Facility Engineering Action Based on Total Civil and Plant Engineering for Mitsubishi Heavy Industries Group's Product to Offer Customers a Wide Range of Services (Sequel)

Business Development Managing Department
Engineering Business Unit
Mitsubishi Heavy Industries Transportation and Construction Engineering, Ltd.

Facility Engineering is a Mitsubishi Heavy Industries (MHI) Group-wide cross-functional project. With our capabilities in the fields of construction and engineering at the core, we, MHI Transportation and Construction Engineering, Ltd. (MHI-TC), have been engaged in Facility Engineering in which our civil engineering and construction work is provided as a package combined with MHI Group's products and systems. Our activities in this regard, which we are expanding, were presented in detail in the past MHI Technical Review. (2022, Vol. 59, No. 2)

Since then, this collaboration project has been widely spread to group companies through sales expansion activities conducted by the business discussion information sharing liaison meeting, where group companies gather regularly to create synergy among them, and has produced a number of successful results. As a sequel to the previous report, this report mainly focuses on our collaboration project cases with MHI Air-Conditioning & Refrigeration Corporation (MJR) and MHI Engine & Turbocharger, Ltd. (MHIET), among many. Our experience in Facility Engineering has been accumulated especially through the collaboration with these group companies.

1. Our Facility Engineering project cases

As shown in **Table 1**, our Facility Engineering is to provide a one-stop solution that is enabled through the collaboration with other MHI Group companies. In other words, we can handle wide-ranging needs of customers throughout the stages from planning to production, construction and after-sales services by collaborating with other group companies. This not only enables customers to reduce the time and effort needed, which are otherwise spent making the arrangements for smooth transitions of construction phases, but also allows us to make use of our group's comprehensive engineering capabilities for achieving economically advantageous design and a shorter construction period.

Table 1 Major project cases in our Facility Engineering

Year	Project case	Partner company
2020	Refrigerated warehouse for Kyoto Enkangyo Oroshi Kyodo Kumiai	MJR
2022	Shin-Higashi waste incineration plant for Nagasaki City	MHIEC
	Construction of power generation facility for Hiroshima Gas Co., Ltd.	MHIET
	Liquefied carbon dioxide tanks for Resonac Gas Products Corporation	MJR
	Automotive environmental test equipment (environmental wind tunnel) for unspecified company	MJR
	Construction of CCR and office buildings for Hibiki Power Plant	MHI
	Repair work for Tajima Dome	MHI-MS
2023	Construction of new refrigerated warehouse for Sankyo Chemical Co., Ltd.	MJR, LN
	Construction of new geothermal power plant in Kijiyama for Tohoku Sustainable & Renewable Energy Co. Inc.	MHI
	Installation of EBLOX for Mitsui Fudosan Co., Ltd. and ENEOS Real Estate Corporation	MHIET

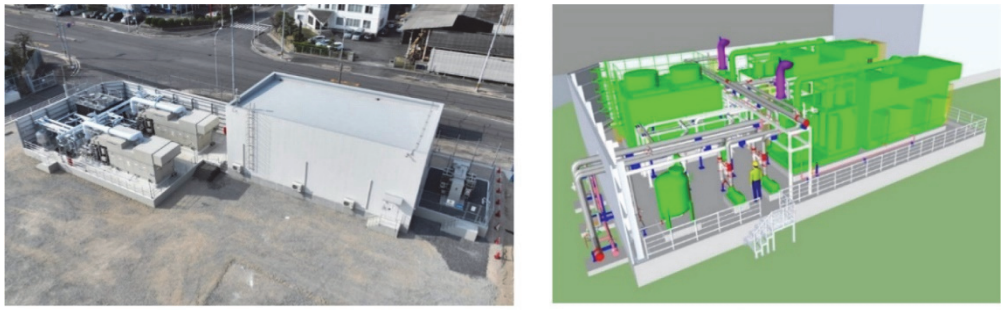
MHIEC: Mitsubishi Heavy Industries Environmental & Chemical Engineering Co., Ltd.
MHI: Mitsubishi Heavy Industries, Ltd.
LN: Logisnext Chugoku Co., Ltd.
MHI-MS: Mitsubishi Heavy Industries Machinery Systems, Ltd.

1.1 Construction of power generation facility for Hiroshima Gas Co., Ltd.

In this construction, we were involved from the stage of the customer's planning a gas engine power generation facility and the related civil engineering work/building facilities. As shown in **Figure 1**(a), our proposal was one-stop services through which a complete set of power generation facilities including the related equipment/systems will be provided.

MHIET was responsible for the production of a gas engine generator, while we were in charge of the peripheral systems, civil engineering and building structures, power transmission and substation systems, and modification of the control system. Their layout suitability and operability were verified using 3D CAD, as shown in Figure 1 (b).

The construction was completed in October 2023 and the facility has been operating smoothly.



(a) Full view of completed facility　　(b) 3D CAD

Figure 1　Construction of power generation facility for Hiroshima Gas Co., Ltd.

