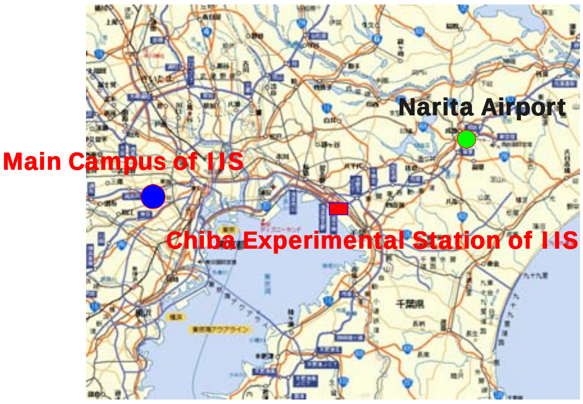
Group Discussion 3
New Facilities

Session Chairman: Prof. Shigeru Naito

1. PRESENTATIONS

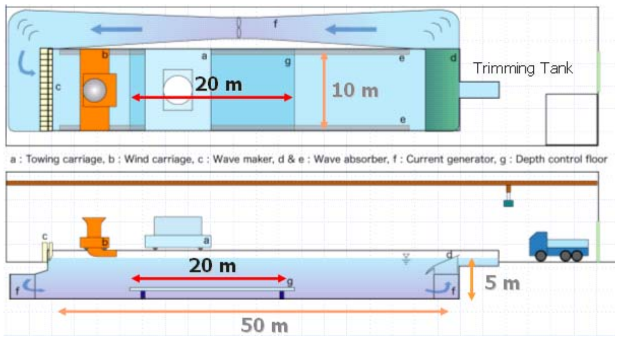
1.1 By Prof. Takeshi Kinoshita, University of Tokyo, Japan, on Ocean Engineering Basin

Location.



Housing:

Layout.



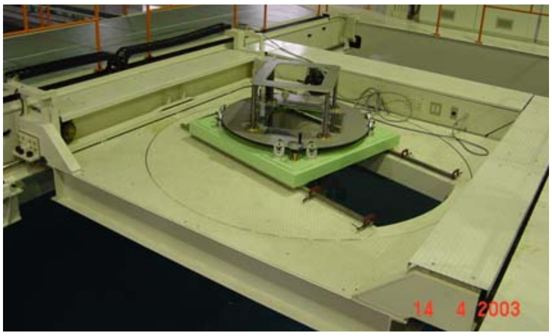
Main Facilities:

- Towing carriage,
- Y-direction carriage and turntable,
- Multi-directional wave maker,
- Wind blower,
- Current generator.

Towing Carriage: Towing speed of the carriage 0-2 m/sec.

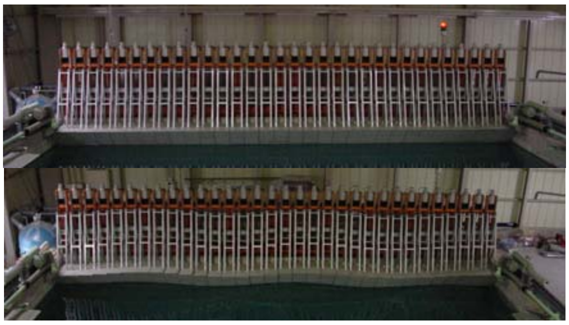
Y-direction carriage and turntable:

- Traverse Motion: ± 2.3 m,
- Traverse Speed: 0 – 30 cm/s,
- Turning Angle: ± 180 deg,
- Turning Speed: 0 – 15 deg/s.



Muti-directional wave maker:

- Type: Plunger Type with 32 Triangular Shape units,
- Multi-Directional Wave by Multi-reflection at Side Wall,
- Wave Period: 0.5 – 5 sec,
- Max. Wave Height: 30 cm.

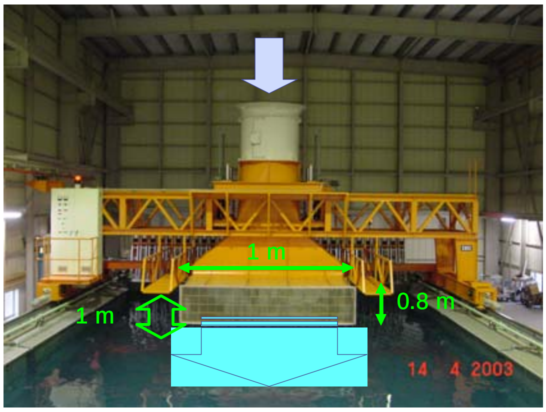


Wave Absorbers:

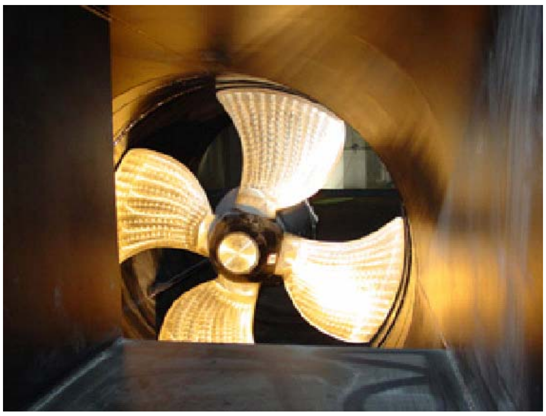
Figure 1.1- Side wave absorber.

Figure 1.2: Front wave absorber.

Wind blower: Maximum wind speed is 10 m/sec.



Current generator: Maximum speed is 20 cm/sec.

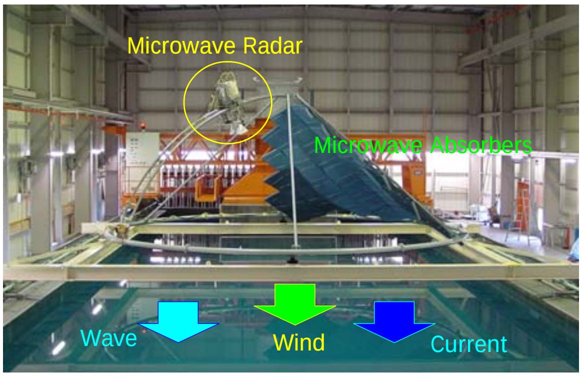


Rail system:

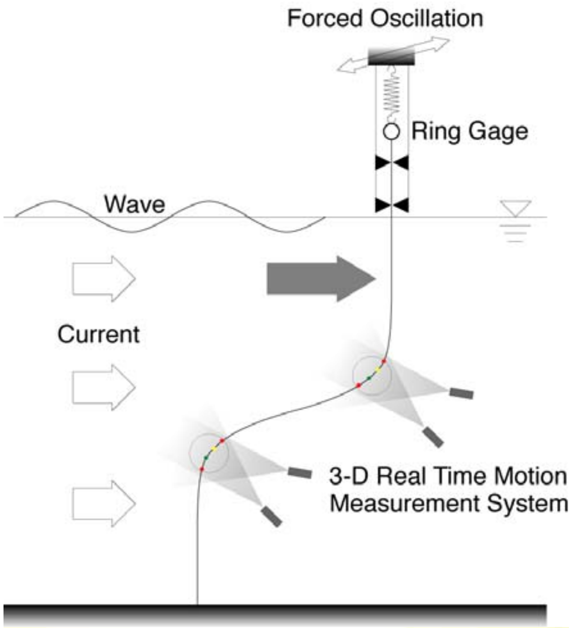
Research subjects:

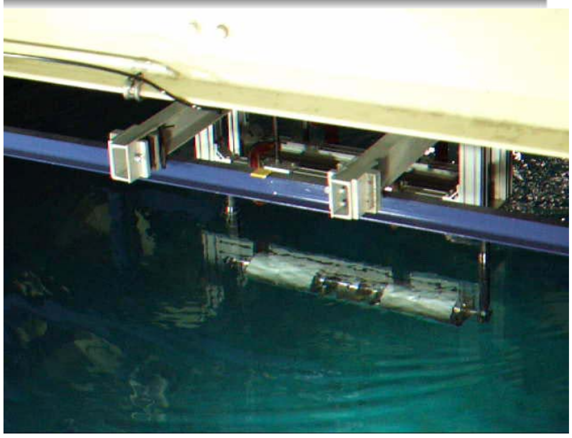
- Remote sensing of sea surface,
- Ocean riser behaviour,
- Freak wave,
- Renewable natural energy,
- Underwater robot.

