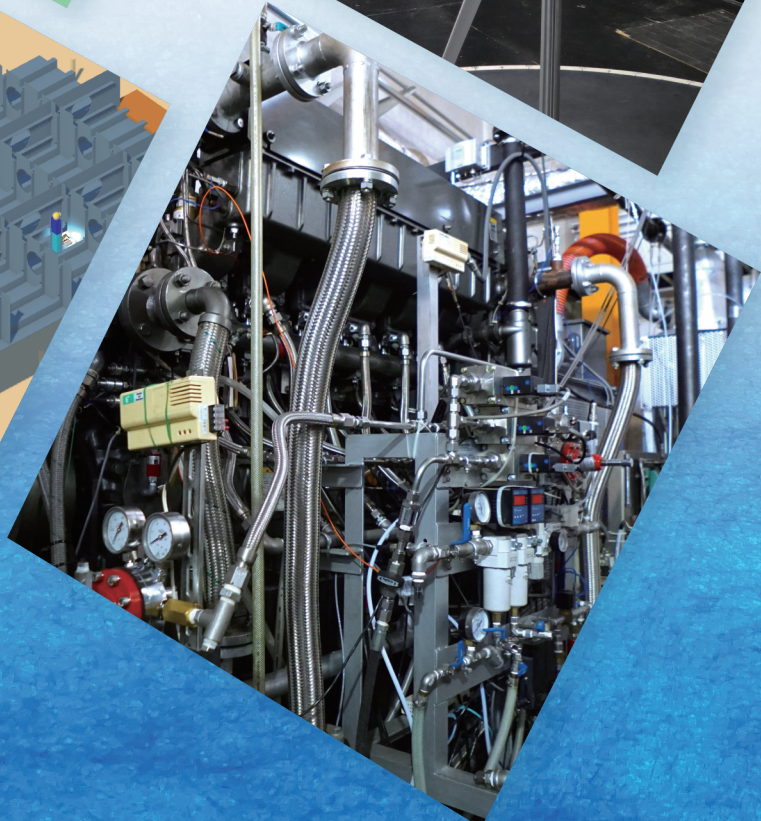
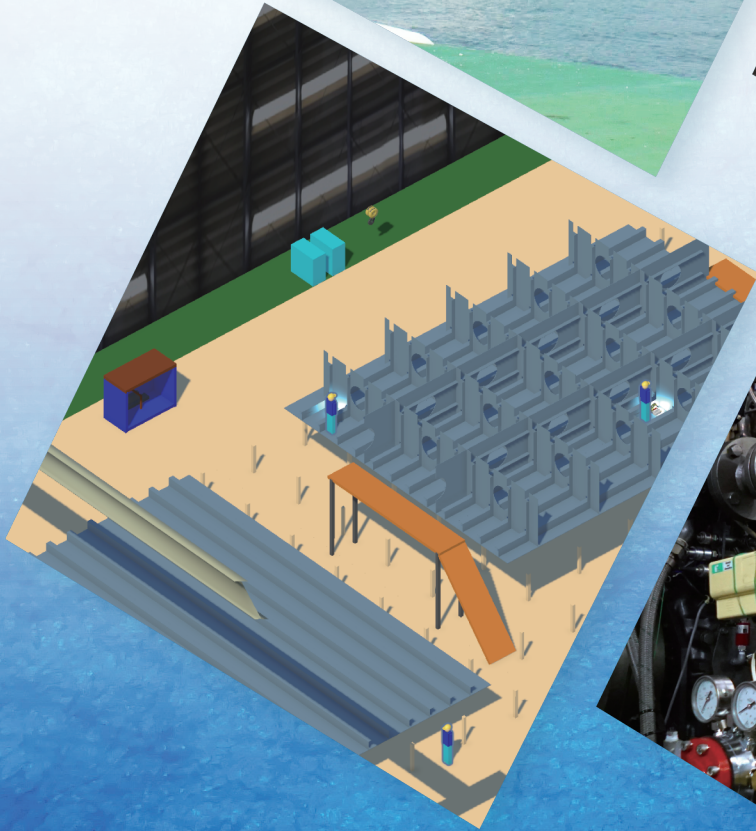




