Voith Turbo

VOITH

Enhanced Comfort of Ferries driven by Voith Schneider Propeller

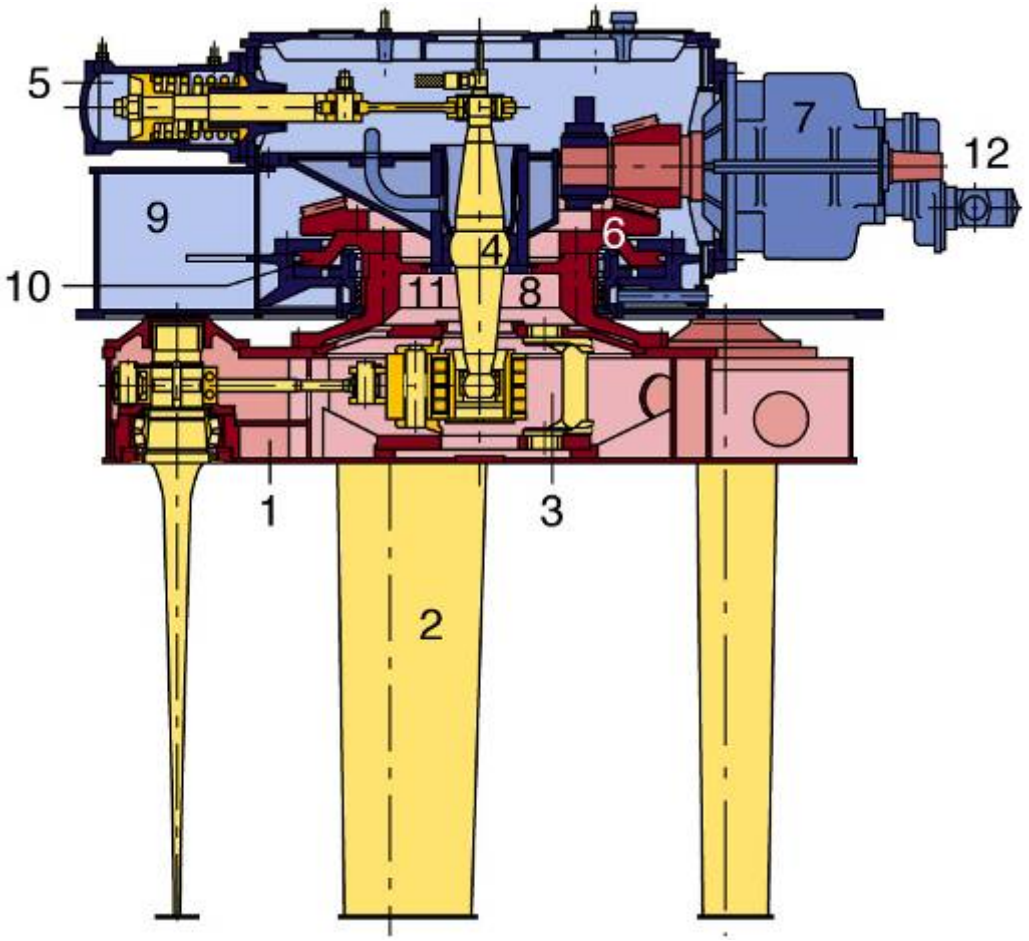
Dirk Jürgens, Double ended ferries, 2007-05-07, Bergen, Norway

Topics

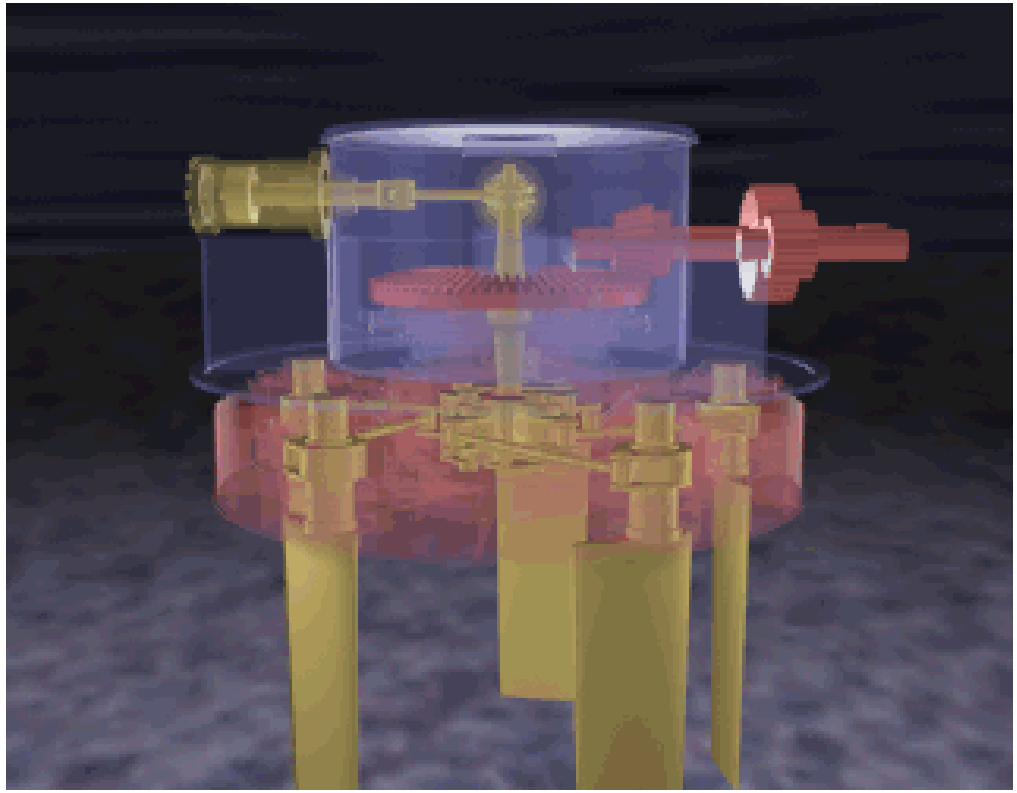
- Technical principle of the Voith Schneider Propeller (VSP)
- Voith Roll Stabilisation (VRS)
- Slamming loads for Vessels with VSP
- Engineering for improving comfort on board
- Conclusion

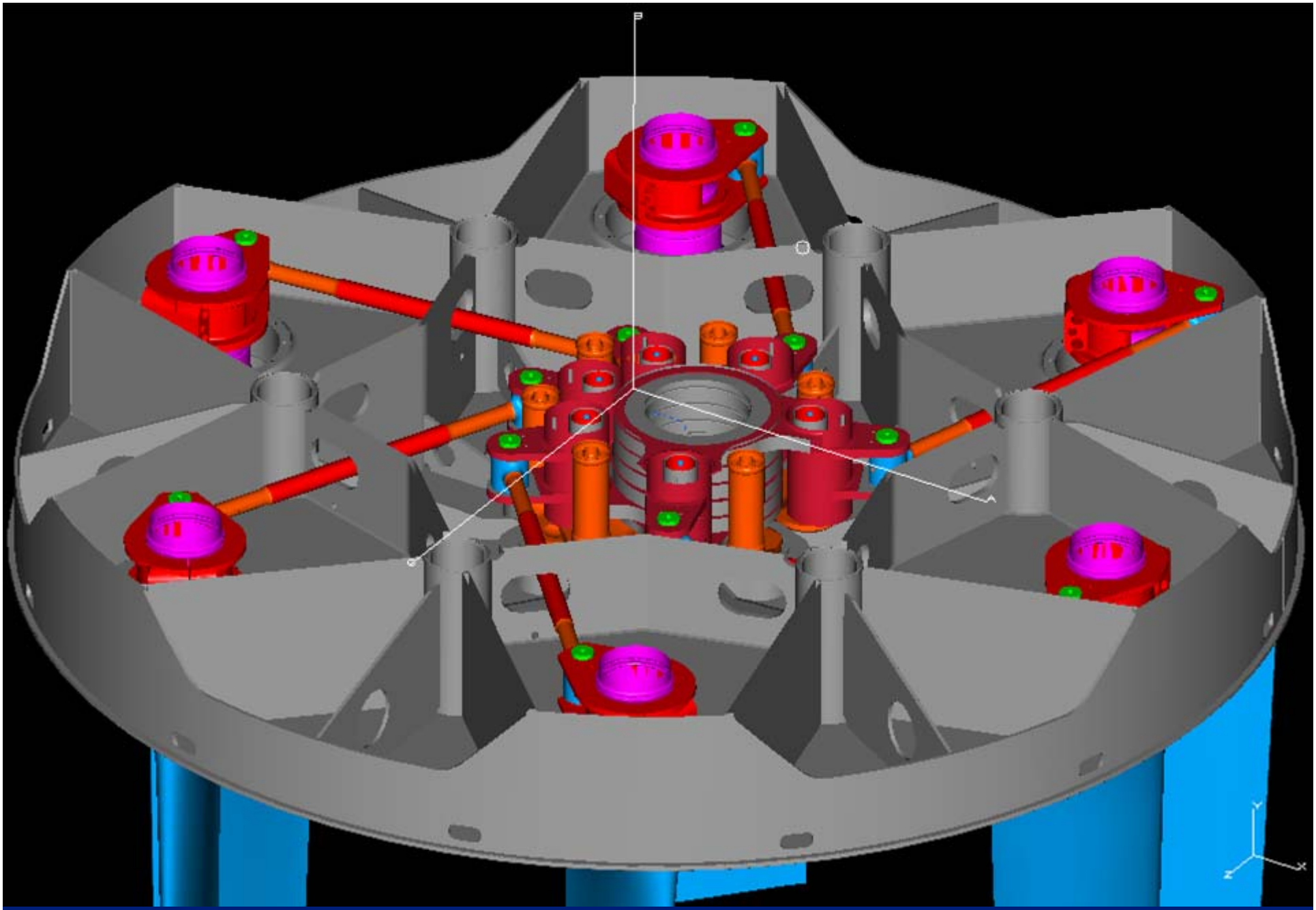
Voith Schneider Propeller

1 rotor casing
2 blade
3 cinematic
4 control rod
5 servomotor
6 bevel gear
7 reduction gear
8 driving sleeve
9 propeller housing
10 thrust plate
11 roller bearing
12 gear pump

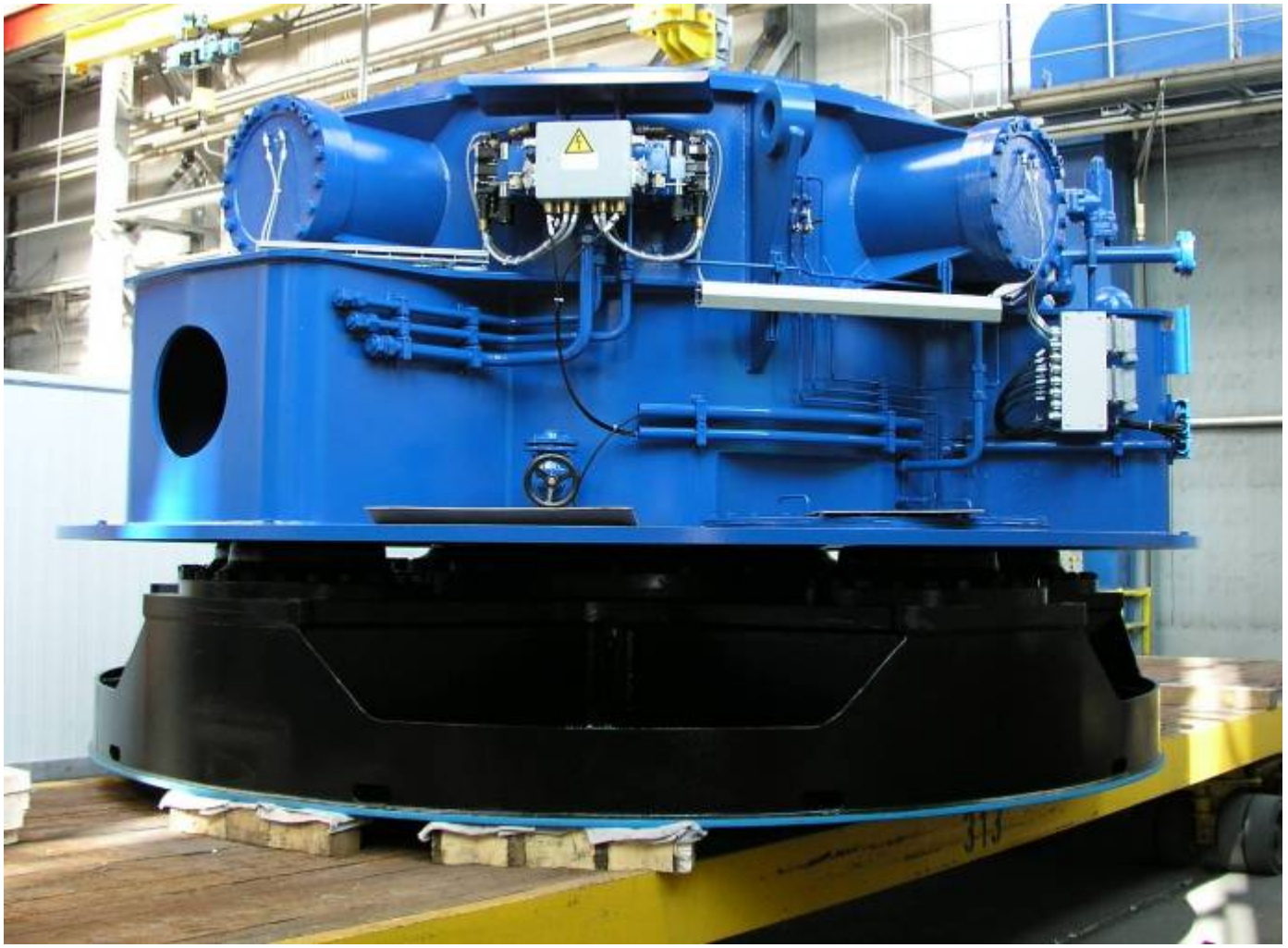


VOITH SCHNEIDER PROPELLER (VSP)




