

# GATE RUDDER SYSTEM AS A RETROFIT FOR THE NEXT GENERATION PROPULSION AND STEERING OF SHIPS

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## Introduction

The project title “GATERS” stands for “GATE Rudder System as a Retrofit for the Next Generation Propulsion and Steering of Ships. The project promises the first retrofit application of a novel propulsion and manoeuvring device for ships, called “Gate Rudder System”. Taking advantage of the remarkable fuel saving (max of 14% in trials and 30% in-service) and excellent manoeuvrability of the gate rudder system, GATERS demonstrates significantly reduced emissions from ships particularly within coastal and port areas to challenge and even exceeding the current and future legislative requirements of the IMO and local regulations for emissions.

## Gate Rudder System

- “Gate Rudder”, a twin rudder system with two rudders at each side of a propeller.
- Two individual, asymmetric cambered blade system efficiently accelerated propeller flow. The duct effect provides additional thrust and hence power saving.
- The remarkable flap effect increases the lateral forces and the yaw moment leading to improved steering and course keeping capabilities

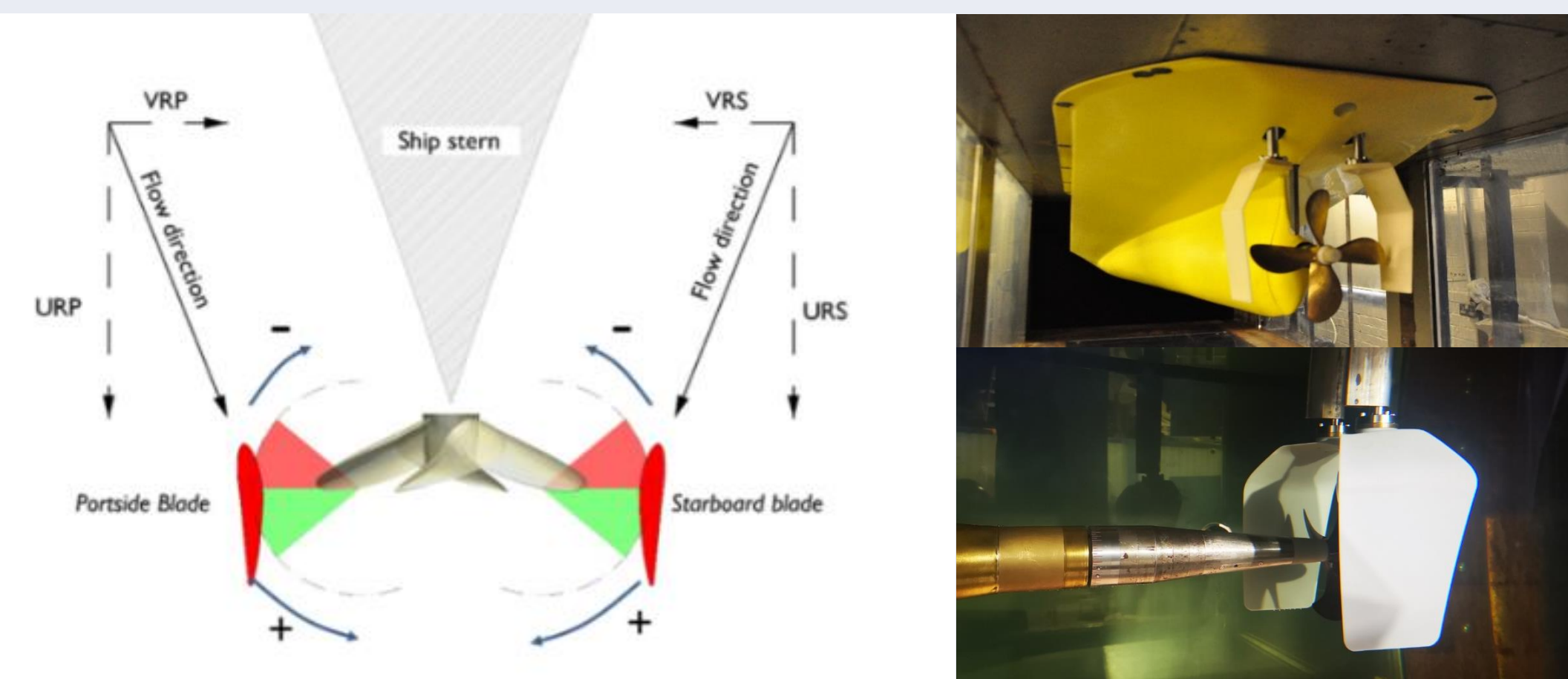


Figure 1: The integral and experimental arrangements of gate rudder system

The Gate Rudder propulsion system was installed on a 400TEU domestic container ship ‘SHIGENOBU’ in Japan for the first time. Meantime, a sister ship ‘Sakura’ was installed Conventional Rudder system.



