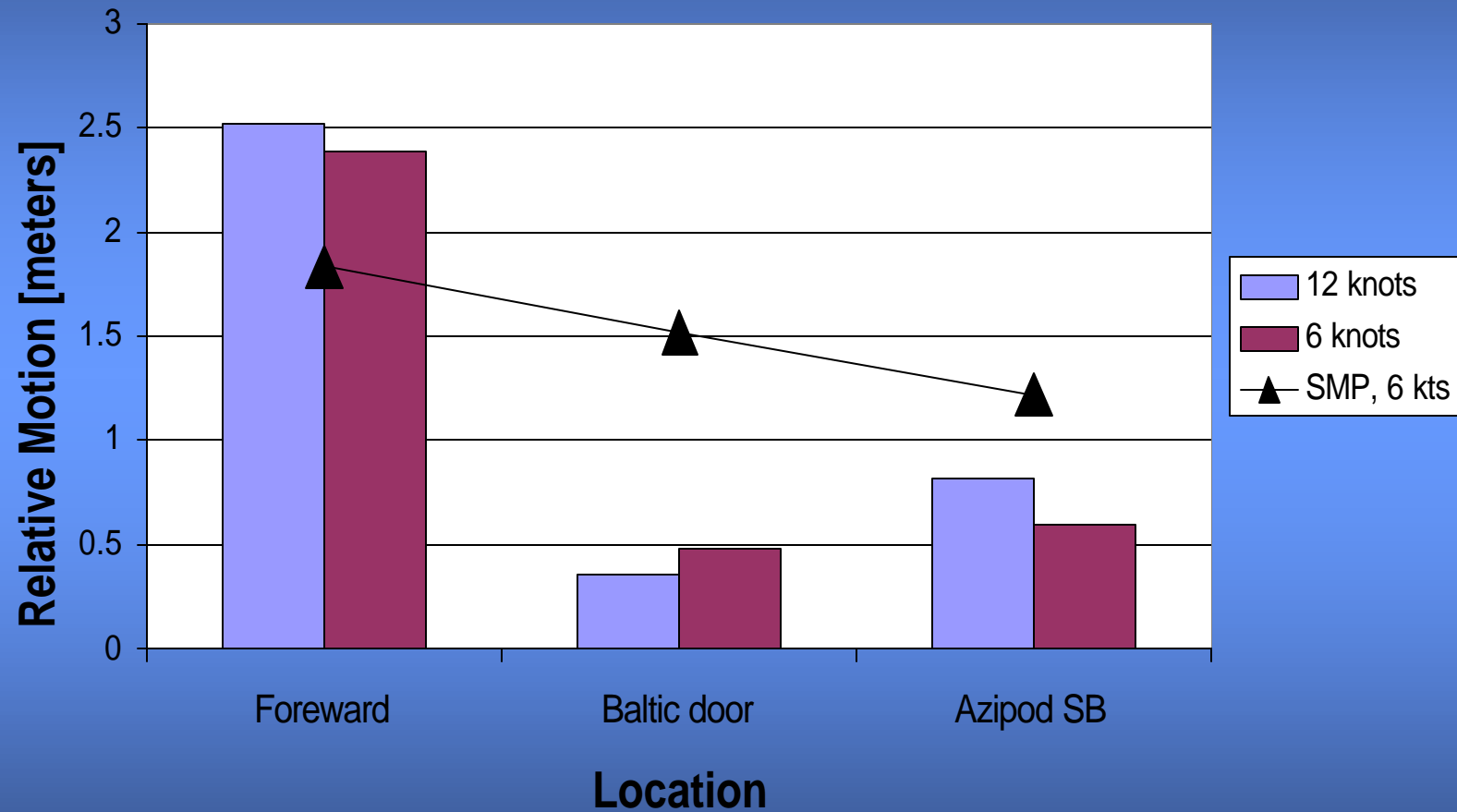
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