Japan: A look at its future

by Gregg M. Taylor

With one of the largest nuclear power programs in the world, Japan is looking ahead to doubling the number of its power reactors by the year 2010, although industry and government officials admit that the pace of construction necessary to reach this goal may be difficult to achieve. Japan also plans to burn reprocessed plutonium in light water reactors (LWRs) and—in the next century—commercial fast breeder reactors (FBRs).

The planned recycling of plutonium, intended to avoid creation of a large stockpile and to use energy resources more efficiently, has sparked some international opposition. And the siting of new nuclear plants in Japan has become more difficult because of local opposition in some areas.

In separate interviews, *Nuclear News* talked to two Japanese nuclear industry executives—at the Japan Atomic Industrial Forum (JAIF) and Tokyo Electric Power Co. (Tepco)—for an update on the nuclear future in Japan.

Public opinion

For nuclear power, "the prospect here is not bad, compared to other countries," said Kazuhisa Mori, executive managing director of JAIF, in Tokyo. "Although we cannot say that everything seems to be very smooth for the future, at least compared to a couple of years ago, the situation has been improving gradually."

Speaking in a typical Japanese poetic analogy, Ryo Ikegame, executive vice president of Tepco, reflected that "it rained after Chernobyl, and now it's cloudy—but we can see the sunny part of the sky. I'm rather optimistic about the future of nuclear power plants [here], because Japan has no oil, no coal, no gas—so we have to depend on nuclear, and this is good for the environment."

Siting of nuclear plants in Japan can have difficulties, Mori said. "The problem is that in various areas of the country where siting seems to be rather easy, there is no urgent need for such facilities." In fact, "the local assemblies or local parliaments are passing bills to try to attract additional plants to existing sites." On the other hand, "in some other regions where additional plants are urgently required, it seems that siting for new sites is getting difficult."

Ikegame noted that, "of course, some people are against nuclear, but others are against fossil-fired plants because they will produce NO_x, SO_x, and CO_2."

In an August 1991 JAIF poll of Japanese citizens, 70 percent considered nuclear power generation to be necessary, Mori said. "When they were asked if they think nuclear power will be safe, somewhere between 47 and 48 percent of them answered that they had apprehension about safety. So, in the past year, the general population's apprehension about the safety of nuclear power generation has not been greatly improved."

Mori said that two plant incidents at Japanese units—the disintegration of a recirculation pump bearing in January 1989 at Tepco's Fukushima Daiini-3, and a steam generator tube rupture and emergency core cooling system (ECCS) actuation in February 1991 at Kansai Electric Power Co.'s Mihama-2—"were just a reliability problem, not a safety problem." Nonetheless, he noted, "it was reported as if those incidents, reliability problems, directly threatened safety, and that was the way they were perceived by the general public."

Mori: The prospect is not bad

As a result of this misunderstanding by the public, Mori said, persons in the nuclear power industry are asking themselves if they should provide the public with a consistent and logical explanation of what is really meant by safety. "Twenty years ago, we used to say, 'nuclear power plants are safe because if anything goes slightly wrong, the system will stop—therefore nuclear power plants are safe.' But recently, because capacity factors have been very efficient, it's been said that Japanese power plants are safe because they don't stop." In the Mihama-2 incident, for example, "the ECCS worked, the reactor stopped, and therefore in the older way of interpretation safety was ensured. But in the recent way of people's thinking, if the emergency system worked and the reactor stopped, it was a major safety problem."

Mori observed that "certain political opponents are taking advantage" of the public's apprehensions about nuclear power. For instance, if they do not like an incumbent mayor, they use opposition to nuclear power to prevent him from being associated with any major achievements, such as construction of a nuclear plant. In another context, Mori noted that when mayoral candidates who oppose nuclear power are elected, "quite often those candidates turn out to be a very reliable mayor—even from the viewpoint of the utilities."

Dealing with nuclear

Unlike the United States, which has state-level public utility commissions for rate regulation of nuclear and other power plants, "we don't have any prefecture-level regulation," Ikegame explained.

However, he said, the consent of the prefecture governor is required by law for construction of a power plant. "Recently, the governor of Shizuoka Prefecture opposed the construction of a thermal plant in Shimizu City, which is a territory of Chubu Electric," he said. Although the city had agreed to the plant, because of the governor's opposition, plans for building the unit were canceled.

