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MARTEC

ERA-Net Maritime Technologies

Co-ordination Action

ERA-Net

D2.3 Report on the use of new and existing network for European maritime research and testing facilities

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Ship Design and Research Centre S.A. (CTO S.A.)

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Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Content

1 Introduction

The following report addresses to the issues of cooperation between the marine research institutions in Europe. Therefore the report contains the overview of the testing facilities. The choice of the facilities has been made with regard to the testing capabilities of the individual institution and thematic research areas recognised by MARTEC. The following part of the report contains the description of the existing or past associations and common initiatives of research institutions. Finally The SWOT analysis of the cooperation capabilities is conducted.

2 Scope of the task

Task 2.3. SWOT (strengths, weaknesses, opportunities, threats) analysis of the synergistic use of maritime research and testing infrastructures

This task investigates the possibilities for synergies in relation to the existing research and testing facilities in Europe. The report addresses to the following issues:

- Complementarities, gaps and opportunities and on the synergistic use of maritime research and testing infrastructures.
- Linkages between national and trans-national projects and programs, and the development of networks arising from their execution, to determine the level of interest to other groups and to the European scientific community.
- Use of new and existing network in order to increase efficiency and enhance synergy of the European maritime research and testing facilities.

3 Definition of MARTEC priority areas

Basic priority areas within the maritime research that are common for most countries in Europe were identified within WP 1. It was decided to distinguish between thematic priority areas and horizontal priority areas during the workshop at London on 20 June 2007. Eight thematic and three horizontal priority areas are structured in MARTEC at the moment:

Thematic priority areas	**Horizontal priority areas**
shipbuilding	safety and security
maritime equipment and services	environmental impact
ship and port operations	human factors
inland water and intermodal transport	
offshore industry/offshore technology	
offshore structures for renewable energy	
polar technology	
fishing/aquaculture	

3.1 MARTEC basic priority areas

3.1.1 Shipbuilding

1.1.1.1 New ship types, structures, ship design and construction
new ships, hull concepts, structures and components, next generation ships, new floating structures, risk based design, simulation and planning tools, computational fluid dynamics
1.1.1.2. Production processes and technology
standardisation, modularisation, optimisation, mechanisation, robotisation, production control, forming, cutting and joining techniques, laser welding, surface treatment technologies,
production methods, networking, simulation, software tools, productivity, use of new materials, supply chain management, recycling, life-cycle approach

3.1.2 Maritime equipment and services

bridge systems, information and communication technologies, telematic applications, engine and propulsion systems, automation systems, cargo handling, maintenance

3.1.3 Ship and port operation, services

vessel traffic services, manoeuvring, cargo handling, waste & ballast water facilities

3.1.4 Inland water and intermodal transport

1.1.4.1 Shipbuilding
1.1.4.2 Maritime equipment and services
1.1.4.3 Ship and port operation
1.1.4.4 Transport chains, hinterland connections, short sea shipping, traffic management
1.1.4.5 Transport logistics, intermodality, interoperability

3.1.5 Offshore industry/offshore technology

new structures, design and construction, production processes and technology, equipment and services, maintenance and decommissioning of offshore structures, offshore operations, underwater process technology, underwater technology, underwater robotics (AUV, ROV)

3.1.6 Offshore structures for renewable energy

1.1.6.1 Water power, wave, tidal and current energy technology

1.1.6.2 Wind power, wind energy technology, installation technology

3.1.7 Polar technology

arctic sea transport, shipbuilding, equipment and services for polar regions, operation of ships, offshore structures

3.1.8 Fishing/aquaculture

platforms and devices, fish farms in open sea, new generation of fish-farms, teledetection, information and communication technologies, automation and monitoring

3.2 MARTEC horizontal priority areas

3.2.1 Safety and Security

1.2.1.1 Ship safety

collision, grounding, evacuation, fire safety, search and rescue, manoeuvring, cargo handling and lashing, tracking and tracing, first aid

1.2.1.2 Ship and port security

preventive measures against terrorism, piracy

3.2.2 Environmental impact

reduction and improvement of the efficiency of fuel and energy consumption, anti fouling, ballast water handling, wash waves, waste management, recycling, monitoring, reduction of emission, prevention of contamination, noise and vibration

3.2.3 Human elements

training aspects, education, improvement of working conditions, intellectual property rights (IPR)

The listed above thematic areas served as the key criterion regarding the choice of the research facilities described in the next chapter.

4 Overview of the testing facilities in maritime research

The following paragraph contains the description of testing facilities active in the field of applied research in marine technology. The facilities are aggregated according to the country. Each facility description is constructed according the clear and repeatable scheme. For each individual institution the data is organised in the following way:

Basic description	
Name of the institution	
Address	
Other information	*Status, membership in international associations*
Activities	*Research activities*
Description of facilities	
Kind of a facility	
Technical data	
Additional description	
Tests performed	
Measuring devices & instrumentation	

The information is collected from the companies web sites, printed information material, annual reports, newsletters and acquired from the companies representatives. The list includes mostly the research institutions, however the significant number of academic facilities is presented too.

The appropriate conduction of the SWOT analysis has to be always preceded with the thorough analysis of the actual potential of involved players. Another motivation of the following chapter is to provide the Reader with the most updated information on the capabilities of the European maritime research facilities. Such kind of database should be helpful in the process of searching partners for particular research topics arising from the coordination of national R&D programmes.

4.1 Austria

Basic description	
Name of the institution	**Schiffbautechnische Versuchsanstalt in Wien**
Address	Brigittenauerlände 256 A-1200 Wien XX http://www.sva.at/
Other information	Private company, member of ITTC and ECMAR
Activities	- Performance of measurements on ship models, floating craft, and propulsion units. - Analysis of the test results and consulting for further development. - Theoretical modeling (Computational Fluid Dynamics, CFD) and research in the field of ship hydro- and aerodynamics. - Preparation of expert opinions and surveys. - Publications and lectures

Description of facilities	
Towing tank	
Length	180 m
Breadth	10 m
Depth	5 m
Towing carriage data	- Maximum speed 7.5 m/s - Propulsion: linear-type motors
Wave generator	- Fully computer operated, duplex-flap type - Provides regular as well as irregular wave - Maximum wave lengths up to 7 m - Maximum wave heights up to 50 cm.
Additional description	The shallow water bottom allows to test ships at special shallow water conditions.
Tests performed	- Resistance and propulsion tests in still water and wave packets, - Measurement of wake field and boundary layer, - Open water tests of conventional propellers, ducted propellers, contra rotating propellers, podded drives etc. - Paint tests, - Manoeuvring tests (zigzag tests, course keeping tests, turn on tests, system identification tests, stopping tests), - Estimation of seakeeping characteristics, - Investigations of slamming damage, - Measurement of force and moment pulses, hydrodynamic spindle torque on a single blade, - Towing tests in oblique flow.
Measuring devices & instrumentation	- Dynamometer for open water tests H 29 of Kempf & Remmers up to a thrust of 400 N, a torque of 15 Nm - Dynamometers for azimuthing thrusters and podded drives - Mechanical force balance - Electrical force balance - Several inboard dynamometers of Kempf & Remmers up to a thrust of 150 N, a torque of 15 Nm - Z - drives

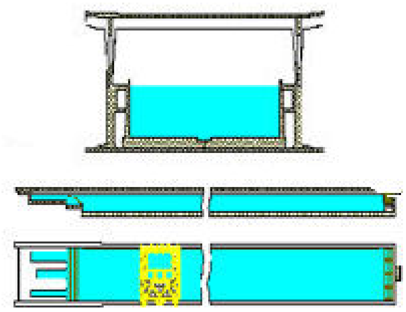
	- Balance for 1 degrees of freedom - Balance for 6 degrees of freedom - Gyro for 1 degree of freedom - Gyro for 2 degrees of freedom - HBM - measurement devices - 40 - hole probes
Cavitation tunnel	
Test section dimensions	- 500 x 500 x 2200 mm - 710 x 710 x 2200 mm
Centre to centre of horizontal sections	7 m
Max. water speed	20 m/s
Model propeller speed	up to 3500 rpm
Minimum pressure	0.02 bar
Tests performed	- Cavitation observation tests, - Measurement of the propeller induced pressure impulses, - Cavitation inception tests, - Axial wakefield tests. - Special investigations, i.e.: propeller induced noise, erosion tests, measurements of forces, moment pulses and hydrodynamic moments of blade adjustment on a single blade, nozzles and profiles as well as thruster measurements.
Measuring devices & instrumentation	- Dynamometer for open water tests H 29 of Kempf & Remmers up to a thrust of 400 N, a torque of 15 Nm - Online frequency analyzer - Prandtl's tube
Wind tunnel	
Basic description	closed return type, with a glass walled working section
Test section dimensions	Cross-section 2.8 m x 1.5 m
Maximum wind speed	30 m/s
Measuring devices & instrumentation	- 6 component resistance balance - Smoke generator - Hot wire anemometer - Gas analyzer chambers - Data acquisition system
Tests performed	- Smoke tests, observation of the exhaust gases - Measurement forces and moments by the wind - Tracer gas concentration measurements - Deck's comfort tests - Visualisation of the flow over the superstructure

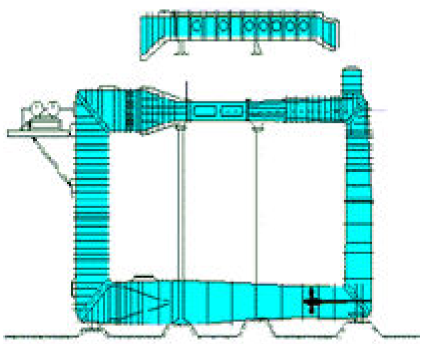
4.2 Belgium

Basic description	
Name of the institution	**University of LIEGE**
Address	Chemin des Chevreuils nr 1 (bat. B52), B-4000 Liege, Belgium http://www.ulg.ac.be/anast
Other information	Member of ITTC, WEGEMT
Description of facilities	
Towing tank	
Length	100 m
Breadth	6 m
Depth	4 m

Basic description	
Name of the institution	**University of Gent**
Address	Maritime Technology, Technologiepark-Zwijnaarde 9, B-9052 Gent – Zwijnaarde, BELGIUM
Other information	Member of ITTC, WEGEMT
Description of facilities	
Towing Tank for Manoeuvres in Shallow Water	
Length	88 m
Breadth	7 m
Maximum depth	0.8 m
Towing carriage data	- Main carriage maximum speed 2 m/s - Sway carriage: 1.3 m/s - Yawing table: 16 deg/s - Computer controlled, motor driven, horizontal planar motion carriage - Motor power: main carriage 4 x 7.2 kW, sway carriage 1 x 4.3 kW, yawing table 1 x 1 kW
Wave generator	- Fully computer operated, piston type - Electro-hydraulic drive - Piston characteristics: max. stroke: 0.3 m. max. velocity: 0.6 m max. acceleration: 4.4 m/s^2
Additional information	- Maximum model length: 5m
Tests performed	- Captive manoeuvring model tests - Seakeeping tests
Measuring devices & instrumentation	- 4 x 2 dynamometers for longitudinal and lateral forces (20N, 50N, 100N, 200N) - 2 propeller thrust and torque dynamometers (30N, 0.5Nm) - Measurement of vertical motion at two posts - 2 rudder force and moment dynamometers (50N, 2Nm) - Data acquisition sampling frequency: 40 Hz

4.3 Bulgaria

Basic description	
Name of the institution	**Bulgarian Ship Hydrodynamics Centre**
Address	P.O. Box 58 9003 Varna, Bulgaria http://www.bshc.bg/
Other information	Member of ITTC and ECMAR
Description of facilities	
Deep Water Towing Tank	
Length	200 m
Breadth	16 m
Depth	6.5 m
Towing carriage data	Max. carriage speed - 6 m/s
Wave generator	Generating regular and irregular waves - Wave length 1-12 m - Wave height 0.1 - 0.4 m - Wave steepness 1/20
Additional description	Ship models: - Max. length – 12 m - Max. weight – 12 t
Tests performed	– Resistance and propulsion model tests of ships – Seakeeping tests – Open water propeller characteristics – PMM tests – Wake field investigation
Measuring devices & instrumentation	- Set for resistance and propulsion tests in calm water, type UB - 5 - Set for effective model wake field investigations, type M1115 - Set for model wavemaking investigations, type BA - 1 - Set for seakeeping tests, type EU - 64 - Set for testing of pelagic trawl models - Six component balance for seakeeping tests, type USC - Oscillator for forced vertical motion, type OBK - Oscillator for forced rolling motion, type OBK -1 - Large Amplitude Horizontal Planar Motion Mechanism - Capacity wire probes for wave measurement - Steering gears - Set of dynamometers • Open water propeller dynamometers, type H49/H29

	• Dynamometer for measuring of propeller thrust and torque fluctuations in non-uniform wake field, type PCM001 • Dynamometers for measuring of CP propeller blade torque • Propeller dynamometers for ship models • Standard electronic instrumentation (counters, recorders, digital voltmeters, oscilloscopes, etc.)
Shallow water towing tank	
Length	200 m
Breadth	16 m
Depth	Up to 1.5 m
Towing carriage data	Max. carriage speed - 6 m/s
Additional description	Ship models: - Length: 4-18 m - Max. weight – 12 t
Tests performed	– resistance and propulsion tests in calm, shallow water – captive manoeuvring tests in shallow water
Measuring devices & instrumentation	- Set for resistance and propulsion tests in calm water, type UB - 5M - Set for effective model wake field investigations, type M1115 - Oscillator for forced vertical motion, type OBK - Oscillator for forced rolling motion, type OBK -1 - Large Amplitude Horizontal Planar Motion Mechanism - Steering gears - Set of force dynamometers: • Open water propeller dynamometers, type H49/H29 • Dynamometer for measuring of propeller thrust and torque fluctuations in non-uniform wake field, type PCM001 • Propeller dynamometers for ship models - Standard electronic instrumentation (counters, recorders digital voltmeters, oscilloscopes, etc.)
Cavitation tunnel	
Type	K 15 B , Kempf & Remmers, Germany (vertical set-up), closed circulation, closed working section.
Dimensions	Length (between vertical axes) – 12 m Height (between horizontal axes) - 2.6 m
Min cavitation number	0.2
Max absolute pressure	200 kPa
Min absolute pressure	6 kPa

Measuring sections	
Measuring section No.1	square, rounded corners
Dimensions	600 x 600 x 2600 mm
Max. flow velocity	14 m/s
Max. propeller diameter	0.3 m
Measuring section No.2	rectangular
Dimensions	1400 x 700 x 6000 mm
Max. flow velocity	4.5 m/s
Max. propeller diameter	0.5 m
Tests performed	- Cavitation tests on FP & CP propellers, isolated and ducted, tandem and CR propellers, in axial and oblique, uniform or non-uniform flow, including behind a ship model - Hydrodynamic tests of underwater foils, propeller shaft struts, rudders, etc. - Phase-dependent velocity mapping around operating propeller - Flow visualization - Erosion tests - Pressure distribution on the blade surface of an operating propeller - Hydrodynamic and cavitation tests on waterjets - Hydroacoustic tests - Propeller generated pressure pulses on the ship hull
Measuring devices & instrumentation	<u>Propeller dynamometer No. 3</u> Type R46, Kempf & Remmers, Germany, watertight, intended for tests of propeller models behind ship models in Measuring section No.2. Specifications: - Thrust:± 400 N - Torque:± 15 Nm - Rate of rotation up to 50 rps - Propeller shaft inclination towards the flow:± 18° - Accuracy:± 0,15% <u>Six-component balance</u> Type H36, Kempf & Remmers, Germany intended for tests of ducted propellers, rudders, hydrofoils and various axisymmetric bodies. Specifications: - Forces: Fx = ± 2000 N; Fy = ± 500 N; Fz = ± 2000 N; - Moments: Mx = ± 100 Nm; My = ± 800 Nm; Mz = ± 200 Nm; - Accuracy:± 0,15% <u>Other instrumentation</u>: - Wake rake - fourteen Pitot-static tubes for measurement of axial flow distribution - 3-D Wake rake - six 5-hole Pitot tubes for measurement of 3-D flow distribution - Pressure transducers - Measuring amplifiers and filters - Electronic counters

	- Digital voltmeters - Digital frequency meters - High precision digital manometers - Laser Doppler anemometer - Strobe and video system

4.4 Croatia

Basic description	
Name of the institution	**Brodarski Institut**
Address	Av. V. Holjevca 20, P.O. Box 237, 10020 Zagreb, CROATIA http://www.hrbi.hr/
Other information	Brodarski Institute was founded in 1948 as an institution of special interest to the Republic of Croatia in the field of marine industry, science and technical systems. Between 1991 and 1993 Brodarski Institute was transformed from a budgetary financed institution into a limited liability company completely owned by the Government. Since then Brodarski Institute has been financed through commercial contracts with both public and private sectors. Member of ITTC.
Activities	- Ship Hydrodynamics - Vessel Design and Development - Control Engineering - Civil Engineering Technical Systems - Acoustics - Vibrations, shock and strength - Safety & Protection in Work - Thermal Analysis - Field Testing - Applied Technologies - Ecological Engineering - Calibration Laboratory for Acoustics & Vibration
Description of facilities	
Large Towing Tank B1	
Length	276.3 m
Breadth	12.5 m
Depth	6.0 m
Towing carriage data	- Speed range: 0.014 - 14 m/s - Drive power: 8 EM (8x15.8/115 kW) + 2 EM(2x2.5/12.3 kW) - Max. Acceleration: 1 m/s^2 - Mass: 55 t - Computer controlled
Wave generator	- Double flap - Drive (power): EH (2 x 55 kW) - Wave length: max 40 m - Wave height: 0.08 - 0.7 m - Wave period range: 0.1 - 3.0 Hz - Computer controlled
Additional description	Max. model length - 10.0 m.
Towing Tank B2	
Length	302.5 m
Breadth	5.0 m
Depth	3.2 m
Towing carriage data	- Speed range: max. 14 m/s

	- Max. Acceleration: 1 m/s^2 - Drive (power): 2 EM (2x37/110 kW); - Mass: 11 t
Wave generator	- Flap - Drive (power): EH (30 kW) - Wave length: max 10 m - Wave height: max 0.25 m - Wave period range: 0.4 - 1.8 Hz
Additional description	Max. model length - 5.0 m.
Small Towing Tank B3	
Length	44/67m
Breadth	3 m
Depth	2.5 m
Towing carriage data	- Speed range: max 3.14 m/s - Drive (power): 1 EM (2kW) - Mass: 2.5 t
Wave generator	- Plunger - Drive (power){ EM (22 kW) - Wave length: max 7 m - Wave height: max 0.35 m - Wave period range: 0.4 - 2.5 Hz
Additional description	Max. model length - 2.0 m.
Rotating Arm Tank B4	
Diameter	32 m
Rotating arm length	12 m
Depth	2.5 m
Carriage data	- Max. angular speed: 0.7-1 - Max. acceleration: 1 m/s2 - Drive (power): EM (2.94 KW) - Mass: 11 t - Computer controlled
Additional description	Max. model length - 3.0 m.
Large Cavitation Tunnel K1	
Test section dimensions	- Section A: 1000 x 1000 x 3500 mm - Section B: (with free surface) 6500 x 2000 x 1000 mm
Max. water velocity	- Section A: 11.3 m/s - Section B: 5.5 m/s
Ship model length:	Section B: up to 7 m
Pressure range	0.1 -2 bar
Propeller EM power/rev	110 kW/3000 rpm
Impeller EM power/rev	220 kw/1450 rpm
Additional description	Computer controlled
Small Cavitation Tunnel K2	
Test section dimensions	2.2 x 0.5 x 0.5
Max. water velocity	8 m/s
Max. propeller diameter:	0.250 m
Pressure range	0.1 -2 bar
Propeller EM power/rev	12 kW/3500 rpm
Impeller EM power/rev	24.4 kW/1450 rpm
Additional description	Computer controlled

Ship Model Manufacturing Shop	
Manufacturing of ship models and fabrication of other models for testing is done. Models are typically made of wood, fibreglass, paraffin wax or expanded foam. The shop is equipped with two special purpose machines: a milling machine for machining of ship models up to 10 m in length and up to 1.4 m in width and a machine for measurement of ship geometry and positioning of its appendages.	
Propeller Model Manufacturing Shop	
Propeller models, 2D and 3D hydrofoils, nozzles, rudders and appendages are manufactured.	
Tests performed	Resistance and propulsion - Resistance and propulsion tests for performance evaluation of proposed design - Measurement of 3D wake to assist in design of propellers and shaft brackets - Flow studies to determine optimum position of appendages Propulsors and cavitation - Propulsors and rudder models installed on ship hull models (geometrically similar or dummy model) - Propeller models in non-homogeneous wake field - Resistance of propellers to erosion due to cavitation - Ship propeller models in oblique flow - Models of main and auxiliary propulsion and steering units (e.g. rotable thrusters) - Propeller induced pressures on a ship hull - Forces and moments acting on hydrodynamic profiles and foils in cavitating flow - Propeller hydro acoustic properties - Pressures and flow velocities around road and rail vehicles - Resistance of materials to cavitation erosion - Erosion resistance of paint coatings in high velocity flow. - Tests with free floating surface or submerged ship models Manoeuvrability and control - Tests with captive surface or submerged ship models - Evaluation and assessment of ship model tests and their correlation with full-scale ship manoeuvring data - Prediction of ship manoeuvres using computer modelling techniques based on the results of model tests and in-house accumulated data - Computer modelling of ship's sea-keeping parameters in early design stage Seakeeping - Model tests in regular and irregular waves (maximum wave height 0.7 m) - Performance prediction, identification of problem areas related to ship motions (accelerations, slamming, shipping of green water, pressures, speed loss, propeller racing, seasickness, bending moments, etc.) measurements of relevant parameters and recommendation of solutions Launching - Launching tests of ship models and measurement of speed, accelerations, angles, vertical and horizontal trajectories, forces and bending moments during launching

Other services	- Consultancy at any stage of ship design - Numerical representation of ship geometry - Preliminary prediction of performance - Theoretical investigation of resistance components - Optimization of hull forms on the basis of model tests - Design and optimization of ship hull forms using standard series, proprietary SH series and statistical methods - Development of special purpose ships - Design of conventional propellers, including propeller in no homogenous velocity field in oblique flow - Analysis and comparative evaluation of propulsor systems for the purpose of selecting the most suitable propulsor configuration - Prediction of propulsor induced vibration - Feasibility studies of non-conventional propulsors - Feasibility studies of specific applications of conventional propulsors. - Basic research related to propulsion and development of experimental investigations (e.g. development of systematic propeller series) - Development of computational procedures for calculation of propulsor characteristics - Study of wall effects on the flow with cavitation - Evaluation of current developments in propulsor technology - Design of rudders and design of special stability control devices - Design of ship hull forms, control surfaces and devices to meet required manoeuvrability performance - Design of ship hull forms with high percentage of operability and good ability to sustain speed in rough seas. - Preliminary studies and optimization of launching - Improvements in launching techniques to obtain required degree of ship's stability safety and to minimize ship's hull deformation during longitudinal or side launching
Measuring devices & instrumentation	Measurement and Instrumentation Division is responsible for day to day operation of the towing tanks and carriages, operation of measurement equipment and data acquisition systems, maintenance of instrumentation and measurement equipment, and operation and maintenance of computers and peripherals. The Division is also involved in development, manufacturing and calibration of special equipment, instruments, transducers and automatic testing systems.

4.5 Denmark

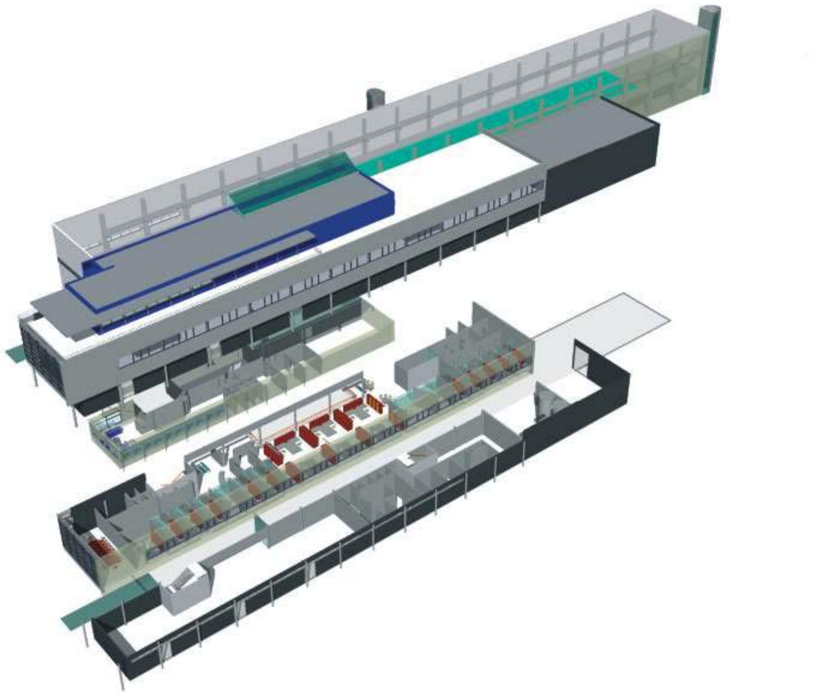
Basic description	
Name of the institution	**Force Technology, Division for Maritime Industry**
Address	Hjortekaersvej 99, DK-2800 Lyngby, Denmark http://www.force.dk
Other information	Member of ITTC and ECMAR
Activities	Consulting and development services: - Welding & Production - Materials & Constructions - Sensors & Measurements - Ships & Offshore - Production Optimisation & Industrial Processes - Product Development - •Integrity Management - Structural Integrity Services - Energy - Environment & Sustainability - Quality & Environment Maritime: - Hydro and aerodynamics - Simulation technologies and mathematical modelling - Human Factor Management (HFM) - Education and training. Shipyards and shipping companies - Propulsion analyses and testing - Manoeuvring inspections - Sea-keeping analyses and testing - Stability analyses - Aerodynamic design and design optimisation - Ship simulation training. Harbours - Optimisation of harbour design - Training of captains and pilots in connection with new entrance conditions - Advise and sales of simulators. Offshore - Platform motion and acceleration - Flows around platforms and offshore units - Platform stability tests - Handling of resources and training - Collision analysis. Process industry - Process optimisation - Production flow analysis

	- Statistic process control. Construction industry - Aero elastic modelling - Full-scale surveillance - Measuring of wind loads. Ship Stability & Movement - CFD (Computational Fluid Dynamics) - Numerical methods - PMM (Planar Motion Mechanism) - Stability training - Aerodynamics - Flow visualisation.
Description of facilities	
The deep water towing tank	
Length	240 m
Breadth	12 m
Depth	5.2 m
Towing carriage data	- Speed: from 0 to 10 m/s - Accuracy: ± 0.2 % of actual value
Wave generator	Maximum wave heights up to 90 cm.
Additional description	Towing tanks provide the opportunity of testing ships and offshore structures under extreme weather, wave and current situations.
The shallow water manoeuvring basin	
Length	25 m
Breadth	8 m
Depth	Variable from 0 to 0.8 m
Towing carriage data	- Maximum speed: 2 m/s - Accuracy: ± 0.2 % of actual value
Wide boundary-layer wind tunnel	
Principal data	- Length: 15.50m - Width: 13.60m - Height: 1.70m - Max Flow Velocity: 7.3m/s
Additional description	Wide boundary-layer wind tunnel (WBLWT) has been purpose-built for aeroelastic and environmental model testing, e.g. large-scale landscapes and long suspension and cable-stayed bridges.
Boundary-layer wind tunnel	
Principal data	- Length: 20.40m - Width: 2.60m - Height (adjustable): 1.80 - 2.30m - Max Flow Velocity: 24m/s
Measuring devices & instrumentation	- Dynamic Section Model Rig, - High Reynolds Number Section Model Rig, - 1-DOF Forced Motion Rig - 6-DOF Dynamic Force Balance
Additional description	The boundary-layer wind tunnel (BLWT) is designed for investigations of wind effects on building structures and the

	environment. Its field of application includes wind conditions in complex terrains as well as pressure measurements on engineered onshore and offshore structures..
Closed circuit wind tunnel	
Principal data	- Length: 2.60m - Width: 1.00m - Height: 0.70m - Max Flow Velocity: 80m/s
Measuring devices & instrumentation	- Grids upstream of the working section, varying turbulence intensities
Additional description	The flow velocity of up to 80m/s enables the investigation of fluid dynamical problems at high Reynolds numbers. Small-scale models, section models or details, e.g. buildings and ships, are tested to identify forces, surface pressures or to observe the flow field around the respective body
Laser centre	
Principal equipment	- CO_2 lasers for laser welding with an output (CW) of 3.5 kW and 17 kW respectively - Nd:YAG lasers with an output of 400 W (pulsed avr.) - Fibre optically coupled Nd:YAG lasers with an output of 4.0kW (CW) - LASMA ducting with granite plane - XY-workstation with a capacity of up to 1800 kg - XYZ-workstations with various capacities - A robot which can be coupled with the Nd:YAG laser via a fibre optic cable - Glovebox with controllable atmosphere for the handling of processes using titanium - Facilities for thermal spraying.
Ship simulators	
Full-mission simulators	- Bridge A, 360º FOV 18m diameter (watch-1 type) configurable with HSV, ASD tugs, VSP tugs or POD ships - Bridge B, 180º FOV 10m diameter configurable with HSV or POD ships - Bridge C, 155º FOV 8m diameter configurable with HSV or POD ships - Bridge D, 155º FOV 8m diameter equipped with 2 dynamic positioning stations - Bridge E, R&D facility - Tug cubicles fully interactive VSP or ASD tug stations - Dynamic positioning ALSTOM Duplex system.
Engine room simulator	- STN-ATLAS engine room simulator
Debriefing facilities	- Manoeuvring analyzer combined with a/v replay