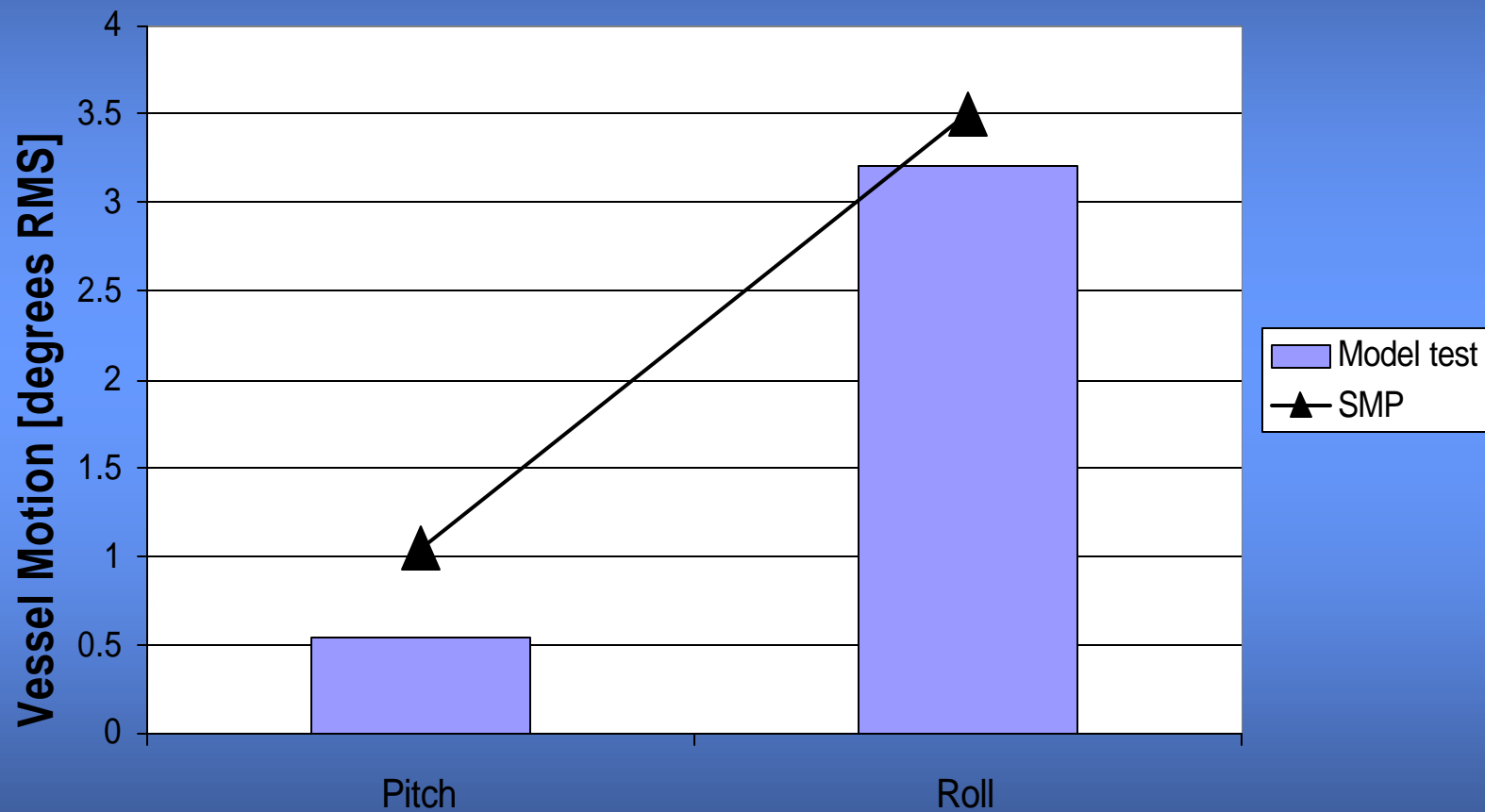
Vertical Acceleration - Head Seas



