Station Keeping Criteria for Dynamically Positioned Vessels

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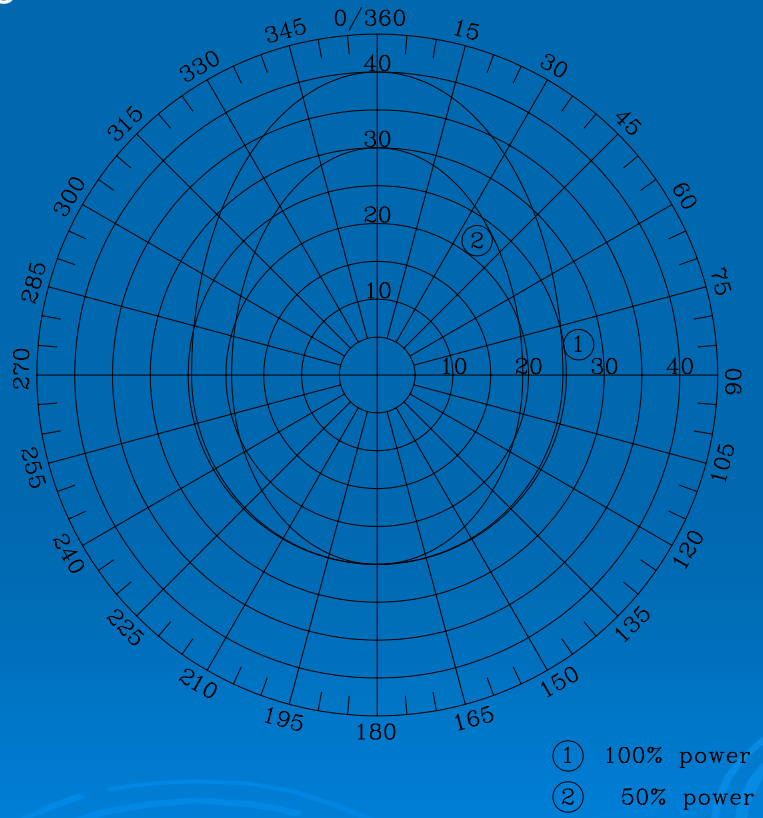
Capability Plot

Wind Speed in Knots, 1 minute mean

Current speed, rotating, 1.5 knots



Capability Plot
Data to be required:

- Wind forces acting from various directions
- Wave drift forces acting from various directions
- Current drag forces acting from various directions
- Propeller, rudder and thruster efficiency

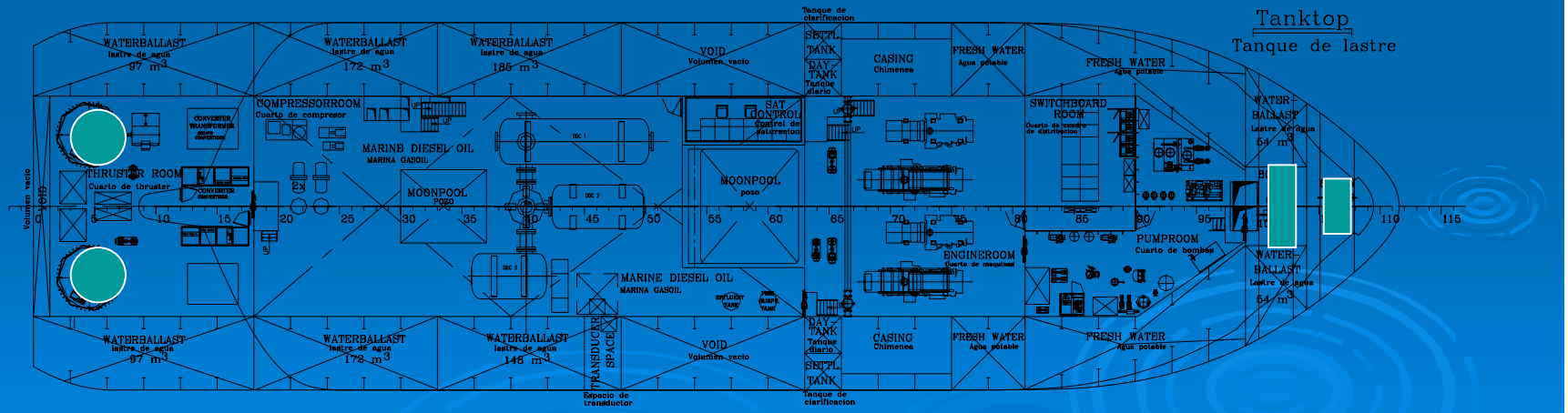
One of the first vessels to obtain an ERN notation

Det Norske Veritas ERN

- Considers Environmental forces, Beam on only
- Current speed 1.5 knots
- Wind speed and wave height relation, North Sea
- No thruster efficiency considered
- No restoring forces to be considered
- Method for comparing various vessels with each other

ERN
Example: (99, 99, 99)

- First group 100 % thrust and power
- Second group, most ineffective thruster fails
- Third group, most effective thruster fails



