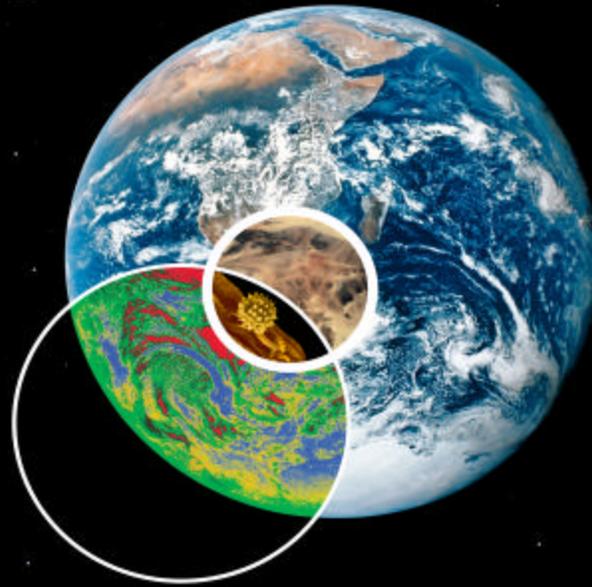


LAMONT-DOHERTY  
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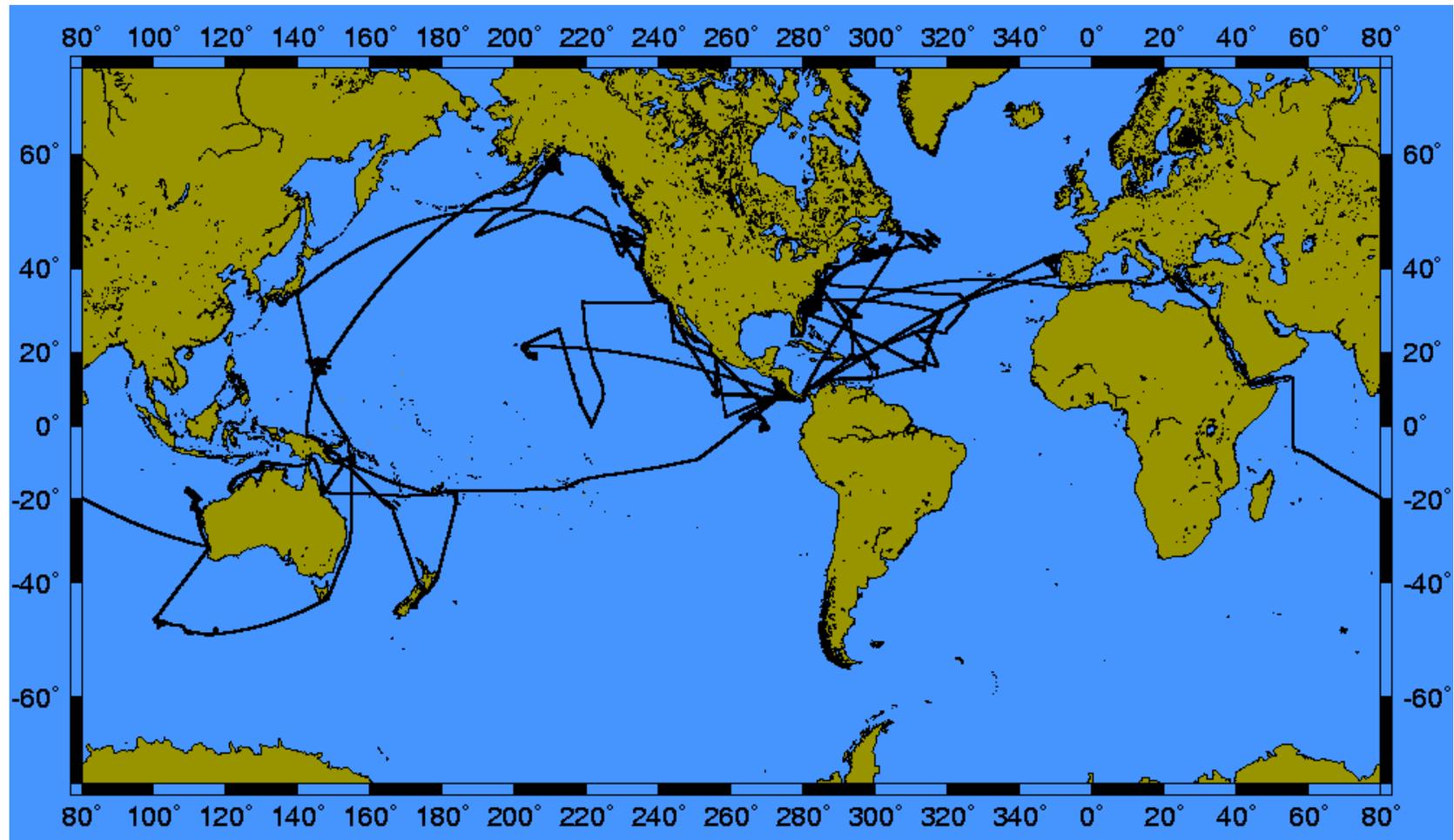
*Research Vessel Maurice Ewing in the Gulf of Corinth August 2001*

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## The Research Vessel *Maurice Ewing*

Length:	237 feet
Disp. Tonnage:	2598 long tons
Year Built:	1983 (converted 1989- 1990)
Endurance:	50 days
Science Berths:	29

# R/V *EWING* 1997 - 2002

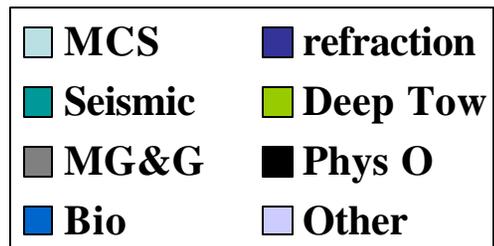
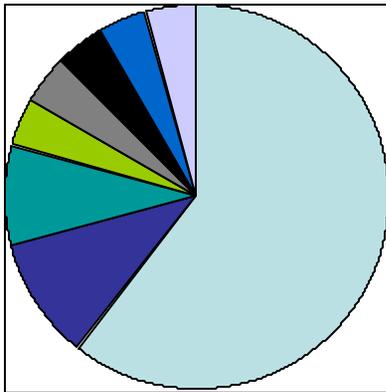


## R/V *EWING* Task Categories

- Multichannel Seismic [MCS] Profiling
- Refraction shooting; OBS/OBH, onshore
- Other Seismic [high resolution, SCS,....]
- MG&G [Coring, Heatflow, Dredging,...]
- Multibeam [specifically – always acquired]
- Physical Oceanography
- Biology, Chemistry, “Other”