4.6 Finland

Basic description	
Name of the institution	**Aker Arctic Technology Inc**
Address	Kaanaankatu 3A FI-00560, Helsinki, Finland http://www.akerarctic.fi
Other information	Member of ITTC
Activities	<u>Concept development including:</u> - Ship development for specific task - Project evaluation, feasibility, infrastructure, construction - Transit simulations, given route, economics and needed fleet - Development of efficient loading / offloading operations - Development and dimensioning of the best propulsion system for specific project <u>Model Testing</u> - Model testing in ice of ships and structures, - Ice formation and operational tests - Development of design criteria based on environmental conditions - Hull form optimization, open water / ice conditions - Ship performance and power prediction, icebreaking capability in different conditions - Loading and offloading operations; manoeuvrability - Ice loadsand impacts on structures - Manoeuvrability in icy conditions <u>Full Scale Testing and Ice Research</u> - Data acquisition and site studies, ice properties, ice condition studies, ice reconnaissance field trips with ships as research platform or land based helicopter operations. - Ship testing in ice, measurements, operation, manoeuvring - Testing of offshore structures in ice, measurements, ice formation and operation - Valuation of ice conditions, ice profiles, general/detailed information packages - Structural hull/structure measurements, global and local forces
Description of facilities	
Ice model test basin	
Length	75 m
Breadth	8 m
Depth	2.1 m
Towing carriage data	Speed range 0 - 3 m/s
Second carriage data	Speed range 0 - 1.5 m/



1. workshop
2. preparation room
3. cooling elements
4. testing carriage
5. observation windows
6. main basin
7. entrance hall
8. workshop
9. apparatus room
10. ventilation
11. conference room
12. offices
13. model store
14. sauna department
15. refrigerating machinery
16. main entrance
17. conference room

Basic description	
Name of the institution	**Helsinki University of Technology**
Address	Ship Laboratory, Tietotie 1, P.O. Box 4100, 02015 TKK, FIN-02150 HUT, Espoo, Finland http://www.hut.fi/Units/Ship
Other information	Member of ITTC and WEGEMT
Fields of Research	- Ship Safety and Structure - Computational and experimental hydrodynamics, ship Hydrodynamics - Arctic Marine Technology - Ship Automation - Ice breaking technology and ship operation in ice covered waters - Arctic offshore - New structures in ships - Reliability of ship machineries
Description of facilities	
Towing tank	
Length	130 m
Breadth	11 m
Depth	5.5 m
Towing carriage data	– Maximum speed 8 m/s – Manned motor driven – DC, thyristor rectified, 570 kW
Wave generator	- Plunger, electro-hydraulic, 11 m wide - Regular wave length: 1.5-12 m, slope 2-12 deg - Irregular wave: sine waves summation or user defined
Tests performed	- Resistance & propulsion in calm water and waves - Upright and heeled model tests of sailing yachts - 3D wake measurements - Flow visualisation - Wave induced motions - Measurement of forces on ship models, floating structures and submerged bodies - PMM tests of floating and submerged bodies
Ice (multi purpose) model basin	
Length	40 m
Breadth	40 m
Max. ice thickness for tests	70 mm
Ice area	39 m x 37 m
Towing carriage data	– Bridge type carriage with under carriage – DC, thyristor rectified motor, 88kW – Maximum speed in x direction: 2 m/s – Maximum speed in y direction: 3 m/s – Maximum pushing/towing force: 20kN x carriage , 5 kN y carriage

Wave generator	- Multi section plunger type, motor power 270 kW - Period: 0.8-4 s - Maximum wave height: 0.265 m
Additional description	- Maximum model length: 6 m - Structures: maximum 38 m wide
Tests performed	- Resistance & manoeuvring in pressurized ice field - Ships and fixed structures in moving ice field - Manoeuvring and seakeeping test - Shallow water tests

<table>
<tr><th colspan="2">Basic description</th></tr>
<tr><td>Name of the institution</td><td>VTT Industrial Systems</td></tr>
<tr><td>Address</td><td>Maritime and Mechanical Engineering, Otakaari 7B, P.O. Box 1705, FIN-02044 VTT, Finland
http://www.vtt.fi/</td></tr>
<tr><td>Other information</td><td>VTT is a Technical Research Centre of Finland, member of ITTC and ECMAR
The Maritime Institute of Finland is a joint venture of the Technical Research Centre of Finland (VTT) and the Helsinki University of Technology (HUT). Both institutions share the same facilities</td></tr>
<tr><td>R&D services</td><td>- Information and communication technology, electronics
- Machinery, materials, industrial engineering
- Transport, traffic, logistics
- Biotechnology, food industry, pharmaceuticals
- Pulp & paper, chemistry, environment
- Building, built environment
- Energy
- Other services

Machines, materials, production technology group of services include the following items:

<u>Machines and vehicles</u>
- Aircrafts
- Ships, boats and marine structures
- Railway vehicles
- Rotating machines
- Industrial vehicles
- Automobiles
<u>Product development</u>
- Lightweight structures
- Product performance
- Remote Control and Life Cycle Services
- Control Systems
- Innovative product concepts
- Noise and vibration control
- Ergonomics
- Loads
<u>Design methods</u>
- Simulation and virtual reality applications
- Virtual Prototypes
<u>Use and maintenance</u>
- Development of maintenance services and service business support
<u>Materials</u>
- Characterisation and usability
- Plastic materials
- Coating materials</td></tr>
</table>

	- Natural materials - Metals and composites - Composite materials - Functional materials - Nanomaterials <u>Production and manufacturing technology</u> - Machining - Production development and simulation - Simulation of manufacturing processes - Tool making - Welding and joining - Management of the production environment and air filter technology <u>Information services</u> - Training and consultation - STN International - International research (searches, surveys and analyses) - Patent landscapes, surveys and analyses - Publishing and publications <u>Innovation studies</u> - Innovation and industrial renewal - Innovation Policy Research and Impact Assessment of R&D - Technology Foresight and Technology Assessment <u>Development of business operations</u> - Enterprise risk management - Management of collaborative networks and their information - Business models and networking - Innovation processes and technology strategy - Organisational assessment and development - Management accounting and network economy <u>Testing and inspection, certification</u> - Expert consultation - Medical device technology - Boats, vehicle equipments - Electronics product technology - Structural testing - Analysis - Type approval services - Certification and product approval - Construction products - Fire testing and inspection <u>Within the area of ships, boats and marine structures the following services are mentioned</u> - Product development. - Design and use of ships, boats and floating offshore constructions, as well as their propulsion systems. - Development of high-performance, energy-efficient, safe and comfortable ships, boats and offshore constructions equipped

	with reliable systems. - Development of computational fluid mechanics and model testing technology for the improvement of the hydrodynamic properties of maritime technology products. - Improvement of the safety of maritime transport. - Maritime tests of the speed and steering properties of ships and boats by means of movement, acceleration, elongation, vibration and noise measurements. - Monitoring of the loads imposed on ships, boats, offshore constructions and their propulsion systems.
Description of facilities	
Towing tank	
Length	130 m,
Breadth	11 m,
Depth	5.5 m
Towing carriage data	- Maximum speed forward 8.5 m/s - Maximum speed backward 3 m/s
Wave generator	- Plunger-type, for regular and irregular waves - Provides regular as well as irregular wave - Maximum wave heights up to 32 cm.
Tests performed	- Resistance & propulsion in calm water & waves. - 3-D wake measurements, flow visualization. - Wave induced motions & forces on ships and floating structures. - Hydrodynamic forces on submerged bodies. - PMM tests for floating and submerged bodies etc.
Measuring devices & instrumentation	- PMM mechanism for captive manoeuvring model tests
Multipurpose basin	
Length	40 m,
Breadth	40 m,
Depth	2.9 m
Ice area	39 m x 37 m
Maximum level ice thickness	80-100 mm
Model ice	in 20 hours 50 mm thickness
XY towing carriage data	Functions: - ice making, - ice removal, - pushing ice against structures, - towing structures, - automatic following free-running models with telemetric data transmission. Carriage speed: 2 m/s(x), 3 m/s(y).
Wave generator	- Wedge-type, with15 separate sections,. - Regular and irregular waves. - Maximum wave heights up to 40 cm.
Additional description	Built for ice, manoeuvring and seakeeping tests

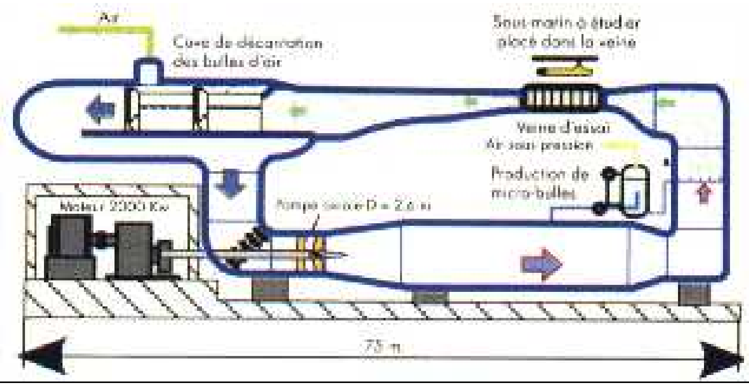
4.7 France

Basic description	
Name of the institution	**Bassin d’Essais des Carĕnes**
Address	Chaussée du Vexin, F-27100 Val de Reuil, France http://www.bassin.fr
Other information	Bassin d'essais des carènes is the centre of DCE (Direction des centres d'expertise et d'essais) in charge of the expertise for hydrodynamics, hydroacoustics and structure of vessels for wave loadings and vibroacoustics Member of ITTC
Activities	- Computer simulations - Tests on scale models - Sea trials Within the following areas: - Naval hydrodynamics and hydroacoustics, which determine the powering performance, the behaviour at sea, before and after damage, the hydrodynamic noise signature, cavitation, etc … - The structure of vessels in terms of response to wave loadings and vibroacoustics. - Underwater vehicle manoeuvrability and multi phase missiles behaviour The sea trials include - Speed and Powering measurements - Wave measurement ant platforms motions - Vibration behaviour, accelerometry - Cavitation visualisation - Acoustic measurement - Motion control systems

Description of facilities	
Towing Tank B600	
Length	545 m
Width	15 m
Depth	7 m (7,7 m without waves) max speed of carriage : 12 m/s Regular and irregular waves : 1 m crest to crest, period 0>3 s to5 s
Towing carriage data	Max. carriage speed - 12 m/s
Wave generator	double-flap wave generator, capable of creating regular waves or spectra of irregular waves. - 1 m crest to crest, period 0>3 s to5 s
Additional description	Ship models: - Length: 4-18 m - Max. weight – 12 t
Tests performed	- Prediction of the hull resistance - Self propulsion tests with either conventional or ducted propellers, or waterjet propulsion, or again podded propulsion - Powering performance of ships at full scale (shaft horsepower,

	shaft rotation rate, and ship speed)
	- Optimisation of the hydrodynamic performance of the ship including flow velocity surveys using Laser Doppler Velocimetry (LDV)
	- Flow visualisation using a variety of different techniques
	- Local pressure or force measurements
	- Seakeeping
	  - Motions in waves
	  - Slamming pressure and loads
	  - Added resistance in waves
	  - Stabilization systems performance
	  - Segmented models (structural model)
	  - Seakeeping of free running models
	  - Passengers comfort assessment
	- Stability
	  - Intact and damaged
	  - Dynamic in a seaway

Rotating arm Tank	
Diameter	65 m
Depth	5 m
Arm	Maximum speed 17°/s
Tests performed	- Manoeuvrability model tests of submarines The loads and moments to which a submarine is subjected are accurately measured by forced circular motion testing, for which the forward speed, drift angle and speed of rotation are stipulated. Tests in the horizontal and vertical planes are performed in the same manner: for horizontal movements, the sca!e model is attached under the rotating arm, whereas for vertical movements the model is placed on its side with the conning tower or sail towards the inside or the outside of the gyration - Tests on a free model of a surface vessel: zigzag, pull-out, crash-stop and straight line stability
Associated Computational tools	- COPLAN : Determination of hydrodynamic coefficients of manoeuvrability based on a shape plan. - DYSCO Three-dimensional simulation of emergency manoeuvres (steering fouit, boarding, ballast problem) using either the mathematical model supplied by COPLAN or the results of model tests. - CFD : Computation software based on Navier-Stokes equations for determining the forces acting on the hull and the wake around bearing surfaces and the possible interactions between the propeller and control surfaces.
Measuring devices & instrumentation	- 3-D laser velocity meter to measure speeds of flow - Optical trajectograph capable of following the movement of luminous marks on the model in order to reconstruct its trajectory for any type of manoeuvre
Roger Brard Wave tank	
General description	Used for the systematic experimental study of the hydrodynamic performance of surface vessels and submarines at a standstill or very low speeds under the most realistic environmental conditions (unidirectional or multidirectional waves in deep or shallow waters)

Length	32.5 m
Width	10 m
Depth	3.5 m in the flow section
Carriage	Maximum speed 1 m/s
Wave maker	Segmented wave maker composed of 24 blades 0.4 m wide and 2.3 m high. This segmented generator enables oblique waves to be created whose direction is different from that of the axis of the tank (30° max.), with multidirectional waves coming from more than one direction. 0,8 m (crest to crest) period 0,8 s to 2 s.
Additional description	The tank has a central pit 10 m x 10 m with a depth of 2,8 m. The depth of the tank can be adjusted: - maximum depth 2.7 m relative to the bottom (i.e. 5.5 m relative to the bottom of the pit). - minimum depth 0.4 m. The tank is equipped with perforated- plate damper to allow waves to be generated over prolonged periods and measurement platform
Tests performed	- Intact and damaged stability tests of a surface vessel. - Stationary roll tests. - Tests of stabilisation systems at low speeds. - Tests of mooring systems. - Study of swell. - Study of interaction between undersea acoustic waves and the structures present in the water.
Hydrobalistic Tank	
Dimensions	diameter 10 m, depth 16 m
Tests performed	study of the penetration of the free surface by objects ejected towards air or falling into water
Large Hydrodynamic Tunnel	
General description	Two parallel test sections, controlled injection of cavitation nuclei, control of dissolved gas concentration, very low noise level
Bigger test section	
Dimensions	10 x 2 x 1.35 m
Maximum speed	12 m/s
Pressure range	9kPa to 200kPa
Smaller test section	
Dimensions	6 x 1.14 x 1.14 m
Maximum speed	20 m/s
Pressure range	9kPa to 500kPa
Tests performed	- Propeller performance: power, cavitation, radiated noise, fluctuations of pressure on hull, erosion, fluctuations of pressure

	on blades, in open water or behind the complete hull. - Performance of lifting surfaces: drag, buoyancy, cavitation, transient phenomena. - Tests of models of surface and submarine vessels for different hull configurations: wake with and without appendages, aerodynamic simulations, flow noise, stabiliser fins and control surfaces etc. .. - Fluctuating pressures, vibration and noise measurement
Measuring devices & instrumentation	- Associated equipment: drive casing for one or two (contra-rotating) propellers with a silent 500kW hydraulic turbine, six-component force-measurement device for fins, water jet covers usable for surface vessels and submarines. - Associated instrumentation: data acquisition, 2x2D laser velocity meter, acoustic hydrophone and acoustic porthole, photographic and video recording, laser vibrometer .
Additional information on particular configuration, equipment and testing in GTH	<u>Submarine, torpedo:</u> Configuration of the test tunnel - closed tunnel - complete hull - D <250 mm - V< 10m/s - with or without drift angle Measurements - cavitation (t, J, K_t) - self-propulsion with or without cavitation K_t, K_q, - acoustic fluctuations of pressure on hull - hull -loads on blades - speed of flow before and after propeller Equipment - silent drive - soufflage boundary layer blowing 0.1 % dynamometer - connection for hydrophone and/or antenna and anechoic porthole - LDV2 x2D <u>Surface vessel</u> Configuration of the test tunnel - closed tunnel - complete hull - D < 250 mm - V < 10 m/s - wake generator Measurements - cavitation (σ, Kt} - self-propulsion with or without cavitation K_t, K_q - nominal or actual wake - acoustic - fluctuations of pressure on hull - loads on blades - speed of flow before and after propeller Equipment

	- special tunnel cover - silent drive blowing 0.1 % dynamometer - hydrophone connection - LDV 2 x 2D <u>Evaluation of propellers</u> Configuration of the test tunnel - closed tunnel - V_{max} 20 m/s - propeller alone - specific operating conditions (deceleration, manoeuvring, performance in reverse) - inclination of shaft between 0° and 10° Measurements - cavitation (J, Kt) - self-propulsion with or without cavitation Kt, Kq, - nominal or actual wake - acoustic - speed of flow before and after propeller Equipment - contrarotating casing - silent drive - dynamometer 0.1% - six-component load measuring rig - LDV2 x 2D - hydrophone connection
Small hydrodynamic Tunnel (PTH)	
Test section dimensions	3,6 x 0,5 x 0,6 m
Maximum speed	7 m/s, pressure;
Pressure range	7kPa - 200kPa
Additional information	variable water height from 0, 15 m to 0,5 min free surface configuration
Manufacturing facilities	- Design and project development unit using the CAO Circé and Euclid software products - Wooden model workshop - Composite materials workshop - Digital controlled machine workshop fitted with 5 axis milling machines, and with a measuring machine.
Data processing equipment	- Workstations and microcomputers all network connected, - Software for propeller design, for Navier-Stokes flow, time and frequency domain seakeeping, wave resistance calculations, as well as structure and radiated noise calculations.

Basic description	
Name of the institution	**Centre d'Études et de Recherches de Grenoble (CERG)**
Address	ALSTOM Fluides et Mécanique F-38800 Pont de Claix http://www.cerg-alstom.com
Other information	Member of ITTC
Activities	The following areas are addressed - aerodynamics, - hydrodynamics, - internal flows, - head loss or transient flows calculations for fluid networks, - cavitation. The activities concern: - General applications to fluid mechanics - Process engineering - Atmospheric environment - Noise and vibration - Special equipment supply (e.g. prototypes of turbomachines, valves, etc. as well as test facilities components, didactic benches, research equipment)
Description of facilities	
List of the facilities	- pump test loops - hydrodynamics and cavitation tunnels (8 m^3/s and 2 m^3/s) - free surface channels, controllable pressure tanks and wells - specialised loops for high pressure, crude oil, hydro-acoustic
Measuring devices & instrumentation	- data acquisition and storage, - signal processing, - video, photography, cinema, image processing, - flow visualisation

Basic description	
Name of the institution	**École Centrale de Nantes** **Laboratoire de Mécanique des Fluides**
Address	UMRCNRS 6598, 1 Rue de la Noe, B.P. 92101, F-44321 Nantes Cedex 3, France http://www.ec-nantes.fr/DHN
Other information	Member of ITTC, WEGEMT

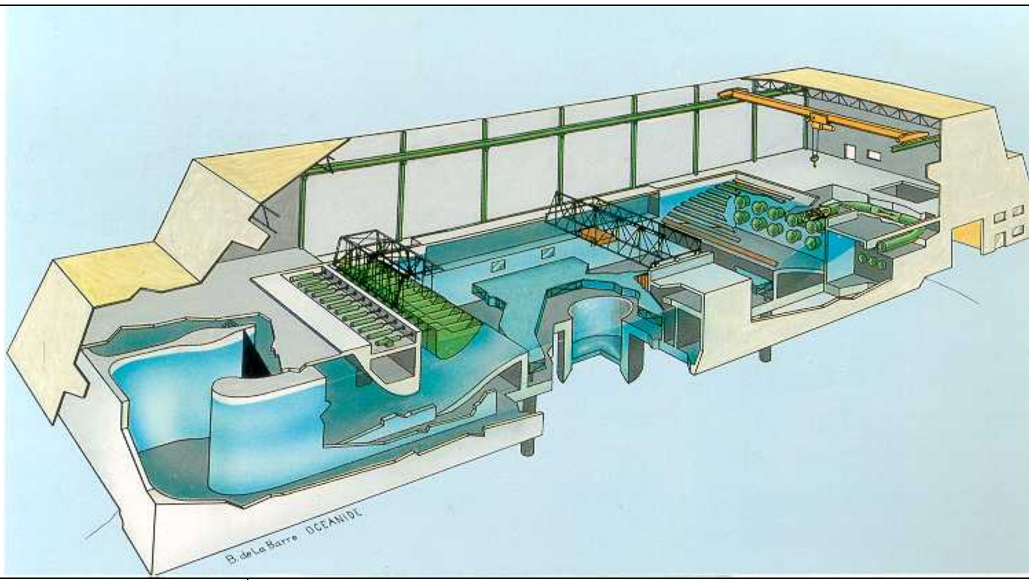
Basic description	
Name of the institution	**Institut de Recherches de la Construction Navale (IRCN)**
Address	1 Rue de la Noe, B.P. 72108, F-44321 Nantes Cedex 3, France http://www.principia.fr
Other information	Member of ITTC
Principal fields of activity	- Fluid Mechanics - Thermal Hydraulics - Neutronics - Criticality - Radioprotection - Environment - Hydrodynamic - Structural Engineering - Simulation Integrator <u>Marine fields of activity include:</u> - Ship Manoeuvring - Hydrodynamic & loads - Stability - Collision and Grounding - Fatigue life prediction - Crack propagation - Operation limits - Monitoring - Ship evacuation - Static Analysis, optimization - Vibration and comfort - Buckling & Ultimate Strength - Fluid/structure Coupled analysis - Slamming /Whipping - Classification rules checks - Underwater shock analysis - Shocks and explosions

<table>
<tr><td colspan="2">Basic description</td></tr>
<tr><td>Name of the institution</td><td>Bassin du Génie Oceanique First (OCEANIDE)</td></tr>
<tr><td>Address</td><td>Port de Bregaillon, B.P. 63, F-83502 La Seyne/Mer Cedex
http://www.oceanide.net</td></tr>
<tr><td>Other information</td><td>Private company, since 1986, member of ITTC</td></tr>
<tr><td>Activities</td><td>- Coastal simulations (model and numerical tests)
- Exhibition and mechanical models fabrication
- Offshore model tests

<u>Offshore typical services</u>
- Modelling (CAO, instrumentation, design of experiment) ;
- Model fabrication ;
- Currents, waves and winds calibration ;
- Basin tests and data acquisition;
- Data processing ;
- Results analysis and interpretation ;
- Complex behaviour expertise.

<u>Coastal engineering - experimental studies with small-scale models</u>
- Harbour development
    - stability and crossing breakwaters studies
    - harbour roughness studies
    - efforts measures on maritime structures
    - shifting measures
- Bathing development and coastal protection
- Draining

<u>Studies on plans; Numerical simulations</u>
- Harbour development
- Bathing development and coastal protection
- Draining
- Impact studies
- Expert evaluation on site</td></tr>
</table>

Description of facilities	
Offshore tank	
	
Length	24 m
Breadth	16 m
Depth	Movable bottom, variable depth: from 0 to 5 m , with slope of 7 m Central pit : depth 10 m, diameter 5 m
XY carriage data	Maximum speed: longitudinal=1.2 m/s; transversal=0.8 m/s
Wave generator	- 12 independents waves makers - Regular and irregular waves - Periods from 0.7 s to 3.0 s - Heights up to: 0,8 m - Oblique regular waves.
Current generation	- 12 electrics pumps - Waves direction and opposite direction - Maximal flow : 25 m3/s - Maximum speed, 3 m depth(optimum): direct=0.4 m/s; indirect=0.25 m/s
Wind generation	- Maximum speed= 7 m/s (any directions) - XY mobile carriage - Allows to fix a trajectory to a model - Maximum speed: longitudinal = 1,5 m/s, transversal = 0,8 m/s
Additional description	Shock absorbers: - Longitudinal: parabolic beach, which does not disturb the current - Laterals: die down the reflected waves and the ones diffracted by the models.
Tests performed	- Developments of fixes structures «offshore» - Developments of floating structures «offshore» - Naval engineering - Link between sea bed and surface - Coastal works
Measuring devices &	- Tracking system: aerial (Krypton), underwater (Trajectory)

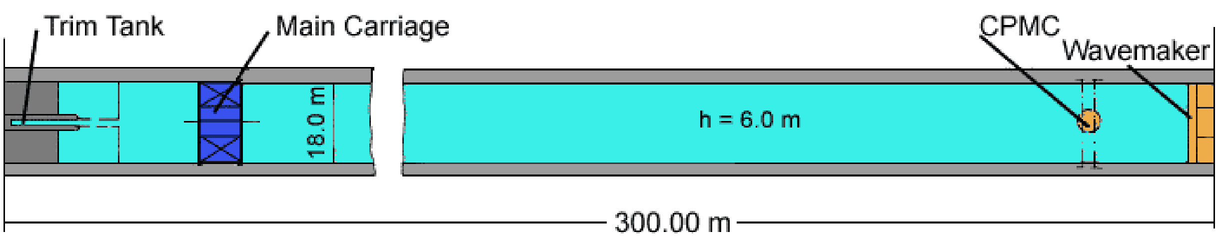
instrumentation	- 6 components dynamometer, anemometers, accelerometers, current meters - Pressure sensors, strain gauges - Waves gauges (resistive and capacitive)
Wave tank	
Beater	standard float oscillating duck
Generated swells	- Random and regular - Period simulated: [0,8 – 2,2 S]
Revolving plate	Modification of attack angle swell on the models
Additional description	Shock absorbers: - The main thing: ballast out of roller - Side: the vague parasites absorb due to reflexions on the models tested
Tests performed	- Three-dimensional modelling of ports (agitation harbour and held works), - Measurements; efforts (in 3 directions) on structures, - Sedimentological study of recharging General
Measuring devices & instrumentation	- Capacitive probes, - Dynamometric balance 6 components • - Incremental position sensors standard LVDT, - Accelerometers - Telemeter laser, - Acquisition: from 16 to 64 multiplexed ways, - Conversion A/D with 100 KHz.
Flume test	
Beater	standard float oscillating duck
Generated swells	- Random and regular - Period simulated: [0,8 – 2,2 S]
Generation of current	- Circulation with speed of 1 knot(without convergent) - Simultaneous generation of swell and possible current Modification of attack angle swell on the models
Additional description	Shock absorbers: - The main thing: ballast out of roller - Side: the vague parasites absorb due to reflexions on the models tested
Tests performed	- Stability and crossings of dams with slope, - Efforts on a vertical face breakwater or an immersed box, - Efforts on an immersed cylinder, - Sedimentological study of recharging of beach, - Measurements of flows of crossing on a reef, - Study of structures with convergent and diverge
Measuring devices & instrumentation	- Resistive probes, - Balance dynamometric 6 components, - Incremental position sensors standard LVDT, - Accelerometers • - Telemeter laser, - Acquisition: from 16 to 64 multiplexed ways, - Conversion A/D with 100 KHz.