# National Maritime Research Institute





# 1. Securing Safe Marine Transportation

## Research on Evaluation Technology of Hull Structure

To realize the next-generation hull structure design utilizing digital data, NMRI is engaged in research and development to accurately grasp and estimate yield strength, quality, and condition of hulls based on NMRI Direct Load and Structural Analysis (NMRI-DLSA) and the digital twin technology for hull structures using sensing data.

## Research on Fluid Dynamic Performance Evaluation for Safe Navigation of Ships

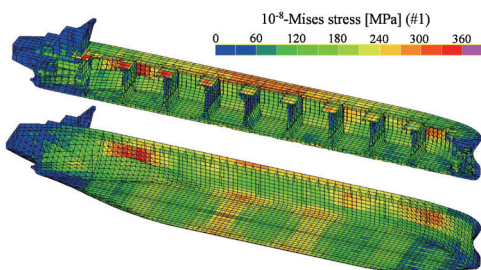
NMRI conducts tank tests at the Actual Sea Model Basin and theoretical calculations related to maneuvering and seakeeping performance for safe navigation. NMRI also develops theoretical or numerical tools for ship performance evaluation.

## Development of Risk Analysis Techniques Essential for Social Implementation of Next-Generation Ship Technologies

NMRI conducts R & D on risk assessment methods for new cargo carriers, such as liquefied hydrogen, and on techniques for sophisticated control of marine traffic flows and evaluating their impact.

## Research on Autonomous Ship Technologies

The shortage of seafarers has become a critical issue in the marine transportation industry, and manpower-saving/unmanned ships acceptable to seafarers are needed. Since the objective demonstration of safety is necessary for society to accept automatic/unmanned ships, NMRI is conducting research on their safety evaluation in parallel with technology development.



Distribution of Long-Term Maximum Stress Estimated by NMRI-DLSA  
(Research on Evaluation Technology of Hull Structure)



Hazardous Event Reproduction Test in Short Crested Irregular Waves  
(Research on Fluid Dynamic Performance Evaluation for Safe Navigation of Ships)

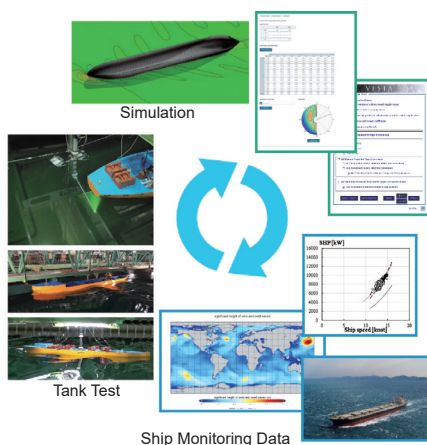
# 2. Preserving the Marine Environment

## Research on Improvement of Ship Performance in Actual Seas

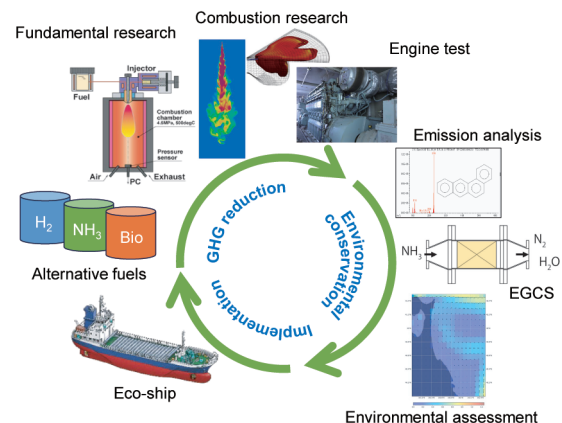
Further countermeasures for reducing GHG emissions from international shipping based on accurate evaluation in actual waters are required. NMRI is developing high-accurate simulation methods based on ship performance integrated database and research to enable proposals for improving ship performance in actual seas.

