» Topics

Ishikari Bay New Port Offshore Wind Power Generation Project Submarine Cable Installation Completed

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ABSTRACT In Japan's first commercial offshore wind power generation project, we completed an installation of a 66 kV submarine cable without any accident or disaster.
A power plant with a generating capacity of 112 MW, consisting of fourteen wind turbines, each rated at 8 MW, was built offshore of Ishikari Bay New Port. We designed a submarine cable system with a total length of approximately 16 km to connect the wind turbines and transmit power from the wind turbines to the mainland. This was a one-time contract for "design, manufacturing and installation."
As a top runner in submarine cables, we will continue to contribute in the construction of offshore wind power generation and the expansion in the introduction of renewable energy, as well as to the realization of carbon neutrality through the supply and the installation of submarine cables.

1. INTRODUCTION

Green Power Investment Corporaion began the initial development of the Ishikari Bay New Port offshore wind power generation project in 2007, and it is the first project in Japan to use large wind turbines with a single unit output of 8 MW and to construct one of the largest commercial offshore wind power plants in Japan.

The power plant is built approximately 1,600 meters offshore from Ishikari Bay New Port, in an area of approximately 500 ha, and consists of 14 units of 8 MW wind turbines with a power generation capacity of 112 MW.

This project was developed and constructed by Green Power Ishikari, a limited liability company established by Green Power Investment Corporation, and a joint venture formed with Shimizu Corporation and Nippon Steel Engineering Co., Ltd. was in charge of the offshore construction including the installation of offshore wind turbines etc.

The Company was contracted by Shimizu Corporation, the prime contractor for the offshore construction to design, manufacture, and install a submarine cable system with a total length of approximately 16 km that connects the wind turbines and transmits power from the wind turbines to the mainland.

Table 1 shows an overview of the project. The amount of power generation is enough to supply approximately 83,000 households in terms of number of households, and the electricity sales period is planned for 20 years.

* Renewable Energy Project & Offshore Engineering Department, Power Cable Project Department, Power Cable Division, Energy Infrastructure Division

Table 1 Project summary.

Project company	Green Power Ishikari GK
Power generation equipment construction site	Ishikari Bay New Port in Hokkaido
Equipment capacity	8000 kw × 14 units 112,000 kW (Connection capacity 99,990 kW)
Conversion to number of households	Approximately 83,000 households
CO_2 reduction amount	Approximately 202,000 t-CO_2 / year
Electric sales destination	Hokkaido Electric Power Network Co., Ltd.
Start operation	Jan. 1, 2024
Electricity sales period	20 years

2. INSTALLATION PLAN OF THE SUBMARINE CABLE

Figure 1 shows a layout diagram for Ishikari Bay New Port offshore wind power generation. Fourteen units of 8 MW wind turbines are installed, seven on the onshore section and seven on the offshore section, and these are connected by the submarine cables, which are then landed at the beach manhole and connected to the land cables. The wind turbines on the onshore section and the offshore section are also connected by the submarine cables in a loop, creating a submarine cable system with a total length of approximately 16 km.

The wind turbine consists of four steel pipe pile foundations and a lower steel structure called a jacket, on which the wind turbine is installed. The wind turbine will be approximately 200 m above the water level. These works were carried out according to the schedule shown in Table 2. The process involves installing a jacket on top of a pre-drilled pile foundation, laying and pulling in the submarine cables, and then installing the wind turbine itself.