4.8 Germany

Basic description	
Name of the institution	**Hamburgische Schiffbau Versuchsanstalt GmbH (HSVA)**
Address	Bramfelder Strasse 164, D-22305 Hamburg, Germany http://www.hsva.de
Other information	Member of ITTC and ECMAR
Activities & services	CAD - Lines Design –the design of hull lines according to customer specifications. - Production Fairing - Scale Model Fabrication CFD - Wave resistance - Hull form optimisation - Wake predictions - Propeller flow - Submarine hydrodynamics - Manoeuvring - Aerodynamic flow Ship hydromechanics - Resistance and Propulsion - Design optimisation for hull forms and appendages - Accurate prediction of the speed/power requirement of a ship and propeller design - Full scale measurements Ice and Offshore - Icebreaking ships - Numerical ice technology - Structures in ice - Arctic engineering - Full scale measurements - Measuring services - Ice mechanics

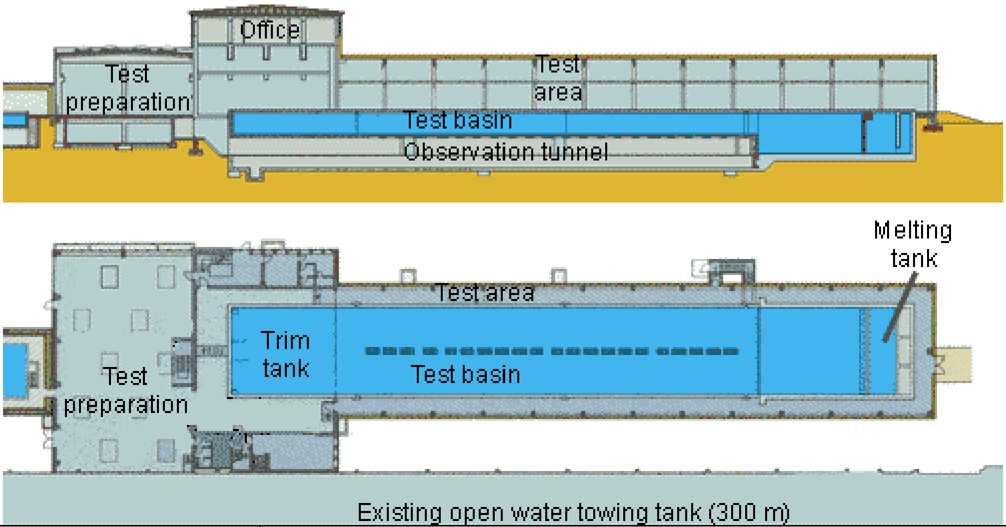
Description of facilities

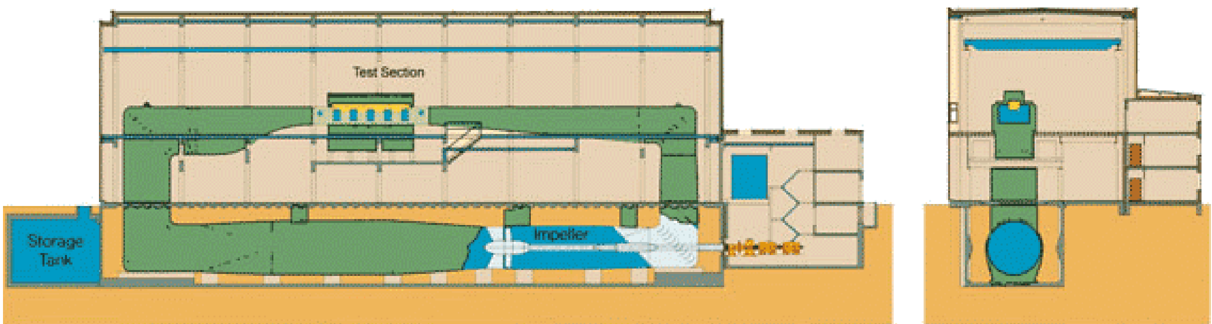
Large towing tank

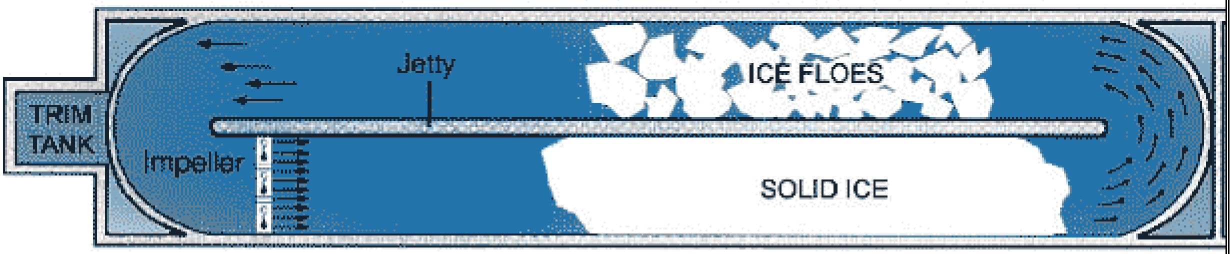


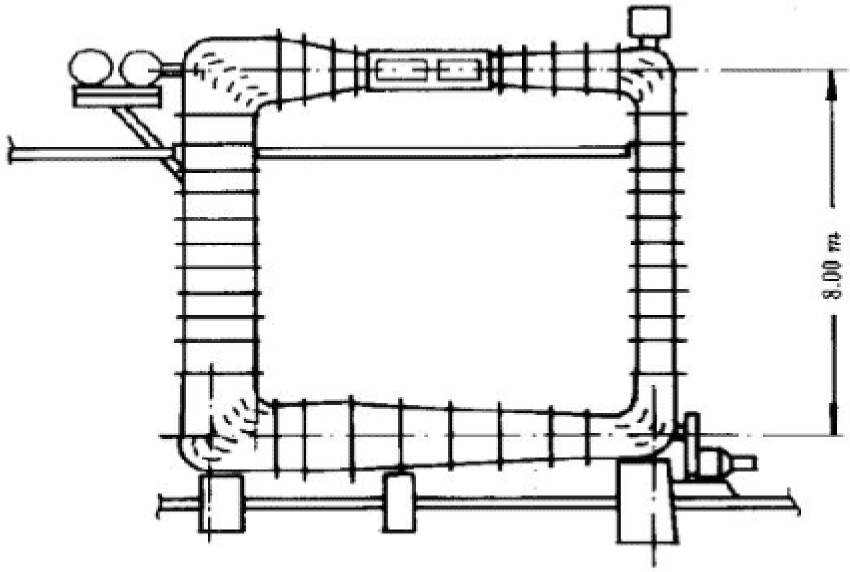
Length	300 m
Breadth	18 m

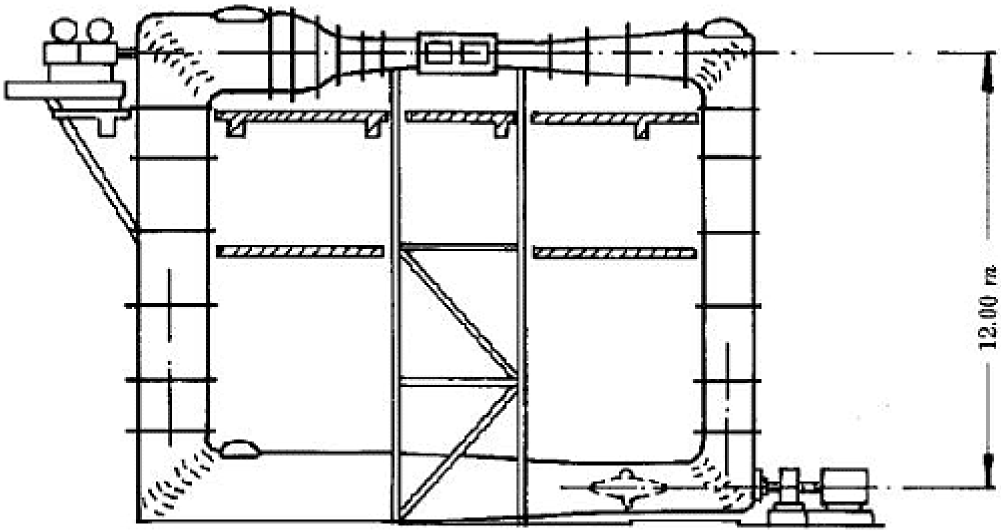
Depth	6 m
Towing carriage data	- Manned. Main carriage equipped with transverse carriage. Separate computerized planar motion carriage (CPMC) - Type of drive and total power: 4-wheel motor drive with Leonard System - Equipped with computer for control of experiments and online data acquisition and processing - Maximum speed 8 m/s - Maximum acceleration 0.64 m/s^2 - Maximum deceleration 1.40 m/s^2
Wave generator	- Duplex flap type, hydraulic, 18 meters wide - Beach type and length: sparred wood grating at trimming tank side - Method of wave generation: regular waves, computer generated wave trains with chosen spectra, wave packets and reproduction of measured wave trains - Method of irregular wave generation: spectra composed of at least 100 single components (electro-mechanical) - Maximum regular wave heights up to 50 cm.
Additional description	- Model size range: 2 - 12 meters - Model tracking techniques: controlled by human operator or fully automatic by process control computer <u>CPMC characteristics:</u> - CPMC max speed, longitudinal: 3.0 m/s - CPMC max speed, transverse: 1.9 m/s - CPMC max yaw rate 24°/s
Tests performed	- resistance, - propulsion and tracking tests, - horizontal planar motion testing (Towing and tracking, CPMC), - flow observation (paint and underwater TV), - wake measurements, - propeller open water tests, - seakeeping tests (in regular or irregular waves), - measurement of forces and pressures acting on hulls or offshore structures, - rolling tests, - mooring tests, - static submarine tests, - nonsteady submarine tests.

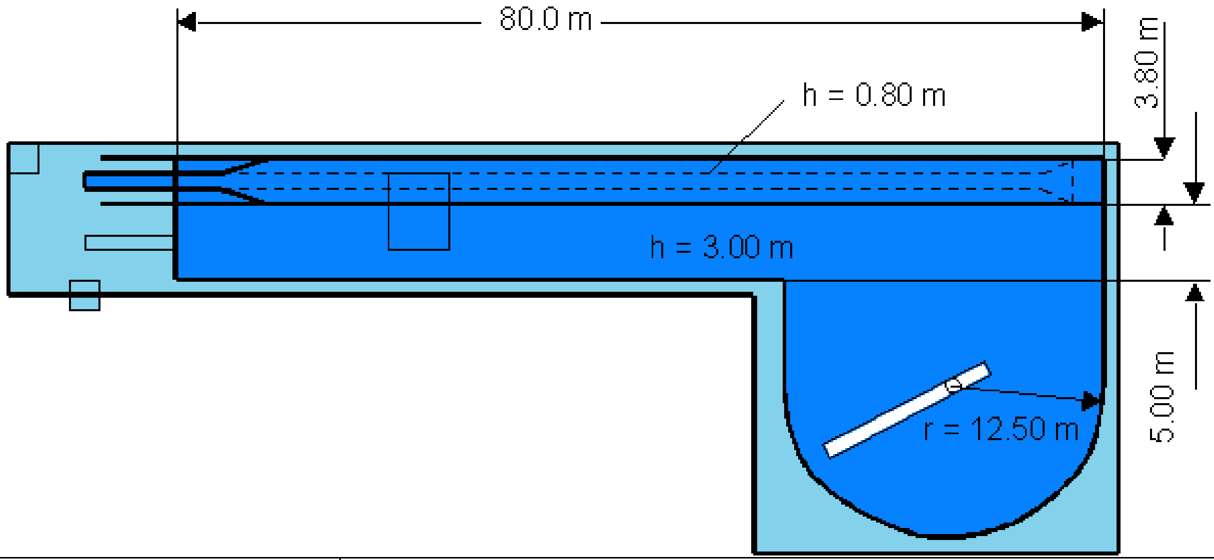
Large ice model basin	
	
Length	78 m
Breadth	10 m
Depth	2.5 m
Ice frrezing rate	2 mm/hour
Shallow water bottom	Adjustable over length and depth
Towing carriage data	- Speed range 1 mm/s <-> 3000 mm/s - Towing capacity: 50 kN
Transverse carriage:	- Static load capacity (horizontal): 5 kN - Static Load capacity (vertical): 10 kN - Load application on vertical lever: up to 1.2 m - Maximum driving force : 3 kN, at speeds up to 0.5 m/s
Additional description	At the end of the ice tank a deep water section of 12 m x 10 m x 5 m is available. A shallow water bottom covering the entire ice basin can be adjusted to simulate shallow water conditions or inland waterways. An air forced cooling system generates air temperatures as low as -20°C, by which the NaCl-doped water freezes at a rate of about 2 mm/hour. The mechanical ice properties of the model ice are correctly scaled in order to simulate the natural icebreaking processes. A motor-driven carriage the width of the tank and runs up to 3 m/s and provides a towing force of 50 kN. A transverse carriage is installed as a sub-carriage to the main ice tank carriage. Both carriages together make it possible to run offshore structures or floating vessels in a combined and computer-controlled x-y-motion (planar motion) through the ice sheet. The device gives us the opportunity to simulate, for instance, ice drift scenarios with slow or rapid ice drift direction changes, whereby the model ice sheet is kept stationary. The transverse carriage has a maximum static load capacity of 5 kN in any horizontal direction, and a load capacity of nearly 10 kN in vertical direction. The horizontal load can be applied on a vertical lever of up to 1.2 m length. A maximum driving force of about 3 kN is applied to the transverse carriage at speeds of up

	to 0.5 m/s by a geared electric motor. Service carriages above water as well as underwater are available to carry experimental equipment, measuring devices e.g. a variety of load cells, dynamometers, accelerometers, and video cameras (both above water and below water). Direct observation of the model tests is also possible through windows in the tank bottom. According to Froude's and Cauchy's model laws the following ice conditions can be simulated in the tank: - Level ice - Rafted ice - Pressure ice ridges - Broken ice - Rubble ice pack ice - Snow covered ice
Tests performed	<u>Icebreaking ships:</u> - Resistance tests - Self-propulsion tests - Manoeuvring tests - Ice management in rivers and inland waterways <u>Structures in ice:</u> - Ice forces on fixed structures (vertical or conical shaped) - Mooring forces on floating structures - Global ice forces on artificial islands - Ice forces on offshore loading terminals - Ice accumulation and ice pile-up on artificial islands and arctic harbours.
HYKAT – hydrodynamics and cavitation tunnel	
	
Description	Closed circulating cavitation tunnel with horizontal top, bottom branch submerged in a trench, numerous acoustic treatment features, variable speed, variable pressure, aeration/deaeration system.
Type of drive system	2 electric motors (each 850 kW) driving a 3.775 m diameter seven bladed impeller, stator with nine blades
Test section max. velocity	12.6 m/s (22.5 knots)
Max. & min. absolute pressures:	2.5 bar, 0.15 bar
Dimension of test section:	2.80 x 1.60 x 11.00 meters
Propeller and model size range:	Up to 11.0 m length, 1.7 m beam, behind hull propeller diameter 200 to 300 mm
Max. revs. of model propeller:	60 1/s
Measuring devices &	- Propeller dynamometers with drive motors inside flooded

instrumentation	models - Pressure sensors, hydrophones in the acoustical trough under the test section floor or in the models, computerized data collection, video system inside the flooded models, Laser-Doppler-Anemometer (LDA), Particle-Dynamic-Analyser (PDA) - Planar Motion mechanism (PMM) - High speed video system
Tests performed	- Propeller and rudder cavitation tests, - cavitation inception investigations, - force measurements, - determination of hydrodynamic coefficients from maneouvring tests, - flow visualization, - noise tests on complete hull - appendage - propulsor configurations, - investigations on surface ships, submarines, torpedoes and full scale propulsor units, - flow noise investigations, - wake measurements
Arctic environmental test basin	
	
	HSVA operates the largest refrigerated Arctic Environmental Test Basin world wide. The basin is 30 m long, 6 m wide and 1.2 m deep., allowing the simulation of typical arctic ice conditions such as level ice, broken ice, frazil ice and pancake ice, pack-ice, rafted ice and pressure ice ridges. In addition to the ice-making facilities (ice growth rate 2 mm/h), special features include a Various types of experiment for the investigation of ice properties are carried out in HSVA's refrigerated ice laboratory.
Length	30 m
Breadth	6 m
Depth	1.2 m
Ice frezing rate	2 mm/hour
Air temperature	-20°C to + 20°C
Additional description	The basin is equipped with current generator and a mobile wave generator capable of producing wave heights of about 0.3 m. Windows in the bottom of the basin as well as an underwater video system allow visual observation and documentation of scenarios underneath the ice cover. Generation of wind (max. speed 10 m/s). Controlled lighting for optimum algae growth The following ice conditions can be simulated: - Frazil ice and pancake ice can be produced by operating the

	- Level ice - Broken ice - Pancake ice - Rafted ice - Pressure ice ridges
Tests performed	- Study of physical ice growth processes - Investigations on microstructure of ice - Study of sedimentological processes - Penetration and distribution of oil in ice - Biodegradation of oil polluted ice - Weathering of oil - Study of marine biological processes in the ice - Sea ice ecology - Modelling of oil spill fate - Development of oil spill combat techniques and methods
Medium cavitation tunnel	
	
Description	Produced by K & R, square working section 570 x 570 mm
Type of drive system	4 bladed axial flow impeller, 4-quadrant thyristor converter control
Test section max. velocity	10.0 m/s
Min. cavitation number	0.50
Max. & min. pressures:	1.5 bar absolute down - vapour pressure
Dimension of test section:	0.57 x 0.57 x2.20 meters
Range of propeller diameter:	230-290 mm
Max. revs. of model propeller:	50 1/s
Measuring devices & instrumentation	- Laser Doppler Velocimeter and equipment for nuclei distribution measurement - Type and location of torque and thrust dynamometer: mechanical, upstream, horizontal shaft, 14.3 kW at 3500 1/min
Tests performed	- Cavitation tests in uniform flow as well as in simulated wake

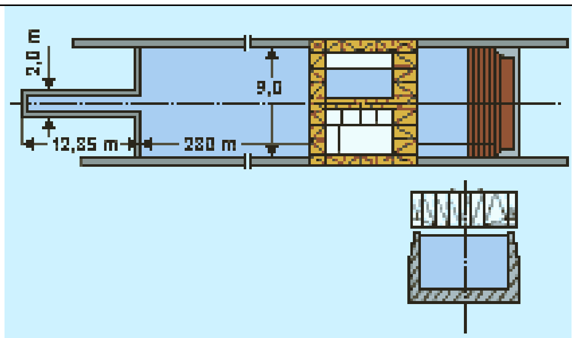
	field. - Measurement of unsteady propeller blade forces, hull pressures, propeller noise and gas content. - Measurements of 3-dimensional velocity field by Laser Doppler Velocimetry.
Large high speed cavitation tunnel	
 	
Description	Produced by K & R, circular working section d = 750 m
Type of drive system	4 bladed axial flow impeller, Leonard-System Impeller: 350 kW at 375 1/min Propeller: 130 kW at 4500 1/min
Test section max. velocity	19.5 m/s s
Min. cavitation number	0.13
Max. & min. pressures:	2.5 bar absolute down - vapour pressure
Dimension of test section:	Diameter 0.75 m, length 2.25 m
Range of propeller diameter:	1. 320-400 mm 2. 280-320 mm
Max. revs. of model propeller:	75 1/s
Measuring devices & instrumentation	- Laser equipment for nuclei distribution measurement Dynamometers: - Mechanical, upstream, horizontal shaft, 130 kW at 4500 1/min - Strain gauges, downstream, inclined shaft up to 12 degree
Tests performed	- cavitation tests in uniform flow as well as in simulated wake field. - measurement of unsteady propeller blade forces, hull pressures, propeller noise and gas content, - partial rudder model testing

Small towing tank, shallow water flow channel	
 	
Length	80 m
Towing carriage data	- Manned. - Motor drive with Leonard system - Maximum speed 3.6 m/s
Wave generator	- Plunger type - Wave length up to ~ 6.0m, height up to~ 0.3 m.
Additional description	- Model size range: 2 - 6 meters - Model tracking controlled by human operator
Tests performed	- resistance - Propulsion - propeller open water - turning circle tests. - especially experiments with ships as well as structures for which the test preparation is extremely time consuming

Basic description	
Name of the institution	**Schiffbau Versuchsanstalt Potsdam GmbH**
Address	Marquardter Chaussee 100, D-14469 Potsdam, Germany http://www.sva-potsdam.de
Other information	Member of ITTC
Activities	<u>Ship design</u> - Development of ship form - Lines drawing in appropriate scale - Form optimisation <u>Hydrostatic booklets</u> - Loading conditions - Critical stability - Regulations (tonnage, freeboard, floodable length) <u>Recommendations for</u> - Main dimensions - Propeller, rudder, nozzles - Stern arrangement - Bulbous bow <u>Prediction of speed and power</u> - Based on statistics - Based on calculation programs <u>Prediction of seakeeping and ship motions</u> <u>Recommendations for energy saving devices and propulsion systems</u> - Asymmetric stern - Nozzles - Fin systems - Contra rotating propelles, ducted propellers, tip-fin propellers, CLT-propellers etc. - Z-drives - Podded drives - Water jets

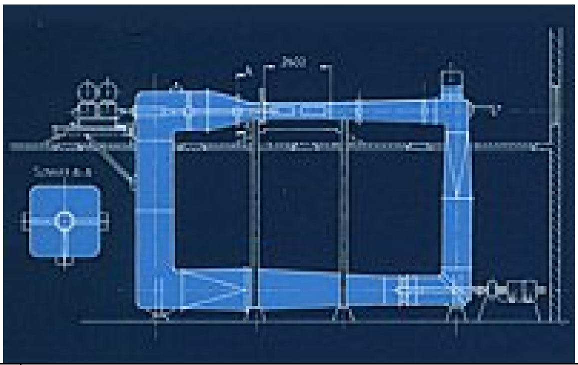
Description of facilities

Towing tank



Length	280 m
Breadth	9 m
Depth	4.5 m
Towing carriage data	- Maximum speed 8 m/s - Propulsion: linear-type motors
Wave generator	yes
Additional description	Additional test facilities - Slamming test facility - Wave maker for wave packets - SUBPMM for underwater models
Tests performed	- resistance and propulsion tests, - measurements of wake field and boundary layer, - paint flow - open water tests of conventional propellers, ducted propellers, contra rotating propellers, podded drives etc.. - optimisation of hull form, - determination of manoeuvring and seakeeping characteristics including slamming damage, - measurements of forces and moments on a single blade of propellers as well as arrangements of energy saving devices, tunnels and nozzles. - towing tests with fishing gears, life-saving appliances and sport boats as well as underwater models - towing tests in oblique flow
Measuring devices & instrumentation	- Dynamometer for open water tests H 29 of Kempf & Remmers up to a thrust of 400 N, a torque of 15 Nm - Dynamometer for open water tests H 39 of Kempf & Remmers up to a thrust of 1000 N, a torque of 55 Nm - Dynamometers for azimuthing thrusters and podded drives TP 200, TP 400, TP 600 - Mechanical force balance - Electrical force balance - Several inboard dynamometers of Kempf & Remmers up to a thrust of 400 N, a torque of 15 Nm - Balance for 6 degrees of freedom for nozzles - Z - drives - Potentiometer for measurement of trim - Balance R 35 - L for 1 degree of freedom - Balance R 37 S for 6 degrees of freedom - LDV - measurement devices - 5 - hole probes

Cavitation tunnel



Description	K 15 A (Kempf & Remmers, Hamburg)
Impeller	100 kW, 360 min-1, Di = 1078 mm
Test section dimensions	- 600 mm x 600 mm - 850 mm x 850 mm
Max. water speed	- 12 m/s - 6 m/s
Pressure range	P_{min} = -0.93 bar, P_{max} = 1.20 bar
Tests performed	- open water tests of free and ducted propellers in uniform flow and in a wake field - cavitation tests - cavitation erosion tests - measurement of propeller induced pressure pulses - measurement of propeller induced pressure noises - measurement of velocity with Pitot - tubes and LDV anemometer - measurement of force and moment pulses as well as hydrodynamic spindle torque on a single blade - measurement of force, moments of pressure on nozzles, rudders and profiles - investigations of bow thrusters.
Measuring devices & instrumentation	- LDV-measurement devices for 2D and 3D velocity measurements - Dynamometer for open water tests J 25 of Kempf & Remmers up to a thrust of 3000 N, a torque of 150 Nm and a speed of 60 rps - Dynamometer for open water tests H 36 of Kempf & Remmers up to a thrust of 2000 N, a torque of 100 N and a speed of 50 rps - Propeller dynamometer R 45 of Kempf & Remmers up to a thrust of 400 N, a torque of 150 Nm - Balance R 37 for 6 degrees of freedom - Balance R 35 - x for 1 degree of freedom - Dynamometers for azimuthing thrusters and podded drives TP 200, TP 400, TP 600

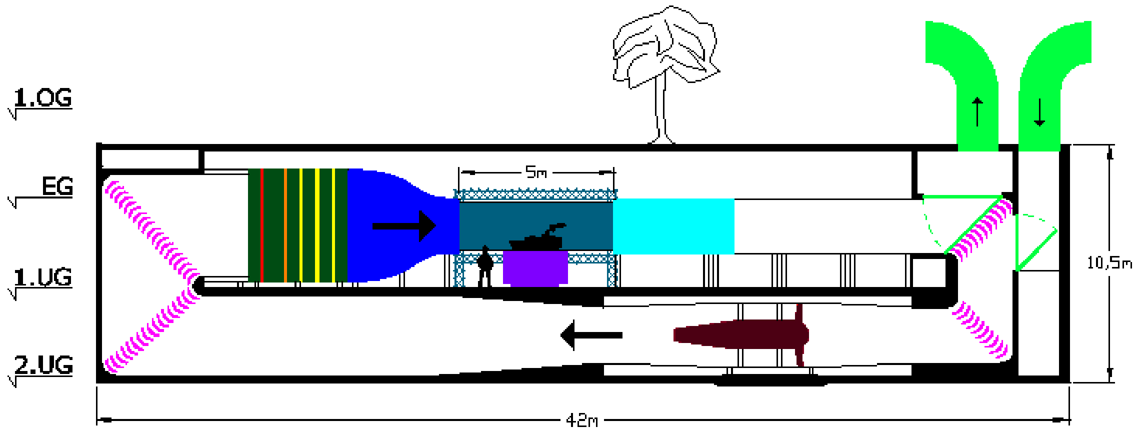
Basic description	
Name of the institution	**Technische Universitat Berlin**
Address	Institut für Schiffs- und Meerestechnik, Salzufer 17-19, D-10587 Berlin, Germany http://www.ism.tu-berlin.de/MT
Other information	Member of ITTC and WEGEMT
Concluded research projects	- Oil Skimming: Analysis of Oil Separation within an Oil Skimming System - Optimization of Extreme Waves - SinSee: Evaluation of Ship Safety in Severe Seas - MAXWAVE - BIODEEP - BIOtechnology from the DEEP - Hydrodynamic Shape Optimization of Offshore Structures Using Global Optimization Strategies - ROLL-S - KENSTSE: Computer Controlled Capsizing Tests in High Wave Groups - GEOSTAR 2"GEophysical and Oceanographic STation for Abyssal Research" - "Schleppfisch": experimental investigations of towed bodies - "Artificial Reefs": Underwater filter systems for coastal protection - Numerical simulation of nonlinear transient wave groups - MARNET-CFD - Global optimization strategies for offshore structures - Automated form generation of offshore structures using NURBS - Floating cranes as a technical problem of Nonlinear Dynamics - Optimization of seakeeping tests - Hydrodynamic improvements of oil recovery vessels by integrated wave absorbers - Hydrodynamic optimization of offshore structures - Analysis and optimization of vertical wave absorbers - Interactions between vessel, stinger and pipeline during laying operations in high seas - Optimization of vertical wave absorbers for coastal protection
Current Research Projects	- MPLS20 — Maritime Pipe Loading System 20" - Handling Waves — Decision support system for ship operation in rough weather - LaSSe — Lasten auf Schiffe im Seegang - mar-ing — Netzwerk Schiffs- und Meerestechnik - S O S: Seaway Independent Oil Skimmer
Description of facilities	
Small wave basin	
Length	15 m
Breadth	0.3 m
Depth	0.4 m
Additional description	- construction made of Plexiglas - electrically driven wave maker

	- all kinds of waves can be generated s.
Deep water tank	
Length	12 m
Breadth	1.5 m
Depth	3/5 m
Additional description	for deep water tests in offshore engineering research
Seakeeping basin	
Length	120 m
Breadth	8 m
Depth	1.1 m
Additional description	- electric driven three flap wave maker, allowing flap type and piston type motion - electric driven carriage for towing tests with optical motion tracking system

Basic description	
Name of the institution	**Technische Universität Hamburg-Harburg (TUHH)**
Address	Fluiddynamik und Schiffstheorie (AB 3-13), Lammersieth 90, D-22305 Hamburg, Germany http://www.tu-harburg.de/fds/
Other information	Member of ITTC and WEGEMT
Concluded research projects	- Development and application of a finite-volume-method for computation of flows around moving bodies on unstructured, overlapping grids. - Bewegungssimulation schwimmender Körper in viskoser Strömung - Entwicklung eines numerischen Verfahrens zur Berechnung der Wechselwirkung zwischen inkompressiblen Strömungen und linear-elastischen Strukturen - Numerische Simulation turbulenter Strömungen um eine Kugel - RANSE-simulation of ship manoeuvres - Vertäu- und Schleppsysteme - Virtual Reality for CFD post-processing - Rolldämpfung mittels Voith-Schneider-Technologie, Bericht für Voith Turbo Marine GmbH, 2004. Not published. - Schleppen eines Vorschiffs der Aker MTW Werft. Bericht an den Germanischen Lloyd, Juni 2004. Not published. - Upgrading of the ditching simulation for the aircraft A400M. Report for Airbus, September 2005. Not published. - Comparison of the seakeeping behaviour of 3 tugs. Internal Report October 2005.
Current projects	- Nonlinear dynamics of offshore systems in stochastic sea-wave - Netzwerk Schiffs- und Meerestechnik: mar-ing - Network maritime technologies - Development of a Mesh Free Simulation Method for the Study of Port Hydrodynamics - Ditching of Aircraft - Development of parallel RANS-solver for unstructured grids. - Patch Method with free surface

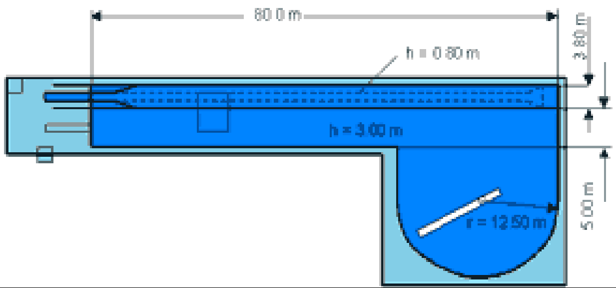
Description of facilities

Wind tunnel



Length	83.2 m (one circulation on middle axis)
Length	42.0 m (maximum dimension)
Breadth	5.5 m
Height	10.5 m
Length of test section	5.0 m
Test section cross sections and corresponding maximum velocities	- 2.0 m x 3.0 m: approx. 30 m/s - 2.0 m x 2.0 m: approx. 45 m/s - 1.35 m x 1.35 m (planned): approx. 90 m/s
Measuring devices & instrumentation	6 component balance: non-decoupled weighing platform (under floor): - max. model weight: 150 to 250 kg - max. forces: 200 to 400 N - max. moments: 200 Nm

Towing tank



Length	80.00 m
Width	5.00 m
Depth	3.00 m
Towing carriage	- max. velocity: 3.6 m/s - model size range: 2 to 6 m - height over water surface: 0,8 m
Wave maker	- max. wave length: approx. 6 m - max. wave height: approx. 0,3 m
Measuring devices & instrumentation	6 DOF inertial system, consisting of three fibre-optical gyro sensors and three acceleration sensors, for survey of motions during manoeuvring and seakeeping tests

Basic description	
Name of the institution	**Versuchsanstalt für Binnenschiffbau Duisburg**
Address	Europäisches Entwicklungszentrum für Binnen- und Kütenschiffahrt, Oststrasse 77-77a, D-47057 Duisburg, Germany http://www.vbd.uni-duisburg.de/
Other information	Member of ITTC and ECMAR
Activities	Predictions - speed-performance ratio, - resistance, - navigational dynamics. Vessel Optimisation - fuel consumption, - wave formation, - operating areas. Development of New Vessel Types and Concepts - transport tasks, - operating areas, - conventional and unconventional fast ships and surface effect craft. Ship Design Investigations into Vessel Safety - stability, - steering safety/damage stability. Manoeuvring - give-way manoeuvres and stopping ability, - passing-by and overtaking procedures. Consulting Services - safety regulations, - registration regulations, - modernization of existing vessels, - waterway and port construction. Environment - investigation of pollution control vessels and equipment, - emissions, - vessel influence on waterway embankments.