Before submitting a formal application to get site approval for a new power plant, a Japanese utility will work earnestly to develop a positive consensus with area residents and local government. The process is an example of the Japanese tradition of seeking harmony in the implementation of a project. "This is the most difficult part of the entire licensing procedure," commented Ikegame.

Electricity rates in Japan are governed by the Ministry of International Trade and Industry (MITI), Ikegame said. "Every time we want to change the rate base, then the government [MITI] will say that 'you can reduce the cost.'"

Mori said that persons in the nuclear business tend to listen just to people "who are nice to them," and it seems difficult for utilities to listen to those who are critical. "They turn away from those people who tend to become their enemies." He suggested that this "attitudinal problem" on the part of the nuclear business and utilities is an area for improvement.

"In my personal opinion, we often say that the public are misled, that there is misreporting on the part of the newspapers," Mori continued. "That might be true, but on the other hand, we must also admit that kind of attitudinal problem on the part of utilities or people in the nuclear business."

In response to concerns about the public perceptions of nuclear power, Kansai Electric announced last February the creation of the Institute of Nuclear Safety Systems, Inc., an independent company wholly owned by the utility. The institute will conduct studies and R&D on safety engineering at nuclear plants, and on how to harmonize nuclear power generation with society. In its third-party role, it will also strictly monitor Kansai's safety approach.

The utility's intention is for institute activities to improve nuclear power plant reliability and restore public confidence in nuclear energy, in the wake of the Mihama-2 incident.

The institute announced that its chairman would be Shoichiro Kobayashi, chairman of Kansai, and the president and director-general would be Nobuaki Kumagai, former president of Osaka University. A Nuclear Safety System Advisory Committee, of about 15 authorities in engineering and the humanities, will advise the director-general. There will also be an Overseas Advisory Committee, chaired by Lord Marshall of Goring, chairman of the governing board of the World Association of Nuclear Operators. Two small research institutions will be set up, focusing respectively on social and technical areas, for researchers from Japan and abroad.

Ikegame: "I'm rather optimistic"

Nuclear goals

An Atomic White Paper, released by the Atomic Energy Commission of Japan and then approved by the Cabinet in October 1990, set targets for the country's nuclear capacity of 50.5 GWe by the year 2000, and 72.5 GWe by 2010. In 1990, Japan had 39 operating nuclear units, and to meet the 2010 goal, about 40 units would have to be built in the following 20 years—an average of two completed each year.

It would be difficult to meet the goal for 2010, Mori said. But, he added, this also will be the case for the 30 million–kiloliter-oil-equivalent goal set for 2010 for new non-nuclear energy sources, such as solar, geothermal, and wind power.

The calendar 1991 average capacity factor for the 41 commercial nuclear power units in Japan (with a total capacity of 33.239 GWe), was 73.5 percent, and the availability factor was 74.6 percent, according to MITI. In 1990, the average capacity factor of the 39 units operating then was 71.2 percent.

In calendar 1991, the capacity factor was 76.1 percent for boiling water reactors (21 units), 70.2 percent for pressurized water reactors (19 units), and 65.1 percent for one gas-cooled reactor. The BWR statistic was 8 percent better than the previous year because all 13 BWRs of Tepco were fully operable throughout the summer. The PWR figure was 5.1 percent lower than in 1990 because of the Mihama-2 steam generator tube rupture and resulting inspections of steam generators at several units.

Recycling fuel

Plutonium, reprocessed from spent fuel from Japanese nuclear plants by BNFL in Great Britain and Cogema in France, is to be be recycled into uranium-plutonium mixed-oxide (MOX) fuel, and burned in Japanese reactors. Uranium also will be recycled. Ikegame said there will be a shipment of plutonium from Europe to Japan this year. Nuclear industry officials in Japan stress that the purpose of recycling is to reduce the level of the stockpile of plutonium returned to Japan.

Mori said that without recycling, by the year 2010, Japan would be consuming 10 to 20 percent of the total world uranium production. "Our concern is not vulnerability—it is that we might be disturbing the marketplace," he explained. "We should try to control our consumption to 5 to 10 percent at most. And exploration activity alone can be disruptive to the environment, be it for uranium, oil, or whatever." He predicted that "ultimately, mankind will be required to make efficient use of uranium—using it 50 or maybe 100 times more efficiently."

