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CHINA SHIPBUILDING INDUSTRY CORPORATION

中船重工第七〇二研究所
CHINA SHIP SCIENTIFIC REAEARCH CENTER

Research Activities on Minimum Propulsion Power (MPP) under the Framework of EEDI

China Ship Scientific Research Center

2018/10/24

A decorative graphic at the bottom of the slide, consisting of a blue wave-like shape that curves upwards from left to right, with a lighter blue gradient on top and a darker blue gradient on the bottom.

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PART ONE

Introduction

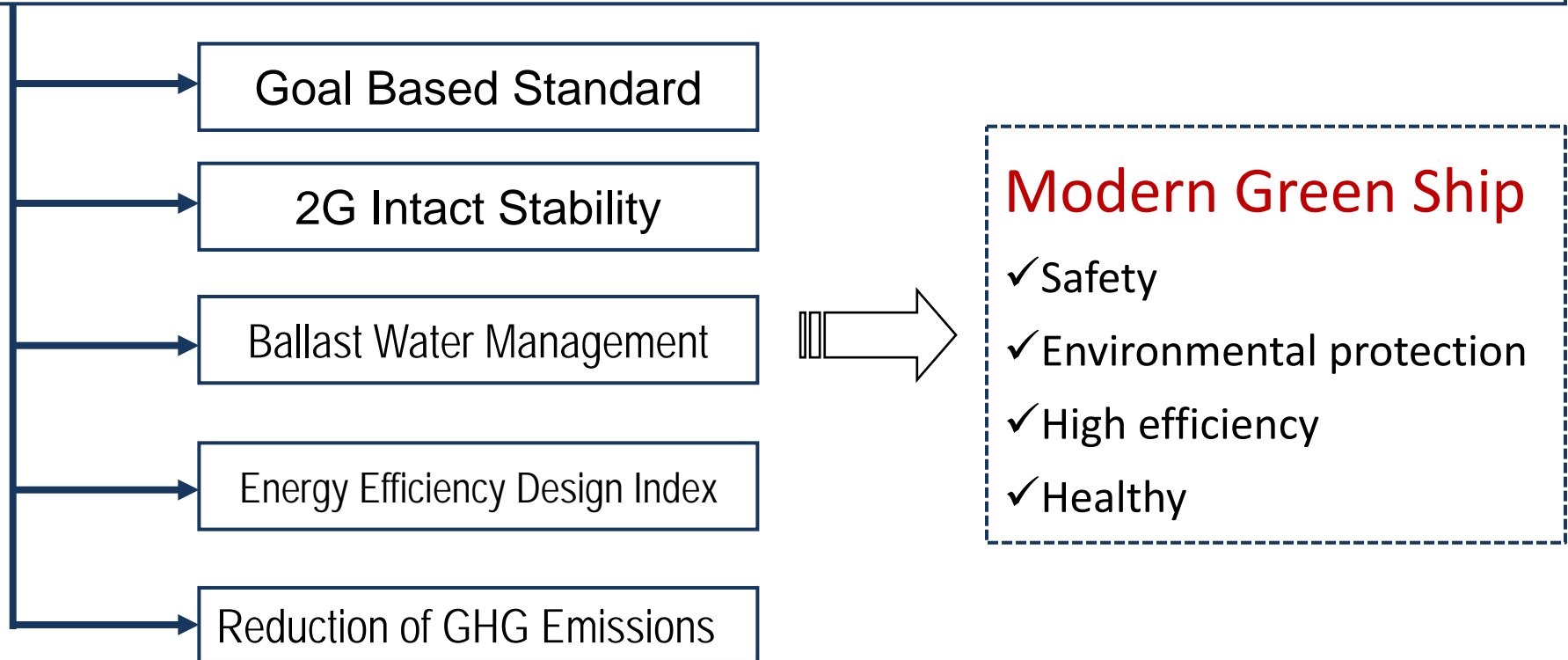




Introduction

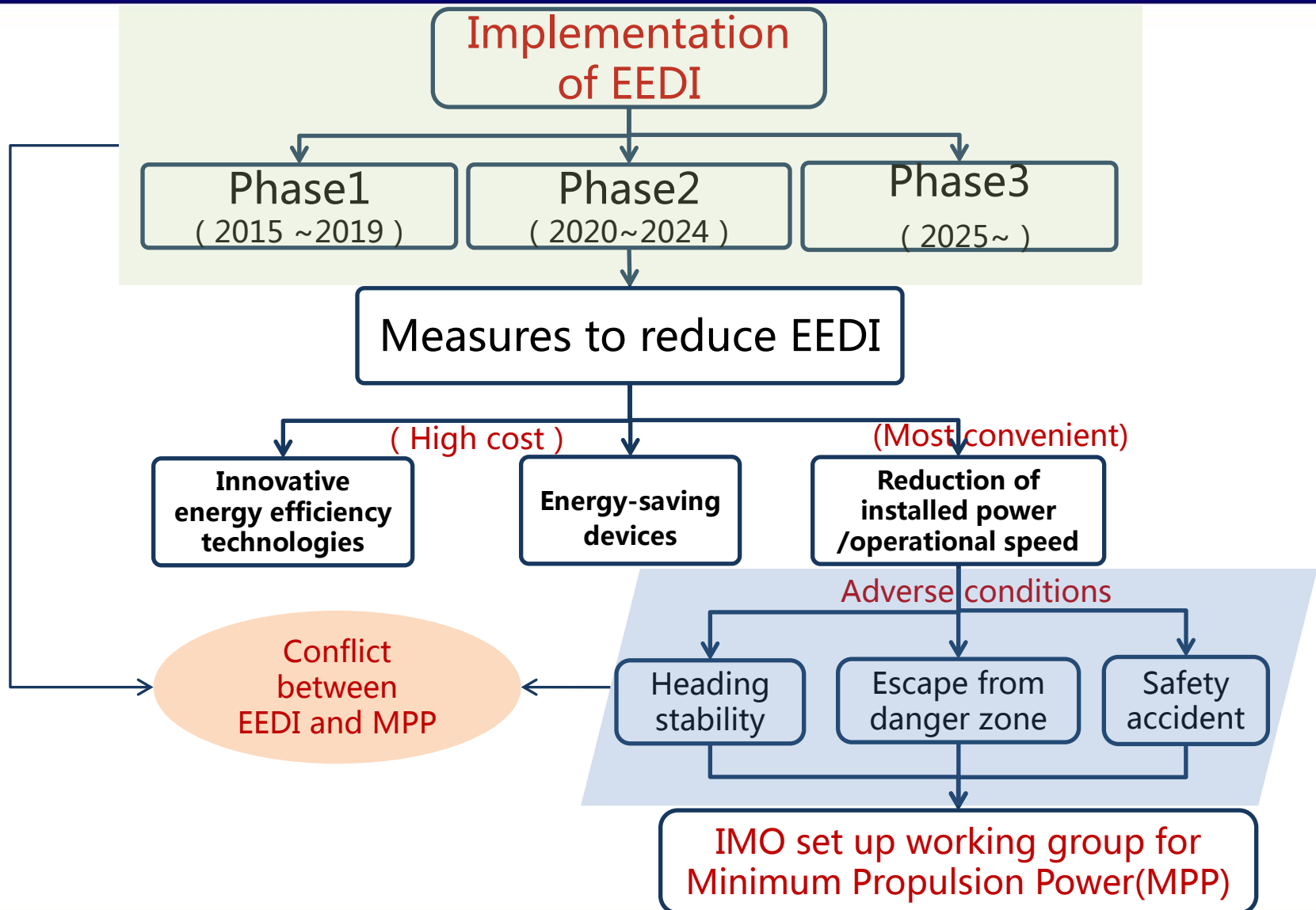


IMO put forward a series of new conventions, new codes and new standards for energy saving and GHG emission reduction.





Introduction

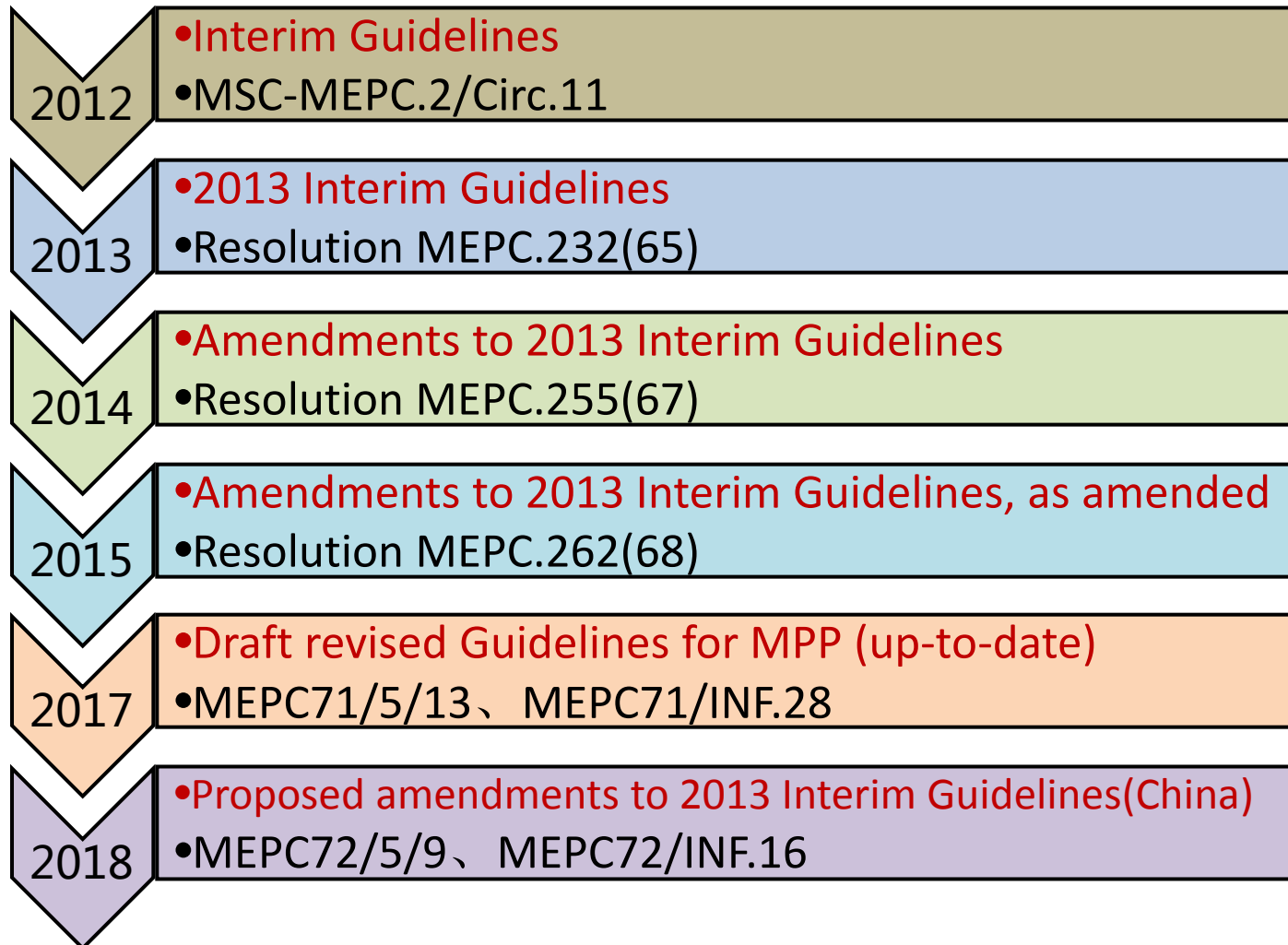




Introduction



◆ Development history of Guidelines for Minimum Propulsion Power in IMO





Introduction



◆ International research status of EEDI and Minimum Propulsion Power

- ✓ Research project Energy Efficient Safe Ship Operation (**SHOPERA**) and Japan's R&D project (**JASNAOE**) have carried out in-depth research on Minimum Propulsion Power for **revising the 2013 Interim Guidelines**, and they finally proposed a draft revised Guidelines at MEPC 71;
- ✓ At MEPC70, one proposal was submitted for **pulling ahead of phase 3 standards to 2022** and **considering phase 4 to go into effect 2025** as an alternative to revising phase 2 standards, which means the EEDI requirement becomes increasingly demanding;
- ✓ At MEPC72, the ***Initial IMO Strategy on Reduction of GHG Emissions from Ships*** has been issued, the conflict between EEDI and Minimum Propulsion Power continuously increase.



