

# MARITIME INSTITUTE OF FINLAND ANNUAL REPORT 2002



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## INTRODUCTION

The Maritime Institute of Finland is a joint venture of the Technical Research Centre of Finland (VTT) and the Helsinki University of Technology (HUT). The aim is to coordinate and strengthen research efforts in the fields of ship and ocean technology. Both publicly funded and commissioned research is covered. The Institute combines the scientific activities of a university and the applied research of a research centre. The research projects and programmes are developed and performed in areas that are considered to be essential for Finland's maritime industry. This results in close co-operation between the parties concerned.

The Institute is governed by a board consisting of three members from both organisations. In 2002 the chairmanship was held by Professor Petri Varsta from HUT. The activities are supervised by an advisory committee consisting of members drawn from the related industry and government bodies. The committee met on three occasions in 2002. The volume of commissioned research activities was over EUR 4 million (including commercial and public funding). The personnel within the institute totalled about 90.

The yearly Institute Seminar was arranged on 15 March as a workshop mainly for the Institute researchers in order to acquaint them with research work performed outside their own area of expertise.

The facilities of the Institute comprise an open water towing tank, a combined manoeuvring, seakeeping and ice tank, a system simulator and a virtual design studio. A wind tunnel, a full navigation bridge simulator and structural testing facilities are also available. An engine room simulator is under development.

## MAIN RESEARCH ACTIVITIES

### General

The year 2002 was the third and last full year of the SEATECH 2000+ national maritime industry research programme, with a total budget of about EUR five million. The programme is funded in part by TEKES (the National Technology Agency of Finland). The Institute acts as a supplier for the industry in this programme. The main themes are: new ship concepts, design methods, system solutions, shipbuilding practices, and EU research priorities. The Institute itself also carried out associated projects.

The Institute has been and is active within the Fifth Framework Programme in several thematic networks. VTT is a partner in several projects: three deal with POD propulsion, one with highly loaded propellers, one with the ballast water treatment systems, one with the virtual reality of ship systems and one with the safety of high-speed vessels. Both VTT and HUT are partners in a project examining structural concepts for advanced passenger vessels.

### Hydrodynamic Research

In the field of CFD, further development of the Finflo-ship code was carried out. This development was primarily aimed at speeding up execution times and improving the user-friendliness of the programme. The Finflo-ship code was passed on to Deltamarin Oy, which is developing a commercial version of the programme. The validity of the code was tested thoroughly by evaluating the total model resistance of three modern-type vessels for several Froude numbers. The code was also successfully used in evaluating ship resistance at the prototype scale.

The hybrid propulsors comprising the fixed front propeller and the Azipod-type turnable thruster as a rear propeller were investigated both experimentally with the aid of model tests and theoretically. In particular the maneuvering forces developed by this arrangement were studied for the entire propulsor alone and the unit being fixed to

the ship model. The components of the propulsor unit were investigated separately. A theoretical model of the hybrid propulsor yielding the steering forces was developed and successfully validated with the aid of tests.

The theoretical method of evaluating large amplitude ship motions in waves was successfully applied to the evaluation of the ship dynamic response due to grounding.

### Structures

The research related to the development of light laser-welded sandwich panels has continued both as part of the SANDWICH EU-project and part of the national KENNO research programme. Design formulations for these panels have been further developed and design software programmed. Pilot applications on various locations onboard ships and lift floors have been developed and installed onboard the Voyager class cruise ship. The strength of the cover plate under impact loading is one example of the topics presently being studied in order to develop optimum design solutions.

The EU-funded DISCO project was also continued during the year with the aim of developing innovative structural design solutions and early design tools for advanced passenger ships. All the leading shipyards building cruise liners are partners in the project. VTT's role is to study simplified methodologies for the structural analysis of passenger vessel hull and fatigue aspects. The ultimate strength of these types of ships under extreme loading is one of the topics studied by HUT.