## Research on GHG Reduction Technologies and on Safety and Environmental Measures

NMRI is developing combustion and analysis technologies for alternative fuels (hydrogen, ammonia, biofuels, etc.) to reduce environmentally hazardous substances emitted from ships and to protect the environment. NMRI also conducts research on environmental assessment, energy conservation for coastal and ocean-going vessels, GHG reduction measures and practical technologies, and oil recovery systems.



Improvement of Ship Performance in Actual Seas through Data Linkage  
(Research on Improvement of Ship Performance in Actual Seas)



Research on GHG Reduction Technologies and on Safety and Environmental Measures

## 3. Ocean Development

### Research on Equipment and Operational Technologies for Ocean Development

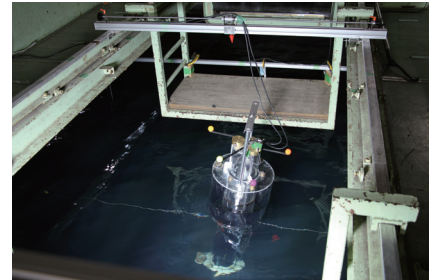
NMRI conducts research on the operation of Self-Elevating Platforms (SEPs) and Crew Transfer Vessels (CTVs) for offshore wind power generation facilities, offshore production, loading, and bunkering of next-generation fuels, marine operation technology such as offshore CO<sub>2</sub> injection in CO<sub>2</sub> Capture and Separation (CCS).

### Research on Safety Assessment and Optimization of Total Systems for Expansion of Ocean Renewable Energy

In addition to research and development of floating offshore wind power generation systems, NMRI also conducts research on optimizing the control of moving parts to maximize the amount of power generation by wave as another marine renewable energy source.



NMRI C-AUV#4: Honored as the Ship of the Year 2018, Presented by JASNAOE  
(Research on Equipment and Operational Technologies for Ocean Development)



Tank Test for Wave Power Generation  
(Research on Safety Assessment and Optimization of Total Systems for Expansion of Ocean Renewable Energy)

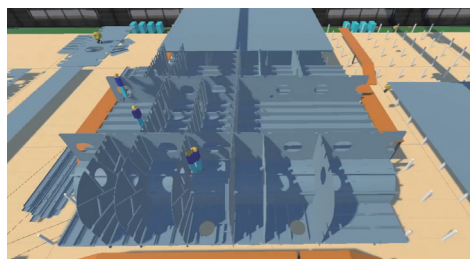
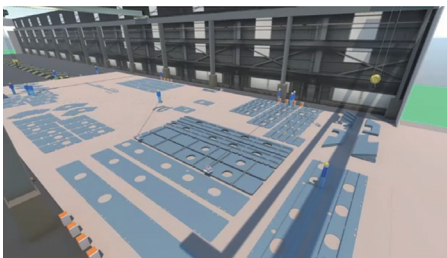
## 4. Developing Fundamental Technologies for Marine Transportation

### Research on Digital Transformation of Shipyards

NMRI conducts research on the digital transformation of shipbuilding to respond to complex product development of ships in future. NMRI is working on the development of a data integration platform for shipbuilding, the development of shipbuilding production simulation technology, digitalization of quality, and research on new materials utilization and new construction methods.

### Research on Advanced Transportation Systems by Utilizing Big Data

NMRI conducts research on the state of transportation, including marine transportation, utilizing big data analysis technology. NMRI also conducts research on understanding international logistics in detail and forecasting shipbuilding demands.