Microwave radar:



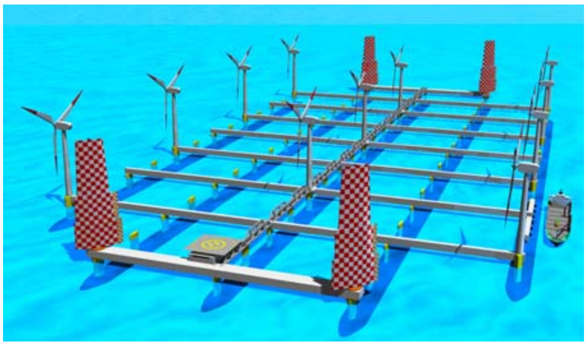
Riser:





Ship response in freak waves:

Floating wind farm:



Underwater robot:

1.2 By Prof. Antonio Carlos Fernandes, LabOceano (COPPE/UFRJ), Brazil, onthe Brazilian Ocean Basin at LabOceano

<u>The Ocean Basin and the Offshore Industry.</u>

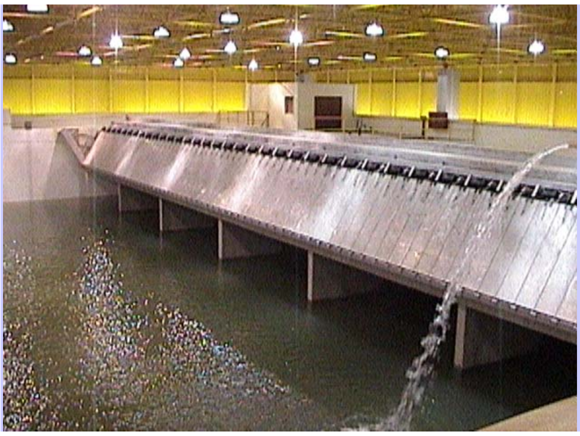
- Relevancy: Model testing is essential for competitive solutions,
- Challenges: Deep water (floating bodies and lines),
- Requirements: Major investment (done),
- LabOceano approach:
  - Academic links,
  - International cooperation,
  - Self-sustainable strategy,
  - Alternative for R&D approaches.

<u>LabOceano General Overview.</u>

LabOceano water depth is a record (15m) and dry underwater view is unique.

State-of-the-art wave-maker:

- Regular:
  - Max. height: 0.52m,
  - Period: 0.5 a 5.0s,
  - Multi-directional,
- Irregular:
  - Max. significant height: 0.3m,
  - Peak period: 3.0s,
  - Long/short-crested,
- Overall maximum power: 45KW,
- Active reflected wave compensator.



Other features:

- Parabolic beaches (frontal and lateral),
- Movable bottoms (overall and pit),
- Measuring and acquisition data,
- Wind generation (under construction),
- Current generation (under construction).

Scientific and technical staff:

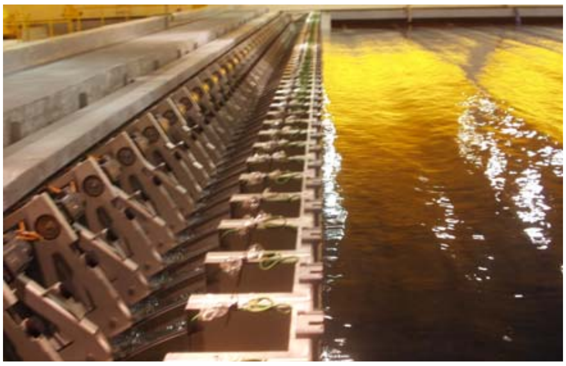
Activities: Conventional and Novel.

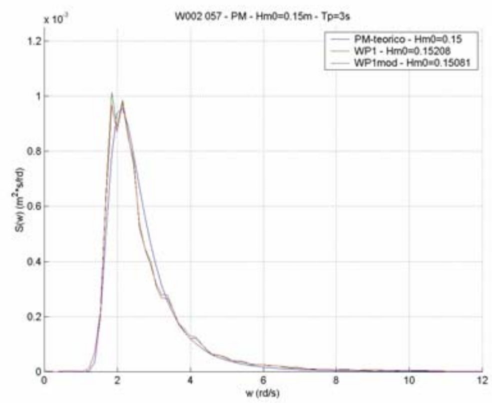
- Conventional: Floating bodies,
- Novell: Installation of offshore structures and industrial modules.

Conventional Activities.

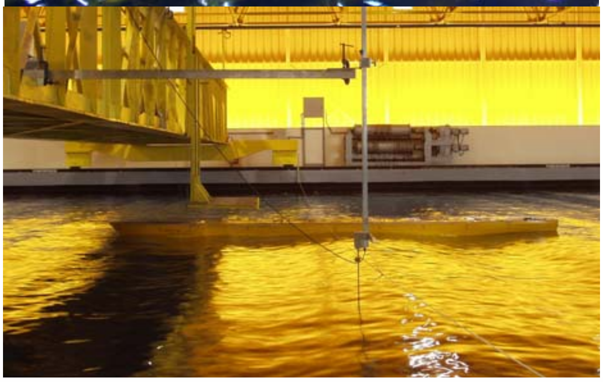
- Calibration: ITTC semi-submersible FPSO bodies,
- Applications: FPSOs and mono column platform.

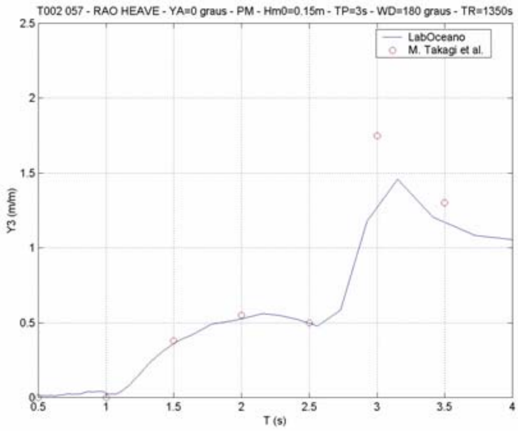
Wave calibration:

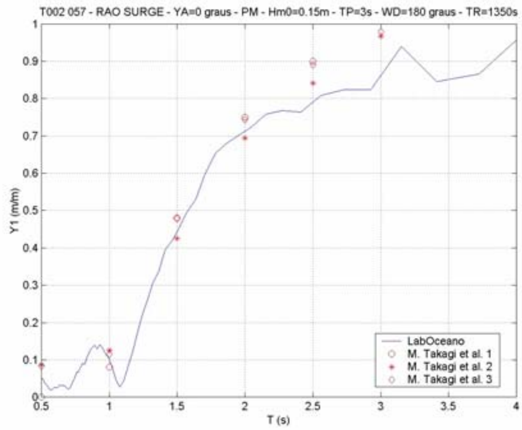


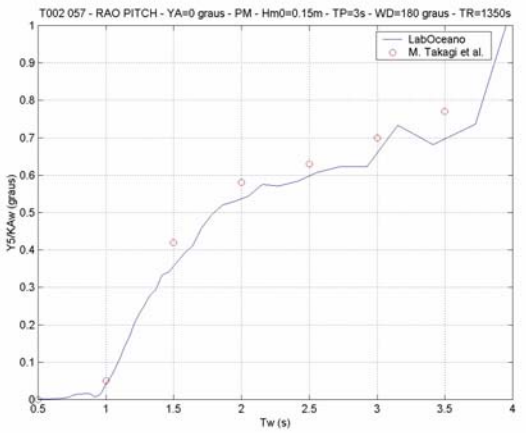


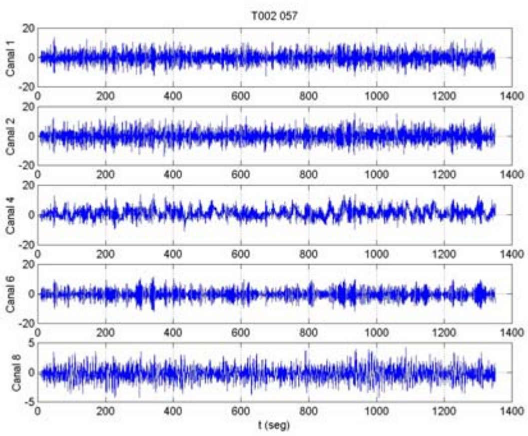
Calibration/validation: semi-sub and FPSO:



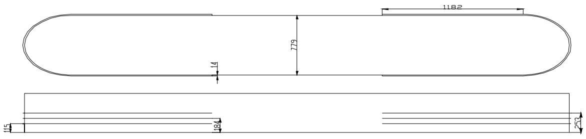




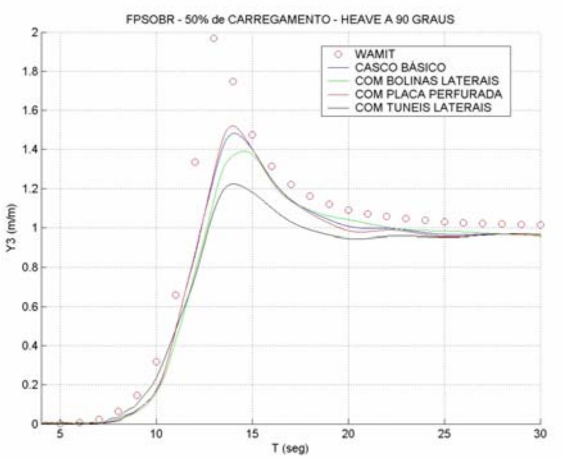


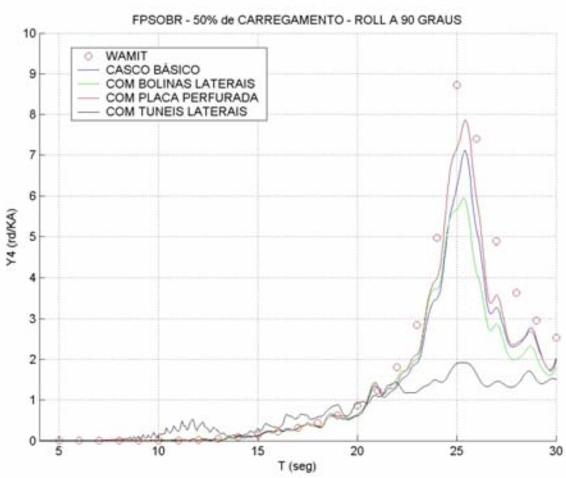


FPSOBR C, new built FPSO:

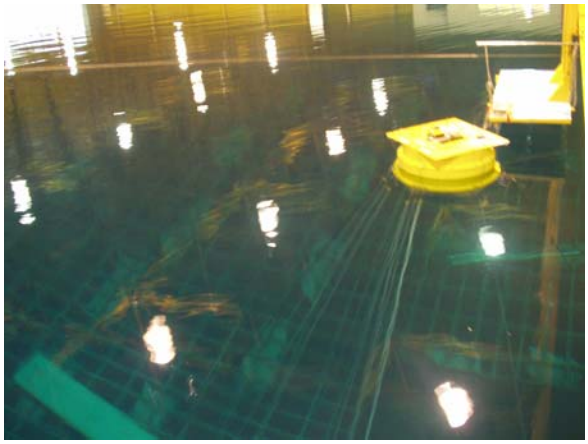


FPSOBR C, heave and roll:





MONOBR, new floating production:



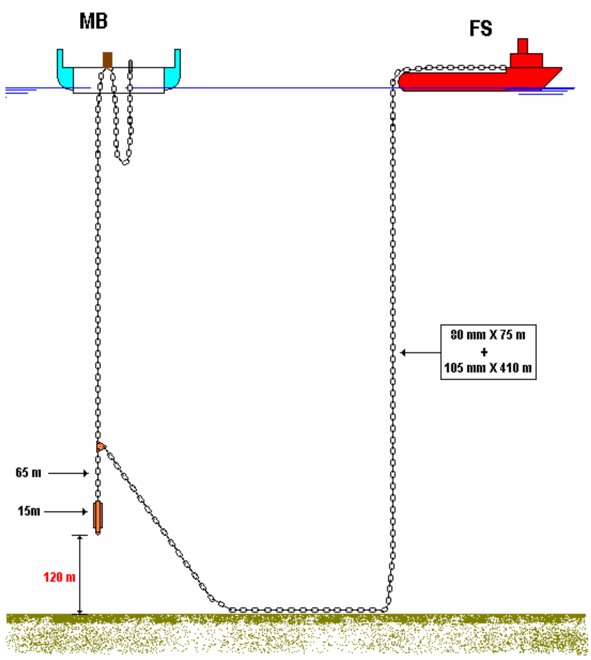
<u>Novel Activities.</u> Installation operations:

- Torpedo anchor,
- BSR (Subsurface Riser Support Buoy),
- Risers on the BSR,
- Pendular launching.

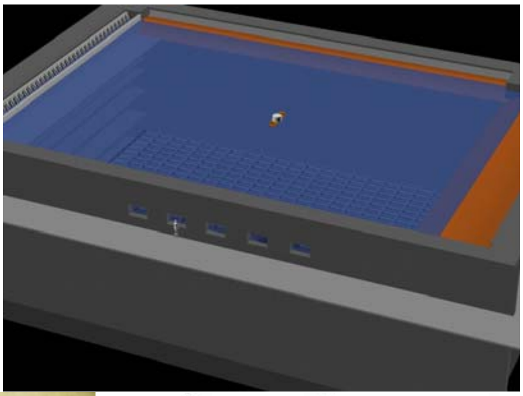
Possible new trend for model testing.

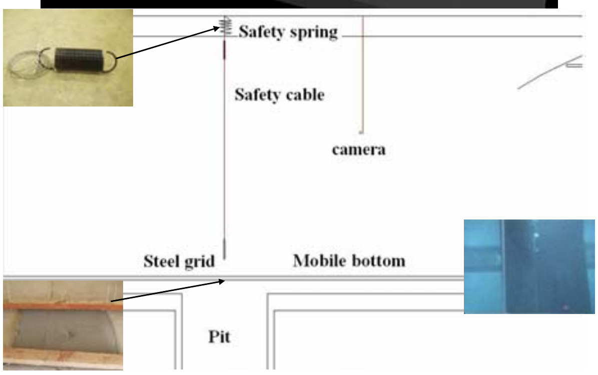
Torpedo anchor:

- Drag,
- Directional stability with rear line.



- Model test at LabOceano (15m deep),
- Expedite analytical approach.





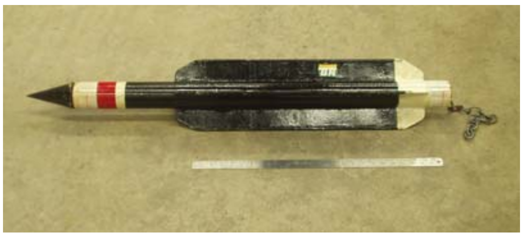


Figure 1.3- Form F1.

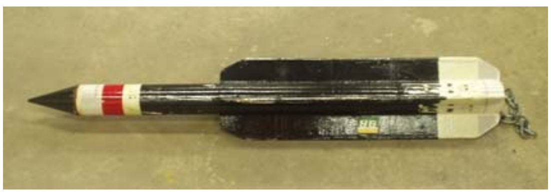


Figure 1.4- Form F2.

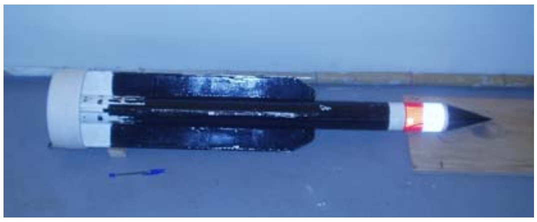
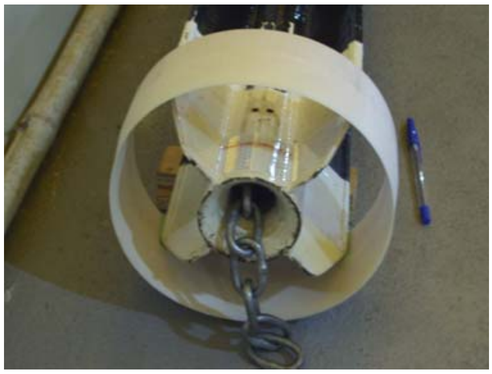


Figure 1.5- Form F3.



Test examples:

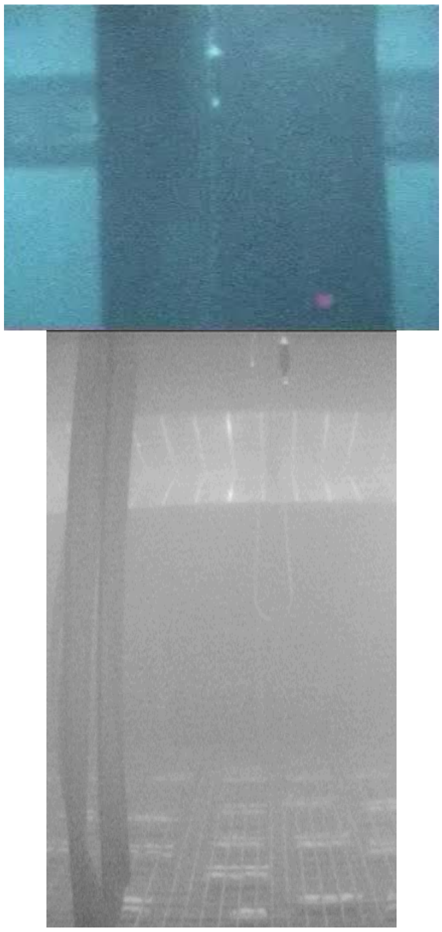


Figure 1.6- Video tracking acquisition samples, F1C2 camera 1.

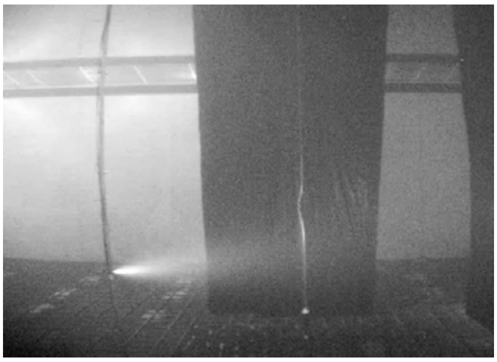


Figure 1.7- Set up for rear line effect verification.

