

## Human Ties and the Future for Fukushima

Interest in energy issues has risen in Japan as a result of the accident at the Fukushima Daiichi Nuclear Power Station. Hopes for renewable forms of energy are especially high. Renewable energy projects are also underway in Fukushima Prefecture with the aim of contributing to the recovery there. One of these is the Fukushima Floating Offshore Wind Farm Demonstration Project.

Offshore wind turbines are increasingly widespread in Europe, but they are bottom-mounted in design, meaning that the wind-generation system is fixed to the sea floor. But since the sea around Japan is deep, bottom-mounted systems are not very suitable. The solution, then, was to have the wind turbine float on the surface of the water. Floating offshore wind power generation systems are currently being developed in Norway and Portugal, but they remain in the experimental stage.

The total energy generated in Japan through wind power on land has been rising each year, but International Energy Agency (IEA) data show that such energy accounts for only about 0.5 percent of electric power demand. Nevertheless, the potential for offshore wind power generation in Japan is very great. According to the Japanese Ministry of the Environment's report "Study of Potential for the Introduction of Renewable Energy" released in April of 2011, the theoretical potential from offshore wind power generation may be as high as about 1.6 billion kW, which is ten times that of solar power generation. It is also about eight times of the combined generation capacity for all ten Japanese electric power companies.

Off the coast of Fukushima



COURTESY OF FUKUSHIMA OFFSHORE WIND CONSORTIUM

Fukushima Mirai, a wind generation facility floating about 20 kilometers offshore of Fukushima Prefecture



COURTESY OF FUKUSHIMA OFFSHORE WIND CONSORTIUM

Fukushima Kizuna (left), a floating substation two kilometers distant from Fukushima Mirai (horizon)

Prefecture in particular, wind speeds regularly exceed seven meters per second, making the region ideal for wind power generation. However, two ocean currents flow together off the Fukushima coastline, making the waves high and the sea currents rapid. There is no precedent anywhere in the world of installing wind turbines in such a severe natural environment.

"A number of well known Japanese companies have come together for this project," says the University of Tokyo professor Ishihara Takeshi, who serves as technical advisor for the project. "This project is very challenging, and there isn't enough time. Still, everyone involved is highly motivated by the prospect of helping Fukushima back on its feet."

Commissioned by the Ministry of Economy, Trade and Industry, the project was kicked off in March of 2012 by a consortium of eleven business firms and organizations, including the University of Tokyo, Marubeni Corporation, Mitsubishi Corporation, Mitsui Engineering and Shipbuilding, Nippon Steel, Hitachi and Shimizu Corporation. Wind generation started up in November of 2013, just a year and a half later.

The related electrical generating facilities fall into three basic categories. The first facility is Fukushima Mirai, a

wind generation facility floating offshore in waters some 120 meters deep. It has a generating capacity of 2 MW. Measuring 80 meters across, it sports three blades each 40 meters long. The unit rests on a floating structure. The turbine is 106 meters tall measured from the waterline. It will be anchored to the sea floor with six massive chains 714 meters long weighing 280 tons in order to prevent it from being swept away by strong winds and sea currents.

The second facility is Fukushima Kizuna, a floating substation 2 kilometers away from Fukushima Mirai. Fukushima Kizuna is a transformer facility which transmits wind-generated electric power to shore. It is the first time anywhere in the world there has been a 66 kV floating transformer facility.

The third component is a transmission line which links Fukushima Mirai and Fukushima Kizuna and carries electric power to shore. Transmission lines known as riser cables float in the water and reconcile the motion of the floating facility and the movements of the waves and currents. It is the first time anywhere in the world that such a cable has been placed between the floaters. The electricity generated is also being sold to electric power companies. The total power is enough to supply

about 1,700 households.

The project has sparked a great deal of interest from overseas. In addition to requests from media sources overseas such as the *New York Times*, Professor Ishihara has given presentations at the invitation of a number of foreign embassies in Japan and has given interviews to energy industry representatives from a number of countries. He has also visited China and South Korea to give presentations on the project.

"People overseas apparently had the impression that Japan would take a long time to put the project into effect," says Professor Ishihara. "But when they saw floating wind power being generated in just a year and a half, many were surprised and said that things had changed in Japan. In the past, Japan learned quite a lot from countries overseas. Now, I hope we can return the favor to the international community by sharing the benefits of this project with the people of the world."

The project calls for floating two additional facilities with a wind generating capacity of 7,000 kW between this year and next. The rotor diameter of the turbines will be 167 meters across, or much larger than Fukushima Mirai. They will, in fact, be the largest such facilities in the world.

As a result of his work on the project, Professor Ishihara now plans to work on the construction of a wind farm of 140 wind turbines generating 7,000 kW each for a total output of 1 million kW. If this plan comes to fruition, Fukushima will become a base for wind farms. Factories and research facilities will concentrate in the region and jobs will be created for the operation, maintenance and reconstruction of such facilities (since the useful life of wind power generation systems is about twenty years), all of which will greatly contribute to the recovery of Fukushima.

"When the Tokyo Olympics open in 2020," says Professor Ishihara, "I hope people from around the world will be able to see many more floating wind power generation facilities symbolizing Fukushima's recovery. That will surely contribute to the sustainable development of the region." □

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