



Nuclear power: the Japanese experience

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Tokyo Electric Power Company (TEPCO) has more than 28 million customers and the company's aggregate sales total roughly 300 terawatt hours (TWh). Currently, our 17 nuclear units comprise nearly 30 per cent of our total generation. We plan to build three more nuclear power plants by 2017 and another one around 2020 as we focus on creating a low-carbon energy mix. Japanese Power Utilities plan to derive 50 per cent of our energy from non-fossil sources and to reduce CO₂ emissions per kWh to 0.33kg by 2020. In September 2006, we applied for a reactor installation permit for the Higashidori 1 plant and have since been implementing on-land preparation work and port work. TEPCO together with the Japan Atomic Power Company (JAPC) established the Recyclable-Fuel Storage Company in November 2005. An interim storage facility for spent fuel is planned to begin operations in 2012. In Japan, spent fuel that exceeds the annual reprocessing capacity of Rokkasho Reprocessing Plant is stored for future reprocessing. In FY2009, the two nuclear power stations in Fukushima Prefecture achieved a capacity factor of 82.5 per cent. Recently, regulations were revised so that the operating period, which was previously set at 13 months for all plants, was extended to a maximum of 24 months. We can therefore anticipate the capacity factor to improve even further. In August 2010, Fukushima Daiichi 3 loaded mixed oxide (MOX) fuel, which proves that we are making steady efforts towards the establishment of the nuclear fuel cycle.

Nuclear power generation and low-carbon policy

Nuclear energy, with its superior characteristics in terms of energy security, environmental protection, and economic competitiveness, holds the key to promoting and sustaining a low-carbon society due to the following:

1) Supply stability

Japan's energy self-sufficiency rate is only 4 per cent. Nuclear power plants can generate a large amount of energy from a small amount of fuel. Operations alone can be maintained for 2.5 years using our domestic storage. Nuclear fuel is also recyclable. We can increase our energy self-sufficiency ratio by using spent fuel as a resource. Of the total content of spent fuel, 95 per cent is reusable materials and the remaining 5 per cent is 'real' waste. Reprocessing spent fuel will reduce the volume of high-level waste and produce domestic energy resources. MOX fuel use will save 20-30 per cent of total

uranium resources. There will effectively be no resource limitations with the full-scale use of a fast breeder reactor.

2) CO₂ reduction abatement cost

Nuclear power does not release CO₂ through electricity generation. Even if fuel mining and plant construction are taken into account, CO₂ emissions are still extremely low. The annual CO₂ reduction of one 1,000MW nuclear power plant is estimated to be approximately 5 million tonnes of CO₂ compared with oil-fired power plants. Improving Japan's nuclear capacity factor by merely 1 per cent reduces emissions by approximately 3 million tonnes. The CO₂ reduction benefits of nuclear power account for about 171 million tonnes per year (Japan's total emissions account for 1,214 million tonnes of CO₂).

3) Economic performance

Nuclear generation cost was at par with any fossil-fuel-fired power source when the oil price was US\$27. With the rise of fossil fuel prices, the cost advantage is stronger. Nuclear power also has positive impact on GDP. When 10 NPP units are constructed, it has been estimated that this would generate a ¥38 trillion increase in income due to an increase in capital expenditure, reduction in fuel imports such as oil, income effect of lowered rate, and spillover effects.

Current status of nuclear power plants and fuel cycle in Japan

In Japan, 54 reactors are currently in operation, with a total capacity of 49GW. This gives Japan the world's third largest nuclear power capacity, after the US and France. An additional 14 reactors will soon be in operation.

The Japanese government has chosen a closed fuel cycle as the national policy. Japan Nuclear Fuel Limited (JNFL) is operating a nuclear fuel cycle facility in Rokkasho village of Aomori Prefecture, where a Uranium Enrichment Plant, Low Level Radioactivity Waste Disposal, and a Vitrified Waste Storage Centre have begun operations. A Reprocessing Plant is now undergoing a final commissioning test.

