Under the New Growth Strategy adopted by the Japanese government last year, science and technology are positioned as the platform supporting the nation's economic growth and must become the driving force in realizing innovation. For the National Maritime Research Institute (NMRI), which began its 3rd Mid-Term Plan in April 2011 amid intensive knowledge competition in maritime affairs with China, South Korea, and other countries, this is the year when we should provide advanced technical solutions to the diverse range of problems assigned to us by the government, society, and industry and new technologies which generate innovation, and thereby fulfill our role as a core research institution in the maritime and marine fields.

In fiscal year 2011, we are undertaking challenges in the following three broad areas:

First, we have set high targets and new themes in connection with achieving zero emissions of CO2, NOx, etc., improvement of ship performance in actual seas and its evaluation, development and safety assessment of a hybrid propulsion system, rapid, high-level analysis of maritime accidents, power generation using floating offshore wind power systems, safety and environmental impact assessments of marine resource development, and support to safe, efficient ship operation, among other issues. It is necessary to take on these challenges and promote research on these topics in a full-scale manner.

In combination with this, it is also important to follow up on various research results achieved during the 2nd Mid-Term target period, and to implement measures to ensure their dissemination.

Beginning in 2011, we will introduce a new style of research, in which research is promoted in collaboration with industry and universities by the OpenLab system, centering on the world's premier Actual Sea Model Basin, which NMRI completed in 2010 with support from the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). In this new research system, we intend to develop innovation technologies through collaboration with industry and academia.

Second, it is necessary to have a vision of NRMI as "Safety and environmental specialist" and "Maritime innovation center," and to create unrivaled technologies on this basis. NMRI will merit the name of a research institute which responds to the expectations of the Japanese people only when it achieves research results through advanced technologies and independence which are unobtainable at other institutions. Therefore, while also pursuing results from research on priority themes, we will make the best use of these results to further advance core technologies designated by NMRI. To expand collaboration with universities and other research organizations, we will seek new ideas from these counterparts and promote new "seeds" type technical development utilizing the facilities possessed by NMRI and our research budget. We are promoting in-house training aimed to further upgrade our research potential, and in this area, we are working to improve the content of training. We also intend to enable easier use by other organizations of our training facilities and contribute to maritime industries which demand higher potential in maritime and marine technologies.

Third, efficient management which produces the maximum results with a limited budget is necessary. In December of last year, a basic policy on reviews of Independent Administrative Institutions (IAI) like NMRI was adopted by the Cabinet. In particular, this requires IAI's to further streamline management by specializing in roles which cannot be fulfilled by the private sector or universities, eliminate redundancy in research work and stamp out research with little necessity from the viewpoint of policy. As a research institute which receives the larger part of its budget from the national government, we must seek methods of conducting our business which will win the understanding of the Japanese people. This means promotion of prioritizing research themes and thoroughly eradicating waste from research we undertake.

We are committed to inspecting and improving all aspects of our business and are set to actively conduct the reviews deemed necessary to achieve this goal. In this, we will not be bound by established conventions, but will analyze the current situation from the perspective of the Japanese people, carry out reforms based on new thinking, and conduct our business activities on this basis.

Kazuhiro Mori, President
(IAI) National Maritime Research Institute
The NMRI’s Basic Principles and the Code of Conduct shared by all its employees are as follows.

**NMRI’s Basic Principles**

- To contribute to the realization of a safe and secure society.
- To contribute to the realization of a society in harmony with the environment.
- To contribute to strengthening the competitiveness of the maritime industry.
- To contribute to the creation of future-oriented technologies.

**Code of Conduct**

- **To consider our clients’ satisfaction.**
  We will endeavor to grasp and respond to needs from the client’s viewpoint at all times, in order to provide technical solutions which will ensure the satisfaction of all of our clients, including the government and industry involved in maritime and marine issues, and eventually the people of Japan.
- **To grasp social trends and work flexibly to solve identified challenges.**
  We will quickly and accurately grasp and analyze the challenges that arise successively in an ever-changing society, and will put immediately into action to solve those challenges.
- **To pursue innovation at the individual level and challenge new possibilities.**
  We will pioneer new fields and address the technical challenges left unresolved by our predecessors with resolute determination and a forward-looking attitude at all times, unfettered by individual specialties and existing technologies.
- **To maintain a commitment to higher-level outcomes.**
  We will maintain a constant commitment to providing research results of such a high level that no other institutions can reach, in a manner that our clients highly evaluate them, instead of being satisfied with simply solving challenges.
- **To clarify our awareness of objectives and demonstrate our creative capabilities.**
  We will be constantly aware of our individual targets for achievement, and will strive to realize those targets by demonstrating new creative capabilities, when taking action based on this Code of Conduct.
Development of Advanced Analysis Technology for Maritime Accidents

NMRI established the Marine Accident Analysis Center in September 2008 and has implemented a system which actively utilizes its wealth of specialized knowledge when a serious accident occurs. NMRI constructed a comprehensive accident analysis system for accident cause analysis comprising the following technologies, among others:

- Technology with automatically prepares track charts for ships involved in accidents from AIS (Automatic Identification System) data
- Method of measuring hull shape by 3-dimensional laser scanner under constricted environmental conditions
- Technology for reproducing accidents with a sense of actual presence using the NMRI Bridge Simulator for Navigational Risk Research, based on the obtained data

This makes it possible to realize rapid and detailed analyses of diverse types of accidents.