VOITH

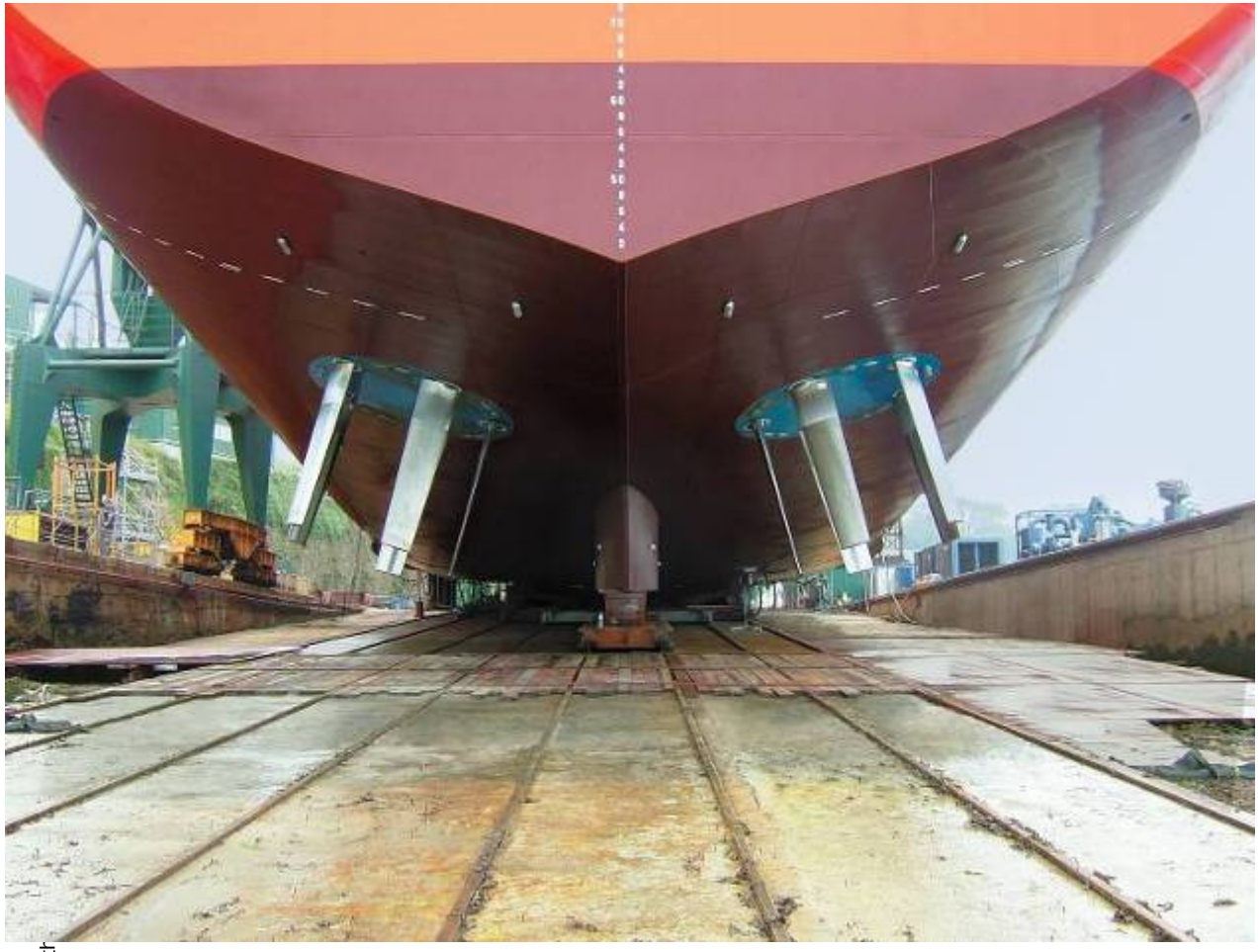
➢VSP Type 32 R5 EC/300-2
VSP HARDANGER

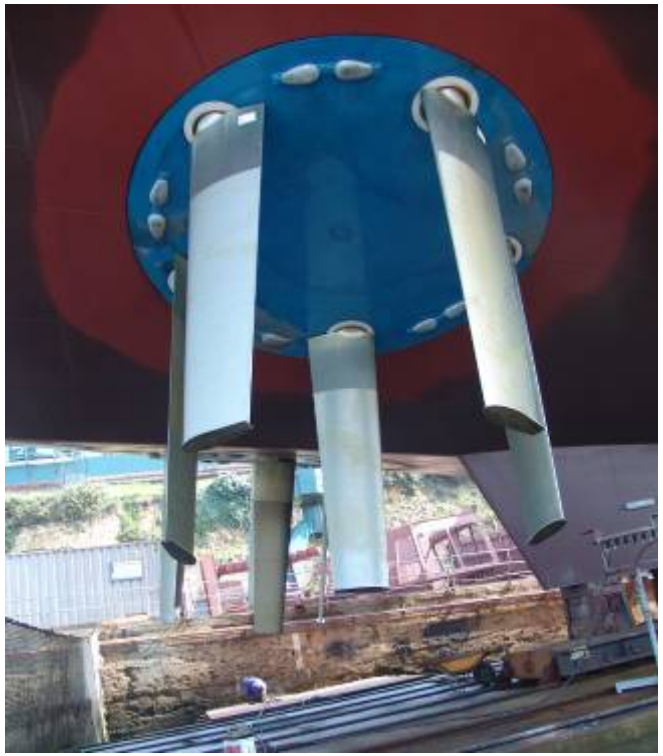


VSP Type 32 R5 EC/300-2
VSP HARDANGER -blade

Voith Turbo

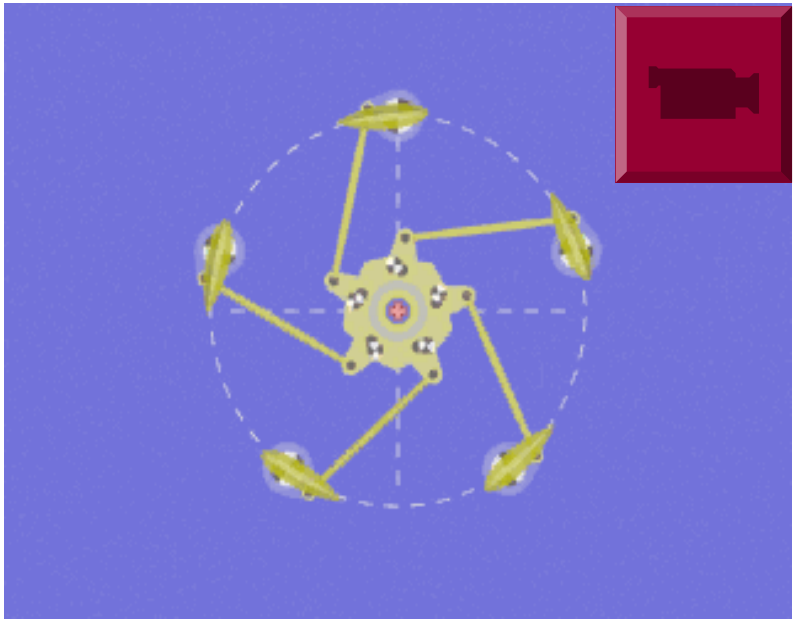
VSP Type 32 R5 EC/300-2
VSP HARDANGER -blade

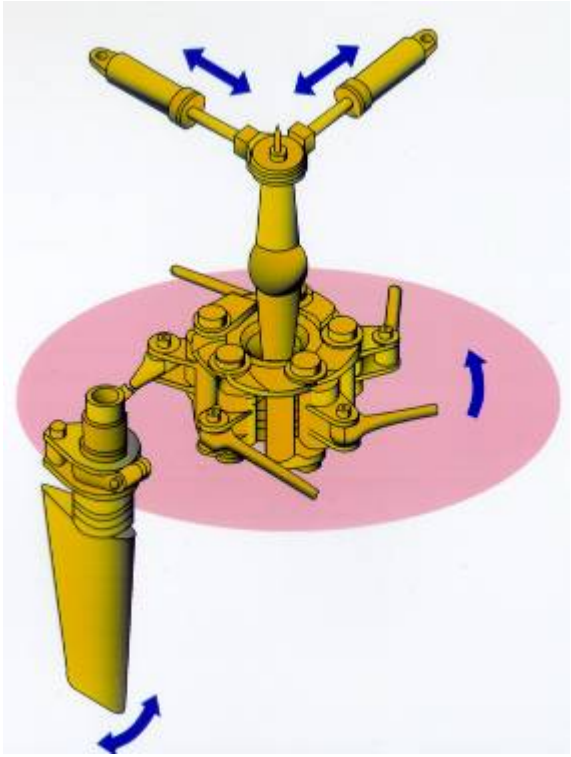




CYCLOIDAL PROPULSOR

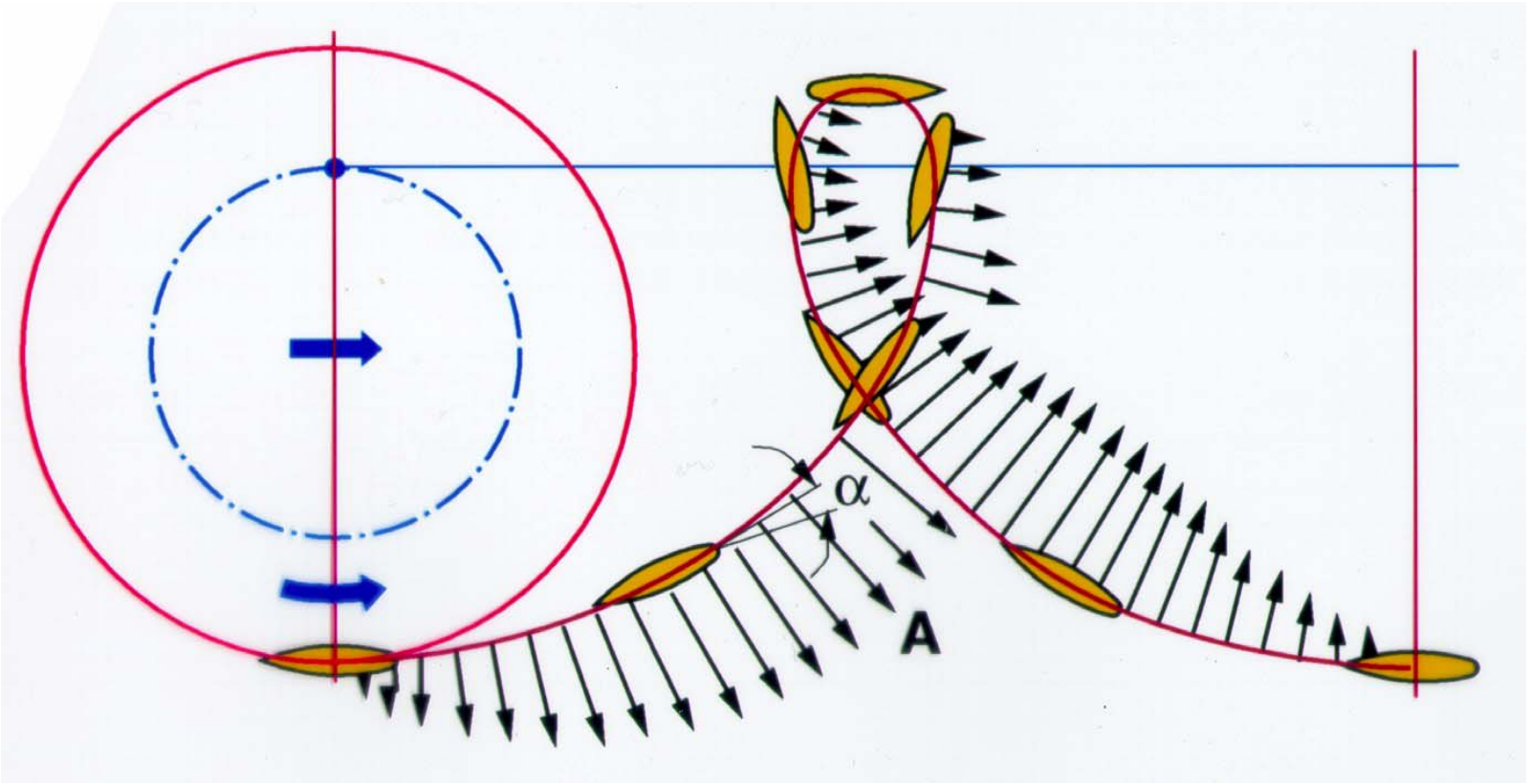
KINEMATICAL PRINCIPLE





CYCLOIDAL PROPULSOR

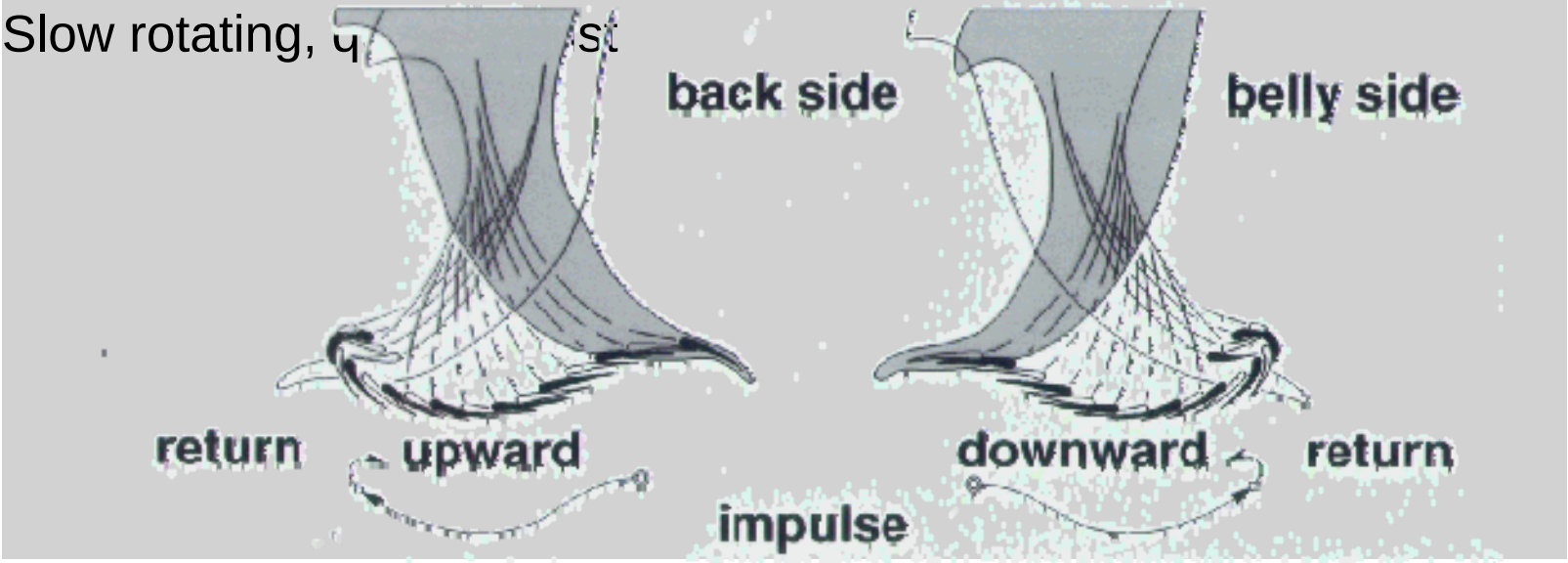
LIFT FORCE DURING CYCLOIDAL PATH OF A BLADE



