Photo from the left:
Takayuki Miyaji, The Vice-Chief, Kobe Shipbuilding & Repair Department, Shipbuilding & Ocean Development
Kentaro Kuroda, Acting Manager, Designing Section, Kobe Ship & Ocean Business Department, Shipbuilding & Ocean Development
Masataka Azuma, Acting Manager, Hull & Engine Outfitting Shop, Kobe Shipbuilding & Repair Department, Shipbuilding & Ocean Development

Sea Trials — A Trying Time for New Ships

Engineers' Passion to Perfect Engine Performance

If, for any reason, a ship's engine was to fail during a voyage, the ship would be nothing more than a gigantic drifting hulk, with the ship's owners suffering huge losses as a result. No matter what happens, the engines must not fail. Freight distribution must not be halted. To that end, skilled engineers have no choice but to go to sea and test for themselves performance under extreme conditions. That important mission is the final test: the sea trials. Here three men provide an insight into sea trials: Takayuki Miyaji, who has spent many years supervising sea trials as chief engineer; Kentaro Kuroda, who manages the design of the engine propulsion system, focusing on the engine; and Masataka Azuma, who supervises the engine propulsion system as a whole at the shipbuilding site.

The Grueling Crash-Stop Astern Test

Of the performance checks these men conduct, the most dramatic is the crash-stop astern test. While the ship is underway, at an order from the captain or chief engineer, the ship's propeller is put into reverse — in effect, jamming on the brakes. The test is conducted under the assumption of conditions necessitating an emergency stop in order to avoid a collision — the kind of situation that may not occur even once during the ship's lifetime. "We set the propeller running full-astern, putting on the brakes," says Kuroda. "The engine produces enormous amounts of horsepower, turning the 6.6m diameter propeller at a rate of 100 revolutions per minute, so when we throw it into reverse, there's a thunderous roar fit to blow off the turbocharger. It's enough to make the ocean surface bubble, changing it from deep blue to white foam." Kuroda joined the company about 18 years ago and has been supervising the design of engine propulsion systems ever since. He speaks quite calmly when he talks about this tense moment. You can hear the confidence that comes from an engineer with wide-ranging experience. Is there not a chance that this excruciating test will damage the engine? "The shaft that joins the engine to the propeller is over 50m long, but is positioned with great precision within a tolerance of 1/100th of a millimeter. The engine, propeller and shaft core are designed to handle the stress placed on them by sharp turns and similar maneuvers, so none of them so much as flinch." Kuroda, Azuma and the others speak with pride of the capability of the engine rooms they build together.

"We carefully calculate the output on paper, and we also perform tests on the engine, pumps and other components as single units. However, we can't say that the ship is complete until we've attached the shaft and propeller to the engine and turned them, testing whether the machinery functions properly as a whole," Kuroda explains.

A car carrier that recently completed its sea trial was some 200m long and 40m high. The ship was huge, capable of carring 5,200 passenger cars. It was composed of several tens of thousands of types of equipment, and over 200,000 parts; more than 6,000 sections of piping were used in the engine room alone. These gigantic vessels are precisely assembled from an almost unimaginable number of components, and sea trials are used to test whether all parts work together smoothly as a single system on the open ocean, safely and with the expected performance.

Checking Everything to Guarantee Safety and Peace of Mind

The engine room, the seat of the engine itself, is at the stern. The room is below the waterline and has no windows. The environment is the complete opposite to that of the wheelhouse, where one can look out over the expanse of ocean, but it here that the ship's heart is located. "The temperature in the engine room reaches over 40 degrees Celsius; in the rainy season, it's sweltering. The engine is as tall as a three-story building, and its roar tops 90 decibels, so it's impossible to stay there long without ear plugs," says Azuma. In that situation, engineers carefully perform final adjustments and maintenance on the engine and individual pieces of equipment according to directions from the engine control room.

During the test, Miyaji, Kuroda and Azuma take up their positions in the engine control room, using the monitors to check fuel, water temperature and pressure, fluctuations in combustion efficiency, and other indicators of the operating state of the equipment. If there are any irregularities, alarms sound. A wall separates them from their companions performing the checks in the engine room, so contact must be made via transceiver. Relying on their colleagues' voices, they must guess at and identify the cause of the irregularity, then make a series of swift adjustments.

Most irregularities are within the scope of assumption. "During sea trials, the accumulated precision of all the work done so far becomes clear. When alarms just keep sounding, it's one tense moment after another; on occasion, we've been frustrated because we couldn't finish making adjustments before the sea trials," says Azuma. In this way, by checking every detail and resolving problems while out on the ocean, safety and peace of mind are guaranteed. In the very last run of the trial, not a single alarm sounds.

Birth of a Ship and Its Upbringing

The stage for sea trials is the majestic open ocean. The weather factor is significant, and trials occasionally take place in extraordinarily harsh conditions. Miyaji recalls one unforgettable such experience. A front that had looked set to pass through settled in, and they were hit with bad weather. The ocean was rough, and the waves were so high that the propeller broke the ocean's surface. "We wanted to carry out a speed trial, but we couldn't get the engine's speed of rotation up because of the storm. That said, when we stopped, the ship began to roll. We had no choice but to keep the ship underway until the front passed through." However, if they were going to keep the delivery date, they would not be able to put out to sea for another trial. Under pressure, Miyaji flexibly changed the plan, solving the problem by switching the order of the tests and making other adjustments to the schedule. Despite the crisis, they managed to carry out all the tests and return to the shipyard very nearly on schedule. "When we made it through that, I felt like I'd finally reached the pinnacle of success. It felt so good to have correctly gauged how the schedule needed to be changed," he says, laughing about this struggle that could happen only to a chief engineer.

About the sea trial, Azuma says, "It's a real pleasure to be able to confirm the results of a job you've all worked on together. Sometimes the ship owner will say a few words to you to express his gratitude as well; I think it's an occasion to be valued."

Kuroda adds, "It's tough. You get tense over events you didn't see coming, and things happen that cause you trouble. Even so, it's great when you manage in the end to resolve them, and the solutions get incorporated into the next design."

In the case of merchant vessels, the construction period spans about two years, from the beginning of the design phase to final delivery. During this period, there is an important event known as the 'ship's birthday' — the first time the ship touches water at its launching. The subsequent sea trials, implemented as part of the process of seeing the ship to maturity, is a very important process: 'we're sending this child of ours out to sea for the very first time.' The knowledge and know-how gained here will be put to use in building ships that are even safer and more reliable in the future.

Kobe Shipyard and Machinery Works, with members of the Shipbuilding and Repair Department involved in sea trials

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