The first shipment of plutonium to Japan, due in late 1992, will be escorted by the recently commissioned 6500-tonne *Shikishima,* specially built for the purpose. The lightly armed ship is operated by Japan's civilian Maritime Safety Agency, similar to the U.S. Coast Guard. The Japanese navy is banned by the country's constitution from operating more than 1000 miles (about 1600 km) from Japanese shores.

Shipment by air has been denied by the U.S. Congress. Under a 1988 agreement, U.S. approval is required for shipment of plutonium derived from uranium fuel from the United States used in Japanese reactors.

Two activist groups, the Nuclear Control Institute and Greenpeace International, have charged in a May news conference in Washington, D.C., that the shipments would have "inadequate safety provisions and emergency preparation."

"The Japanese people are most strongly committed to the Nuclear Nonproliferation Treaty," said Mori, "because by nature, as a people, we are most committed to the exclusively peaceful use of nuclear material." Japan is a signatory to the NPT. "If we stockpile excessive amounts of plutonium—although we do not have such intention—that leads to misunderstanding by people outside of the country." Ikegame said, "We are planning not to store a significant amount of plutonium because everybody's very nervous about the storage of plutonium."

Mori said that plutonium to be burned in LWRs is unlike that used for atomic bombs: "LWR plutonium degrades very quickly because it is lower in quality." It is difficult to process into bomb-grade material "because of too many impurities—we can't do that in Japan," he said, adding that perhaps countries with advanced military technology—such as the United States or Russia—could process it.

Another problem with LWR plutonium, Mori noted, is that with time, "the impurities will become radioactive, so it becomes even more difficult to reprocess after being left idle for many years. Therefore, we should get rid of surplus plutonium as soon as possible."

MOX fuel is now used at the Fugen prototype advanced thermal reactor (ATR), a 148-MWe (net), heavy-water moderated/light-water cooled, pressure-tube–type reactor, in Tsuruga, Fukui. The plant started operation in March 1979. MOX fuel is also used at the experimental Joyo FBR, a 100-MWt unit that began operation in 1978, and will be used at the Monju prototype FBR, in Tsuruga, a 280-MWe unit scheduled to start operation in early 1993. All three sites are operated by the state-owned Power Reactor & Nuclear Fuel Development Corp. (PNC), which also makes MOX fuel for them.

A 1991 advisory committee report to the AEC said that utilities should study the timing of starting overseas fabrication of MOX fuel from plutonium recovered from reprocessing there. It called such overseas fabrication appropriate for at least a transitional period. Fabrication of MOX fuel will be eventually commercialized by the Japanese private sector.

"We have to increase the use of MOX fuel gradually," said Ikegame. "Our main source of the plutonium will be Cogema and BNFL for the first 10 years. And that will be changed to the Rokkashomura reprocessing plant," a facility to be built at Rokkashomura (Rokkasho village) by Japan Nuclear Fuel Service Co. JNFS is a private company mostly owned by utilities, with lesser ownership by industrial and financial companies. Rokkashomura is located in Aomori Prefecture, 600 km north of Tokyo, at the northern end of Honshu island. Using the Purex process, the facility would start recovering uranium and plutonium from spent LWR fuel at the end of the century. It would reprocess plutonium for use in LWRs, ATRs, and FBRs. Local opposition has been delaying construction of the plant.

A smaller PNC reprocessing plant at Tokaimura currently recovers plutonium for use in reactor R&D, such as at the Fugen ATR.

The fast breeder reactors

An FBR uses fuel with high efficiency. Not only can an FBR "burn" plutonium, such as that in MOX fuel, but it can also—using fast neutrons—convert U-238 into plutonium, producing more fuel than it consumes. Natural uranium contains only 0.7 percent U-235, with the remaining portion being U-238, Ikegame said. "If we develop FBRs, we can use 60 times more energy from the same amount of natural uranium," he said. The 1991 report assigns to FBRs the top priority in plutonium recycling.

A demonstration FBR would be built, to start operation about 2005, according to Kansai Electric president Yoshihisa Akiyama, quoted in the January 1992 *Atoms in Japan*. The reactor would be operated by the private sector.