Sub-surface buoy:

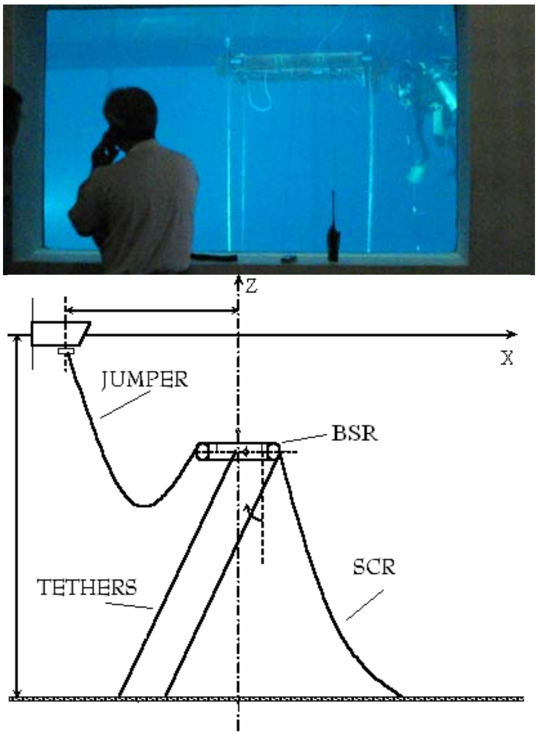
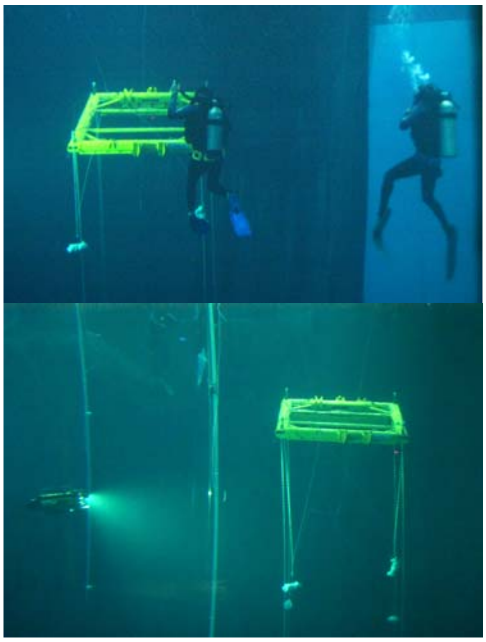
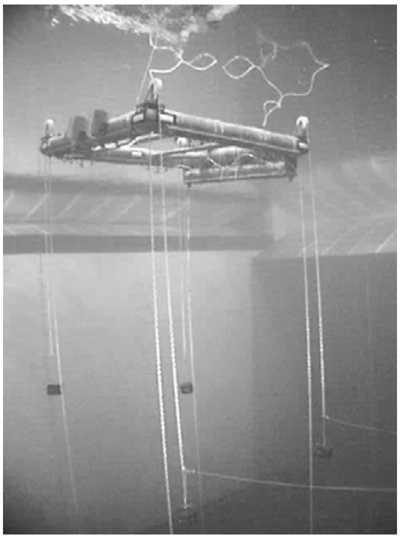


Figure 1.8- BSR, Bóia de Suporte de Riser (Riser Support Buoy).

First model:

Set down:





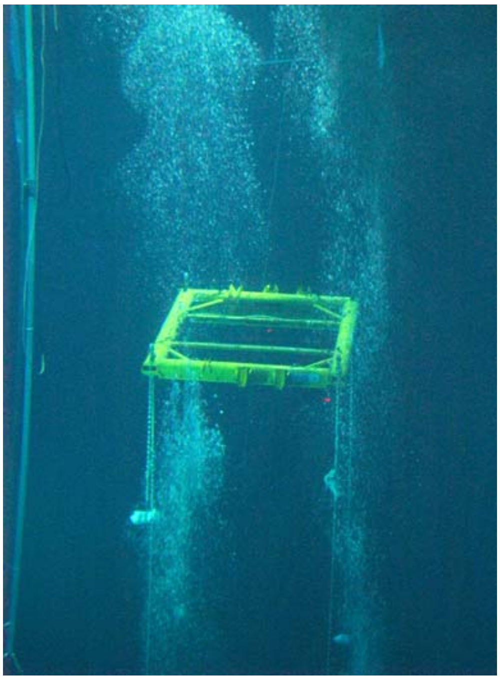
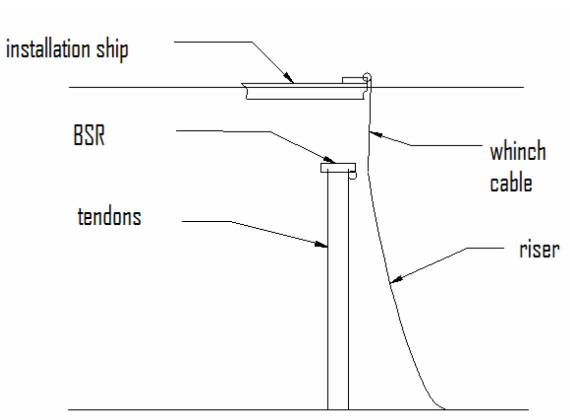
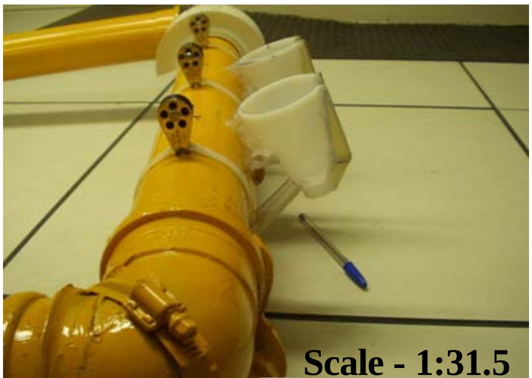


Figure 1.9- De-ballasting.

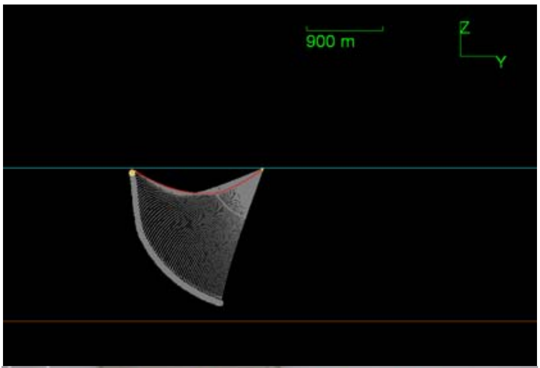
BSR – Riser Installation.

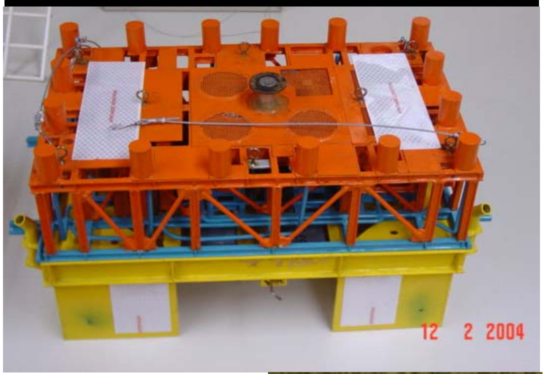


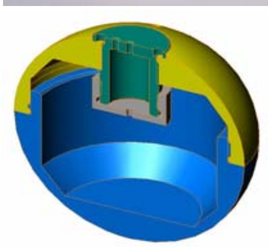


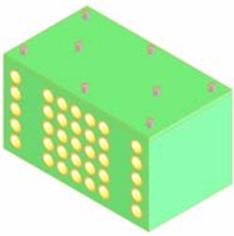
Manifold Pendular Launching.

- Vertical MSGL eixo Z,
- Sphere pendular,
- Porous box pendular.









LabOceano Other Features. Current generation system main features (under construction):

- 6 internal galleries,
- Water speed from 0.25m/s at the surface to 0.1m/s at the bottom,
- Pumps (06) of impeller type and power = 500kW/each,
- Diesel engines (06).

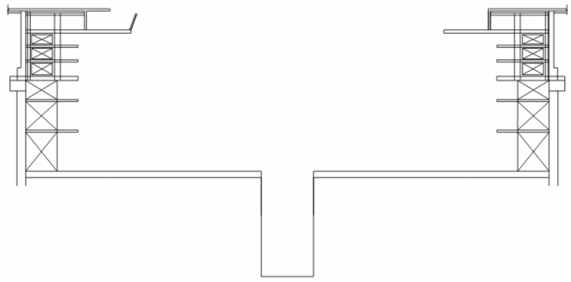


Figure 1.10- Ocean basin longitudinal cut.