Figure 2: Retrofit GATE RUDDER and its counterpart conventional single rudder on Japanese twin container vessels

## Results and Discussion

### ➤ Induced velocity due to Gate Rudder, improve the propeller efficiency

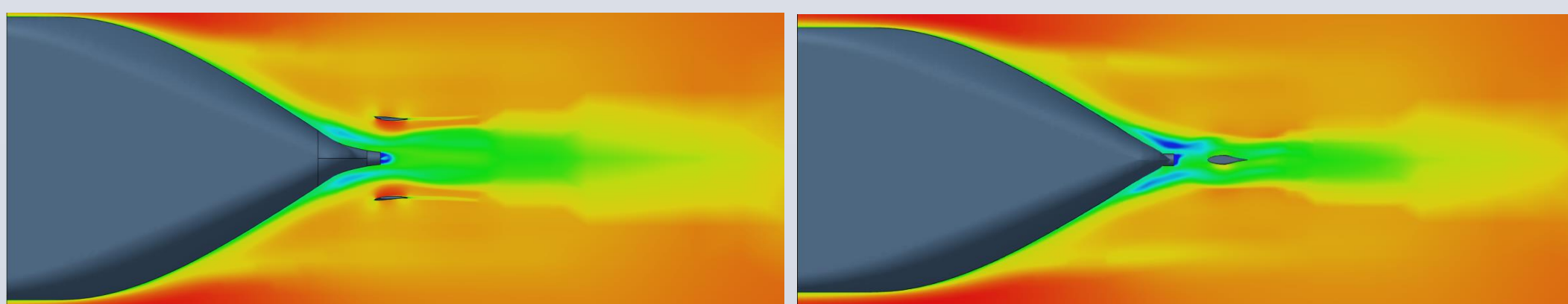


Figure 3: Velocity magnitude around Gate Rudder (left) and Conventional Rudder (right)