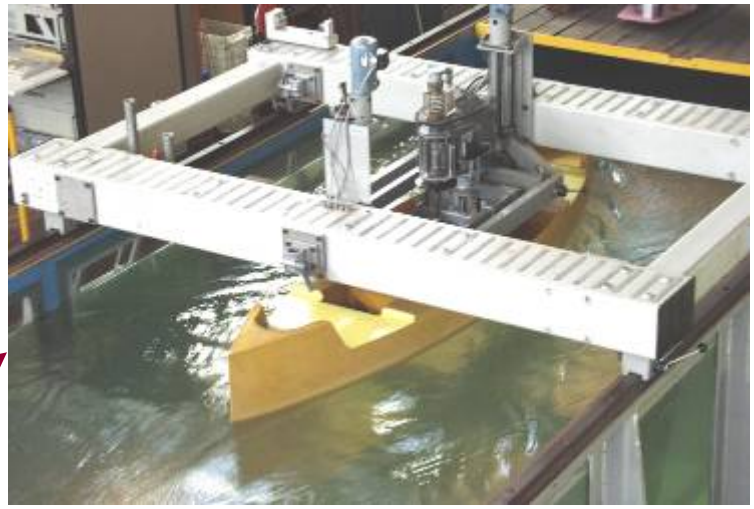
Cycloidal Propulsion

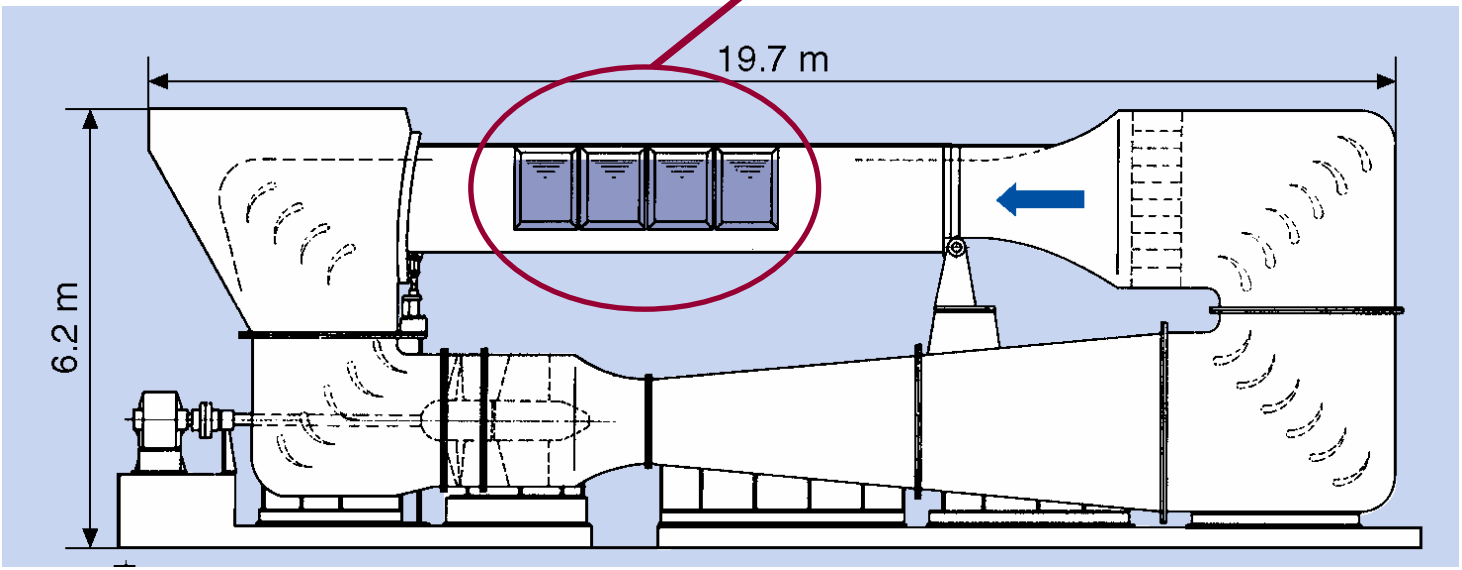
Modeled on Nature

Steering and propulsion combined
Control of thrust direction and magnitude steppless
Blades not twisted, zero thrust
Slow rotating, q st