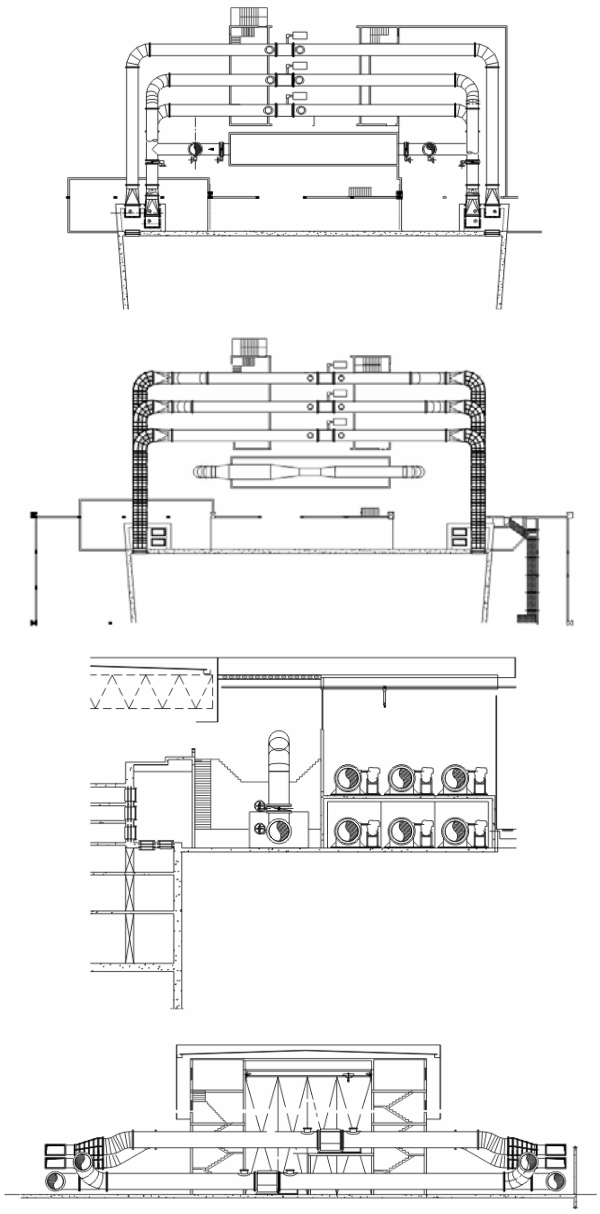
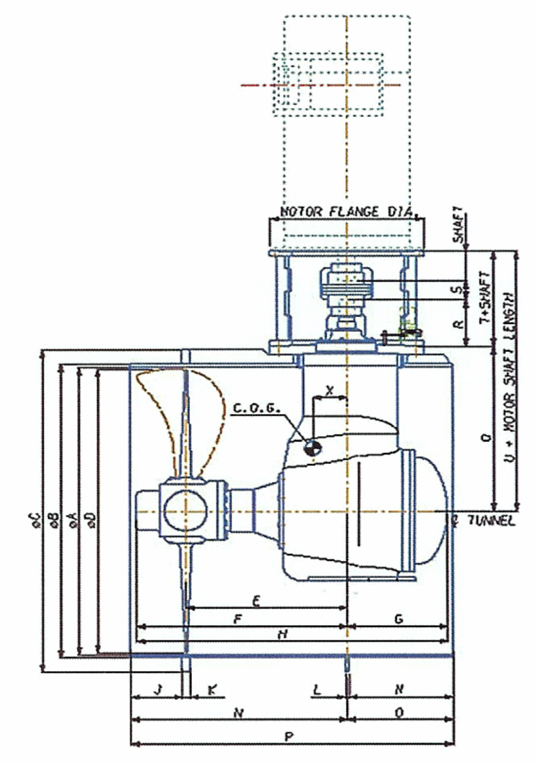


Figure 1.11- Current generating system general layout.



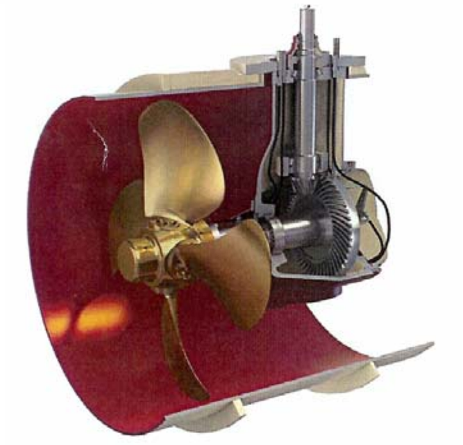


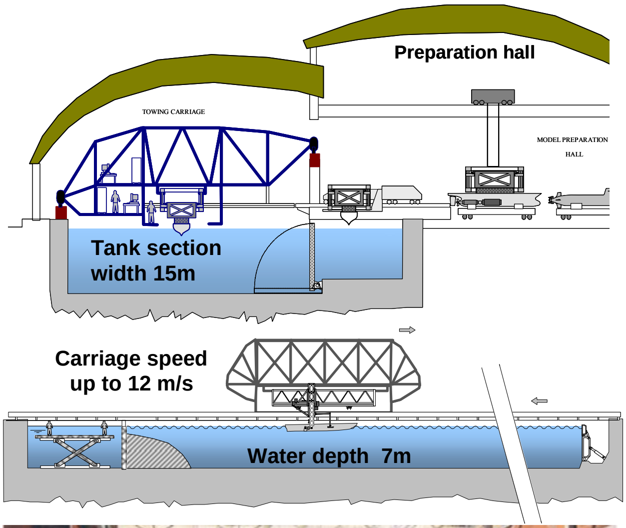
Figure 1.12- Thruster adapted pump.

Figure 1.13- Small scale model.

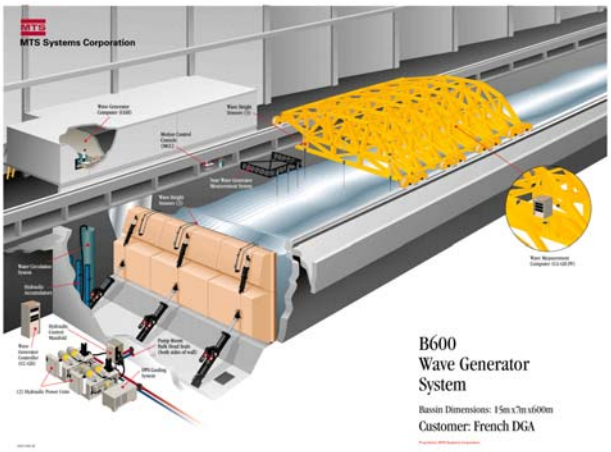
1.3 By Dr. Jean-Marc Quenez, Bassin d'Essais des Carènes, France, on a New Large Towing Tank B600

New large Towing Tank B600:

- Dimension : 545m x 15m x 7m,
- Carriage speed : 12m/s,
- Wave 0.5s < T < 5s Hmax =1m.



Wave maker capabilities: wave height up to 1m crest to through (sea state 8-9 similarity).



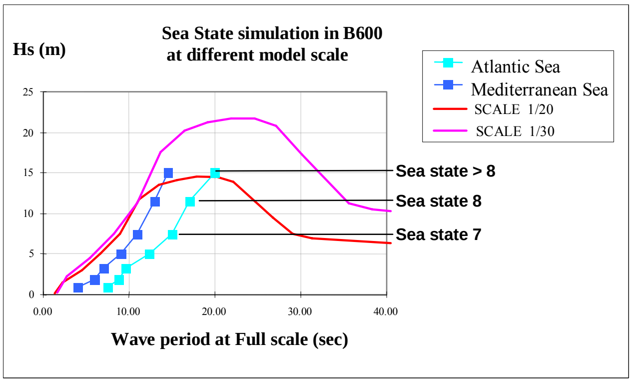
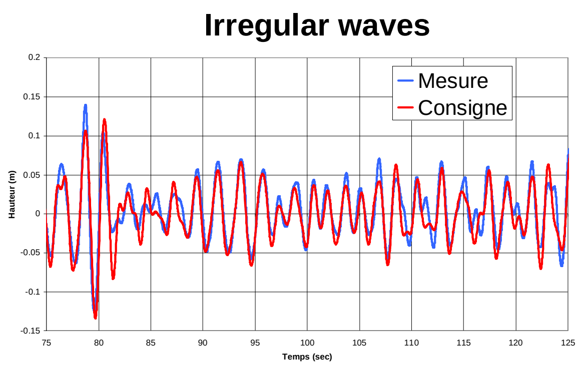
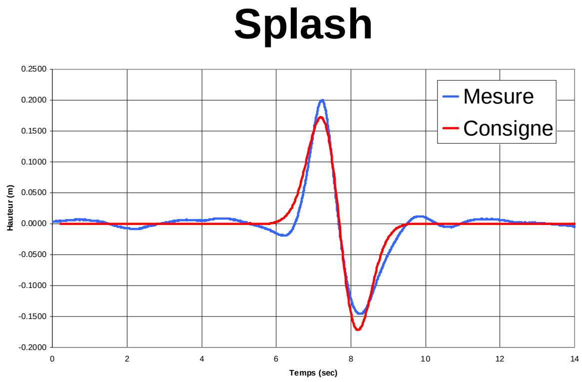
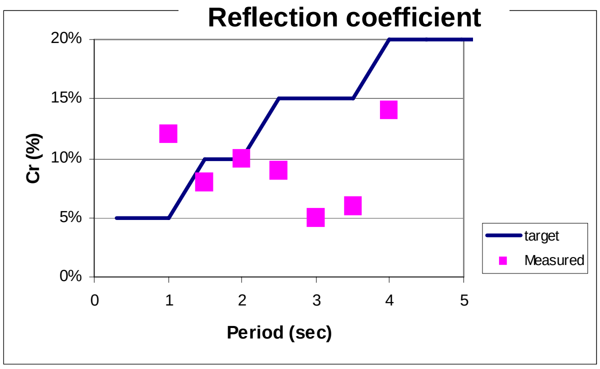


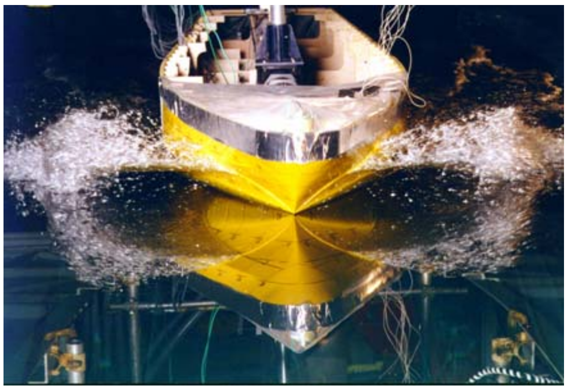
Figure 1.14- Wave absorber.