Introduction



◆ Key aspects of MMP research

Minimum Propulsion Power

**Safety maneuverability in
adverse sea conditions**

**Added resistance
in wind and waves**

Characteristics and differences with f_w :

- More adverse sea conditions (BF8~BF9);
- Lower advance speed (2~4 knots);
- Lack of high accuracy numerical methods;
- Model test becomes unstable.

**Propulsion performance
in waves with low speed**

Irrationalities of the 2013 Interim Guidelines:

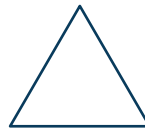
- The deduction factor t and wake fraction w represents the interaction between ship hull and propeller, the value of t and w in bollard pull state ($v=0$ knot) is quite low. **Does this mean the lower the speed, the weaker the interaction?**

In-depth study is necessary for revising the 2013 Interim Guidelines.

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PART TWO

China's research activities on MPP



China's research activities on MPP



◆ Structure of China's EEDI and MMP research team



China's research activities on MPP



◆ Brief introduction of CSSRC



More than 30 research facilities



Beautiful working environment

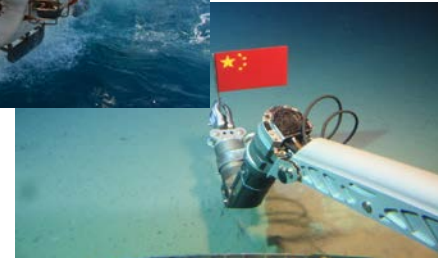


China Ship Scientific Research Center

Marine applied basic research ,
design and development



Deep-sea equipment R & D



▶ China's research activities on MPP



◆ Main contents of China's research work

1

Numerical and Experimental study on ship behavior in adverse sea

- In house developed code for prediction of wave added resistance
- Experimental validation of ship behavior in winds and waves, low speeds

2

Analysis of Minimum Propulsion Power assessment for new ships

- Statistical analysis of assessment Level-1 according to Interim Guidelines
- Depth analysis of assessment Level-2 for new designed ships

3

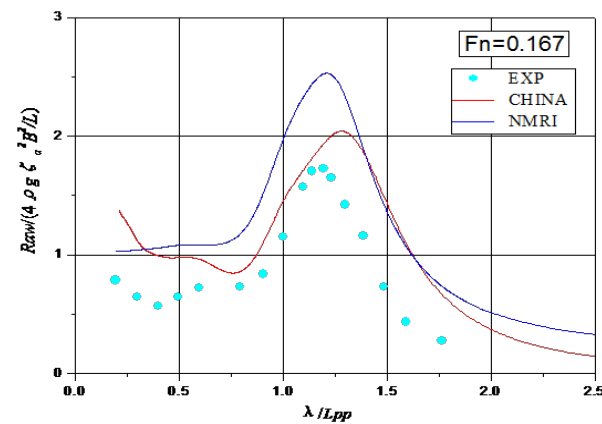
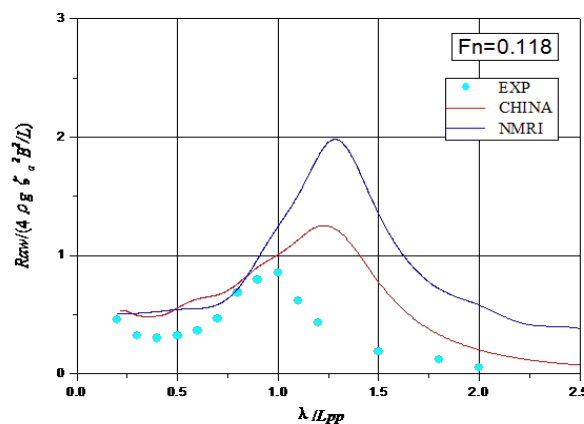
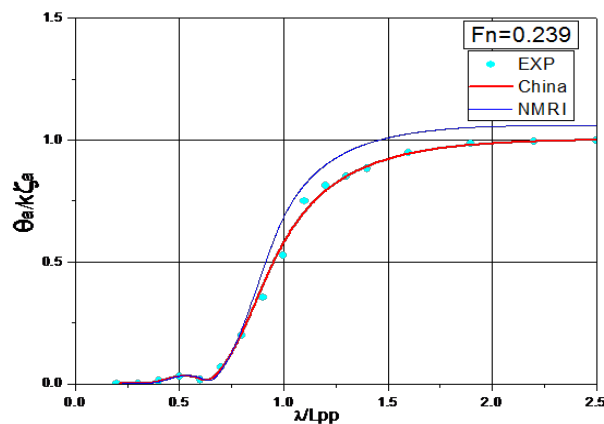
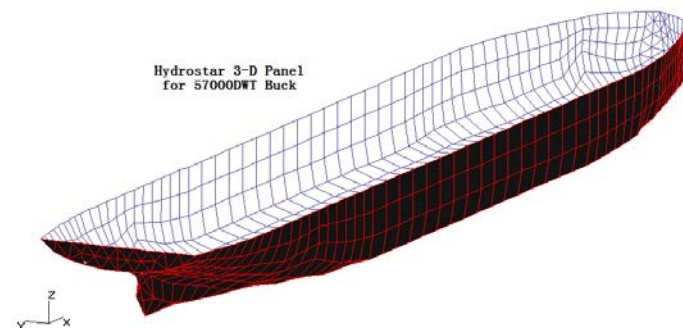
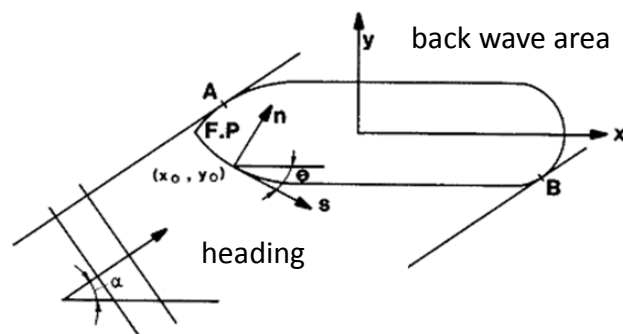
Research on innovative energy efficiency technologies

- Air Lubrication System
- Wind Propulsion System

China's research activities on MPP



- ◆ In house developed code for prediction of wave added resistance
- Improved STF strip method[DUAN & LI(2013)]



More consistent with the model test results.