### ➤ Remarkable fuel saving (up to 14% in trials), especially in-service and rough weather (up to 30%)

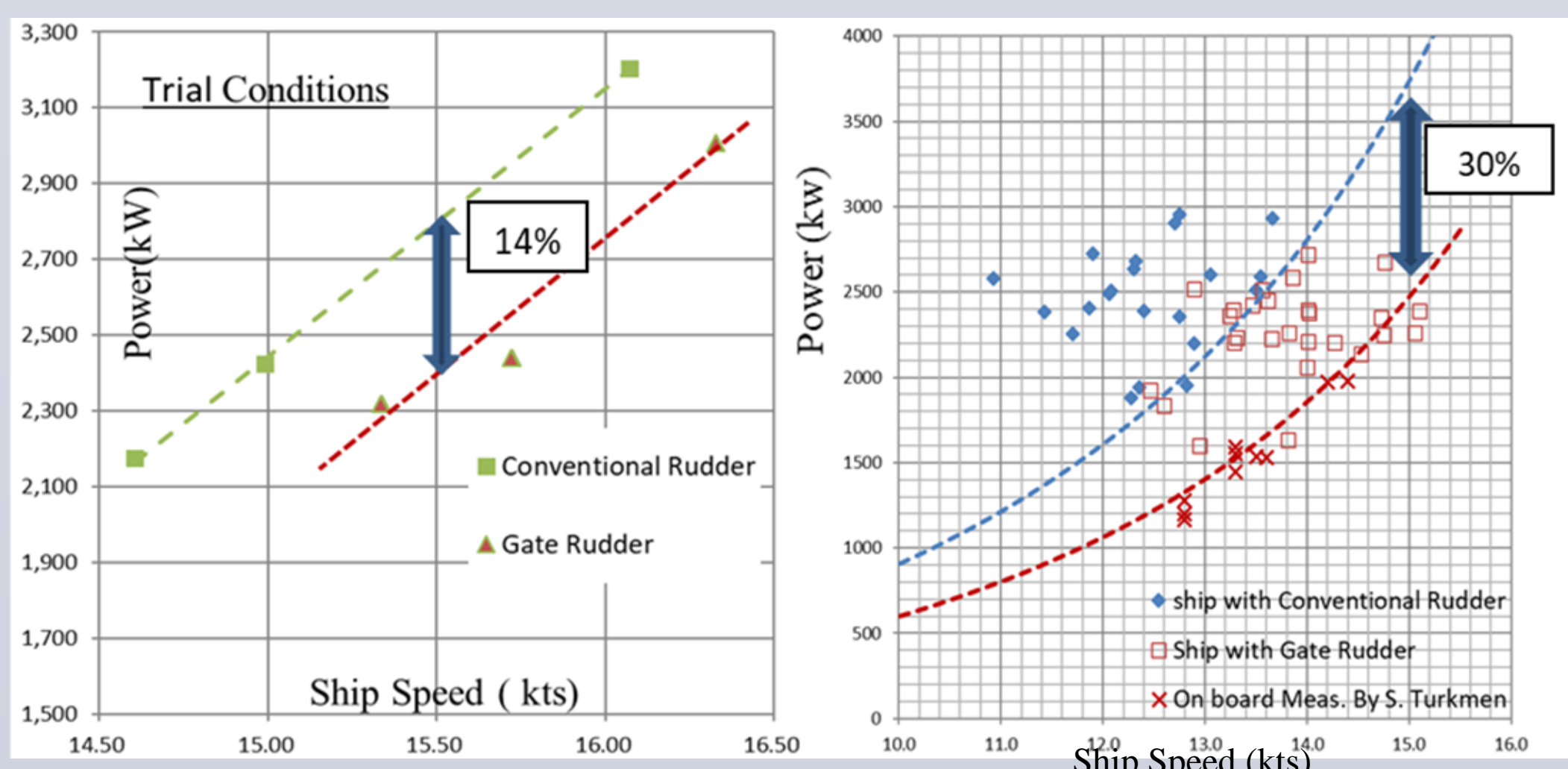
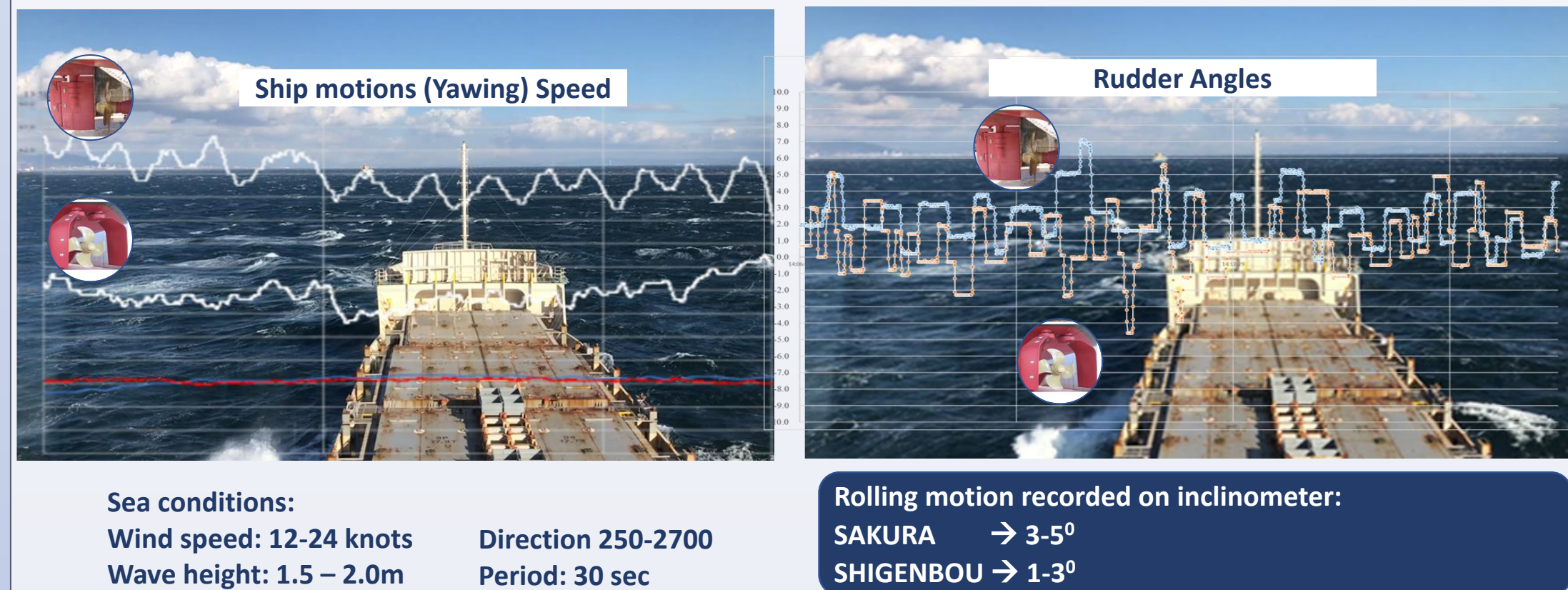


