

## World's First Loading Arm for Ship-to-Shore Transfer of Liquefied Hydrogen

Tokyo Boeki Engineering, Ltd. (TEN), Kawasaki Heavy Industries, Ltd. (Kawasaki), Japan Aerospace Exploration Agency (JAXA), and Japan Ship Technology Research Association (JSTRA) developed the world's first loading arm for transferring liquefied hydrogen (LH<sub>2</sub>) from a carrier to an on-shore storage facility, as part of the Cross-ministerial Strategic Innovation Promotion Program (SIP)\* led by the Cabinet Office of Japan.



Hydrogen has been attracting global attention as an energy source that releases no CO<sub>2</sub> when used, just as solar, wind, and other renewable energies do not. Various initiatives are underway to broaden its applications, such as fuel cell cars and hydrogen power generation. Against such a backdrop, Japan has committed itself to achieving low-cost utilization of hydrogen. One such initiative has been construction of an ocean-going LH<sub>2</sub> carrier and a handling terminal needed in order to build a global hydrogen supply chain by which mass procurement and distribution of hydrogen will be possible. When completed, the supply chain will provide hydrogen produced from renewable energies, as well as from unused energy resources available outside Japan which integrate CCS (carbon dioxide capture and storage) into the hydrogen production process.

Because marine transport of LH<sub>2</sub> by a dedicated carrier is unprecedented, the four organizations have developed one of the key components for connecting carriers and on-shore terminals — a loading arm for LH<sub>2</sub> transfer. Since the temperature of LH<sub>2</sub> is lower than the liquefaction temperature of oxygen, using loading arms which were designed for liquefied natural gas (LNG) and developed based on earlier technology would run the risk of fire, because during LH<sub>2</sub> transfer, liquid oxygen (LO<sub>2</sub>) may be generated on piping surfaces. To prevent such generation, a structural design has been developed that provides high thermal insulation performance and ensures safety.

\*The Cross-ministerial Strategic Innovation Promotion Program (SIP) is a national project led by the Cabinet Office for achieving scientific and technological innovations. This development project was conducted between October 2014 and March 2019 as one of the themed projects under the "Energy Carrier" program of SIP, entitled "Development of Cargo Loading/unloading System for Liquefied Hydrogen and the Relevant Rules for Operation."

## World's Largest GTG Plant Launched in Turkmenistan

In June Kawasaki launched the world's largest gas-to-gasoline (GTG) plant for State Concern Turkmengas, Turkmenistan's state-owned gas company headquartered in Ashgabat. The engineering, procurement and construction (EPC) contract was signed in August 2014, and Kawasaki fulfilled the main role as the consortium leader, with the support of its partner Renaissance Heavy Industries, a Turkish construction company registered in Ankara. This GTG plant is located in the Ovadan-Depe area, on the north side of Turkmenistan's capital Ashgabat. As the consortium leader, Kawasaki assumed responsibility for overall project supervision and control, plant engineering, and equipment supply. Kawasaki also cooperated with Sojitz Corporation on project implementation.

The plant is based on an advanced technology developed by Haldor Topsoe,

a Danish company providing chemical process technologies and catalysts, the GTG plant is the only one of its kind worldwide that produces 600,000 tons annually of high-quality gasoline from natural gas. In this plant, gasoline is produced from methanol synthesized from natural gas. Gasoline produced at the new plant contains no heavy metals, so no toxic substances are emitted during its combustion. Moreover, because the gasoline is 100% chemically synthesized from natural gas, it contains only small amounts of sulfur and other impurities and thus

meets strict environmental standards in countries around the world.

Turkmenistan boasts the world's fourth largest reserves of natural gas, and in addition to exporting this gas, in recent years the nation has focused its efforts on producing improved, value-added natural gas products as well. This recently completed GTG plant, along with a fertilizer plant completed by Kawasaki in 2014 in the eastern Turkmen city of Mary (annual urea output: 640,000 tons), has been highly praised throughout Turkmenistan for its contributions toward achieving high value-added products using natural gas resources.