Lloyd's Register PCR Position Capability Rating

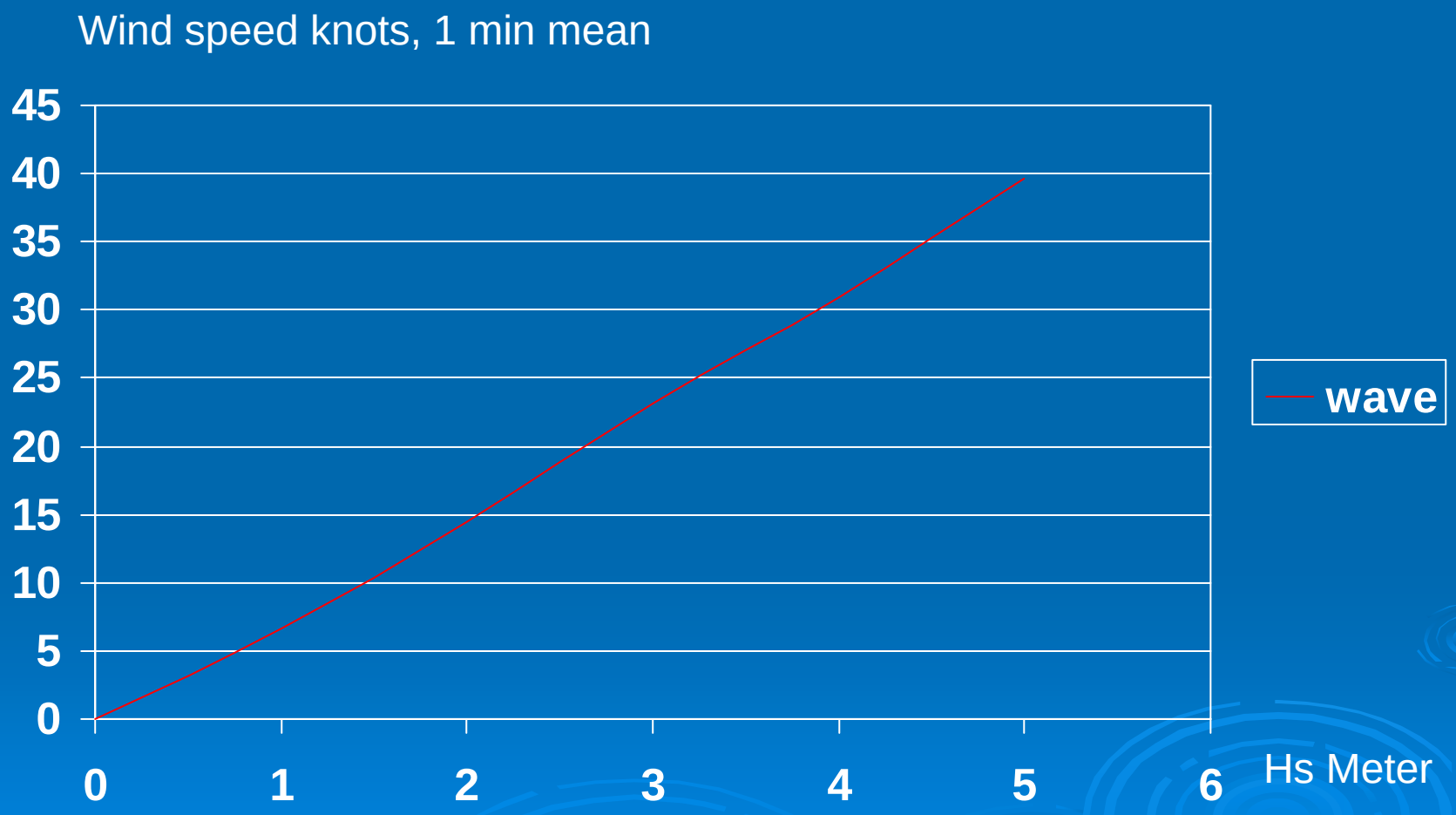
LR PCR

- Environmental Forces to be calculated for every 15º
- Thruster and Hull efficiencies to be considered
- Thruster and Hull interactions to be considered
- Current speed 2 knots
- Restoring forces to be considered

LR PCR
Example: (97, 78)

- First group, 100 % thrust and power
- Second group, most effective thruster off
- The digits refer to the amount of time the vessel can maintain position in a fully developed North Sea wind / wave spectra

Wave Height and Wind Speed



North Sea

Joint Frequency table significant wave height (m) and Zero Crossing Period, Tz (s)

Significant Waveheight (m)	0 4	4 5	5 6	6 7	7 8	8 9	9 10	10 11	11 12	12 13	Sum
9 - 10							1				1
8 - 9						1	0	2	1		4
7 - 8					1	3	4	3	0		11
6 - 7					1	5	6	5	1		18
5 - 6				4	9	15	12	3	0		43
4 - 5			1	10	29	40	17	4	1		102
3 - 4			8	37	70	57	15	3	1		191
2 - 3		2	18	109	97	41	11	3			281
1 - 2	1	8	59	131	46	23	5	1			274
0 - 1		7	17	26	11	6	2	1			70
Sum	1	17	103	317	264	191	73	25	4	0	995