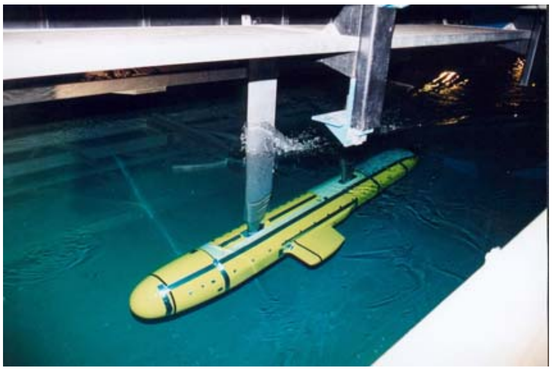






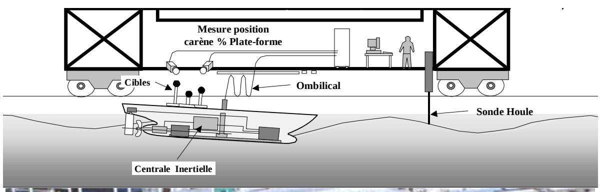
Model Tests. Standard experiments: Resistance and self-propulsion tests on surface ship and submarine.



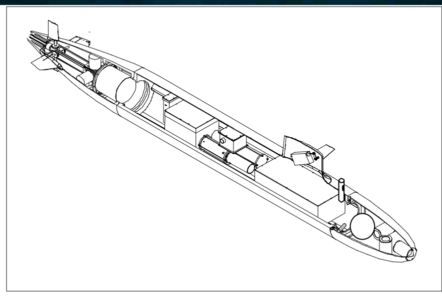


Standard seakeeping tests using free running models:

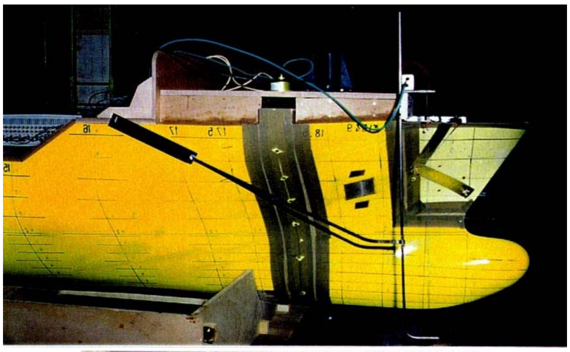
- Seakeeping with and without active fin control system for surface ship,



- Seakeeping and manoeuvrability with waves of submarine.

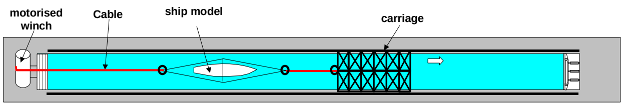


Special Tests. Seakeeping up to sea state 8 (head sea and following sea) with slamming loading measurements:

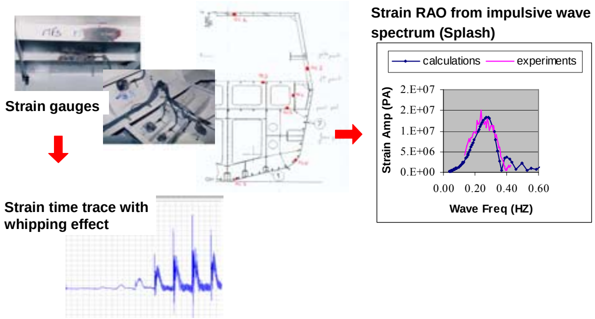


High scaled model in similarity to full scale of mechanical structure:

- λ=1/5, L= 23m, Δ=20tons, V_m=3.5m/s and Steel structure 1 to 10 mm of thickness.



High scaled model in similarity to full scale of mechanical structure:



1.4 By Dr. Yoshitaka Ukon, National Maritime Research Institute, Japan, on a New Large Cavitation Tunnel called The Flow Noise Simulator

Overview. The Flow Noise Simulator (FNS) of the 1st Research Center of TRDI / JDA is a large, variable pressure, re-circulating water tunnel with very low background noise level. The construction of the FNS was initiated in 1999 and completed recently in March 2005. The overall geometry is shown in Fig. 1.15 Major specification of the tunnel is given in Table 1.1. The FNS is intended to be used for the hydrodynamic and hydroacoustic research using large scale models in a controlled environment. This required extensive study, particularly for the noise prediction and reduction. Although the tunnel performance measurement is yet to start this year, an outline of the FNS is presented in this paper. More details may be found in references listed at the end.

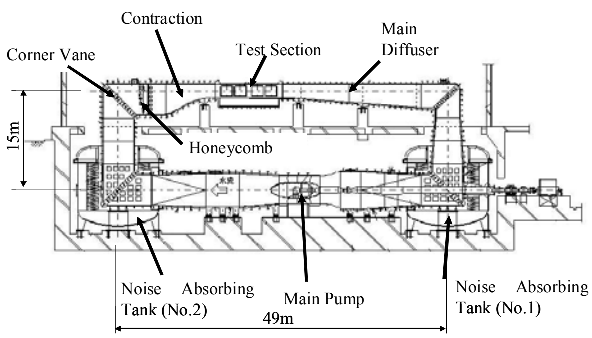


Figure 1.15- FNS overall geometry.

Table 1.1- FNS performance specification.

Item	Specification
Test Section Dimension	2m x 2m x 10m
Test Section Velocity	1.5～15m/s
Test Section Pressure	10～300kPa(abs)
Flow Non-Uniformity	±1% at 5m/s
Turbulence	0.5%
Background Noise Level	88dB at 8m/s (1/3 Octave Band, 1kHz ref. 1μPa)

Hydrodynamic Design. A series of detailed CFD analysis and wind tunnel testing was conducted to determine the geometry of the circuit components of the FNS, which included the contraction, diffuser, corner vanes, and honeycomb. Designed circuit was confirmed to satisfy the hydrodynamic performance goal by the measurement using a 1/8.6 scale model of the FNS. Figures 1.16 and 1.17 show the longitudinal velocity profile and turbulence intensity, respectively, measured 180mm downstream of the test section entrance. These measurements were made with a 2D fiber optic Laser Doppler Velocimetry (LDV).

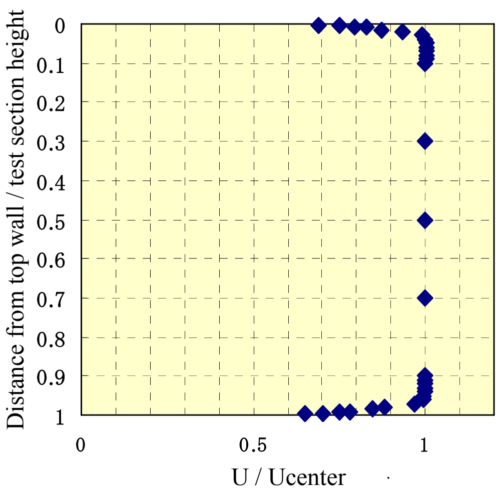


Figure 1.16- Velocity profile at the test section.

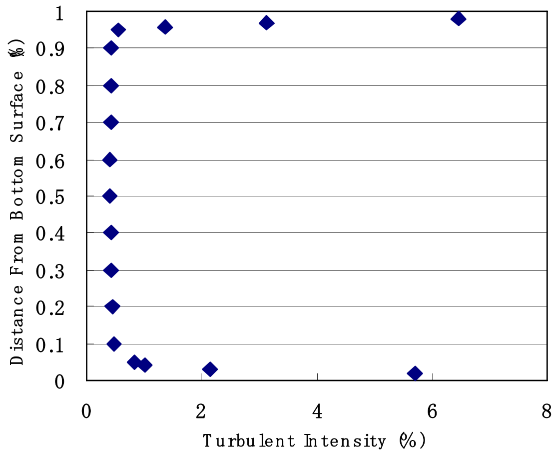


Figure 1.17- Turbulence intensity at the test section.

Background Noise Prediction and Reduction. In order to achieve the acoustic performance goal, major noise sources in the tunnel were identified and careful design was given to each component contributing to the noise. The design and manufacture of the main pump was the most important task to minimize the background noise. The final design was a 4.3m diameter, 7-bladed, forward skewed impeller with a 9-bladed stator downstream. Figure 1.18 shows the impeller geometry. The impeller is cavitation free for the whole range of the tunnel operating condition. Unique equipment to the FNS is a pair of Noise Absorbing Tanks located at the lower elbows of the tunnel. The Noise Absorbing Tanks are filled with water and a large number of pine-wood wedges are arranged along the inner walls. On the walls of the two elbows, a large number of acoustically transparent plexiglass windows were installed to pass the acoustic energy from the tunnel circuit to the Noise Absorbing Tanks. A sketch of the Noise Absorbing Tank is shown in Fig. 1.19. For the prediction of the background noise at the test section, "Acoustic Power Balance Method" was applied to the FNS, where the tunnel was divided into a number of elements and the acoustic power balance between the elements was considered. Figure 1.20 shows the divided elements of the FNS.