The 1991 report says the aim of LWR fuel recycling is for it to have a role in the energy supply sector, and to develop the technologies and infrastructure for commercial-scale recycling, with eventual commercialization of FBRs. It also recommends that a plutonium recycling program in LWRs be implemented in the mid-1990s, based on results of demonstration programs in LWRs conducted with a small number of MOX fuel assemblies. It recommends that MOX fuel be used in the mid-1990s in ¼-reactor cores of one BWR and one PWR. It says that recycling should be gradually and systematically expanded, to load ⅓-reactor cores of four 1000-MWe-class LWRs with MOX fuel by the end of the 1990s, and 12 of them shortly after the year 2000.

The 1991 report estimates that plans for recycling plutonium in LWRs, ATRs, and FBRs through about the year 2010 would require 80–90 tons of fissile plutonium (Puf). It calculates that the Japanese supply of plutonium through the year 2010 will total about 85 tons of Puf—with about 5 tons coming from the Tokai reprocessing plant, about 30 tons from overseas reprocessing, and about 50 tons from the Rokkashomura reprocessing plant.

Akira Oyama, vice chairman of the AEC, said in the January 1992 *Atoms in Japan* that an estimated 20 to 30 tons of plutonium would be used in FBRs and prototype and demonstration ATRs. And if MOX recycled fuel were used in 12 LWRs at the beginning of the 21st century, about 50 tons will have been used by 2010. "Supply and demand should thus balance well in this way," he said.

"In the long term, we plan to recover plutonium from spent fuel and burn it as recycled fuel. This is the policy of Japan—to recycle fuel and conserve energy."

"I know the spot market for uranium is very miserable—the price is very low," Ikegame said. "If we see that it will continue for many years, then nobody will talk about FBRs. But I think that recycling of the fuel is very important—reprocessing and the use of the fuel itself. Plutonium or the recovered uranium is very important for Japan for the long term. So, we are determined to continue the development of the FBRs—but this is not for today or tomorrow," but for farther into the future.

"In the long term, we plan to recover plutonium from spent fuel and burn it as recycled fuel," Ikegame said. "This is the policy of Japan—to recycle fuel and conserve energy. And in the meantime, we have to burn it in light water reactors, because to develop the FBR takes time, and we don't [want] to have a big stock of plutonium." He said that Tepco LWRs will be among those burning MOX fuel.

"If you look at the period up to the year 2010," Mori commented, "the FBR is not likely to be a real facility in the near future. So, it was not the intentional goal to burn plutonium in LWRs, it just happened to be."

In the annual JAIF meeting last April, Kozo Iida, executive vice president of Kansai Electric Power Co., said that to commercialize FBR technology, Japanese utilities intend to build three fast reactors between now and 2030—one every 10 years.

"If some day, by any chance, the construction costs for the FBR can get equivalent to LWR construction costs, then everything can be burned in the FBR, ultimately," said Mori. "It also depends on the price of uranium. If uranium gets five times as expensive as it is today, then we will be using mostly FBRs."

Recently, a different use for FBRs was discussed by the PNC's president, Takao Ishiwatari. He suggested in a speech last April to the Foreign Correspondents Club of Japan that the breeding capability of FBRs be deemphasized, and that instead there be a focus on the fast reactor's ability to burn plutonium—because of the high level of world plutonium stocks.

The advanced thermal reactor

The future role of the advanced thermal reactor in Japan is apparently undetermined as yet. The importance of the ATR and the extent of its use will largely depend on the economics of its operation.

The ATR, being developed primarily by Japanese technology, can use a variety of fuels, such as plutonium and depleted uranium recovered from reprocessed LWR spent fuel. If necessary, it could supply plutonium for FBR use, by using enriched uranium.

"In the case of the LWR, assuming that we will continue with the present level of technology, we have to use a combination of fuels and carefully design the position of the different kinds of fuel in the core—for only up to one-third can be plutonium," Mori said. "That is very complex and difficult to manage." In contrast, in an ATR, 100 percent can be plutonium and therefore provides "ease of operation."

A 606-MWe demonstration ATR (DATR) is planned to be built by the Electric Power Development Corp. near Ohma in Aomori Prefecture. It is to start operation about the year 2001. If the DATR "turns out to be economically viable, ATRs will have an active role to play," Mori said. The 1991 report to the AEC said the PNC will produce MOX fuel for the DATR at a new MOX fuel fabrication facility to be built at its plutonium fuel production site.