Status of Kashiwazaki-Kariwa NPS after earthquake

On 16th July 2007, an earthquake with a magnitude of 6.8 struck the Niigata Chuetsu-oki area. TEPCO has been conducting an inspection and evaluation of all facilities and implementing the necessary restoration work for upgrading

seismic safety. The analysis and tests reveal that the reactors and other core safety items have the durability to resist an acceleration rate exceeding 1,000 galileo units (gal). However, the pipings require approximately 3,000 individual reinforcements attached to each reactor in order to be able to withstand a seismic acceleration of 1,000 gal. Unit 7 resumed commercial operation in December 2009, followed by Unit 6 in January 2010 with the approval of the government's safety authorities and consent from local governments. In addition, Unit 1 resumed commercial operation in August 2010. Unit 5 is ready to commence start-up tests. The seismic upgrading work for the remaining three reactors is also making steady progress. We are applying the same initiatives to the other nuclear power stations.

TEPCO is also sharing the knowledge and data they have acquired in dealing with this earthquake with specialists around the world. Seismic Safety Workshops organized by the International Atomic Energy Agency (IAEA) took place in Kashiwazaki City, where global experts gathered to reassess international seismic safety standards such as Guidelines for Seismic Safety Assessment for Existing Plants and Guidelines for Plant Restart after Earthquake. TEPCO's earthquake-related expertise is highly valued.

ABWRs and next-generation reactors

Units 6 and 7 at the Kashiwazaki-Kariwa Nuclear Power Station were the first Advanced Boiling Water Reactors (ABWRs) built in Japan with home-grown technology. ABWR technology was developed, with the support of the Japanese government, by the manufacturers and power companies that have had experience in building and operating Boiling Water Reactors. The development objectives were: enhancing safety and reliability; reducing occupational radiation exposure and radioactive waste; enhancing operability and manoeuvrability; and improving the economy. Over a decade ago, in 1995/96, we already achieved a work schedule of 40 months from bedrock inspections to fuel loading, which is a substantial shortening of the normal work schedule. As of August 2010, four units are in operation, another four units under construction, and ten units in the planning phase.

Furthermore, towards the commencement of commercial operation in 2030, next-generation reactors are being jointly developed under public-private partnership. We have set development goals such as the unit construction cost of approximately 130,000 yen/kW, plant life of 80

years, and availability factor of 97 per cent. Given the achievements we have made so far, these goals are likely to be accomplished.

Overseas business opportunities

In July 2010, TEPCO established the International Nuclear Project Group in the company's Nuclear Department. It will provide advice to other countries interested in ABWRs and seek new business opportunities. On the premise of obtaining a conditional guarantee of liabilities from the US Department of Energy (DOE), in May 2010, TEPCO decided to make investments in the South Texas Project (STP) Units 3 and 4 construction project. Taking into consideration the long-term benefits such as CO₂ reduction, stable energy supply, and economic efficiency, we believe that investments in nuclear power will pay off in the long run. We are committed to sharing our 40 years of experience in safe and stable nuclear power plant operation with operators all over the world. As active participants in the Nuclear Renaissance, we continue to be involved in overseas development projects as well. TEPCO remains continually committed to advance the safe operation of nuclear power in order to secure the stable supply of energy, both at home and abroad.

Social trust

Nuclear energy is the key to sustaining a low-carbon society due to its superior characteristics in terms of stable supply, CO₂ reduction and economic performance. However, while the latest opinion polls in Japan show that 60 per cent are for the promotion of nuclear power, as in Europe and the US, over 50 per cent are still anxious about nuclear power. TEPCO recognises the need for continuous efforts to promote public understanding. Transparency and proactive information disclosure are important to reassure and win social trust. All 'nonconformity events' such as irregularities and malfunctions that occur at the company's nuclear power stations are released to the public through press releases and on the company's website. In addition, the daily efforts of the power stations in respect of safety and quality control are communicated to local communities through public relations magazines and newspaper advertisements. Such initiatives are valued by the local residents. The trust of society is indispensable for nuclear power operation and development. Thus, TEPCO aims to establish a brand that is trusted by society, through safe and stable operation, proactive information disclosure and dialogue with public. □