Relative Motion - Head Seas



Vessel Motions



12 knots – $H_s=4m$



Model Test Program

Maneuvering


- Azimuthing thruster and bow thruster
→ Highly-maneuverable vessel
- Limited program, single zig-zag test to assess tracking

Azipods



AZIPOD® Milestones

 **Conceived**
1988

 **First Installation**
1990

Seili
1MW

 **Compact AZIPOD®** **2000**

 **First Installation** **2001**

 **First Tanker**



45 units delivered - 60 on order



Alaska Region Research Vessel



Contracted AZIPOD® Units

(As of March 2002)

- Delivered

- Cruise vessels

29 units 13 vessels

- Icebreakers

4 units 2 vessels

- Icebreaking supply vessels

5 units 2 vessels

Total AZIPOD® Propulsion Power: 1 099 200 kW

Total AZIPOD® Operating Hours: 415 000 h

- Arctic Product Tankers

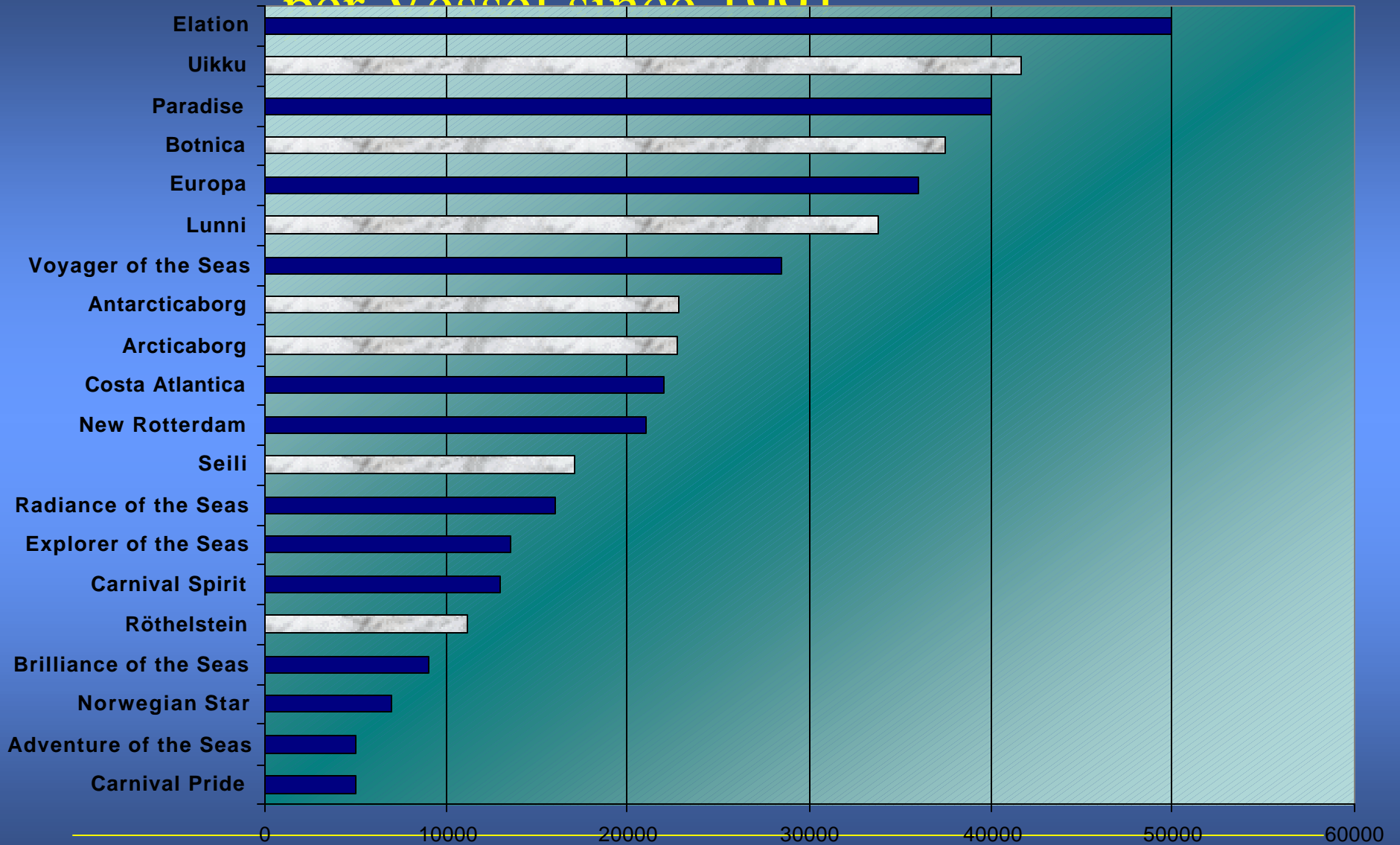
2 units 2 vessels



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AZIPOD® Units Operating Hours per Vessel since 1991