Using the Actual Sea Model Basin, which was completed during 2010, NMRI established a wave-generating technology capable of producing arbitrary waves such as choppy waves, so-called “freak waves,” and similar phenomena which could not be simulated with wave generation in model basins until now. This achievement enables faithful reproduction of maritime accidents in rough weather and established the basic technology for research to elucidate the causes of accidents and prevent their recurrence.

Using the Actual Sea Model Basin, a model experiment was carried simulating the "Ferry Ariake listing accident," which occurred in the Kumano Sea off Mie Prefecture in November 2009. As a result, NMRI successfully verified the sequence eventually resulting in the listing of the Ariake, as estimated in the accident cause investigation by the Japan Transport Safety Board.
Development of Practical Wave Load Estimation Method for Structural Strength Evaluations of Ships

Goal-based standards (GBS) for hull structural strength are being studied in the IMO. However, in order to establish a rational system of standards, it is important to grasp the external forces and other factors which affect hull strength.

NMRI developed a time-series calculation method with 6 degrees of freedom called NMRIW (Nonlinear Motion in Regular and Irregular Waves) for calculation of ship motion in oblique seas and beam seas under high wave conditions, which was not possible in the past. This method makes it possible to calculate composite loads including longitudinal bending, transverse bending, and torsion, and also enables rapid calculation of response in irregular waves. As a result, statistical values for loads, which are important for strength evaluation, can now be obtained by direct calculation.

This calculation method also makes it possible to calculate elastic vibration such as whipping (hull vibration phenomenon accompanying slamming when the sea surface strikes the ship bottom), supporting more advanced load estimations than were possible in the past.

Research for construction of a probabilistic safety assessment method.

Application of FSA assessment techniques in the safety field to oil spill accidents, and contribution to the establishment of international standards.

In order to establish ship standards which are both rational and efficient, NMRI is conducting research on the probabilistic (risk-based) safety assessment method, which is a method for quantitatively assessing the risk reduction achieved by safety measures.
Contribution to GHG emission reduction measures by application of method for evaluating ship performance in actual seas.

NMRI proposed to the IMO a detailed review of the Energy Efficiency Design Index (EEDI), which is an index showing the GHG emissions per unit of transport capacity of newly-constructed ships and is considered important as the basis for a framework for GHG emissions reduction in the IMO, and a draft of guidelines for a concrete calculation method, thereby contributing toward agreement on an EEDI regulation package.

As part of the “10 Mode at Sea Project” of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), NMRI developed a high accuracy technique (Index of Ship Performance at Sea) for evaluating the performance of ships when operating in seas under actual wind and wave conditions while still in the design stage. This Index was developed with the support and cooperation of the related Ministries and government agencies, industrial groups, shipping companies, shipbuilders, and other related parties in Japan. Measurements/tests of actual ships demonstrated that this method is capable of estimating the performance of ships in actual seas with high accuracy. This project also envisions appeals to establish the technical superiority of the Japanese shipbuilding industry in the world market.

Using part of the results of this work, a Ship Performance at Sea (10 Mode at Sea) appraisal service business has started in the Nippon Kaiji Kyokai (Class NK).

Technology for reducing GHG emissions by reducing hull drag with microbubbles at ship bottom: “Air Lubrication Method.”

NMRI is engaged in research on an air lubrication method for reducing hull drag (frictional resistance) by covering the area around the ship’s hull with bubbles of air. As one achievement, which was the first practical application of this research to a coastal ship, a cement carrier, the “Pacific Seagull,” owned by the Azuma Shipping Co., Ltd., was fitted and is now in service with the Air Lubrication System.

The system has also been installed on an ocean-going ship, and analysis and evaluation aiming at further improvement are continuing.
Research on Prevention of Atmospheric Pollution due to Discharge of Ship Exhaust Gas, Etc.

Challenging an 80% reduction of NOx, and establishment of basic technology for a ship engine PM measurement method.

Under the Tier III limit on NOx, which takes effect in 2016, an 80% reduction in NOx emissions from the Tier I limit will be required.