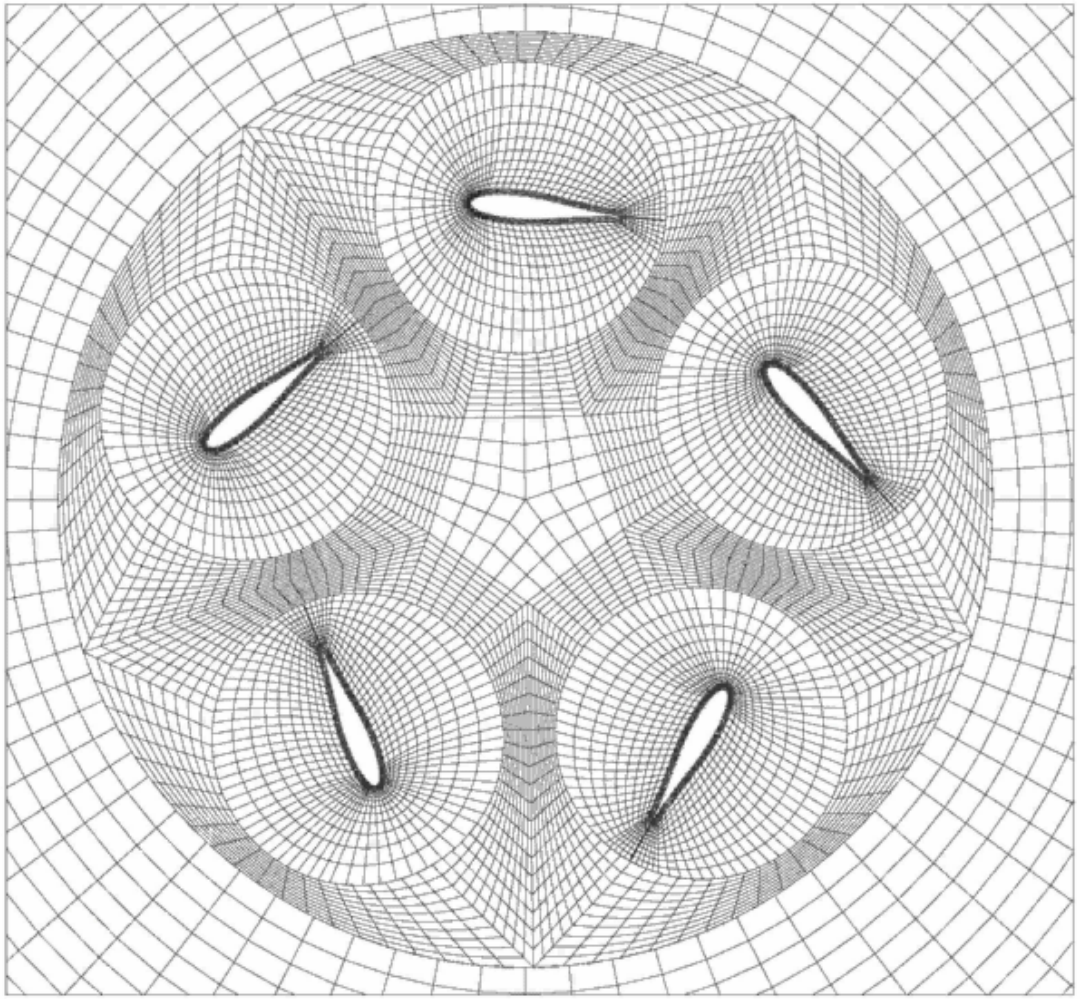
Voith Circulation Tank





Tools for VSP-Enhancement: CFD

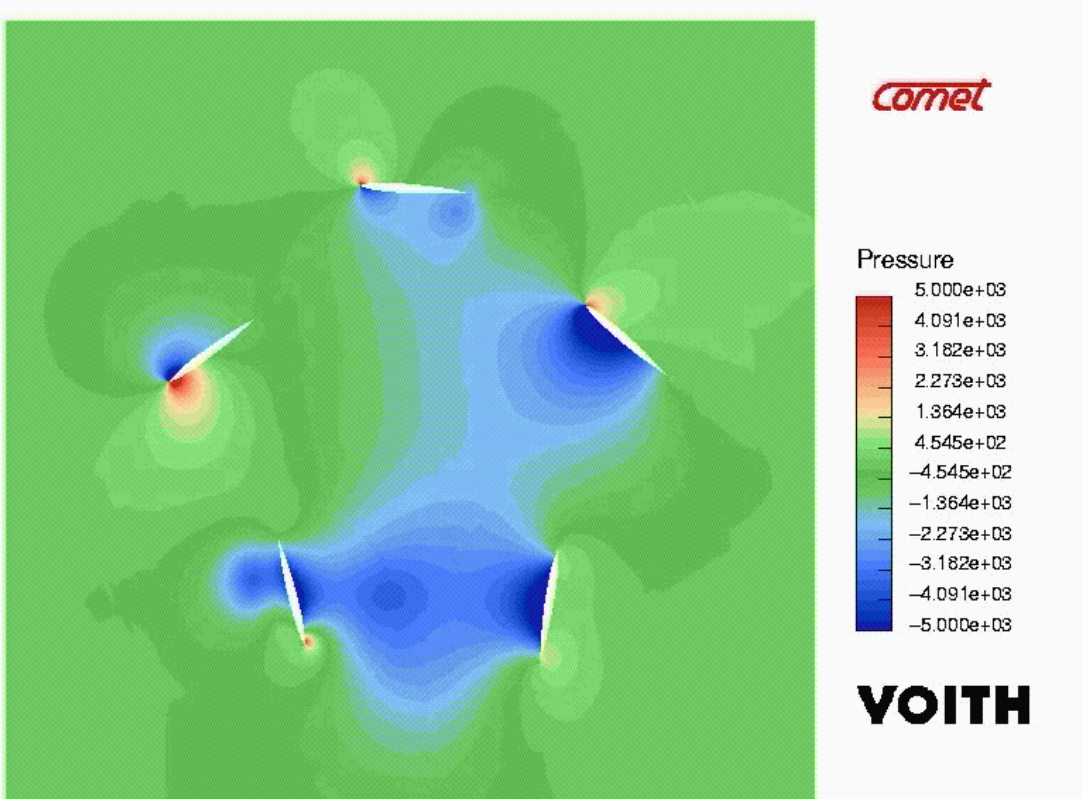
Voith Turbo



Research and Development

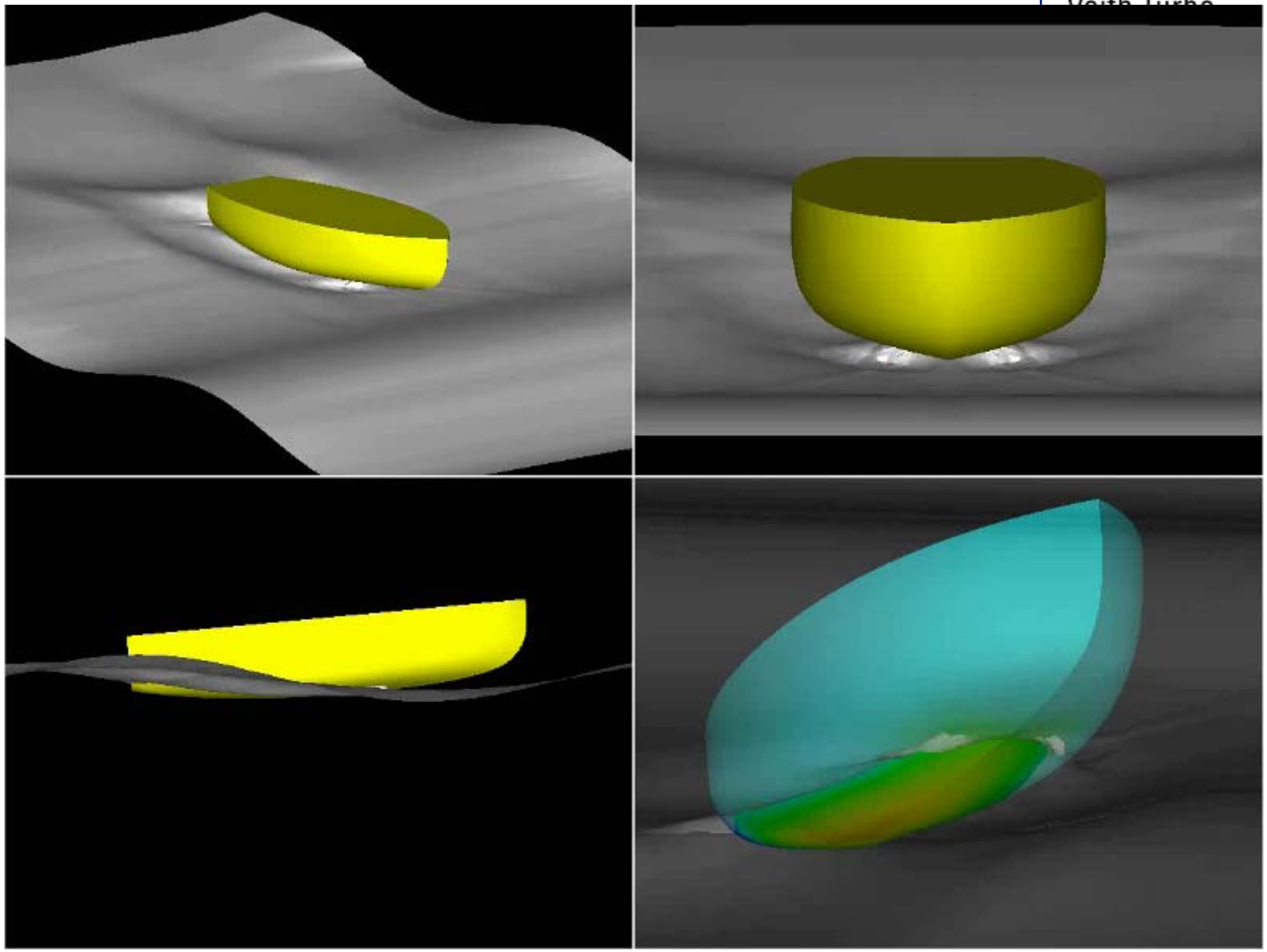
CFD-Calculation results

Thrust



Blade - Rotor - Channel

Water – Hull Interaction



resistance prediction

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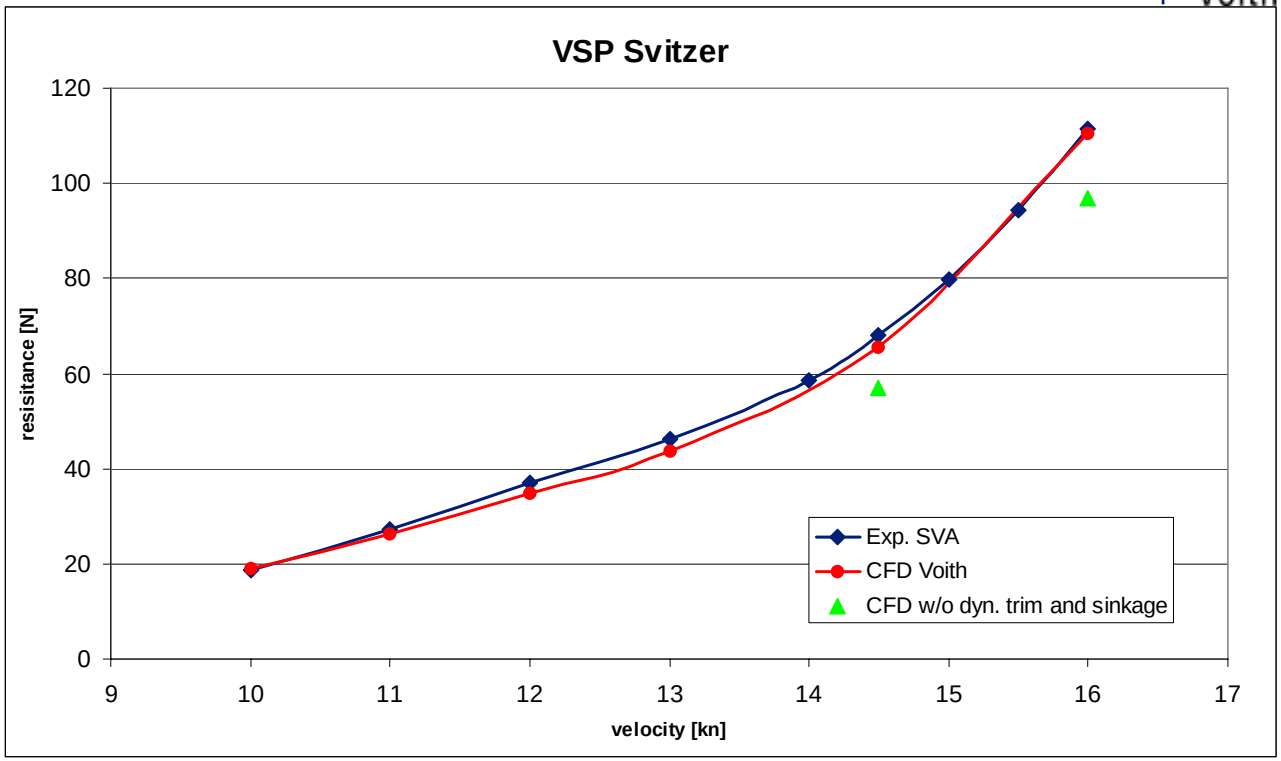
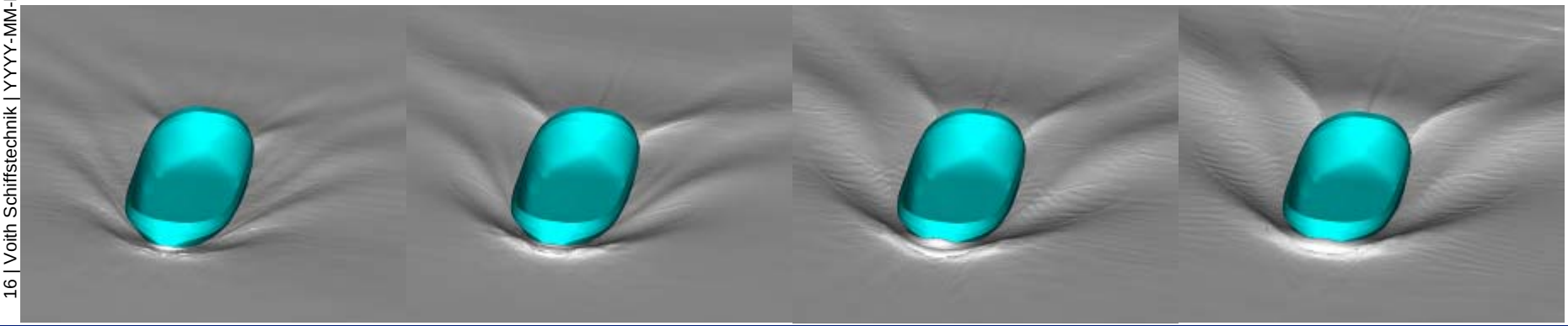


10kn 12kn 14.5kn 16kn



VOITH

VWT, DOUBLE-ENDED FERRIES, MINE HUNTERS

Topics

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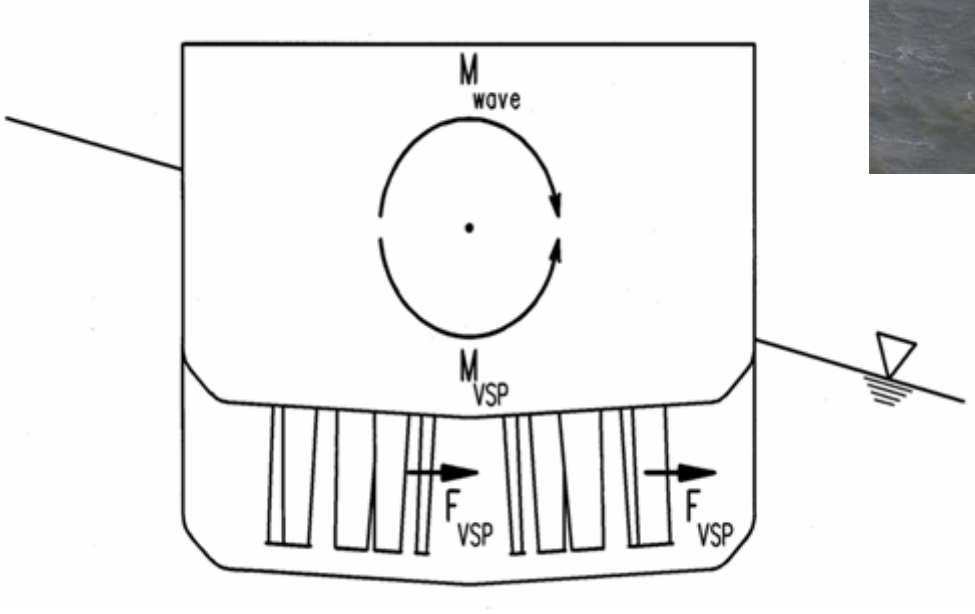
Voith Roll Stabilisation (VRS)