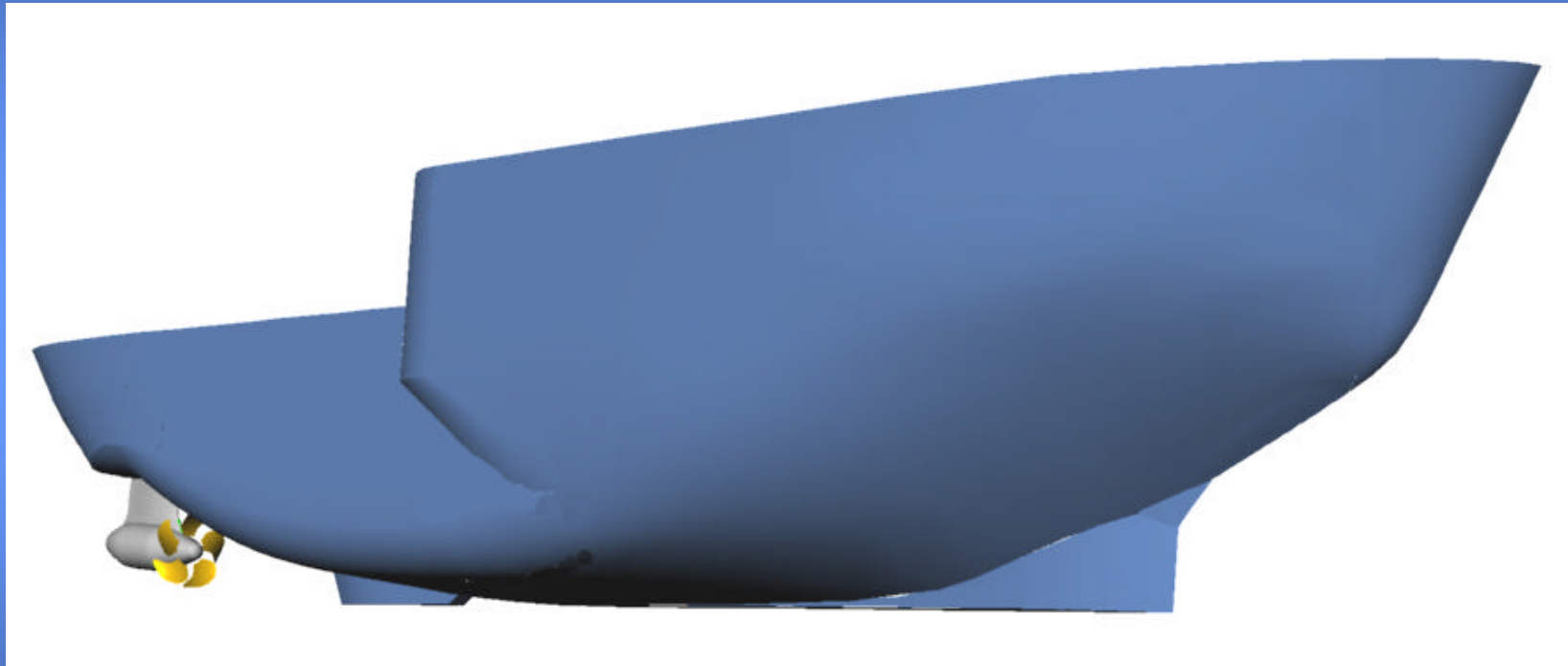
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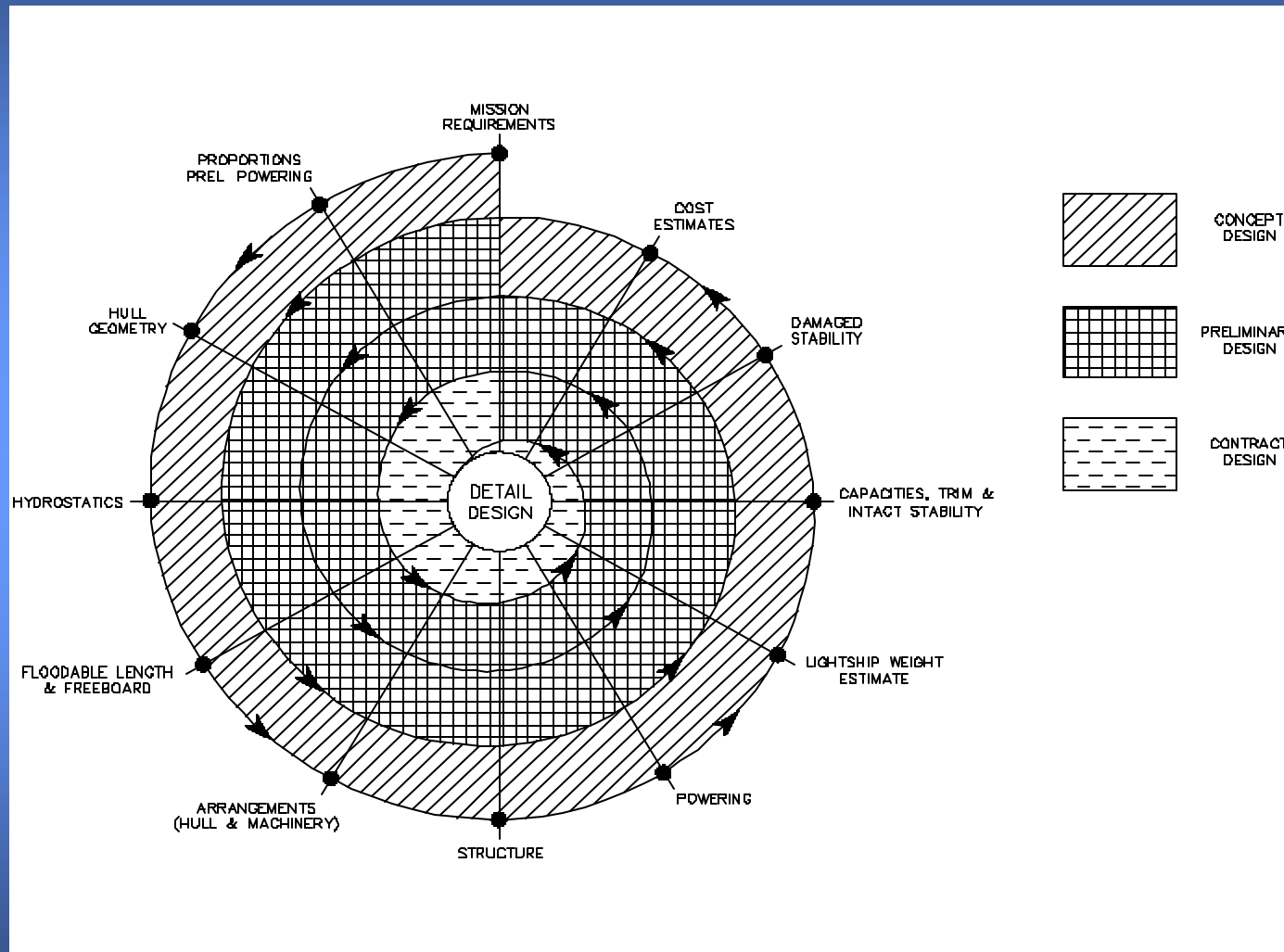
Results Recap

