A New Hope for Energy Issues

Introducing a Seismic Vessel with a Unique Hull Form

A Special Hull Designed for More Efficient Surveys of Oil and Natural Gas below the Seabed — Realized Using MHI Technology.

Ms. Hege Renshus of PGS wearing a Norwegian folk costume at the christening ceremony where cutting of support cables was conducted.

A Seismic Vessel that Demands a Closer Look

On April 26, 2013, at the Nagasaki Shipyard & Machinery Works, a state-of-the-art seismic vessel was christened the "*RAMFORM TITAN*." The vessel's distinctive triangular hull, called 'Ramform,' caught the attention of the large number of visitors at the christening ceremony.

The vessel is 104 meters long with a breadth 70 meters wide and is specially designed for more efficient 3D seismic surveys. Its completion drew upon all of MHI's wealth of shipbuilding experience and advanced technologies, including 3D design*.

The vessel was built for Petroleum Geo-Services ASA (PGS), a major natural resource survey company in Norway specializing in offshore oil and gas fields that has supported seismic surveys for the Japanese government. The vessel is the first 5th generation Ramform fleet series vessel and will start seismic surveys in the North Sea in the summer of 2013.

Complex Hull Takes Shape through MHI Know-How and Synergies

This vessel will conduct seismic surveys using acoustic waves (also referred to as seismic waves). Air sources emit acoustic waves that strike the seabed and strata boundaries and bounce back as echoes. These echoes are detected by sensors inside multiple streamer cables several kilometers in length that are towed from the vessel's stern. When the data from these cables is processed and analyzed by computer, it is possible to identify likely oil or natural gas below the seabed.

In the past, the main seismic survey method was single-cable 2D seismic survey, which could render only cross sections of underground structures. The method was improved by adding more cables to increase the amount of data that could be gathered, resulting in 3D seismic surveys, in which the cross sections are replaced by 3D images of underground structures.

Adding more cables also allows vessels to explore a wider area of the seabed, improving efficiency and safety. This vessel can be equipped with 24 cables, and its stern width has been increased from the 40 meters of PGS's previous series of vessels to 70 meters.

Although the unique shape and concept for this seismic vessel were devised by PGS, the vessel was realized using MHI technology, from basic design to completion.

3D design played a particularly important role. The new vessel had to comply with the rules and regulations stipulated for this kind of vessel despite its unusual shape, requiring many pipes, wires and other equipment to be installed in flat, subdivided sections. This complex design had to be implemented in a short time frame, and 3D design was used to create a high-density plan in which an array of equipment could be positioned close together while avoiding interference between pipes or between pipes and structural elements of the hull.

Measures to counteract vibration and noise are very important when constructing this type of vessel. To that end, the Vibration Laboratory and the Fluid Dynamics Laboratory at Technology & Innovation Headquarters worked closely with the design team from the outset. The synergy produced by specialists from each field working across divisions resulted in vessel performance that not only met but surpassed PGS's requested specifications. This outstanding cooperation between the design and manufacturing departments and the in-house research facilities played a vital role in the successful completion of this unique vessel.

Growing Hopes for the Resolution of Energy Issues

The economic development of emerging nations has meant growing demand for such resources as oil and natural gas. However, the limited onshore resources could eventually become exhausted, and their uneven distribution in just a few regions, including some areas considered politically unstable, is problematic. In an attempt to resolve these issues, more effort is now being focused on searching for, discovering and excavating offshore resources. This trend has created rising demand for seismic vessels. For example, the number of vessel exploring the seabed using acoustic waves increased from 156 in 2010 to 163 in 2011, and the market is steadily expanding.

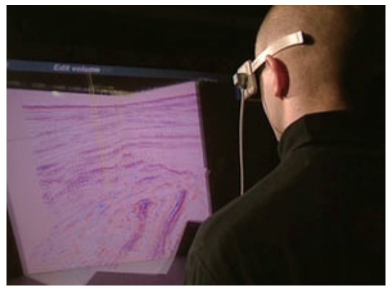
As needs change and the demand for seismic vessels increases, MHI will leverage the experience gained in this project, seeking orders and promoting sales of 3D seismic and other specialized vessels. As more of these ships survey the world's oceans, there are high expectations that they will contribute to resolving the energy problems we face.

The vessel was built at the Koyagi Plant at Nagasaki Shipyard & Machinery Works.

*A design method that allows drafting of 3D plans, in contrast to 2D plans drawn on a flat surface.

■Geophysical exploration analysis

Air sources produce acoustic waves that bounce off the seabed and are picked up by sensors.



Data from multiple sensors is analyzed to visualize the structure of the seabed in 3D.

Stern of the *RAMFORM TITAN*. The streamer deck at the vessel's stern can house 24 streamer cables.

Overcoming Difficulties with Help from the Laboratories

MHI handled this project from basic design to completion, and the manufacturing process was challenging. The ship's unique hull form was one of the reasons.

One of the biggest problems was propeller cavitation*. To suppress noise emitted underwater, propellers that would not induce cavitation were necessary for this vessel. However, at a stage when the design had progressed substantially, it became apparent that cavitation could not be completely eliminated. To resolve the problem, it was not just the propeller design but the hull form around the forward vicinity of the propellers that had to be rethought— even though it was very nearly time to begin construction. A new design proposal had to be developed right away, so help from the Fluid Dynamics Laboratory at Technology & Innovation Headquarters was requested. Several researchers started working together immediately, implementing everything from modified design proposals to effect verification, and created a cavitation-free design. PGS told us we had solved their problem.

Seismic vessels are vital in opening up the sea floor frontier, and we believe they can contribute to the resolution of energy issues. This vessel, which required advanced design and manufacturing know-how, has enabled us to improve our shipbuilding technology. I would like to continue working hard so that MHI's technologies can contribute to a prosperous future for all mankind.

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*When the speed of water flowing over the propeller surface changes, pressure on certain areas of the propeller drops. This difference between local and surrounding pressure results in faster vapor bubble formation and collapse.