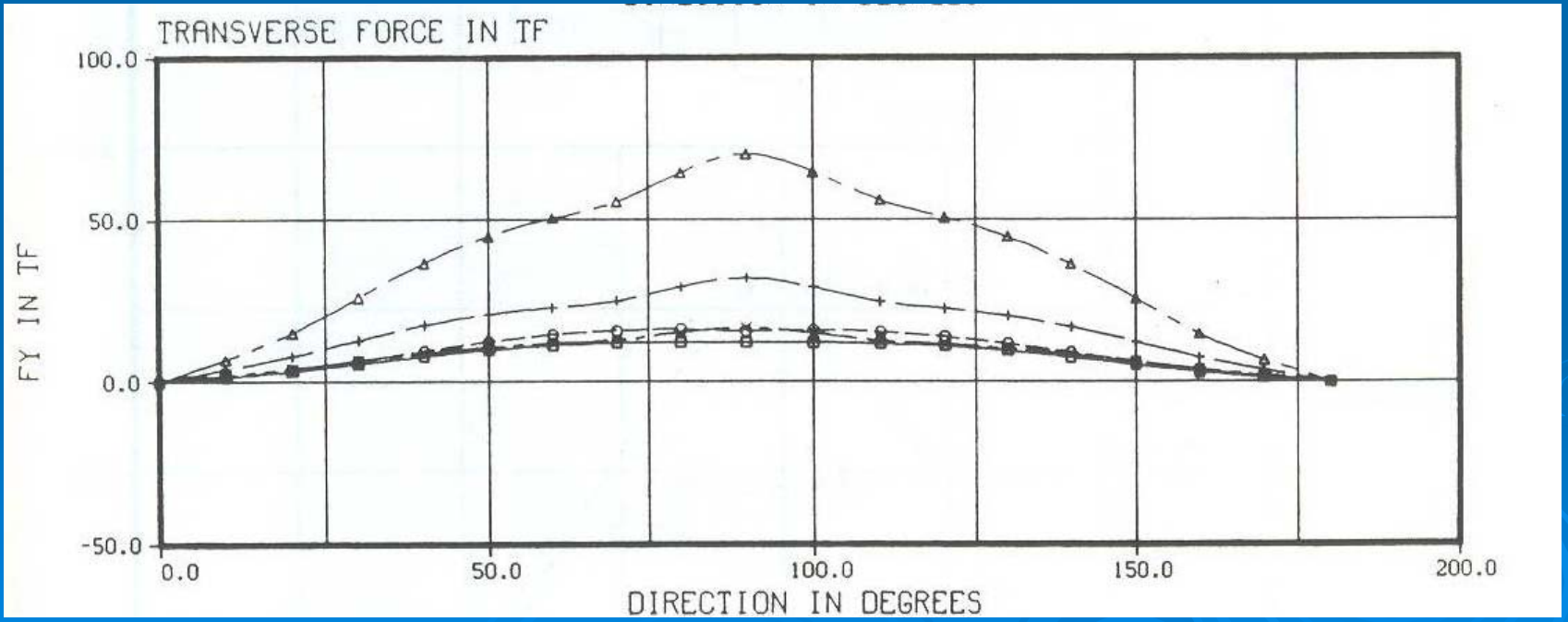
Mexican Gulf

Joint Frequency table significant wave height (m) and Zero Crossing Period, Tz (s)

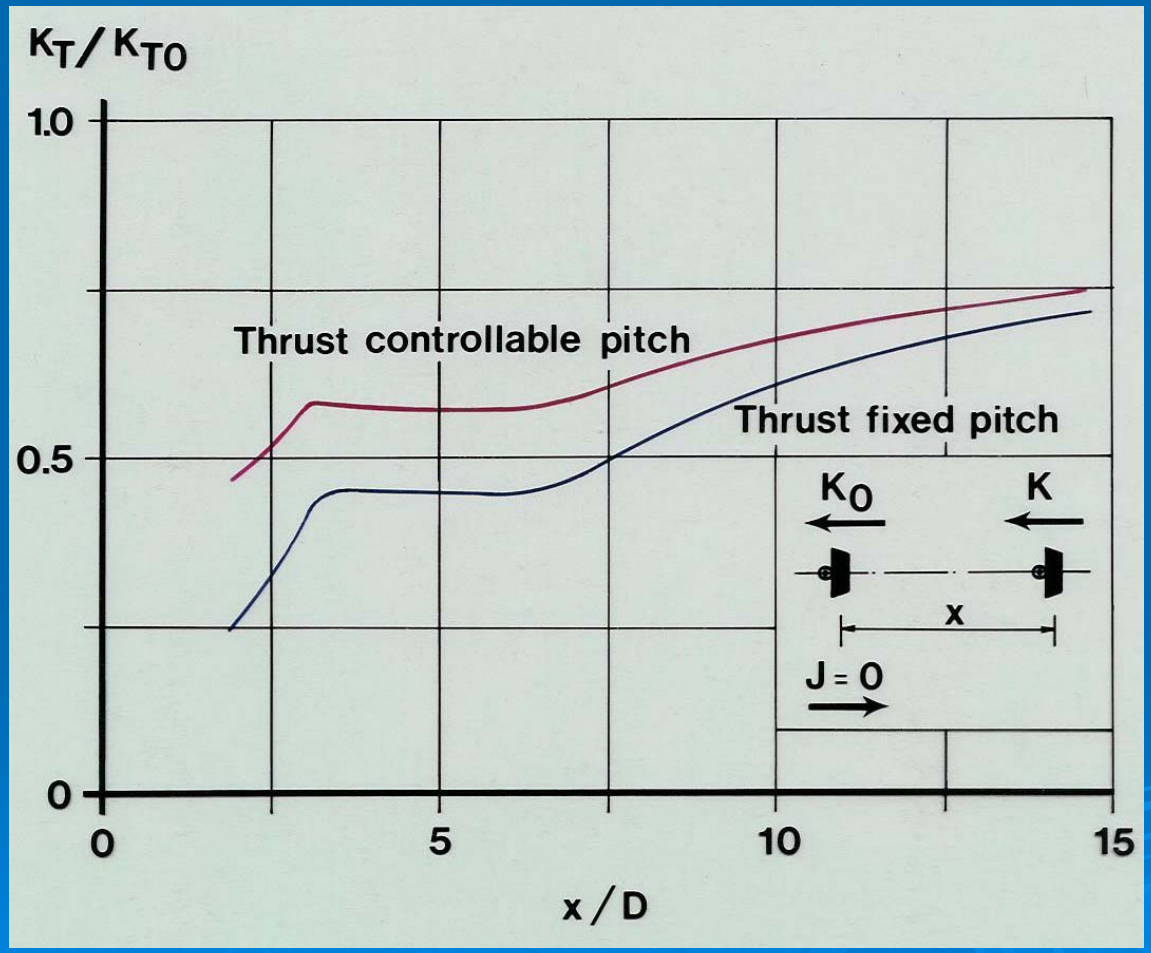
ZERO CROSSING PERIOD(s) Tz

Significant Waveheight (m)	0 0	0 4	4 5	5 6	6 7	7 8	8 9	9 10	Sum	%
6 - 7					1				1	0.1
5 - 6				1	1	1			3	0.4
4 - 5			2	4	3	1			10	1.4
3 - 4		1	8	14	9	4	1		37	5.1
2 - 3		7	38	50	28	9	2		134	18.5
1 - 2		42	140	129	53	13	3		380	56.4
0 - 1		135	182	91	23	4	1		436	100.0
Sum	0	185	370	289	118	32	7	0	1 001	