As technologies for achieving this 80% reduction in NOx emissions, NMRI studied combustion improvement by improvement of the fuel injection system, and higher functions, extended life, and compact size in catalytic post-treatment devices (SCR: Selective Catalytic Reduction denitrification device for ships), and promoted research toward practical application of marine SCR systems, including engine control. NMRI also established the basic technology for a method of measuring particulate matter (PM) released from ships.

To prevent environmental pollution by harmful substances accompanying ship-breaking, the IMO ratified the Ship Recycling Convention in May 2009.

In work leading up to ratification, NMRI played a central role in drafting guidelines on the preparation of inventories of harmful substances used in ships, which is the most important element for implementation of the convention, and this was adopted by the IMO in July 2009. For smooth implementation of the convention, NMRI also prepared an inventory preparation manual for small- and medium-scale shipyards.

Research for Prevention of Environmental Pollution in Ship-Breaking

Contribution to establishment of the Ship Recycling Convention.

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In work leading up to ratification, NMRI played a central role in drafting guidelines on the preparation of inventories of harmful substances used in ships, which is the most important element for implementation of the convention, and this was adopted by the IMO in July 2009. For smooth implementation of the convention, NMRI also prepared an inventory preparation manual for small- and medium-scale shipyards.
Efficiency Design of Floating Offshore Structures Supporting Japan as a “Resource Power”

Development of a basic planning support tool for offshore platforms, contributing to utilization of the oceans surrounding Japan.

Japan’s Exclusive Economic Zone (EEZ) is the 6th largest in the world and comprises an area 12 times larger than the country’s land area. In addition to a wealth of energy resources, which includes methane hydrate and seafloor hydrothermal deposits, mineral resources, and potential natural energy such as wind, wave, and tide power, Japan’s EEZ is also important as a space for production activities such as aquaculture.

NMRI carried out “Research and development on offshore platforms” as a project of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and developed a tool (basic planning support tool) which supports design of the optimum offshore platforms for diverse purposes, considering the balance of safety, economy, etc. This tool enables efficient preparation of new marine development plans.

Research for Construction of Safety Techniques for Deep-Water Oil/Natural Gas Production Systems

Contribution to solving technical problems toward practical application of MPSO systems.

For MPSO (Mono-column hull-type floating Production, Storage and Offloading) systems, NMRI developed a control algorithm for shuttle tankers which maintains the ship’s position by DP (Dynamic Positioning), and performed safety assessments based on water basin safety tests and various types of simulations, including collision of a shuttle tanker with the MPSO. This work made an important contribution to solving technical problems related to practical application of MPSO systems.
Development of Basic Technologies for Realizing New Production Systems

To transfer skills to the younger generation of workers and realize more advanced production technologies in response to the declining number of experienced personnel in the ship industry, NMRI is engaged in research on a skill transfer method which scientifically elucidates the unique Japanese manufacturing technologies called monodzukuri, and the basic technologies for a new production system applying this.

To date, NMRI has prepared DVD and text materials for use in skill training in plate-forming and piping design/engine installation and DVD educational materials for process managers in charge of outfitting. These materials are organized by the contents/processes of each type of work, and are an explicit formulation of the know-how of actual process managers obtained through surveys.

NMRI has also begun work to achieve higher efficiency in production systems by applying the technologies obtained in the preparation of these manuals. As one result, NMRI developed a curvature expansion method, which expands curved shell plates in an plane, and a program which writes the press-machine press lines and gas heating lines for plate forming in shell plate expansion diagrams and outputs the finished form after press-forming in 3 dimensions. This technology has greatly improved efficiency in plate-forming work.

Patents for this curvature expansion method have been granted in Japan, the United States, and other countries.

Research for Development of Technologies for Reducing Emissions of Volatile Organic Solvents (VOC) from Ship Paints

The Japanese government set a target of reducing emissions of VOC (volatile organic compounds) by 30% by 2010. NMRI, in joint work with related organizations, began work on this challenge and succeeded in developing a low VOC antifouling paint which not only reduces VOC emissions to 1/2 the conventional level, but also reduces paint consumption by approximately 30% (= approx. 30% reduction in painting time). Paint manufacturers are promoting application of this paint to actual ships.
Mission and Mid-to Long-term Strategy

Mission

◆Requirements from government and society◆

Promoting Safety in Maritime Transport
Preserving the Marine Environment
Marine Development
Advance Maritime Transport

Quick and accurate response to various requests

Potential of NMRI

Wealth of specialized knowledge
Large-scale research facilities
High quality technical capabilities

Creation of new marine technologies
Promoting safety/Preserving environment
Proposal of Japanese and International technical standards

Collaboration
External organization

Marine innovation center for creation of new technologies
anticipating needs and regulatory trends

Proposal of technical standards

Government

Industry

Contribution to the development of international regulations and standards, and to prevent marine accidents
Preserving Marine environment
Marketable technologies

Wealth of specialized knowledge
Large-scale research facilities
High quality technical capabilities

Proposal of technical standards

Government

Industry

Contribution to the development of international regulations and standards, and to prevent marine accidents
Preserving Marine environment
Marketable technologies
NMRI has established the following four priority research areas in order to realize its Mission as set forth in the 3rd Mid-Term Plan.

