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Nippon Gas Line Co., Ltd.

# Commencement of $CO_2$ Handling Demonstration onboard

Nippon Gas Line Co., Ltd. (Head Office: Matsuyama City, Ehime Prefecture; President: Yasuhiro Muramatsu. Hereinafter NGL) has been operating a domestic gas carrier since its foundation in 1962 and has accumulated extensive expertise in this field. As a joint contractor on the NEDO*1 Projects*2 aimed at developing safe, large-scale, long-distance transportation technology for liquefied $CO_2$, the company is responsible for the operation and management of the liquefied $CO_2$ transportation demonstration vessel "EXCOOL" as well as conducting transportation demonstration tests using the vessel.

For the social implementation of CCUS, reducing transportation costs is a major challenge, and one approach to solving this challenge is to shorten loading/unloading times by increasing pipeline flow speed.
NGL is conducting studies to evaluate the effects of increasing the pipeline flow speed of liquefied $CO_2$, and as part of this effort, we conducted onboard $CO_2$ handling demonstration using two tanks installed onboard the vessel by transferring liquefied $CO_2$ between the cargo tanks mutually.

In this onboard $CO_2$ handling demonstration, NGL repeatedly transferred the low-temperature and low-pressure (LTLP) liquefied $CO_2$ loaded into one tank to the other tank using a cargo pump. We then confirmed changes in the condition of the liquefied $CO_2$ through measuring the parameters from dozens of sensors (temperature, pressure, flowmeter etc.), equipped along onboard piping.

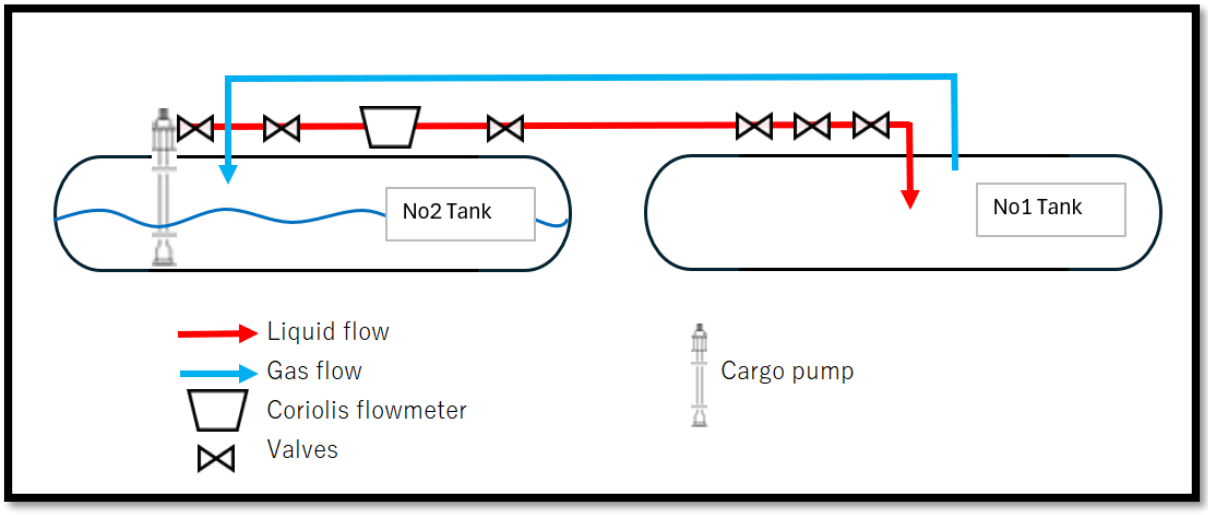
In this time demonstration test, liquefied $CO_2$ at approximately -50° C and 0.6 MPaG was transferred, and no localized temperature, pressure increase/decrease nor unusual vibrations were observed. The heat input from the cargo pump was also as expected. There was no pipe blockage caused by dry ice formation, and the flow speed in the piping was gradually increased from 2 m/s, finally achieved a transfer speed to over 4 m/s.

This demonstration experiment was conducted onboard the vessel, where the piping distance between tanks are short and the elevation difference is minimal, making it easier for liquefied $CO_2$ to flow. Therefore, opening degree of some valves were adjusted to create a resistance for simulating the conditions of vessel-from/to-terminal cargo handling.

Subsequent to the above, NGL will conduct multiple $CO_2$ handling demonstration tests onboard by changing conditions such as the temperature and pressure of liquefied $CO_2$ and the vessel equipment settings and increasing the number of measurement points.

*1　NEDO: New Energy and Industrial Technology Development Organization
*2　NEDO Projects: CCUS R&D and demonstration related projects / CCUS Large-scale demonstration test in Tomakomai / Demonstration test on $CO_2$ transportation / Technology development and demonstration test on $CO_2$ vessel transportation

[Conceptual diagram of the demonstration test]




Liquified $CO_2$ at low-temperature and low-pressure (LTLP) loaded into Tank No. 2 was transferred to Tank No. 1 by using a cargo pump, with the flow speed gradually increased from 2 m/s → 2.5 m/s → 3 m/s → and finally 4 m/s. By simultaneously transferring the liquid and returning the gas, the pressure in each tank was controlled. During this process, various sensors were used to monitor the temperature and pressure of the liquefied $CO_2$ inside the piping and tanks, and vibrations were measured at the bends in the piping. Although the duration was shorter compared to vessel-from/to-terminal cargo handling, we confirmed that it is possible to transport liquefied $CO_2$ of low-temperature and low-pressure (LTLP) at a flow rate of 4 m/s stably.

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