Kawasaki-LNG floating power plant obtains AiP from DNV GL 112

Kawasaki Heavy Industries, Ltd.

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Kawasaki Heavy Industries, Ltd. has developed an LNG floating power plant equipped with its own high-efficiency power generation equipment and the gas engine model has obtained Approval in Principle (AiP)*1 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. The plant is towed on the sea or river, and then moored at the installation site, where power is generated and 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 stable power sources are difficult to secure, and also in areas with geographical problems such as lack of land for constructing onshore power plants. LNG has a cost advantage over heavy oil for power generation as a fuel of the power plant, 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.

The main features of the Kawasaki - LNG Floating Power Plant are as follows:

(1) The plants are equipped with in-house developed gas engine or gas turbine with the world's highest level of power generation efficiency in this class. (Gas engine: 49.5%, Gas turbine combined cycle: 54.4%) These system have low nitrogen oxide (NOx) emissions and low environmental impact.

(2) The gas engine (of the gas engine model) can reach the rated load in 10 minutes from start, and can also achieve high partial load performance over a wide power range (30 - 100%).

(3) A durable, highly insulated aluminum tank is used with the same specifications as for small LNG carriers/bunkering vessels.

(4) High quality and reliable delivery are achieved through a seamless manufacturing value chain at Kawasaki's own factories for the main products such as power generation facility, tank, and barge.

Kawasaki has built over 40 LNG-related vessels since constructing Asia's first LNG carrier in 1981, including large LNG carriers and LNG fuel vessels, and has received an order for Japan's first LNG bunkering vessel. Kawasaki is a leader in LNG transportation technology with abundant expertise and rich experience. In addition, Kawasaki has extensive capabilities of developing, designing, and manufacturing the core equipment, gas engines, gas turbines, steam turbines, and heat recovery steam generators (HRSG) using its own expertise in the power plant field, and abundant experience of plant engineering in Japan and around the world. Therefore Kawasaki can provide integrated package solutions for the LNG bunkering vessel and tanks for the LNG secondary terminal.

Taking advantage of synergies between these LNG and energy related technologies, Kawasaki will actively market its energy related products and equipment including small and medium-size distributed power sources, which will contribute to development in areas where stable power sources are difficult to secure.

Outline of Specifications of Kawasaki-LNG Floating Power Plant

Model	Gas engine (*Obtained AiP from DNV GL)	CCPP (*Applying for AiP to DNV GL) (combined cycle power plant)
Conguration	Gas engines: 4 units	Gas turbine combined cycle (2 gas turbines, 2 heat recovery steam generators, 1 steam turbine)
Power output	30MW	80MW
Barge size	L120m x W36m x D6.5m	L110m x W48m x D20m
LNG tank	3,500m^3 x 2 units	5,500m^3 x 2 units

(Note)

*1 **Approval in Principle (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.

Kawasaki has successfully verified the Close-range Subsea Pipeline Inspection by Autonomous Underwater Vehicle (AUV) 113

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Kawasaki Heavy Industries, Ltd. announced the successful completion of verification tests for the close-range inspections of a subsea pipeline by an autonomous underwater vehicle (AUV) off the coast of Awaji Island, Hyogo Prefecture on July 15, 2020.

With a focus on the growing demand for pipeline maintenance in offshore oil and gas fields, Kawasaki has been developing an AUV called SPICE*1 (Subsea Precise Inspector with Close Eyes) equipped with a robot arm for performing subsea pipeline inspections—the world's first—based on a fusion of submarine technologies and industrial robot technologies fostered in-house over many years. During verification testing, SPICE executed a close-range inspection process which involved deployment at sea to locate and perform tracking operations on a subsea pipeline, after which it returned to its docking station*2 for recovery. These tests were part of a series of tests required to verify autonomous operation capabilities, and were conducted from June 1st to 12th with the support of the Joint Technological Development Support Program for Offshore Oil and Natural Gas Fields,*3 which is supported by DeepStar*4 and The Nippon Foundation. SPICE's verification tests entailed inspections of a mock pipeline used to simulate a real subsea pipeline, located off the shore of Awaji Island in Hyogo Prefecture. The tests succeeded in verifying the performance of SPICE's autonomous robot arm control and sensor-equipped close-range inspection unit to track the pipeline while the AUV maintained stable travel, and represent a major step forward along the company's path to commercialization. Moreover, attendees at demonstrations carried out during the testing period expressed high praise and great expectations in response to the success of the tests.