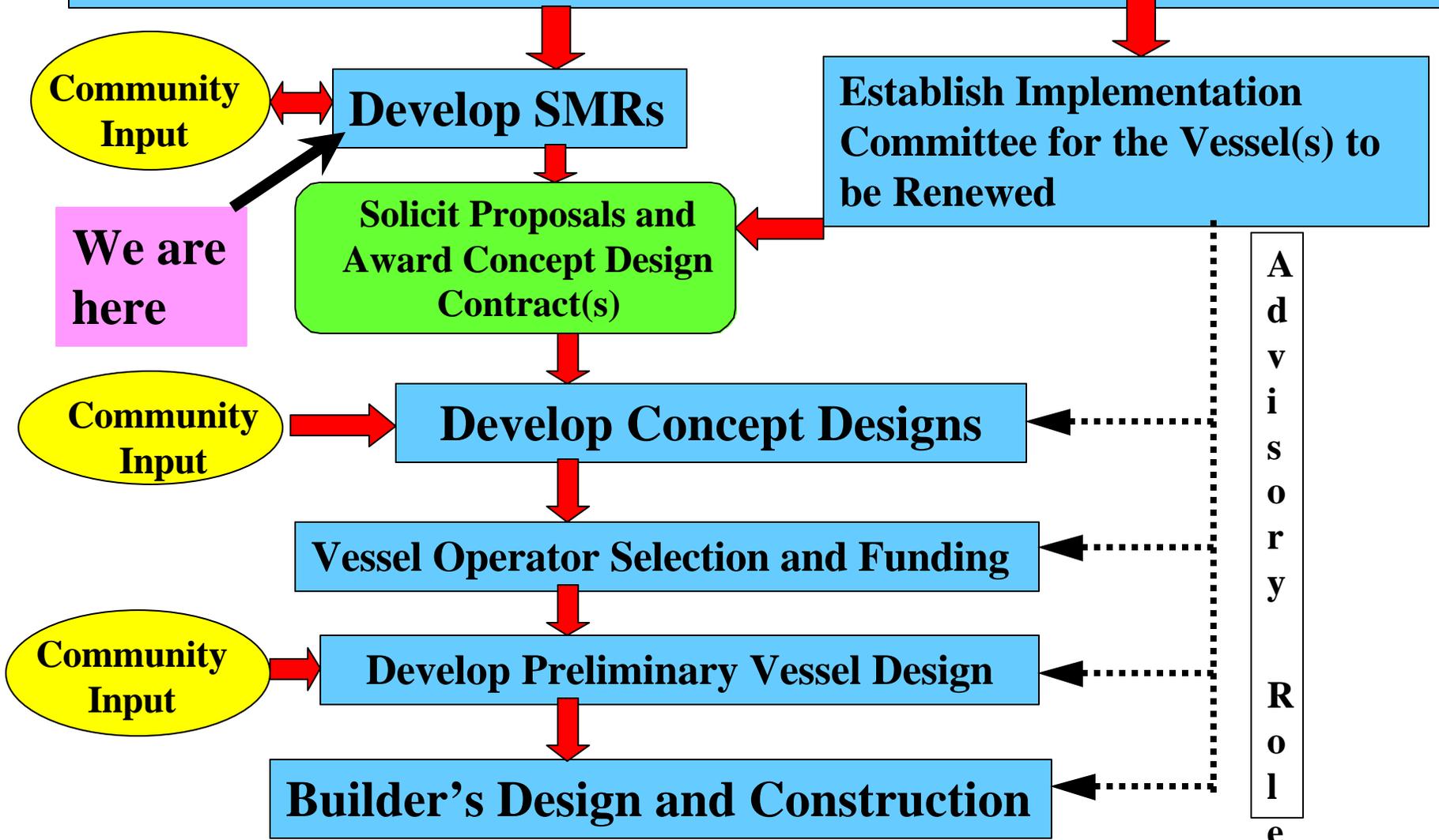
# R/V *EWING* use '97-'02

## Principal use, by legs

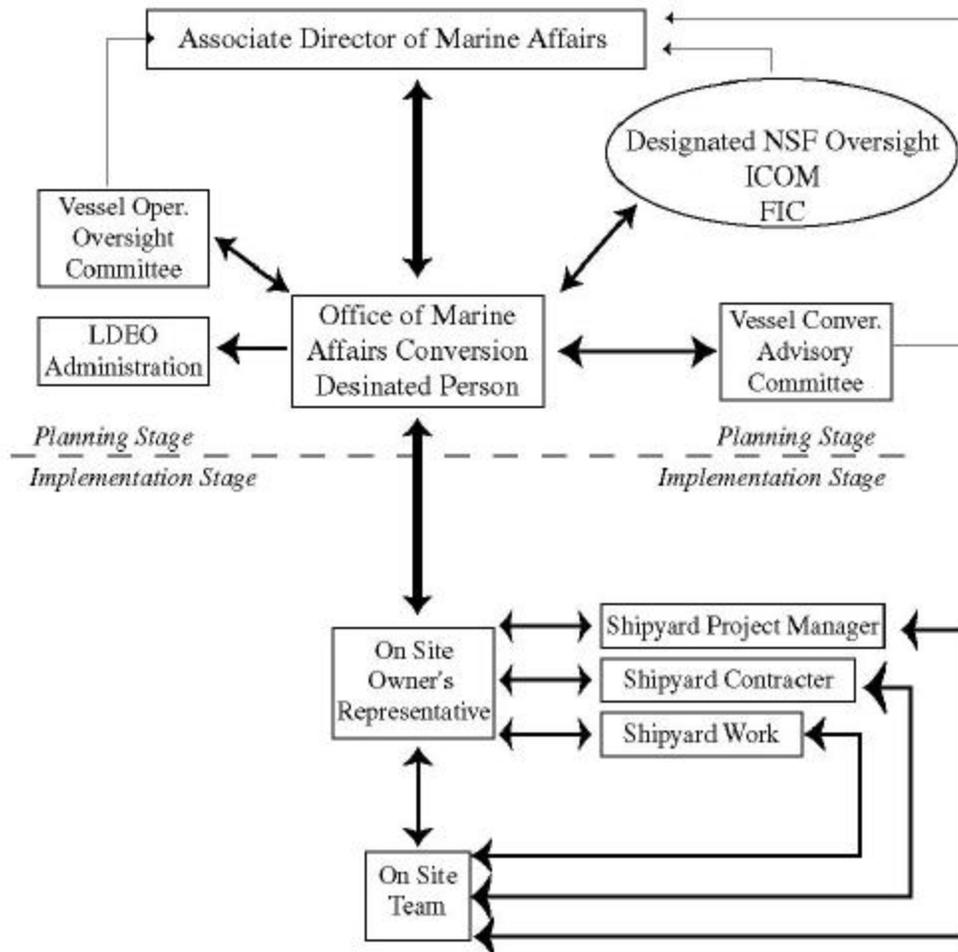


# FIC Roadman

## UNOLS Ship Renewal Process – Introduction and FIC’s Role



### Project Management



# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## The Questions:

How might *Ewing* be upgraded to best address the scientific needs of the community?

What additional capabilities should the ship have?

What are the tradeoffs between optimizing seismic capabilities and general-purpose capabilities?

What is practical - reasonable - optimal?

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*These questions must be answered in  
the context of both:*

- The evolving science needs of the U.S. community
- The strengths and capabilities of the other vessels within the UNOLS fleet
- The Federal plan for fleet enhancement and replacement over the next 15 years

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## The Process

- Solicitation of input from community via EOS ad; direct mailing; requests in community Newsletters
- Establishment of new internal advisory committee
- Establishment of a community-wide steering committee
- Production of extensive set of 'Technical Option Papers'
- Workshop Activity and production of workshop report
- Formulation of set of feasible options for discussion

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## Workshop: Overall Summary & Conclusions

### Key Statements:

- A refit of *Ewing* cannot improve 2-D MCS *and* provide an effective multiple streamer capability (for 3D) *and* substantially improve general-purpose operations.
- Quality of present *Ewing* MCS operations would be substantially improved through increased repeatability of the sound source.

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## **Key Statements** *(continued)*:

- In the refit of ***Ewing***, use of a linear airgun array forces serious compromises in OBS and general purpose operations.
- In the refit of ***Ewing***, without a linear airgun array, there are excellent options for new lab and deck layouts.

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## Workshop Recommendations:

*If the goal is to:*

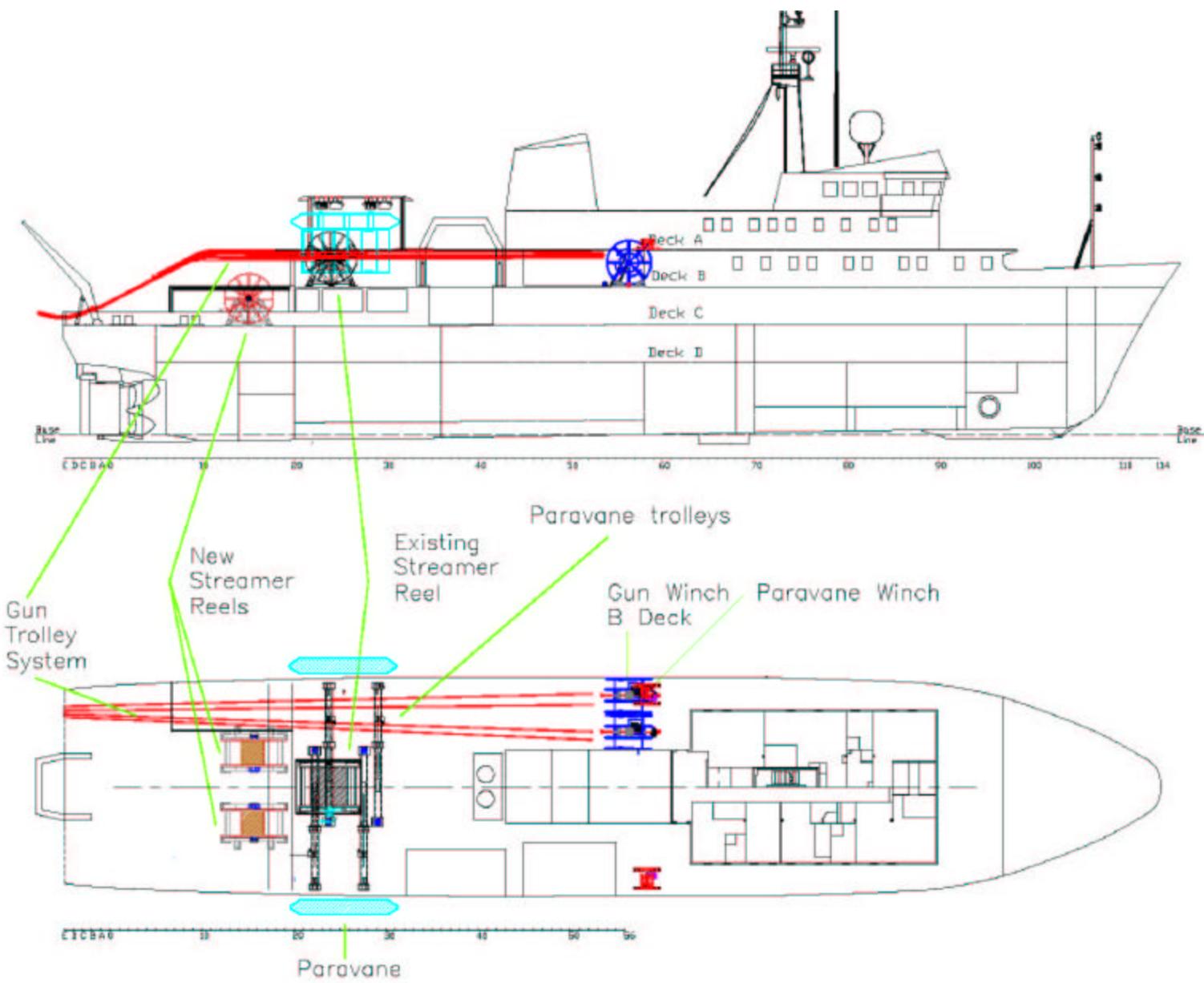
- Tow multiple long streamers
- Improve source repeatability using linear gun arrays

*and*

- Improve general purpose/OBS capabilities

*then*

- **Ewing** cannot satisfy these needs, and the possibility of securing a used industry vessel should be studied



# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

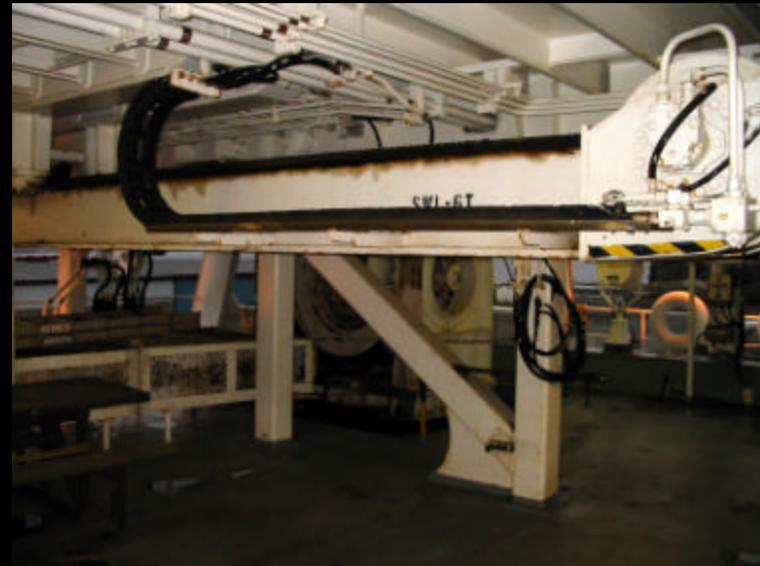


**Paravanes**

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY



**Winch**



**Handling Equipment**

## **Paravanes**

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY



# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY



Main Deck Center Aft From Gun Winches

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## Three Options for Discussion:

1. Maximize *Ewing* general purpose capabilities, and enhance conventional MCS.
2. Outfit *Ewing* with Linear Gun arrays
3. Replacement Vessel

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## Replacement Vessel Science Capabilities

Streamers:	4 Streamers x 4 km (8 km) with separation up to 100m
Sound Source:	4 Linear Gun Arrays
DP:	Twin Screw with Bow Thruster expandable to include forward azimuthing thruster and stern tunnel thruster
Sonars:	Wide Hull for high resolution Deep Sea Multibeam and high resolution medium depth multibeam and subbottom profiler
Over the Side:	Ability to match or exceed Ewing for over the side handling
Lab Area:	Lab area far exceeds Ewing's capacity
Open Main Deck:	More open deck than Ewing
Portable Vans:	5 Van/Container capacity without effecting other operations

# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## Replacement Vessel –XXX as an Example