Voith Roll Stabilisation (VRS) - Mode

Full scale Test - North Sea: Norderney

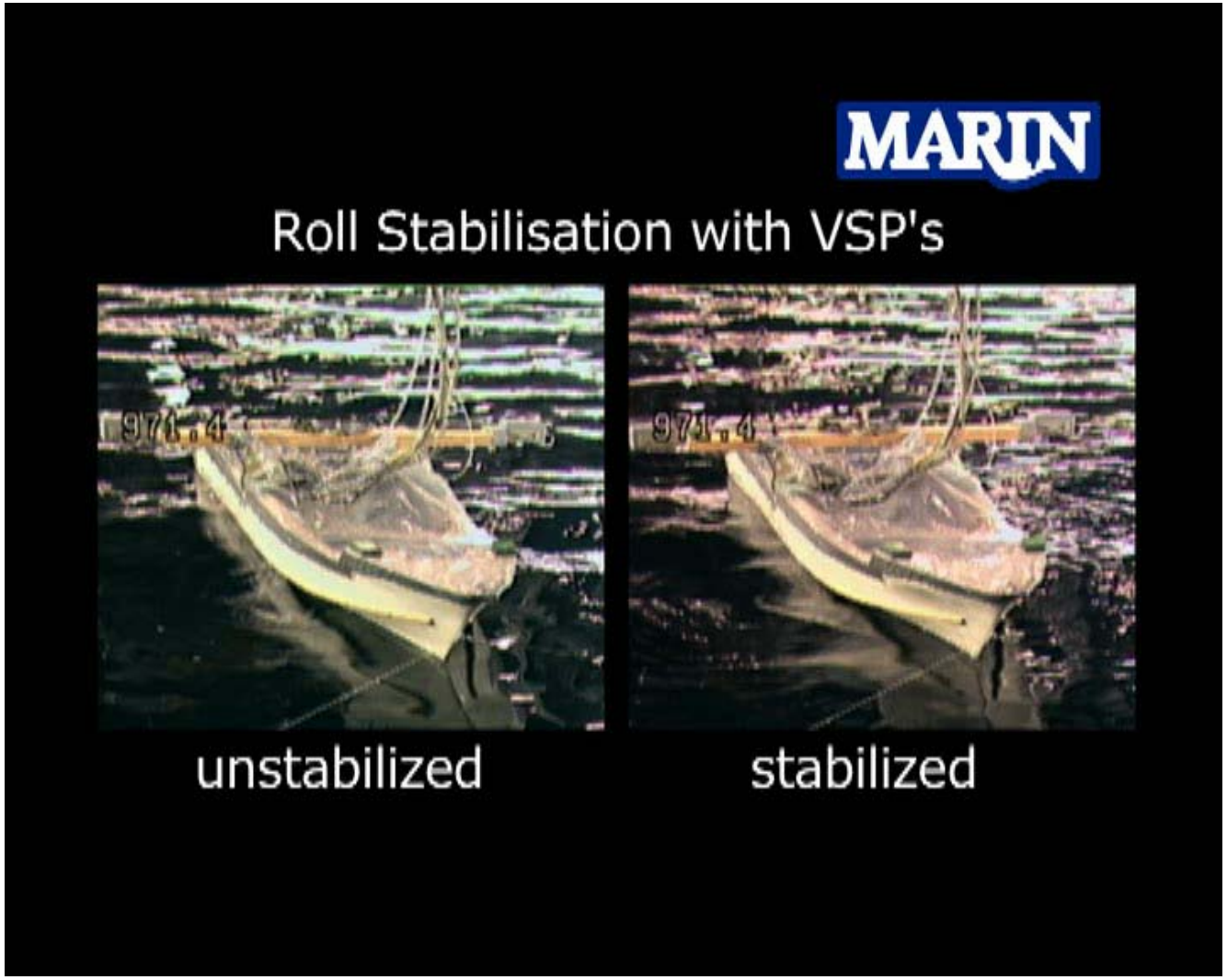
Voith Roll Stabilisation (VRS) - Mode

Voith Turbo

Full scale Test - North Sea: Norderney

Rollstabilisierungstests (VRS), Time in full scale, Hs = 0.75 m

Voith Turbo



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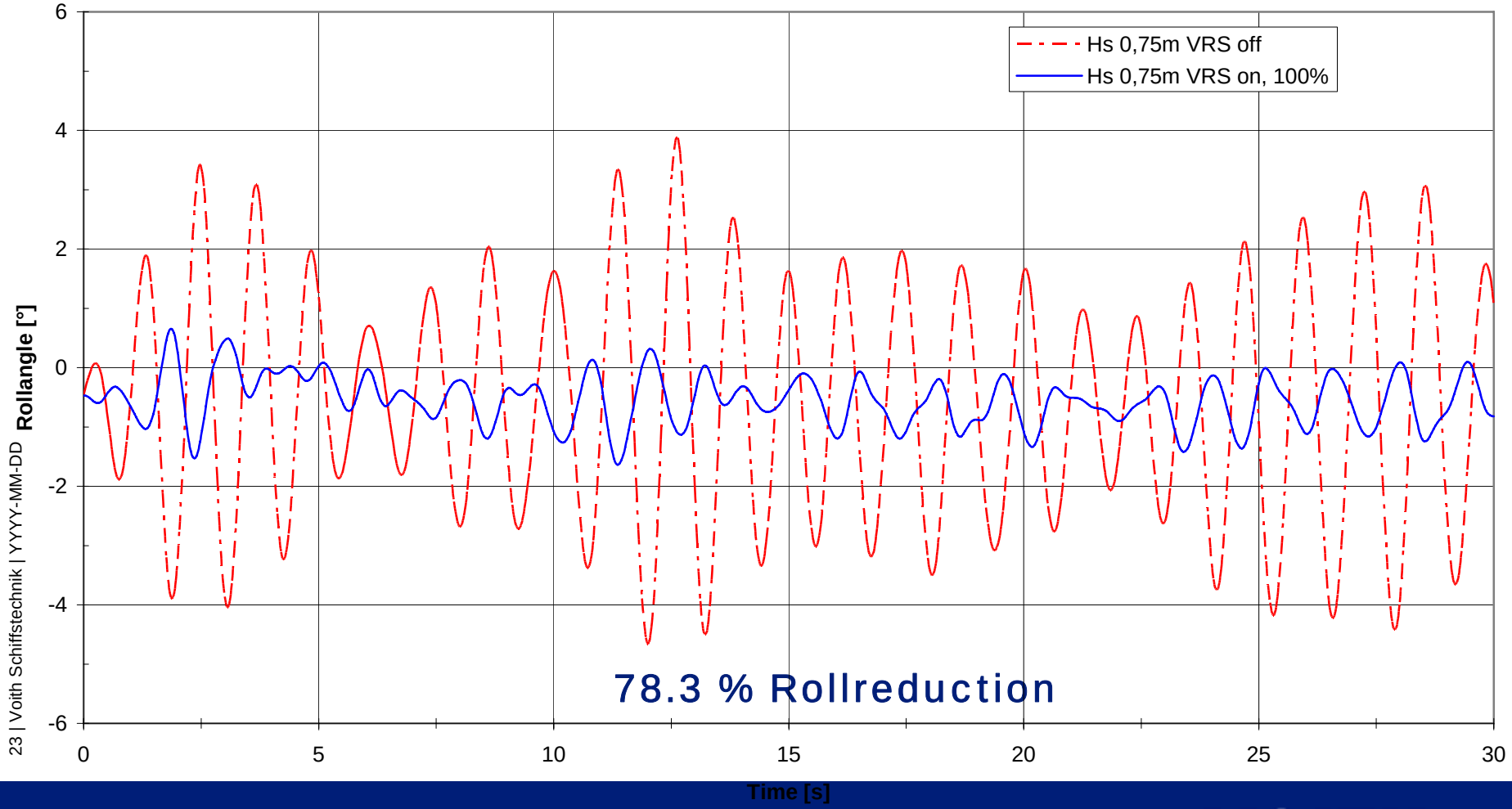
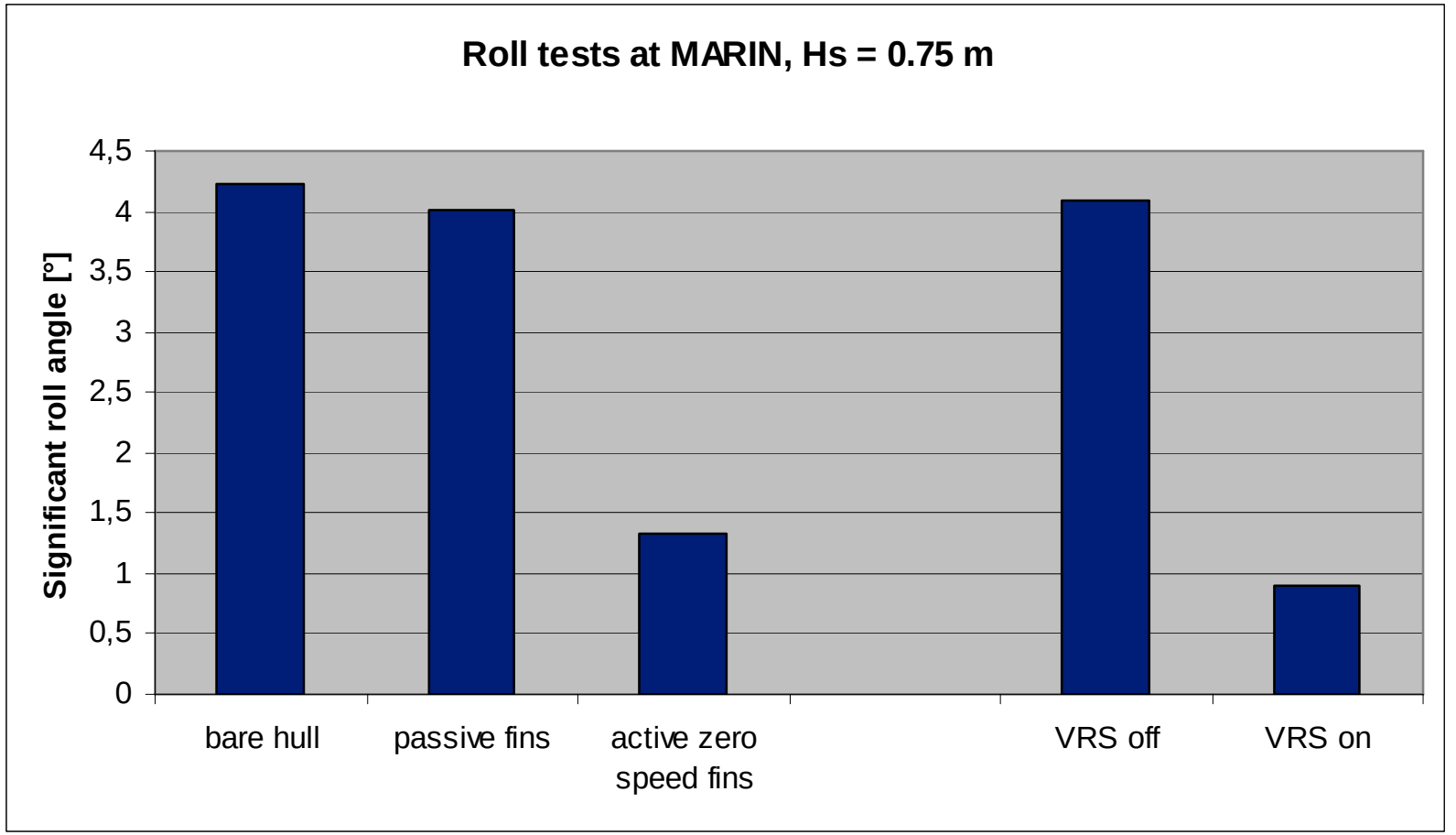
Rollstabilisierungstests (VRS)
Hs = 0.75 m

Voith Turbo

Hs 0,75 m; Periode 5.0s; 135° Bowq. seas; VRS on/off

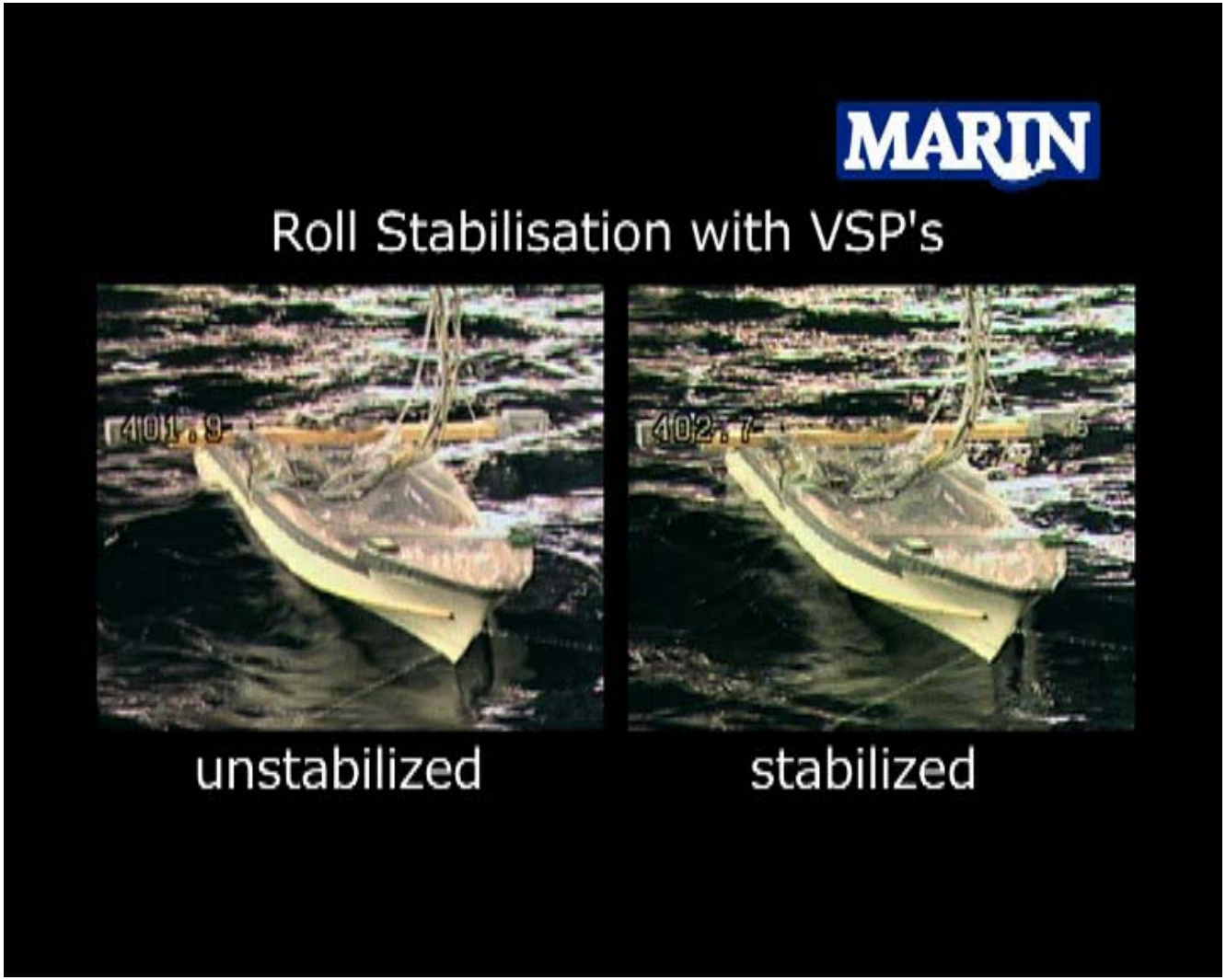


VOITH


Roll tests at MARIN, Hs = 0.75 m
Significant roll angle [°]
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
bare hull
passive fins
active zero speed fins
VRS off
VRS on

Rollstabilisierungstests (VRS), Time in full scale, Hs = 1.5 m

Voith Turbo

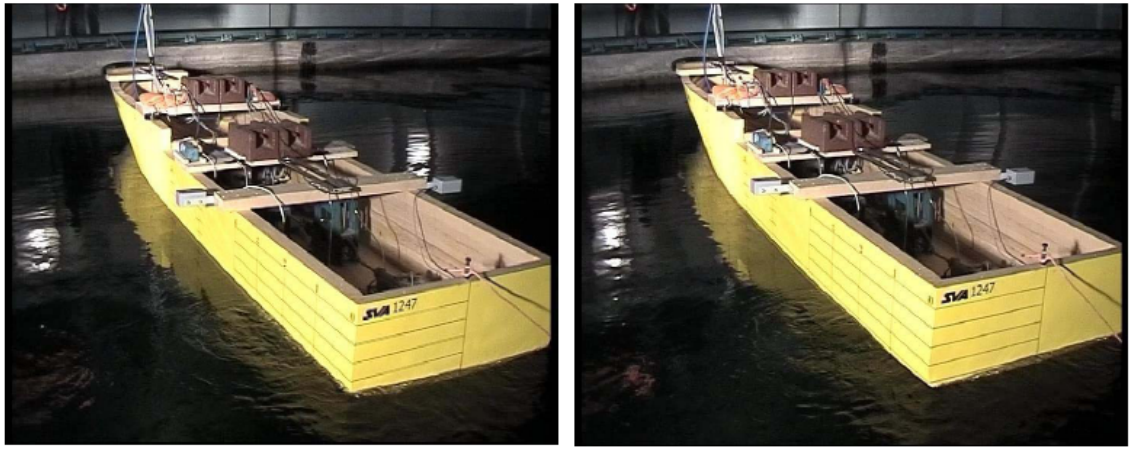


VOITH

Roll Tests - 90 M-Yacht, SVA Potsdam

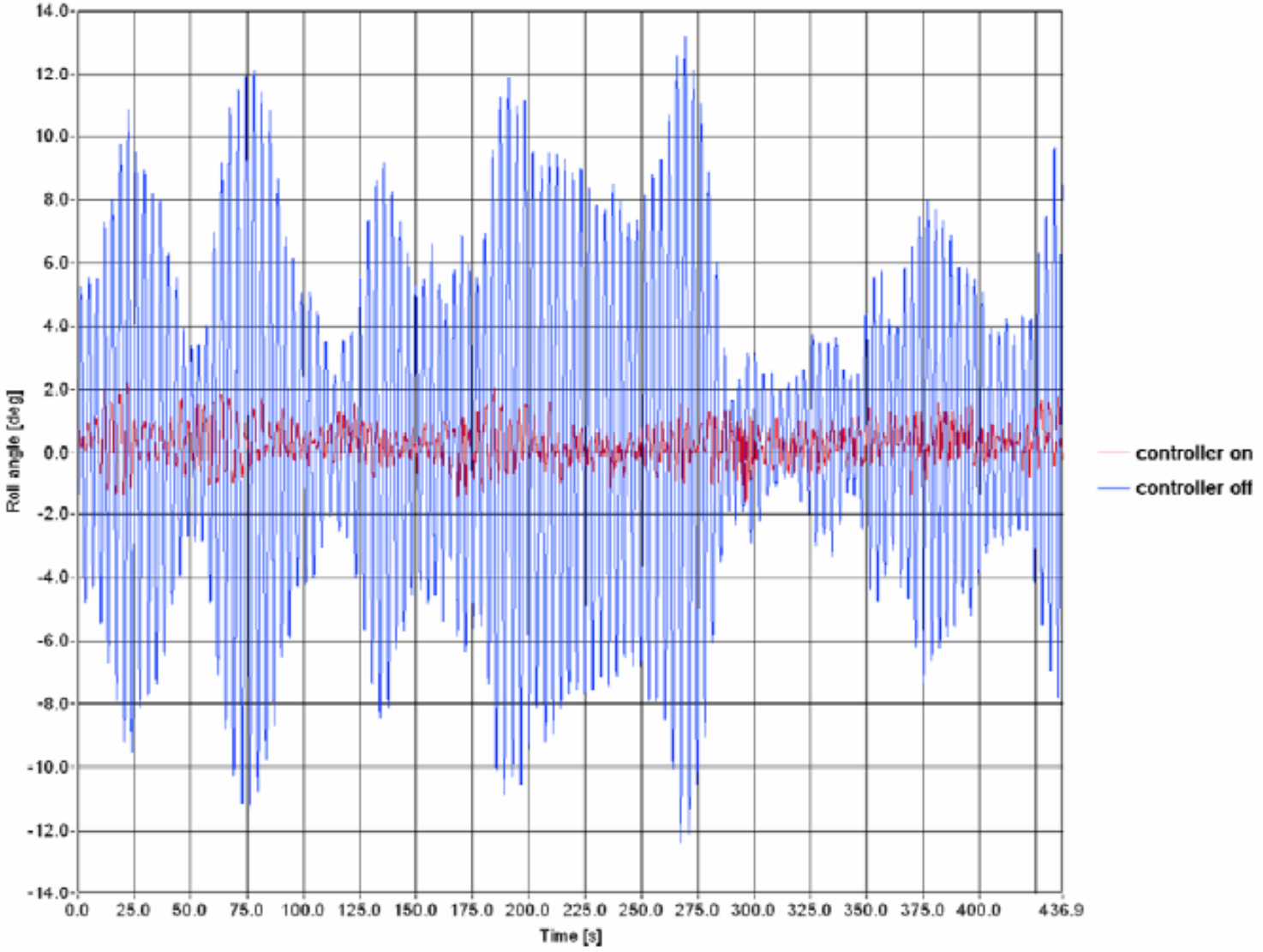
Voith Turbo

without active controller of the fins of the Voith-Schneider propellers, $rpm_M' = 0\ min^{-1}$



with active controller of the fins of the Voith-Schneider propellers, $rpm_M = 159\ min^{-1}$

Roll Tests - 90 M-Yacht, SVA Potsdam



runs 0744-00 (rpm_M = 318 min^{-1}) and 0744-01 (rpm_M = 0 min^{-1}); ζ_{Wsig} = 1.0 m; T_P = 12.2 s