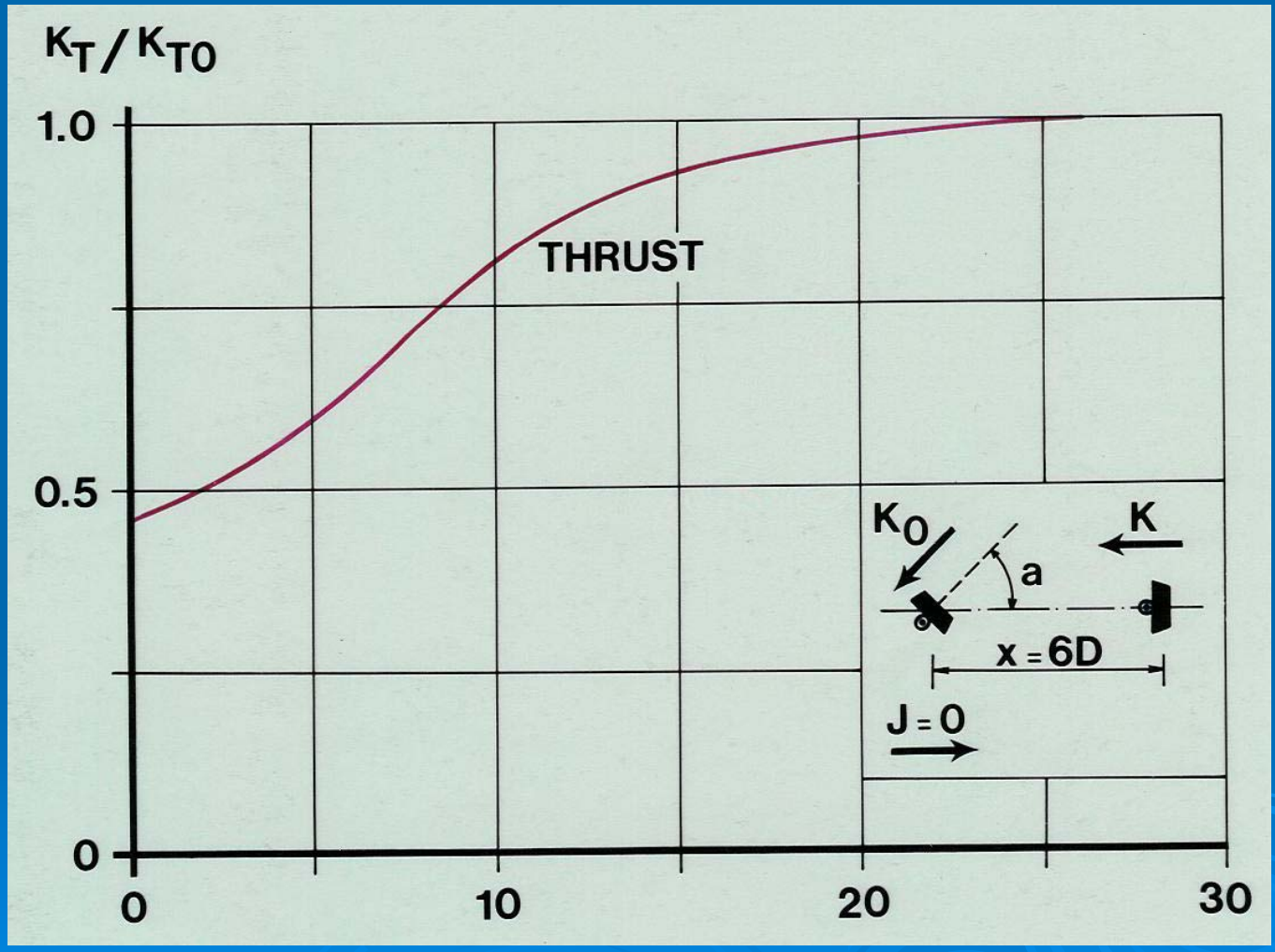
Waves Hs = 4 M, 6 seconds
Waves Hs = 4 M, 8 seconds
Waves Hs = 4 M, 10 seconds
Wind speed 15 meter/second
Current speed 1.5 knots