1. Securing Safety in Marine Transportation

Against the background of concern about increased social costs due to the introduction of safety regulations that lack technical rationality under international agreements, the construction of a system of safety regulations which satisfies both improved ship safety and balanced social costs is demanded. Moreover, collisions involving large ships, maritime disasters such as the sinking of smaller vessels by abnormal waves, and other accidents are continuing to occur at a high level, requiring quick elucidation of the causes of maritime accidents, drafting of appropriate measures to prevent the recurrence of accidents, and verification of their cost-benefit and social rationality.

Therefore, under its 3rd Mid-Term Plan, NMRI will carry out the following research in order to contribute to realization of a “safe and secure society” by construction of safety regulations which substantially reduce maritime disasters and are also socially rational, and further contribute to construction of advanced safety standards by strategic involvement in the formation of international rules.

Research related to the development of safety assessment techniques utilizing advanced structural analysis technology, etc. and safety assessment techniques responding to new technologies such as innovative dynamic systems and the like.

- Development of a program (NMRI-DESIGN) which enables integrated assessment and analysis from wave loads to structural strength.
- Development of safety assessment techniques for ship hybrid systems, ship electrical propulsion systems, ship lithium cells, and other new technologies and large scale systems which are being developed to achieve broad reductions in environmental impacts.

Research related to the development of a rational safety regulation system using risk-based safety assessment techniques, etc.

- Development of design support tools applying risk-based safety assessment techniques, etc., and preparation of guidelines for the safety of new systems such as LNG-fueled ships, etc.
- Development of inspection/diagnosis technology for the hull structure over time, and assessment of the effect of plate thickness on fatigue strength.

Research to reproduce the conditions when maritime accidents occurred with high accuracy, realize advanced analytical techniques, and propose appropriate countermeasures.

- Development of simulation techniques for improving the reproducibility of maritime accidents and accelerate the analysis of their causes by linking Actual Sea Model Basin and the Bridge Simulator for Navigational Risk Research.
- Development of a maritime traffic flow simulator which enables safety assessments of navigational regulations, etc. based on the causes of maritime accidents and the viewpoint the cost-benefit of regulations.
Preserving the Marine Environment

In order to respond to increasing serious global environmental problems, efforts to prevent global warming, atmospheric pollution, and damage to marine ecosystems are being promoted at the world scale. To achieve these goals, new environmental regulations are being introduced and existing regulations are being strengthened. There is also extremely high social demand for the development of environmental technologies which respond to these regulations, in other words, “green innovation.” To address these social needs, an international debate is now underway in ship-related fields with regard to the strengthening of measures which will greatly reduce CO2, NOx, etc. from ships.

NMRI will carry out the following research under its 3rd Mid-Term Plan in order to contribute to the realization of environmental regulations which are both socially rational and substantially reduce environmental impacts by formulation of international rules under Japanese leadership, and the development of infrastructural technologies aiming at “Zero emissions (zero environmental impacts),” which will contribute to strengthening the international competitiveness of Japan’s maritime industries.

Research for more advanced environmental assessment technologies and the construction of an environmental regulation system, contributing to the realization of environmental regulations which are both socially rational and substantially reduce environmental impacts.

◆ Development rational, quantitative social cost-benefit assessment techniques which can be used in study of the introduction of new environmental regulations for ships in the IMO and other organizations.
◆ Development of techniques for assessment of atmospheric pollutant reduction effects contributing to the establishment of appropriate emission control areas (ECA) in the IMO.

Research related to the development of innovative technologies for reducing environmental loads and techniques for assessing navigational performance in actual seas, contributing to the realization of green innovation in ships.

◆ Development of techniques for assessment of navigational performance in actual seas, such as development of a simulator for navigational performance assessments in connection with energy saving in actual seas and development of a CFD system which makes it possible to assess the performance of energy saving devices, etc. in actual seas in the design stage.
◆ Development of basic technologies for CO2 emission reduction technologies, such as devices with high energy saving performance in actual seas using a 2-shaft reaction pod system and stern streamline control technology enabling high propulsion efficiency and substantial energy saving.

Research related to the development of infrastructure technologies and performance assessment techniques contributing to reduction of atmospheric pollutants such as NOX, SOX, and PM and prevention of impacts of ship navigation on the ecosystem in order to realize “greener” ships.