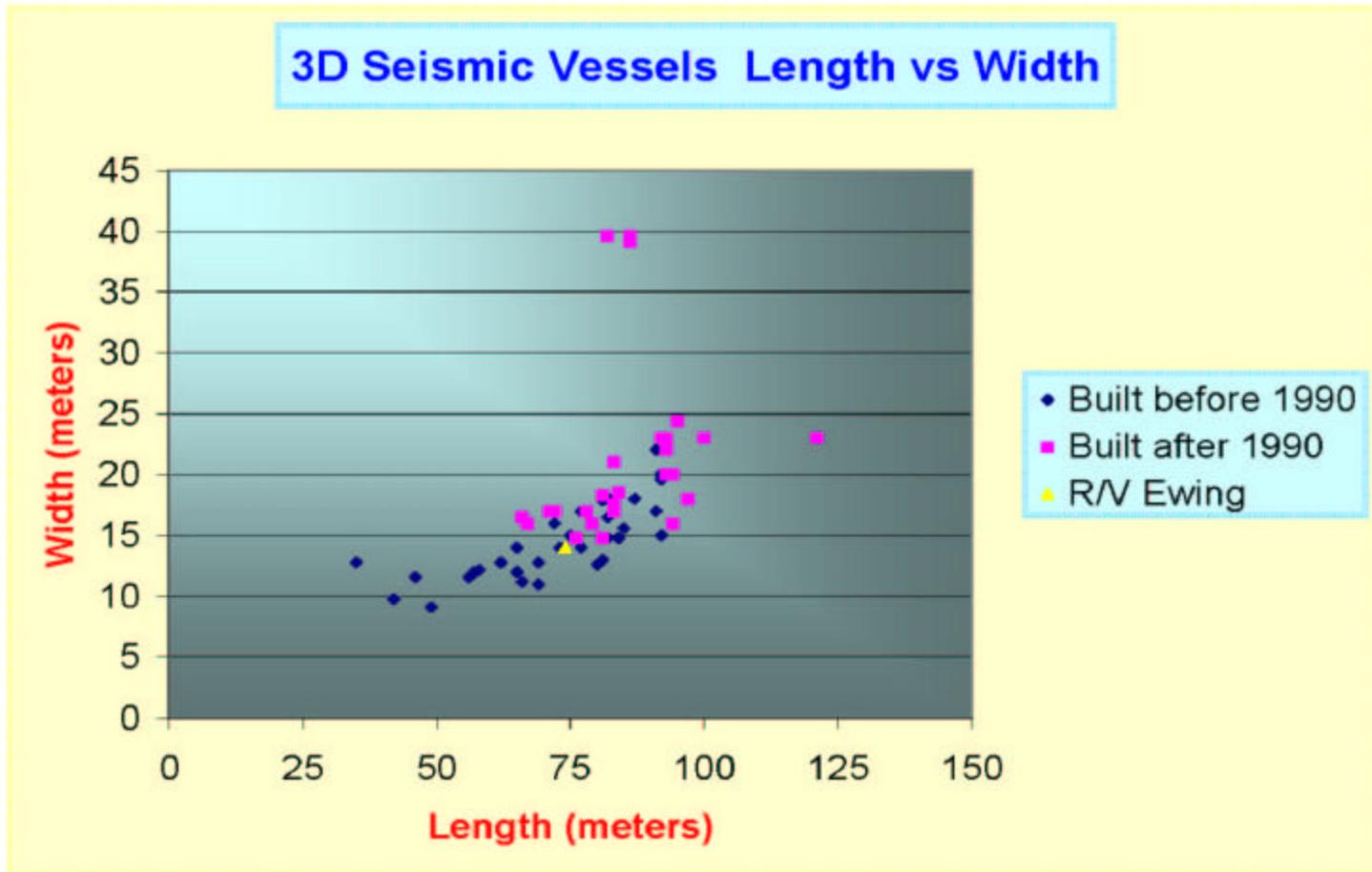
*(EWING after midlife in parenthesis)*

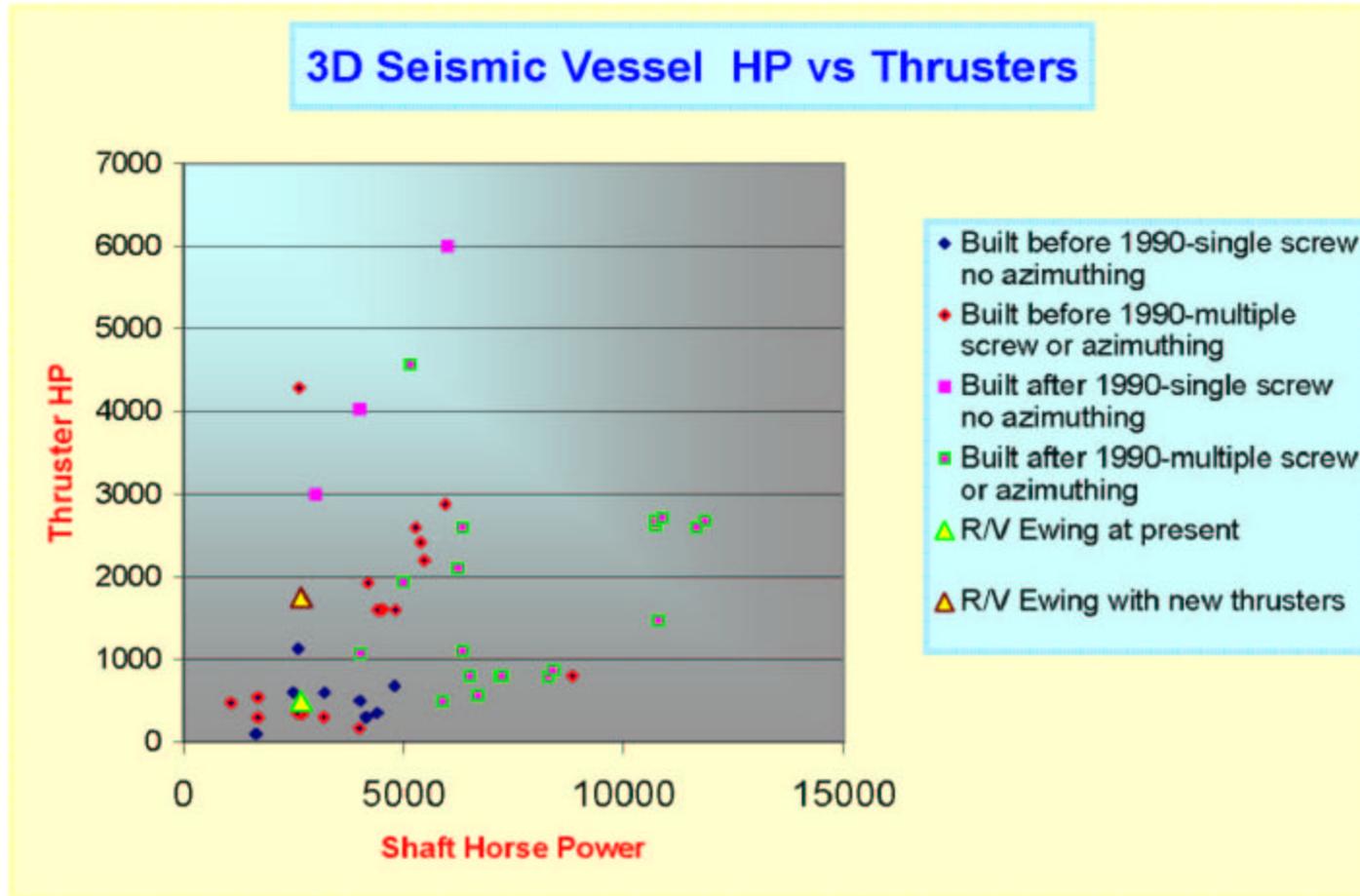
Length:	235 feet	<i>(237 feet)</i>
Beam:	56 feet	<i>(46 feet)</i>
Displacement Lightship Tonnage:	2578 metric tons	<i>(1867 metric tons)</i>
HP:	7200 HP	<i>(3200 HP)</i>
Bollard Pull:	86.2 metric tonnes	<i>(20.2 metric tonnes)</i>
Compressor Capacity:	2x2750cfm	<i>(3x1000cfm)</i>
Speed Cruising/Max:	12/14 kt	<i>(11/13 kt)</i>
Ship's Complement/ Minimum Science Party	55/34 people	<i>(50/29 people)</i>

3D MCS Vessels



12-20 Streamers Built 1996





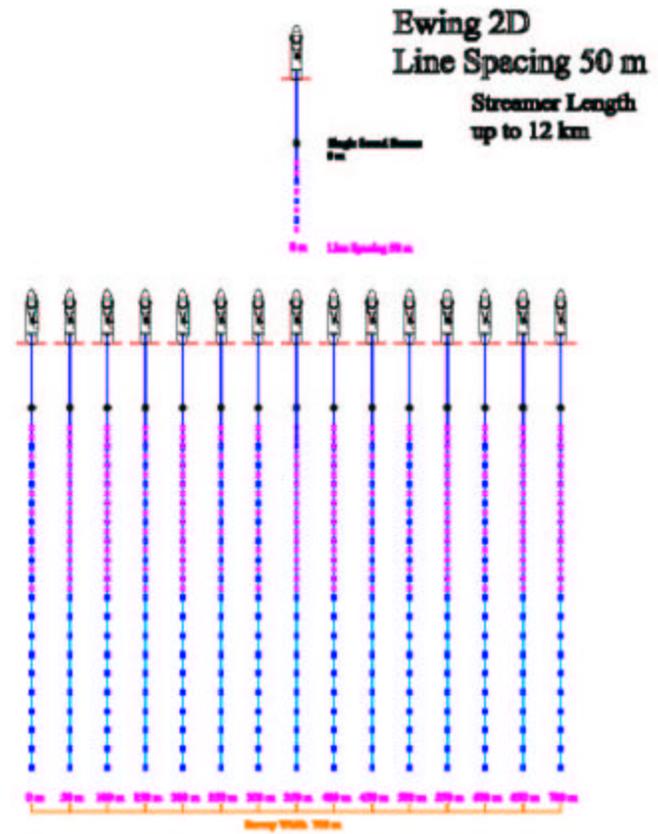
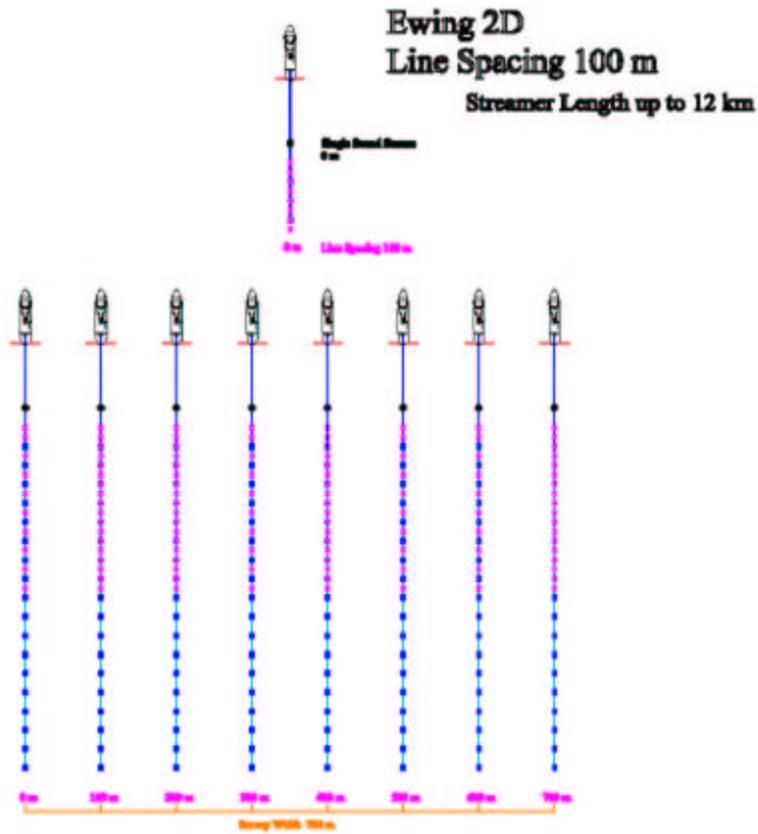
## Available and Appropriate