Description of facilities	
Large shallow water tank	
Length	190 m
Breadth	9.8 m
Depth	variable water depth (max. 1,25 m)
Towing carriage data	- Model tests up to 6.5 m/s - Equipped with planar-motion-mechanism of max. amplitude ±

	0.75 m. - Fast towing carriage with max. velocity V = 15 m/s can be used as single carriage or in combination with the big carriage for overtaking and encounter tests
Wave generator	3 single applicable flaps with translation and rotation for regular waves and swell, wave spectrum can be defined
Additional description	The tank has underwater-observation-window.
Small deep water tank	
Length	73 m
Breadth	3 m
Depth	max. 3 m deep
Wave generator	small wave generator
Manoeuvring basin	
Length	25 m
Breadth	25 m
Depth	variable water depth (max. 1,25 m)
Additional description	Equipped with rotating arm facility

4.9 Greece

Basic description	
Name of the institution	**National Technical University of Athens**
Address	Department of Naval Architecture and Marine Engineering, 9 Heroon Polytechniou Str., Zografou, Athens, 157-73, Greece http://www.naval.ntua.gr
Other information	Member of ITTC and WEGEMT
Activities	Divisions - Ship Design & Maritime Transport - Ship Hydrodynamics - Marine Engineering - Marine Structures Labs - Marine Engineering Lab. - Lab. for Ship & Marine Hydrodynamics - Ship Building Technology Lab. - Ship Design Lab.

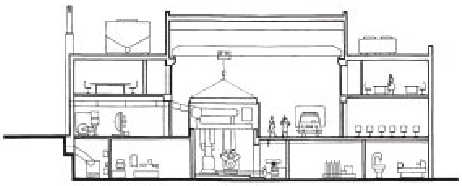
Description of facilities

NATIONAL TECHNICAL UNIVERSITY OF ATHENS - Department of Naval Architecture and Marine Engineering - **Laboratory of Marine Engineering**

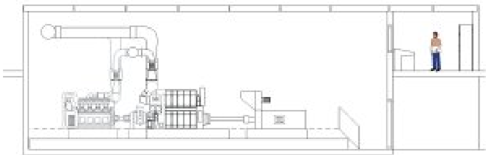
THE NEW LABORATORY FACILITY "MARTHA" FOR PROPULSION SYSTEM RESEARCH AND DEVELOPMENT

Exterior view of the Laboratory

- Experimental investigations of engine performance.
- Analysis & control of propulsion systems under transient operating conditions.
- Propulsion system computer model development and experimental validation.



Cross section of the Laboratory building



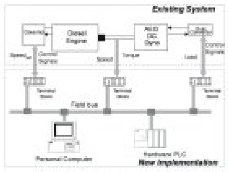
Cross section of the test cell and the control room

The state-of-art facility houses two four-stroke, marine diesel engines, coupled respectively to hydraulic and electrical dynamometers, allowing for complex, transient loadings. The facility is equipped with automated monitoring, alarm, control and data acquisition systems, facilitating extensive engine performance measurements.

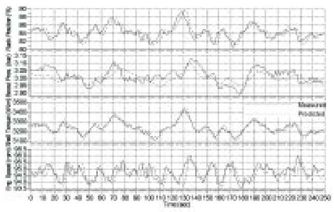
The test cell superstructure

Transient test bed, MAN B&W Holeby 5L16/24 engine

The transient testing test bed in its completed form will enable testing of complex engine loading profiles. This, together with programmable controllers and actuators, will allow to close the design loop of analysis, simulation, prototype design, implementation and experimental evaluation of novel engine component and control systems.

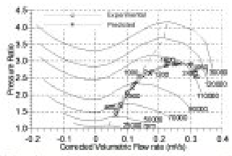


Schematic of the AEG/LDW dynamometer control system



Comparison between measured data and simulation results with the "virtual powerplant" code MoTher after determining the engine governor constants. MAN B&W 9K90MC-VI engine

Heavy fuel treatment system, ALFA LAVAL

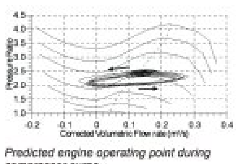


Experimental and predicted engine operating line at full load superimposed on the compressor map (MoTher code).

Component test bed, CATERPILLAR 3508 engine

STATE-OF-ART RESEARCH IN PROPULSION SYSTEMS

The Laboratory activities are focused on marine propulsion system research with particular emphasis on experimental and theoretical investigations of engine/load dynamics and control. These are complemented by numerical modeling of propulsion systems, using in-house developed powerplant performance simulation and thermo-structural analysis codes and optimisation software, achieving an integrated systems approach.



Predicted engine operating point during compressor surge

Contact:
Prof. N.P.Kyrtatos
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Tel. (+30-1)-772 1119
Fax (+30-1) -772 1117
Email: nkyrt@naval.ntua.gr
http://www.lme.naval.ntua.gr

4.10 Italy

Basic description	
Name of the institution	**Centro per gli Studi di Tecnica Navale (CETENA)**
Address	Via Ippolito d'Aste 5, I-16121 Genova, Italy http://www.cetena.it/
Other information	Company of the FINCANTIERI Group, member of ITTC
Activities	<u>Ship design</u> - CFD computations - Seakeeping - Propeller design - FEM computations - Composites - Noise level assessment - Vulnerability Assessment - IR signature - Ergonomic design - Logistic support - Virtual prototyping - Fire simulation <u>Ship production</u> <u>Ship operations</u> <u>Ports and maritime operations</u> <u>Workshop tests</u> <u>Hydrodynamics</u> CETENA's know how in this field has been developed through a number of research projects covering four topics: - flow around ship hull - seakeeping - propeller behaviour - ship manoeuvrability In house software programs WARP (potential flow code for wave resistance computation), PROPACE (potential flow code for propeller flow computations), SOAP (seakeeping software for the evaluation of ship operability and comfort on board) and SIMSUP (manoeuvrability code) have been developed and upgraded. <u>Research activities are currently focused on:</u> - development of a numerical model and software code to compute unsteady potential flow around propeller and predict cavitation inception - development of tools for accurate prediction of slamming loads and their effects on ship structures - development of a time domain seakeeping code – in cooperation with other research institutes

Basic description	
Name of the institution	**Istituto Nazionale per Studi ed Esperienze di Architettura Navale (INSEAN)**
Address	Via di Vallerano 139, I-00128 Roma, Italy http://www.insean.it/
Other information	Autonomous organisation under the supervision of the Italian Ministries of Defence and of Transport and Navigation, member of ITTC and ECMAR
Activities	- Study, testing and research of the hydrodynamic aspects of naval and merchant shipbuilding, ocean and maritime engineering - Perform, promote and coordinate research in the field of naval architecture - Carry out experiments with modelsand their propulsion and control systems - Supervise the sea trials - Gather and keep the documentation of the scientific activity relevant to the area of competence

Description of facilities	
Towing tank no.1	
Length	470 m
Breadth	13.5 m
Depth	6.5 m
Towing carriage data	- Motor driven, manual control and automatic, manned - Maximum speed 15 m/s (accuracy 1mm/s) - Electric drive system with 4 pairs of drive wheels, each pair coupled to a DC main motor via a reduction gear. Electric main motors (4 x 92kW), electric secondary motors (2 x 5.5kW)
Model size range	1.5-8 m
Additional description	The carriage supports the set-up of the 6 components balance for submerged bodies or the vertical and horizontal PMM for surface ships and submarine tests up to 5 m/s.
Tests performed	- Resistance and self-propulsion in calm water - 3-D wake surveys - Vertical and horizontal planar motion experiments - Resistance, self-propulsion and hydrodynamic forces on submerged bodies - Resistance , self-propulsion tests at high speed on high speed marine vessels - Upright, yawed and heeled sailing yachts tests - Longitudinal wave cut experiments
Measuring devices & instrumentation	- Force balance dynamometers - Model propeller transmission dynamometers - Pitot tube rakes - Five hole Pitot tube for wake surveys - Capacitive transducers for wave cut experiments - Special rig for sailing yacht tests - 6 component balance and model propeller transmission

	dynamometers for manoeuvring tests (PMM) - LDV 2-D measurement system - PIV measurement system
Towing tank no.2	
Length	220 m
Breadth	9 m
Depth	3.5 m
Towing carriage data	- Motor driven, manual control and automatic, manned - Maximum speed 10 m/s (accuracy better than ±0.15%) - Electric drive system with 4 pairs of drive wheels, each pair coupled to a DC main motor via a reduction gear and 2 pairs of a horizontal guide wheels (only on the rail) . Electric main motors (8 x 57kW)
Model size range	1.5-8 m
Wave generator	- One side, flat type, 9 m wide, electro-hydraulically powered with 3 pumps of 38.5 kW total power, controlled by 100 harmonic components electronic programming device, each harmonic modulated both in amplitude and frequency - Regular waves fro 1 to 10 meter in length, with corresponding height of 100 to 450 mm irregular wave according to any desired sea spectrum condition in appropriate scale - Beach: 2 crossed layers of square tubular 70 x 70 mm equally spaced
Wind generation	- Oriented in a horizontal plane - Air blowing system of 2 rows of 6 fans each, capable of a continuous variation of speed fro 0 to 20 m/s, direction 0-20 deg, vertical gradient
Tests performed	- Resistance and self-propulsion in calm water (in deep and shallow water) - 3-D wake surveys - Open water propeller characteristics - Seakeeping and propulsion evaluation in head and following waves - Hydrodynamic forces on profiles, especially of rudders and medium and large sized ship models - Mooring tests
Measuring devices & instrumentation	- Force balance dynamometers - Model propeller transmission dynamometers - Five hole Pitot rakes for wake surveys - 1 to 6 components balance for rudder and ship model tests - Fully submerged propeller dynamometer (thrust range ±400 N, torque range ±15 Nm, speed range 40-3000 rpm, motor power 5kW, right and left hand rotation, inclined operation up to ±15 deg in vertical plane) for open water propeller characteristics in axial or inclined inflow - 3-D optical sustem and inertial platform for measuring of ship model motions in waves
Circulating water channel	
Description	Vertical plane, free water surface channel, recirculating 4 million litres variable water speed, variable pressure, rectangular uniform cross-sectional shape with large viewing windows on either side of

	the test section, overhead travelling 15 ton crane fo handling movable cover and large and heavy models, special board can be used on the top of the working section to cut free surface waves
Drive system	Two 4-bladed axial flow impellers, Ward-Leonard controlled operating on two separate and parallel trunks Total impeller motor power: 2 x 435 kW at 1500 rpm
Working section max. velocity	5 m/s
Working section dimensions	- Length: 10 m - Width: 3.6 m - Maximum water depth: 2.25 m with 1m of freeboard above the free surface water level
Pressure range	3kPa – 101kPa
Towing carriage data	- Motor driven, manual control and automatic, manned - Maximum speed 10 m/s (accuracy better than ±0.15%) - Electric drive system with 4 pairs of drive wheels, each pair coupled to a DC main motor via a reduction gear and 2 pairs of a horizontal guide wheels (only on the rail) . Electric main motors (8 x 57kW)
Model size range	- Propeller: 0.15 – 0.30 m - Hull: 1.5-6 m
Tests performed	- Cavitation, force measurement, noise and flow visualisation tests on complete hull-appendage-propulsor models - Out-of-flow measurements on surface ships, submerged bodies, torpedoes - Acoustics and vibration tests - Propeller tests in uniform flow and behind the hull
Measuring devices & instrumentation	- 3 component LDV - Dye injection system for flow visualisation experiments - Pressure sensors - Force measuring dynamometers - Hydrophones and noise measuring equipment - Data collection and system control - High speed photographic system - Model motor power supplies - Thrust and torque dynamometers: LVDT type of thrust and torque sensors, dynamometers mountable inside the test section, strain gauge type sensors for 6 component balance

Manoeuvring basin (situated on Nemi natural lake)	
Description	Outdoor natural basin, test area 1300 x 1800 m, max. depth 34 m
Model size range	1.5-8 m
Tests performed	Standard manoeuvring tests such as - zig-zag, - turning circle, - weave, - pull-out, - spiral test, - crash stop, etc.
Measuring devices & instrumentation	- Gyro for measuring course angle and its rate of change - Balance dynamometer for measuring torque and forces acting on the rudder

	- Model propeller transmission dynamometers - DC tachometer for propeller revolution - Rudder angle potentiometer - Ship position by DGPS - Log - Computerised data collection and processing system - Model motor powe supplies to 4kW

Basic description	
Name of the institution	**University of Trieste**
Address	Department of Naval Architecture, Ocean and Environmental Engineering. Naval Architecture and Marine Technology Division
Other information	Member of ITTC, WEGEMT

Description of facilities	
Cavitation tunnel	
Test section dimensions	- 300 x 300 mm
Max. water speed	9 m/s
Model propeller speed	up to 5000 rpm
Maximum propeller model diameter	200 mm
Tests performed	Mainly used for scientific research and educational purpose
Measuring devices & instrumentation	- Propeller dynamometer - torque: 125 kg cm, thrust: 50 kg - Van Lammeren flow regulator

Basic description	
Name of the institution	**Istitute Pollcattedra di Ingegneria Navale**
Address	Via Montallegro 1, 16145 Genova, ITALY
Other information	member of ITTC and WEGEMT
Description of facilities	
Towing tank	
Length	56 m
Breadth	2.9 m
Depth	1.5 m
Towing carriage data	- Maximum speed 3 m/s - Propulsion: motor driven< Ward-Leonard system, electronic speed control, power 4 kW - Unmanned
Additional description	Maximum model length: 1.2 m Model tracked by rope
Tests performed	- Resistance tests - Trim measurements - Wave spectra analysis
Measuring devices & instrumentation	- Probes for measuring model speed and resistance - Wave height probes - Model trim probes
Circulating water channel	
Length	22 m
Breadth	2.4 m
Depth	1.7 m
Working section flow velocity	– 1.5 m/s – Total motor power: 160 kW
Additional description	Maximum model length: 2 m
Tests performed	- Resistance tests - Trim measurements - Wake analysis
Measuring devices & instrumentation	- Probes for measuring model speed and resistance - Wake survey instrumentation - Model trim probes

4.11 The Netherlands

Basic description	
Name of the institution	**Maritime Research Institute Netherlands (MARIN)**
Address	P.O. Box 28, NL-6700 AA Wageningen, The Netherlands http://www.marin.nl/
Other information	Member of ITTC and ECMAR
Activities	- Simulations - Model testing - Full scale measurements and monitoring - Training <u>Services</u> - Concept development - Design support - Operations support - Tool development <u>Ships & Structures</u> - Cargo vessels - Dredgers - Navy vessels - Offshore structures - Passenger and RoRo vessels - Tankers - Work vessels - Yachts
Description of facilities	
Deepwater towing tank	
Length	250 m
Breadth	10.5 m
Depth	5.5 m
Towing carriage data	- Maximum speed 9 m/s - Manned, motor-driven, four drive wheels, four pairs of horizontal guide wheels - Drive system: thyristor controlled power supply, 4 × 45 kW
Model size range	1.5 - 8.5 m
Additional description	Vertical/horizontal PMM, wind-force dynamometer set-up
Tests performed	- Resistance and self-propulsion tests in calm water - Open water propelled/ducted propeller tests - 3-D wake surveys - Flow observation tests by paint or tufts - Measurement of hydrodynamic forces and moments on submerged bodies, foils etc - Vertical/horizontal planar motion experiments - Yacht testing - Longitudinal wave cut experiments - Current force measurements - Unsteady propeller blade force measurements

Measuring devices & instrumentation	- dynamometers with strain gauge transducers in propelled hub - wind-force dynamometer - 6-component force balance dynamometer - 5-hole Pitot tube - laser Doppler velocity scanner - underwater photographic and video tape systems - pressure transducers - transducer for wave cut experiments
Seakeeping & Manoeuvring Basin	
Length	170 m
Breadth	40 m
Towing carriage data	The carriage with a maximum speed of 6 m/s runs over the total length of the tank. It consists of a mainframe, spanning the full width of the basin, and a sub frame with a max. speed of 4 m/s along the mainframe. The carriage can follow all movements of the model in the horizontal plane. With an extra installed turntable, the system has a rotating arm capability.
Model size range	- 2 - 8 m - moored objects up to 10 m - floating structures of any kind, size depending on water depth and wave conditions.
Waves & wind	At two adjacent sides of the basin, segmented wave generators consisting of hinged flaps are installed. Each flap is controlled separately by a driving motor and has a width of 60 cm. The capacity of the wave generator is up to a significant wave height of 0.45 m at a peak period of 2 seconds. Opposite the wave generator, passive sinkable wave absorbers are installed. The wave generator system is equipped with an active wave reflection compensation feature and higher order wave synthesis techniques. Wind can be simulated by an adjustable 10 m wide platform with electrical fans.
Additional description	Free running tests are performed such that the model follows an arbitrary pre-defined track (straight or curved) through the basin. The carriage follows the model during this task. Deviations from the pre-defined track are minimised through a dynamic positioning feedback loop which controls the propulsion units, additional thrusters and steering within a particular control scenario. Motion control is realised by means of a feedback loop which activates related stabilisation systems (fins, foils, rudders, etc).
Tests performed	- Seakeeping tests in waves and wind from arbitrary direction - Resistance and self propulsion tests in calm water and waves - Oscillation (PMM) and rotating arm tests in calm water and waves with a restrained model to determine hydrodynamic coefficients - Captive or free sailing manoeuvring tests in calm water and waves - Installation and sea transport tests of offshore constructions - Tests on moored or fixed objects to determine motions and loads due to waves and wind
Offshore Basin	
Depth	10.2 m with a central 30 m deep pit

Towing carriage data	The carriage enables testing and monitoring of offshore tests. The carriage can follow the movements of the model in both directions of the horizontal plane at a speed up to 3.2 m/s. With an extra installed turntable, the system is able to perform captive manoeuvring tests in shallow and deep water. Therefore rotating arm tests are possible.
Model size range	- Ship model 3 - 6 m - The size of floating structures is depending on water depth and wave conditions (usually between 0.2 m for buoys and 4 m for platforms)
Waves & wind & current	Wave generators are positioned at two adjacent sides of the basin and consist of hinged flaps. Each segment (width 40 cm) has its own driving motor, which is controlled separately. The wave generators are able to simulate various wave types, such as short crested wave patterns. The system is equipped with compensation of wave reflection from the model and the wave absorbers. Opposite this wave generator, passive wave absorbers are installed. For wind generation, a free moving and positionable platform of 24 m width, equipped with electrical fans is available. Current can be simulated with all kinds of profiles (hurricane, deep water current etc). Divided over the water depth of 10.5 m, six layers of culverts, each equipped with a pump, are installed.
Additional description	The concrete movable floor has dimensions of 45 × 36 m and a height of 1.75 m. An optical tracking system is mounted on the sub carriage for the measurement of 6 D.O.F. model motions.
Tests performed	- Offshore structure models, fixed, moored or controlled by dynamic positioning in waves, wind and current - Captive or free sailing manoeuvring tests in shallow water

Depressurised Towing Tank	
Length	240 m
Breadth	18 m
Depth	8 m
Preparation area	26 m long and 4.2 m wide
Ambient air pressure	2500-4000 Pa
Towing carriage main frame data	- Maximum speed 8 m/s - Spanning the full width of the tank - Carriage includes an atmospheric pressure cabin for special test equipment and personnel
Towing carriage subframe data	The subframe consists of a test frame and an observation module, and can be disconnected from the carriage. The test frame holds all measurement and testing equipment, the observation module carries all equipment related to cavitation observations (camera, stroboscopes and remote controlled positioning frame). The subframe can be transferred to the harbour area for preparation through an air lock system and is finally connected to the towing carriage, where it is ready for testing.
Model size range	Max. 14 m Models range from 2 – 12 m in length, up to 4 m beam and a maximum draught of 10 m. Maximum propeller diameter is 0.4 m.
Additional description	The instrumentation allows for measuring 40 channels at 5 kHz. The noise measurement system is able to test frequencies of 2 – 80

	kHz.
Tests performed	- Cavitation observation and inception The observation systems (both inside and outside the model) offers more operational flexibility through the remote control of camera position, camera settings (zoom and focus), stroboscope positions and intensity. The camera and stroboscope housings allow for testing at a reduced cavitation number of σ_v=0.4. - Pressure fluctuation measurements - Radiated noise measurements - Wakefield measurements
High speed basin	
Length	220 m
Breadth	4 m
Depth	Adjustable between 3.5 and 4.0 m
Towing carriage data	- Carriage Manned, motor-driven main carriage - Maximum speed 15 m/s - Thyristor power supply, 210 kW, Driven by water jet released from pressure vessel at 350 bar
Wave generator	- Hydraulic flap type, on short side - Regular and irregular waves - Wave period 0.3 - 5 s - Wave direction 0 - 180 deg - Wave height up to 0.4 m (significant) - Beach type: lattice on circular arc plates
Model size range	Ship model length 2 - 5 m, floating structures ranging from 0.2 to 3 m
Additional description	Model tracking techniques: - Air-lubricated bearings with potentiometers for resistance tests on fast displacement ships - Model fixed to high speed carriage for very fast (planing) hulls - Optical tracking systems for moored objects or self-propelled ships
Tests performed	- Resistance and self-propulsion tests in calm water and in waves of models of ships and high speed craft - Testing of hydrofoils at high speed - Seakeeping tests on high speed ships - Launching, up-ending, installation, template mating and critical wave tests for offshore platforms - Stability tests for offshore structures - VIM tests (forced oscillation)
Measuring devices & instrumentation	- Forced oscillation equipment - MMS (measuring frequency up to 10,000 Hz - 40 channels (extendable) - High speed film and video recording equipment available
Shallow water basin	
Length	220 m
Breadth	15.75 m
Depth	adjustable from 0 to 1.15 m, 1.0 m for wave tests
Towing carriage data	- Manned, motor-driven

	- Maximum speed 3 m/s - AC Thyristor power supply, 4 × 15 kW
Wave generator	- Flap type, on short side - Regular and irregular waves - Wave period 0.5 - 3 s - Wave direction 0 - 180 deg - Wave height up to 0.25 m (significant) - Beach type: adjustable in height, lattice type
Wind	- Generated by portable fans
Model size range	- Particularly equipped for inland waterways push-boat and tow configurations. Overall length of 26 m and total beam of 5.5 m is the largest tested so far - Manoeuvring tests (zig-zag, PMM), model length up to 8 m - Floating structures and mooring arrangements depending on water depth and wave conditions
Additional description	Objects are tracked by optical system
Tests performed	- Manoeuvring tests, zig-zag tests, stopping tests, PMM tests for determination of manoeuvring coefficients as input for the manoeuvring simulator - Resistance and self-propulsion tests especially for shallow water and/or narrow channels for ships and large push-tow fleets - Seakeeping tests with measurements of motions, wave loads and added resistance in waves for self-propelled ships - Behaviour of vessels in waves during beaching - Oscillation tests and tests in waves with a restrained model to determine hydrodynamic coefficients - Tests for moored and fixed objects to determine the motions, mooring forces and loads due to waves and wind
Measuring devices & instrumentation	- PMM equipment - Portable electric resistance type wave probes - Data recording on magnetic tape and/or UV paper strip chart - First analysis on line by PDP 11/34 computer - Number of channels: maximum 64 Numbers of samples: adjustable - High speed film and video recording equipment available

Cavitation tunnel	
Description	Vertical plane, closed recirculating, variable speed and pressure, de-aerator
Type of drive system	1.48 m diameter fixed pitch four bladed axial flow impeller, thyristor controlled, 220 kW, 1200 rpm (impeller 300 rpm)
Propeller motor	Thyristor controlled, 184 kW, 3000 rpm
Working section max. velocity	10-11 m/s
Test section	Rectangular 0.9 m × 0.9 m with rounded corners, length 4 m
Pressure range	10 - 180 kPa
Cavitation number range	σ_n = 0.2 - 6
Propeller size	Max. diameter 400 mm
Wake field simulation	Dummy model representing aft part of single screw ship fitted to top side (centre) of test section, or dummy model representing port or starboard aft part of twin screw ship fitted to one of the top corners in the test section; length or dummy models about 3 m

Measuring devices & instrumentation	- Dynamometers,
	- strain gauge elements,
	- pressure transducers,
	- hydrophones,
	- 5-hole Pitot tube,
	- laser Doppler velocity scanner,
	- strobe lights,
	- time lapse film recorder
	- Hottinger strain gauges between motor and tunnel
	    - Thrust range ± 5000 N
	    - Torque range ± 500 Nm

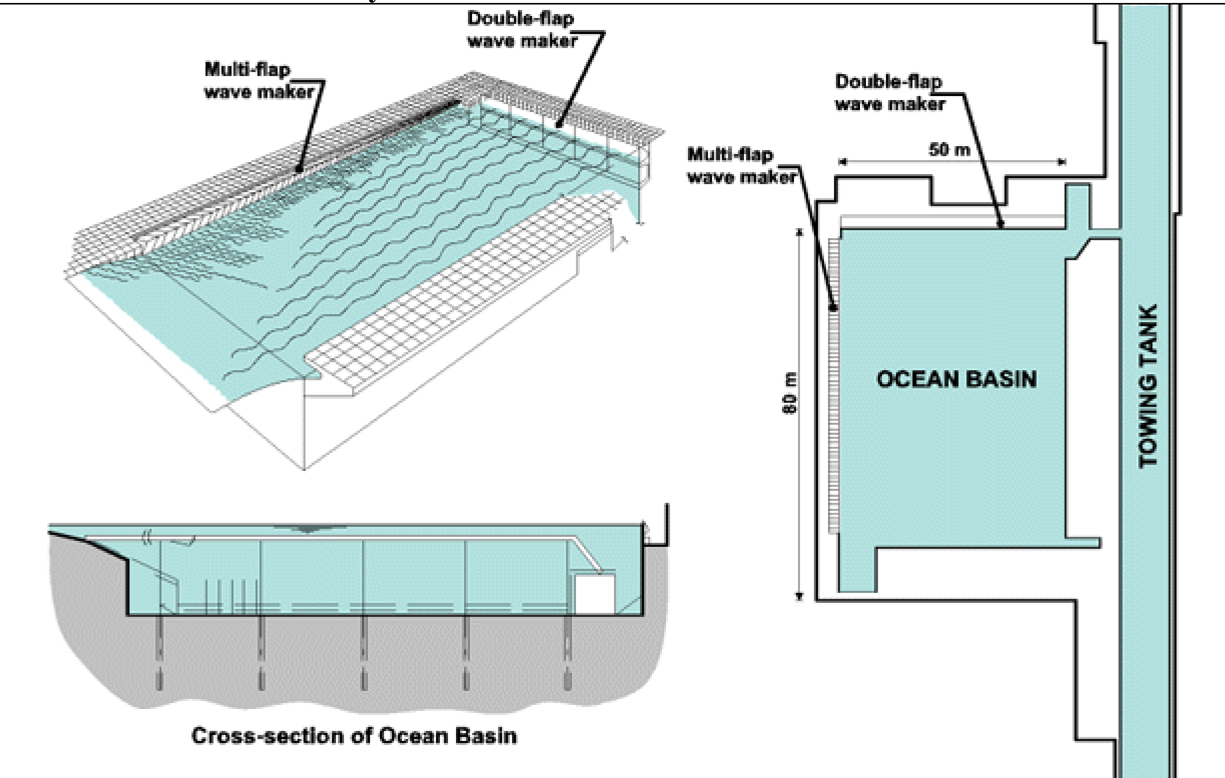
Tests performed	- Cavitation observation tests, cavitation inception measurements and performance tests with propellers in wake field behind dummy model or in oblique flow set-up - Hull pressure fluctuation measurements - Propeller noise measurements - Blade spindle torque measurements - Measurement of forces and torques on nozzles, rudders, hydrofoils etc - Supercavitating propeller testing with right angle drive (up to 6000 rpm)

Basic description	
Name of the institution	**TU Delft**
Address	Department of Marine Technology, Mekelweg 2, NL-2628 CD Delft, The Netherlands http://www-mt.wbmt.tudelft.nl/
Other information	Member of ITTC, WEGEMT

Description of facilities	
Towing tank	
Length	142 m
Breadth	4.2 m
Depth	2.5 m
Towing carriage data	- Maximum speed 5 m/s - Propulsion: motor driven, Ward-Leonard control, power: 20 kW
Wave generator	- Pneumatic - Regular wave length: 0.75 – 6.5 m
Additional description	- Maximum ship length: 5 m - Maximum floating structure 4.2 m
Towing tank	
Length	85 m
Breadth	2.75 m
Depth	1.25 m
Towing carriage data	- Maximum speed 2 m/s - Propulsion: motor driven, Ward-Leonard control, power: 2 kW
Wave generator	- Flap type - Regular wave length: 0.4 – 6.5 m
Tests performed	- Resistance and self propulsion in calm water or waves - PMM tests of floating and submerged bodies - Wave induced motions and loads on ships, floating and moored structures - Sailing yacht upright and heeled tests
Additional description	- Maximum ship length: 3.5 m
Cavitation tunnel	
Type	Kempf und Remmers, closed recirculation tunnel, Propeller diameters from 50 - 160 mm
Propeller model diameter	50 - 160 mm
Pressure range	102 kPa (max) - 11 kPa (min)
Tests performed	- Propeller tests in uniform flows. - Forces and pressure distributions on rudder, fins etc.
Measuring devices & instrumentation	- propeller dynamometer: T- and Q dynamometer at the end of propeller shaft, Tmax 400 N, Q,max 10 Nm - 5-hole pitot-tube, - various pressure sensors, - Laser Doppler Anemometry

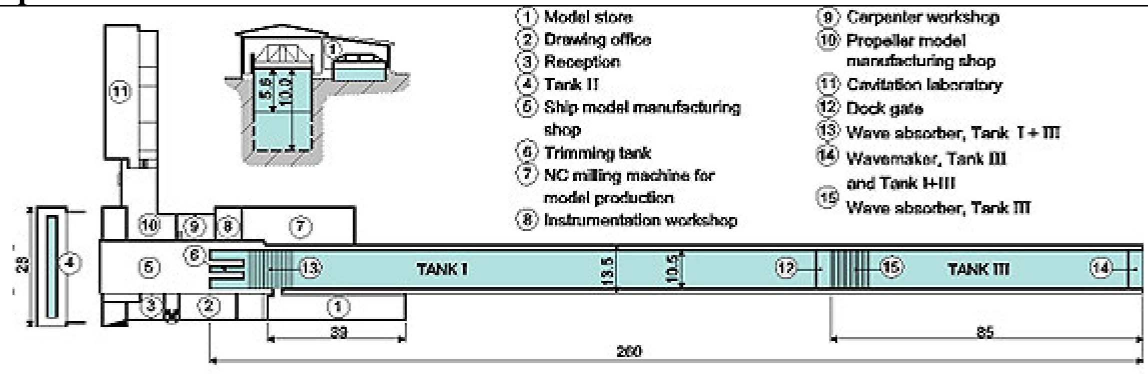
4.12 Norway

Basic description	
Name of the institution	**Norwegian Marine Technology Research Institute (MARINTEK)**
Address	P.O. Box 4125 Valentinlyst, N-7002 Trondheim, Norway http://www.marintek.sintef.no
Other information	Member of ITTC and ECMAR
Activities	- Analysis of motions and loads of marine structures - Analysis of weather sensitive operations - Development of analysis methods and tools - Model testing of marine structures - Hydrodynamic tests for installation - Overtrawlability tests - Response analysis - Hydrodynamics - Mooring and positioning - Hydrodynamic testing - Numerical analyses - Hull design and resistance - "Wash" in harbours and coastal waters - Speed/power in the seaway - Advanced model manufacturing facilities - Unique hydrodynamic laboratories - Seakeeping carriage - Operational limitations, motions and loads - Simulation and prototyping - Ship and vehicle hydrodynamic models and automatic control - Dynamic loads: Slamming <u>Oil and Gas</u> - Oil field development - Subsea equipment - Risers and pipelines - Platforms - Marine operations - Value chains <u>Maritime</u> - Ship performance - Ship model testing - Operation and manoeuvring - Logistics - Maintenance technology - Environment and energy

Description of facilities	
The ocean basin laboratory	
 Cross-section of Ocean Basin	
Length	80 m
Breadth	50 m
Depth	0-10 m
Towing carriage data	- follows free running models with no constraints at speed up to 5 m/s, at any heading to the waves
Double flap wave maker	- Hydraulic driven, hinged double-flap type. - Wave characteristics: - Regular waves. Maximum wave height: 0.9 m. - Wave periods: 0.8 s and above. - Wave spectra: Computer generated or from magnetic tape.
Multiflap wave maker	- Electrically driven, hinged single-flap type. - 144 individually controlled flaps. - Wave characteristics: - Regular waves: Maximum wave height: 0.4 m. - Wave periods: 0.6 s and above. - Wave spectra: Computer generated shortcrested or longcrested waves of specified direction.
Tests performed	- Seakeeping - Ship manoeuvring - Fixed and floating structures - Mooring systems - Energy production from the sea - Floating islands - Offshore loading systems - Offshore floating production - Offshore marine operations

	- Subsea systems and operations - Pipelines.