Production accuracy was studied as part of the SeaTech 2000+ national research project. The research project concentrates on systematic analysis and measurements of the accuracy of ship hull production in the



*National KENNO research program: a panel after testing.*

various production phases. The main activity in this area was to develop calculation methods to estimate welding distortions in ship production.

As part of the TUKEVA research programme funded by the Academy of Finland the research project related to the fatigue of laser and laser hybrid welding continued. Both theoretical and experimental methods have been applied to study fatigue crack initiation in these types of welds in order to develop a sound design basis and to utilise the extremely good fatigue characteristics of these welds to the full extent in structural design.

The grounding risk of a ROPAX vessel was studied as part of the SeaTech 2000+ national research project. This research project concentrated on powered hard grounding and especially on the grounding process and grounding consequence model, thus enabling a quantitative risk analysis. The principles of FSA were applied when studying the effects of some changes on the double bottom of the ship. This research project resulted in the publication [Matusiak & Varsta, 2002], the report [Tabri, 2002], the M.Sc. thesis of Timo Yrjövuori and the Lic.Sc. thesis of Risto Jalonen.

## Arctic Technology

The research related to the Finnish and Swedish ice class rules continued with two topics. A project to update the hull rules was commenced with a collection of all the measurement data available on ice loads in the Baltic. This work resulted in the M.Sc. thesis of Samuli Hänninen. An analysis of the impact of the new power requirement on the required power of small ships was also carried out. It was shown that the present ship profile is not expected to have a significant effect. The propulsion coefficients of ice-going ships were investigated in a project related to the present SeaTech-programme. The first part of the project was completed. The research concerning ship safety in ice-covered seas was started by analysing the risks encountered in wintertime. This work was partly related to the new VTMS and partly to an initiative to investigate the risks of shipping in the Gulf of Finland. Finally, the simulation project for the breaking process of level ice was launched with Shuqin Wang's doctoral dissertation. The work was continued during 2002 in a project funded by the Academy of Sciences in Finland.

*Oil combating: the field trials of a vibrating oil collecting device.*

## Ship Operations, Safety and the Environment

VTT and HUT carried out a preliminary research project concerning the risks of maritime transport in the Gulf of Finland. The project was made possible with financial aid from TEKES. The aim of the project was to collect and describe the risk factors related to both open water and winter navigation seasons and to make proposals for action to correct the faults found. The relevant research projects in the Gulf of Finland and the Baltic Sea area are also listed. The report (in Finnish) is published on the Internet at <http://www.mintc.fi/www/sivut/dokumentit/liikenne/merenkulku/meririski.pdf>.

A Formal Safety Assessment study has been carried out with respect to the proposed VTMS system for the Gulf of Finland. The focus is on the risk of ship-to-ship collisions. The risk-modelling framework used in the FSA study was based on the GRACAT software developed by the Technical University of Denmark to support maritime safety studies. The implementation of the system was approved by the International Maritime Organisation in December 2002. The FSA study was also presented at the Royal Institute of Naval Architects (RINA) conference in London in September 2002. The representatives of Estonia, Finland and Russia gathered at the Maritime Safety Training Centre in Otaniemi, Finland from 19 to 20



*The sea rescue in the Gulf of Finland: training onboard "Jenny Wihuri".*



September 2002 to launch the development work for the harmonisation of the Gulf of Finland Ship Reporting System (SRS) operational procedures. This work will continue in April 2003 during the second Operational Exercise.

A research project MARTOB (On Board Treatment of Ballast Water (Technologies, Development and Applications) and Application of Low-sulphur Marine Fuels), partly funded by the EU, was established in 2001 to find solutions for the development of onboard ballast water treatment. Thermal, de-oxygenation, ultraviolet, ultrasonic, oxidant and ozone treatment methods were tested at the University of Newcastle in June 2002 by a group of scientists all over Europe, including VTT.