Kawasaki will continue to carry out verification tests using equipment fitted with various inspection sensors in reflection of actual market needs, while simultaneously pursuing classification-society certification for its AUV. Furthermore, the company will keep on developing high-performance, high-quality products capable of uncrewed, automated operation for the AUV market, where demand is expected to grow for such underwater equipment, while proactively pursuing commercialization in FY 2021.

***1 "SPICE" is a trademark for AUV developed by Kawasaki Heavy Industries, Ltd.**

***2 A subsea docking station under development by Kawasaki. SPICE docks underwater with the station, which is attached via a cable to the mother ship (base ship for operations), enabling the AUV to charge and send collected inspection data to the mother ship. This arrangement enables SPICE to work for long periods undersea without frequent launch and recovery, thus reducing boat crew workload and improving safety.**

***3 A collaborative support program of The Nippon Foundation with the aim of participating in technological development in the ocean development field. Kawasaki was selected for participation in the program in FY 2019 in order to pursue applications for autonomous underwater robots in offshore oil fields, and the abovementioned verification tests were carried out as part of this program.**

***4 A marine technology development consortium comprising major oil companies, companies involved in ocean development, universities, research institutions and other such organizations with the aim of surveying, developing, and pursuing production in offshore oil and natural gas fields.**

Kawasaki Receives Order for SPICE, World's First AUV with Robot Arm for Subsea Pipeline Inspections 114

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Kawasaki Heavy Industries, Ltd. received of an order by Modus Subsea Services Limited (MODUS) in UK for an AUV*1 called SPICE.*2

Kawasaki has undertaken research and development for AUVs in response to growing demand for pipeline maintenance in offshore oil and gas fields. SPICE is the world's first AUV equipped with a robot arm for performing subsea pipeline inspections, developed based on a fusion of submarine-related technologies and industrial robot technologies fostered at Kawasaki over many years. SPICE will be used for operations in the North Sea and other sea areas around the world after delivery to MODUS in 2021. MODUS has committed to acquire two units of SPICE from Kawasaki, of which first one was placed an order this time.

By Kawasaki's technological synergies, a robot arm fitted with an inspection tool unit at the end enables SPICE to perform close-range inspections of subsea pipelines not possible with traditional AUVs. In addition, it is operated using a docking station also developed by Kawasaki, which increases inspection operation efficiency and reduces cost requirements, while also benefiting crews working on a support vessel by reducing their burden and improving safety.

SPICE's basic specifications and features are as follows.

Specifications	
Length overall	Approx. 5.6 m
Width	Approx. 1.4 m
Height	Approx. 1.1 m
Weight	Approx. 2,500 kg (in air)
Max. depth	3,000 m
Max. speed	4 knots
Propulsion equipment	Main propulsion propeller ×1, side thrusters ×2, vertical thrusters × 2
Navigation equipment	Inertial navigation system, sonar
Safety equipment	Ballast release equipment, iridium beacon

Features

1. After being submerged into the sea along with the docking station, SPICE launches itself, searches for the pipeline to be inspected, performs inspections, and returns to the docking station once its mission completes. As this entire process is handled autonomously, SPICE does not require a dedicated ROV*3 operator or a highly sophisticated support vessel capable of dynamic positioning, unlike ROVs that used to be the standard pipeline inspection equipment.
2. SPICE comes equipped with an inspection tool unit fitted with close-range sensors at the end of the robot arm. When inspecting pipelines, SPICE controls robot arm autonomously to track the pipeline and performs efficient close-range inspection operations.
3. SPICE is capable of automated continuous detecting and tracking of subsea pipelines. It automatically avoids obstacles along the pipeline and continues inspections once the obstacle has been cleared. This enables uninterrupted continuous inspection operations.
4. After returning to the docking station under water, SPICE enables recharging the battery and sending collected data to the support vessel. SPICE can be launched and recovered under water for better operational efficiency than a conventional launch and recovery method.

Moving forward, Kawasaki will reflect user feedback and requests from MODUS in future development efforts and supply high-performance and high-quality products to meet the growing demand of AUV in the subsea inspection market. In this way and others, Kawasaki will play its part in creating a safe and secure remotely-connected society.

***1 Autonomous underwater vehicle.**
***2 Subsea Precise Inspector with Close Eyes. SPICE is a trademark of Kawasaki.**
***3 Remotely operated vehicle. While connected to the mother ship via a tether cable, the vehicle is operated by a dedicated operator.**