Figure 1.18- Impeller geometry (model).

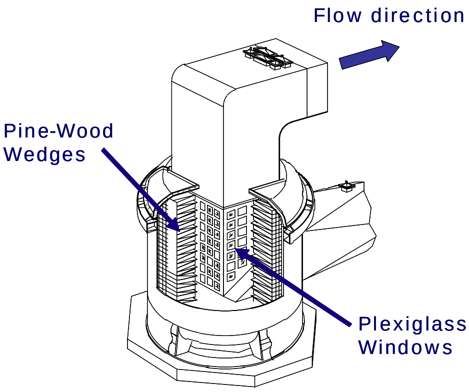


Figure 1.19- Noise Absorbing Tank.

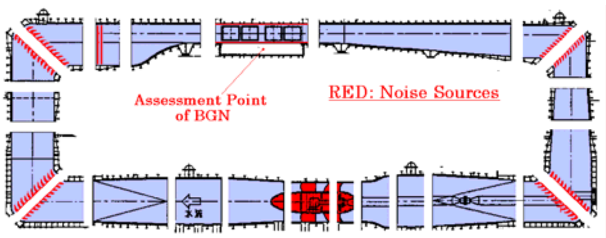


Figure 1.20- Divided elements of FNS for Acoustic Power Balance Method.

Measurement System. Current FNS measurement capabilities include acoustic measurement system, velocity measurement system, and hydrodynamic force measurement system. For the acoustic measurement, bottom and side hydrophone arrays, each of which has 32 hydrophones, are used for the real-time and post-processing analysis. A two-component fiber optic LDV system with a traverser is available for the velocity measurement. Propeller dynamometers are used for the propeller thrust and torque measurement. The dynamometers may be installed in submarine models, twin-screw surface ship models, and the propeller open test housing. Introduction of a Particle Image Velocimetry (PIV) system and a nuclei distribution measurement system is also planned.

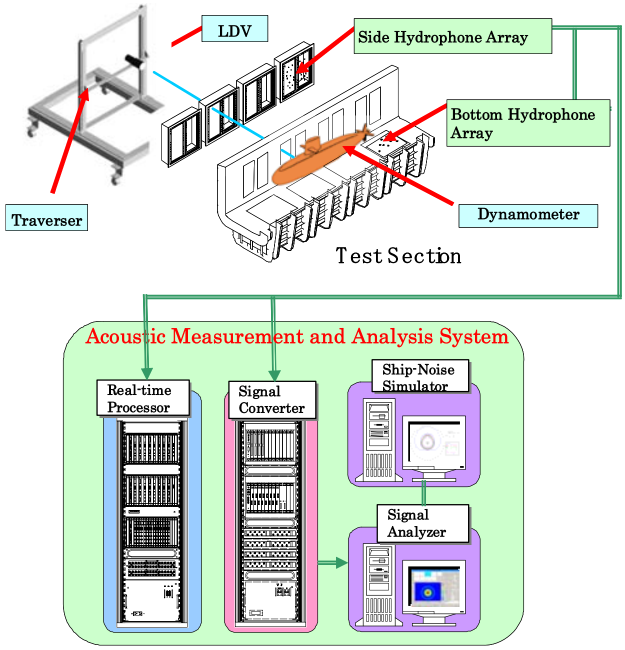


Figure 1.21- Measurement system.

Conclusions. The FNS is starting its operation this year. In the first year, basic tunnel performance and characteristics will be measured to confirm that all the design requirements are met. Then a couple of years will be spent to establish standard test procedures for the most effective tunnel operation in the future. Tests to be performed at the FNS will include propeller cavitation tests, flow noise measurement, velocity and pressure measurement, and flow visualization. Taking advantage of its large test section, surface ships and submarines with appendages, full scale torpedoes, and large scale partial models of surface ships and underwater vehicles will be tested.

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Sato, R., Mori T., Yakushiji, R., Naganuma, K., Nishimura, M., Nakagawa, K. and Sasajima, T., 2003, "Conceptual Design of the Flow Noise Simulator", Proc. of the 4th ASME Joint Fluids Engineering Conference, Honolulu, Hawaii, USA.

Kudo, T., Nishimura, M., Sawada, S., Mori, T. and Sato, R., 2003, "Noise Prediction of the Cavitation Tunnel", Proc. of the 4th ASME Joint Fluids Engineering Conference, Honolulu, Hawaii, USA.

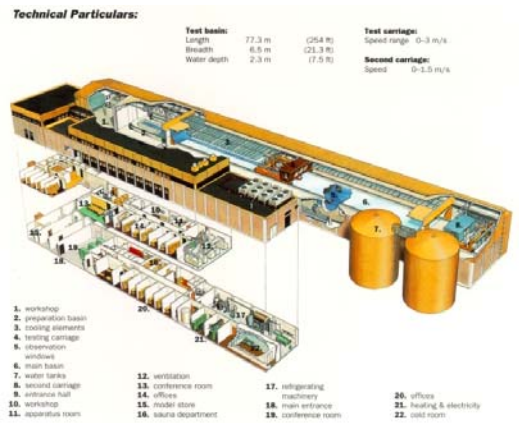
1.5 By Dr. Göran Wilkman, Aker Arctic Technology Inc., Finland, on Next Generation Ice Laboratory for Testing Ships and Structures

History.

- The first ice model testing facility (WIMB) in Finland was established in 1969,
- In February 1983 Wärtsilä Arctic Research Centre, WARC was inaugurated,
- In November 1989 the parent company changed to Masa-Yards/Kvaerner,
- In January 2005 Aker Arctic Technology Inc. Started operation.

Present Development.

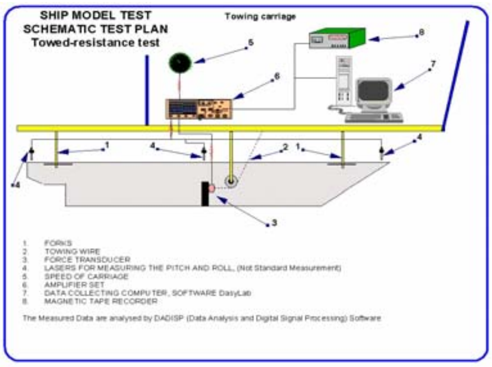
- After some 2000 ice sheets, property lease under MARC facility expires in 2005,
- The construction of the new facility started in January 2005,
- The new facility will be calibrated at the end of 2005 and in early 2006 the laboratory will be in full service,
- Simultaneously with the building of the new testing facility the business unit has been separated from the Finnish Shipbuilding company Aker Finnyards to be an independent company: Aker Arctic Technology Inc., AARC,
- In addition to the traditional services AARC offers more comprehensive design packages.

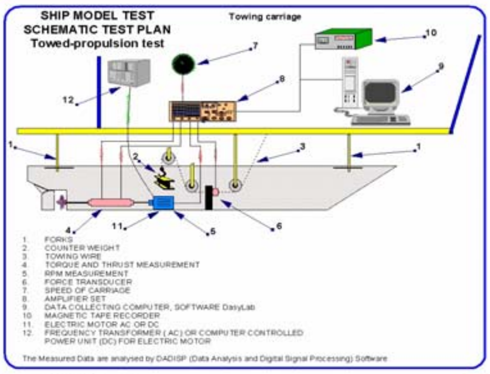


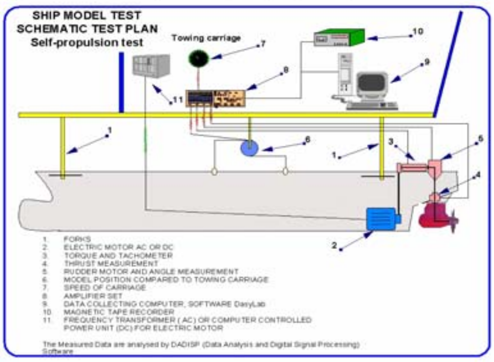
Development in Testing Practices.

- In the early days of model testing the ship models were towed either with constant force or speed. Most of the tests were done with a bare hull without propulsion.
- During the last 15 years, thanks to the FGX model ice, the behaviour of model ice has enabled to move towards more natural way of testing, namely self propulsion.
- Today all the tests are done in self propulsion and manoeuvring tests with a free model.

This has been the basic design feature when the new laboratory project was started.

