Power

1 Panoramic view of the Ohgishima Power Station

1 Ohgishima Power Station No. 3 Generator Unit

The Ohgishima Power Station No. 3 generator unit with a generating capacity of 407.1 MW developed for Ohgishima Power Co., Ltd. began service operation on February 1, 2016. The No. 3 unit was targeted for an early operational start amid concerns of power supply shortages with the shutdown of nuclear power plants and other developments in the wake of the Great East Japan Earthquake that struck on March 11, 2011. Construction was completed on a tight schedule.

The equipment is combined cycle generating equipment provided under an engineering, procurement and construction (EPC) contract where construction, installation and equipment are delivered as a complete set. By sharing spare parts and high-temperature components for turbines with the No. 1 and No. 2 units, for which Hitachi has concluded a long-term service agreement (LTSA), the plant has helped Hitachi provide equipment that boasts exceptional reliability and operability in every aspect from construction to operation and maintenance.

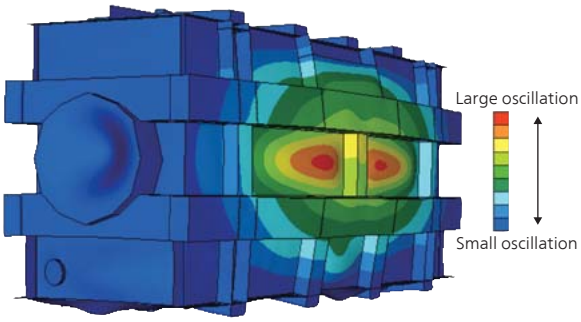
During construction, the work proceeded only after full consideration to avoid impacting the adjacent No. 1 and No. 2 units, which were engaged in commercial operation. Guaranteed performance figures were met without any accidents or disasters, and Hitachi managed to reach the service operation launch date on schedule. With business operators requiring an even more stable power supply due to the full deregulation of electric power sales in April 2016, Ohgishima Power Station operates as a valuable power plant.

2 Environmental Conscious Low Noise Transformers

With the aim of realizing "green innovation," an environmentally conscious low-noise transformer (154 kV, 100 MVA three-phase) designed for low loss, low noise and reduced maintenance was completed as Shinkansen substation equipment for Central Japan Railway Company. While the main transformer unit of the existing equipment used an oil forced air natural cooling system and type A sound insulating wall, the updated equipment employed an oil immersed natural cooling system and removed the sound insulating wall.

The main features are as follows.

(1) By using high orientation electromagnetic steel sheets for the iron core, no-load loss has been decreased by around 30% compared with the previous product to reduce loss.



2 Transformer (top) and sample of main tank noise barrier performance analysis (bottom)

(2) Noise barrier performance has been improved by optimizing the structure of the transformer's main tank part. This enabled a design without a sound insulating wall and supported low-noise operation.
(3) Pumpless operation was achieved with the use of an oil immersed natural cooling system to save energy and reduce maintenance work.

Looking ahead, Hitachi is committed to the commercialization of power transformer products that feature high reliability and accommodate a diverse range of needs.

3 Construction of the Shizukuishi Solar Power Plant

Hitachi received an order for subcontracted construction work to construct the Shizukuishi Solar Power Plant for Shizukuishi Solar Godo Kaisha, a joint venture of Etrion Japan K.K. and Hitachi High-Technologies Corporation. The power plant, which includes solar battery modules with a rated output of 24,760 kW and a power conditioning system (PCS) with a rated output of 18,480 kW, began operation in October 2016.

As the power generating equipment is situated on 39.6 hectares (396,000 m²) of private land in a heavy-snow region in Shizukuishi, Iwate Prefecture, it was necessary to design the array frames to specifications

3 Pile loading test conducted in the field (top) and array frames (bottom)

that could withstand heavy snowfall. Taking into account strength calculations and the results of tests conducted in the field and indoors, the array frames were designed with a 20-degree angle of inclination to facilitate snow-sliding on the photovoltaic (PV) panels. Pile foundations were also used in the construction of the sloped surfaces of the power generating equipment.

In constructing the generating equipment, a more accurate construction schedule management was required due to a customer request to shorten the construction period. In response, Hitachi introduced the unique construction management system that enables the management of products, schedules and work progress and achieved coordination between the construction site and related Hitachi Group sites. As a result, the delivery of receiving and transforming facilities, the PCS, step-up transformers and 95,232 PV panels was thoroughly managed, and it began operation a month ahead of schedule despite a construction period that spanned the winter holidays.

4 5 MW Floating Wind Turbine

"Fukushima Hamakaze," the 5 MW down-wind floating wind turbine under the phase II of the Fukushima

4 5 MW down-wind floating wind turbine (photograph courtesy of Fukushima Offshore Wind Consortium)

Floating Offshore Wind Farm Demonstration Project funded by the Ministry of Economy, Trade and Industry is scheduled to begin commercial operation in April.

The wind turbine was constructed on a floating foundation off the coast of Sumoto, Awaji-shima Island between May and June 2016 and towed to a point off the coast of Fukushima from July to August. After connecting moorings and power cables, the wind turbine started initial power receiving in September.

