Power Generation

Renewable Energy and New Energy
Solution Services

As efforts toward the realization of a decarbonized society become a global trend, in Japan, the basic policy for achieving a Green Transformation (GX) was approved by Cabinet decision in February 2023.

To reduce greenhouse gas emissions and achieve carbon neutrality by 2050, suggested policies include "promoting renewable energy in harmony with local communities" and "utilizing nuclear power with safety as the top priority" while ensuring a stable supply of electricity.

In the power generation segment, Fuji Electric is steadily promoting the transformation of our business portfolio and accelerating our contributions to society. For example, we are promoting the introduction of renewable energy sources, such as geothermal, hydroelectric, solar, and wind power, in harmony with local communities; decentralized power sources, such as energy storage systems; and power supplies with high resilience; as well as making efforts to further ensure safety in nuclear power generation. We are also expanding our efforts to bring to market the products necessary for realizing a hydrogen society.

Renewable Energy and New Energy

In the field of geothermal power generation, in which Fuji Electric enjoys a leading share of the market, we are making continued efforts to leverage our track record of our project experience in Japan and in countries in the Asia and Africa regions, as well as in Iceland, New Zealand, the United States, and other promising regions. In 2024, the Tauhara Geothermal Power Station in New Zealand is scheduled for completion as the power station with the world's largest output of a single unit. In Japan, the Appi Geothermal Power Station owned by Appi Geothermal Energy Corporation is also scheduled for completion. In addition to promoting ongoing projects in Japan and overseas, we will aim to increase the number of orders we receive. We will thus strengthen our efforts in binary geothermal power generation facilities equipped with locally sourced major equipment in Japan and develop stronger relationships with local companies overseas, thereby enhancing our presence.

In the field of hydropower generation, nearly 20 replacement and renovation projects are scheduled to be completed in FY2023. In these projects, we are promoting initiatives such as the improvement of power generation output through the use of the latest technology, as well as the application of the "hybrid servo system," an environmentally friendly hydraulic turbine control mechanism designed with local communities in mind. Going forward, we will continue to actively work on projects to replace aging equipment and renovate power generation equipment for long-term use. We will also expand the scope of our products and services to promote pumped storage generation, which plays an important role as a regulating power source, as well as digital transformation (DX) in equipment operation and maintenance.

In the field of solar and wind power generation, companies and local governments in Japan are introducing self-consumption power generation equipment and constructing regional microgrids. Meanwhile, Fuji Electric is proposing solutions that best meet diversifying and complex needs by combining our strengths, such as our output stabilization technology that uses storage batteries, and our expertise on collaborative operation with existing power generation equipment that we have cultivated at our own factories. March 2023 saw the completion of a regional microgrid with solar power generation equipment designed for regional use, contributing to the expansion of the introduction of renewable energy.

In the field of fuel cell power generation, we are promoting the development of a hydrogen fuel cell power generation system that is highly responsive, durable, and capable of continuous power generation by utilizing system design technology cultivated in phosphoric acid fuel cells and control technology that intermittently operates multiple battery modules. We will launch it in FY2024 to contribute to the realization of carbon neutrality.

Solution Services

In the field of maintenance and replacement, we are aiming to provide more high value-added offerings in response to the trend toward decarbonization, responding

to the need for improved equipment reliability due to the tight electricity supply demand balance, and providing a wide range of service options such as deterioration diagnosis and remaining life assessment to improve equipment utilization. In Japan, we are working to minimize the risk of the shutdown of existing thermal power stations and to provide solutions that will contribute to the increase of power output. Outside Japan, we are actively proposing maintenance, replacement, and increased power output solutions by leveraging our extensive delivery record of geothermal power generation equipment.

In the field of nuclear power, we are making use of Fuji Electric's unique technologies, which are mainly focused on remote handling, radiation measurement, and radioactive waste treatment processes, such as remote cutting and advanced solidification. Using these technologies, we are continuously contributing to the safe resumption of operations of nuclear power stations in Japan, as well as to radioactive waste treatment and decommissioning, and next-generation innovative reactors (including high-temperature gas-cooled reactors, fast reactors, and fuel production for fast reactors), which are currently attracting attention. In FY2022, we also worked on applying SIAL®, an advanced solidification technology, in radioactive waste and decommissioning, as well as the development of multi-nuclide analysis to meet the need for rapid and accurate quantitative measurement of radionuclides.