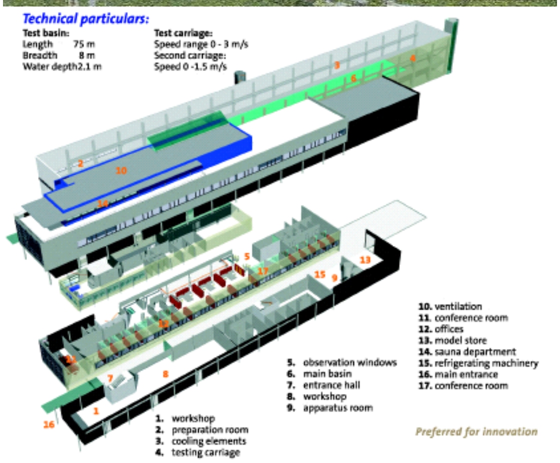




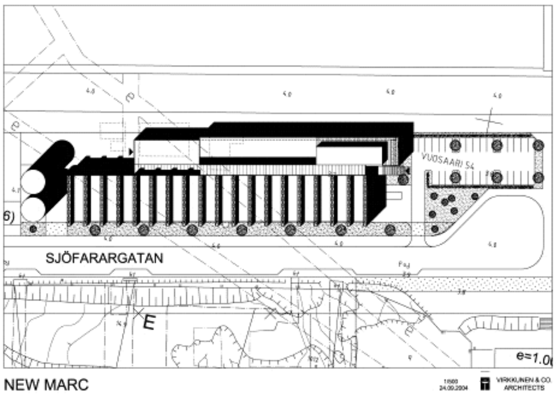


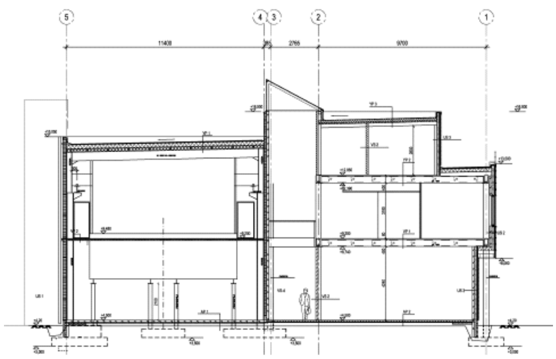
New Laboratory.

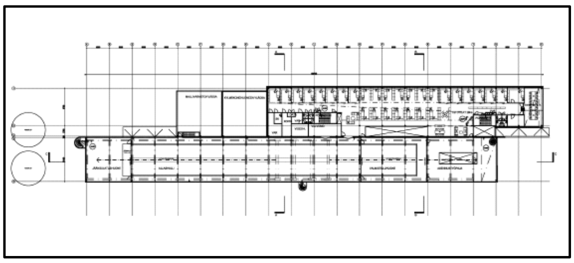
- The facility is under construction in Finland, in eastern Helsinki, in Vuosaari.
- Helsinki City is building a new giant harbour to the area where the Valmet Shipyard was operating in the seventies and eighties.
- Location is next to the new harbour at Vuosaari Marine Business Park.
- The development of the area offers excellent connections to the centre of Helsinki and Helsinki-Vantaa Airport.



	MARC	AARC
Length (m)	77,3	75
Width (m)	6,5	8
Depth (m)	2,3	2,1
Water volume (m3)	1000	1300







Fabrication and workshops:

- carpenter shop,
- paint shop,
- welding shop,
- electric work shop,
- outfit area,
- basin area,
- video editing room,
- model storage spaces,
- work clothes lockers,
- wash rooms and a sauna.

Offices and other spaces:

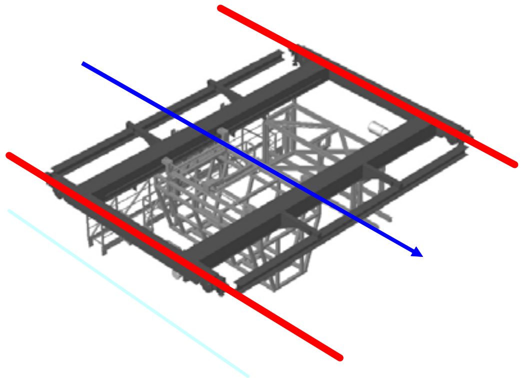
- work spaces/rooms for 25 employees,
- visitor/client spaces with a PC and internet connection,
- 3 conference rooms,
- rooftop sauna,
- recreation area with a sea view.

Basin:

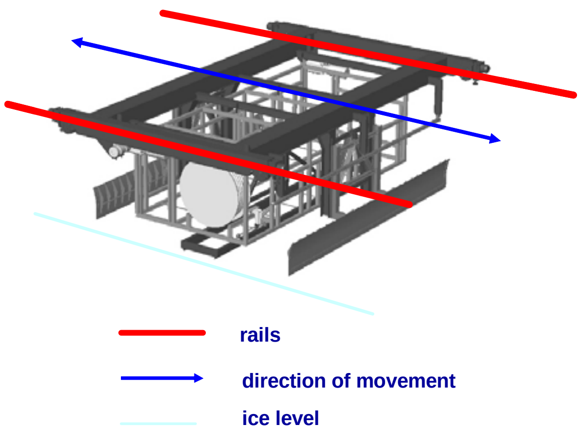
- The basin is of steel,
- Width of the basin is 8m (increased by 1.5m),
- Eight underwater side windows and continuous window throughout the whole length of the bottom of the basin,
- The new refrigeration system is based on completely new technique,
- Instead of cooling large amounts of coolant liquid, only 80kg is cooled and through a heat exchanger liquid CO_2 is cooled and circulated in the refrigeration elements,
- Total power of 540kW is to be installed three units.

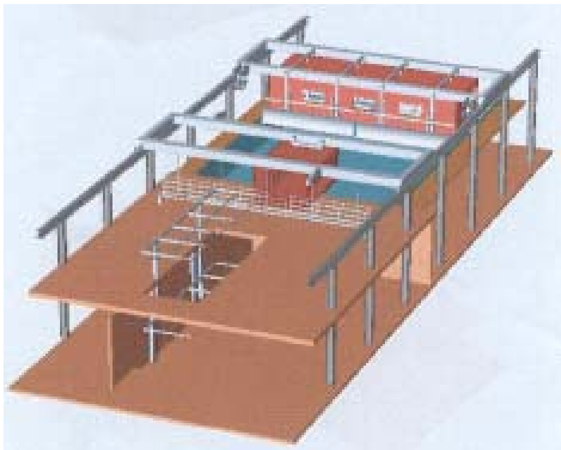
Carriages:

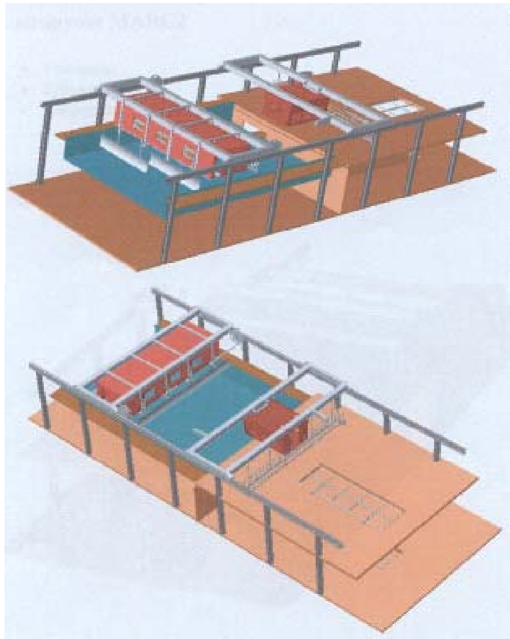
- Measurement/test carriage:
  - speed 0 to 3m/s,
  - rails above the carriage,
  - no visibility restricting elements,
  - measuring unit moves also sideways in the carriage,
  - may follow the model in synchronous mode,
  - synchronous operation with the ice treatment/ice making carriage.



- Ice treatment/ice making carriage:
  - speed 0 to 1.5m/s,
  - rails above the carriage,
  - semiautomatic operation (for ice making),
  - synchronous operation with the measurement/test carriage,
  - ice can be pushed both ways.







Other systems:

Air conditioning/ventilation: In an ice model basin facility, where water, ice and cold are the basic elements, one problem rises above all: humidity.

In the present facility, the biggest actual problem has been the humidity in the spaces under the basin. Need a lot of window wiping.

This has been solved in the new facility by cooling the pre-dried air before circulating in the problematic spaces.

Visual observations: It was already mentioned about the windows around the basin. In addition it is planned to arrange an online video link to the conference rooms from the cameras recording the tests.

Model ice: Simultaneously with the construction of the new facility a project to study the modelling of ice properties has been launched. Possibly some improvements can be expected.

Infrastructure:

The new AARC facility is located in the eastern part of Helsinki, Vuosaari, at the end of the eastern subway line. Vuosaari is a suburb with some 40000 inhabitants and increasing industrial activity, new harbour and marine business park. Also next to the AARC facility there is a golf course and large leisure boat marina.

Construction:

September 2004

February 2005

March 2005

Early April 2005


May 25 2005

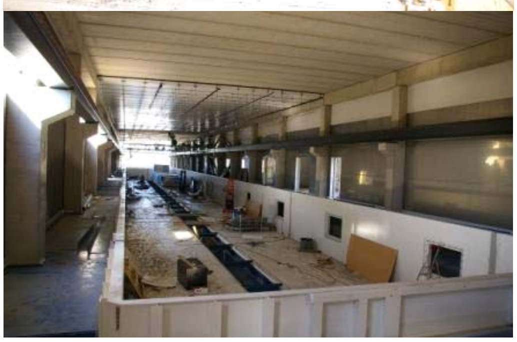

May 30 2005


June 6 2005


June 9 2005


June 15 2005


July 29 2005




Sept. 05 2005

Conclusion. Arctic business in the past has been like a rollercoaster.

However, we believe that operations in the cold climate get more and more tempting as the oil/gas exploration moves to the stable north and new facilities are needed to serve the industry well.