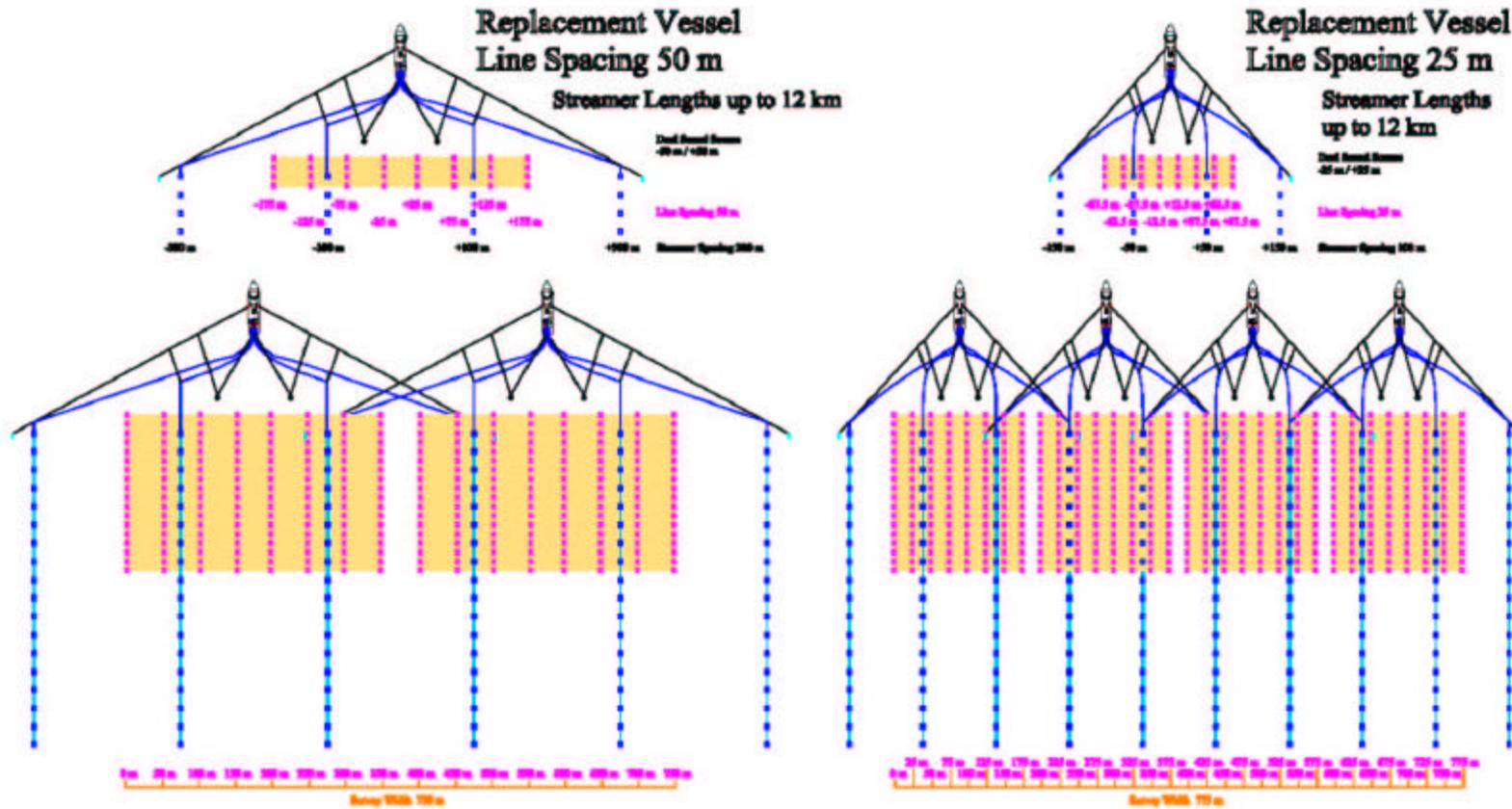
- An extensive search for all appropriately sized, available 3D MCS vessels over the last two and a half years yielded the following:

Two older vessels within the target range

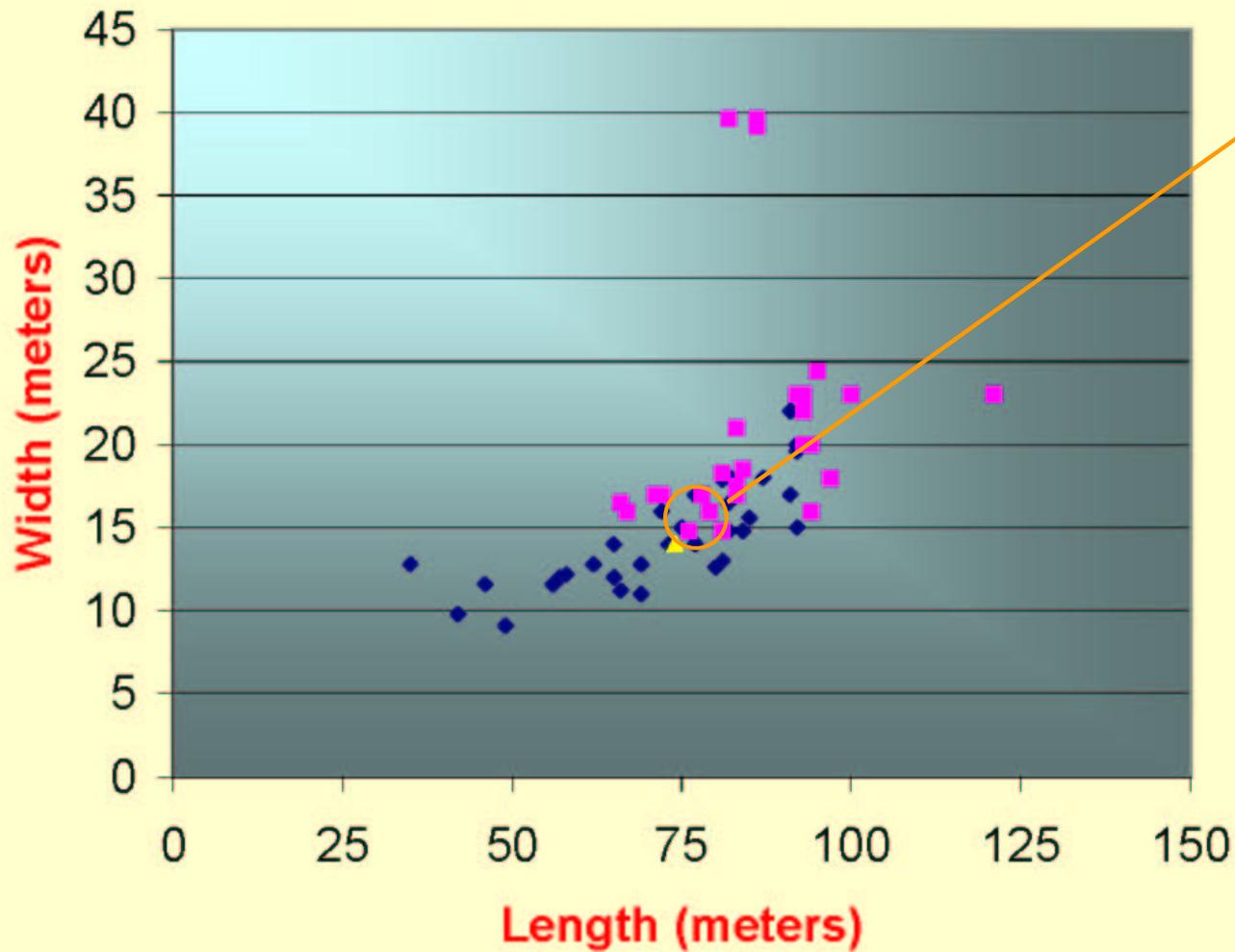
Three post 1990 vessels within the target range