- Ice
 - 2.5 ft level ice Achieved
 - 7 ft ridges (sail height) Achieved
- Resistance & Propulsion
 - 14 knots trial speed Achieved
- Seakeeping
 - Operational in SS 5 Achieved

Preliminary Hull Geometry



Design Spiral



Design Schedule

- Concept Design- Complete
- Preliminary Design - 95% complete
- Contract Design- 1st Quarter 2003



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Acquisition Program

- Design
- Bid
- Build
- Challenge – Manage Risks



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Acquisition Cost

• Base Shipyard Contract ('96)		\$29.0M
– Inflation 1996-2003 (3%)	6.7M	
– Ice Capability – Structure	1.6M	
– Ice Capability – Propulsion	1.9M	
– Special Science Features & ICES	2.0M	
• Subtotal		\$41.2M
– Uncertainty Allowance (15%)	6.2M	
– Program Management (10%)	4.1M	
– Change Order Allowance (5%)	2.1M	
– Vessel Design	3.0M	
• Total		\$57.0M



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Annual Operating Cost

- Salaries & benefits \$1.8M
 - (17 crew + relief + shore staff)
- Maintenance & repair 0.4M
- Fuel 1.3M
- Insurance, subsistence, & repairs 0.7M

- Total 4.2M
- Budgeting allowance \$5.0M per year