The industry

Ikegame said the nuclear industry in the United States has only a few "very strong" manufacturers and many small utilities. In Japan, he said, there are "three big manufacturers"—Hitachi, Mitsubishi, and Toshiba—which "are not strong enough to do things by themselves," and some 10 utility companies. As a result, he said, the utilities there have to assist the manufacturers in development efforts. "There are three big utility companies: Tokyo, Kansai, and Chubu," he observed. "So the leadership of the utility companies in Japan is stronger than that in the United States."

In France, Ikegame added, "there is only one manufacturer and one user." He reflected that "The leadership of the [Japanese] utility companies is stronger than that of the U.S., but less [strong] compared with France."

Mori said that in Japan, "Nowadays, the young people fresh out of college, university, or graduate school do not seem to be attracted by nuclear science anymore—so it's getting difficult to try to recruit highly qualified young people out of school for this sector of the industry."

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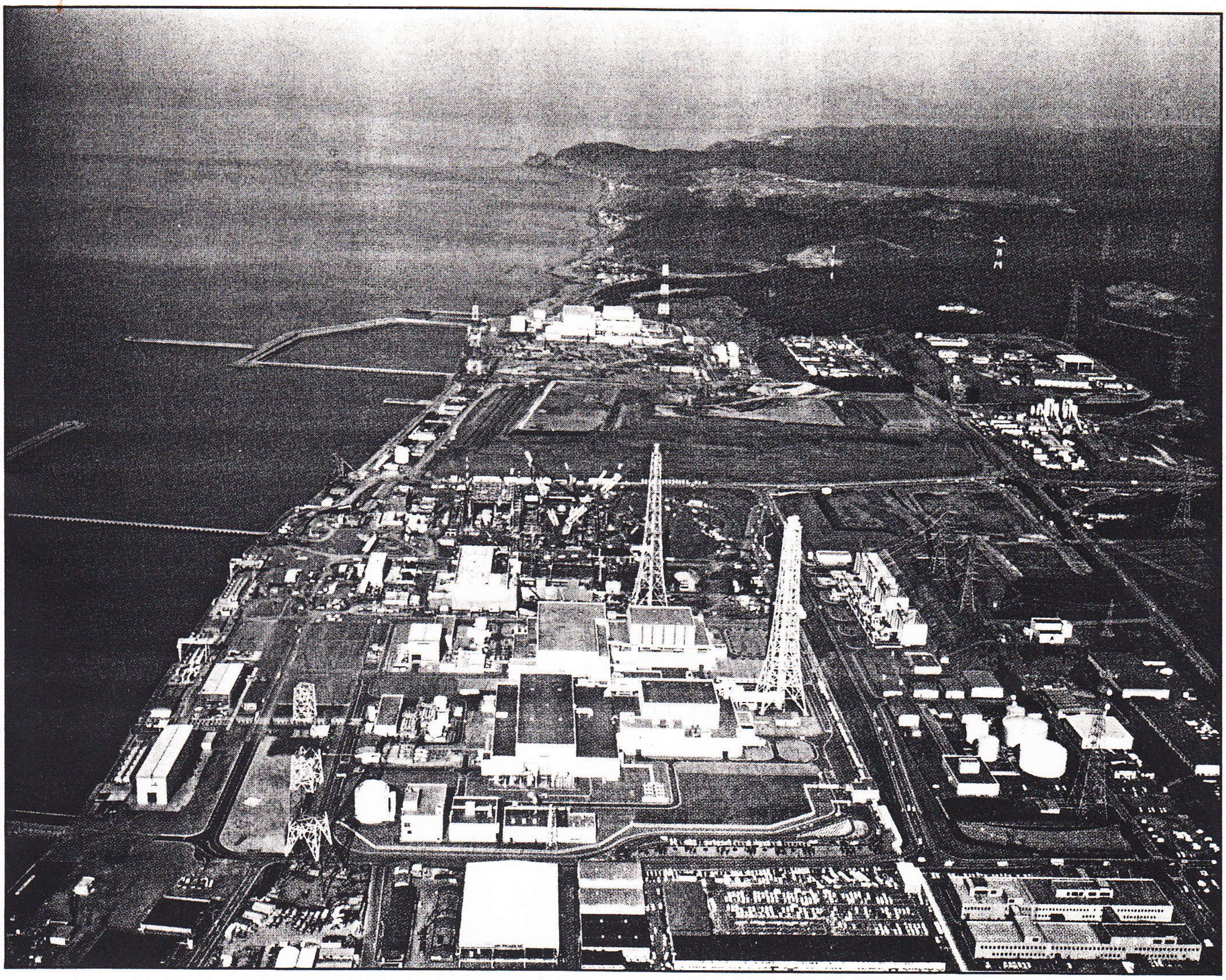