Ship Model Tank



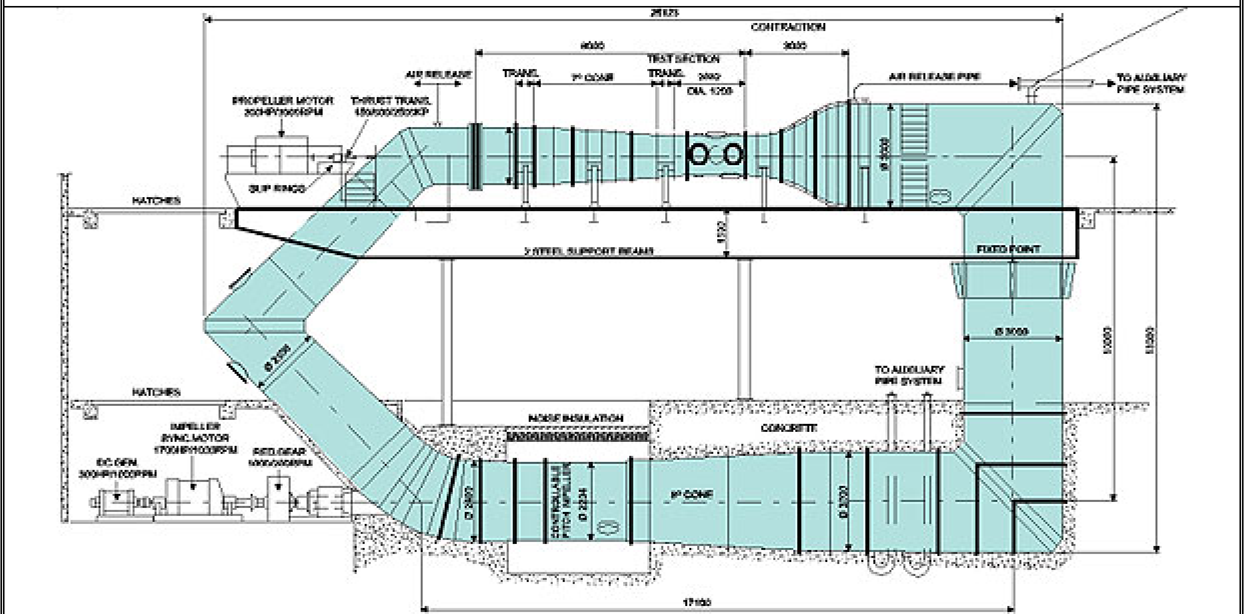
	Tank I	Tank II	Tank III	Tank I+III*
Length:	175.0 m	25.0 m	85.0 m	260.0 m
Width:	10.5 m	2.8 m	10.5 m	10.5 m
Depth:	5.6 m	1.0 m	10.0 m	5.6/10.0 m

* Tank I and III can be used simultaneously and also as one long tank (Tank I+III) by removing the gate (12) and wave absorber (15).

Tank I	
Length	175 m
Width:	10.5 m
Depth:	5.6 m
Total weight carriage:	20 t
Carriage type:	Tubular member truss
Wheelbase:	11.04 m
Speed range:	0.02-8 m/s
Maximum acceleration:	1 m/s^2
Driving motors: Power system:	4 DC shunt motors in series Thyristor controlled
Model size range:	8 m

Tank II	
Length	25 m
Width:	10.5 m
Depth	1.0 m
Total weight carriage:	0.2 t
Carriage type:	Open bay
Wheelbase:	3 m
Speed range:	0.05-1.75 m/s
Maximum acceleration:	1 m/s^2
Driving motors:	1 DC induction motor with gear and remotely controlled variation. Wire traction
Power system	Thyristor controlled
Model size range:	8 m
Wavemaker:	Single flap, regular and irregular waves
Maximum wave height	0.3 m
Wave period range:	0.25-3 s
Maximum wave steepness:	1:8
Wave spectra	Computer generated, based on 4000 sine components

Tank III	
Length	85 m
Width:	10.5 m
Depth	10 m
Total weight carriage:	4 t
Carriage type:	Closed beam
Wheelbase:	11.04 m
Speed range:	0-0.9 m/s
Maximum acceleration:	1 m/s^2
Driving motors:	2 DC shunt motors
Power system	Thyristor controlled
Model size range:	-
Wavemaker:	Double flap, regular and irregular waves
Maximum wave height	0.9 m
Wave period range:	0.8-5 s
Maximum wave steepness:	1:10
Wave spectra	Computer generated, based on 4000 sine components
Additional information	Tank I and III can be used simultaneously and also as one long tank (Tank I + III) by removing the gate (12) and wave absorber (15). In tank I + III either of the two carriages can be used.
Measuring devices & instrumentation	<u>Towing tank I+III</u> - Dynamometers for ship model testing All dynamometers compatible with computerized data collection and reduction. Strain gauge based dynamometers for: - Towing force - Open water tests - Propulsion tests - Test equipment for fixed and floating structures measuring: - Pressure - Forces and moments in six degrees of freedom - Displacement in six degrees of freedom - Modular force gauges give flexibility for special instrumentation requirements - 3-dimensional wake measurements by use of 5-holes Pitot tubes - Strain gauges and inductive propeller nozzle dynamometers - Marine track motion capture system for motion measurements in six degrees of freedom <u>Towing tank II</u> - Dynamometers: 6-component dynamometer, forces and moments in 3-dimensions. - Marine track motion capture system for 6DOF measurements. - Modular force gauges for special requirements.

Cavitation tunnel	
	
Height between centre lines	10 m
Width between centre lines:	22.22 m
Contraction area ratio:	6.25
Diameter of working section	1.20 m
Length of working section	2.08 m
Type of working section	Closed throat
Maximum water velocity	18 m/s
Maximum propeller RPM	3000
Propeller motor power	50 KW
Maximum working pressure	6.0 atm.abs
Minimum working pressure	0.1 atm.abs./σ_V~0.2
Impeller motor power	1150 KW
Additional equipment	Honeycomb for flow straightening
Tests performed	- Open water tests with propeller (and duct) in axial or oblique flow. - Behind hull condition with single, twin or triple screw installations. MARINTEK's standard procedure for propeller cavitation testing in behind condition, is to use dummy aftbody model and simulation of estimated full scale wake distribution, based on the measured wake distribution in the towing - Azimuth thrusters. - Z-drive installations. - Underwater vehicles (submarines, ROV's etc.) - Hydrofoils with or without remotely controlled flaps.

	- Cavitation erosion detection by paint technique - Cavitation observation (Documentation by sketches, photos and video recordings). - Measurements of propeller induced pressure fluctuations in the aftbody. - Measurements of propeller induced noise. - Six-component force measurements.

4.13 Poland

Basic description	
Name of the institution	**Centrum Techniki Okrętowej S.A.**
Address	Wały Piastowskie 1, 80-958 Gdańsk, POLAND http://www.cto.gda.pl
Other information	State owned joint stock company, member of ITTC and ECMAR
Activities	- Ship hydromechanics - Ship construction mechanics - Ship design - Material research - Anti-corrosion protection - Environment protection - Information technology - Training
Description of facilities	
Large towing tank	
Length	260 m
Breadth	12 m
Depth	6 m
Towing carriage data	Maximum speed 12 m/s
Wave generator	- Fully computer operated, flap type - Provides regular as well as irregular wave - Maximum modelled sea state 8B to a scale 1:25 - Maximum regular wave height: 0.7 m for wave length up to 7 m
Additional description	The carriage is equipped with with a multi-purpose computerized logging stand
Tests performed	- Resistance and propulsion tests in calm water and waves - Measurement of wake field - Open water tests of propulsors. - Paint tests, - PMM manoeuvring tests, - Investigations of slamming - Measurements of wave loads on floating structures
Measuring devices & instrumentation	- Dynamometer for resistance, propulsion and propeller (ducted propeller) open water tests - Computer controlled wake measuring device - Wave probes - Load cells - Optical system for model tracking
Auxiliary towing tank	
Length	55 m
Breadth	7 m
Depth	Adjustable 0.2-3.25 m
Towing carriage data	- Maximum speed 4 m/s - Propulsion: linear-type motors
Wave generator	- Fully computer operated, duplex-flap type - Provides regular as well as irregular wave

	- Maximum modelled sea state 8B to a scale 1:50 - Maximum regular wave height: 0.5 m for wave length up to 7 m and 0.18 m for wave length up to 14 m
Additional description	The carriage is equipped with with a multi-purpose computerized logging stand
Tests performed	- Resistance and propulsion tests in calm water and waves - Resistance and propulsion test in shallow water - Measurement of wake field - Open water tests of propulsors. - Paint tests, - PMM manoeuvring tests, - Investigations of slamming - Measurement of wave loads on floating structures
Measuring devices & instrumentation	- Dynamometer for resistance, propulsion and propeller (ducted propeller) open water tests - Computer controlled wake measuring device - Wave probes - Load cells - Optical system for model tracking
Side launching test basin	
Length	5 m
Breadth	5 m
Depth	Maximum 0.6 m
Additional description	- Arbitrary modelled bottom - HS video recording - Optical system for on-line model tracking
Shore station – open water station for manoeuvring tests at the Wdzydze lake	
Description	- The models for maneouvring tests are self-propelled and radio-controlled. - Optical and GPS equipment is used to record the path of a model - On line test results analysis and display
Cavitation tunnel	
Test section dimensions	800 x 800 x 3000 mm
Centre to centre of horizontal sections	22 m
Max. water speed	20 m/s
Model propeller speed	up to 3500 rpm
Minimum pressure	0.03 bar
Maximum pressure	4 bar
Tests performed	- Cavitation open water propeller test - Cavitation tests of propulsors in simulated behind conditions with the use of dummy hull model - Cavitation observation tests, - Measurement of the propeller induced pressure impulses, - Cavitation inception tests, - Axial wakefield tests. - Propeller induced noise, - Erosion tests.
Measuring devices &	- equipment for measuring hydrodynamic characteristics of

instrumentation	cavitating propeller model, - equipment for observation and recording of cavitation, - laser system for measuring velocity field, - equipment for measuring hydrodynamic forces and moments acting on the dummy hull model located in cavitation tunnel as well as pressure on hull surface - HS video

Basic description	
Name of the institution	**Gdansk University of Technology**
Address	Ocean Engineering and Ship Technology Narutowicza Str. 11/12, 80-952 Gdansk, POLAND http://www.pg.gda.pl/~wwwoce/WOiOSite/HTMLdocs/ English/Home.htm
Other information	Member of ITTC and WEGEMT
Laboratories	- Ship Hydromechanics Laboratory, - Ship Automation and Turbine Propulsion Laboratory, - Ship Equipment Laboratory, - Ship Machinery and Power Plant Laboratory; - Computer laboratory; - Research centre at the lake in Ilawa
Description of facilities	
Towing tank	
Length	30 m
Breadth	3 m
Depth	1.3 m (adjustable)
Towing carriage data	- Maximum speed 3 m/s - Gravitational drive
Additional description	The tank is equipped with regular waves generator
Tests performed	- Resistance tests in calm water and in waves - Trim measurement
Measuring devices & instrumentation	- 6 component balance - Resistance dynamometer - Wave probes
Cavitation tunnel	
Test section dimensions	- 500 x 500 x 2200 mm
Max. water speed	12 m/s
Tests performed	- Cavitation observation tests, - Propeller cavitation performance tests in open water and in simulated wake conditions.
Measuring devices & instrumentation	- Dynamometer for propeller thrust and torque measurement
Flume tank	
Test section dimensions	- 3000 x 800 x 1000 mm
Max. water speed	1.5 m/s
Tests performed	- Flow investigation - Flowed bodies hydrodynamic loading
Measuring devices & instrumentation	- 6 component dynamometer

4.14 Romania

Basic description	
Name of the institution	**University Dunarea de Jos of Galati (UDJG)**
Address	Domneasca Str, 47, 800008-Galati, Romania http://www.ugal.ro
Other information	Research in the following maritime domains: shipbuilding, off shore, aquaculture (Faculties: Mechanical engineering, Shipbuilding, Food chemistry)
Activities	<u>Ship design</u> - CFD computations - Propeller design - FEM computations - Composites - Virtual prototyping - Publications and lectures - Structural analysis <u>Hydrodynamics</u> UDJG's know how in this field has been developed through a number of research projects covering four topics: - flow around ship hull - propeller behaviour Licenced software programs SHIPFLOW Towing tank: Length: 40m, Breadth: 5m Depth: 4m. <u>Shipstructure</u> UDJG's know how in this field has been developed through a number of research projects covering the topics: - Ship structure strength (general and local) - Vibrations - Ultimate strength - Fatigue - Fracture mechanics - Collapse - Optimization - Composites - FEM analysis In house software programs COMPO (strength analysis of structures made of composite materials), VIBHULL (vibration of ship hull), OPTIM (optimisation of ship hull cross section). <u>Research activities are currently focused on:</u> - development of numerical models and software code to compute strength of ship structures made of metallic and composite materials; - development of methodologies for accurate prediction of

	influence of imperfections on the behaviour of plates made of composite materials. - development of a time domain seakeeping code – in cooperation with other research institutes
Description of facilities	
Laboratory of ship structure strength	
Length	40 m
Breadth	20 m
Hight	8 m
Equipment	- stretching machine of 500 kN - strain gauge equipment - equipment for vibration testing - equipment for shocking tests - other equipment
Additional description	- Full scale parts of ship structure - Scaled testing models - Ship hull components made of composite materials
Tests performed	- Static, dynamic and buckling tests; - FEM analysis - Strain gauge measurements; - Motion and loads on fixed offshore structures measurement.
Small towing tank	
Length	43 m
Breadth	4 m
Depth	4 m

Laboratory of ship structure strength

Test on ship structure part model

Test on containership structure hull model

Buckling test on plates made of composite materials

4.15 Russia

Basic description	
Name of the institution	**Krylov Shipbuilding Research Institute**
Address	44 Moskovskoye Shosse, 196158 St. Petersburg, Russia http://www.krylov.com.ru
Other information	Member of ITTC, the Krylov Institute has a status of the Russian Federation State Research Centre for naval and commercial ships
Activities	- Naval ship conceptual design studies (trend prediction, future programme planning, methods for military/economic efficiency evaluations, shipbuilding industry technical/economical evaluations, etc.) - Hydrodynamics (seakeeping , performance, manoeuvrability , etc.) - Development of promising shipbuilding programmes for shipyards and regions - Development of conceptual designs for interior arrangement of offshore structures and special-purpose ships - Design analysis and conceptual designs of cargo and fishing vessels - Experimental checking and development of ships and offshore engineering structures in the Ice Model Basin - Prediction of ship propulsion performance in ice and shallow water - Investigations on naval and commercial ship seaworthiness, ocean engineering structure dynamics and wave loads in the model basin - Expert examination of ship and oil & gas production structure designs - Theoretical and experimental investigations on propulsive performance of all kinds of ships: surface displacement-type vessels, cargo ships, fishing boats, seagoing and river ships, combined sea/river vessels, high-speed craft (SES, hovercraft, hydrofoil, planing, high-speed catamarans, multi-hull vessels, wing-in-ground vehicles) - Hullform optimisations for all the above-mentioned kinds of ships - Prediction and achievement of propulsive performances of designed submersibles of any kind, including the selection of control devices and techniques - Theoretical and experimental research on hydrodynamics of all types of propellers, waterjets and thrusters - Customised design of all kinds of propulsors based on the results of tests performed at the Division or on data provided by the Customer - Numerical predictions of full-scale ship propulsion performances - Design of low-noise propulsors for submarines, torpedoes and submersible vehicles - Development of hullforms, appendages, rudder systems, manual

	and automatic control patterns ensuring manoeuvrability and safety of displacement-type ships and unconventional high-speed vehicles - Development of numerical models describing navigation of all kinds of ships, both in calm water and under the effects of wind and waves, as well as simulation of unique operations (navigation of large-size barge trains in narrow channels, haulage in wind and waves, mooring, etc.) - Computer simulations of dynamic positioning of ships and marine structures under the effects of wind, waves and currents - Determination and improvement of wind structure in order to provide favourable take-off and landing conditions for winged aircraft and helicopters, as well as to resolve ecological problems - Design and development of test facilities for hydrodynamic research centres, including cavitation tunnels, various model basins, etc. - Support to all sorts of full-scale trials of naval and commercial ships with KSRI expert teams and relevant instrumentation - Commercial ship and offshore engineering conceptual design studies - All kinds of marine propulsors (propulsive, acoustic and strength performances) - Structural mechanics (static and dynamic strengths of ship structures, marine equipment and machinery strength, structural protections and armouring, shock and vibration endurance) - Marine power plants and power generation, including nuclear, as well as nuclear and radiation safety issues - Equipment, machinery and ship acoustic performance (calculation, measurement and monitoring methods, noise control tools, instrumentation, platform noise affecting sonar operation) - Stealth technologies for low-signature ship design (calculation, measurement and control methods for magnetic, electric, extreme-low-frequency electromagnetic, radar, lidar and infra-red signature parameters, including EMC problems of electric and electronic hardware and the reduction of electromagnetic noise affecting sensor operation) - Hydrophysics interactions between engineering products and the marine environment; ecological monitoring for technology-infested water areas subjected to accidental pollution risks, and marine environment condition predictions - Generation and updating of the shipbuilding industry database of technical regulations and standards, certification and licensing, microfilming of engineering documents - Practical design , including construction documents, for commercial vessels, naval auxiliaries and offshore structures

Description of facilities	
Deep water towing tank	
Length	1324 m
Breadth	15 m
Depth	7 m
Towing carriage data	Each part of the tank is equipped with two towing carriages (in total 4) permitting to test ship models of up to 10m in length at speeds of up to 20m/s. The submersion depth limit is to 2m.
Tests performed	- Towing and self-propelled tests of surface ship and submerged models in deep waters and near the surface, - Testing propellers and propulsion units under open-water conditions.
Measuring devices & instrumentation	Allows: - measuring forces on ship hull and propulsor models, - studying characteristics of non-uniform unsteady 3D flow in propulsor vicinities, - simulating full-scale conditions of the flow around the hull with the help of polymer injections, - conducting self-propelled model tests, - testing models with artificial air cavities of their bottoms.
Rotating-Arm Basin	
Diameter	70 m
Depth	6.7 m
Towing carriage data	Models can be towed with linear speeds from 0.3m/s to 50m/s with the help of two rotating arm systems available in the Basin
Additional description	- The arm with a manned cabin travelling along the arm: up to linear speed 15m/s - The unmanned streamlined arm with fixed seats for models: up to linear speed 50m/s - Maximum model length: 6 m
Tests performed	- Determination of naval and commercial ship hull hydrodynamic characteristics associated with curvilinear motion paths, - Evaluation of hydrodynamic characteristics of steering and other control devices.
Measuring devices & instrumentation	Allows: - determining hydrodynamic characteristics of all types of ships, towed systems and special-purpose vehicles, - physical modelling of their behaviour under any relevant service conditions.
Seakeeping-&-Manoeuvring Basin	
Length	35 m
Breadth	22 m
Depth	3 m
Towing carriage data	The basin is equipped with a small rotating arm of the towing radii 0~8m; speeds up to 5m/s
Wave maker	- plate-type wavemaker for irregular waves with a specified energy spectrum, superposition of 41 harmonic components using electromechanical system

	- wavemaker power 14 kW - wave length 0.7-5.0 m - wave height up to 0.15m
Tests performed	- Determination of hydrodynamic characteristics of ship models up to 3m in length, - Calm water, wave and dynamic positioning tests of radio-controlled self-propelled models.
Measuring devices & instrumentation	- Dynamometers, - Wide range camera - Special tests rigs for determining ACV model static characteristics and for testing models of free-fall lifeboats.
High-Speed Seakeeping Tank	
Length	250 m
Width	4 m
Depth	2.5 m
Towing carriage data	for towing models of up to 3m in length with speeds of 0.2~12m/s
Wave maker	two wavemakers for head and following seas
Tests performed	- resistance and seakeeping tests of dynamic-lift high-speed craft models of up to 3.5m in length weighing up to 200kg.
Measuring devices & instrumentation	- instrumentation for measuring model resistance, kinematic parameters, air-cushion static and dynamic pressures, forces on individual components of the model, controls for individual details of the model, - video system.
Vacuum tank	
Length	60 m
Width	5 m
Depth	3.5 m
Towing carriage data	- Manned, rope drive - Electric motor with thyristor inverter, power:50kW - Speed:: up to 6m/
Wave maker	Plate-type wavemaker
Additional information	Minimum pressure over the free surface: 3•103N/m2 (98% vacuum).
Tests performed	- testing models of hydrofoils, fixed- and controllable-pitch propellers, nozzles and Z-drive ducted propellers, azimuthal thruster pods - self-propelled ship model tests with propellers or waterjets - measurements of forces on hydrofoils and propellers and of propeller-induced hull pressures under cavitation conditions
Complex of cavitation tunnels	
Large cavitation tunnel	
General description	- closed recirculation - closed working section
Test section dimensions	1300 x 1300 x 5100 mm with cut-off angles
Centre to centre of vertical sections	17.3 m
Centre to centre of horizontal sections	8 m

Max. water speed	15 m/s
Impeller motor power	up to 1800 kW
Drive system	Electric drive with Ward-Leonard control
Maximum pressure	300 kPa
Minimum pressure	30 kPa
Cavitation number range	From σ=0.5
Propeller and model size range	- Propeller diameter: 0.2 – 0.7 m - Model length: max. 4.5 m
Tests performed	- Hydrodynamic tests on cavitation - Cavitation noise tests.
Measuring devices & instrumentation	- Two component propeller dynamometer - Three and six components dynamometers for non-propeller models - Hydrophones - Weight sensors on balance electric motor with a floating suspension
Medium cavitation tunnel	
General description	- closed recirculation - circular working section
Test section dimensions	- Diameter: 660 mm - Length: 1120 mm
Centre to centre of vertical sections	11.5 m
Centre to centre of horizontal sections	6.75 m
Max. water speed	13 m/s
Impeller motor power	up to 180 kW
Drive system	Thyristor electric drive
Maximum pressure	100 kPa
Minimum pressure	5.1 kPa
Cavitation number range	From σ=0.15
Propeller and model size range	- Propeller diameter: 0.2 – 0.3 m - Hydrofoil chord up to 0.2 m
Tests performed	- Hydrodynamic tests on cavitation - Cavitation erosion tests.
Measuring devices & instrumentation	- Two component propeller dynamometer - Three components dynamometer for non-propeller models
Small cavitation tunnel	
General description	- closed recirculation - circular working section
Test section dimensions	- Diameter: 500 mm - Length: 1000 mm
Centre to centre of vertical sections	7 m
Centre to centre of horizontal sections	5 m
Max. water speed	17 m/s
Impeller motor power	up to 77 kW

Drive system	Electric drive with Ward-Leonard control
Maximum pressure	100 kPa
Minimum pressure	5.1 kPa
Cavitation number range	From σ=0.0.3
Propeller and model size range	- Propeller diameter: 0.2 – 0.4 m - Duct diameter up to 0.3 m
Tests performed	Hydrodynamic tests on cavitation
Measuring devices & instrumentation	- Two component propeller dynamometer - One component dynamometer for tests with propeller ducts
Special propulsor cavitation tunnel	
General description	- closed recirculation - circular working section
Test section dimensions	- Diameter: 400 mm - Length: 1000 mm
Centre to centre of vertical sections	5.2 m
Centre to centre of horizontal sections	5.9 m
Max. water speed	9 m/s
Impeller motor power	up to 38 kW
Drive system	Electric drive with Ward-Leonard control
Maximum pressure	100 kPa
Minimum pressure	10 kPa
Cavitation number range	From σ=0.3
Propeller and model size range	- Propeller diameter: 0.2 – 0.3 m - Rudder size up to 0.3 x 0.3 m
Tests performed	- Hydrodynamic tests on propeller and rudder cavitation
Measuring devices & instrumentation	- Two component propeller dynamometers - Three components rudder dynamometer
Other cavitation tunnels: high speed and acoustic	
Large wind tunnel	
General description	- closed circuit configuration - open elliptical test section
Test section dimensions	- Diameters: 4000 mm, 2300 mm - Length: 4000 mm
Max. water speed	100 m/s
Tests performed	- Determination of hydro- and aerodynamic characteristics of naval ships and commercial vessels, - Measurement of velocity fields and pressure distributions over body surfaces, - Flow structure studies.
Small wind tunnel	
General description	- closed circuit configuration - closed test section
Test section dimensions	- Cross section: 450 x 300 mm - Length: 600 mm
Tests performed	Internal flows in waterjets, pipelines, channels of hydraulic machines, etc.

Shallow-Water Towing Tank	
Length	200 m
Width	16 m
Depth	Variable from 0 to 1.75 m
Towing carriage data	enables to test models of up to 10 m in length (barge trains of up to 20 m) at speeds from 0.1 m/s to 6 m/s
Wave maker	Wave length: 1~10 m, Wave height: 02~0.35 m
Tests performed	Ship and offshore structure models at variable depths, in calm water and in waves.
Seakeeping Basin	
Length	161 m
Width	20 m
Depth	- Deep water part: 4 m (over the length of 89 m) - Shallow-water part: 0.2~1.5m (over the length of 72m)
Towing carriage data	- if used over the whole tank length the maximum speed is 5.5m/s. - when used in the shallow water part, the maximum speed is.5m/s.
Wave maker	- Wavemakers for regular and irregular seas at arbitrary angles to the tank axis, - Wave length 1.5~8 m, - Wave height up to 0.3m.
Additional information	Mono- or multihull ship models of 2.5~4m in length and weighing 50~300kg
Tests performed	- Model towing tests at any heading, including tests under the effects of the wind in regular and irregular seas, - Determination of wave-induced bending moments and shearing forces with the help of segmented ship models.
Measuring devices & instrumentation	- two towing carriages, - wind-simulation fans, - instrumentation for resistance, motion parameters and wave-induced hull bending moment measurements.
Ice model basin	
Length	45 m
Width	6 m
Depth	1.75 m
Towing carriage data	- Speed range from $0.5 \cdot 10^{-3}$ to 1.2m/s. - The towing carriage of 186 kN weight delivers traction forces of up to 5000 N at speeds of 0.15~2.0m/s or up to 20000 N at speeds of 0.0005~0.2m/s. The accuracy of carriage speed measurements is 0.22%.
Additional information	- ice sheet length: 35 m - filled with a freezing salt solution, and the NaCl concentration is 12.2‰ - deepwater zone up to 3.8m of 8m length extending across the entire width of the tank - seabed imitator can be installed in the basin for simulation of shallow water conditions - maximum ice thickness is 0.08m - minimum temperature is -29°C - ship models of up to 7m in length and 1.3m in width

	- propulsion units up to 0.25m in diameter - offshore platform models of up to 2.5m in width - It is possible to prepare model ice of two types: FG (fine-grain) granulated ice or Columnar ice
Tests performed	- ice tests with, ship models, offshore platform models and other towed objects. - the following ice conditions may be simulated: level and layered ice, broken ice, rubble field, ridges - the following model ice properties are measured in the model tests: geometry • for level ice - ice thickness along the basin • for broken ice - the sizes of ice blocks and concentration • for rubble field - thickness of the ice blocks; keel depth • for ridges - consolidated layer thickness, keel and sail profiles, keel porosity, keel width strength and physical properties • bending strength • compressive strength • elasticity (Young's) modulus • indentation tests • ice density • dynamic friction coefficient of model ice/surface under test - the model tests can be performed in two following modes: either the model under test is fixed to the towing carriage and towed through the model ice sheet (Towing tests), or the model under test is fixed to the special stationary frame, and the ice model sheet is pushed towards the model. - the following aspects of a ship performance are investigated: icebreaking resistance (Level Ice, Broken Ice Field, Channel), ridge breaking, propulsive efficiency, manoeuvrability.
Measuring devices & instrumentation	- set of dynamometers for forces and moments on models of Arctic offshore structures, ship and propeller models; - set-up for testing fixed platforms by pushing the ice against them (with an adjustable-compliance elastic foundation for the model platform).