Roll Tests - 90 M-Yacht, SVA Potsdam

Voith Turbo

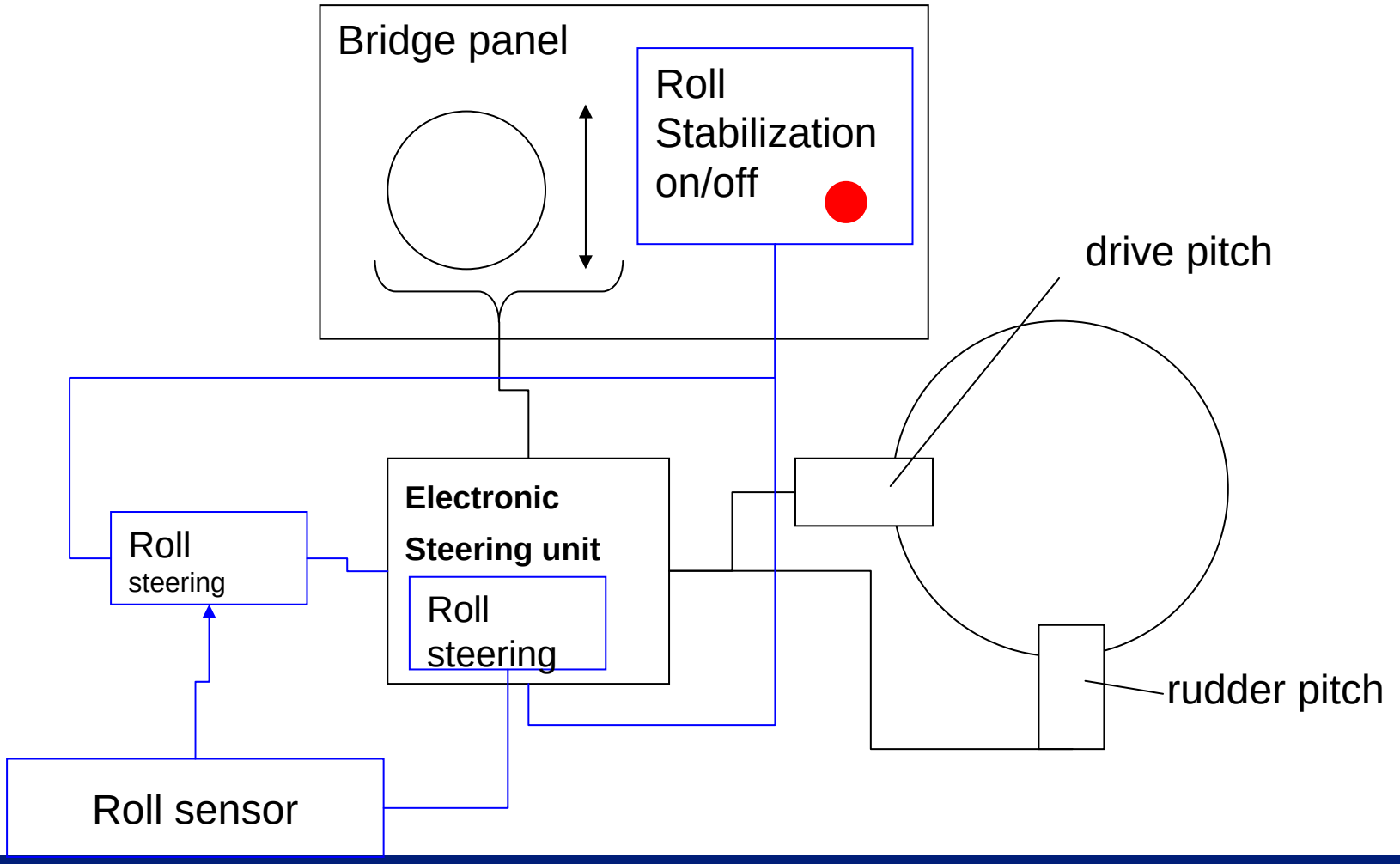
Results of the roll tests **M1247Z000** **λ = 12.000**

Datei	ζ_{sig}	T_p	rpm_M	video	φ_{sig}	ζ_{asig}	θ_{asig}	$a_{zasigCG}$	remarks
06-M-	[m]	[s]	[min^{-1}]	[No.]	[°]	[m]	[deg]	[ms^{-2}]	[-]
irregular beam seas, JONSWAP-spectrum									
0742-00	0.0	0.0	0.0	01	-	-	-	-	decay test
0743-00	0.5	12.2	318	02	-	-	-	-	controller test
0743-01	0.5	12.2	318	03	-	-	-	-	controller test
0743-02	0.5	12.2	318	04	0.57				ntroller on
0743-03	0.5	12.2	0.0	05	5.20				ntroller off
0743-04	0.5	12.2	318	06	4.14	0.39	0.13	0.11	controller off
0743-05	0.5	12.2	159	07	0.42	0.35	0.14	0.15	controller on
0744-00	1.0	12.2	318	08	1.05				ntroller on
0744-01	1.0	12.2	0.0	09	9.43				ntroller off
0744-02	1.0	12.2	159	10	2.09	0,60	0.34	0.34	controller on
0744-03	1.0	9.1	159	11	0.60	0.55	0.25	0.31	controller on
0744-04	1.0	9.1	0.0	12	2.58	0.48	0.16	0.35	controller off
regular beam seas									
Datei	ζ_W	T	rpm_M	video	φ_{sig}	ζ_{asig}	θ_{asig}	a_{zaCG}	remarks
06-S-	[m]	[s]	[min^{-1}]	[No.]	[°]	[m]	[deg]	[ms^{-2}]	[-]
0745-00	2.5	9.4	318	13	-	-	-	-	controller at times
0745-01	2.5	9.4	318	14	-	-	-	-	controller at times

89.0 % Roll reduction

88.9 % Roll reduction

Steering system for the tests



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Voith Schneider Propeller for PSV

Voith Turbo

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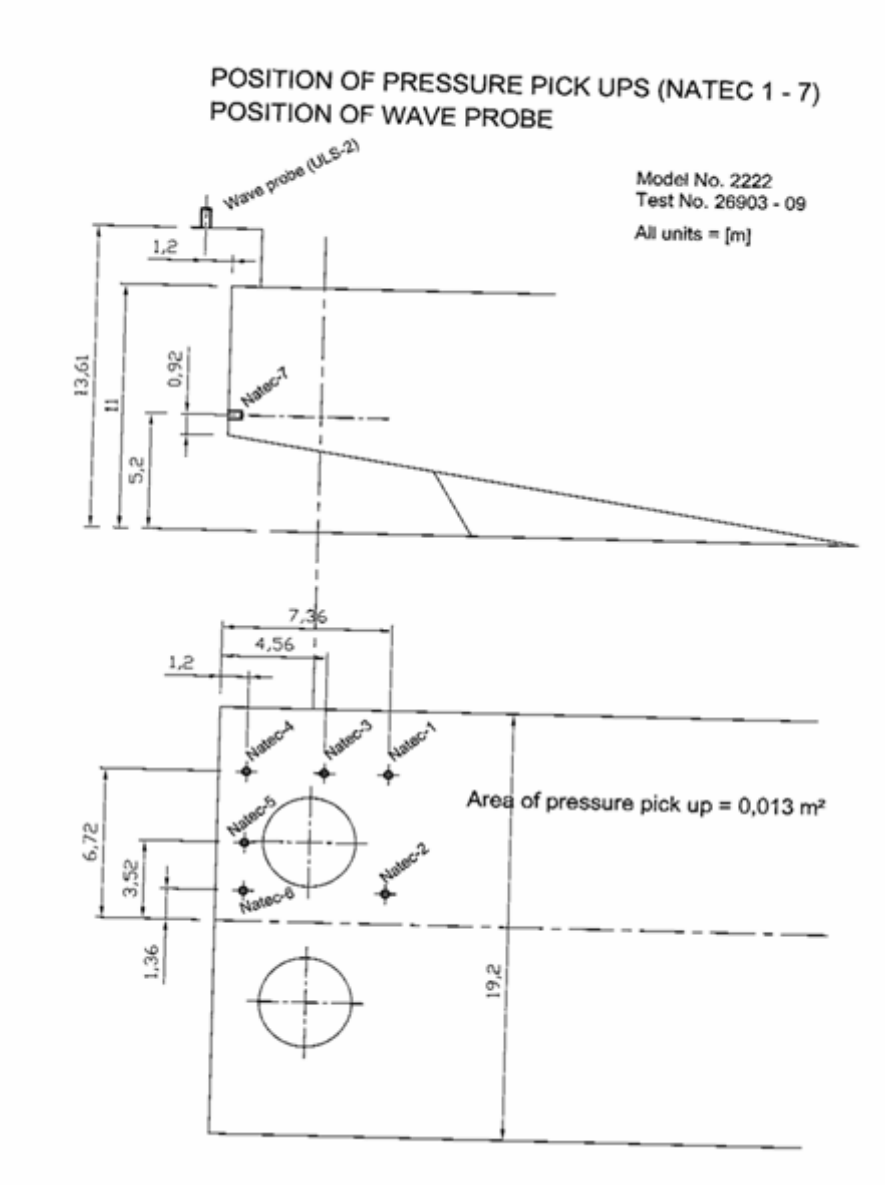
PSV model in Vienna

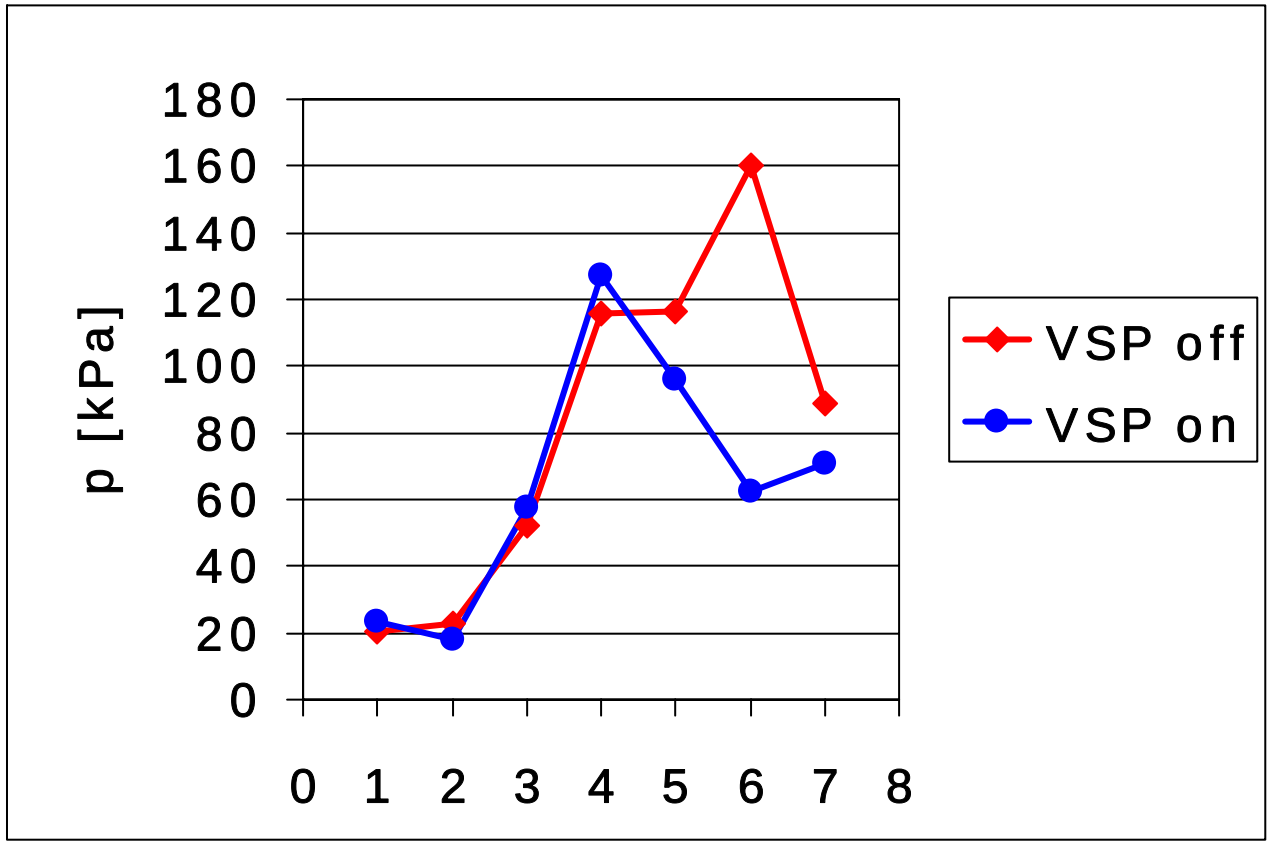
PSV model in Vienna with pressure sensors

Slammingtest (H sign = 4,0m, H max = 8 m)



Location of Load Cells for Slamming Pressure Measurement

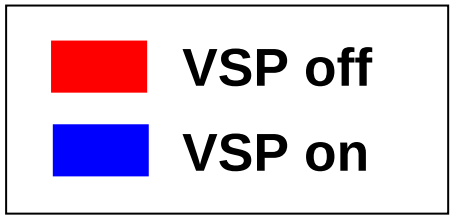
Maximum Slamming Pressure at the Load Cells