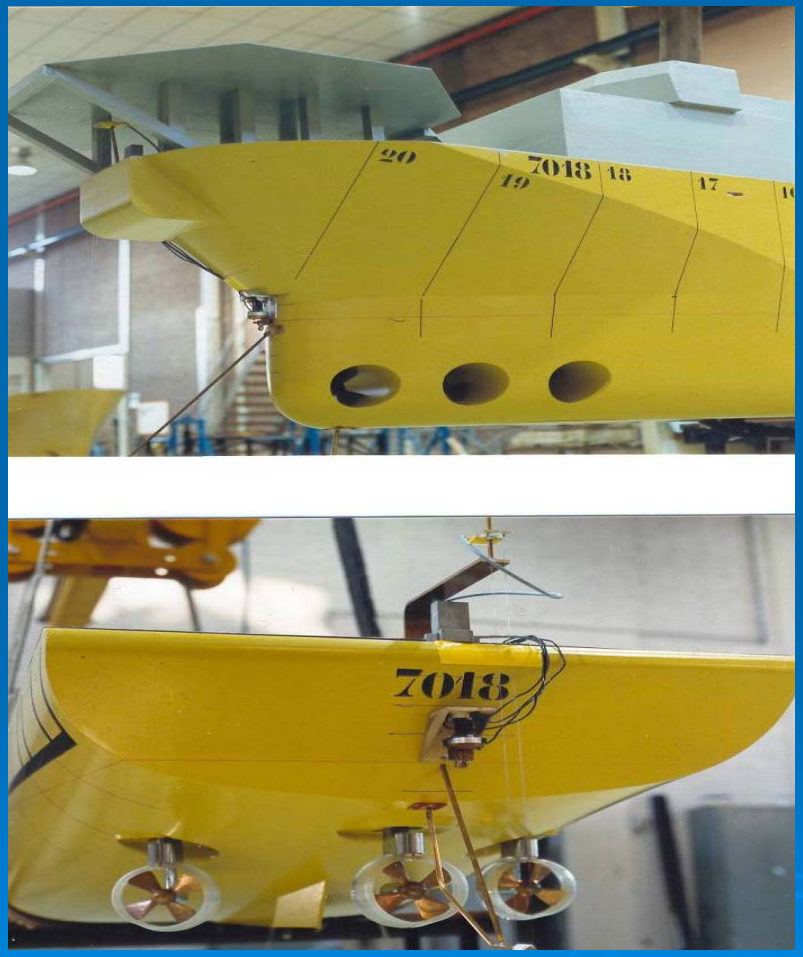
Thruster Efficiency



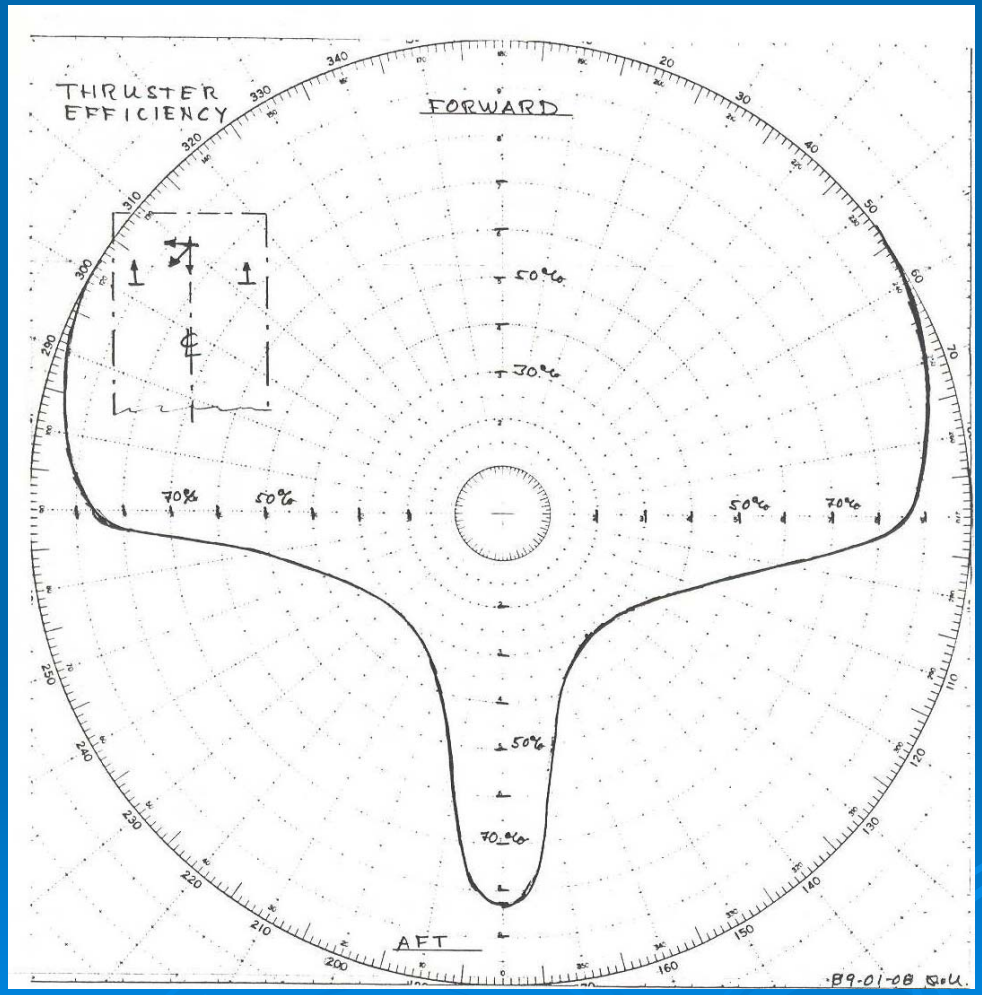
Thruster Efficiency



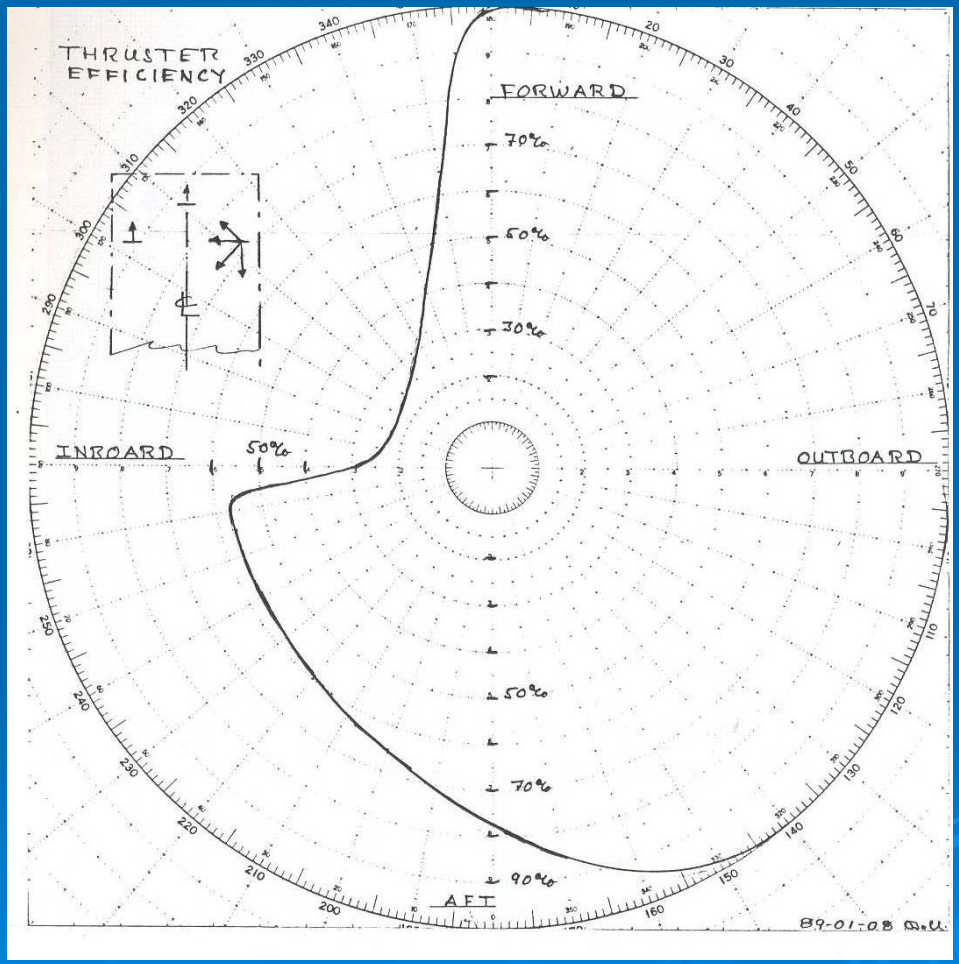
Typical Three thruster configuration forward and aft



