

Power Generation



Power Plants
New Energy

Outlook

The Japanese power market in FY2017 generally showed steady growth. However, on April 1, 2017, “Partial Revision of the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities” (revised FIT scheme) was put into force, and power project development is anticipated to decrease from FY2018. Furthermore, the opportunities for new coal-fired power generation have rapidly declined under CO₂ emissions continuous reduction, and careful and close monitoring is needed along with the number of nuclear power generations that restart. On the other hand, as a renewable energy, the geothermal power generation market is expected to be more active, owing to the easier planning, for example, by faster evaluation on environment impact assessment. As for photovoltaic power generation, new project development tends to decrease, while the maintenance business opportunities are expected to increase. Wind power generation projects have completed the assessment and the projects are expected to be developed. Fuel cell growth is expected in South Korea as renewable energy.

In the overseas power market, the ratio of renewable energy will rapidly increase. This may lead power sectors in the mature countries, where the power demand growth cannot be expected, to be reorganized and accelerate the business expansion towards overseas markets.

Under mega trend in the energy field, such as distributed generation, lower carbonization, digitalization, higher efficiency and energy savings, wider introducing of flexible power generation, electricity storage technology and smart grid are anticipated.

To be aligned with market trend in thermal power and geothermal power generation, Fuji Electric is enhancing its services for higher plant efficiency, digitalization, lower carbonization, and safe and stable operation.

For the results in FY2017, thermal power generation business continuously received orders for Japan on steam turbines and generators for multi-fuel biomass power projects, and also, received orders for new proj-

ects overseas.

Geothermal power generation business completed second binary power plant in Japan at the end of FY2017, while in overseas secured an order for large scale project on engineering, procurement and construction (EPC) basis.

Service business received several rehabilitation orders for improving efficiency. Diagnosis technology services were enhanced towards slight demand increase and resulted with orders mainly for Japan. Fuji Electric will diligently continue providing higher efficiency of steam turbines and generators and strengthen its organization to comply with the needs of customers.

In the photovoltaic power generation business, outdoor stand-alone type 1,000-kW power conditioning systems (PCS) having the world's smallest footprint have reached approximately 200 units of accumulative order receipts. In addition, the construction of 7 large EPC projects received by FY2016 is progressing smoothly. The existing photovoltaic power plants are reaching their scheduled maintenance, and maintenance business opportunities are increasing.

In the fuel cell business, 5 units of phosphoric acid fuel cells were delivered to South Korea and one unit to Germany and France. South Korea has Renewable Portfolio Standard (RPS) requiring the power sectors to introduce specified ratio of renewable energy resources including fuel cells, driving the fuel cells widely in use, and the RPS is expected to accelerate the demand growth. In addition, Fuji Electric is participating in the project of New Energy and Industrial Technology Development Organization (NEDO) to commercialize solid oxide fuel cell (SOFC) system having high efficiency power generation. 50-kW class demonstrator completed 3,000 hours operation and evaluation. Field demonstrations will be progressed for the product launch in the market within FY2018.

In the nuclear power business area, Fuji Electric is offering technology and products for high earthquake resistance and fire prevention and extinguishing properties conforming to new regulatory requirements for the restart of nuclear power plants and

the construction of nuclear reprocessing plants and mixed oxide (MOX) fuel plant. Decommissioning of the prototype fast breeder reactor Monju, as a part of Japanese Government nuclear power plant decommissioning program, is steadily progressing preparation for fuel removal using Fuji Electric fuel handling systems. Further, to stabilize radioactive waste generated during operation and decommissioning of nuclear power facilities, Fuji Electric is developing waste solidification technology employing a geopolymer material for the application in Japan, collaborating with John Wood Group

PLC in Scotland.

Fuji Electric will diligently and actively work on utilizing renewable energy such as geothermal, photovoltaic and wind energies towards low-carbon society. In the field of thermal power and fuel cells, Fuji Electric is developing high efficient and eco-friendly power generation equipment. Fuji Electric will also provide operation and maintenance (O&M) technology so as to provide stable power safely and continuously to contribute to society with comprehensive power supply technology.

Power Plants

1 Start of Commercial Operation of Power Generation Facility No. 1 at Ishinomaki Hibarino Power Plant of Nippon Paper Ishinomaki Energy Center Ltd.