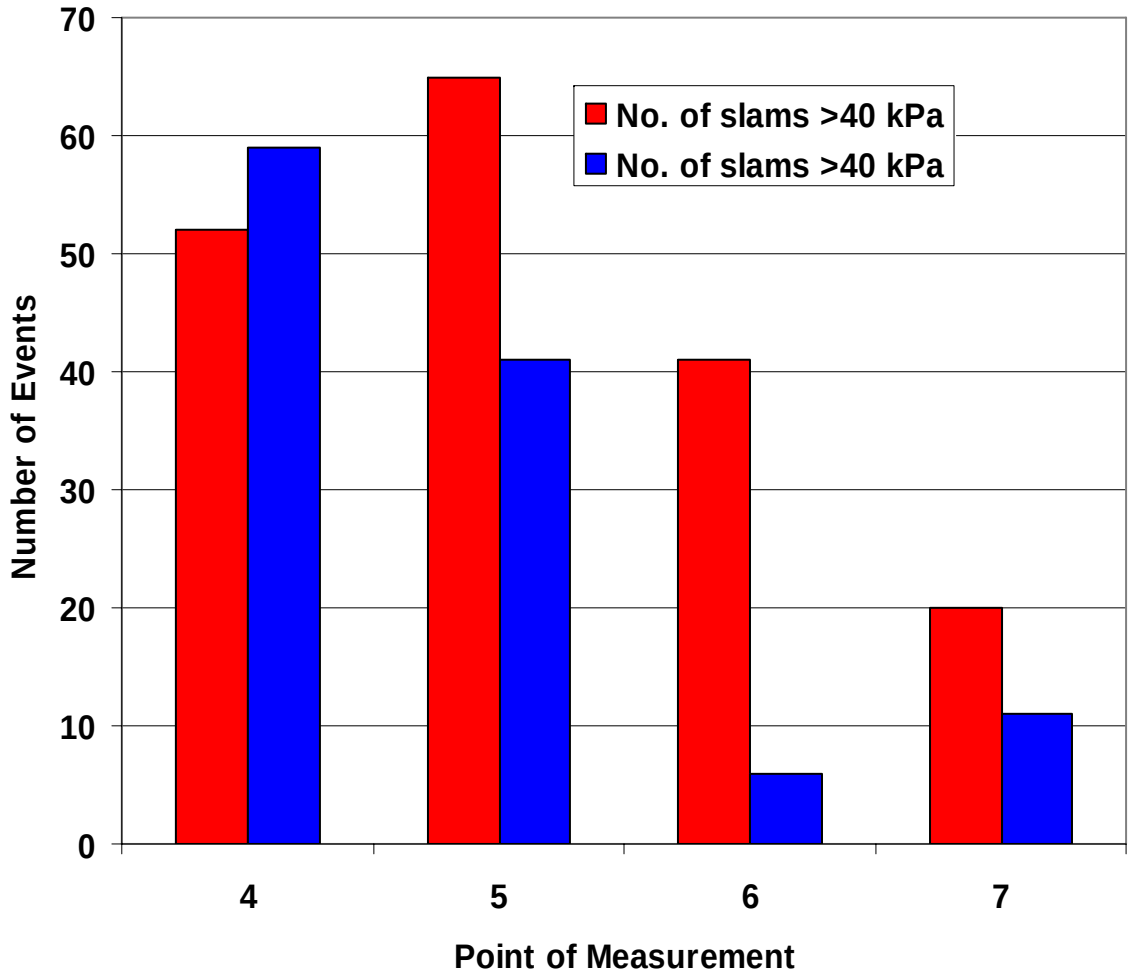


hw = 4.0 m
d = 5.2 m

Number of slams > 40 kPa per 30 minute

Voith Turbo





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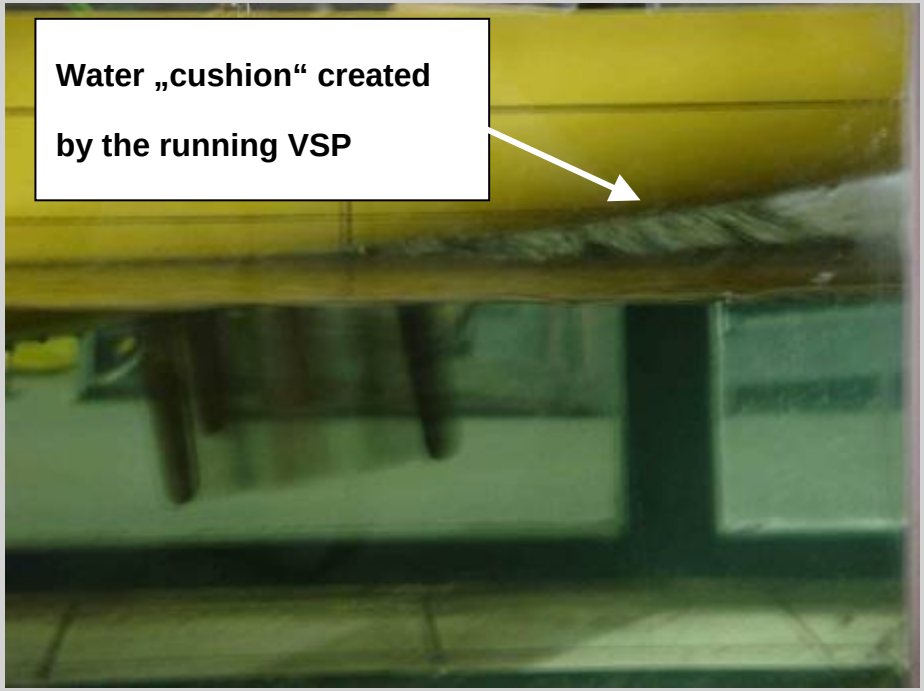
110 m – Cable Layer Vessel with Voith Schneider Propeller – reduction of slamming

VSP is **not running**,
the blades are partly in air



VSP **is running**, a water “cushion” is created and reduces the slamming load

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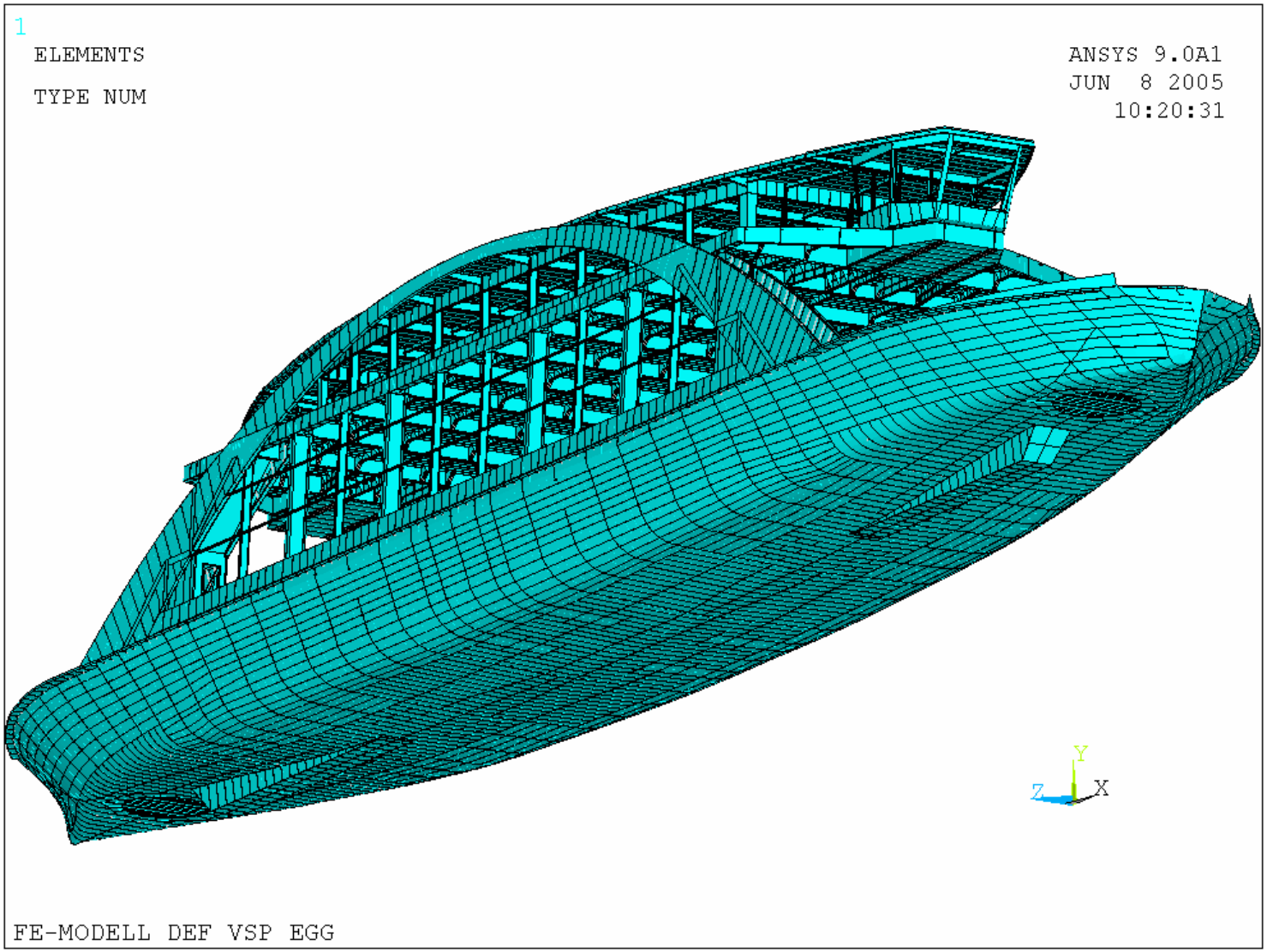
VSP Ferry at the Lake of Constance, DEF TABOR

Voith Turbo

VOITH

FEM Model, DEF TABOR

Voith Turbo



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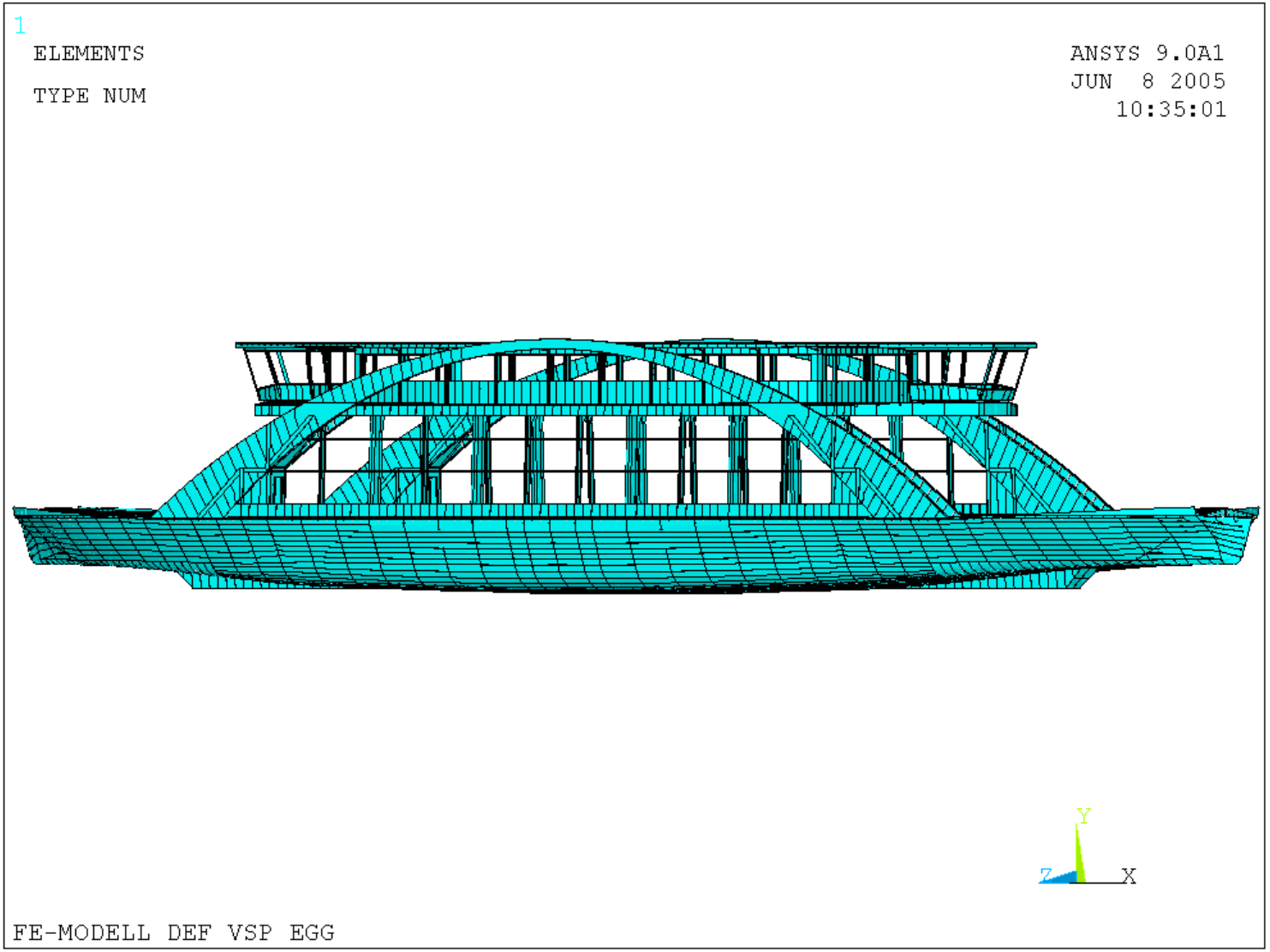
FEM Model, DEF TABOR

Voith Turbo



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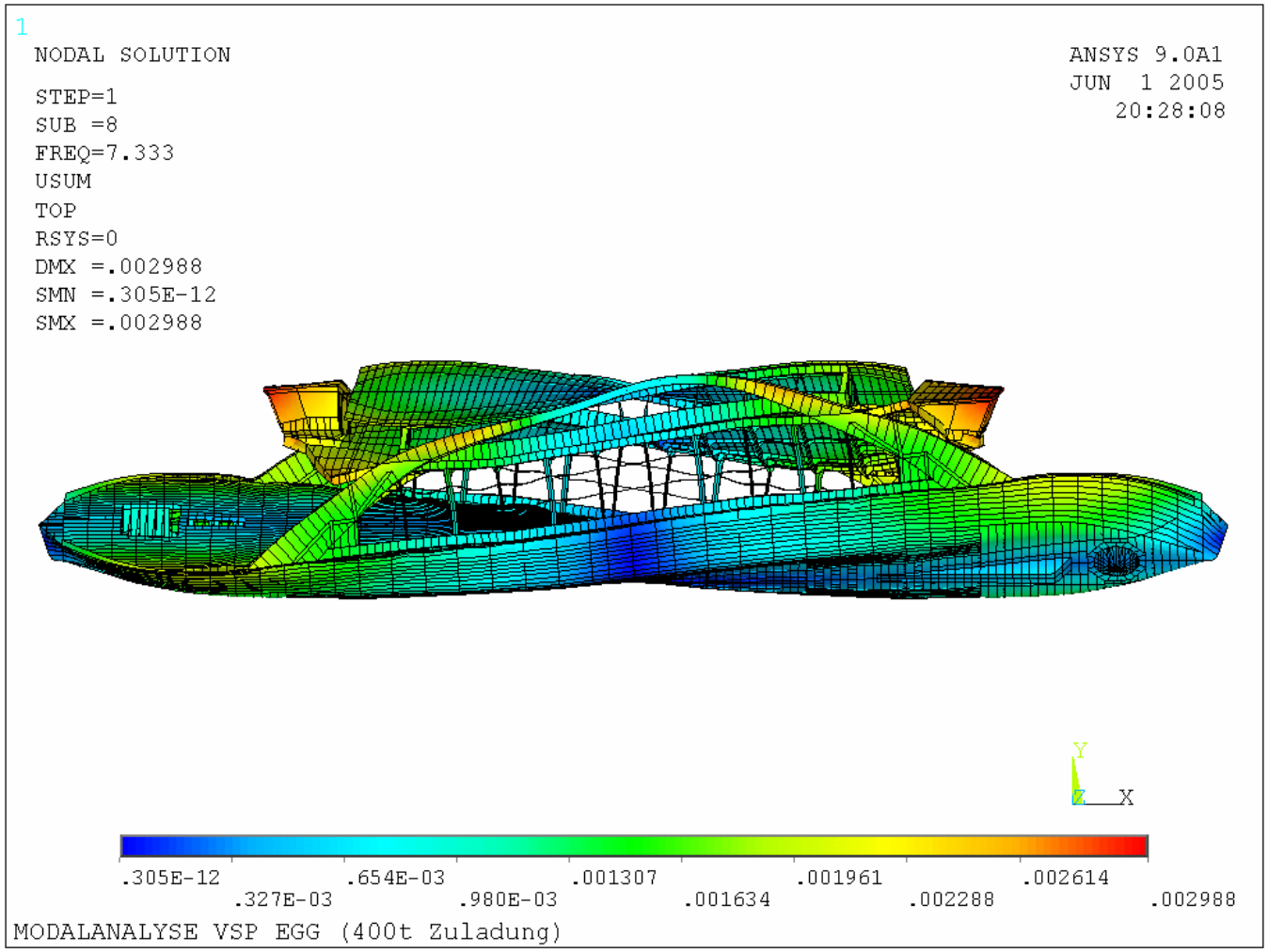
FEM Model, DEF TABOR