1.2 Liquefied carbon dioxide tanks for Resonac Gas Products Corporation

This project case is about the production facility consisting of a liquefied carbon dioxide production system and spherical storage tanks. The full view of the facility is given in **Figure 2**(a). In the initial stages of the talks between MJR and the customer over the liquefied carbon dioxide production system, we joined as a manufacturer of spherical storage tanks and a civil engineer for the related work. The one-stop services were thus provided as MHI Group, including the verification of the suitability of facility layout arrangements using 3D CAD, as shown in Figure 2(b). The orders were placed separately from the customer: the liquefied carbon dioxide production system to MJR and the spherical storage tanks (including civil engineering work) to our company.

The storage tanks, which we are responsible for, were delivered to the customer in February 2024. The following construction of the production system by MJR is now in progress.

(a) Full view of completed tanks　　(b) 3D CAD

Figure 2　Liquefied carbon dioxide tanks for Resonac Gas Products Corporation

1.3 Refrigerated warehouse for Kyoto Enkangyo Oroshi Kyodo Kumiai

This is a case of our first large collaboration project with MJR, which was previously reported. A full view of the refrigerated warehouse is in **Figure 3**. The orders were placed separately from the customer: construction of a refrigeration system to MJR and building construction to our company. However, while MJR took the lead role in planning the performance of the refrigeration system, the plan was developed in collaboration by streamlining from both viewpoints of the refrigeration system and warehouse construction. Once the on-site construction started, we supervised the ongoing work

as a general safety and health supervisor. The construction was completed in January 2023. The refrigerated warehouse has been operating smoothly as of February 2024.

Figure 3 Full view of completed refrigerated warehouse for Kyoto Enkangyo Oroshi Kyodo Kumiai

1.4 Installation of EBLOX for Mitsui Fudosan Co., Ltd. and ENEOS Real Estate Corporation

The installation of EBLOX is aimed at optimizing the use of electricity at the logistics center planned by the customers. MHI-TC collaborated with MHIET to design an energy-saving system in which MHIET's control system "COORDY" is the pivot. The layout of the facility was proposed, as shown in **Figure 4**. MHI-TC received the order as the prime contractor for a series of construction works from the construction of electric power systems (including storage batteries) and civil engineering structures to the commissioning of these systems. Detailed design has been underway since February 2024.

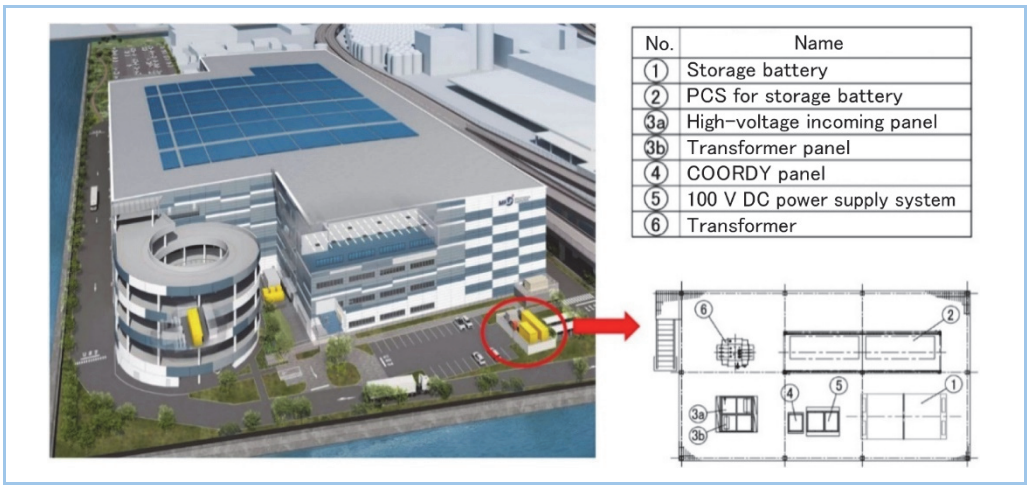


Figure 4 Image perspective of installed EBLOX and layout drawing for Mitsui Fudosan Co., Ltd. and ENEOS Real Estate Corporation

EBLOX and COORDY are MHIET's registered trademarks in Japan (Trademark Registration Nos. 6213361 and 6213362, respectively).

1.5 Automotive environmental test equipment for unspecified company

In regard to the all-weather automotive environmental test equipment (environmental wind tunnel), which was previously reported, the equipment itself is closely connected with the structure of the building. It is therefore necessary to work on both the equipment and the building structure in an integrated manner, as shown in **Figure 5**(a). The orders were placed separately from the customer: the environmental wind tunnel test equipment to MJR and the construction of the building to our company. However, since the initial stage of planning, MJR and our company have been providing one-stop services as MHI Group.

As of February 2024, the frame structure of the building was under construction. The progress is shown in Figure 5(b).