Basic description	
Name of the institution	**Central Aero-Hydrodynamic Institute (TsAGI)**
Address	1 Zhukovsky Street, Moscow Region, 140160, Russia http://www.tsagi.ru/
Other information	State Research Centre
Activities	<u>Testing and Research</u> - experiments in wind tunnels, flight simulators and test installations; - tests of propellers and propfans; - static strength and fatigue tests for airframes under varying conditions of heat and pressure; - wind tunnel tests combined with complex physical analysis; - analytical and experimental research on structural dynamics and aeroelasticity phenomena. <u>Design and Development</u> - aerodynamic configurations, control systems and engine design; - design and fabrication of test models; - advanced equipment development to test aerodynamics, aerothermodynamics, flight dynamics and material strength; - customized software development and state of the art strength analysis. <u>Concept and Creation</u> - concepts for flight control systems; - concepts of definition and choice of parameters for aircrafts and engines; - creation of modern digital airborne computer-based control systems; - structural concept studies in compliance with constants of aeroelasticity or static/fatigue strength; - creation of test equipment for vibration-resistance tests and flutter

Testing facilities

- Wind tunnels
- Thermal Strength Vacuum Chamber
- Full Scale Structures Static Strength Laboratory
- Materials, Structural Components and Full Scale Parts Fatigue Strength Laboratory
- Structural and Material Strength Laboratory
- Laboratory for Investigating Dynamic Characteristics of Structures and Control System
- Acoustic Reverberation Chamber
- Experimental complex for investigation of thermal, physical and radiation characteristics of materials and structural parts
- Towing tank
- Impulse hydrodynamic tonnel
- High Speed Water Test Rig
- Variable Pressure Tank
- Horizontal Test Rig

- Towing Boat - Floating Catapult Selected facilities capable to perform tests witin the field of marine technology are described below.

Subsonic wind tunnel T-1-2	
Inscribed diameter	3 m
Length	6.5 m
Flow velocity	5-60 m/s
Reynolds number	up to $3.8 \cdot 10^6$ (L=1m)
Dynamic pressure	up to 2.14 kPa
Additional description	The flow is generated by a six-blade fan that consumes 1.000 kW
Tests performed	- Models of airships, aerostats, airplanes, ground-effects vehicles, ships, and various industrial objects
Measuring devices & instrumentation	- automated three-component balance, - a dynamic stability device, - a device for investigating the model aerodynamic characteristics via the mirror method, - a translational vibrations device. - two screens available for carrying out ground-effects tests. - a 3.030 x 2.210-mm rectangular metallic screen used for ground-effects investigations (i.e., 0 to 300-m altitudes) of total static and unsteady aerodynamic characteristics. - a 2.000-mm diameter round wooden screen is used for determining surface pressure distributions.

Subsonic wind tunnel T-5	
Inscribed diameter	2.2 m
Length	3.15 m
Flow velocity	5-55 m/s
Reynolds number	up to $3.4 \cdot 10^6$ (L=1m)
Dynamic pressure	up to 1.8 kPa
Additional description	Closed layout facility with an open test section
Tests performed	Models of all types of civil and military vehicles and objects: - airships and aerostats, - airplanes, - submarines, - aircraft carriers, - wing-in ground effect flying machines, - buildings and industrial constructions.
Measuring devices & instrumentation	- automatic six component balance with a remote-control screen, - propeller facility, - calibration device for moving pressure probes to the given locations of the test section

Water channel	
Length	202 m
Width	12 m
Depth	6 m
Towing trolley description	Maximum velocity: 14 m/s

Additional description	Towing trolley is a light metallic structure of thin-walled tubes equipped with 4 electric motors with power of 4 x 51 kW. Computerized thyristor actuator allows following the prescribed speed with high accuracy. The special structural feature of the water channel is a cantilever type attachment of rails with the width of track 8.2 m at water surface width 12 m.
Tests performed	- investigation of forces, moments, pressure distributions, linear and angular displacements, speeds and accelerations while testing models of various classes moving steadily and unsteadily
Measuring devices & instrumentation	- screen mounted in the water channel, designed to investigate aircraft and ground transport aerodynamic characteristics in proximity of the screen at unrepressed motion conditions. - computer complex to process measurement data at the rate of experiment - wave generator, trusses for mounting underwater screen and boxes for filming and photographing of the processes under investigation.

Impulse water channel	
Test section dimensions	250 x 250 x 500 mm
Flow velocity	Up to 15 m/s, by varying the cross section of the flow velocity can be increased up to 40 m/sec.
Total pressure	(1... 10) • 10^5Pa
Additional description	Time of operation at the maximum speed: 20sec
Tests performed	- determination of hydrodynamic characteristics of models in a vertical or horizontal flow including cavitation regime. - Tests of under water objects and various hydraulic components at high pressure close to real one.
Measuring devices & instrumentation	- The equipment allows to determine main hydrodynamic characteristics of models: C_x, C_y , M_z. - Supply of air to a model; - Filming and photographing equipment.

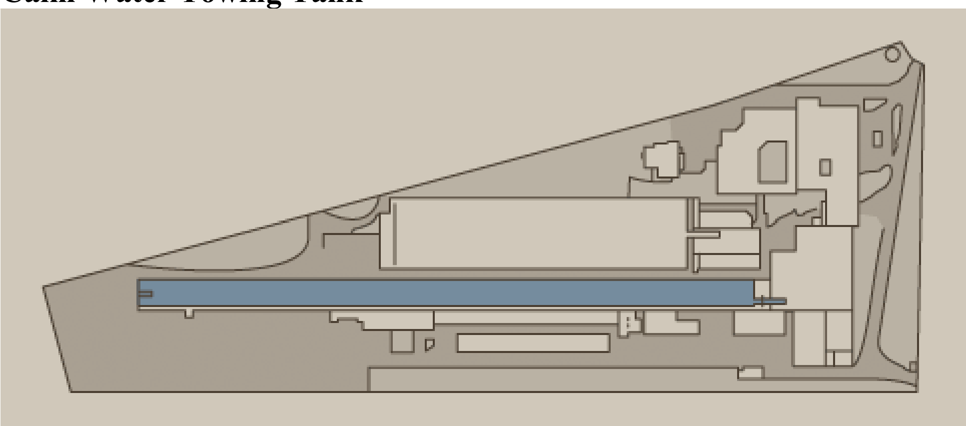
Variable Pressure Tank	
Length	2 m
Width	1 m
Height	3 m
Pressure over free surface:	(0.03 ... 5) • 10^5Pa
Bottom trolley speed:	up to 4.0m/s
Additional description	Attitude relative to the vertical axis: 0 ... 90 degrees. Launcher's inclination allows launching models at any angle relative to the vertical axis.
Tests performed	- Ballistic tests of models moving under water, emerging from the water and entering into the water, including launches from moving carrier..
Measuring devices & instrumentation	- Launcher, located on the bottom trolley and a pneumatic gun - Equipment for rapid filming of processes and to determine pressure inside the launcher and of ambient liquid

4.16 Spain

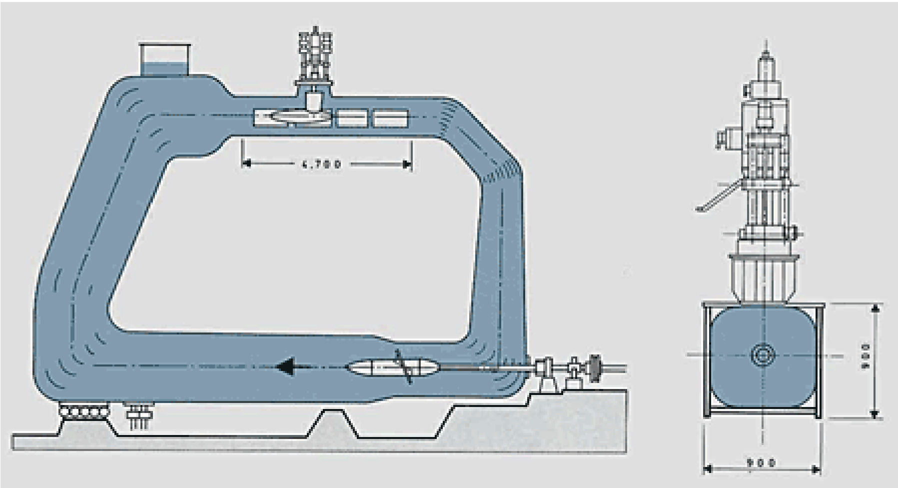
Basic description	
Name of the institution	**Canal de Experiencias Hidrodinámicas de El Pardo (CEHIPAR)**
Address	Carretera de la Sierra s/n, 28048 El Pardo-Madrid, Spain
Other information	Independent public centre for research, member of ITTC and ECMAR
Activities	Studies, model tests and R+D into hydrodynamic aspects involved in the construction of military, merchant, fishing and recreational seagoing vessels. - Experimental tests on models for hydrodynamic study and design of ships, equipment and devices. - Research and experimentation on energy-saving projects for ships. - Certification of the ship's speed and other hydrodynamic parameters that can be deduced from full-scale tests. Standardization of those tests and of other systems and equipment, when required. - Hydrodynamic studies of interest in other branches of industry or science. - Collaboration with national and international research organizations, in order to disseminate Spanish technology within the scope of the CEHIPAR brief. - Promotion of the collaboration with similar foreign centers and pooling of scientific and technical research work. - Training of specialized technical staff in cooperation with universities and companies. - Numerical simulations and computational fluid dynamics (CFD) software. - Full-scale sea-trials.

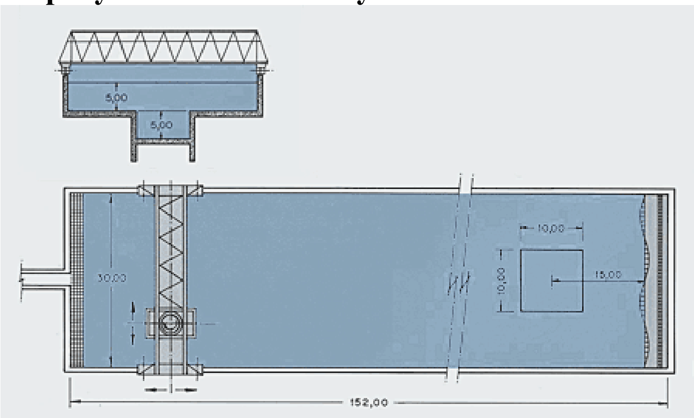
Description of facilities

Calm Water Towing Tank



Length	320 m
Breadth	12.5 m
Depth	6.5 m
Towing carriage data	- Maximum speed 10 m/s

	- maximum acceleration of 1 m/s^2 - control software automatically establishes the velocity profile of the tests
Additional description	digital data acquisition system collects model test data automatically and a computer program is used for the analysis and presentation of results.
Tests performed	- Resistance tests. - Propulsion tests. - Open water tests. - Wake survey tests. - Streamline tests..
Measuring devices & instrumentation	- Towing dynamometer. - Propeller dynamometer. - Dynamometers for propulsion tests. - Six-component dynamometer. - Video cameras and registration equipment.
Cavitation tunnel	
	
Test section dimensions	- 900 x 900 x 4700 mm
Max. water speed	11 m/s
Propeller models diameter range	150 to 450 mm.
Variable static pressure	1.22 - 0.22 atm
Cavitation number range	0.32 - 130.
Tests performed	- check and optimize propeller design by observing the cavitation inception and development, erosion risk, pressure fluctuations and noise generation. - The tests are performed with the propeller in free-stream, behind a screen simulating the ship wake, or introducing a dummy body (partial model of the ship hull). - Non-conventional propulsors are tested.
Measuring devices & instrumentation	- Laser-Doppler anemometer

Ship Dynamics Laboratory	
	
Length	150 m
Width	30 m
Depth	5 m Not far from the wave generator the tank has a square (10x10) sectional pit of 5 m additional depth, thus achieving total depth of 10 m.
Wave generator	The side wave generator is a multi-flap type and has 60 articulated rigid flaps, 30 meters total width. The hinges are located 2 meters above the bottom of the tank. The flaps are hydraulically driven. A wave absorber beach is mounted on the opposite side. This consists of stainless steel shavings, piled together to a thickness of 50 cm. Types of waves generated: - Longitudinal and oblique regular waves of lengths between 1 and 15 m and heights up to 0.9 m. Oblique waves ± 45 º. - Long and short-crested irregular waves of significant heights up to 0.4 m. - Standard and arbitrary spectra. - Capacity to reproduce group spectra. - Episodic waves.
Tests performed	Model tests of ships and other floating structures in the presence of waves and wind.
Measuring devices & instrumentation	C.P.M.C. (Computerized Planar Motion Carriage) - Consists of a principal carriage and sub-carriages. - The principal carriage can be moved uniformly and horizontally along the tank. The three sub-carriages hang below the principle one and are mechanically independent and permit transverse, incremental and rotational motions that are superposed onto the movement of the principle carriage. - The transversal sub-carriage can vary the vertical position of the incremental and rotational sub-carriages, thus adjusting the conditions required for the tests. - The CPMC automatically controls the movements of the carriages, their positioning, the position of the model, acquisition of data and evaluation of the test runs. Other instruments and devices for measuring the movements of ships and other floating structures.

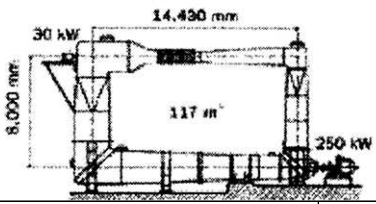
Basic description	
Name of the institution	**Escuela Técnica Superior de Ingenieros Navales (ETSIN)**
Address	Universidad Politécnica de Madrid, Av.da Arco de la Victoria s/n, 28040 Madrid, SPAIN http://www.etsin.upm.es/
Other information	Member of ITTC
Research Activities	<u>Hydrodynamics</u> - Rolling motion, damping coefficient - Passive tank stabilizers - Direct determining of wavemaking resistance - Computational fluid dynamics - Seakeeping - Uncertainty analysis of experimental tests - Application of smoothed particle hydrodynamics for stabilizer tanks simulation <u>Structures</u> - Noises and vibration on board - Design of anchorage and mooring lines and buoys - Structural design of yachts - Composite laminated structures <u>Welding</u> <u>Materials</u> <u>Thermal engineering</u> <u>Electricity and electronics</u> <u>Chemistry</u>

Description of facilities	
Towing tank	
Length	100 m
Breadth	3.8 m
Depth	2.2 m
Towing carriage data	- Maximum speed 4.5 m/s
Wave generator	- Screen type - Provides regular as well as irregular wave - Wave period form 0.5 to 2 seconds - Maximum wave heights up to 20 cm.
Tests performed	- Development of methods for experimentation in hydrodynamics - Optimization of ship hull design - Forward resistance assessment - Seakeeping of ships, mainly with forward and stern seas - High speed vessels
Measuring devices & instrumentation	- Bench for testing passive anti-roll tanks aimed at testing passive anti-roll tanks, in order to obtain ther characteristics and define their optimal point of operation

4.17 Sweden

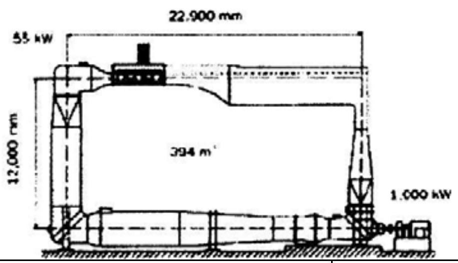
Basic description	
Name of the institution	**Rolls-Royce Hydrodynamic Research Centre (formerly KAMEWA)**
Address	P.O. Box 1010, SE-68129 Kristinehamn, SWEDEN http://www.rolls-royce.com/
Other information	Company, member of ITTC
Activities	- Hydrodynamic research - Development of advanced propulsors - Powering and motions in a seaway - Propeller design - Study of propeller/hull interactions

Conventional cavitation tunnel



Test section dimensions	800 x 800 x 2530 mm
Max. water speed	14 m/s
Min. static pressure, absolute	0.05 bar
Max. static pressure, absolute	3 bar
Max. diameter of model propeller	300 mm
Measuring devices & instrumentation	- Power of dynamometer motor: 30 kW - Max. dynamometer shaft speed: 50 r/s - Max. torque of dynamometer: 120 Nm

Free surface cavitation tunnel



Test section dimensions	800 x 1500 x 4000 mm
Max. water speed	12 m/s
Min. static pressure, absolute	0.05 bar
Max. static pressure, absolute	1 bar
Max. diameter of model propeller	300 mm
Measuring devices & instrumentation	- Power of dynamometer motor: 55 kW - Max. dynamometer shaft speed: 60 r/s - Max. torque of dynamometer: 147 Nm

Basic description	
Name of the institution	**SSPA Sweden AB**
Address	P.O. Box 24001, SE-400 22 Göteborg. SWEDEN http://www.sspa.se/
Other information	Member of ITTC and ECMAR
Activities	<u>Maritime Operations</u> - Environmental impact assessment EIA - Environmental management systems - Integrated coastal zone management ICZM - Ship operations - Maritime safety - Oil spill - Port development - Risk and safety - Wash waves <u>Ship Design</u> - America's Cup - Acoustics and vibration - Aerodynamics - CFD - Container and Ro-Ro - High speed - Hull design - LNG vessels - Manoeuvring - Offshore - Operability analysis - Propulsor development - Seakeeping - Simulation activities - Speed-power predictions - Stability - Structural design - Submarines - Twin-skeg <u>Research areas</u> - Transport Systems - Risk, Safety and Environment - Ship Technology <u>Software</u> - CFD, Hull design optimisation, Multi-hull positioning, Shallow water investigation, Lifting device analysis, Appendage positioning and design - Graphical conning display, GCD - Hydrodynamic predictor, HdP - Hydrodynamic ship models - Portgen - PORTSIM® PC-based real time ship manoeuvring simulator - Portsim® CBS Compact Bridge Simulator - Shipgen PC-based program for generation of mathematical ship

	models and performance of manoeuvring simulations - Simnontm: tool for computer simulations
Description of facilities	
Towing tank	
Length	260 m
Breadth	10 m
Depth	5 m
Towing carriage data	- Maximum speed 11 m/s - Speed accuracy ± 0.001 m/s
Wave generator	- Flap type - Provides regular as well as irregular waves - Wave length: 0.4 < lambda < inf. m - Wave height: 0 < H < 0.3 m - Frequencies: 0 < f < 2 Hz
Additional description	- Arrangements and techniques for testing submersibles (submarines and other underwater vehicles), sailing boats, and fishing gear are available
Tests performed	- Applications concerning hull form optimisation for all kinds of ships with respect to resistance/propulsion - Determination of seakeeping characteristics and ride comfort
Cavitation tunnel	
Test section dimensions	- Circular: 1000 x 2500 mm - Rectangular: 2600 x 1500 x 9600 mm - Rectangular: 2100 x 1220 x 8000 mm
Additional description	The tunnel has three exchangeable test sections
Max. water speed	- 23 m/s - 6.9 m/s - 9.9 m/s
Min cavitation number	- 0.06 - 1.45 - 0.30
Tests performed	- Cavitation studies - Measurement of pressure pulses and radiated noise from all kinds of vessel as well as torpedoes. - Flow studies
Measuring devices & instrumentation	- Dynamometers - Conventional or laser probes for flow studies
Maritime dynamics laboratory	
Length	88 m
Breadth	39 m
Depth	0-3.2 m Rectangular pit: 5 × 9 m, depth 8 m
Towing carriage data	The computer controlled multi-motion carriage, spanning the whole basin is equipped with large-amplitude PMM-tests and rotating arm. Motion speed - x: ± 3.50 m/sec - y: ± 3.00 m/sec - psi: ± 30 °/sec

Wave generator	- Provides regular as well as irregular waves - Wave length: 0.2 < lambda < inf. m - Wave height: 0 < H < 0.4 m - Frequencies: 0 < f < 3 Hz
Additional description	- Wind speed approx.: 0 - 10 m/sec - Current: towing up to 3.5 m/sec, pump system up to 1.0 m/sec
Tests performed	- Seakeeping behaviour of ships and other structures - Captive or free sailing manoeuvring tests - Assessing manoeuvring properties in waves - Model tests in oblique wave conditions

4.18 Turkey

Basic description	
Name of the institution	**Istanbul Technical University**
Address	Faculty of Naval Architecture and Ocean Engineering, Ayazaga Kampusu, 80626 Istanbul, TURKEY http://www.gidb.itu.edu.tr
Other information	Member of ITTC
Activities	The faculty provides education, research, and development activities for the faculty and consultancy service for the marine industry. The activities of the Ship Model Testing Laboratory are focused on ship resistance and propulsion, offshore technology, ship design and transportation. They include the development of theoretical, computational and experimental methods and design tools to be used in ship design and ocean engineering applications. - Preliminary computational investigations into hull forms and propellers design for optimization in the preliminary design stage. - Calm water resistance tests for powering - Self-propulsion tests with stock or built-on-order propellers - Flow visualization tests by using tufts, paint injection and oil film for investigating flow lines, separation and stern flow - High speed crafts and yacht resistance and propulsion tests in both calm water and seaway - Hull form development including optimization of LCG, trim, spray, transom wedges and application of bulbous bows - Wake field measurements on the propeller disk plane by means of Pitot tubes and/ or electronic pressure transducers to investigate wake quality and hull efficiency - Open water propeller tests to determine the characteristics of propellers - Resistance and motion tests of ship models in head and stern seas including pitch and heave measurements - Tests on the behaviour of offshore structures both in regular and irregular seas - Cavitation tests on propellers, rudders and wings with or without simulated ship wake - Stability tests - The effect of stationary fins and movements of sliding loads on rolling motion by mean of orbital wheel - Wave Pattern Analysis Experiments

Description of facilities	
Large towing tank	
Length	160 m
Breadth	6 m
Depth	3.4 m
Towing carriage data	- Speeds of up to 6 m/s

	- Numerically controlled
Wave generator	- Flap type operated by a hydraulic piston drive - Regular and irregular waves - Maximum regular wave height: 27 cm - Significant wave height (irregular): 15 cm - Maximum regular wave length: 6 m
Additional description	Ship models up to 4.5 m long.
Tests performed	- Standard resistance tests - Open-water propeller tests - Self-propulsion tests - Wake field measurements - High-speed craft tests - Measurement of the motions of ship models and motions of offshore platforms in regular or irregular waves
Measuring devices & instrumentation	- resistance, propulsion and open-water propeller dynamometers - wave probes - wake rake - 3 component vertical dynamometer - flow measurement
Small towing tank	
Length	40 m
Breadth	2 m
Depth	1 m
Towing carriage data	Speeds of up to 2 m/s
Additional description	- Semi-circular cross section - Made of steel - Ship models up to 1.8 m long - Utilizes a falling weight dynamometer operating directly with a wire towing arrangement or a towing carriage moving on the rails.
Tests performed	- Used mainly for academic studies and students training - Ship resistance - Tests of special types of hydrofoil sections
Measuring devices & instrumentation	- dynamometer - electronic speedometer
Cavitation tunnel	
Test section dimensions	- 630 x 350 x 2300 mm - 300 x 300 x 1290 mm
Centre to centre of horizontal sections	4.4 m
Max. water speed	- 3.8 m/s - 9 m/s
Drive system	- Ward-Leonard control - Total motor power: 50 kW
Max. model propeller diameter	200 mm
Minimum absolute pressure	2.94 kPa
Maximum absolute pressure	196.2 kPa

Tests performed	- Cavitation tests, - Propeller tests - Propeller-hull interaction tests - Tests with submerged bodies (rudders, hydrofoils) - Flow visualisation tests
Measuring devices & instrumentation	- Propeller dynamometers - 6 component balance - Pressure sensors - Prandtl's tube - Stroboscope
Circulating water channel	
Principal characteristics	Vertical plane open recirculation
Test section dimensions	1500 x 750 x 6000 mm
Max. water speed	- 2 m/s
Drive system	- 4 bladed axial flow impeller - Total motor power: 35 kW
Max. model size	4 m
Tests performed	- Flow observations - Resistance in channel - Shallow water effects - Offshore structures tests
Measuring devices & instrumentation	- Resistance dynamometer - Instrumentation for deaeration - Prandtl's tube - Flow visualisation instrumentation

4.19 United Kingdom

Basic description	
Name of the institution	**BMT SeaTech Ltd.**
Address	Building 144, Haslar Marine Technology Park, Gosport, Hampshire, PO12 2AG, UK http://www.bmtseatech.co.uk
Other information	Independent engineering and technology business, member of ITTC and ECMAR
Activities	Hydrodynamics consultancy services include: - support of preliminary design through to final design validation - development of optimum hull forms for new designs or modifications to existing vessels for either change of use or performance enhancement - assessment and optimisation for efficiency and operability - assessment and optimisation of vessel motions and passenger / crew comfort - compliance with regulations - assessment of navigation risks - assessment and optimisation for minimum environmental impact - ensuring quality of testing - independent assessment of hydrodynamic assessment and optimisation - resistance and propulsion predictions, using a range of approaches - seakeeping predictions and operability analysis - assessment of manoeuvring and control - port approach, channel design and low-speed vessel handling - wash assessments - independent witnessing and project management of test programmes - development of model test specifications - trial assessment and interpretation

Description of facilities	
GKN Towing tank (GKN Aerospace Engineering Services, at the Isle of Wight)	
Length	200 m
Breadth	4.6 m
Depth	1.7 m
Towing carriage data	Maximum speed 15 m/s
Wave generator	- Fully computer operated, single flap type - Provides regular as well as irregular wave - Wave length: 0.6-15 m
Additional description	Maximum model length: 4m.
Tests performed	<u>Resistance and propulsion</u> - Calm water powering; - Deep or shallow water. <u>Seakeeping and motions</u>

	- Body motions and accelerations; - Slamming, deck wetness, bow diving; - Power increase in waves; - Human factors. Wake surveys and flow - Propeller plane wake; - Alignment of appendages; - Air drawing and ventilation. Wave wash - Vessel wash performance; - Prediction to far field.

Basic description	
Name of the institution	**DERA Centre for Marine Technology**
Address	Haslar Marine Technology Park, Haslar Road, Gosport, Hampshire, PO12 2AG, UK
Other information	QinetiQ Maritime Systems Haslar Marine Technology Park, Haslar Road , Gosport Hampshire , PO12 2AG, UK
Areas of Activity	- Civil Aviation - Electronics - Energy - Environment - GPS & RFID Solutions - Health - Human Performance & Human Protection - Space - Transport - Advanced Sensors
Description of facilities	
Towing tank	
Length	270 m
Breadth	12.2 m
Depth	5.5 m
Towing carriage data	- Maximum speed 12.25 m/s - Thyristor controlled drive - Maximum power 1089 kW
Wave generator	- Computer controlled, hinged flap type - Hydraulically actuated - Maximum regular wave height 86 cm - Random seas wave heights up to 55 cm
Additional description	- Planar motion mechanism, vertical or horizontal - Models up to 10 m
Tests performed	- Towing of constrained models of ships, submarines, submersibles and other maritime systems. - Measurement of forces acting on vessels under steady state and oscillatory motion. - Towing of partly constrained models. - Measurement of motion induced by waves in head seas and following seas.
Measuring devices & instrumentation	- Six components dynamometer for force and moment acting on the models in steady state or oscillatory motion - Pressure sensors - Fibre-optic Doppler velocimeter - Minicomputer data acquisition system
Manoeuvring and seakeeping tank	
Length	122 m
Breadth	61 m
Depth	5.5 m

Rotating arm data	- Length: 27.5m - Maximum angular speed of up to 0.6rad/sec - The models can be rotated at any radius and speed, with superimposed drift/yaw and pitch angles if required - Six components of force and moment acting on the model can be measured.
Wave generator	- Capable of generating long crested regular and random waves - Regular wave heights up to 0.6 m - Random wave heights of up to about 0.2m
Additional description	- Models normally up to 6 m
Tests performed	- Testing of free manoeuvring models of ships, submarines, submersibles and maritime structures, with and without long-crested waves - Submarine depthkeeping, autopilot and control tests - Seakeeping tests at all headings
Measuring devices & instrumentation	3D acoustic tracking system
Cavitation tunnel	
Test section dimensions	2400 x 1200 x 5350 mm
Max. water speed	7.9 m/s
Total impeller motor power	295 kW
Maximum model size	Ship and submersible models up to 5m long Propulsors of about 0.5 m diameter
Minimum abs. pressure	3 kPa
Maximum abs. pressure	150 kPa
Tests performed	- Propulsion and cavitation testing of scale model marine propulsors both in open water and in the correct flow field behind scale model hulls - Flow measurement and visualisation, wake survey
Measuring devices & instrumentation	- Single or multiple shaft arrangements can be tested behind models, with or without dynamometers in the shaft lines. - A single centre line shaft allows open water tests to be carried out, with or without dynamometry - Outer drive, strained gauged dynamometer, not watertight, thrust ±4.4 kN, torque ±250Nm - Outer drive, strained gauged dynamometer, watertight, thrust ±4.4 kN, torque ±203Nm
Circulating water channel	
Test section dimensions	1400 x 840 x 5000 mm There is an adjustable false floor that can be angled and/or raised to reduce the effective depth to a minimum of 0.15m.
Max. water speed	5.5 m/s
Total impeller motor power	75 kW
Minimum abs. pressure	40 kPa
Maximum abs. pressure	100 kPa
Tests performed	- Video or visual observation of flow phenomena under cavitating and non-cavitating conditions for both surfaced and submerged bodies.