China's research activities on MPP



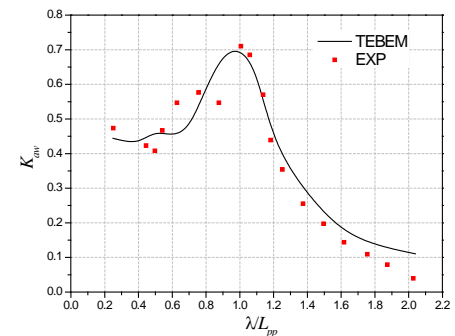
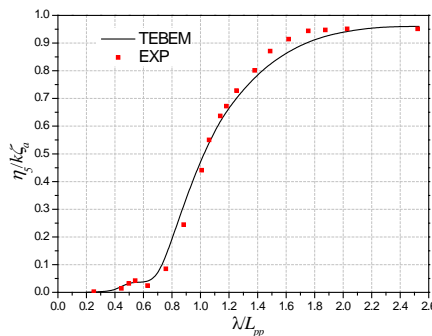
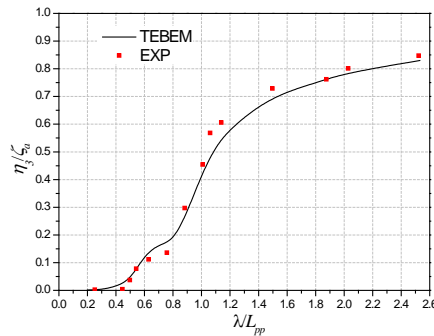
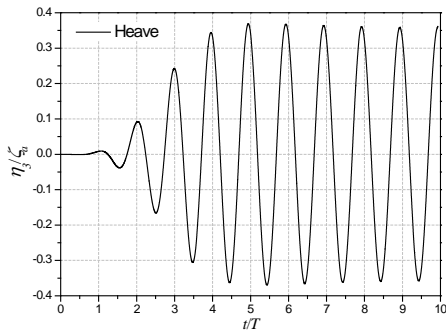
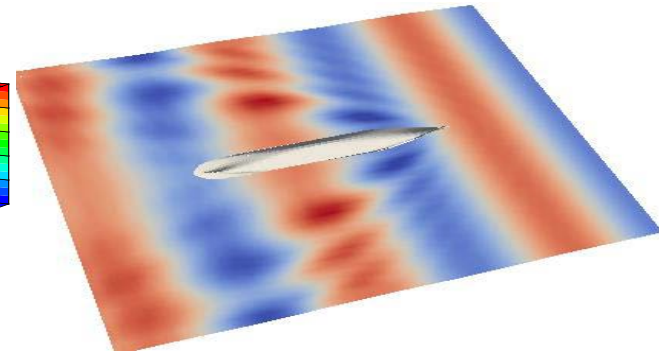
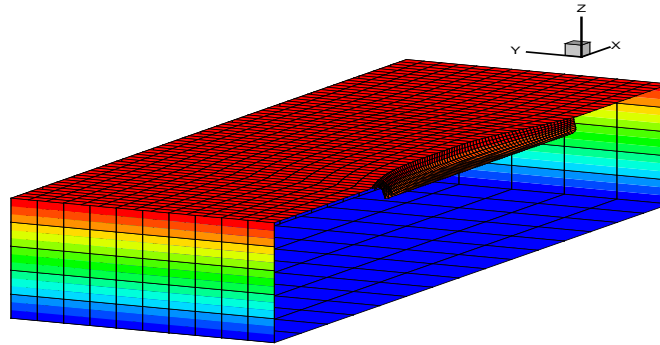
- ◆ In house developed code for prediction of wave added resistance

Hybrid TEBEM method [DUAN & CHEN(2017)]