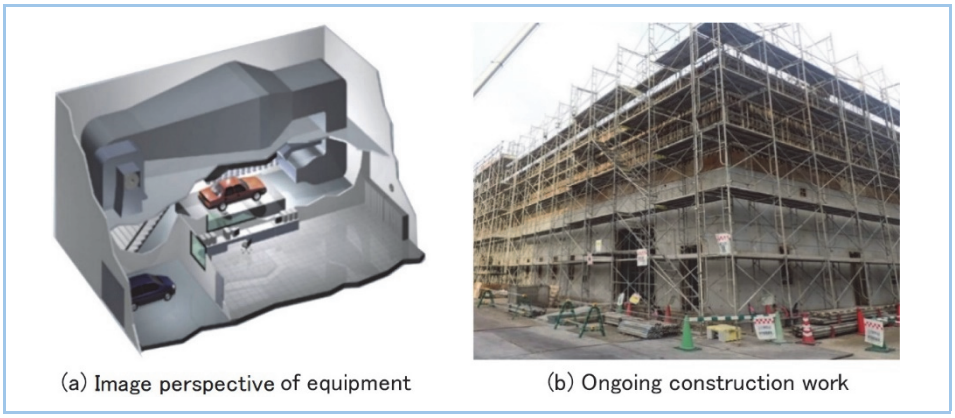


Figure 5 Automotive environmental test equipment for unspecified company

1.6 Construction of new refrigerated warehouse for Sankyo Chemical Co., Ltd.

This construction pertains to the customer's plan to build a new refrigerated warehouse, on which we collaborated with MJR and Logisnext Chugoku Co., Ltd, each in charge of their respective fields in terms of the components of a refrigerated warehouse, that is, the warehouse building, the refrigeration system, and the movable racks. The three group companies prepared and laid out the plan together to move the talks with the customer forward. As the prime contractor, MHI-TC received the order for a series of construction works. An image perspective of the warehouse is in **Figure 6**(a), while the building floor layout is in Figure 6(b).

This collaboration, therefore, is based on the relationship of prime contractor (MHI-TC) and subcontractors (the other two group companies), unlike the aforementioned case of Kyoto Enkangyo Oroshi Kyodo Kumiai in which orders were placed separately.

As of February 2024, the building's foundation was under construction.

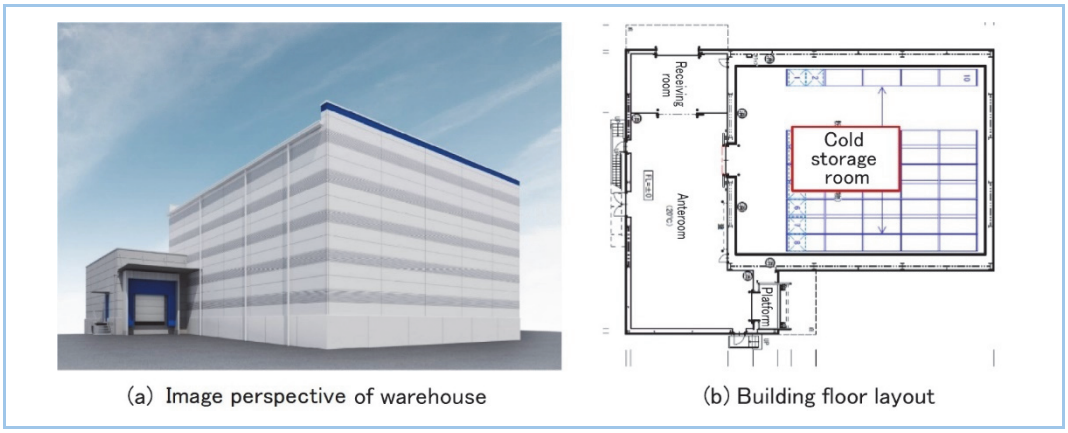


Figure 6 Construction of new refrigerated warehouse for Sankyo Kasei Corporation

1.7 Plant-related construction work

In MHI Group businesses, MHI-TC has engaged in the construction of various types of plants for wide-ranging purposes including power generation, environmental and chemical field. Our civil engineering and construction capabilities are based on the solid experience of our having built MHI's plants and facilities. Being often subcontracted for plant-related construction work, we aim to satisfy the needs of group companies and customers by making full use of our expertise.

Table 2 shows the recent major collaborations with MHI Group companies in the field of plant construction.

Table 2: Major collaboration project cases in field of plant construction

	Under construction since 2022	To be constructed from 2024
Partner company	MHI Environmental & Chemical Engineering Co., Ltd.	Mitsubishi Heavy Industries, Ltd. MHI Power IDS Co., Ltd. MHI Power Control Systems Co., Ltd.
Work description	Shin-Higashi waste incineration plant for Nagasaki City Civil engineering and construction work (Nagasaki Prefecture)	Kijiyama geothermal power plant Civil engineering and construction work (Akita Prefecture)
Exterior view		

2. Future directions

As described so far, with our capabilities in the fields of civil engineering, construction and plant engineering at the core, MHI-TC collaborates with other MHI Group companies to provide one-stop services, thereby satisfying wide-ranging needs of customers and solving the problems they are facing. Towards achieving an optimal, efficient and sustainable society, we will further expand our Facility Engineering in which MHI Group's products and systems are utilized.