◆ Establishment of practical technologies necessary in NOX Tier III regulations in the IMO, including improving durability/reduced cost of ship SCR systems, preparation of certification guidelines, etc., and development of technologies for measurement, assessment, and treatment for further reduction of NOX, envisioning post-NOX Tier III regulations. Also, development of measurement, assessment, and treatment technologies responding to future SOX and PM regulations.
◆ Establishment of techniques for assessment of the risk of adhesion to hull/contamination of ship systems by organisms adhering to the hull, and assessment of the risk of oil leaks from sunken ships.
3 Marine Development

High expectations are placed on the development of marine resources/energy as a foundation supporting the growth of Japan and an effective solution to structural problems which are expected to continue over the long-term future, as exemplified by the problem of resource/energy security. For this reason, the government's New Growth Strategy mentions "Promotion of development and popularization of marine resources and marine renewable energy, etc." On the other hand, due to the excess risk of development by the private sector, cooperation between the national government and private sector for the promotion of marine development and cultivation of marine industries is vitally important in actual marine development.

Therefore, NMRI will carry out the following research under its 3rd Mid-Term Plan, based on collaboration with related organizations in Japan and other countries, in order to contribute to the development/popularization of marine renewable energy, securing marine resources, and strengthening of industrial competitiveness, through technical contributions to national projects/policies aimed at making Japan a marine-oriented nation and technical support of the Japanese companies involved in actual development and production.

Research related to the development of basic technologies for marine renewable energy production systems, such as floating offshore marine wind power generating equipment, etc., and the development of related safety assessment techniques.

◆ Development of a sway control technology for floating offshore wind power generating systems, and preparation of guidelines for safety assessments.
◆ Development of safety and performance assessment techniques for composite renewable energy power generating systems.

Research related to the development of basic technologies for offshore resource production systems using floating structure engineering, and the development of related safety assessment techniques.

◆ Development of an operation simulator for offshore unloading under composite external environmental forces for offshore natural gas production systems, and the development of a total safety evaluation technique.
◆ Technical development of a subsea (extraction/lifting) system for use in the development of sea floor hydrothermal deposits, and the development of a safety assessment technology for its operation.

Research related to reducing environmental loads, such as the development of assessment techniques for environmental impacts caused by use/development of oceans.

◆ Development of a technique for estimating environmental loads accompanying water discharge, extraction, etc. in the development of sea floor hydrothermal deposits, and the development of a technique for estimating environmental loads accompanying the development of marine renewable energy production systems.

National Maritime Research Institute
Priority Subjects in the 3rd Mid-Term Plan

4 Development of Basic Technologies Supporting Maritime Transportation (Advanced Maritime Transportation)

To ensure the sustained development of the Japanese economy amid ongoing changes in the social environment, such as increasingly serious global environmental problems, the low birthrate/high age society and localized high population densities/depopulation, deterioration of the business environment due to recent wide swings in exchange rates, higher efficiency in maritime transportation, which supports the foundations of the Japanese economy, total improvement in logistics systems, including maritime transportation systems, and strengthening of competitiveness in maritime industries is demanded.

In its 3rd Mid-Term Plan, NMRI will conduct basic technical development in the fields of shipbuilding, shipping, and logistics which support maritime transportation.

Research related to the development of techniques for policy assessments of efficiency measures/optimization of maritime logistics.

◆ Development of a tool enabling advance assessment of policies such as activation of coastal feeder transport, etc., and development of an assessment program for links between the oceangoing shipping network and coastal feeder routes.

Research related to the development of navigation support technology/transportation systems, etc. responding to new needs in maritime transport

◆ Development of basic technologies, etc. for construction of a watch/engine operation support system from shore for promotion of shipboard labor-saving and reduction of navigation costs, and realization of reductions in maintenance and initial costs for coastal service vessels.

◆ Development of a collision avoidance system based on rapid progress in IT technology, establishment of a usability assessment method for navigation support equipment, and preparation of related guidelines.

◆ Preparation of guidelines for promoting smoother navigation and securing improved convenience of users.
National Maritime Research Institute

Dissemination of Intellectual Property and Publicizing Research Achievements

- NMRI is making active efforts to efficiently and effectively secure intellectual property rights, disseminate research achievements, and return intellectual property to society.

- **Dissemination of Intellectual Property**

  - **Flow analysis system for ship hull form design**
    NMRI provides grid generation software (HullDes) and CFD software (NEPTUNE, SURF) developed by the Center for CFD Research. NMRI also provides a packaged solution called “One-Click CFD” which enables grid generation and CFD analysis with simple operation.

  - **NMRIW: Wave Load Assessment Tool**
    NMRIW (Nonlinear Motion in Regular and Irregular Waves) is a NMRI-developed program for time-series calculation of ship motion, acceleration, wave load, and hull surface water pressure distribution in regular and irregular waves. Constructed based on the concept of a nonlinear strip method, NMRIW enables calculations which consider instantaneous changes in fluid forces for various ship speeds and wave heights, directions, and periods.