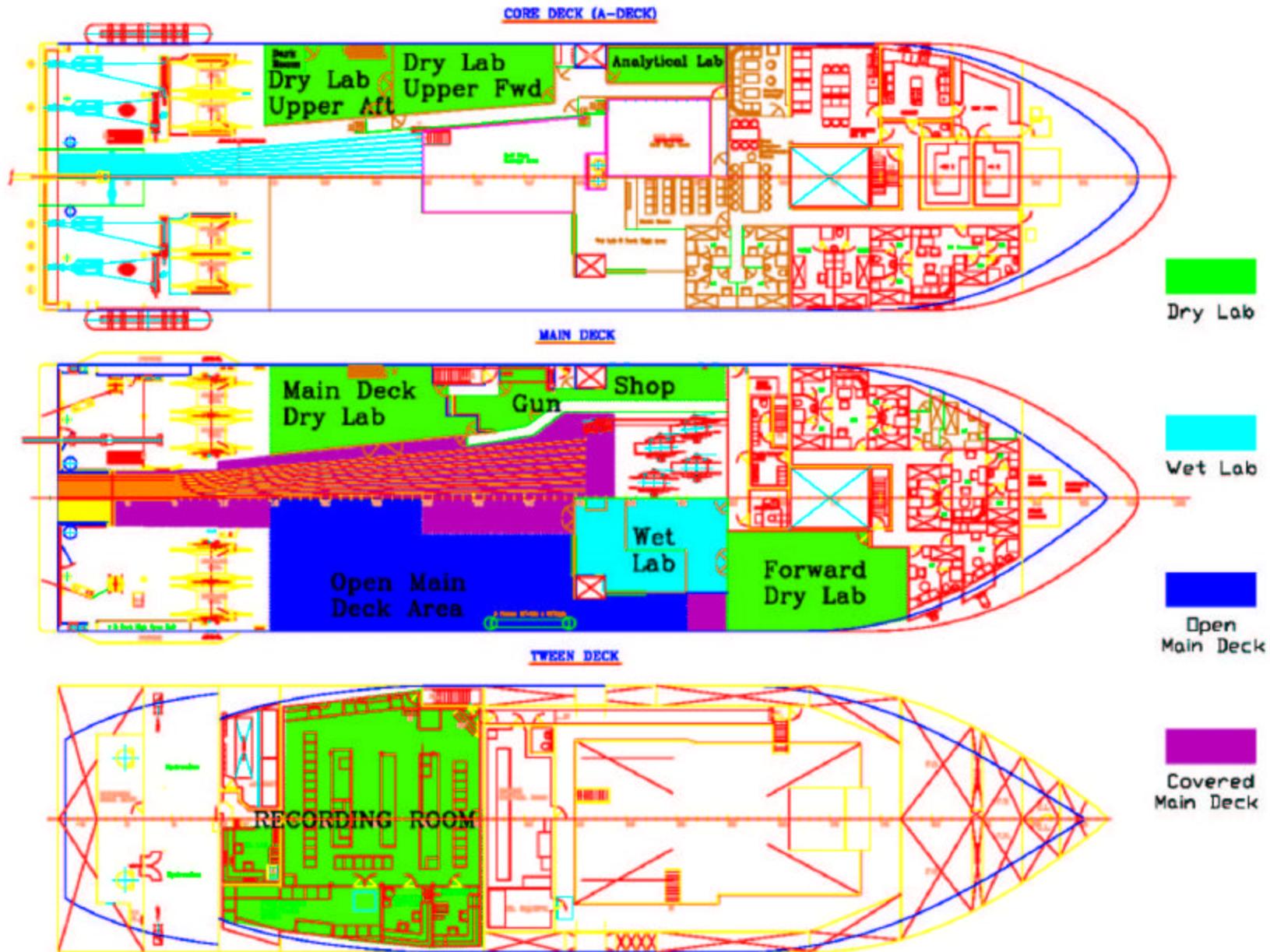


## 3D Seismic Vessels Length vs Width



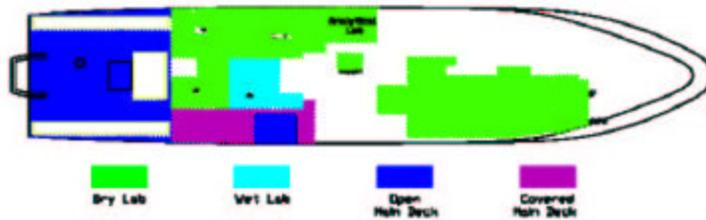
Target Area  
More Space than Ewing  
But, not too Big

- ◆ Built before 1990
- Built after 1990
- ▲ R/V Ewing

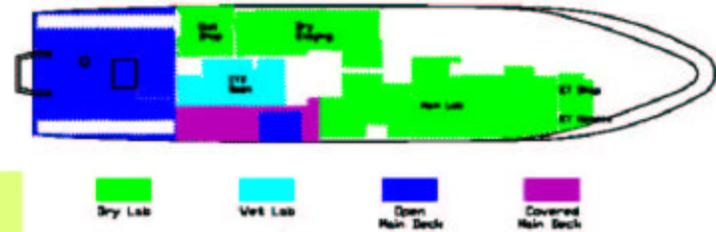


# Scientific Areas

Ewing – Existing



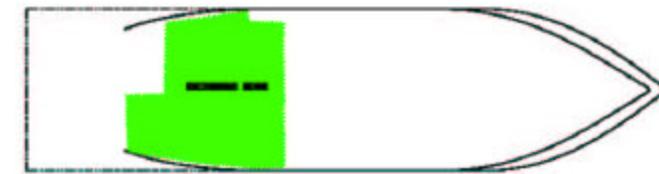
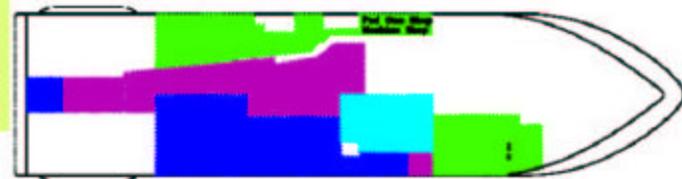
Ewing – Midlife



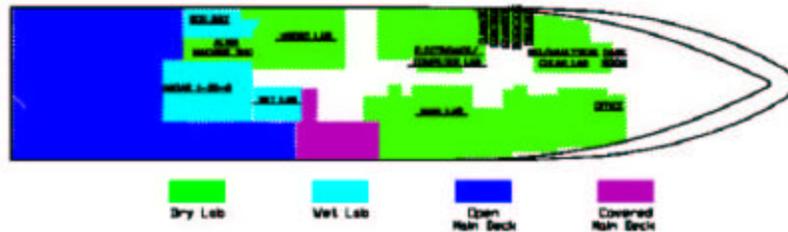
Areas in m<sup>2</sup>

	Ewing Existing	Ewing Midlife	Replacement Vessel	AGOR 23 Atlantis	Ocean Class SMR
Total Laboratory	268	316	522	488	188
Dry Labs	207	264	465	390	149
Wet Labs	61	52	57	98	74
Open Main Deck	150	165	181	294	N/A
Covered Main Deck	40	40	91	30	N/A

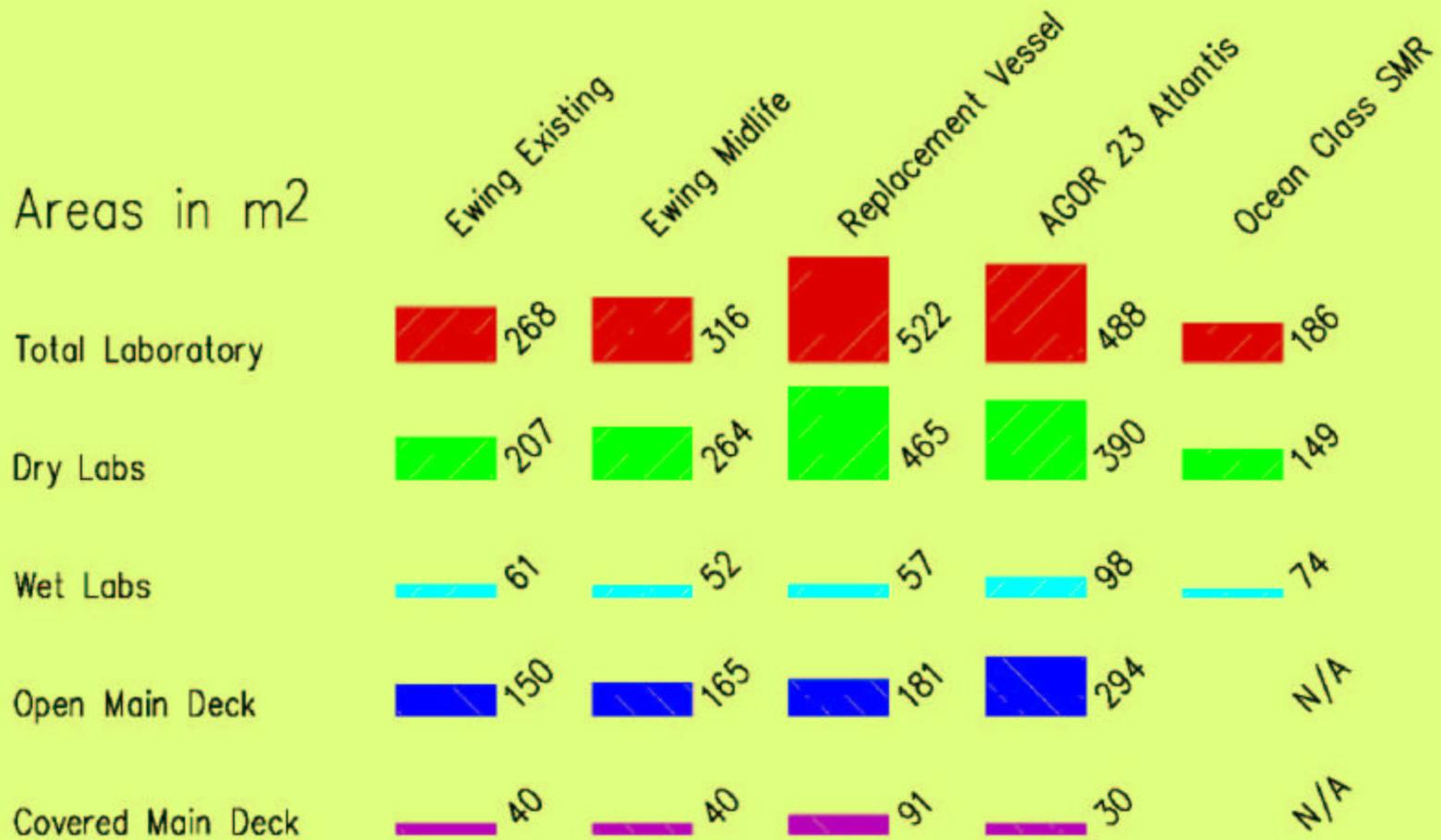
Replacement Vessel



AGOR 23 Atlantis



## Areas in m<sup>2</sup>







# LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY

## COMMUNITY INVOLVEMENT

22,23 Oct 2002 Dave Hebert of UNOLS FIC attends *EWING* refit and gives presentation on the The Academic Research Fleet Plan. (Tim Cowles, UNOLS Chair and Bob Knox, UNOLS Past Immediate Chair invited to *EWING* Midlife Planning Meeting.)

12 February 2003 Midlife Workshop Report sent to Knox, Cowles, Atkinson

5 March 2003 UNOLS Council meets and *EWING* Midlife Workshop Report is an agenda item

2 June 2003 UNOLS Council meets and *EWING* Midlife is an agenda item. A summary of recent activities related to the *EWING* Replacement was submitted.