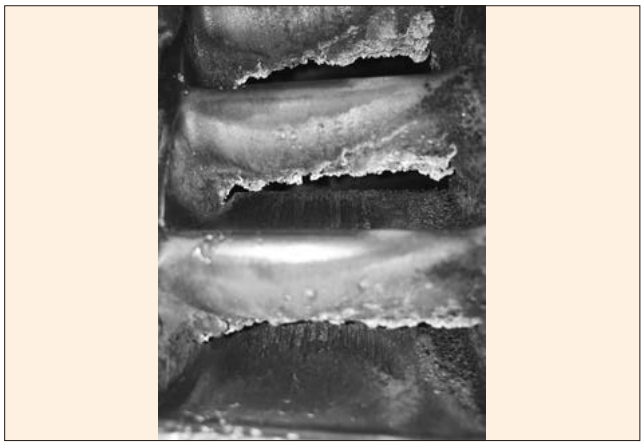
We will continue our efforts aimed at a virtuous cycle between the economy and the environment, from the supply of highly efficient and environmentally friendly clean energy to the provision of services such as monitoring, maintenance, and management of a safe and secure energy supply.

Renewable Energy and New Energy

1 DLC Coating on Geothermal Turbine Blades as a Scale Countermeasure

Geothermal steam, which is an energy of geothermal power generation, contains large amounts of silica and other impurities. When silica is deposited on the blade surface of a turbine in the form of scales, the deposition narrows the steam flow path and causes reductions in power output. For this reason, when a drop in power output caused by scale adhesion is observed, the blade surface needs washing with high-pressure water or other means. Fuji Electric has developed a DLC coating technology to suppress scale adhesion on the surface of geothermal turbines. Using real steam from a geothermal power plant, we demonstrated that the amount of adhering scales can be reduced to a tenth or less. We also confirmed that the DLC coating was effective in reducing scale adhesion caused by geothermal hot water. Going forward, we will continue to develop coating technology for pipes and valves that come in contact with geothermal hot water.

Fig.1 Scale adhesion to the turbine blade surface



2 Commencement of Commercial Operation of the Yufutsu Biomass Power Plant, Yufutsu Energy Center, LLC.

Fuji Electric delivered key equipment including a steam turbine, generator, and condenser to Yufutsu Biomass Power Plant Unit #1 owned by Yufutsu Energy Center, LLC. through TAKUMA Co., Ltd. The plant began commercial operation in March 2023. The main features are as follows:

(1) The highest power generation output of 74,950 kW in dedicated biomass combustion plants in Japan.
(2) Fuels for the plant include wood chips, palm kernel shells (PKSs), and unused wood such as forest residue from Hokkaido, thereby contributing to global warming countermeasures and the local production and consumption of energy.
(3) Use of a single-casing non-reheat turbine and a brushless excitation air-cooled generator achieves high efficiency and high reliability.

Fig.2 Steam turbine and generator for the 75-MW biomass power plant

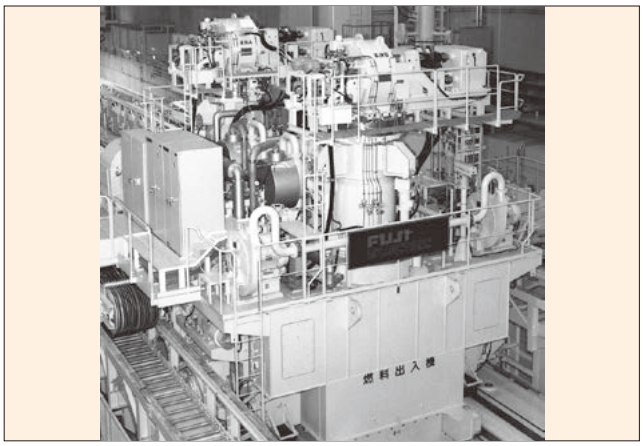
Solution Services

1 Completion of Fuel Unloading at the Prototype Fast Breeder Reactor Monju

At the prototype fast breeder reactor Monju, fuel unloading, the first stage of the decommissioning plan, was completed in October 2022. As Fuji Electric had supplied the fuel handling facility system, it provided technical support for the entire fuel unloading operation and made a significant contribution to the completion of this task, which is one of the most important steps in the first stage of decommissioning. The fuel handling facility system is composed of the ex-vessel fuel transfer system and many other systems. The fuel handling facility system requires advanced technology to remotely and safely handle fuel assembly in an environment where visibility is obscured by liquid metal sodium, which is the coolant of the fast reactor. Despite this, the long-term fuel assembly unloading and handling operation was completed successfully.

By actually operating the fuel handling facility system, we were able to obtain a large amount of data. We will utilize this data in the development of the next fast reactor.