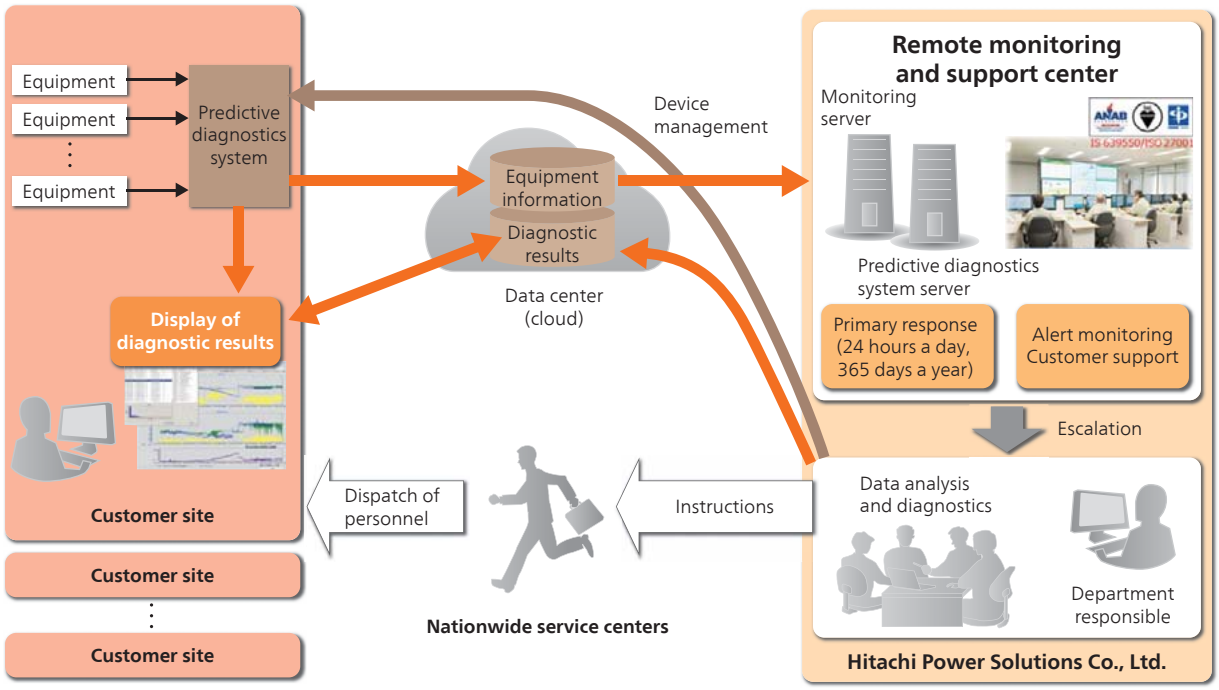
The demonstration project started with "Fukushima Mirai," a 2 MW down-wind floating wind turbine and "Fukushima Kizuna," a 25 MVA floating offshore substation as phase I demonstration project during 2011. Following the installation of "Fukushima Shinpu," the phase II 7 MW floating wind turbine, the construction of "Fukushima Hamakaze", the 5 MW down-wind turbine was started. The project will become the world's first large-scale floating offshore wind farm. The research body in charge of the effort is a consortium comprising entities from industry, government and academia.

An advanced spar floater produced by Japan Marine United Corporation is used for the 5 MW down-wind turbine. The three different types of floaters are employed for each 2 MW, 5 MW and 7 MW for research purposes. A compact semi-submersible type was used for the 2 MW down-wind turbine, and a V-shaped semi-submersible type was employed for the 7 MW wind turbine. Hitachi delivered the floating offshore transformer equipment, the 2 MW and 5 MW wind turbines.

Moving forward, Hitachi will continue to verify the validity of designs of offshore wind turbines through the demonstration project and make improvements for more reliable maintenance and operational performance for offshore commercial projects.

5 Digital Solutions in Maintenance Services

Hitachi Power Solutions Co., Ltd. has developed a



5 Maintenance service leveraging digital solutions

service platform that combines operational technology (OT), technologies to optimally control and operate customer facilities with IT, digital solutions, to promote the increased sophistication of maintenance services.

Collecting operational information on customer facilities in real-time to predict equipment malfunctions and support maintenance through remote operation helps to prevent unexpected equipment shutdowns and facilitates stable operation. In addition, performing analysis and diagnostics as needed on the information received by the remote monitoring and support center means that maintenance personnel can be promptly dispatched and accurate handling can be implemented. Moreover, as analysis and diagnostic results can also be confirmed from the actual site via the cloud, appropriate responses can be developed for the source inducing malfunctions.

(Hitachi Power Solutions Co., Ltd.)

6 SGET Hitachi-Omiya Megasolar Power Plant

The SPARX Green Energy & Technology Co., Ltd. (SGET) SGET Hitachi-Omiya Megasolar Power Plant (solar battery modules with rated output of 21,206 kW, PCS with rated output of 17,820 kW) began operation in July 2016. In a first for Hitachi, the power plant was constructed on part of an operating golf course (nine out of 27 holes).

To avoid interfering with operation of the golf course, a special high-voltage substation was installed outside the golf course, and high-voltage transmission cables from the power plant to the special high-voltage substation were laid underground to preserve the scenery. In addition, pile foundations able to conform to the slanting terrain of the golf course were employed, allowing all PV panels across the approx. 220,000 m^2 site to be arranged facing due south to ensure high generating performance. Moreover, a twenty-year maintenance service ensures the provision of highly reliable power generating facilities.

Moving forward, Hitachi aims to control CO_2 emissions and contribute to the realization of a low-carbon society through megasolar and other renewable energy-based power generating systems while striving to maintain a high-quality supply of electric power.

6 Arrangement of solar battery panels through pile foundations that utilize the topography of a golf course