View from Japan

by Shunsuke Kondo

Bridging the transition to a safe & secure energy future

Japan's 52 nuclear power plants supply about a third of the country's electricity, becoming a safe, reliable and competitive energy source. Even if nuclear power rightfully is considered a domestic source of primary energy, Japan's degree of self-sufficiency in primary energy supply is only about 20%, of which 16% comes from nuclear and the rest mostly from hydropower.

Over past years, nuclear power has contributed to the rising percentage of electricity generation from non-fossil fuels from 38% in 1990 to 44% in 2001. By 2010, 49% of total generation is predicted to come from non-fossil fuels.

Japan's environment is benefiting. Though electricity generation rose by more than 21% since 1990, associated carbon dioxide emissions increased less than 7%. By 2010 Japan's electricity demand is predicted to reach 900 billion kWh. The electric utility companies are committed to reducing the CO_2 emissions, and are continuing construction of four nuclear power units and preparing to build six additional ones, though it will take more than ten years before the completion of latter.

Expansion and growth prospects for nuclear power are weak globally with growth predominantly centered in Asia. Of the 36 units under construction worldwide, 20 are located in Taiwan, China; India; Japan; and South Korea.

Why are Asian countries starting and/or increasing the use of nuclear power? In my view, three reasons, mainly. One is that the per capita endowment of energy resources in the region is scarce compared with others. Nuclear power is practically a unique energy source that contributes to making their energy supply portfolio more attractive from the viewpoint of energy supply security. A second reason is the increasing recognition that we have already started to confront adverse environmental effects; the world cannot reconcile human needs and environmental security if we continue the reliance on the burning of fossil fuel for energy production. A third reason is the recognition that nuclear power has reached a technical and institutional maturity.

Nevertheless Asia's relatively positive scene does not mean that nuclear will be a major player for future electricity generation in this region. According to the International Energy Agency's World Energy Outlook of 2002, more than half of the new electrical generating capacity projected in Asia for construction by 2030 will be gas-fired. New nuclear capacity is projected to be about one-tenth that of natural gas.

These predictions seem to be inconsistent with the result of long-term forecasts of energy supply and demand, including that of the International Panel on Climate Change (IPCC) Special Report on Emission Scenarios (SRES). This report indicates that nuclear energy may be a major component of the global energy supply mix in the latter half of this

Photo: Akashikaikyou Oohashi Bridge, Awajisma Island, Japan. Credit: Junichi Higo/IAEA

century to curb the accumulation of greenhouse gas in the atmosphere.

Break of Dawn

The Japan Atomic Energy Commission (AEC) believes that we are not at the brink of nuclear power to be a minor electricity supplier but at the break of dawn for nuclear power to become a major player in the world. To this end, the AEC is asking relevant administrative organizations and industries to pursue coordinated strategic efforts, sharing the vision that safe, economical, and reliable nuclear energy technology will contribute as a mainstay of electricity and heat generation technology, fostering economic growth, providing security and fuel diversity, and enhancing environmental quality in many parts of the world.

The AEC has recommended a three-tier strategy — or a well coordinated mix of near-term, mid-term, and long-term plan of actions. The objective of the near-term plan is to continue the most effective utilization of existing nuclear power plants and fuel cycle facilities.

This can be done not only by developing a broad range of technologies that promises enhancement of their long-term performance but also by assuring public acceptance through accountable behavior. Actions toward this objective are, on the one hand, to promote use of the plutonium recovered from spent fuels by reprocessing in light-water reactors (LWRs), securing adequate interim spent fuel storage capacity at-reactor and away-from-reactor facilities, and preparing for the selection of the site for geological disposal of vitrified high-level radioactive wastes.

On the other hand, the AEC also requests to develop and apply advanced technologies for increased output of existing units, longer-term reliable operation of existing units, high burn-up fuel to improve the economy of operation, and economical dismantling of nuclear facilities and management of radioactive wastes generated in the process, adopting risk-informed decision making of inspection and maintenance activities and accountability-conscious quality management systems. These measures are essential to the maintenance of a high level of safety, safeguards and security, continuously improving the economy of the construction and operation of fuel cycle facilities as well as nuclear power units. We request that these activities be promoted with toughness, resolution, and consideration to details, as they directly affect the performance of existing plants and facilities and around 70% of the general public still feels uneasy toward the safety of nuclear facilities, swayed by widespread media coverage of any incident when it occurs.