Objective: VLCC

Sea condition: BF8

Advance speed: 6.3kn

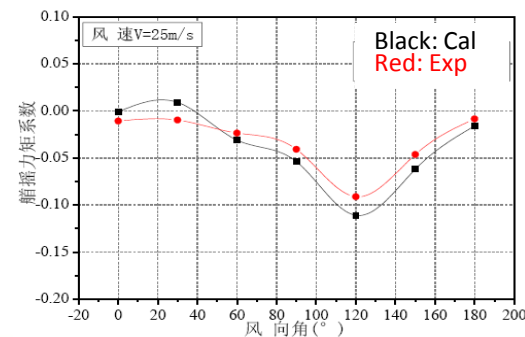
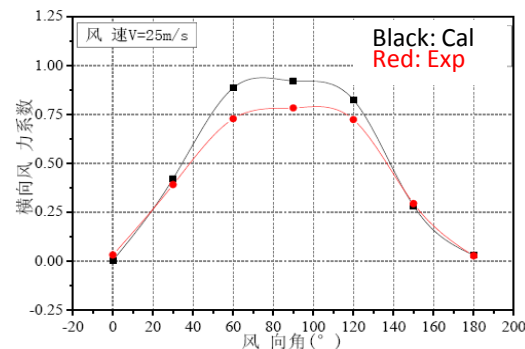
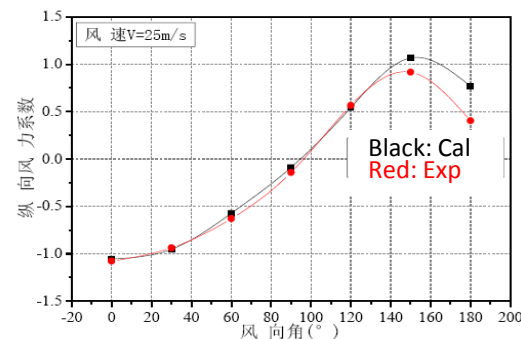
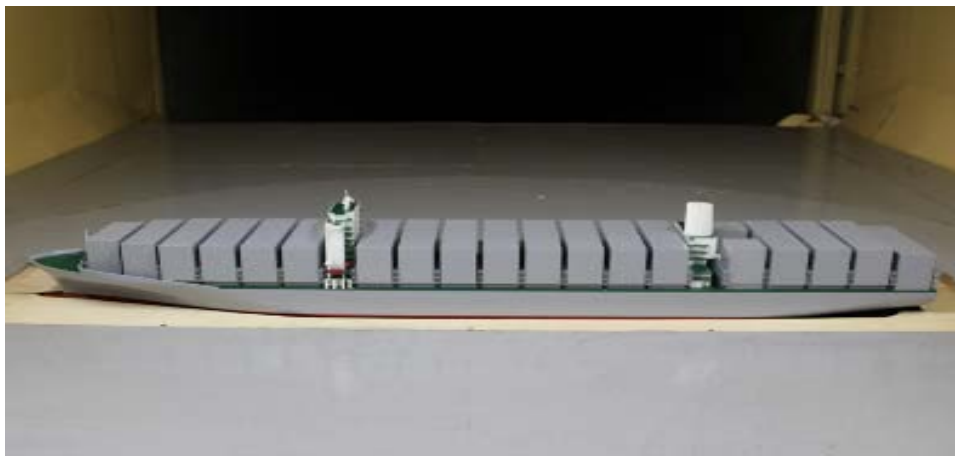
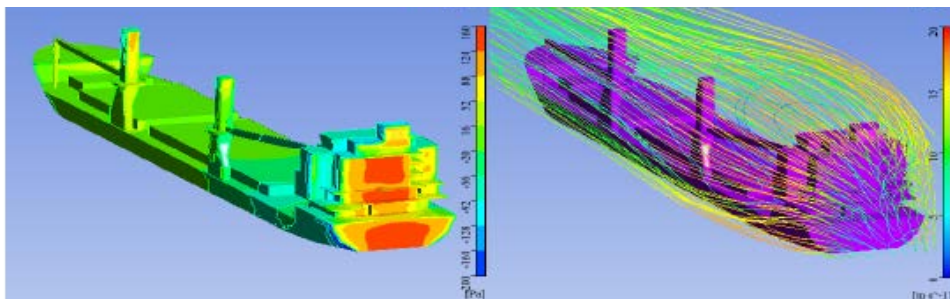


The proposed method can solve the inaccurate prediction for seakeeping performance of ships at low speeds in adverse conditions.

China's research activities on MPP



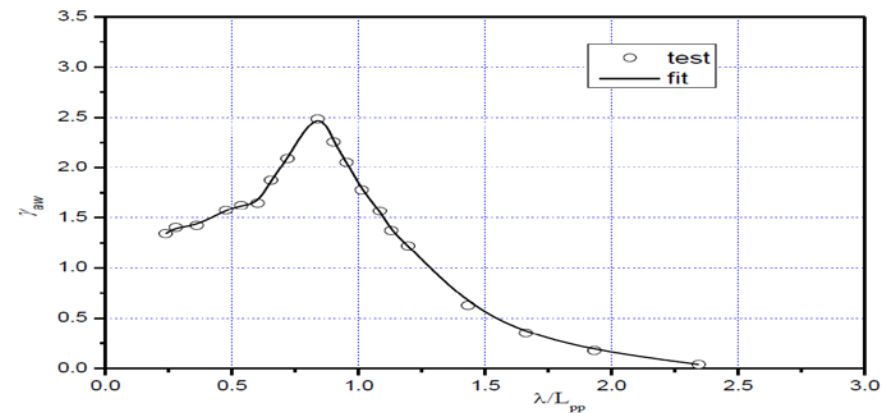
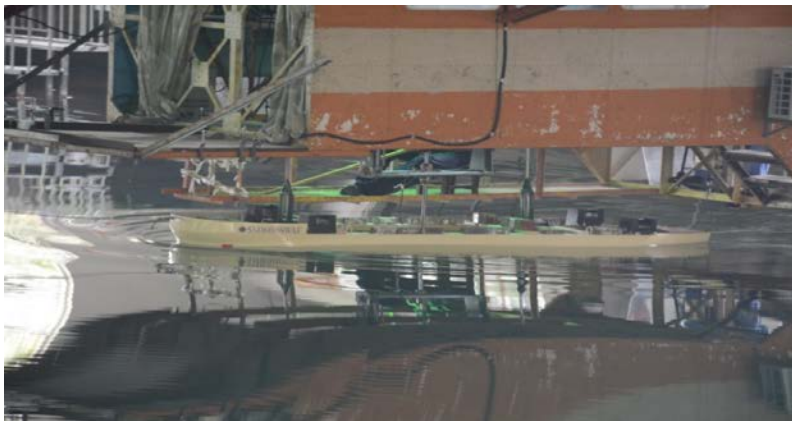
◆ Numerical prediction and experimental validation of wind resistance