Fuji Electric has received an order from IHI Corporation, the main contractor, and made a turnkey contract for a reheat steam turbine power generation facility of the Ishinomaki Hibarino Power Plant of Nippon Paper Ishinomaki Energy Center Ltd. We completed designing, manufacturing, procuring, installing, and commissioning, of the steam turbine generator, condensing and feed water system, main circuit and house electrical equipment. In this power generation facility, a single-cylinder reheat steam turbine with axial flow exhaust and an air-cooled generator with upper arrangement of the main terminal are employed. It has high efficiency and saves space by suppressing installation height compared with that of conventional power generation equipment, contributing to the reduction of the construction costs.

Ishinomaki Hibarino Power Plant, which started commercial operation in March 2018, can carry out multi-fuel firing of woody biomass. The power plant can utilize unused materials in the Tohoku region especially in Miyagi Prefecture, and it is expected to prevent the destruction of forests, which has become a problem in Japan recently.

Fig.1 Steam turbine and generator of Power Generation Facility No. 1 at Ishinomaki Hibarino Power Plant



2 Start of Commercial Operation of Peistareykir Geothermal Power Plant in Republic of Iceland

Fuji Electric has received an order for steam turbines, generators and cooling system equipment for Peistareykir Geothermal Power Plant (2 × 45 MW) from National Power Company of Iceland (Landsvirkjun) in cooperation with Balcke-Dürr GmbH of Germany. We designed, manufactured, and delivered steam turbines, auxiliary systems, generators and spare parts, and conducted on-site installation and commissioning. The commercial operation started in December 2017 for Unit 1, and April 2018 for Unit 2. The system is expected to help meet power demand and stabilize the power transmission system of north-east Iceland. Renewable energy power generation accounts for 99% of the annual power generation amount in Iceland.

The steam turbine facility, which needs to be highly efficient, uses an axial exhaust flow type. This steam turbine has low pressure blades of 6.3m², the largest size for a geothermal steam turbine. In addition, corrosion-resistant (corrosion resistance and erosion resistance) technology unique to geothermal power generation were also adopted to resist corrosive geothermal fluid.

Fig.2 Delivered geothermal steam turbine and generator



Power Plants

③ Start of Commercial Operation of 2nd Nagoya Power Plant of Nakayama Nagoya Kyodo Hatsuden Co., Ltd.

Fuji Electric has received an order from IHI Corporation, the main contractor, and made a turnkey contract for a reheat steam turbine power generation facility for Second Nagoya Power Plant of Nakayama Nagoya Kyodo Hatsuden Co., Ltd. We have completed engineering, equipment design, manufacturing, procurement, installation, and commissioning of the steam turbine, generator, condenser, boiler feed water heaters, main circuit electrical equipment, and plant auxiliary power supply system. The commercial operation started in September 2017.

The steam turbine facility needs to be highly reliable and efficient, and it therefore uses a reheat turbine with one casing and an air cooling power generator of a brushless excitation type, which has high reliability and a proven track record. This configuration contributes to high reliability and a compact arrangement of a 110-MW reheat turbine and generator facility.

Fig.3 Steam turbine and generator for 2nd Nagoya Power Plant



④ Low-Pressure Turbine Replacement for Existing Power Generation Facility at Noshiro Thermal Power Station of Tohoku Electric Power Co., Inc.

Fuji Electric has replaced main components of 2 low-pressure turbines, including low-pressure turbine rotor, low-pressure inner casing and diffuser, of Noshiro Thermal Power Station of Tohoku Electric Power Co., Inc. by applying the latest technology to increase yield strength and improve efficiency.

The reaction stages have 3DS blades, which were developed using the latest analysis technology, to reduce profile loss and secondary flow loss. An optimized 3DV blade arrangement was also adopted to remove the classic distinction between reaction stages and impulse stages. Further, efficiency improves due to the use of a high-performance exhaust diffuser with reduced turbine exhaust loss.

Construction of the power generation facility was completed as planned, and the operation restarted in December 2017.

Fig.4 Low-pressure turbine rotor



⑤ Replacement of Generator Air Cooler Made by Another Company for Saline Water Conversion Corporation of Saudi Arabia

The Saudi Arabian Company Saline Water Conversion Corporation (SWCC) has 5 generators made by another company operating at Shoaiba Power Plant (phase 2). Fuji Electric received the order of replacing 12 air coolers (3 generators \times 4 units), which are installed in 3 out of the 5 generators. We designed an air cooler on the basis of on-site investigation results. After manufacturing, we performed a hydraulic pressure test witnessed by SWCC employees, shipped the products in March 2018 and completed delivery to the plant in May.