	- Small scale complete ship models or larger portions of craft can be tested. - Model tests of fixed structures such as platforms or bridges. - Force and moment measurements with strain gauged posts - Flow measurement by laser Doppler velocimetry
Measuring devices & instrumentation	- Multi-channel data acquisition system - Underwater closed circuit TV
30" Quiet Water Tunnel	
General description	Low turbulence, low noise, high speed water tunnel
Circular test section dimensions	Diameter: 700 mm Length: 4570 mm
Max. water speed	15 m/s
Maximum model size	Propulsors of about 0.4 m diameter
Minimum abs. pressure	10 kPa
Maximum abs. pressure	300 kPa
Tests performed	- Hydrodynamic and acoustic measurements - Validation of propulsor design software - Investigation of noise caused by propulsors
Measuring devices & instrumentation	- Laser Doppler velocimeter - Hydrophones
Quiet Wind Tunnel	
General description	Open circuit, open jet wind tunnel
Test section dimensions	Floor: 3 x 3 m Height: 2 m
Max. air speed	50 m/s
Additional description	- Longitudinal turbulence level of 0.2% - Anechoic at frequencies above 400Hz - The structure is made of anti–vibration mountings and couplings to minimise noise transmission. The working chamber itself is further isolated from ambient noise by a muffler and sound absorbent linings at the inlet and from fan noise by fan inlet and outlet silencers, and by the plenum chamber and its lining.
Tests performed	- Propulsor and fan noise measurements - Flow and turbulence studies. - Flow visualisation
Measuring devices & instrumentation	- Sensors mounted on a computer controlled robot - Pitot-static - Hot-wire - Laser Doppler systems for the measurement of mean flow velocity and turbulence.

Basic description	
Name of the institution	**University of Southampton**
Address	School of Engineering Sciences, Ship Science, Southampton, SO17 1BJ**, UK** http://www.ses.soton.ac.uk/
Other information	Member of ITTC and WEGEMT
Activities	- AERODYNAMICS AND FLIGHT MECHANICS - research in fundamental fluid dynamics, applied aerodynamics and flight mechanics. - BIOENGINEERING - Evaluation of the performance of orthopaedic devices and associated materials, as well as the likely response of the supporting biological tissues. - ELECTRO-MECHANICAL ENGINEERING - The application of transducers, measurement systems, and control systems to a broad range of activities. - ENGINEERING MATERIALS AND SURFACE ENGINEERING - Modelling, aluminium alloy technology, materials characterisation and experimental mechanics. - ASTRONAUTICS - Fundamental and applied research in the field of space physics and spacecraft engineering. - COMPUTATIONAL ENGINEERING DESIGN - Design optimisation, applied computational modelling and computational methods. - ENERGY TECHNOLOGY - Energy research within the School with activities covering a wide spectrum of mainstream and renewable energy technologies. - FLUID STRUCTURE INTERACTIONS - Covers the diverse nature of the maritime field with focus on the dynamic behaviour of marine structures.

Description of facilities	
Towing tank	
Length	30 m
Breadth	2.4 m
Depth	1.2 m
Towing carriage data	- Maximum carriage speed: 2.5 m/s - Drive system: cable, 3.7 kW motor
Wave generator	- Seasim flat type, 3 segments - Capable to generate regular, irregular and transient waves - Arc beach
Additional description	- Unmanned towing carriage - Maximum ship model length: 2 m
Tests performed	- Ship hull resistance - Ship motion
Measuring devices & instrumentation	- Capacitance and resistance probes for wave height measurement - Dynamometers for resistance, yaw moment and side force measurements - PMM - Digital and analogue data acquisition systems

Towing tank	
Length	60 m
Breadth	3.7 m
Depth	1.8 m
Towing carriage data	- Maximum carriage speed: 4.5 m/s - Drive system: thyristor controlled, 6 kW motor
Wave generator	- Seasim flat type, 3 segments - Capable to generate regular, irregular and transient waves - Arc beach
Additional description	- Manned towing carriage - Maximum ship model length: 3 m
Tests performed	- Ship hull resistance - Ship motion - Wave cut/wave pattern resistance - Wake survey
Measuring devices & instrumentation	- Capacitance and resistance probes for wave height measurement - Dynamometers for resistance, yaw moment and side force measurements - Wake transverse rig - Digital and analogue data acquisition systems
Anechoic water tank	
Length	8 m
Breadth	8 m
Depth	5 m
Additional description	- Maximum model size: 3 m - 1 tonne overhead crane
Tests performed	Acoustic and vibration measurements on submerged bodies and structures
Measuring devices & instrumentation	Instrumentation for acoustic and vibration measurements
Wind tunnel (R J Mitchell wind tunnel)	
Basic description	closed circuit, closed jet tunnel
Test section dimensions	- Cross-section 3.6 m x 2.5 m - Length: 10.5 m
Maximum wind speed	50 m/s
Additional description	- Moving ground in the test section - Less than 0.2% turbulence - Air chiller to control airflow temperature to 19 degC
Measuring devices & instrumentation	- 6-component Nutem load cell balance in tunnel roof with turntable - 6-component strut mounted Aerotech balance for vehicle tests - Moving ground: belt 2.0m wide x 4.0m long with a speed range up to 45 m/s; Boundary layer control gives >99.8% of free stream velocity 2mm above belt - 3 axis laser Doppler anemometer on side mounted traverse system; - Portable Dantec 2D Particle Image Velocimetry (PIV) - Pi Research Ltd Mistral wind tunnel control and acquisition system - Motor drive systems for propeller testing

Tests performed	- Racing cars, another vehicles aerodynamics - Flow simulation on underwater bodies
Wind tunnel	
Basic description	closed circuit, closed jet
Test section dimensions	- High-speed (7'x 5') 2.1 m wide x 1.5m high x 4.4m long; - Low-speed (15'x 12') 4.6m wide x 3.7m high x 3.7m long;
Maximum wind speed	- Wind speed range from 4 to 55m/s; - Maximum wind speed of 11 m/s in low speed test section
Additional description	- Moving ground in the test section - Models up to 3m long in the low-speed section
Measuring devices & instrumentation	- 3-component weigh beam balance in tunnel roof; - 4-component strut mounted Aerotech balance for vehicle tests - Moving ground in the high-speed section: belt 1.0m wide x 2.1 m long with a speed range of up to 40m/s; boundary layer control gives >99.8% of free stream velocity 2mm above belt - Portable Dantec 2D Particle Image Velocimetry (PIV)
Tests performed	- Academic research - Wind engineering studies and work for the marine industry on racing yacht sails - Vehicle aerodynamic
3'x 2' wind tunnel	
Basic description	open circuit, closed jet
Test section dimensions	0.9 m x 0.6 m x 4.5m;
Maximum wind speed	Maximum wind speed of 40 m/s
Additional description	- Moving ground in the test section - Models up to 3m long in the low-speed section
Measuring devices & instrumentation	- 3D computer controlled probe traversing system - 6-component strain gauged balance in tunnel floor on a controllable turntable - 2D Traverse gear for moving instrumentation across the working section - Portable Dantec 2D Particle Image Velocimetry (PIV)
Tests performed	- flow visualisation - calibration of instrumentation

Basic description	
Name of the institution	**University of Glasgow** **Department of Naval Architecture and Marine Engineering** **Hydrodynamics Laboratory**
Address	Acre Road, Glasgow , G20 OTL Scotland http://www.na-me.ac.uk
Other information	member of ITTC and WEGEMT
Activities	Marine Engineering: - Low Emission/High Efficiency Machinery Systems - Reduced Environmental Impact - Ballast Water Treatment - Low Sulphur Fuels - Fuel Cell Technologies - Ship Board Thermal Management - Alternative Fuels - COGAS Propulsion systems - Marine Pollution Reduction - both airborne and waterborne pollution - Engine Studies - including catalytic efficiency during engine cold start, exhaust water scrubber for low emissions Marine Design and Production: - risk-based design - design for producibility - ship design optimisation using first principle tools with multi agent design and case-based reasoning approaches - innovative techniques for ship production - improved understanding of human factors in design and operation **Research centres** Centre for Marine Hydrodynamics (CMH): - Novel techniques for experimental determination of ship motion coefficients - Experiment and theoretical modelling of unsteady ship resistance - Hydrodynamics of marine renewable energy devices - Hydrodynamics of flow around bluff bodies - Vortex Induced Vibration (ViV) - CFD/RANS techniques for complex ship hydrodynamic and hydroelastic problems - Rapid first-principles techniques for ship-wave prediction for high-speed ships - Sailing yacht performance prediction - Evolutionary optimisation techniques in hydrodynamic design for high-speed low-cost ships - Impulsive capsize of small vessels - Wave loading and rock movement on sea cliffs Marine Structures and Reliability Centre (MSRC):

	- Structural response of FPSOs to wave impact forces• - Improved structural design procedures for bulk carriers, accounting for corrosion with coating breakdown - Novel methods for the assessment of the extent of hull damage on grounding or collision - Development of a failure function directory for the improvement of offshore safety - Reliability of floating production platforms in large waves - Rational methodologies for the assessment of through-life reliability of marine structures degrading through corrosion and fatigue - Hull girder strength structural reliability methodology for partial safety factor selection for naval surface vessels - Reliability-based minimum cost design procedures for submarine pressure hulls - Wetness, slamming and green seas loads Ship Safety Research Centre (SSRC): - Manoeuvring behaviour of ships in extreme following and quartering seas - Safety and seaworthiness of bulk carriers in extreme conditions - Time based survival criteria of passenger ro-ro vessels - Vessel-wave interaction in breaking waves - Applications of non-linear dynamics to damage stability - Strength of hatch covers for bulk carriers - Probabilistic approach to subdivision of passenger/ro-ro vessels - Harmonisation of rules and design rationale in damage stability and survivability - Virtual environment for passenger evacuation simulation - Formal safety assessment for modern bulk carriers - Methodology for safe ship design - An integrated approach to limit state performance predictions - Hull-propeller interaction using CFD techniques - Estimation of ship roll damping using the RANS technique
Description of facilities	
Towing tank (Centre for Marine Hydrodynamics)	
Length	77 m
Breadth	4.6 m
Depth	2.7 m
Towing carriage data	- Self propelled - Max speed 5m/s
Wave generator	- Computer controlled single flap type - Regular and irregular waves - Maximum wave heights up to 0.5m
Additional description	Maximum model size up to 4 m
Tests performed	- Ship Resistance measurement - Towed sea-keeping tests in head and following seas. - Hydrodynamics of towed bodies. - Wave impact studies on fixed and floating bodies - 3D wake surveys

Measuring devices & instrumentation	- Non-contact infrared camera system for ship motions measurements - Resistance dynamometers - Six degree-of-freedom dynamometer - 25 wave probes - 3-axis fluid velocity measurement system - Transducers for measurement of pressure distribution on model surfaces - Above-water and underwater video systems - PC based modular data acquisition/control system with 64 input and 20 output channels, maximum sample rate: 60kHz
Towing tank (Hydrodynamics laboratory)	
Length	24 m
Breadth	1.6 m
Depth	0.65 m
Tests performed	Teaching and demonstration of experimental marine hydrodynamics.

Basic description	
Name of the institution	**University of Strathclyde** **Department of Naval Architecture and Marine Engineering** **Ship Stability Research Centre**
Address	Henry Dyer Building, 100 Montrose Street, Glasgow, G4 OLZ, Scotland http://www.na-me.ac.uk
Other information	Member of ITTC and WEGEMT
Activities	See University of Glasgow
Description of facilities	
Towing tank	
Length	93 m
Breadth	6.8 m
Depth	2.75 m
Towing carriage data	- Single manned - DC motor driving rear wheels viqa a variable gearbox - Ward-Leonard control system, power 11.25 kW - Maximum speed: 6 m/s
Wave generator	- Single plunger type paddle with parabolic face - Driven by DC motor - Maximum wave height of regular waves: 50 cm
Additional description	Maximum length of a ship model: 5 m
Tests performed	- Resistance and propulsion - Seakeeping - Manoeuvring - Open water tests of thrusters - Flow visualisation - Extreme tests in waves
Measuring devices & instrumentation	- Force measurement dynamometers - Strain gauge load cells - Capacitance wave probes - Linear transducers array - Propeller dynamometer - Yacht dynamometer (for maximum 2m model) - Computer controlled PMM (for maximum 2m model) - Above water video - PC based data acquisition and control system (32 input and 8 output channels, maximum sampling frequency: 60 kHz))
Seakeeping tank	
Length	15.5 m
Breadth	8.275 m
Depth	3 m
Towing carriage data	- Fitted to the bottom of the tank - Driven via endless wire loop - 135 kW DC servo system - Maximum velocity: 6 m/s - Maximum acceleration: 20 m/s^2

	- Maximum amplitude: 4.75 m - Load measuring system in transverse and inline directions: ±6kN
Wave generator	- Paddle type, consisting of 27 independently DC servo controlled units, computer controlled - Dry backed with 1m hinge immersion - Maximum wave height: regular 0.4 m, significant: 0.25 m
Additional description	Maximum length of a ship model: 3 m
Tests performed	- Seakeeping - Wave and current loading - Flow visualisation - Floating and moored structures
Measuring devices & instrumentation	- Force measurement dynamometers - Strain gauge load cells - Capacitance wave probes - Linear transducers array - Above water video - PC based data acquisition and control system (32 input and 8 output channels, maximum sampling frequency: 60 kHz))

Basic description	
Name of the institution	**University of Newcastle upon Tyne** **School of Marine Science and Technology**
Address	Armstrong Building, Queen Victoria Road Newcastle Upon Tyne, NE1 7RU http://www.marinetech.ncl.ac.uk/
Other information	Member of ITTC and WEGEMT
Activities	- Marine technology - Marine biology - Ship hydromechanics
Description of facilities	
Towing tank	
Length	40 m
Breadth	3.75 m
Depth	1.2 m
Towing carriage data	- mono-rail carriage system - maximum speed: 3 m/s - unmanned
Wave generator	- regular and irregular waves - maximum wave length: 5 m
Additional description	- Maximum model length: 3 m - Maximum diameter of a floating structure model : 1 m
Tests performed	- Ship resistance in calm water and waves - Open water propeller tests - Hydrodynamic forces on towed ad static bodies - Waves induced motions and forces - Shallow water tests
Measuring devices & instrumentation	- Resistance/capacitance wave probes - Force transducers - Computerised data acquisition system
Emerson Cavitation tunnel	
Test section dimensions	810 mm x 1220 mm x 3100 mm
Contraction ratio	4.271
Main pump	- 4 Bladed axial flow impeller with thruster control drive system - Maximum main pump power: 300 kW - Maximum main pump rotational speed: 242 rpm - Impeller diameter 1.4 m
Max. water speed	15.5 knots (8 m/s)
Propeller model diameter	150-400 mm, typical 300 mm
Pressure range	– Absolute pressure range 7.6 kN/m2 (min) to 106 kN/m2 (max) – Cavitation number range 0.5 (min) to 23 (max)
Tests performed	- Propeller tests in uniform and non-uniform streams. - Wake simulation using a wake screen including, if required, flat plate impulse measurements. - Wake simulation using dummy hull model including, if required, hull surface impulse measurements.

	- Tests with ducted propellers in uniform stream or with wake screens including measurements of duct thrust. - Controllable pitch propeller tests. - Propeller model noise measurements. - Drag forces on submerged bodies. - Recording of nature and extent of cavitation, using still and video cameras. - Flow measurement using LDA/PDA.
Measuring devices & instrumentation	- Dynamometer Type 1 - Kempf & Remmers H33 propeller dynamometer, max thrust ± 2943 N, max torque ± 147 Nm, max rpm 4000 rpm - Dynamometer Type 2 - Kempf & Remmers R45 with vertical adjustable drive system and suitable for placement inside of hull models, max thrust ± 687 N, max torque 39 Nm, max rpm 4000 rpm - Bruel & Kjaer 8103 miniature hydrophone and associated instruments, located in a water filled, thick walled steel cylinder placed on a 30mm Perspex window above propeller - Laser Doppler anemometer - PIV flow investigation system
Combined Wind, Wave and Current (WWC) Tank	
Flume length	11 m
Width	1.8 m
Water depth	1 m
Air clearance	1 m
Central measurement section	3 m
Water velocity	1 m/s
Wind velocity	20m/s

Wave capability	- Period: 0.8 - 4 Sec
	- Wave height: 0.02 - 0.2m (period dependent)
	- Wave spectra:
	    - Pierson-Moskowitz
	    - JONSWAP
	    - Bretschneider
	    - Neumann

Tests performed	- Small scale model testing for renewable energy devices - Wind loading on wet and dry structures - Resistance measurements - Seakeeping tests - Combined wind/wave/current interaction - Flow visualisation experiments
Measuring devices & instrumentation	- Vectrino 3D ultrasonic water sensor, - Pitot tube - Qualisys IR tracking system

Basic description	
Name of the institution	**VT Shipbuilding**
Address	Fleet Way, Portsmouth PO1 3AQ, UK http://www.vtplc.com/shipbuilding
Other information	Private company, member of ITTC
Activities	- Naval Architecture - Marine Engineering - Combat System Engineering Research And Development conducts investigations and studies into: - Novel Concepts - New technologies - New or improved production processes Main areas of expertise are as follow: - Machinery Space arrangement and physical integration - General Arrangement - Weight Management - Hydrodynamics including propeller design - Structural assessment and material selection - Composites - Electric Propulsion - EMC - Interface Management - Systems Engineering - On board Noise Prediction - Magnetic Control

Basic description	
Name of the institution	**HR Wallingford Ltd**
Address	Howbery Park, Wallingford, Oxfordshire OX10 8BA, United Kingdom. http://www.hrwallingford.co.uk
Other information	Private company, member of HYDRALAB III
Activities	Research and consultancy in civil engineering and environmental hydraulics. Maritime activities focus on the following: - Dredging & disposal - Environmental Impact Assessment - Estuary management - Port & terminal planning - Ports, harbours & marine terminals - Real time forecasting services - Ship navigation & mooring - Water quality - Waterfront property & marina development
Description of facilities	
Wave basins	
General information	Seven wave basins including separate and linked units
Maximum length	75 m
Maximum breadth	32 m
Wave generator	- Fully computer operated, - Mobile random wave, both long and short crested seas, - Waves of up to 0.2m can be generated in water depths of up to 0.8m.
Coastal research facility	
General information	Wave and current basin
Basin external dimensions	54m x 27m
Basin internal dimensions	36m x 20m
Basin test area	20m x 15m
Wave generator	- Fully computer operated, - Waves are generated by 72 individual, electronically driven 0.5m-wide paddle elements installed along one of the long sides of the basin. - The paddles can be operated at depth between 0.3m and 0.8m.
Current generator	- Shore-parallel currents are circulated through four independent reversible computer-controlled pumps, each with a capacity of $0.3m^3/s$. - Controllable in either direction, continuously through zero, so tidal or uni-directional flows can be generated. - The currents are introduced into either end of the basin through 40 0.5m wide inlet flumes each controlled by its own undershot weir. - Maximum offshore near surface current speed in 0.5m water depth - 0.14m/s.

Additional description	A sediment recirculation system, comprising of four pumps and four hydro-cyclones, can be installed to re-circulate sediment in mobile-bed tests.
Tests performed	Generation of waves, wave-driven currents and tidal currents for investigations into near shore and coastal processes related to the behaviour and influence of: - waves & currents - pollutants & contaminants - sediments - structures
Wave flumes	
General information	Two large wave flumes
Length	40 m
Width	1.2 m
Maximum depth	1 m
Wave generator	- electric paddle - regular and random waves.
Additional description	Equipped with wave absorbing paddles to minimise wave reflections
Tests performed	- performance of a structure under a range of sea state conditions, - stability of armour layers, - structure run-up performance, - overtopping performance of the structure, in terms of mean, peak or wave by wave discharge, - wave reflections from, and transmission through, the structure - susceptibility of the structure to toe scour, - wave forces or pressures imposed on the structure.
General purpose flume	
General information	uses the volume-time approach to measure flow rates
Length	25 m
Width	2.4 m
Maximum depth	0.7 m
Additional description	- flow capacity of 170 l/s, - measurement of the flow rate volumetrically using a 36 m^3 volumetric tank with an overall accuracy of ±0.215%, - measurement of the flow rate by means of an electromagnetic flow meter, - tailgate at the downstream end of the flume allows control of the flow depth.
Tests performed	- hydrometry (i.e. gauging structures such as weirs and flumes), - fish passes, - river structures, - flow meter accuracy evaluation, - bank protection and erosion studies, - scour around structures.
Equipment	- Wavemakers for basins, - Wavemakers for flumes, - Wave generation software, - Wave gauges, - Data acquisition & analysis software,

	- Bed profilers, - Ship movement measurement, - Digital point gauges, - Water level electronic float gauges, - Miniature propeller meters, - High performance pressure sensors, - Differential pressure sensors, - Force measurement sensors, - Two full bridge, real time ship manoeuvring simulators specifically configured for port design and ship operations applications.

5 Cooperation of marine testing facilities – organisations, associations, cooperation within projects

There are different international associations and organisations gathering together marine technology research facilities in Europe. There are worldwide open ones as well as others that are geographically limited to the European Community members. Regarding to the objectives and way of operation different forms of cooperation and integration can be met. Some of them are long lasting (e.g. ITTC, ECMAR Association or WEGEMT), some of them have certain duration (e.g. ERAMAR Thematic Network, Hydrotesting Alliance, HYDRALAB III). The concise overview of the organisations is presented below.

The aims of certain organisations are coinciding partly with those specific for ERA-NET MARTEC programme. This concerns the coordination of national research programmes (see ECMAR or Hydrotesting Alliance) or common use of existing European testing infrastructure (Hydralab III or Hydrotesting Alliance). Many good practices should be incorporated by MARTEC, however there are also selected examples showing that the effective cooperation of the independent research facilities is not an automatic, self governing mechanism. The cooperative use of testing infrastructure is possible and benefits to participants but the aims have to be clear it should not limit the independency of particular facilities.

5.1 ITTC – International Towing Tank Conference

Name of the organisation	International Towing Tank Conference ITTC
Contact data	http://ittc.sname.org/
Brief description	ITTC is the worldwide organisation gathering together ship research institutions and the universities, which have shipbuilding or ocean engineering faculties. The organisation started with the Conference of Tank Superintendents that was held in The Hague in 1933. Membership of the ITTC is be open to all towing tanks or model test laboratories that regularly have direct responsibilities to the designers, builders and operators of ships and marine installations, and also to other organisations that contribute to the aims of the Conference. Each such organisation shall satisfy the Executive Committee that it is eligible for membership. Each Member Organisation shall be represented by its Director, Superintendent or an equivalent. In addition, the Executive Committee may invite individuals who have contributed and/or can contribute significantly to the aims of the Conference to take part in the work of the ITTFC. The Full Conference, held each three years consists of the representatives of the Member Organisations, members of the Technical Committees and Groups, and such additional individuals who are invited and approved by the Executive Committee. The core activities of ITTC are conducted by the Technical Committees, which consist of two types. One type covers "General Subject Areas" (General Committees), such as: Resistance, Propulsion, Manoeuvring, Loads and Responses, and are continuing committees. The other type covers "Specialty Subject Areas" (Specialist Committees), such as: Waterjets, where a specific technical problem needs to be addressed and, as such, is a limited-duration committee. The Technical Committees shall develop detail technical plans in accordance with Conference recommendations. The work of all Technical Committees is directed towards the techniques and understanding of physical and numerical modelling as a means of predicting full-scale behaviour. While maintaining an awareness of progress, fundamental theoretical studies and fundamental aspects of numerical fluid computation should be covered by other forums. The conclusions and recommendations of the Technical Committees should be structured into three separate parts: 1. General technical conclusions; 2. Recommendations to the Conference on carrying out or reporting work requiring Conference action (e.g., testing techniques, symbols, prediction techniques, etc.); and 3. Recommendations for future work of the Committee.
Objectives	The primary aim of ITTC is to maintain systematic progress of methods for solving technical problems that are of importance to towing tanks. ITTC develops, verifies and updates standard research procedures that are intended to be implemented by towing tanks which for giving advice and

	information regarding full-scale performance to designers, builders and operators of ships and marine installations based on the results of physical and numerical modelling. The ITTC aims at - stimulating research in all fields in which a better knowledge of the hydrodynamics of ships and marine installations is needed to improve methods of model experiments, numerical modelling and full-scale measurements, - recommending procedures for general use in carrying out physical model experiments and numerical modelling of ships and marine installations; in validating the accuracy of such full-scale predictions and measurements for quality assurance - formulating collective policy on matters of common interest - providing an effective organisation for the interchange of information on such matters

5.2 ECMAR

Name of the organisation	**European Council of Marine Research Institutions** ECMAR Association
Contact data	
Brief description	ECMAR Association arises from the need of the increasing the role of Maritime Applied Research Organisations in the discussions with the European Commission. The Association for Applied Maritime Research distinguishes itself from the existing ones like COREDES, EMECRID, WEGEMT or EARTO and contributes to formulating research and innovation strategies for the European maritime sector, together with improved support services for technology transfer. The ECMAR Association can and offer added value by developing strategies from trends in research and innovation, from a broad overview of the research area and from the knowledge of both the available technology and the market demands. ECMAR Association is the organisation open to all institutions providing applied maritime R&D, with commercial activities, located in the European member, candidate or economic area states. The activities should be in the field of offshore, shipbuilding or shipping. Initiators of the association are BMT, MARIN, FORCE, VTT, MARINTEK, HSVA, SIREHNA, CETENA, CMT and SSPA. Five of the initiating members have been elected to form the first ECMAR council: Aage Damsgaard Chairman (FORCE) , Jochen Marzi vice-chairman (HSVA), Tony Morrall (BMT), Seppo Kivimaa (VTT), Eivind Dale (MARINTEK) The benefits for the members of the association are; - Organised representation in Brussels of the interests of the maritime applied research organisations. - Presence of the association at meetings in Brussels. - Influence on the European policy through the critical mass of the association. - Initiation and coordination of membership activities related to technology platforms (e.g. Waterborne), networks, projects and R&D agenda's. - A contribution to the European research and innovation programs. - An active European network through meetings and seminars. - First hand information on ongoing developments in the European Maritime Research environment. - A quarterly newsletter with information on relevant EC developments and report of the activities of the association.
Objectives	- Contribution to a common Strategic Plan for Research and Development in the European Maritime Sector that will be taken into account in defining content and priorities of National research programmes. - Support the adoption of the relevant research priorities within the scope of the EU Framework Programmes for Research and Technology Development. - Addressing the Strategic Plan to the Member States, European Union institutions and the European Maritime Industry. - Cooperation with industrial partners, universities and research organisations to develop future R&D in Europe.

Participants		
	FORCE	www.force.dk
	HSVA	www.hsva.de
	BMT	www.bmt.org
	VTT	www.vtt.fi
	MARINTEK	www.marintek.no
	MARIN	www.marin.eu
	CEHIPAR	www.cehipar.es
	SSPA	www.sspa.se
	DST	www.dst-org.de
	CMT	www.cmt-net.org
	CTO	www.cto.gda.pl
	SVA	www.sva.at
	BSHC	www.bshc.bg
	SIREHNA	www.sirehna.com
	ICEPRONAV	www.icedesign.info
	TNO-CMC	www.tno.nl
	CETENA	www.cetena.it
	ABS	www.eagle.org
	INSEAN	www.insean.it

5.3 ERAMAR Thematic Network and WWW.ERA-MAR.NET web portal

ERAMAR was a thematic network within the 5th Framework Programme. The principal objective of ERAMR was expressed by the following: "*By using the principles and instruments of ERA, mobilise the Maritime stakeholders towards a co-ordinated and continuous effort to define their R&D targets for the medium and long term in response to market and society needs and requirements*".

The project intended among the others to collect and exchange the information about the national research programmes in the area of maritime technology carried out by EU member states as well as candidate and associated states. According to the aims of the network its work plan comprised of the following actions:

- Establishment, evaluation and consolidation of the most complete possible picture of the RTD maritime environment in the European Union.
- Establishment and evaluation of the medium and long term market & society needs and the reflection hereof on marine-related technology; resulting in identification and specification of the required knowledge and ability satisfying those needs by means of economically efficient, safe and environment friendly products, processes and services.
- Assessment of the current knowledge and ability with respect to medium and long term requirements for same, establishing of the medium and long term objectives for Research and Development in the Maritime Industry and link these objectives with ongoing and newly submitted research projects under EU and national programmes.
- Enhancement of the current networks with new stakeholders within the Maritime Industry, Research Community and interested parties outside the Maritime Industry (for example naval and leisure sectors); enhancement of the ongoing dialogue on R&D matters at EU and national levels towards the formulation of a common R&D policy for the Maritime European Research Area, upgrading existing communication channels and enhance participation and commitment for R&D activities
- Creation of the foundations for the Maritime Industry's medium and long term R&D activities by means of:
  - common maritime research policy;
  - recommendations for a new edition of MIF R&D Masterplan (currently replaced by Waterborne Strategic Research Agenda with it Implementation Route Map);
  - terms of reference for the R&D needs of the Maritime Industry towards FP6 and recommending co-ordinating activities such as Thematic Networks;
  - synergy-creating links with other EU and National RTD Programmes;
  - the state of the art technology overview including contributions from newly submitted relevant TN's and any other studies etc performed by and/or for the European Commission or at national level, as a reference document for all stakeholders involved in the development and execution of FP6;
  - the active network of stakeholders and centres of maritime excellence (research institutes, universities etc)

The ERAMAR Consortium created a considerably diversified group of industrial representatives emerging from the most of all maritime sectors. The network partners were aware of the policies of the COMMISSION in these maritime sectors, as well as the technological content. It was important that ERAMAR partners emerged from almost all members states of the EU as well as several representing candidate states. The success of ERAMAR (measurable by the number of EU projects accepted by the Commission in the area of maritime technology) resulted from that the ERAMAR consisted of the most important European associations, as well as some of the major industrial partners and research centres. Thanks to the ERAMAR network for a significant period competencies of all the maritime sectors were ready to put their effort together in order to work and discuss with the Commission.