  - **HOPE/HOPE LIGHT: Hull Optimization Program for Economy**
    The program determines the optimum hull depth and propeller dimensions and enables selection of the main engine, simultaneously considering propulsion performance and cost, in calm seas and under actual sea conditions. HOPE LIGHT is a program which makes it possible to obtain optimum performance in calm seas/waves, fuel consumption, maneuverability and MAU propeller etc. using the minimum necessary input data (ship principal dimensions).

- **Publicizing Research Achievements**

  - **Lecture Meetings**
    In November of each year, NMRI holds lectures on research being conducted on its priority research topics (held alternately in the East Japan District and West Japan District). Symposia, seminars, etc. are also held several times each year on designated topics.

  - **Research Presentation Meetings**
    Each June, individual research results are presented at NMRI’s Mitaka Head Office.
Promoting International activities and Collaboration with External Organizations

### Contribution to the Development of International Regulations and Standards for Maritime Safety and the Marine Environment Protection

International regulations and standards for enhancing maritime safety and protecting the marine environment are moving toward international implementation through a process of examination in the International Maritime Organization (IMO), International Organization for Standardization (ISO), and other international organizations.

NMRI actively contributes to the activities in these international organizations by carrying out surveys and research to provide technical support and preparing supporting technical documentation, dispatching experts to international conferences and meetings, serving in the roles of Chairman/Secretary, and inviting and holding related international conferences.

![Activities Supporting Establishment of International Standards](image)

### Promotion of Collaborative Research with External Organizations

Due to the indispensable nature of the coordination with industries, universities, and other public research institutes for sound and smooth implementation of research aimed at solving the policy issues laid out by the Ministry of Land, Infrastructure and Transport (MLIT), NMRI actively promotes exchanges and research efforts with those organizations through joint research, contract research, etc.

NMRI conducts cooperative research with external institutions on research subjects related to their needs and seed technologies where cooperation is feasible.

NMRI has concluded basic agreements on research cooperation with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in marine research and development, with the Japan Oil, Gas and Metals National Corporation (JOGMEC) in the marine oil and natural gas development, and with the Ministry of Defense in the naval field, with the aim of promoting collaborative research with these organizations and achieving technical innovation.
NMRI at a Glance/History

Fiscal year 2011 Number of Personnel

<table>
<thead>
<tr>
<th>Position</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>President</td>
<td>1</td>
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<tr>
<td>Executive Director</td>
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<tr>
<td>Auditor</td>
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<tr>
<td>Staff</td>
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<tr>
<td>(Office Staff)</td>
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<tr>
<td>(Research Staff)</td>
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Fiscal year 2011 Budget

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<td>Other Income</td>
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<td>Research Expenditures</td>
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<td>Commissioned Research Expenditures</td>
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</tr>
</tbody>
</table>

History

- July 1916 Established as the Ship Equipment Inspection Station under the Ministry of Telecommunication and Transport.
- April 1950 Transportation Research Institute was established.
- April 1959 Completion of Mitaka No. 1 Ship Test Tank (80m Square Tank).
- April 1963 Ship Research Institute was established.
- October 1966 Completion of Mitaka No. 2 Ship Test Tank (400m Towing Tank).
- March 1967 Completion of Rolling Test Tank.
- March 1974 Completion of Large Cavitation Tunnel.
- March 1980 Completion of Ice Model Basin.
- April 2001 Start of operation as the Independent Administrative Institution, National Maritime Research Institute (NMRI) (start of 1st Mid-Term Objectives/Plan.)
- June 2002 Completion of Deep Sea Basin.
- April 2006 Start of 2nd Mid-Term Objectives/Plan.
- June 2010 Completion of Actual Sea Model Basin.
- April 2011 Start of 3rd Mid-Term Objectives/Plan.

Organization

- President
  - Executive Director
    - Auditor
    - Senior Director for Research
    - Fluids Engineering & Hull design Department
    - Fluid Engineering & Ship Performance Evaluation Department
    - Structural Engineering Department
    - Marine Environment Assessment Department
    - Power and Energy System Engineering Department
    - Navigation & Logistics Engineering Department
    - Marine Risk Assessment Department
    - Ocean Engineering Department
    - Offshore Renewable Energy Exploitation Department
    - Osaka Branch
    - Project Team for Research on Greenhouse Gases
    - Planning Department
    - Principal Management Planning Executive
    - Administration Department

Research core structure for implementation of based on the Mid-Term Plan, development of research with a certain continuity and identification of needs, and bottom-up type proposal of research subjects.