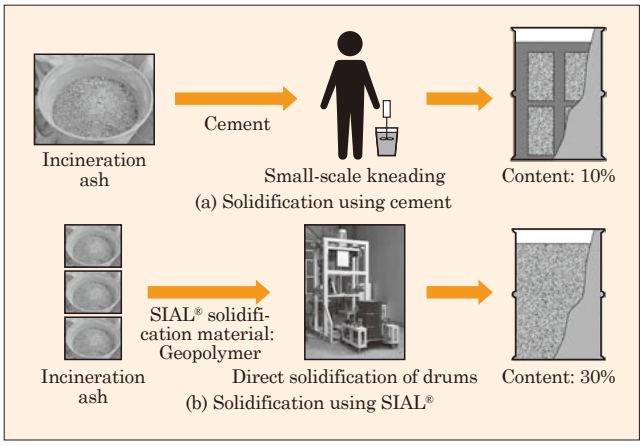
Fig.3 External appearance of the ex-vessel fuel transfer system



2 Applying SIAL®, an Advanced Solidification Technology, to Radioactive Waste

Low-level radioactive waste generated at nuclear facilities is solidified in drums with solidifying materials such as cement and disposed underground. Fuji Electric is focusing on geopolymer that can solidify a larger amount of waste, and is working with Jacobs to develop SIAL®, which has a proven track record overseas, for application in Japan. Cement can solidify only a small amount of incineration ash, a waste material, because it can contain substances that affect cement solidification, whereas geopolymer, which has a different chemical structure, is expected to be able to solidify a large amount. In solidification tests using waste that simulates incineration ash, we confirmed that SIAL® can solidify more than three times as much as cement can do. Going forward, we will conduct demonstration tests using radioactive incineration ash stored at the Tsuruga Power Station of the Japan Atomic Power Company to contribute to radioactive waste disposal.

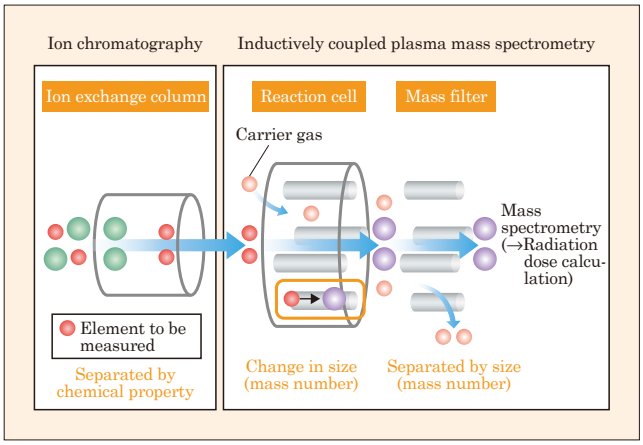
Fig.4 Comparison of waste solidification methods



3 Inductively Coupled Plasma Mass Spectrometry for Analyzing Radionuclide

Low-level radioactive waste generated at nuclear facilities is solidified in drums using cementitious materials and then disposed. Radionuclides contained in the waste are regulated in type and amount, and they have to be analyzed before being disposed. However, for some radionuclides, the long time required to measure the radiation dose has been an obstacle to smooth disposal. With a focus on inductively coupled plasma mass spectrometry as a new method for measuring radionuclides, Fuji Electric has developed a rapid measurement technology for chlorine 36 in preparation for the decommissioning of the Tokai Power Station operated by the Japan Atomic Power Company. The elements to be measured were conventionally separated and analyzed in advance through a complex pretreatment procedure. This method simplifies the pretreatment procedure through the combination of ion chromatography. This can shorten the measurement time to 1/30 of what was previously possible.

Fig.5 Principle of the developed radiation dose measurement method



Solution Services

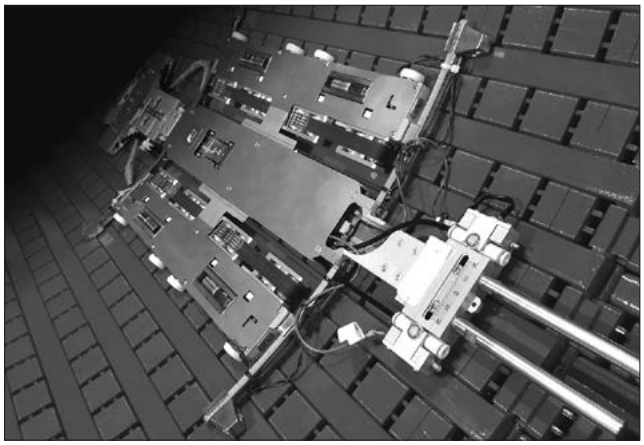
4 Generator Inspection Robot

Precise inspection of generators must be carried out on a regular basis in order to ensure stable operation of a power plant. The problem, however, was that these inspections were costly and took long periods of time to pull out the rotor. To address this problem, Fuji Electric has developed a generator inspection robot that runs through the narrow gap between the generator stator and the rotor without pulling out the rotor, enabling users to plan optimal maintenance work by understanding the accurate status of the generator. The developed generator inspection robot is available in two types, the standard type and the advanced type, which can perform the following inspections, respectively.

(1) Standard type (15 mm thickness)
Stator and rotor visual inspections and iron core defect inspections

(2) Advanced type (19.8 mm thickness)
All of the standard type inspection items, and stator wedge loosening inspections

Fig.6 Generator inspection robot



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Innovating Energy Technology