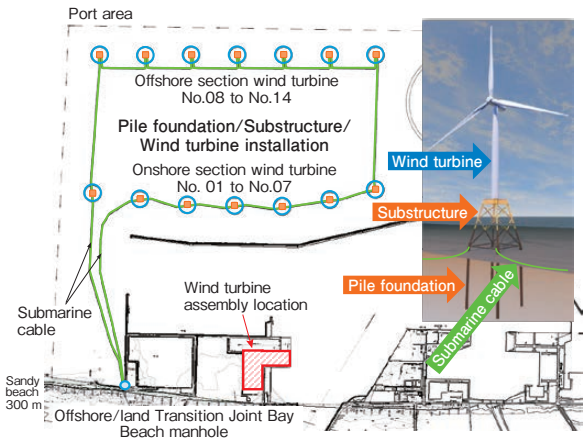


Figure 1 **Layout of Ishikari Bay New Port offshore wind turbine / Foundation / Submarine cable. (Provided by Green Power Investment Corporation.)**

Table 2 **Construction schedule. (Provided by Green Power Investment Corporation.)**

Offshore section Main construction	2022												2023												2024		
	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Wind turbine foundation/ Substructure construction	Steel pipe pile construction									Jacket construction																	
Submarine cable installation (Offshore transmission line)						Beach manhole construction				Cable laying / buried work																	
Wind turbine parts Temporary storage/ preassembly																											
Wind turbine equipment construction																	Trial run										

For the wind turbine's foundation structure, a jacket type was chosen as the optimal structure, taking into consideration the natural conditions of the local sea area, the construction conditions, and the wind turbine specifications. The submarine cable is laid through a conduit (J-tube) installed in this jacket foundation structure, and is an important key component that connects the wind turbines and transmits the generated power to the onshore power grid.

3. LAYING OF THE SUBMARINE CABLE

The submarine cable was laid by "Cable laying barge Awaji" shown in Figure 2. The Awaji is equipped with a Dynamic Positioning System (DPS*), which allows the submarine cable to be sent out while keeping the laying barge in a fixed position.

The laying barge will monitor the tension management according to the angle of entry into the water and confirm that the laid submarine cable does not have excessive tension or bend more than expected.

3.1 Submarine Cable Laying Work at Landing Section

Figure 3 shows an image of the landing section work. When sending a submarine cable to the landing section, a tube buoy is attached to the submarine cable, and the cable is sent to the landing section while floating above the sea surface. After sending it out to a point where the water depth is shallow, the tow rope and cable terminal are connected from the land, and then hoisted up with a land winch (Figure 4). When laying submarine cables, the thrusters gradually advance the cable as it is fed out.

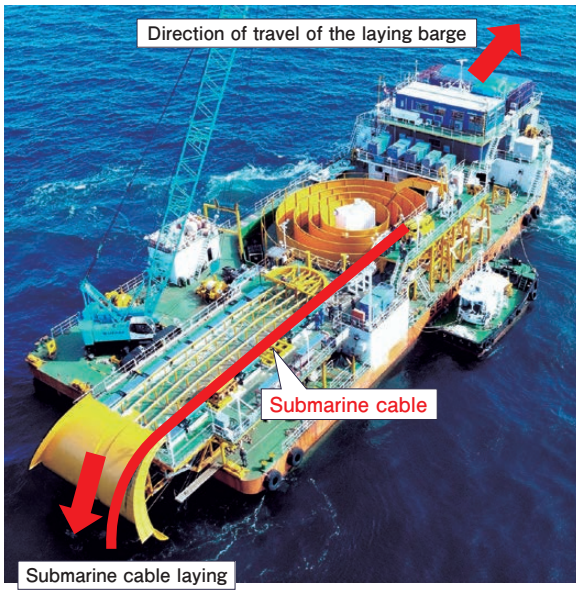


Figure 2 **Cable laying barge Awaji.**

*DPS: Dynamic Positioning System is an automatic barge positioning system that automatically controls the barge's own propulsion device (thruster) to hold the barge in a fixed position without an anchor.