## Kawasaki LNG Floating Power Plant Obtains AiP from DNV GL

Kawasaki has developed an LNG floating power plant equipped with its own high-efficiency power generation equipment. Its gas engine model has obtained Approval in Principle (AiP)\* from DNV GL\*\* based on its "Gas Power Plant" rules which were introduced in 2018.

An LNG floating power plant is an integrated system in which LNG fuel tanks, LNG regasification unit, power generation equipment and switchyard are all outfitted on the hull. It is towed on the sea or river and then moored at the installation site, where it generates power on the hull that is then supplied to the onshore power grid.

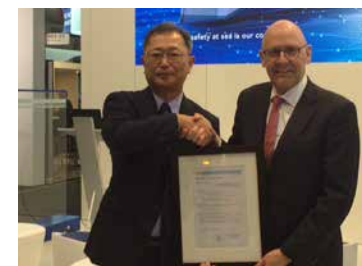
Demand for this type of power plant is expected to be strong in countries where demand for electricity is rapidly increasing, such as in Southeast Asia, especially on islands or in locations where it is

difficult to secure stable power sources, and also in areas with geographical problems such as lack of land for constructing onshore power plants.

LNG, which is the fuel used for power generation, has a cost advantage over heavy oil and emits less greenhouse gases than coal and heavy oil. As an environmentally friendly fuel, the scale of supply and demand as well as applications of LNG are expected to expand.

\* AiP: To obtain confirmation by the classification society as a third party by a risk assessment and verification of compliance with classification rules for the conceptual design of new products and technologies.

\*\* DNVGL: DNV GL is the world's leading classification society and a recognized advisor for the maritime industry. DNV GL enhances the safety, quality, energy efficiency and environmental performance of the global shipping industry, across all vessel types and offshore structures. DNV GL is also a world-leading service provider offering technical consulting services in the oil and gas fields, and other such services.



Yoshinori Mochida, Kawasaki (left) and Mr. Johan Petter Tuttoren, DNV GL (right), at the recent Nor-Shipping trade fair in Oslo.



Image of Kawasaki LNG Floating Power Plant.

## Cutting-edge Training Center Opened for H145/BK117 Helicopter

On May 10, Kawasaki held an opening ceremony for a facility that uses its most advanced equipment, dedicated to training pilots and mechanics for the H145/BK117. The "H145/BK117 Training Center" is located at Kawasaki's Gifu Works.

In Japan, despite an increase in the use of helicopters for emergency medical services, firefighting, disaster relief, and other public duties, there is a shortage of pilots due to aging and retirement, and a shortage of mechanics is also being seen. The recruiting and training of these pilots and mechanics has therefore been a serious challenge in recent years. In response, Kawasaki launched the Training Center to ensure that the skills of pilots who fly Kawasaki-produced helicopters and the maintenance skills of mechanics are kept high, and to contribute to furthering flight safety in helicopter operations.

This Center is the third training facility in the world dedicated to the H145/BK117 helicopter, in addition to Germany and the U.S., and the only one in Japan. Training at the Center is based on the design concept, and is offered by the engineers, pilots, and mechanics at Kawasaki who actually designed and initially operated it. The cutting-edge equipment at the Training Center used for conducting indoor, weather-independent training simulating harsh conditions, which is not possible using actual helicopters.

The Training Center plans to offer training to trainees from outside Japan. It will also provide training for customers of the H145/BK117 who purchased the helicopter from Airbus Helicopters, Kawasaki's development partner for the rotorcraft.



Training Center reception desk.



Inside the Training Center.

\* The H145/BK117 is a mid-size, twin-engine helicopter designed for emergency medical services, firefighting, disaster relief, law enforcement, news coverage, and passenger/goods transport. Since the first one was delivered in 1983, the helicopter has undergone a series of improvements. Backed by Kawasaki's technological prowess and high product reliability, its delivery record has reached 179 units (as of May 10, 2019). When deliveries by Airbus Helicopters are included, the volume is more than 1,500 units worldwide, making it a global best-seller.

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