Shipbuilding Production Simulation Technology  
(left-upper: Sub-Assembling Process; right-lower: Large Assembling Process)  
Cooperation: Asakawa Shipbuilding Co., LTD  
(Research on Digital Transformation of Shipyard)

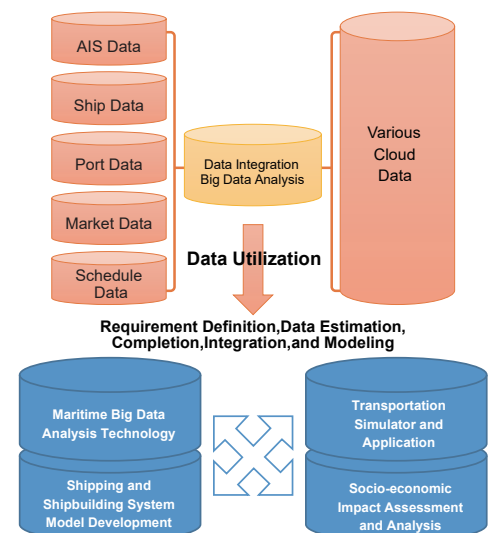


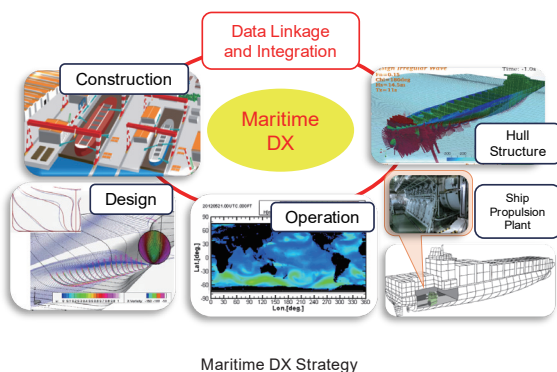
Image of Data Utilization  
(Research on Advanced Transportation Systems by Utilizing Big Data)



# Project Teams

## Digital Transformation Project Team

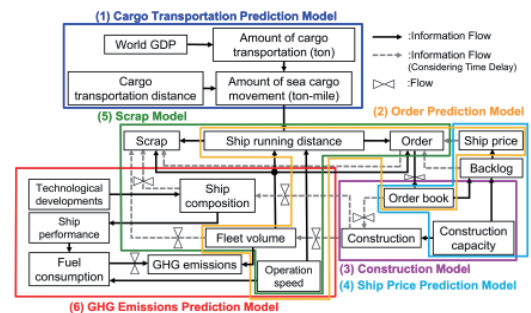
With the research goal of "Developing strategies and business models to realize Digital Transformation (DX) of the maritime industry," this project team is working on the social implementation of individual elemental technologies such as shipbuilding DX, hull form design DX, and operation digital twin.



Maritime DX Strategy

## GHG Reduction Project Team

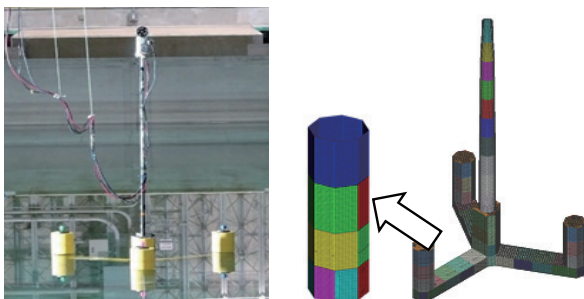
This project team conducts R & D to contribute to meeting IMO GHG reduction targets for international shipping and achieving carbon neutrality in coastal shipping per the Paris Agreement. The focus areas include hydrodynamics, alternative fuels, power sources, and simulation models to assess GHG reduction in marine transportation.



Modeling the Shipping and Shipbuilding Markets with System Dynamics

## Offshore Wind Power Project Team

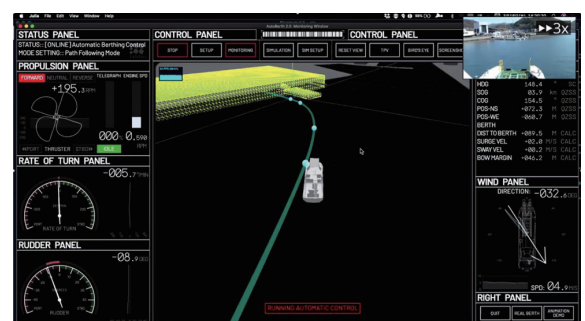
This project team is migrating to R & D on total safety assessment & optimization for future floating offshore windfarms, based on our technologies for a single offshore wind turbine.