China's research activities on MPP



◆ Model tests of seakeeping performance in regular waves

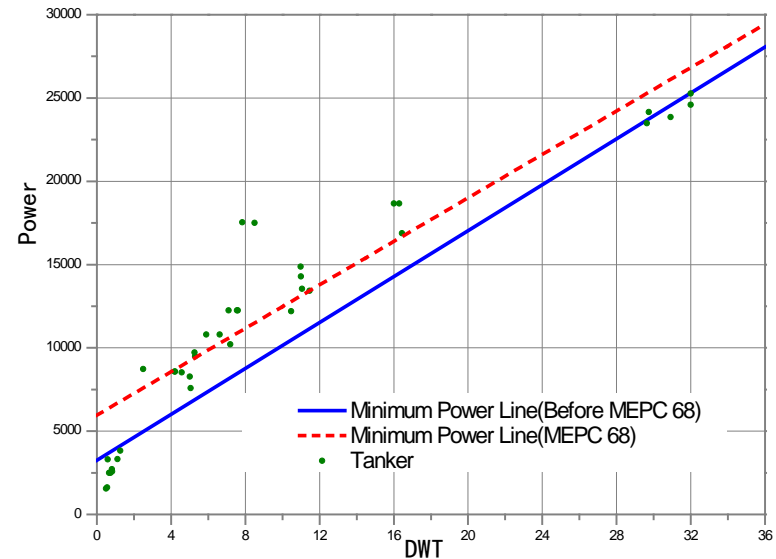
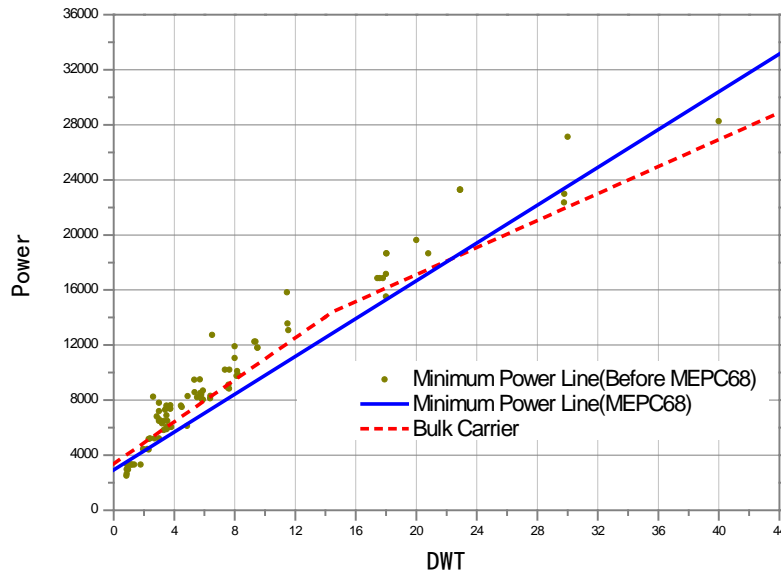


The model test of added resistance in waves at low speed for more than 30 tankers and bulks has been completed.

China's research activities on MPP



◆ Statistical analysis of assessment Level-1 for Minimum Propulsion Power

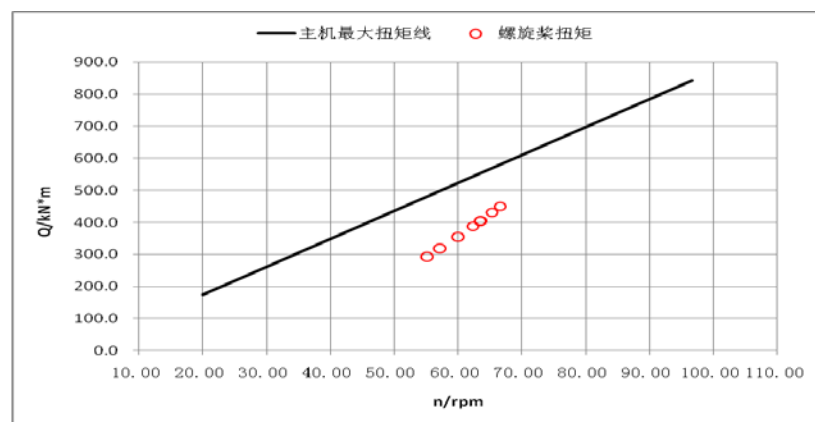
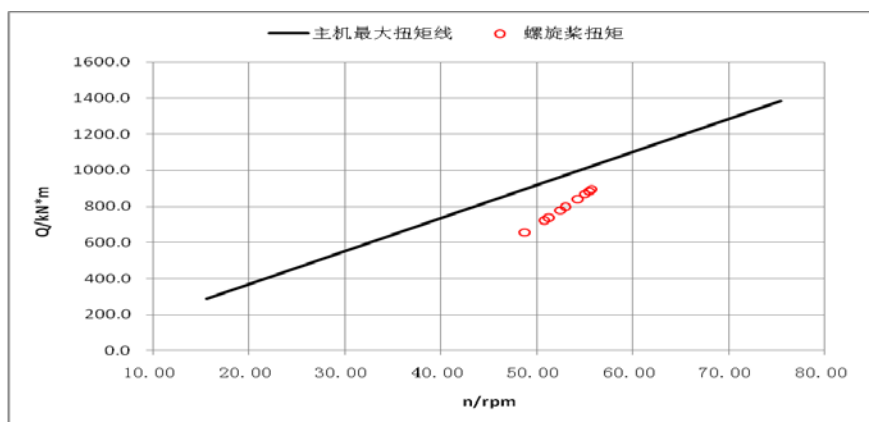
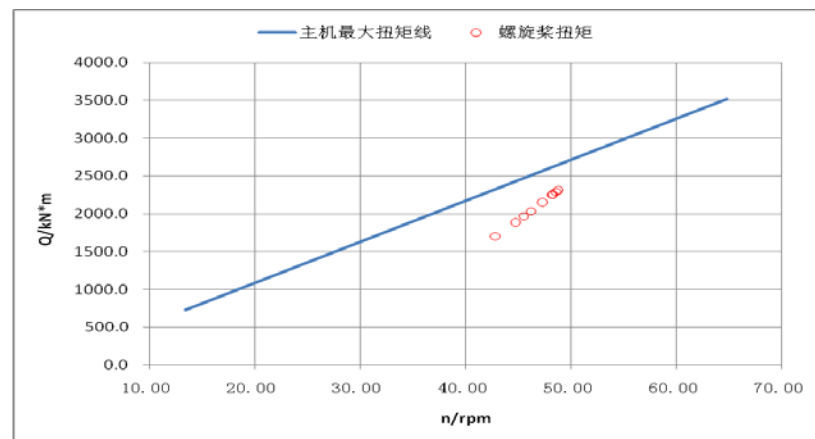
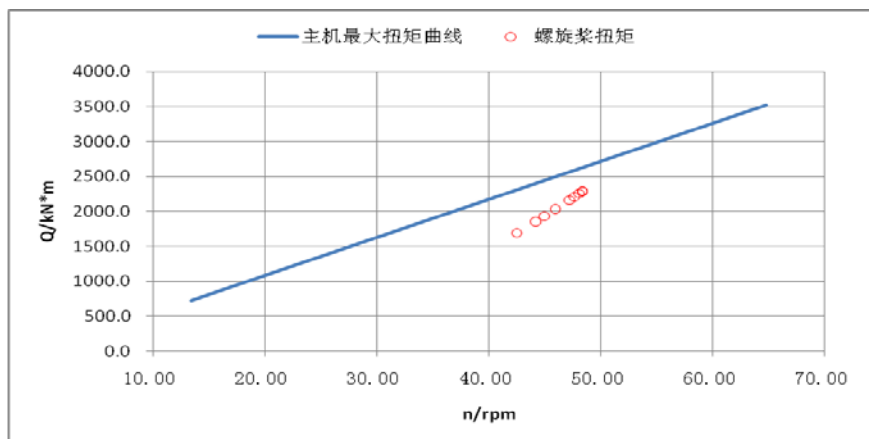


More and more tankers and bulk under 200 deadweight tons can not satisfy the assessment Level-1.