As part of the Interreg IIIA programme, VTT made a lifeboat strategy for the Finnish and Estonian Sea Rescue Societies. Issues related to sea rescue in the Gulf of Finland were dealt with thoroughly in the research report.

The field trials of the vibrating oil-combating device was performed in March 2002. The novel oil-collecting unit designed for ice conditions was tested in rubble ice in the Archipelago Sea. The system is designed by the Finnish Environmental Institute. During the trials other oil combating systems were also tested, such as the use of pneumatic air under the ice field.

## Machinery

Exhaust gas boiler fouling research was continued by systematically collecting operations data in close cooperation with Finnish and foreign shipowners. The results were partly parallel but also some wide deviation was recorded. The parameter study will be continued to define the interrelations. Mathematical simulation was continued in order to explain the dependence of fouling on various parameters. Very few reports have

been published on this subject, and therefore the project report and other HUT publications are important in promoting general knowledge on this subject.

Minor investigation tasks were conducted on machinery plant reliability and seawater cooling systems. These together with the continuous collecting of operator feedback and space utilisation will be utilised to develop an interactive tool for engine room designers' training.

Preparations for the 9<sup>th</sup> ICMES conference were continued. The HUT Ship Laboratory will arrange the conference in close cooperation with SNAME (Society of Naval Architects and Marine Engineers) and IMarEST (the Institute of Marine Engineering, Science and Technology). Triennale ICMES (International Cooperation on Marine Engineering Systems) conferences are the only international forum where ship machinery designers, operators and manufacturers can exchange views on a practical basis. The conference will begin at the HUT campus and continue onboard MS Silja Serenade. We believe that sailing through the Baltic Archipelago in May when the nights are already light will be a memorable event for the foreign participants and their spouses. More information is available at: [www.hut.fi/Units/Ship/ICMES2003](http://www.hut.fi/Units/Ship/ICMES2003)

## Small Craft

The small-craft-related sub-project within the LIIKKUVÄRE project was finalised. The basic principles for acoustics and state-of-the-art damping principles were debated and presented at a workshop. Further measurements were performed on different boats, with different propellers, and the transmission of noise through the structures was studied. The vibration and damping characteristics of fibre-reinforced plastics panels was analysed, as well as the damping of engine enclosures. The results were

collected into a handbook covering calculation principles and examples.

At the end of the year the Nordic Boat Standard covering type certification of boats under 15 m in the Nordic countries was terminated. The system was created in the 1970s, and more than 300 boats have been inspected and received the so-called Blue Shield issued by the Finnish Maritime Administration.

Several hundreds of thousands of boats in the Nordic countries have received the Blue Shield over the years, and many lives have been saved thanks to a good safety level. The most important aspect of the safety standard was good flotation for boats under 5.5 m also in swamped condition. Other aspects included in the standard were strength, freeboard, fire protection and personal safety onboard. VTT played an important role in the development of the standard during the 1980s and has offered inspection services since 1982.

During the development of the EU Recreational Craft Directive, several aspects of the Nordic Boat Standard were taken into account.

## THE MEMBERS OF THE ADVISORY COMMITTEE 2002

### Chairman

Mr Kari Airaksinen, President, CEO, Aker-Finnyards Ltd.

Mr Henrik Bachér, Safety and Environmental Manager, Silja Line Shipping Ltd.

Mr Rauli Hulkkonen, Technology Specialist, Finnish Technology Development Centre

Dr Heikki Kleemola, Research Director, VTT

Mr Jorma Kämäräinen, Senior Maritime Inspector, Finnish Maritime Administration

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Mr Pekka Lopmeri, Captain (Navy Eng.), Finnish Navy, H.Q.

Mr Eero Mäkinen, Director, Kværner Masa-Yards

Mr Henrik Nordell, Director, The Association of Finnish Metal Industries

Mr Erkki Strengell, Director, Aker Finnyards Ltd



*Two versions of the Nordic "Blue Shield" together with VTT's new Small Craft*

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