Project Teams for developing short-term, concentrated research for problem-solving.
Research Departments

Fluids Engineering and Hull Design Department

Advanced Research Center of Ship Performance in Actual Sea
Fluid Control Research Group
Tank Testing Technical Group

This Department, in the face of a variety of needs from the maritime industry, is undertaking for advanced technologies for designing new ship types and system integration of expertise in advanced fluid engineering, represented by boundary layer control (BLC) technology, with the aim of creating new types of ships. Such collective efforts are to culminate in the “newly designed practical ship with reduced GHG emission by 30%”. The Department also contributes to enhancing overall efficiency of relevant research by developing state-of-the-art measurement techniques.

Center for Ship Performance Evaluation at Actual Seas

With increasingly active efforts to reduce emissions of greenhouse gases (GHG), the Center developed a technology for evaluating performance in actual seas as an index that can correctly express a ship’s “fuel consumption in actual seas.” Applying this result, the Center is engaged in the developing technology which supports the design of efficient navigation of ships in actual seas, and a new type of ship which reduces GHG by half as the culmination of that technology.

Fluids Engineering and Ship Performance Evaluation Department

- Marine Dynamics Research Group
- CFD Research Group
- Seakeeping Performance Research Group

This Department conducts research with the aims of assessing and improving ship performance (propulsion, maneuvering, seakeeping, and stability) in actual seas, and contributes to building safe ships through technical backup in elucidation of the causes of marine accidents and development of international regulations for ships. The Department is also conducting research on evaluation of performance in actual seas by CFD (computational fluid dynamic) technology and analysis of the turbulent fields around energy saving devices. The Department has developed CFD software for analysis of the flow fields (streamlines) around ship’s hull with the world’s highest reliability, which it supplies to shipyards in Japan, and also provides various types of support.
Structure Engineering Department

- Ship Structural Standards Research Group
- Structural Analysis & Processing Research Group
- Maintenance Research Technology Group

For the design and construction of safe and economical ships, this Department conducts research on more advanced methods of estimating the loads acting on a ship’s hull in waves and structural analysis methods using the obtained loads as inputs, the corrosion properties and fatigue strength of materials, etc. This Department also conducts research on production technologies such as new production systems, technologies for rationalization of production processes, etc. in order to realize a large reduction in man-hours by preparing and applying educational materials for skill training.

Marine Environment Assessment Department

- Environmental Analysis Research Group
- Heat Transfer System Research Group

For environmental protection related to ships and offshore structures, this Department conducts research on more advanced environmental impact assessment methods in order to realize a rational environmental regulation system for the marine environment, atmosphere, etc., and research for assessment of the performance of various technologies which contribute to reducing CO2, NOX, SOX, PM, and other emissions from ships utilizing chemical analysis technology, material analysis technology, measurement and simulation techniques related to combustion/thermal engineering, and measurement techniques related to the environment and energy.

Power and Energy System Engineering Department

- Environment-friendly Research Group

In order to protect the global environment, this Department is engaged in development for practical application of systems which reduce the NOX, PM, and other harmful substances contained in the exhaust gas from marine diesel engines, and research related to ship hybridization from the viewpoint of CO2 reduction.

Targeting an 80% reduction in the NOX emissions contained in exhaust gas from marine diesel engines, this Center is carrying out research and development on improvement of combustion by improving fuel injection systems, higher performance, longer life, and compact size in post-treatment devices using catalysts (SCR denitrification system), etc. From the viewpoint of CO2 reduction, the Center is also engaged in the development of control systems for hybridization of ships and research on related safety assessment techniques.
Research Departments

**Navigation & Logistics Engineering Department**

Center for Shipping Planning Technology Research
Marine Accidents Analysis Center
- Navigation System Research Group
- Logistics Research Group
- Sensing Technology Research Group

The activities of this department include evaluation of man-machine interface utilizing a navigation risk simulator, reproduction of marine accidents, development of new navigation systems, safety and usability assessments and development of advanced logistics, among others. In addition, the Department also carries out research on measurement technologies, various sensor technologies, and other basic/infrastructure technologies necessary in research.

**Center for Shipping Planning Technology Research**

This Department is engaged in research on technology for plan preparation/evaluation, including energy saving navigation plans considering weather and oceanographic phenomena, optimum ship allocation plans considering transportation demand, and maritime-land transportation plans considering transportation routes and cost requirements, etc., thereby promoting modal shift, and in turn contributing to the realization of a low carbon society.

**Marine Accidents Analysis Center**

This is a readiness system/organization for responding to major maritime accidents. When a major maritime accident occurs, information is analyzed immediately using the wealth of specialized knowledge possessed by the researchers at NMRI, and the results are disseminated promptly. By analyzing accidents and performing simulations which reproduce accidents, etc., this Center also contribute to the drafting of proposals for measures to prevent the recurrence of accidents, in cooperation with the Maritime Bureau and the Japan Transport Safety Board (both under the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)).