China's research activities on MPP



◆ Depth analysis of assessment Level-2 for new designed ships



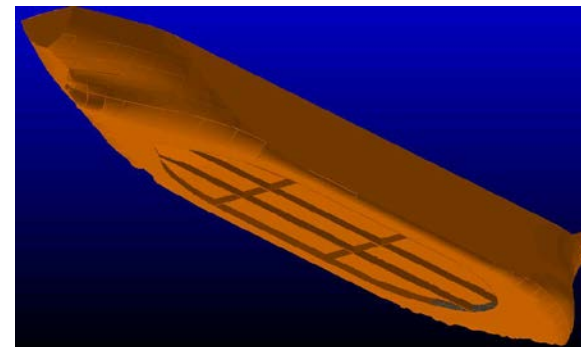
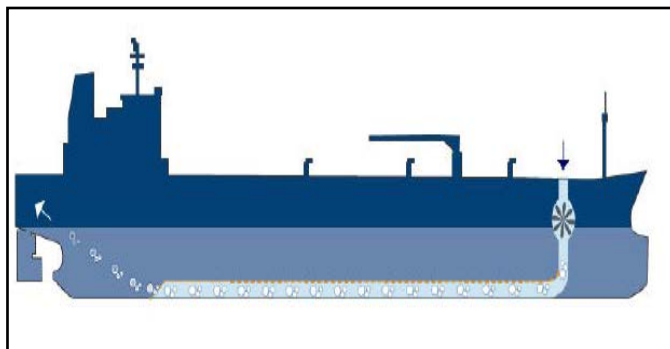
Most of the new designed ships could satisfy the assessment Level-2 by conducting model tests according to the Interim Guidelines.

China's research activities on MPP



◆ Innovative energy efficiency technology — Air Lubrication System

➤ Conceptual design:



➤ Large-scale model test and sea trial:

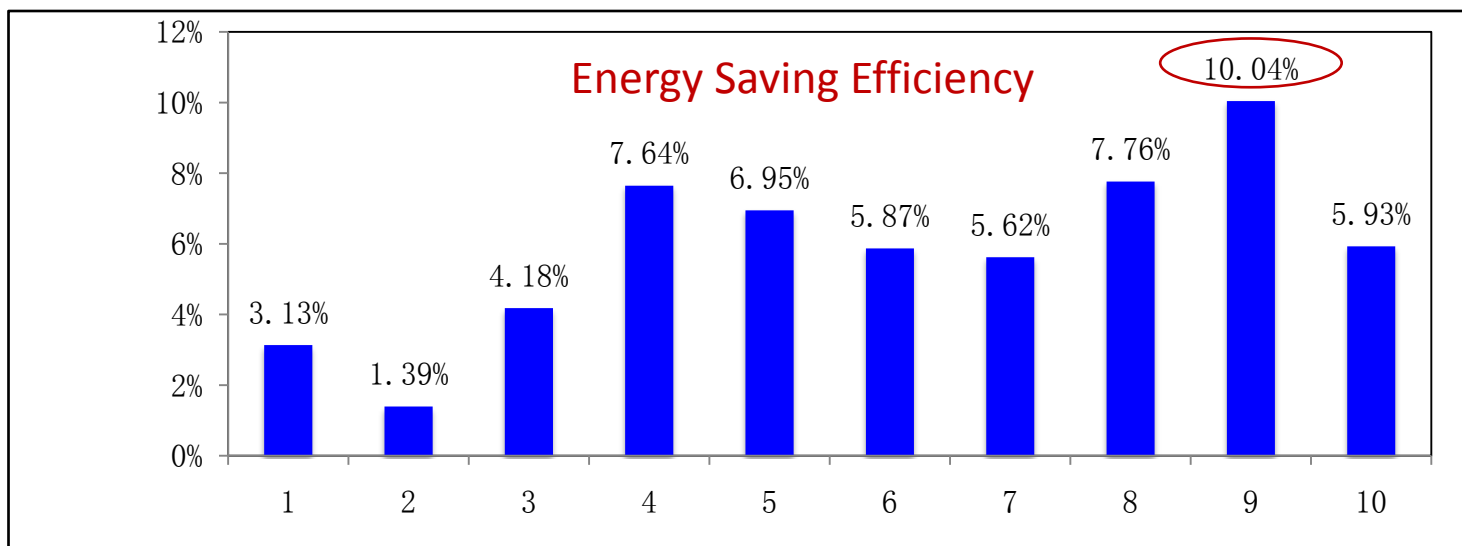
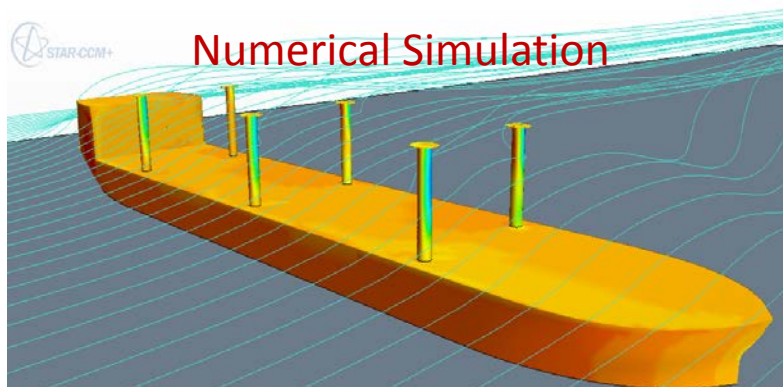


Conclusion: energy saving efficiency is about 7%.