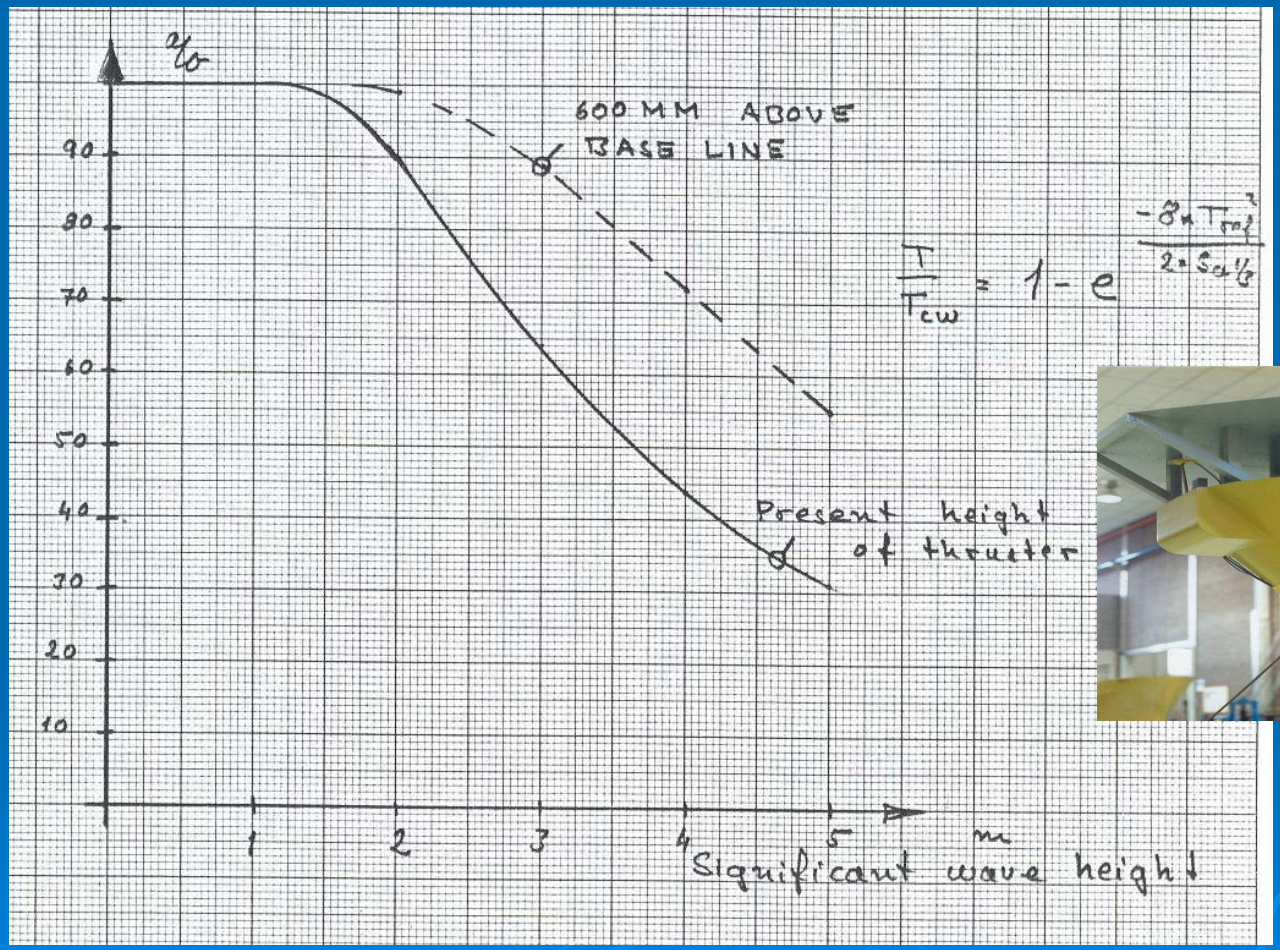
Efficiency of centre thruster aft

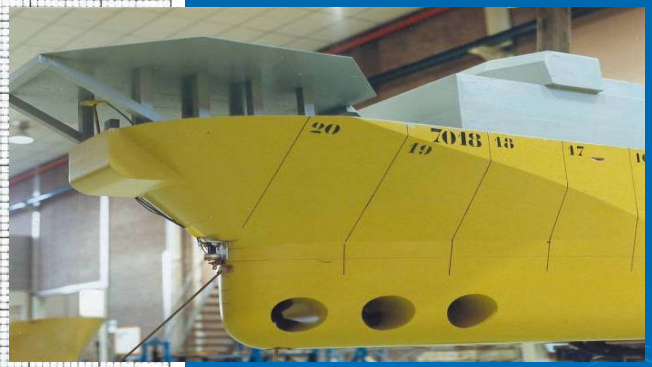


Efficiency of PS thruster aft



Efficiency of Tunnel thruster Forward