28 Jun-2 Jul 2003 Dave Hebert of FIC joins Director LDEO and Marine Office personnel on visit the vessel identified as a potential replacement and upgrade of the *R/V MAURICE EWING*

15 Aug 2003 Submit seismic ship specific SMRs and revised vessel arrangements to FIC

17 Sept 2003 Presentation at FIC Fall Meeting.

18 Sept 2003 Presentation at UNOLS Council Fall Meeting

8 Dec 2003 Town Hall Meeting scheduled at AGU entitled "The Enhancement of Marine Seismic Capabilities in the US Academic Research Fleet"

	2D Ewing 100m Spacing	2D Ewing 50m Spacing	3D Ewing 50m Spacing	Converted Vessel 50m Spacing
3D Survey Nankai	\$2.10	\$3.87	\$1.93	\$1.15
Duration	59 days	109 days	43 days	23 days
3D Survey East Pacific Rise	\$1.47	\$2.75	\$1.31	\$0.71
Duration	41.5 days	77.5 days	29.5 days	14.5 days
2D MCS	k\$35.5 * 90 days \$3.20	k\$35.5 * 90 days \$3.20	k\$35.5 * 90 days \$3.20	k\$37.0 * 90 days \$3.30
Duration	3 months	3 months	3 months	3 months
High Resolution/ Guns Only	k\$25.0 * 30 days \$0.75	k\$25.0 * 30 days \$0.75	k\$25.0 * 30 days \$0.75	k\$27.0 * 30 days \$0.81
Duration	1 month	1 month	1 month	1 month
Non MCS	k\$20.0 * 75 days \$1.50	k\$20.0 * 75 days \$1.50	k\$20.0 * 75 days \$1.50	k\$21.5 * 75 days \$1.61
Duration	2.5 month	2.5 month	2.5 month	2.5 month
Total for Year	\$9.02 10 months 3.5 months of 3D, 3 months of 2D 1 month of HR, 2.5 months other	\$12.07 12 months 5.5 months of 3D, 3 months of 2D 1 month of HR, 2.5 months other	\$8.69 9 months 2.5 months of 3D, 3 months of 2D 1 month of HR, 2.5 months other	\$7.58 7.75 months 1.25 month of 3D, 3 months of 2D 1 month of HR, 2.5 months other
Extra Non MCS for 10 month operating year	-	- 2.0 months @ k\$20.0 -\$1.20	+ 1 months @ k\$20.0 \$0.60	+ 2.25 months @k\$21.5 \$1.45
Total Time-Equivalent	\$9.02 10 months 3.5 months of 3D, 3 months of 2D 1 month of HR, 2.5 months other	\$10.87 10 months 5.5 months of 3D, 3 months of 2D 1 month of HR, 0.5 months other	\$9.29 10 months 2.5 months of 3D, 3 months of 2D 1 month of HR, 3.5 months other	\$9.03 10 months 1.25 month of 3D, 3 months of 2D 1 month of HR, 4.75 months other

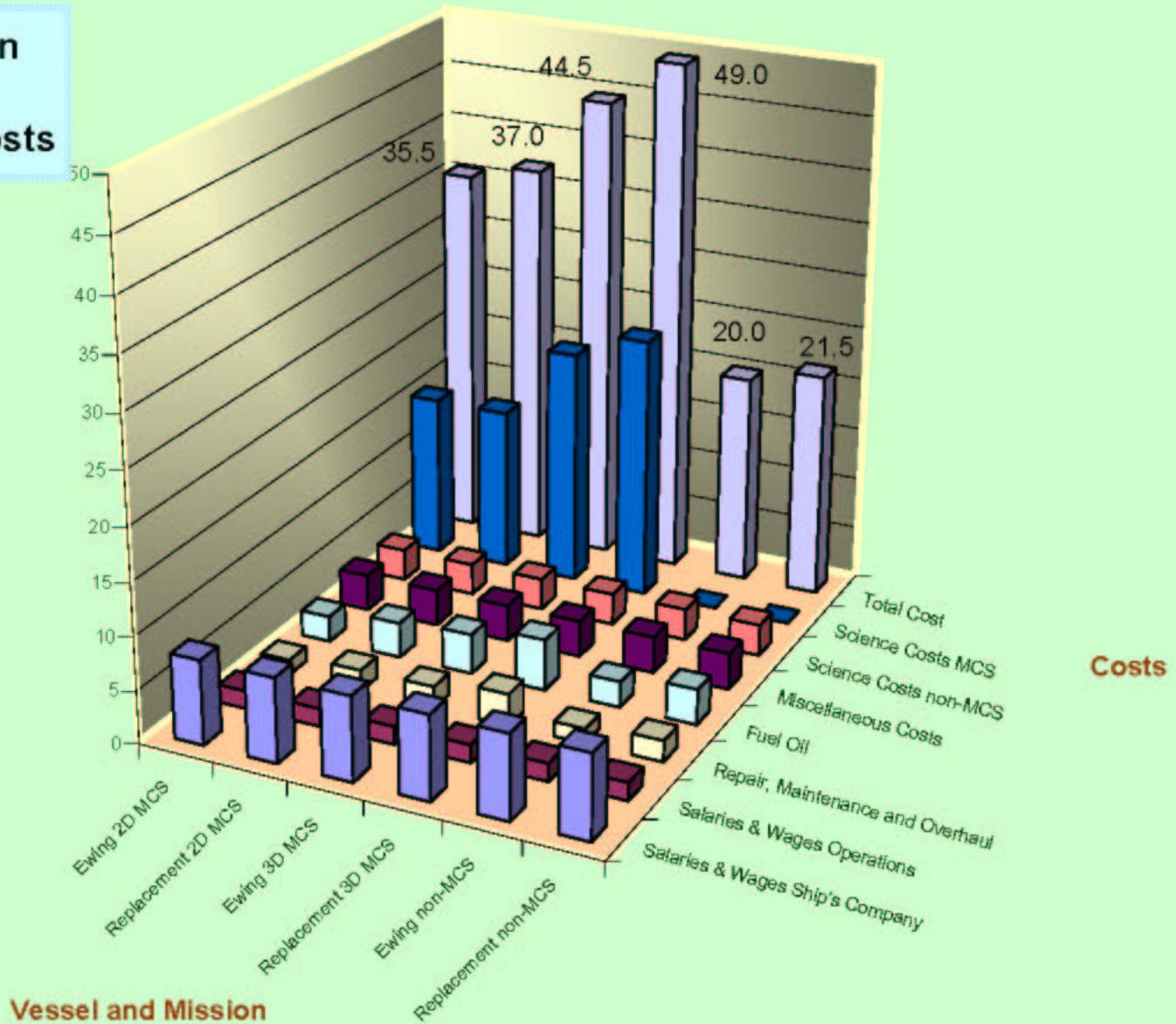
Costs in Millions of Dollars Unless Noted

Comparison of 3D Survey Costs

Ship	MCS Mode	# of Streamers	Sound Source	Nankai Survey	East Pacific Rise Survey
Ewing	2D 100m spacing	One	Single	\$2,100,000	\$1,470,000
Ewing	2D 50m spacing	One	Single	\$3,870,000	\$2,750,000
Ewing	3D 50m spacing	Three	Single	\$1,930,000	\$1,360,000
Ewing	3D 25m spacing	Three	Dual	\$1,930,000	\$1,360,000
Replacement	3D 50m spacing	Four	Dual	\$1,150,000	\$710,000
Replacement	3D 25m spacing	Four	Dual	\$1,760,000	\$1,250,000
Industry	3D 50m spacing	-	-	\$3,920,000	\$3,340,000
Industry	3D 25m spacing	-	-	\$4,560,000	\$3,790,000

# Comparison of Daily Operating Costs

Thousands of Dollars /Day



Operating Year Cost in \$M	Ewing 1 Streamer	Ewing 3 Streamers	Replacement Vessel
1 Month 3D	\$1.065	\$1.335	\$1.470
6 Months 2D/Airguns	\$6.390	\$6.390	\$6.660
3 Months non Seismics	\$1.800	\$1.800	\$1.935
<b>Yearly Total</b>	<b>\$9.255</b>	<b>\$9.525</b>	<b>\$10.065</b>
Assumptions for 3D Month	6 Transit Days 2 Deploy/Recover	6 Transit Days 3 Deploy/Recover	6 Transit Days 4 Deploy/Recover
3D Survey Spacing	<b>100m</b>	<b>50m</b>	<b>50m</b>
3D Survey Area	<b>282 km2</b>	<b>404 km2</b>	<b>1024 km2</b>

### Comparison of Yearly Operating Costs - 1 3D Cruise

	2D Ewing 100m Spacing	2D Ewing 50m Spacing	3D Ewing 50m Spacing	Converted Vessel 50m Spacing
3D Survey Nankai	\$2.10	\$3.87	\$1.93	\$1.15
Duration	59 days	109 days	43 days	23 days
2D MCS	k\$35.5 * 90 days \$3.20	k\$35.5 * 90 days \$3.20	k\$35.5 * 90 days \$3.20	k\$37.0 * 90 days \$3.30
Duration	3 months	3 months	3 months	3 months
High Resolution/ Guns Only	k\$25.0 * 30 days \$0.75	k\$25.0 * 30 days \$0.75	k\$25.0 * 30 days \$0.75	k\$27.0 * 30 days \$0.81
Duration	1 month	1 month	1 month	1 month
Non MCS	k\$20.0 * 120 days \$2.40	k\$20.0 * 120 days \$2.40	k\$20.0 * 120 days \$2.40	k\$21.5 * 120 days \$2.58
Duration	4 month	4 month	4 month	4 month
Total for Year	\$8.45 10 months 2 months of 3D, 3 months of 2D 1 month of HR, 4 months other	\$10.22 11.5 months 3.5 months of 3D, 3 months of 2D 1 month of HR, 4 months other	\$8.28 9.5 months 1.5 months of 3D, 3 months of 2D 1 month of HR, 4 months other	\$7.84 8.6 months 2/3 month of 3D, 3 months of 2D 1 month of HR, 4 months other
Extra Non MCS for 10 month operating year	-	- 1.5 months @ k\$20.0 \$0.90	- + 0.5 months @ k\$20.0 \$0.30	+ 1.3 months @ k\$21.5 \$0.86
Total Time-Equivalent	\$8.45 10 months 2 months of 3D, 3 months of 2D 1 month of HR, 4 months other	\$9.32 10 months 3.5 months of 3D, 3 months of 2D 1 month of HR, 2.5 months other	\$8.58 10 months 1.5 months of 3D, 3 months of 2D 1 month of HR, 4.5 months other	\$8.70 10 months 2/3 month of 3D, 3 months of 2D 1 month of HR, 5.3 months other