China's research activities on MPP



◆ Innovative energy efficiency technology — Wind Propulsion System



China's research activities on MPP

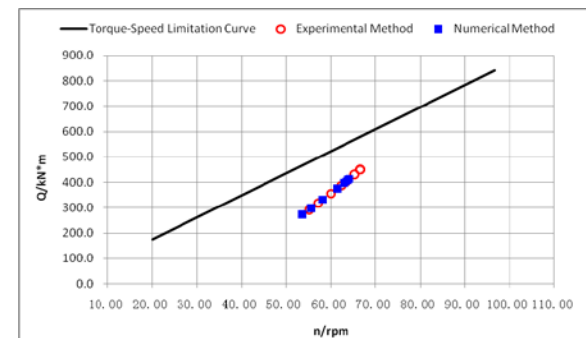
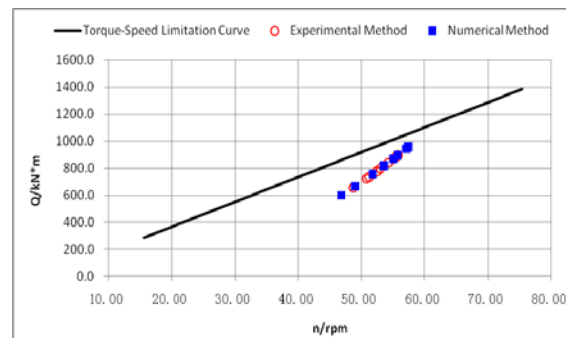
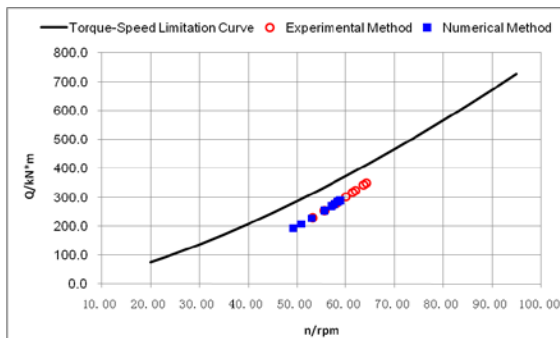


◆ China's proposals on MPP at MEPCs

MEPC 71 (2017)

China proposed amendments to the *2013 Interim Guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions* in the following aspects:

- .1 China is of the view that the value of thrust deduction factor should be obtained from required ship advance speed, while the Interim Guidelines seemingly estimate it with design speed, which is overestimated.
- .2 China also proposes a classical numerical method to calculate wave added resistance, can be used as an alternative option to obtain wave added resistance in the Interim Guidelines.



China's research activities on MPP

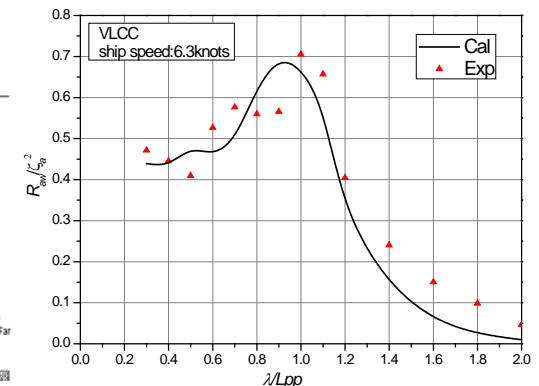
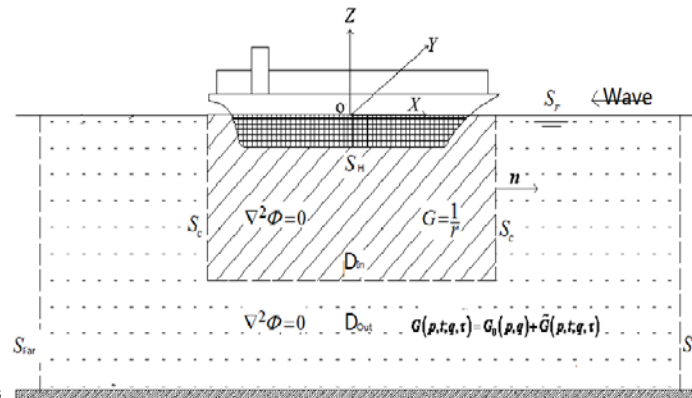
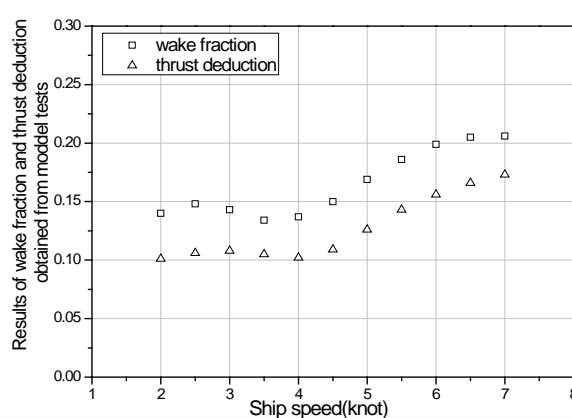


◆ China's proposals on MPP at MEPCs

MEPC 72 (2018)

Based on in-depth research, China proposed amendments to the *2013 Interim Guidelines for determining minimum propulsion power to maintain the manoeuvrability of ships in adverse conditions* in the following aspects:

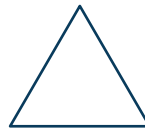
- .1 According to the results of self-propulsion test at low speeds, the values of thrust deduction factor and wake fraction obtained from the model test are fairly lower than these obtained from the Interim Guidelines.
- .2 China proposed a new numerical method for calculating quadratic transfer function of the added resistance in regular waves.



3

PART THREE

Summary





Summary



Summary

1. With the adoption of *Initial IMO Strategy on Reduction of GHG Emissions from Ships*, the requirement of EEDI will become more and more stringent, resulting in more obvious conflict between EEDI and MPP, and this is a great challenge for global shipbuilding industry.
2. China has the ability to participate in the formulation of energy efficiency and safety operation rules for ships, and is willing to develop technical cooperation with any other States around the world.
3. Innovative energy efficiency technologies could become a solution to GHG emission reduction target, and research on alternative low-carbon and zero-carbon fuels as well as Market-based Measures also very important.

Q&A

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