**Maritime Risk Assessment Department**

Risk Analysis Technology Research Group
System Engineering and Safety Technology Research Group

This Department conducts research on Formal Safety Assessment (FSA) for establishment of international standards which consider cost effectiveness, system reliability analysis techniques for quality improvement/prevention of failure of ship equipment, and research on securing safety in the transportation of hazardous cargos such as radioactive materials through improvement of analytical techniques including risk analysis, reliability analysis, etc.
Ocean Engineering Department

Offshore Engineering System Research Group
Deep Sea Technology Research Group

This Department is engaged in a research which is capable of responding to advanced new needs by employing high level model basin test technologies and numerical simulation techniques using unique experimental facilities not found anywhere else in the world, including the Pulsating Wind Tunnel with Water Channel and the Deep-Sea Basin, and data measurement and analysis techniques in actual sea experiments.

Offshore Renewable Energy Exploitation Department

Marine Energy Research Group
Ocean Utilizing Environmental Impact Research Group

Focusing on marine renewable energy, namely, offshore wind farms and ocean energy, NMRI carries out national projects and performs accelerated research and development on projects such as the development of basic technologies for power generating systems and preparation of design guidelines, etc.

Osaka Branch

Materials and Ship Equipment Research Group

The Osaka Branch conducts a research which provides technical support for small- and medium-sized manufacturers in ship-related industries, many of which are located in the West Japan District. This work includes research on ship materials such as FRP molding, material strength/durability assessments, etc., and research related to ship fittings, such as fluid analysis and strength analysis for valves and piping. The Osaka Branch is also involved in research on safety and environment-related testing and analysis.
Main Research Facilities

400m Towing Tank
One of the world’s largest towing tanks
Length 400m Width 18m
Depth 8m Max. speed 15m/s

Large Cavitation Tunnel
Height 10m, Breadth 18m Pressure: 0.005–0.2MPa
No.1 working section: 0.75ø x 2.25m
No.2 working section: 2.0m x 0.88m x 8m

Ice Model Basin
Length 35m
Width 6m
Depth 1.8m
Ice growing rate 2.5mm/h

Ocean Engineering Tank
Length 40m
Width 27m
Depth 2m
X-Y Carriage
Wave, Wind and Current Generator

Pulsating Wind Tunnel with Water Channel
Wind tunnel section
3 x 2 x 15m
Max. wind velocity 30m/s
Water channel section
3 x 1.5 x 15m

Actual Sea Model Basin
Length 80m
Length 40m
Depth 4.5m
X-Y towing carriage
Wave generators around The Entire periphery of the basin
Wind generator
High Pressure Tank

Diameter 1.1m
Height 3.0m
Environments to depths of 6000m

Deep Sea Basin

Max. water depth 35m
Upper basin 14mØ x 5m
Deep pit 6mØ x 30m
Wave & Current generators
Equipment for measuring 3-D behavior underwater

Multi Axis Loading System

Reaction force floor: 12m(L) x 8m(B)
Reaction force wall: 4m(H) x 8m(B)
Capacity of Actuators: Maximum Load ±1200kN(Static)
±1000kN(Dynamic) Stroke ±100mm

Analysis System for Materials and Chemicals

Transmission electron microscope
High resolution scanning electron microscope
Chromatograph mass spectrometer
(Gas, Liquid)
X-ray diffract meter

Bridge Simulator for Navigation Risk

Cylindrical screen r=6.5m 
Field of view (HxV) 240° x 40°
Bridge: Length 4m, Breadth 4m, Height 2.2m
Bridge Motion Platform Pitch ±10°, Roll±15°

FEM Analysis System for Marine Equipment/Resin Injection Device for FRP Molding

Osaka Branch
◆ National Maritime Research Institute
6-38-1, Shinkawa, Mitaka-shi, Tokyo 181-0004, JAPAN

1. From JR Kichijoji Station Park Exit, take the Odakyu bus
or Keio bus (No.3 boarding area, bus for Musashisakai Station South Exit, No.4 boarding area, bus for Chofu Station North Exit, or No.8 boarding area, bus for Chofu Station North Exit). Get off at the "Mitaka Nakyo Mae" bus stop.

2. From Mitaka Station South Exit, take the Odakyu bus
(No.7 boarding area, bus for Sengawa or Koka Gakuen Higashi, or No.8 boarding area, bus for Nogaya). Get off at the "Mitaka Nakyo Mae" bus stop.

3. From Keio Line Chofu Station North Exit, take the Odakyu
bus or Keio bus (No.14 boarding area, bus for Kichijoji Station). Get off at the "Koken Mae" or "Mitaka Nakyo Mae" bus stop.

◆ OsakaBranch 3-5-10, Amanogaharamachi, Katano-shi, Osaka 576-0034, JAPAN

<To Inquire about our pamphlets or our website, please contact the Center for>

◆ Intellectual Property & Information, Planning Department.

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