Additionally the European Associations of the major maritime sectors were effectively used to promote the interests of the European Union in the maritime domain. The focusing issue for the ERAMAR TN was the trans-national character of the R & D projects. Therefore ERAMAR sustained on an European trans-national level the decisions of the Members States and the European Parliament by using R & D studies.

One of the efficient action of the ERAMAR TN was establishment of the series of systematically organized workshops devoted to the current topics of the calls of the EU Framework Programmes. Those workshops supported the exchange of the information about proposals of the projects and created a convenient environment for establishment of project consortia.

The list of the partners of ERAMAR includes the following institutions:

No.	Company name	Country
1.	Aker Finnyards Rauma	FINLAND
2.	AKERYARDS AS Saint Nazaire	FRANCE
3.	Association of Marine Scientific Industries	UNITED KINGDOM
4.	BALance Techology Consulting	GERMANY
5.	Bombardier Transportation Belgium NV	BELGIUM
6.	British Maritime Technology Limited	UNITED KINGDOM
7.	Bureau Veritas	FRANCE
8.	Center of Maritime Technologies e.V.	GERMANY
9.	CETENA s.p.a.	ITALY
10.	Det Norske Veritas	NORWAY
11.	European Commission - DG Joint Research Centre	European Union
12.	European Dredging Ass. Aisbl.	European Union
13.	European Marine Equipment Council	BELGIUM
14.	European Oil & Gas Innovation Forum	BELGIUM
15.	Federation des Industries Nautique	FRANCE
16.	FIMET Shipbuilding Group	FINLAND
17.	Fincantieri Cantieri Navali Italiani S.p.A.	ITALY
18.	Germanischer Lloyd	GERMANY
19.	Institut francais de recherche pour l'exploitation de la mer - Brest Centre	FRANCE
20.	Institute Francais de Navigation	FRANCE
21.	Instituto Superior Tecnico - Institute for Systems and Robotics	PORTUGAL
22.	Kvaerner Masa-Yards Inc.	FINLAND
23.	Logit A.S.	NORWAY

24.	Navantia S.L.	SPAIN
25.	Norwegian Shipowners Association	NORWAY
26.	Rolls Royce Plc	UNITED KINGDOM
27.	Société Marine de Service	FRANCE
28.	TNO Prins Maurits Laboratory	GERMANY
29.	University of Strathclyde - Ship Stability Research Centre	UNITED KINGDOM
30.	Vereniging Nederlandse Scheepsbouw Industrie	NETHERLANDS
31.	WS Atkins Consultants Limited	UNITED KINGDOM

One of the significant long-lasting achievements of the ERAMAR TN is the establishment of the internet information exchange platform www.eramar.net. The platform provides an overview of 28 different thematic networks. Moreover by accessing the Maritme Knowledge Base (which by default remains a restricted web space) it is possible to navigate a considerable data base with respect to:

- All Projects
- EU-Financed RTD
- European National RTD
- International RTD

within maritime technology.

ERAMAR TN (and other thematic networks, e.g. ERASTAR TN) serves as a explicit proof that the effective cooperation between the research facilities can be established when the common aims are appropriately set.

5.4 HYDROTESTING Alliance

Name of the project	**HYDROTESTING Alliance (HTA)** **Network of Excellence within 6th EU Framework Programme**
Coordinator	Albert B. Aalbers MARIN 2 Haagsteeg PO Box 28 6700 AA WAGENINGEN THE NETHERLANDS Phone : +31 317 493 352 Fax : +31 317 493 245 Email : A.B.Aalbers@marin.nl
Brief description	HYDROTESTING ALLIANCE is the Network of Excellence gathering together hydrodynamic testing facilities into facilitate the continuation of world leadership of the European Hydrodynamic testing facilities. HYDROTESTING ALLIANCE initiative is funded by the European Commission under its Sixth Framework Programme. The core activities of the Network is conducted within the frames of the Joint Research Programmes. Each of such a programme is carried out by a group of interested network partners. Currently there are nine following JRP running: - PIV operation in hydrodynamic experimental facilities - Flow data analysis and visualization - 3-D wave field measurements - POD / Dynamic forces - Wireless data transmission - High speed video recording and analysis - Intelligent materials and production methods - Wetted surface - Free running model technologies The project has started in 2006 and is intended for 5 years, however the objective of this alliance is to develop a formal and lasting structure to coordinate the definition and introduction of novel measurement, observation and analysis technologies for hydrodynamic model testing. The HTA is an organisation supporting: - a structured R&D environment for its researches - better commercial acceptance by the maritime industry - better support from the management of the market driven marine testing environment. The Hydrotesting Alliance contributes in short term to competitiveness and excellence of the marine industry, facilitating the continuation of world leadership of the European hydrodynamic testing facilities. The network consists of 19 member organisations from 10 European countries, including 12 major marine hydrodynamic testing facilities. The management structure consists of a steering committee formed by the core members of HTA, and by the representatives of industry and academic education. Thanks to the HTA activities the novel technologies are faster available to the market.
Objectives	The long term objective of the HTA is to create a lasting group of institutions able to co-ordinate the definition and introduction of novel

	measurement, observation and analysis technologies for hydrodynamic model testing. One of the significant element of the long lasting cooperation is the sharing of the most advanced measuring equipment as well as the dissemination of the knowledge about frontier measuring techniques. The principal aims of the network are as follows - Building the confidence between the partners members allowing for the elaboration of a joint measurement policy - European co-ordination of the measuring technology progress in the field of hydrodynamic (model) testing - Increasing the overall competitiveness of EU hydrodynamic testing facilities with regard to the US and Far East.	
Participants		
	Maritime Research Institute Netherands	MARIN
	SIREHNA	SIREHNA
	Hamburgische Schiffbau-versuchsanstalt GmbH	HSVA
	SSPA Sweden AB	SSPA
	Bassin d'Essais des Carènes	BEC
	Centrum Techniki Okretowej S.A.	CTO
	Development Centre for Ship Technology and Transport	DST
	Istituto Nazionale per Studi e Esperienze di Architettura Navale	INSEAN
	Norwegian Marine Technology Research Institute	Marintek
	QinetiQ Ltd	QinetiQ
	VTT Technical Research Centre of Finland	VTT
	University of Newcastle upon Tyne	UNEW
	Chalmers University of Technology	Chalmers
	Norwegian University of Science and Technology	NTNU
	Delft University of Technology	TUD
	Universiteit Twente	UTwente
	Centre National de la Recherche Scientifique Délégation Normandie	CORIA
	Universita degli Studi di Roma "La Sapienza"	

5.5 HYDRALAB III

Name	Integrated Infrastructure Initiative HYDRALAB III
Contact data	Coordinator Deltares | Delft Hydraulics P.O.Box 177, 2600 MH Delft, The Netherlands A.G. van Os tel: +31.15.285.8577 fax: +31.15.285.8582 e-mail: hydralab@wldelft.nl www.hydralab.eu
Brief description	HYDRALAB is the name for the network of testing infrastructure. The first network started in 1997 as a Concerted Action (1997-2000) within FP4. It focused on hydraulics, geophysical fluid dynamics, ship dynamics and ice engineering. Without the significant change of the scope of the activities the group continued as a network called HYDRALAB-II (2000-2004). After March 2004 HYDRALAB continued as an Infrastructure Network at the own cost of the participating partners. In April 2006 HYDRALAB-III started as an Integrated Infrastructure Initiative (I3), i.e. an integrated programme of Networking activities, Transnational Access to 22 unique and/or rare facilities and two Joint Research Activities. The network participants have one common selection panel and have agreed on uniform procedures with respect to selection and performance of access to their facilities. The HYDRALAB III access rules and procedures may serve as a kind of "good practice" for future calls for proposals within MARTEC programme. The network provides European Community periodically with a comparison between the scientific needs for access against the availability and an inventory of relevant Infrastructure available in Europe. The following actions, undertaken by HYDRALAB should be mentioned: - co-ordination and co-operation on a European scale within precisely defined and listed above areas of research especially thanks to the co-operation of similar facility providers and research groups, - bringing well-educated and trained researchers from across Europe to the "world class" top level of research found in few institutions enabling top quality research for selected projects where facilities in specific countries are missing as well as the dissemination of knowledge to young researchers during these projects alongside experienced seniors, - optimising the role of rare and costly experimental infrastructure by integrating them in the concept of "composite modelling", - contributing to EU targets to increase the numbers of women involved in engineering and science by means of the HYDRALAB-III Gender Action Plan In 2004 HYDRALAB developed a strategy paper "THE FUTURE ROLE OF EXPERIMENTAL METHODS IN EUROPEAN HYDRAULIC RESEARCH". TOWARDS A BALANCED METHODOLOGY.

	Except the technical considerations concerning the operation of large scale hydraulic research facilities, the paper contains a chapter dealing with the operational aspects of the facilities. The conclusions included in the paper say among the others that the large-scale and unique facilities should be brought out of the commercial arena and funded, managed, operated and shared at an European level. The authors emphasize that the synergy and innovation potentials of the large scale hydraulic research facilities are not sufficiently exploited. The report suggests that the co-ordination and co-operation of large testing facility providers and research groups on an European scale are the crucial conditions of real progress. The authors express the opinion that the fruitful co-operation is realistic when each partner can offer real value ("equal share") to the others.	
Objectives	- support of the integrated provision of infrastructure related services to the research community at the European level, - better structuring of the hydraulic research in Europe by promoting the coherent use and development of infrastructures in the fields it covers, - improvement of the long-term integrating effect on the way research infrastructures are developed and utilised in the fields of Hydraulics, Geophysical hydrodynamics, Environmental fluid dynamics, Ship dynamics and Ice engineering, thereby contributing to the goal of structuring the European Research Area, - development of a balanced methodology for using the various research tools available for the hydraulic research world, summarised in the term "Composite modelling".	
Coordinator	WL | Delft Hydraulics	the Netherlands
Participants	CEHIPAR	Spain
	CNRS	France
	DHI Water & Environment	Denmark
	DTU (Technical University of Denmark)	Denmark
	EPFL (Ecole Polytechnique Fédérale de Lausanne)	Switzerland
	HR Wallingford	United Kingdom
	Hamburgische Schiffbau-Versuchsanstalt, HSVA	Germany
	Hull, TES	United Kingdom
	LNEC	Portugal
	CNRM	France
	NTNU	Norway
	NERC (Proudman Oceanographic Laboratory)	United Kingdom
	SAMUI, UK	United Kingdom
	UC (University of Catania)	Italy
	UHANN (Forschungszentrum Küste, FZK)	Germany
	UPC (Universitat Politecnica de	Spain

	Catalunya)	
	UT (University Twente)	the Netherlands
	UU (University Utrecht)	the Netherlands
	VITUKI	Hungary
Cooperating institutions	CEDEX	Madrid
	EDF-LNHE	France
	HML (Hydraulics Laboratory Ankara)	Turkey
	IAHR	International Association of Hydraulic Engineering and Research
	IBW-PAN (Institute of Hydroengineering of the Polish Academy of Sciences)	Poland
	Ifremer	France
	IRPHE (Institut de Recherche sur les Phénomènes Hors Equilibre)	France
	Ilmenau University of Technology	Germany
	POLIBA (Politecnico di Bari)	Italy
	Shirshov Institute of Oceanology	Russia
	SOGREAH	France
	UniPt (University of Porto)	Portugal
	NPS (Naval Postgraduate School), Monterey	USA

5.6 The International Ship and Offshore Structures Congress (ISSC)

The International Ship and Offshore Structures Congress (ISSC) is a forum for the exchange of information by experts undertaking and applying marine structural research. The aim of the ISSC is to further understanding in the various disciplines underpinning marine structural design, production and operation through internationally collaborative endeavors.
The aim of the ISSC is to facilitate the evaluation and dissemination of results from recent investigations to make recommendation for standard design procedures and criteria; to discuss research in progress and planned, to identify areas required for future research and to encourage international collaboration in furthering these aims.

Specific **objectives** are:

- to review research in progress and to facilitate the evaluation;
- dissemination of results from recent investigations;
- to identify areas requiring future research;
- to suggest improvements in design, production and operations procedures.

Structures of interest to the ISSC include ships, offshore structures and other marine structures used for transportation, exploration, and exploitation of resources in and under the oceans.

The ISSC is organizing International Congress at every 3 years (the next will take place in August 2009-Korea)).

The ISSC structure

Standing Committee	Standing Committee
Technical Committee I.1	Environment
Technical Committee I.2	Loads
Technical Committee II.1	Quasi-Static Response
Technical Committee II.2	Dynamic Response
Technical Committee III.1	Ultimate Strength
Technical Committee III.2	Fatigue and Fracture
Technical Committee IV.1	Design Principles and Criteria
Technical Committee IV.2	Design Methods
Specialist Committee V.1	Collision and Grounding
Specialist Committee V.2	Floating Production Systems
Specialist Committee V.3	Fabrication Technology
Specialist Committee V.4	Ocean Wave and Wind Energy Utilization
Specialist Committee V.5	Naval Ship Design
Specialist Committee V.6	Condition Assessment of Aged Ships
Specialist Committee V.7	Impulsive Pressure Loading and Response Assessment
Specialist Committee V.8	Sailing Yacht Design
Offshore Working Group	Offshore Working Group
ISSC-ITTC Liaison Working Group	ISSC-ITTC Liaison Working Group

ISSC 2009 Committee Membership

Committee I.1 – Environment
Concern for descriptions of the ocean environment, especially with respect to wave, current and wind, in deep and shallow waters, and ice, as a basis for the determination of environmental loads for structural design. Attention shall be given to statistical description of these and other related phenomena relevant to the safe design and operation of ships and offshore structures.

B Bhattacharya, India
E Bitner-Gregersen, Norway(Chairman)
K Ellermann, Germany
J Falzarano, USA
M Johnson, UK
S-S Leu, China (T)
B Petersen, Denmark
P Queffeulou, France
P Sahoo, Australia
Kevin Evans, Netherlands
T Smith, UK
Y Vorobyov, Ukraine
T Waseda, Japan
U D Nielsen, Denmark

Committee I.2 – Loads
Concern for environmental and operational loads from waves, wind, current, ice, slamming, sloshing, weight distribution and operational factors. Consideration shall be given to deterministic and statistical load predictions based on model experiments, full-scale measurements and theoretical methods. Uncertainties in load estimations shall be highlighted.

X B Chen, France
A Ergin, Turkey
G Hermanski, Canada
O A Hermundstad, Norway
R Huijsmans, Netherlands
Kazuhiro Iijima, Japan
S Krueger, Germany
S Mavrakos, Greece
M Pavicevic, Croatia
G Petrie, USA
H Ren, China
L Sebastiani, Italy
P Temarel, UK (Chairman)
B S Yu, Korea

Committee II.1 – Quasi Static Response
Concern for the quasi-static response of ship and offshore structures, as required for safety and serviceability assessments. Attention shall be given to uncertainty of calculation models for use in reliability methods, and to consider both exact and approximate methods for the determination of stresses appropriate for different acceptance criteria.

S Aksu, UK (Chairman)
N Buannic, France
H-L Chien, China (T)
C Daley, Canada
O Hughes, USA
S Kar, India
T Lindemark, Norway
T M Netto, Brazil
R Poggi, Italy
C W Rim, Korea
J Romanoff, Finland
Y Tanaka, Japan
J Roerup, Germany
H Zhuang, China

Committee II.2 – Dynamic Response
Concern for the dynamic structural response of ship and floating offshore structures as required for safety and serviceability assessments, including habitability. This should include steady state, transient and random responses. Attention shall be given to machinery and propeller exciting forces. Uncertainties associated with modelling should be highlighted.

C Annicchiarico, Italy
S Branchereau, France
D S Cho, Korea,

B Hutchison, USA
G Kryzhevich, Russia
Jianhu Liu, China
H Mumm, Germany (Chairman)
L Murawski, Poland
T Ǿstvold, Norway
H Shuri, Japan
M Söylemez, Turkey
J-F Wu, Singapore

Committee III.1 – Ultimate Strength
Concern for the ductile behaviour of ships and offshore structures and their structural components under ultimate conditions. Attention shall be given to the influence of fabrication imperfections and in-service damage and degradation on reserve strength. Uncertainties in strength models for design shall be highlighted.

K Branner, Denmark
Y S Choo, Singapore
J Czujko, Norway
M Fujikubo, Japan
J M Gordo, Portugal
G Parmentier, France
R Iaccarino, Italy
H Naar, Estonia
S O'Neil, Netherlands
J K Paik, Korea (Chairman)
I Pasqualino, Brazil
C Toderan, Belgium
D Wang, China
X Wang, USA
S Zhang, UK

Committee III.2 – Fatigue and Fracture
Concern for crack initiation and growth under cyclic loading as well as unstable crack propagation and tearing in ship and offshore structures. Due attention shall be paid to practical application and statistical description of fracture control methods in design, fabrication and service. Consideration is to be given to the suitability and uncertainty of physical models.

M R Andersen, Denmark
M Biot, Italy
B Bohlmann, Germany
T Bosman, Netherlands
R Chen, China
A Davidson, USA
T Grafton, UK
S Maherault, France
A M Horn, Norway (Chairperson)
R L Jones, UK
J Kozak, Poland
O Litonov, Russia
N Osawa, Japan

J Park, Korea
H Remes, Finland
J Ringsberg, Sweden

Committee IV.1 – Design Principles and Criteria
Concern for the quantification of general economic and safety criteria for marine structures and for the development of appropriate principles for rational life-cycle design using these criteria. Special attention shall be given to the issue of Goal-Based Standards as presently proposed by IMO in respect of their objectives and requirements and plans for implementation, and to their potential for success in achieving their aims taking account of possible differences with the safety requirements in ISO and similar standards developed for the offshore and other maritime industries and of the current regulatory framework for ship structures. The IMO-related work shall be performed at a timescale consistent with that necessary for submission of documents to the relevant IMO committees.

M Arai, Japan
P Besse, France
R Birmingham, UK
H Boonstra, Netherlands
E Bruenner, Germany
Y Chen, China
J Dasgupta, India
P Friis-Hansen, Denmark
L Hovem, Norway
J H Kim, Korea
P Kujala, Finland
W H Moore, USA (Chairman)
E Rizzuto, Italy
V Shaposhnikov, Russia
A Teixeira, Portugal
W Wang, China (T)
V Zanic, Croatia
K Yoshida, Japan

Committee IV.2 – Design Methods
Concern for the synthesis of the overall design process for marine structures, and its integration with production, maintenance and repair. Particular attention shall be given to the roles and requirements of computer-based design and production, and to the utilization of information technology.

D Brennan, Canada
R Bronsart, Germany
J Chambers, UK
C-T Chen, China (T)
I Chirica, Romania
W Hong, China
D Karr, USA (Chairman)
J McGregor, France
F Oneto, Italy
P Rigo, Belgium
Y Takaoka, Japan

M Ventura, Portugal
J S Yum, Korea

Committee V.1 Damage Assessment after Accidental Events
Concern for extent of damage and local and global residual strength of ship structures after accidental events. Such damage is to be the result from small and large energy events such as wave impact, green water, slamming, dropped and impacting objects, local overload, collision, grounding, explosions, fire and similar. The assessment shall be conducted in both the absence and presence of ageing effects such as fatigue cracks, corrosion and local dents. The assessment shall also include the effects of temporary repairs and mitigating actions following the damage.

J Amdahl, Norway
R Basu, USA
C Berggreen, Denmark
B Cerup Simonsen, Norway
G V Egorov, Ukraine
A Groves, UK
C Guedes Soares, Portugal (Chairman)
C-F Hung, China (T)
S G Lee, Korea
P Lindstrom, Sweden
E Samuelides, Greece
A Vredeveldt, Netherlands
P Yang, China
T Yoshikawa, Japan

Committee V.2 - Floating Production Systems
Concern for the design of floating production systems. Specific emphasis shall be given to semi-submersible, TLP and spar-type hulls and recent industry experience (e.g. Gulf of Mexico 2004 and 2005 hurricanes and model tests) that influences their design methodology. Consideration shall be given to identification of uncertainties in response prediction.

W de Boom, Netherlands (Chairman)
I Chatzigeorgiou, Greece
S Du, UK
J Halkyard, USA
B Leira, Norway
N Ma, China
W Roahimi, Malaysia
I Soedigdo, Indonesia
O Valle, Mexico
P M Videiro, Brazil
C-M Wang, Singapore
Y Won, Korea
J Zhang, USA

Committee V.3 - Materials and Fabrication Technology
Concern for all aspects of materials selection and fabrication processes for ships and offshore structures. Attention shall be given to computer-integrated and automated manufacturing systems, including the effects of manufacturing procedures on the performance of the

structural systems. Consideration shall also be given to design for efficiency and quality in production.

J D Caprace, Belgium
S F Estefen, Brazil
Y S Han, Korea
L Josefson, Sweden
V F Kvasnytskyy, Ukraine
S Liu, USA
T Okada, Japan (Chairman)
V Papazoglou, Greece
J Race, UK
F Roland, Germany
I Schipperen, Netherland
M Yu, France
Z Wan, China

Committee V.4 - Ocean Wave & Wind Energy Utilization
Concern for structural design of ocean energy utilization devices such as offshore wind turbine support structures and fixed or floating wave energy converters. Attention shall be given to the interaction between load and structural response taking due consideration to the stochastic nature of the waves, current and wind.

K Argyriadis, Germany
M Le Boulluec, France
N Fonseca, Portugal
P Liu, Canada
F G Nielsen, Norway (Chairman)
J Sirkar, USA
H Suzuki, Japan
N J Tarp-Johansen, Denmark
S Turnock, UK
J Waegter, Denmark
Z Zong, China

Committee V.5 - Naval Ship Design
Concern for structural design methods for naval ships including uncertainties in modelling techniques. Consideration shall be given to applicability of classification society rules to design of naval ships. Particular attention shall be given to those aspects that differentiate naval ship design from merchant ship design such as blast loading, vulnerability analysis and others, as appropriate.

G Ashe, USA (Chairman)
J Broekhuijsen, Netherlands
Y F Cheng, UK
R S Dow, UK
F V de Francisco, Spain
A Frederiksen, Norway
Carmelo Cartalemi, Italy
J F Le Guen, France
P Hess, USA

P Kaeding, Germany
H Kaneko, Japan
Jianhua Liu, China
J S Ma, Korea
N Pegg, Canada
S R Silva, Portugal (sergio.silva@marinha.pt)

Committee V.6 - Condition Assessment of Aged Ships
Concern for the development of methods for assessing the serviceability and safety of aged steel ships. This shall include assessment of the structural condition (in view of corrosion, fatigue cracking and local denting), methods for repair, quantification of strength of deteriorated and repaired ships (as well as criteria for acceptable damage), with due account of the uncertainties involved. Consideration shall be given to cost-benefit and risk-based decision procedures for remedial action.

B Boon, Netherlands
F Brennan, UK
Y Garbatov, Portugal
C Ji, China
J Parunov, Croatia
T A Rahman, Australia
C Rizzo, Italy
A Rouhan, France
C H Shin, Korea
G Wang, USA (Chairman)
N Yamamoto, Japan
J-M Yang, China (T)

Committee V.7 - Impulsive Pressure Loading and Response Assessment
Concern for direct calculation procedures for evaluating impulsive pressure loadings including slamming, sloshing and green water and their structural response. The procedures shall be assessed by comparison with tests and service experience and with requirements in relevant classification societies rules. Recommendations for structural design guidance against impulsive pressure loadings shall be given.

S R Cho, Korea (Chairman)
D Dessi, Italy
A Engle, USA
L Gruenitz, Germany
X K Gu, China
T-B Ha, Korea
T Hodgson, UK
A Imakita, Japan
G Kapsenberg, Netherlands
T Kukkanen, Finland
Š Malenica, France
T Moan, Norway
I Senjanovic, Croatia
S P Singh, India

Committee V.8 - Sailing Yacht Design
Concern for the structural design of sailing yachts. Consideration shall be given to the materials selection, fabrication techniques and design procedures for yacht hull, mast and keel structures. Particular attention shall be given to the fluid-structure interaction effects of the sail/mast and aerodynamic/hydrodynamic interactions and their effect on the structural sizing.

R Beck, USA
D Boote, Italy
P Davies, France
A Hage, Belgium
D Hudson, UK
K Kageyama, Japan
A Keuning, The Netherlands
C Liu, China
P Miller, USA
R A Shenoi, UK (Chairman)
L Sutherland, Portugal

Offshore Working Group
B Boon, Netherlands
Y S Choo, Singapore
J Halkyard, USA
P A Smedley, UK
L P Sun, China

ISSC-ITTC Liaison Working Group
Concern with a liaison with ITTC with a view to establish linkages in disciplines, subjects and committees where there is potential overlap. The outcome shall be recommendations for working practices and practical measures for optimising discussions between the two communities.

R A Shenoi, UK
Ex-officio, Chairmen of Committees I.1 and I.2

6 Swot analysis of cooperation between marine testing facilities

There are two most characteristic features of the operation of the marine technology research facilities:

- Practically 100% of the commercial research works are conducted by the facilities on the basis of individual contracts with industrial .
- The most of the research projects within EU Framework Programmes or based on international scientific collaboration are conducted by the facilities together.

It is obvious that the topics for both above types of activity are different. The more the research topic is distant from the immediate commercial application the higher is the will of the facilities to cooperate. On the other hand if the particular research topic does not create the opportunity for future practical (commercial) application the research facilities would not be interested in its conduction. Consequently the balance has to be kept between two "distances": i.e. from the actual and future commercial application.

The principal factors of the SWOT and USED analysis concerning the cooperation of the maritime technology is presented below:

strength	**use strength**
• **high interest to cooperate (incl. TU);** • **experience of partners;** • **full-scale feedback;** • **systematic identification of areas for cooperation among the partners;** • **wide diversification and range of facilities.**	• **share the knowledge and experience;** • **create substantial technical and scientific progress** • **introduce effective cooperation agreements;** • **conduct common validation, verification and scaling;** • **take the advantage of good benchmarking environment**
weaknesses	**stop weaknesses**
• **research institutions operate on the open market and are competitors;** • **different testing procedures,** • **different level of existing technology;** • **limited time and personnel for cooperation;** • **risk of overlapping of commonly conducted research projects.**	• **enhance, harmonise and equalise measuring techniques;** • **address at technically challenging marine technology related problems at a common platform;** • **liase with other ongoing external activities (e.g. EU projects, ITTC, IMO);** • **optimise testing procedures:** • **actively contribute to research agenda (e.g. WATERBORNE)**

	• **increase efficiency and accuracy.**
opportunities	**exploit opportunities**
• **high interest of the market in innovation;** • **shipowners demand testing in Europe;** • **majority of manufacturers are located in Europe;** • **expectations of potential customers.**	• **conduct dissemination activities (e.g. summer schools workshops for end-users, seminars, conferences);** • **contact and recognise the needs of end-users e.g. with the help of questionnaires, surveys;** • **integrate industrial partners into research projects – e.g. by benchmark testing;** • **create thanks to conduction of the projects groups, which are recognisable for the market and organisations (industry, classification societies, EC)**
threats	**defend threats**
• **increasing number and quality of foreign model basins;** • **increasing diversity and difficulty of technical problems in marine technology.**	• **cooperate to stay ahead of non European competitors;** • **support the industry to minimise the danger arising from technical problems in marine technology (design and operation of ships and other floating constructions, hydrodynamics, structure mechanics, material sciences, information technology, environment**

	protection).

Complementarities, gaps and <u>opportunities</u> with regard to the synergistic use of maritime research and testing infrastructures:

- research institutions use similar types of testing infrastructure: towing tanks, cavitation tunnels, sea-keeping (off-shore and ocean engineering) tanks, circulating channels, manoeuvring basins (or open water test stations),
- standardised testing procedures are used,
- most of research institutes implement advanced CFD tools,
- the aim of the operation is basically the same: elaborate full scale performance prediction based on the model scale experiment supported with numerical computations

Complementarities, <u>gaps</u> and opportunities with regard to the synergistic use of maritime research and testing infrastructures:

- research institutions use various measuring equipment, based on different principles of experimental approach and differing in measuring range, accuracy and reliability,
- standardised testing procedures do not provide ultimate knowledge and are sometimes modified with regard to the individual experience – usually the modifications are not disclosed,
- data formats, report formats, even scale of colours displaying the results of numerical computations are different – conduction of joint projects requires unification,

<u>Complementarities</u>, gaps and opportunities with regard to the synergistic use of maritime research and testing infrastructures:

- there are no two identical maritime research institutions although they operate for the same purpose,
- the differences in size (e.g. test sections and flow velocities of cavitation tunnels), ranges of testing parameters between the facilities (e.g. velocity of the towing carriage) allow for more thorough conduction of particular experiments what is extremely useful when new experimental techniques are introduced,
- joint projects allow for the exchange of experience e.g. Hydrotesting Alliance NoE

Research institutions in marine technology applied research communicate effectively and organise networking cooperation on different levels.
The networking cooperation addresses to the need of the enhancement of own research capabilities as well as to the need of coordination of the national and European research programmes.
The joint activities are based on the among the others on the conduction of SWOT analysis concerning the networking cooperation – e.g. within Hydrotesting Alliance.

<u>The added value of long term cooperation consists of:</u>

- Commonly developed and accepted standards of measurement procedures (ITTC, Networks of Excellence: HTA, MARSTRUCT.
- Research coordination thanks to widely accepted research agenda – focusing on innovation needs of industry recognised by the research institutions (ECMAR↔WATERBORNE TP)
- Progress in physics (both theoretical and experimental), development computational methods.

<u>The added value of medium term cooperation consists of:</u>

- Enhancement of measuring methods and devices, sharing the knowledge about the frontier techniques.
- Common marketing in front of the industry.
- Development and validation of computational tools.
- Verification of model full-scale extrapolation methodology.
- Sustainable development of the EU research potential.

<u>The added value emerging from short term cooperation consists of:</u>

- Higher value of the developed solutions of particular technological problems.
- Gaining critical mass enough to solve well defined complex industry driven problems, merging together complementary skills.
- Enhancement of own research potential (e.g. by common use of expensive measuring equipment).
- Establishing personal contacts.
- Generation of the well grounded input to the ‘research agenda’.