Voith Turbo



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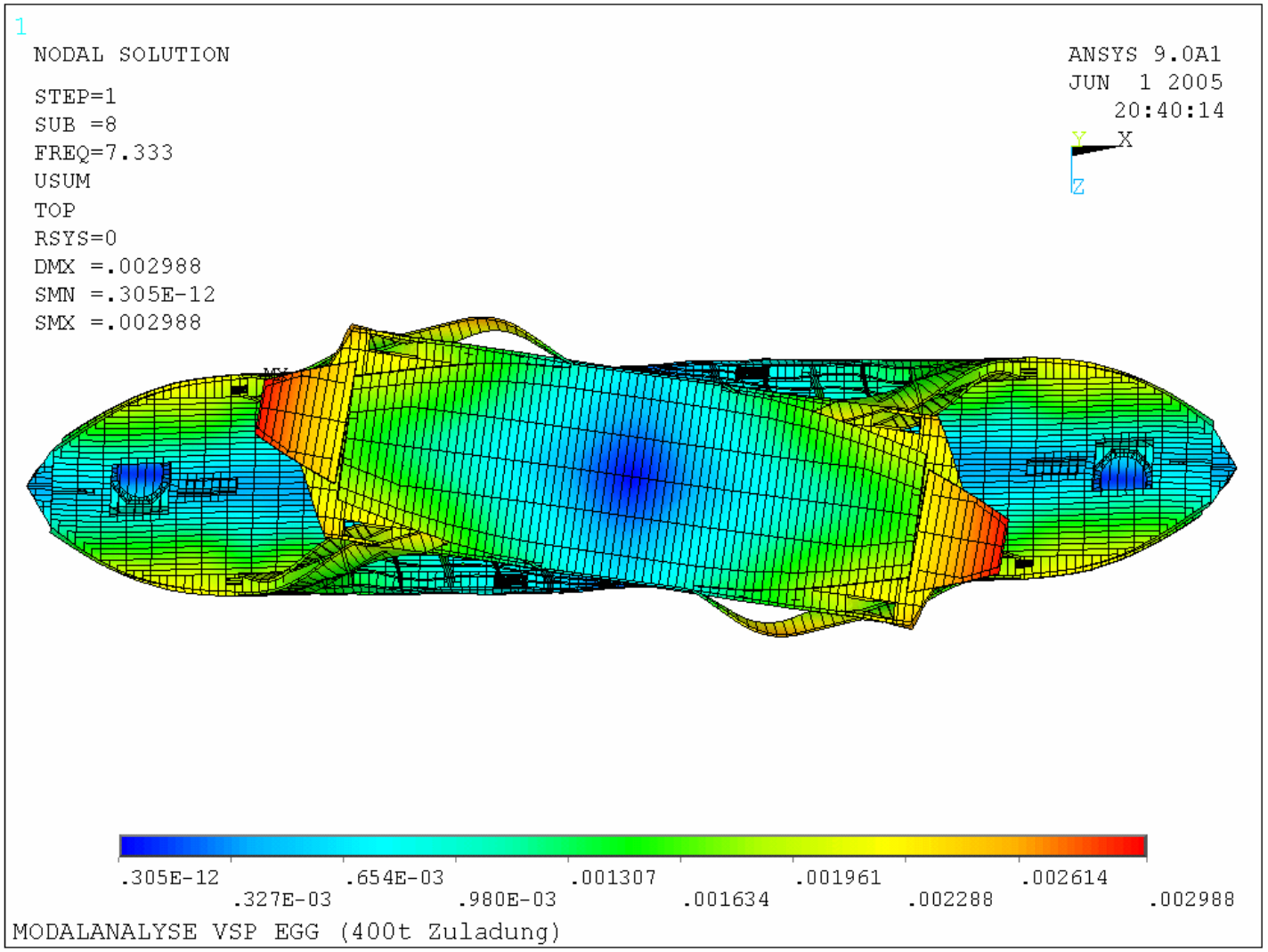
FEM Model, DEF TABOR

Voith Turbo



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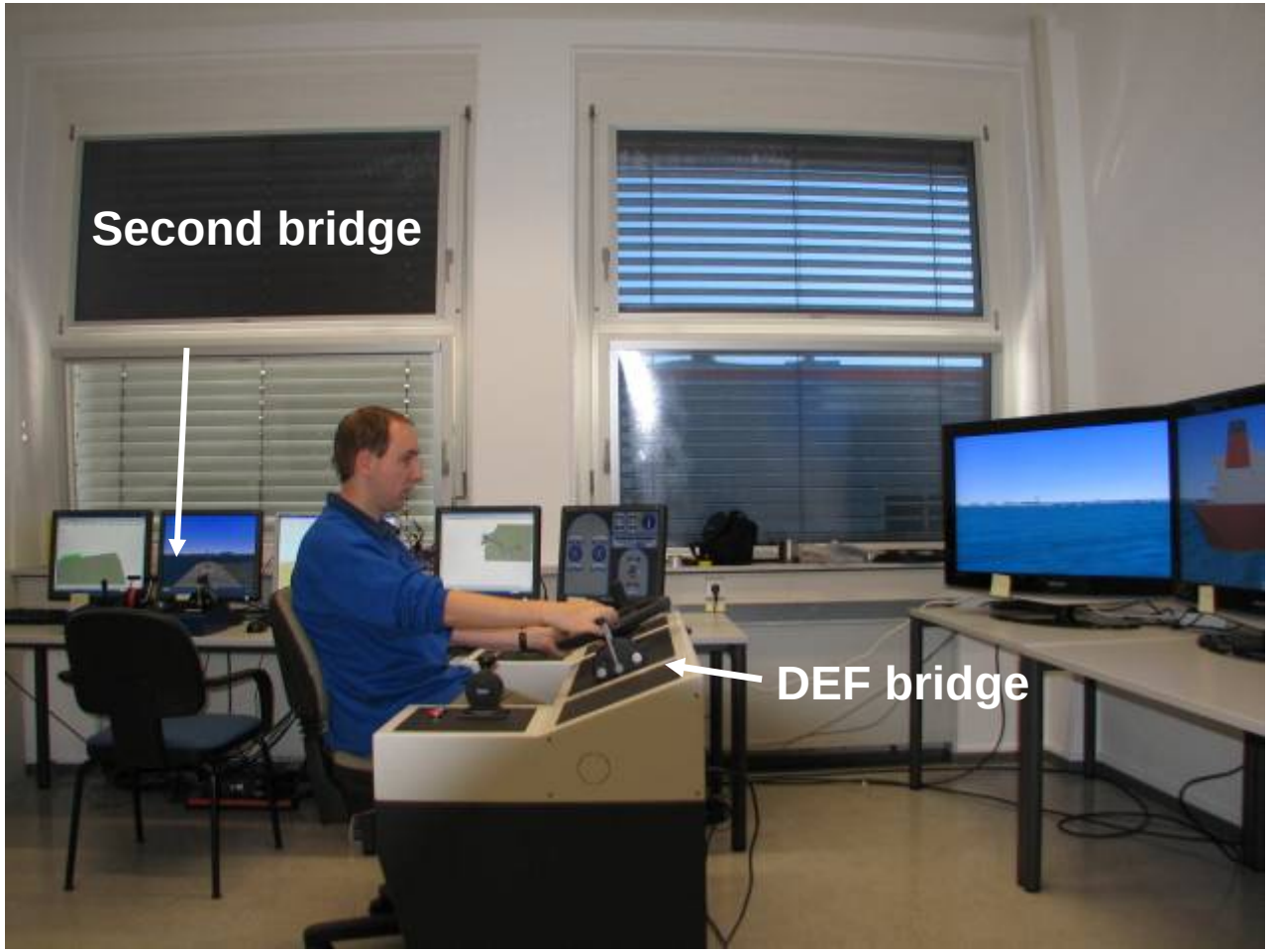
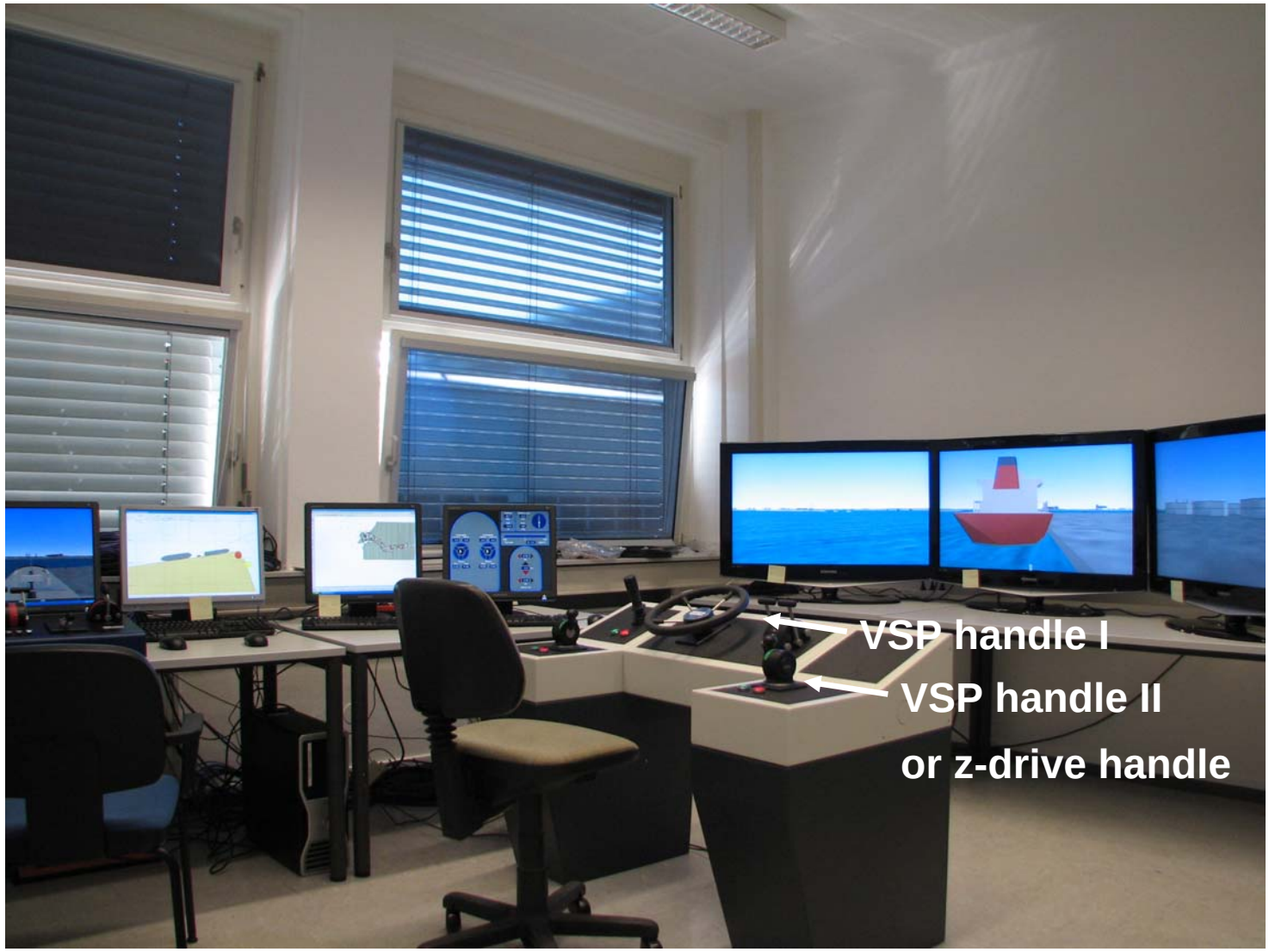
Voith Ship Simulator (Simflex)

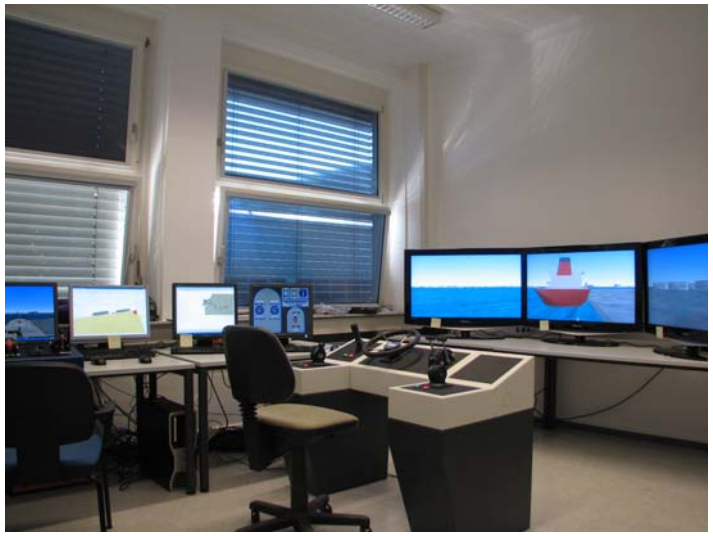


Voith Ship Simulator (Simflex)



Voith Ship Simulator (Simflex)

- Consultant for Shipowner
  - Which is the best hull from (seakeeping, manoeuvring etc)?
  - Which is the best Vessel size?
  - Which power is necessary?
  - Which steering forces are necessary?
- Development of new steering logic
  - Fuel efficiency, response time



Experiences

Ship line design

VSP Development

Full scale test

Simulator

Model test

CFD

Topics

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Conclusion

- Voith Schneider Propeller (VSP) offers an unique manoeuvrability
- VSP a can effectively be used for Roll Stabilisation
- Slamming loads are reduced by an active VSP
- Voith Ship Simulator will be used to develop an fuel-efficient steering system
- Voith Ship Simulator can be used as a consultant system to find the optimum steering and manoeuvring forces
- FEM analyses are used for improving the comfort on board

Engineered reliability.