Costs in Millions of Dollars Unless Noted

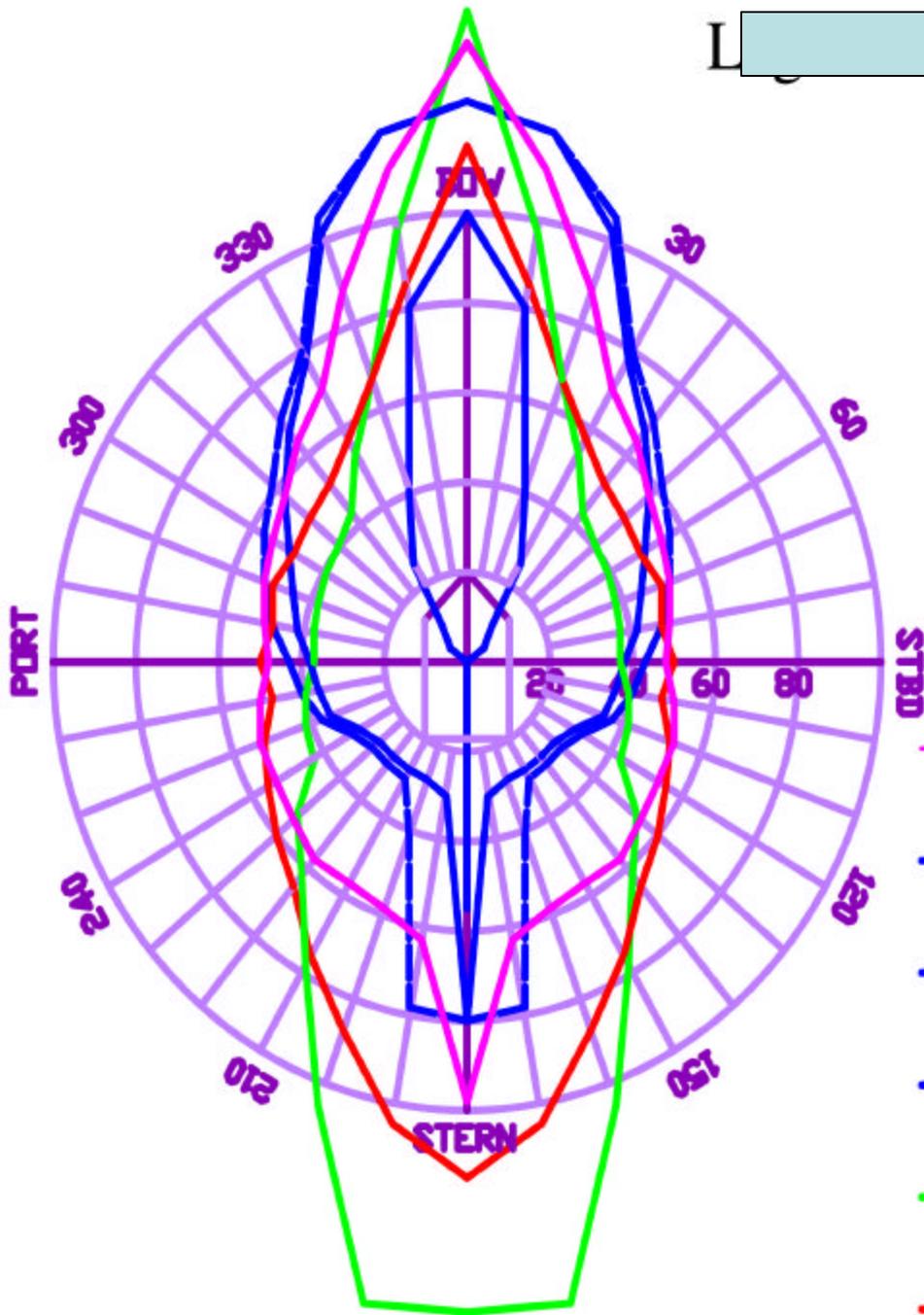
# Legend P Capability (0 knot current)

Azimuthing

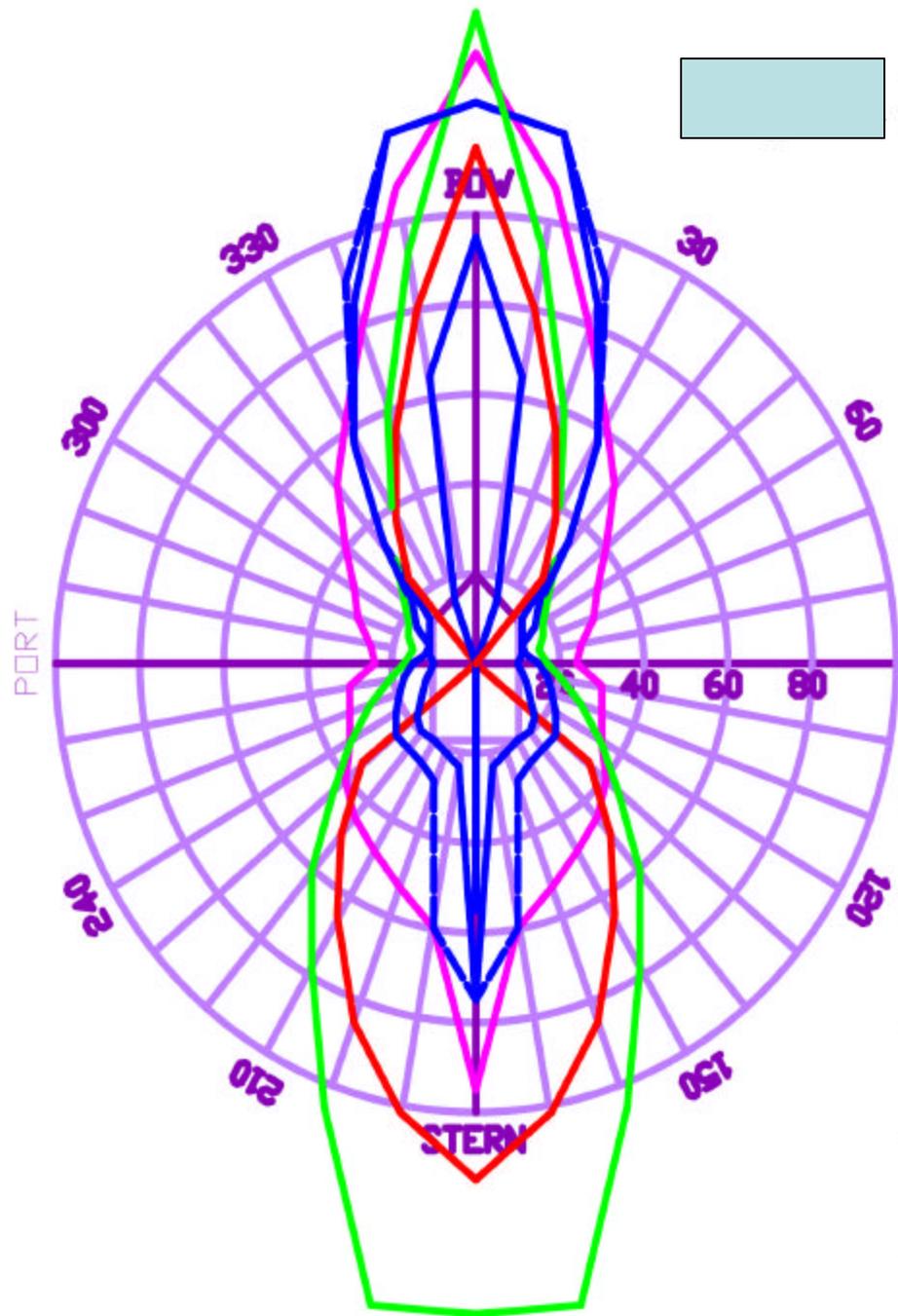
Twin Screw

800HP Bow Tunnel

1000 HP Azimuthing



- Legend
- Ewing As Is
- Ewing + Fwd Azimuth
- Ewing + Azimuth + Aft Tunnel
- AGOR23 Capability
- Knorr Capability



DP Capability (2 knot current)

Azimuthing

Twin Screw

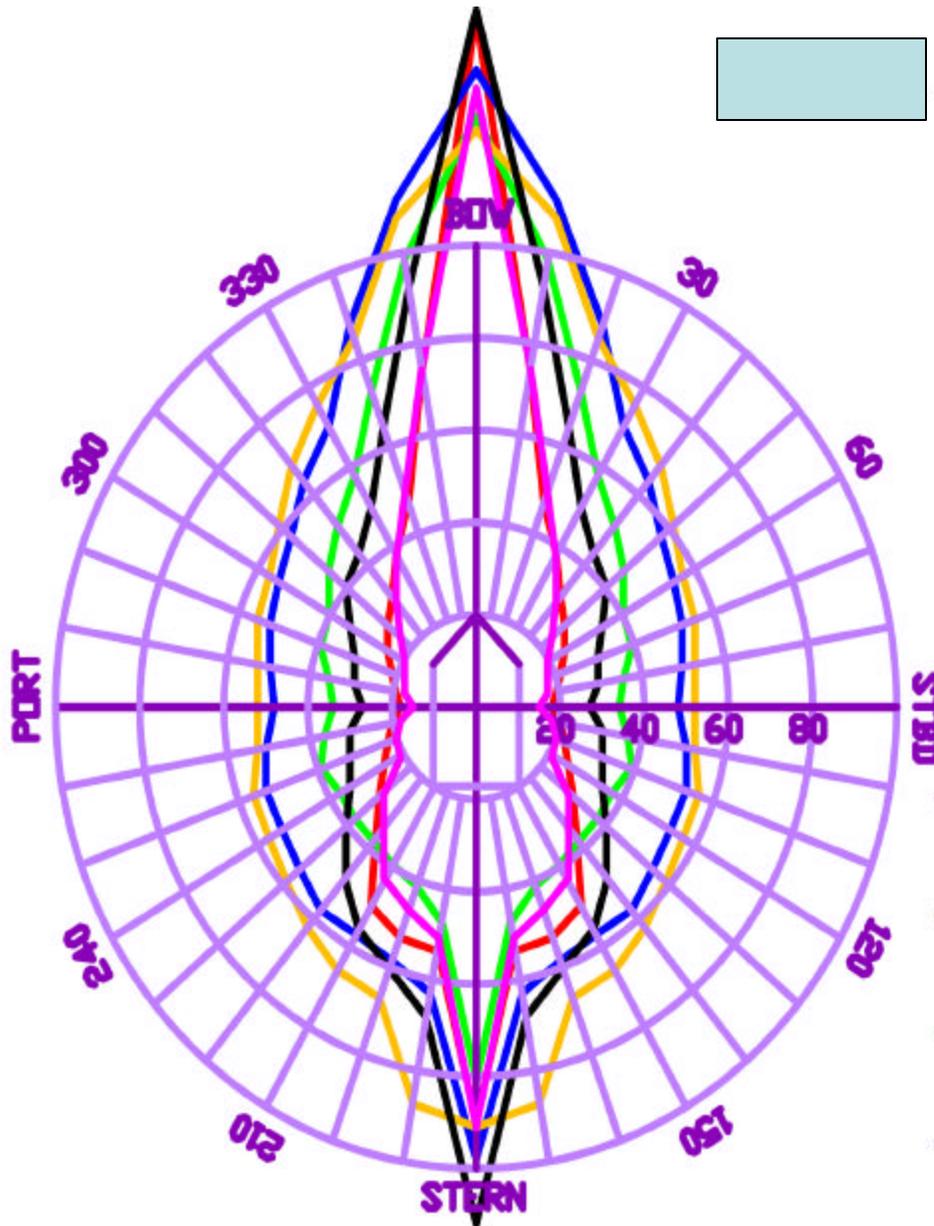
800HP Bow Tunnel

1000 HP Azimuthing

-  Legend
-  Ewing As Is
-  Ewing + Fwd Azimuth
-  Ewing + Azimuth + Aft Tunnel
-  AGOR23 Capability
-  Knorr Capability

DP Capability (0 knot current)

All Options



- Existing
- Becker Rudders
- Bigger BT
- Azimuthing
- Azimuthing + Aft T
- Azimuthing ONLY

DP Capability (2 knot current)