Figure 4: Trials (calm water) and in-service (including rough weather) powering performance comparisons of two sister ships: one Shigenobu with Gate rudder system vs. Sakura with Conventional flap-rudder system

### ➤ Reduced vessel motions (in yawing and rolling) in waves



### ➤ Improved steerability and manoeuvring (especially in harbours) without stern thrusters

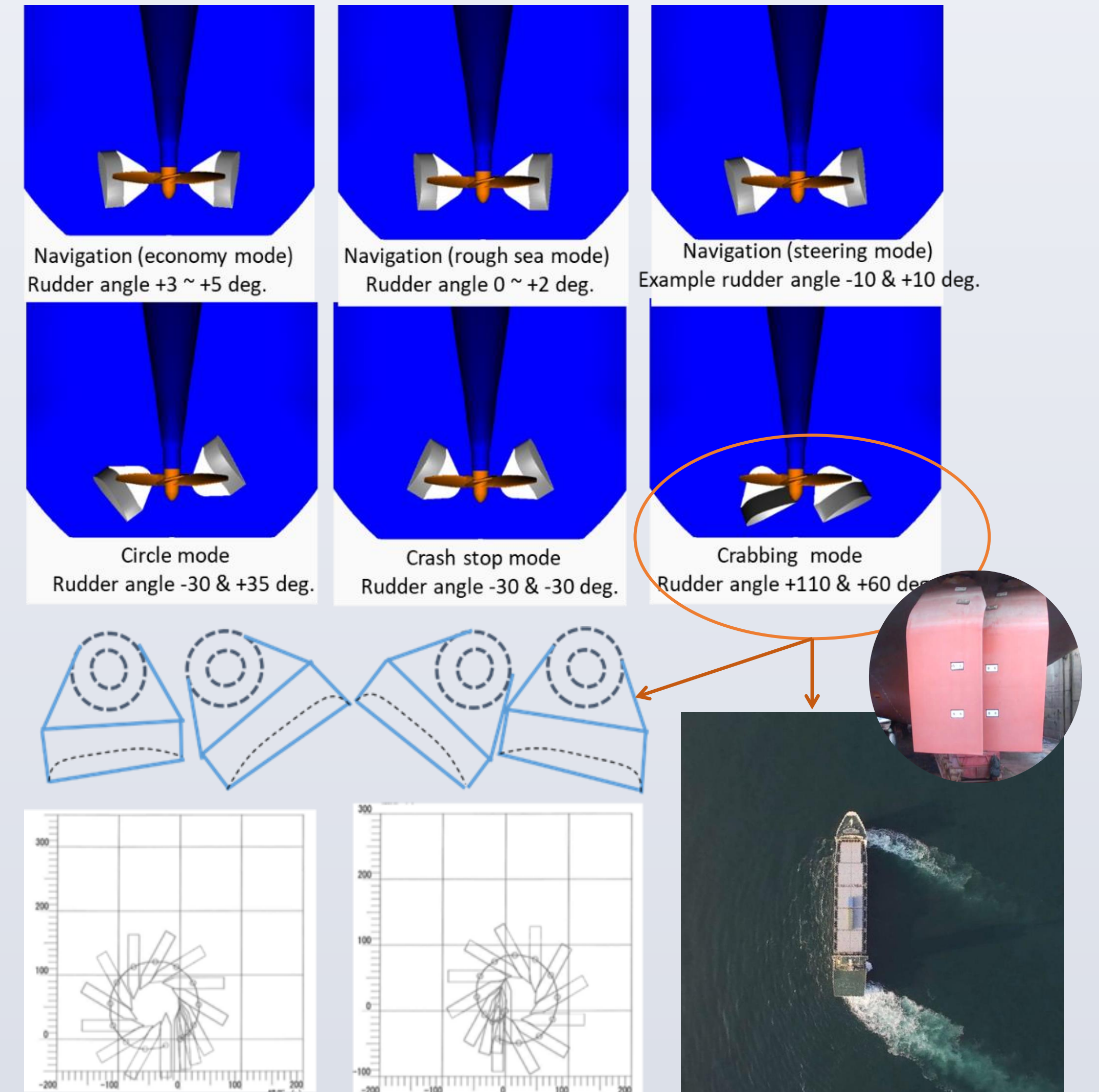


Figure 5: Increased manoeuvring ability with Gate Rudder System

### ➤ Reduced vibration and Underwater Radiated Noise (URN) (up to 15dB)

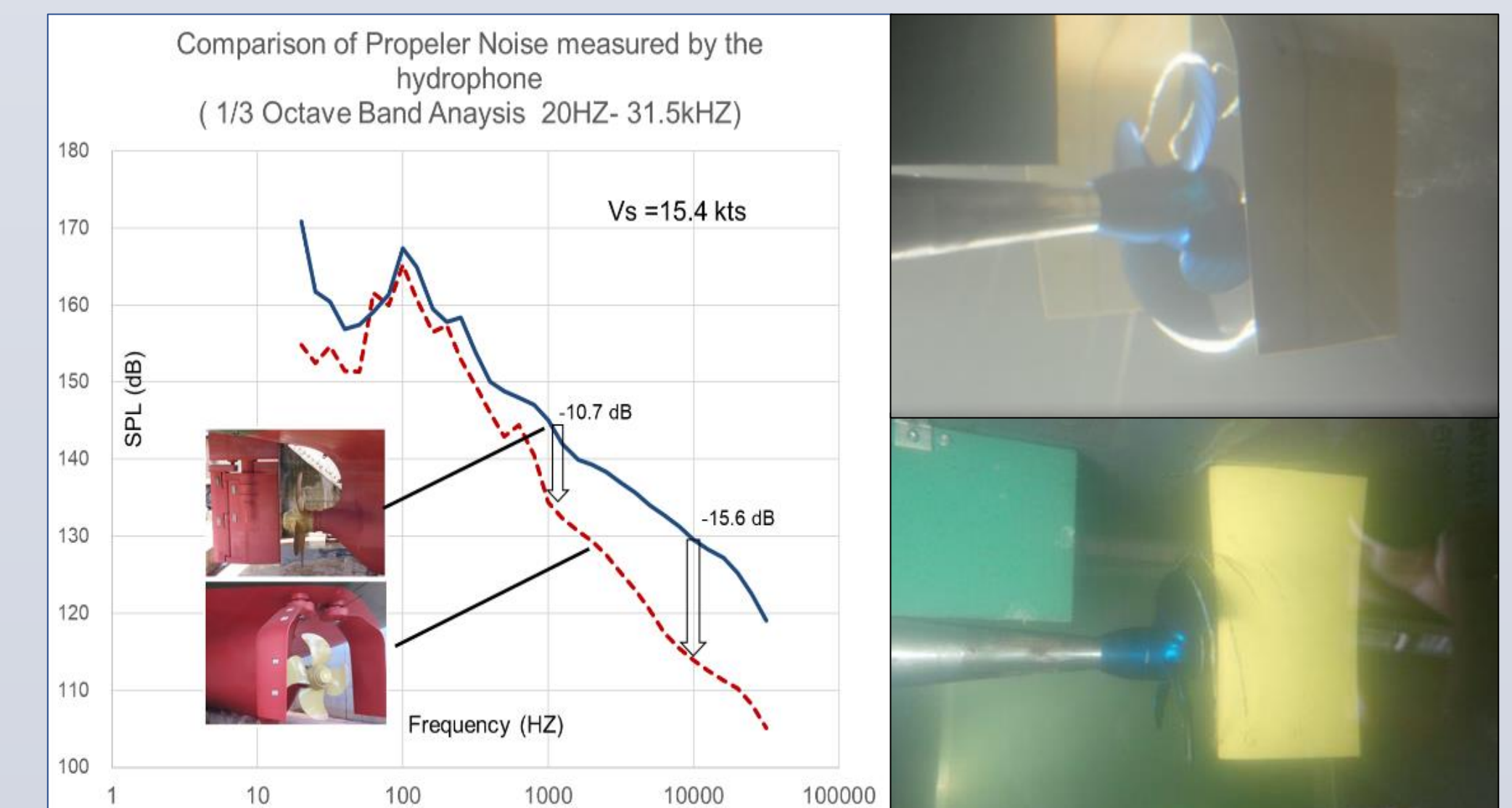


Figure 6: Comparative Underwater Radiated Noise (URN) levels of Sakura (CRS) and Shigenobu (GRS) from trials

## Benefits of Gate Rudder

- Reduction on CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub> and PM pollution due to the improved propulsion efficiency by GRS as reflected on the fuel-saving, particularly around ports, terminals, urban and coastal regions.
- Enable integration of large high power marine fuel cells into ship design and demonstrate their feasibility, cost-effectiveness and identify technical barriers to adoption.
- Significantly, increase the take up of retrofit emission reduction solutions in existing vessels. Superior Steering; Comfort Operation; Reduction of noise and vibration/
- Safe Operation-Performance in waves; Remarkable energy saving