Tank Test with Rigidity Similarity Model & FEM Model for Digital Twin

## Autonomous Ship Project Team

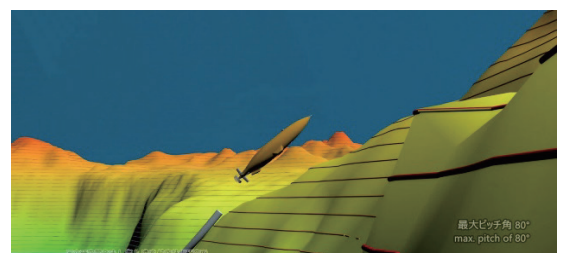
This project team aims to develop autonomous ships with systems that can navigate, berth, and leave shore properly under various navigational conditions, as well as to establish and advance safety evaluation technologies for autonomous ships.



Navigation of Autonomous Ship

## Next-Generation Unmanned Ocean Vehicle Project Team

In light of the remarkable advancements in unmanned ocean vehicles, specifically autonomous underwater vehicles (AUVs), this project team focuses on developing advanced systems and operational methods. This project team aims at propelling unmanned ocean vehicles into the forefront as next-generation mobile platforms, enhancing ocean utilization and fostering sustainable development.



NMRI C-AUV#4 (Honored as the Ship of the Year 2018, Presented by JASNAOE)  
(left: Overall View of NMRI C-AUV#4, right: NMRI C-AUV#4 Soaring through the Water)

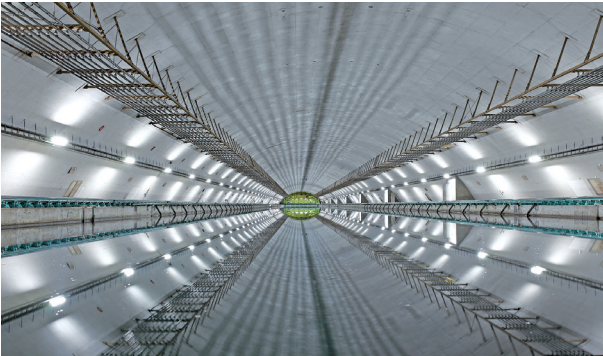


GLOBUS-cloud  
(Global Wind and Wave Database)



# Research Facilities 1

## 400m Towing Tank



400 m (L) x 18 m (W) x 8 m (D)  
Towing carriage (Maximum speed 15 m/s), Wave generator,  
Sub-carriage  
ISO9001 certificated for "propulsive performance tests"

## Actual Sea Model Basin



80 m (L) x 40 m (W) x 4.5 m (D)  
Segmented flap-type absorbing wave generators around the  
entire periphery: 382 units  
X-Y-Ψ towing carriage, Wind generator

## 150m Towing Tank



150 m (L) x 7.5 m (W) x 0 to 3.5 m (D, variable)  
Towing carriage (Maximum speed 6 m/s), Wave generator  
ISO9001 certificated for "propulsive performance tests"

## Large Cavitation Tunnel



18 m (L) x 10 m (H), Pressure range 5 to 200 kPa  
No.1 working section: 0.75 m  $\Phi$  x 2.25 m  
No.2 working section: 2 m x 0.88 m x 8 m  
ISO9001 certificated for "propulsive performance tests"

## Ocean Engineering Basin



44.5 m (L) x 27.1 m (W) x 2.0 m (max. D)  
Wave generator, X-Y towing carriage  
Wind generator, Current generator