All Options

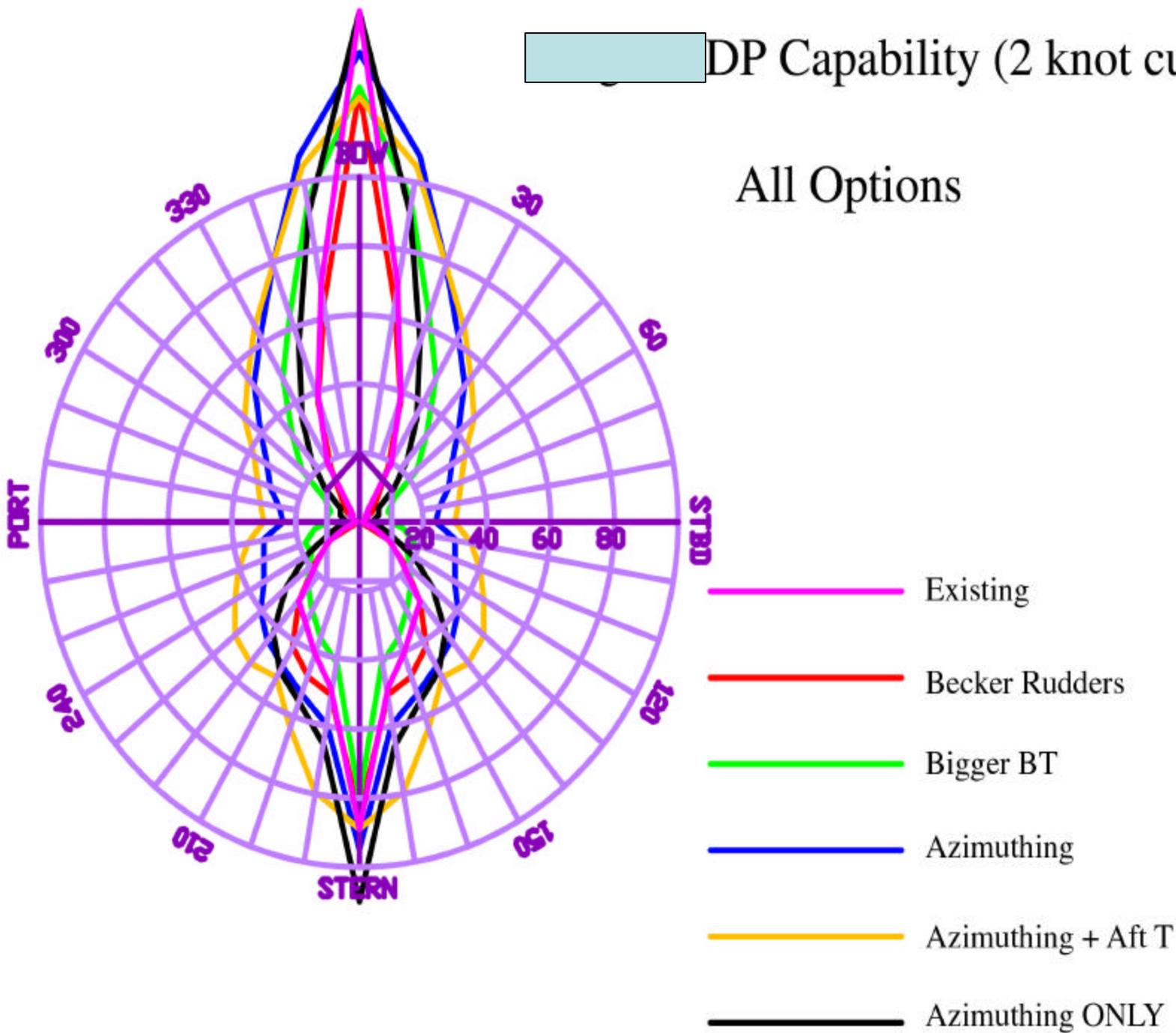
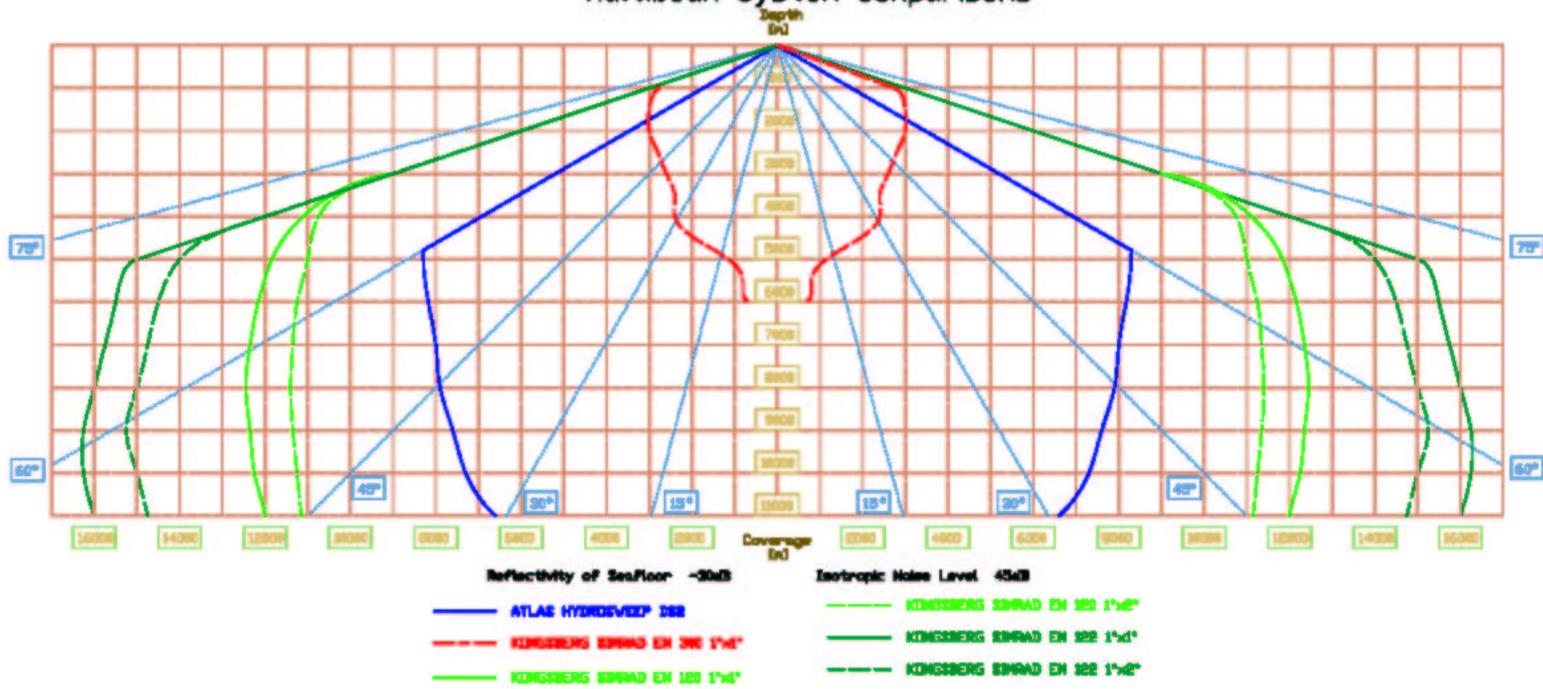
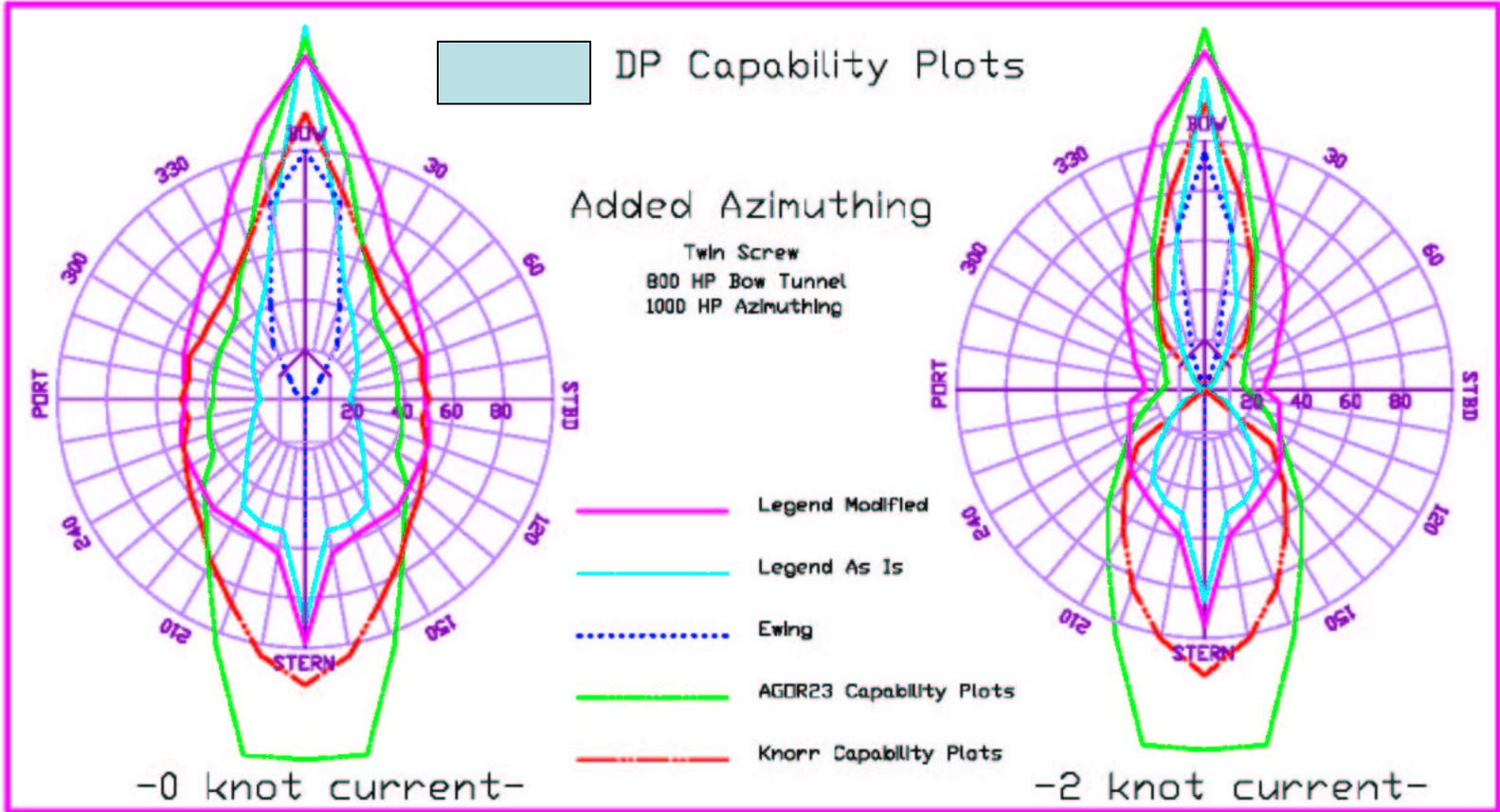


TABLE XX  
Multibeam System Comparisons





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Acquisition of the *Western Legend* is a unique opportunity to revolutionize the international academic community's capabilities for observational marine geophysics.