In parallel with these kind of activities, the nuclear community should prepare relevant measures to mitigate the effects caused by crises that hamper the sustainable use of nuclear energy as well as implement effective measures to prevent the occurrence of such crises. Furthermore, the growing universality of technology now makes successful innovation much more frequently driven by market forces. It is thus important for the nuclear community to pursue the environment shaping strategy that aims at realizing synergistic coexistence of nuclear reactor systems with various industries besides the electricity industry. This entails building networks for mutual learning, knowledge-sharing, and joint deliberation, starting from those utilizing radioactivity and radiation for industrial, medical, scientific and other activities. This will serve to make the man on the street familiar with the application of radiation, radioactivity, and nuclear reactions.

The objectives of the mid-term plan are to develop more economically competitive and "human-conscious" plants that can compete with emerging non-nuclear power technologies for replacement and addition of generation capacity. The need for pursuing this objective is clear. The competitive operation of today's units and facilities by no means guarantees the adoption of the same type of plants and facilities for replacement of retiring units or for the addition of capacity.

In this age of technological innovation, deregulation of the electricity market is sharply altering the financial landscape for utilities, which are no longer guaranteed a fixed return on investment. This makes it extremely difficult to justify the design and construction of capital-intensive plants to stockholders. Added factors are the emergence of innovative and "neighbor–friendly" modular power generation technologies such as renewable energy sources and fuel cells.

Actions to be taken for pursuing this objective are to reduce the capital cost of nuclear power plants by new designs with, for example, innovative concepts and components; to improve robustness of nuclear power plants in safety and reliability by adoption of passive safety features; to minimize environmental impact by reducing volumes of radioactive waste generated during the decommissioning as well as operation of facilities; and to improve the "human consciousness" of nuclear plants by pursuing low occupational exposure to radiation, low workloads in operation, maintenance, and emergency situations.

The major investment for these activities should come from private sectors that operate the plants and facilities. However, government should support research and development for actions of a long-term and/or generic nature. This will ensure that a broad range of technologies is developed that promises to enhance the long-term performance of various types of existing and future facilities.

We believe that the nuclear community should prepare itself better for changes in our society. We are living in a period of "profound transition", according to Peter Drucker, the

renowned policy strategist. The evidence to support his assertion is seen in Japanese society:
❶ in the discussion of future energy demand — energy consumption in Japan is predicted to start decreasing before 2030 and most likely at around 2020,
❷ the pursuance of a "zero emission society", which has found momentum by Japan's enactment of the Basic Law for Establishing a Recycling-Based Society; and
❸ the expansion of niche markets for distributed electricity supply systems.

Oil — most of it imported — remains Japan's largest source of energy, but the level of dependence is shrinking. Nuclear energy and natural gas are making up the difference. Since the oil crises in 1973, oil's share of energy consumption has fallen 25%, while the combined shares for nuclear and gas have grown to top 30%.

Photo: Sendai nuclear power plant, Sendai, Japan. Credit: Kyushu Electric Co.

This transition forces us to acknowledge in the strategic plan that over the long term, not just new but truly radically new energy technologies are coming. They will effectively address the challenges of air pollution, climate change and energy supply insecurity while expanding energy service worldwide. During the second quarter of this century many other technologies — such as photovoltaic power, fuel cell cars, hydrogen derived from many sources and di-methyl ether or similar synthetic fuel derived from biomass — will become as commonplace as gasoline cars and coal-fired power plants are today.

It is essential for the nuclear community, therefore, to continue to explore innovative nuclear energy supply system concepts that can compete in such new energy markets. This will make nuclear energy technology sustainable in terms of social acceptability as well as in terms safety, economy, environmental protection, and non-proliferation.

Preparing for the Future

Such system concepts should include nuclear reactor systems that are consistent with the pursuit of a "zero emission" society. Examples are to develop practical technologies to reduce the toxicity of high-level radioactive waste bound for geological disposal and nuclear reactors that can be used for the production of hydrogen as a fuel in the transport sector.

We believe that the government should support exploratory activities for future energy systems. It is important for the government, though, to establish a level playing field to assure fair assessment of various options, nuclear and non-nuclear. This serves to prevent the emergence of public mistrust of the government's energy policy. International collaboration should be effectively implemented to increase transparency and accountability – and to reduce research and development costs.

Finally, the AEC recognizes the importance of successful continuation of nuclear construction activities by fostering competitive plant designs. Without progress, it will become very difficult to maintain qualified suppliers of nuclear equipment and components, contractor and architect engineer/engineering organizations with the personnel, skill, and experience in nuclear design, engineering, and construction. Therefore we consider it our responsibility to ask concerned organizations to review the situation, plan and execute actions to assure the availability of needed experts in various sectors essential to the maintenance of infrastruc-tures for regulation, construction and operation of nuclear facilities.

These and other key aspects of nuclear knowledge management can be effectively pursued in consultation with professional societies, and through global collaboration among the main institutional players. Preserving and cultivating the "know-how" in this way will bridge the transition in the dawn to a safe and secure energy future integrated with the wise utilization of nuclear energy systems.

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