## Pulsating Wind Tunnel with Water Tank



Wind tunnel: 15 m (L) x 3 m (W) x 2 m (H)  
Capable of generating variously fluctuating wind  
(Maximum steady wind speed 30 m/s)  
Water tank: 15 m (L) x 3 m (W) x 1.5 m (D)



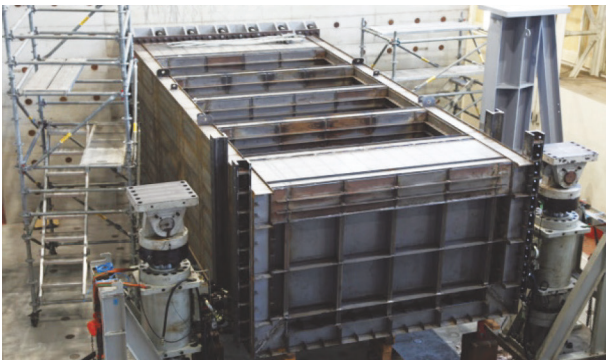
# Research Facilities 2

## Deep Sea Basin



Maximum water depth: 35 m  
Upper section: diameter 14 m x depth 5 m  
Pit Section: diameter 6 m x depth 30 m  
Wave generator, Current generator,  
Underwater 3-D Measurement System

## Research Facility for Life Evaluation of Structural Materials



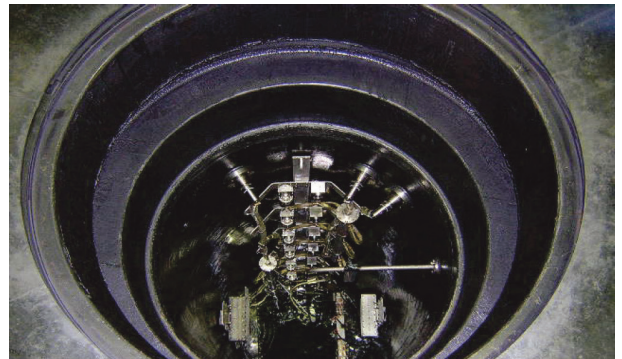
Strong floor: 12 m (L) x 8 m (W)  
Reaction wall: 4 m (H) x 8 m (W)  
Static loading capacity:  $\pm 1,200$  kN,  
Dynamic loading capacity:  $\pm 1,000$  kN,  
Stroke:  $\pm 100$  mm

## Comprehensive Simulation System



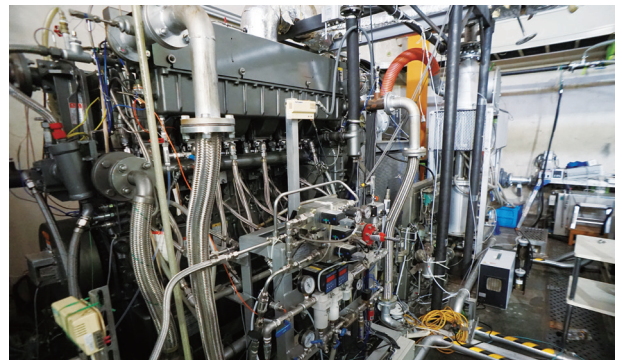
Main system components: 360deg. Cylindrical screen with 6.5m radius, Lower view screen, Navigational equipment (Steering stand, Repeater compass, ECDIS, Radar (S-band, X-band), Engine console, Communication console, etc.)