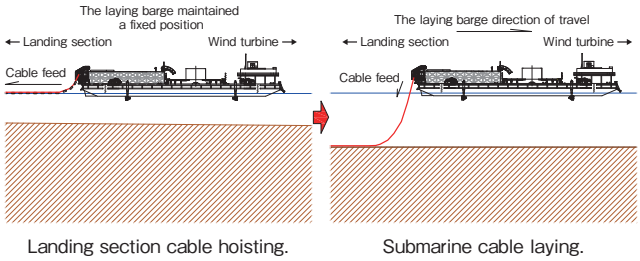


Figure 3 **Laying operation for the submarine cable at the landing section.**

Figure 4 **Landing of the submarine cable.**

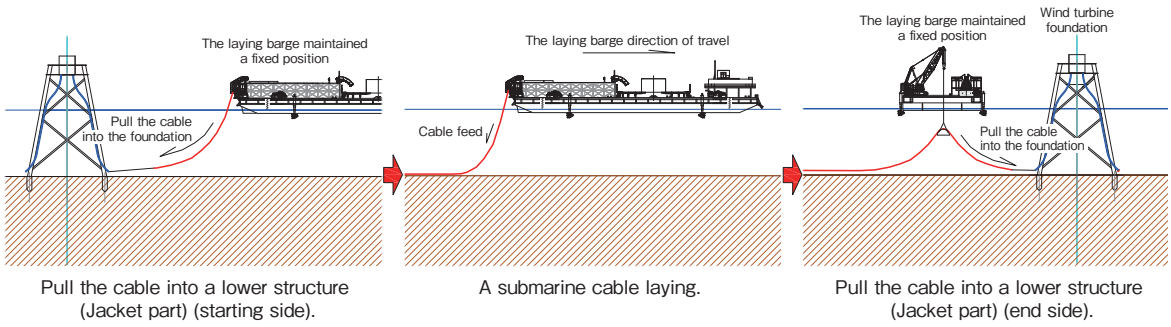


Figure 5 The submarine cable laying operation between the wind turbines.

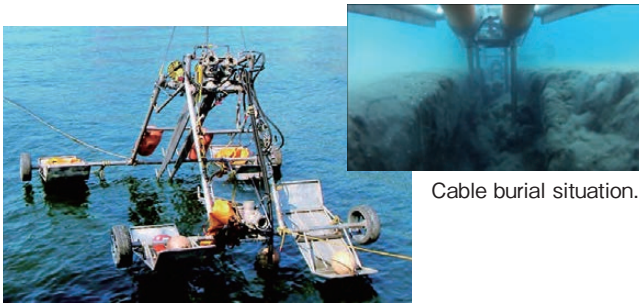
3.2 The Submarine Cable Laying Between Wind Turbines

Figure 5 and Figure 6 show images of a laying between the wind turbines. When pulling the cable into the jacket foundation structure, the submarine cable is sent out to the jacket side with the laying barge held at a fixed point by the DPS. When pulling the submarine cables into the wind turbine foundation, the cable is first hoisted midway and dropped into the sea, then gradually pulled into the wind turbine foundation. This is to reduce a friction, as a large amount of a friction occurs when the cable is laid on the ocean floor.

Figure 6 Laying of the submarine cables to the wind turbines.

4. BURYING THE SUBMARINE CABLE

The cable is sandwiched between the burial machines, a water flow is supplied from the pump ship to the burying machine, and the water stream emitted from the burying machine's nozzle blows away the soil around the cable and buries the cable (Figure 7).



Cable burial situation.

Figure 7 Burial machine.

5. CONCLUSION

As one of Japan's leading manufacturers of the submarine cable design, manufacturing and construction, we are participating in the offshore wind power generation business, and leveraging the knowledge and know-how we have gained through the Fukushima Floating Offshore Wind Farm Demonstration Research Project and Nyuzen Offshore Wind Power Project, we led this project to success.

Going forward, we will continue to contribute to the realization of carbon neutrality by supplying and installing submarine cables and underground cables that are essential for interconnecting renewable energy sources such as the offshore wind power generation with the power grid.

We received a great deal of support from Green Power Investment Corporation, Shimizu Corporation and Nippon Steel Engineering Co., Ltd. for the construction work and we would like to express our sincere appreciation for their support.