Full scale Measurements

Nominal thrust and Power

- Azimuthing thruster with Nozzle:

  0.0163 Tonnes/kW

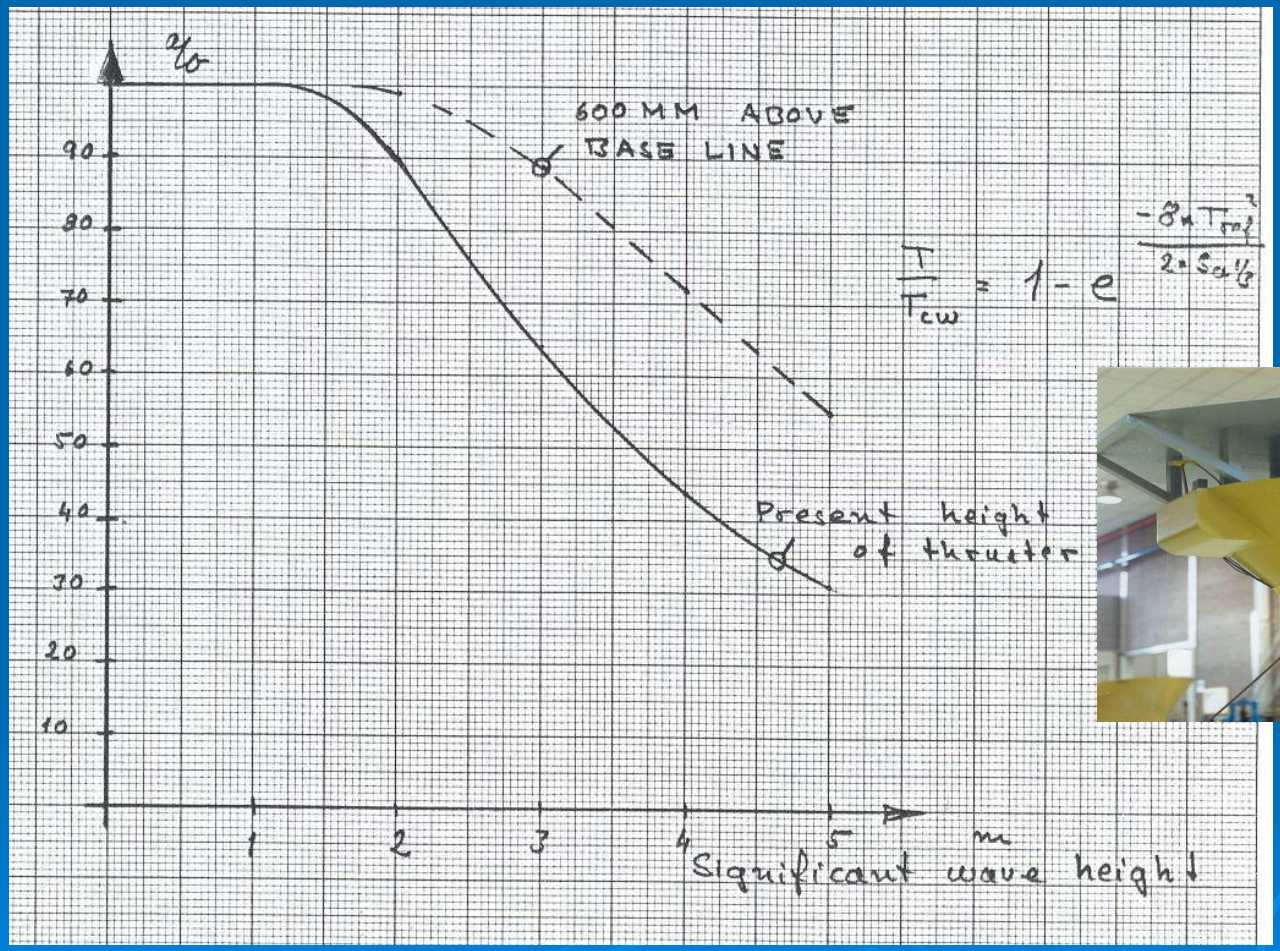
- Tunnel Thruster, short Tunnel:

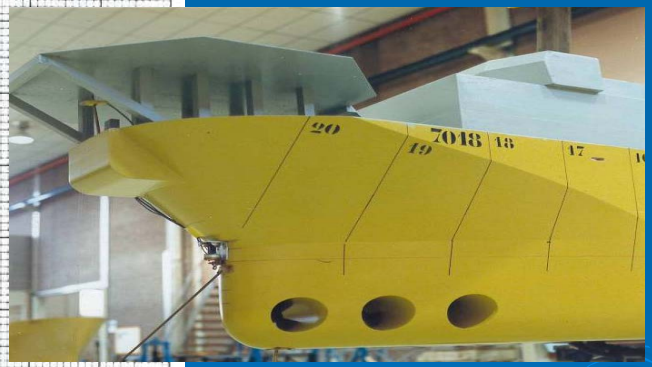
  0.0134 Tonnes/kW

- Tunnel Thruster, long Tunnel:

  0.0121 Tonnes/kW

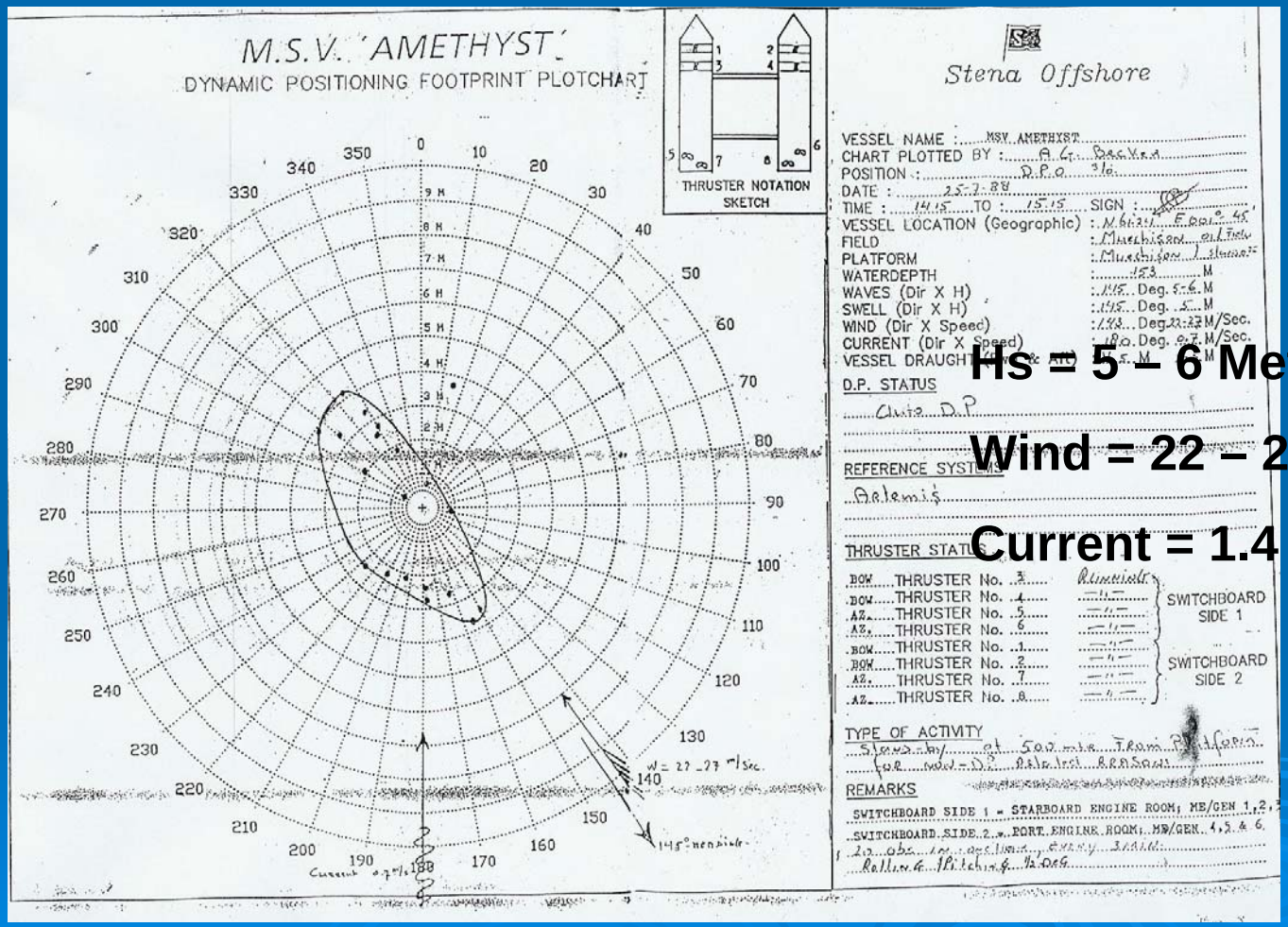
Efficiency of Tunnel thruster Forward





MSV Amethyst

“Proof of the pudding”



Hs = 5 – 6 Meters

Wind = 22 – 27 m/sec

Current = 1.4 knots

Summary

- Difficult to compare various DP vessels on a “fair” basis
- DNV and LR have both completely different methods of calculating the station keeping capability
- Commercial aspects often “confuse” the picture when presenting the DP capability

Proposal

- Test the DP vessel by making speed transverse in calm water

- Use conditions

  100 % Power / Thrust

  50 % Power / Thrust

- Speed should be > 2 knots
- Heading accuracy < ± 3º

  (80 M vessel, bow will sway with ± 2.1 M)

Deepwater 2 (Rockwater 2)

Sea Spider, made over 4 knots transverse speed during DP Trials

Thank you for your attention