## High Pressure Tank



Inner diameter 1.1 m x height 3.0 m  
Maximum pressure: 60 MPa

## Gas-fueled Engine Test Facility



Combustion system: Lean-burn/Pre-chamber spark ignition  
Number of cylinders: 6  
Cylinder bore/stroke: 155 mm/180 mm  
Rated power/speed: 400 kW<sub>e</sub>/1,800 rpm (60Hz)

## Dynamic Positioning Simulator



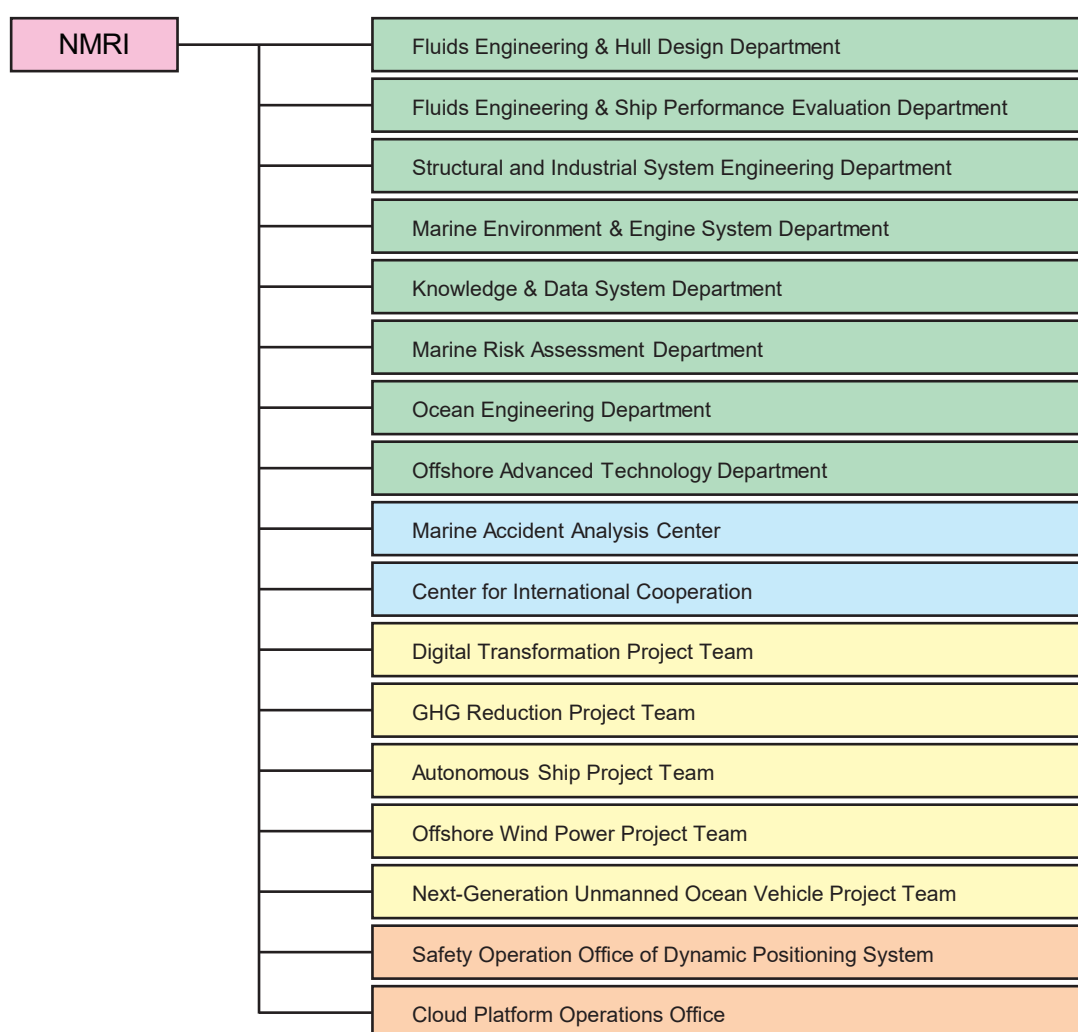
IMO DP Class 2  
6 ship types including drilling vessels, semi-sub, etc.



# Organizations

## NMRI National Maritime Research Institute

*NMRI is the only national public research institute in the maritime and oceanic fields. NMRI is conducting research for “Securing safe marine transportation,” “Preserving the marine environment,” “Ocean development,” and “Developing fundamental technologies for marine transportation.”*



## Contact address