We succeeded in receiving the order because our generators in phase one of the same plant operated well and were highly evaluated by SWCC. We will continue working on quality assurance at the plant to receive an order for replacing the 8 air coolers of the other 2 generators.

Fig.5 Hydraulic pressure test on air cooler

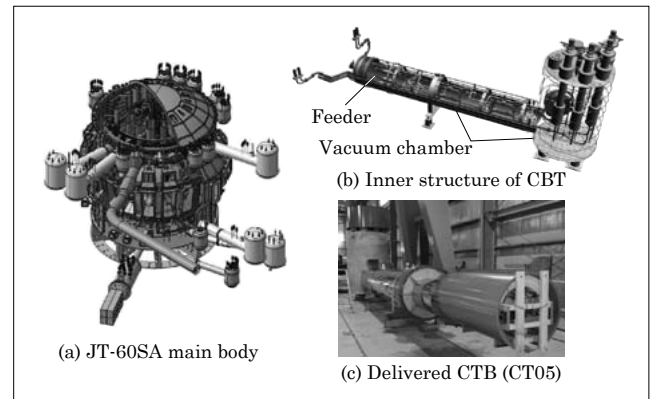


Power Plants

6 Production of Superconducting Power Supply Facility (Coil Terminal Boxes) for JT-60SA

JT-60SA is a large plasma test facility that the National Institutes for Quantum and Radiological Science and Technology is constructing at the Naka Fusion Institute. This project is jointly implemented by Japan and Europe in parallel with the ITER plan to realize fusion energy at an early stage. Fuji Electric received an order for 4 coil terminal boxes (CTB), which supply electricity to superconducting coils of JT-60SA. We delivered 2 CTBs in December 2017, and we are now manufacturing the remaining 2 units. The CTB consists of feeders and a vacuum chamber that houses the feeder. The CTBs receive up to 20-kA electric current at a room temperature and feed it to the coils through the feeders cooled to 4 K by liquid helium. The feeders need to have a break-down voltage performance of 21 kV DC in a vacuum, low-temperature environment and needs to be resistant to thermal deformation due to temperature change. We have worked on the basic design, prototype and testing, contributing to the achievement of JT-60SA.

Fig.6 JT-60SA main body and CTB



Figures courtesy of National Institutes for Quantum and Radiological Science and Technology

New Energy

1 “PVI1000BT-3P/1000-F” PCS for Photovoltaic Power Generation , Completing Product Registration with Provincial Electricity Authority (PEA) of Thailand

The growth rate of commercial photovoltaic power generation are slowing down in Japan, while still being expected to increase in Southeast Asian countries, including Thailand. Thus, Fuji Electric has developed the “PVI1000 BT-3P/1000-F” PCS for photovoltaic power generation (1,000V DC, 1MW) and registered the product with the Provincial Electricity Authority (PEA) of Thailand. Regarding the grid connection function (protection relay and reactive power output), we clarified the difference in requirements between Japan and the PEA. We then developed software that allows functions that meet both by changing the parameter. We confirmed that its grid connection function normally operates by connecting a 1-MW unit to a large-capacity grid simulator to undergo a grid fault specified in the PEA requirements. The witness inspection attended by a PEA examiner proved that the PCS satisfies the requirements and the product registration was completed in March 2018.

Fig.7 “PVI1000BT-3P/1000-F”



2 Phosphoric Acid Fuel Cell for Youil Industry Co., Ltd. in South Korea

In South Korea, renewable energy is becoming widespread due to the government policies, such as the Renewable Portfolio Standard (RPS). The RPS obligates electricity utilities to supply a predetermined rate of electricity generated from renewable energy sources. Electricity utilities are purchasing renewable energy-derived power, and a purchase market is being formed. Fuel cells are also involved in new renewable energy, which is subjected to the new policy, and use of them is expanding rapidly.

Fuji Electric delivered five 100-kW phosphoric acid fuel cells to the South Korean company Youil Industry Co., Ltd. in FY2017. The company generates power with fuel cells and sells the electricity to electricity utilities. We will use this experience to further promote the sales of phosphoric acid fuel cells in South Korea, focusing on the small- and mid-scale power generation business and cogeneration.

Fig.8 Delivered phosphoric acid fuel cells





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