A view of Tokyo Electric Power Company's Kashiwazaki Kariwa nuclear power plant. From the foreground upward are Units 1 and 2 (in operation), Units 3 and 4 (under construction), Units 7 and 6 (the open area; since this photo was taken, construction has started there for both units, the first advanced boiling water reactors being built), and Unit 5 (in operation). All of Tepco's nuclear units, in operation or under construction, are BWRs. Their reactors are variously supplied by General Electric, Hitachi, and Toshiba. (Tepco photo)

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He said that JAIF conducted a survey during the past year, which estimated that to respond to the industry's needs to about the year 2010, about 3 percent of engineering and science graduates need to be recruited into the nuclear energy field. A large number of them would be required by nuclear industry manufacturers, suppliers, and utilities, with fewer for R&D, Mori explained. "Three percent does not sound like a large figure, but like the autumn sky, young people's psychology is apt to change," Mori reflected, "so [someday] it might be difficult to obtain 3 percent recruitment."

PLANNING

Tokyo Electric's future: Advanced BWRs

The average capacity factor in calendar 1991 for Tokyo Electric Power Co.'s 13 nuclear units was 77.2 percent. Six units are at the Fukushima Daiichi plant (ranging from 439 MWe [net] to 1067 MWe), four at Fukushima Daini (all 1067 MWe), and three at Kashiwazaki Kariwa (all 1067 MWe), where four more units are under construction.

At Kashiwazaki Kariwa, Units 3 and 4 (each 1067 MWe) will start commercial operation in July 1993 and July 1994, respectively. Units 6 and 7, rated 1315-MWe each, are the first advanced BWRs and will go commercial in July 1996 and July 1997. All of the utility's nuclear plants in operation or under construction are BWRs, with General Electric, Hitachi, and Toshiba variously the reactor suppliers.

According to Tepco, the ABWR design of Kashiwazaki Kariwa-6 and -7 has numerous advantages, including:

- Enhanced safety—with simplified piping (including internal reactor recirculation pumps), fine-motion control rod drives, improved earthquake resistance (from a reinforced concrete containment vessel and the internal recirculation pumps), and an optimized emergency core cooling system (three divisions each for the high-pressure system, low-pressure system, and residual heat removal system).
- Improved economy—from reduced construction cost (decreased building volume and materials, and shorter construction period) and reduced operating cost (shorter refueling outages, improved thermal efficiency, and lower fuel cost).
- Enhanced operability and maneuverability—including expanded automation.
- Reduced occupational radiation exposure—from the internal recirculation pumps, use of low-cobalt material and corrosion-resistant steel, and water quality control.
- Less radioactive waste—from hollow fiber filtration in the condensate purification system, nonregeneration use of the condensate demineralizer, incineration of combustible solid materials and spent resin, and intensified volume reduction.

Compared to previous BWRs of earlier design, the utility expects that construction costs of Kashiwazaki Kariwa-6 and -7, the ABWRs being built, "will be about 10 percent less—but for the later plants the saving will be much higher," said Ryo Ikegame, Tepco executive vice president. Contracts for the main components were awarded to an international joint venture of General Electric, Hitachi, and Toshiba. Operating costs will be less, too, Ikegame added, because the units will require fewer maintenance personnel.

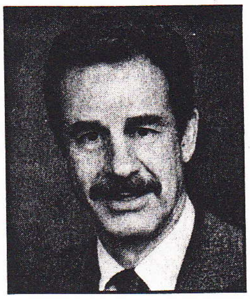
Speaking about Tepco's operating units, Ikegame said that the utility is talking to MITI to see if it can extend operating cycles. To do that, however, the law requiring annual inspection of reactor and other systems has to be revised by the Japanese Diet, he said. And, politically speaking, making a change "is rather difficult," especially in the upper house, he explained.

North of Rokkashomura, along the east coast, in a rural area called Higashidorimura, a site has been jointly purchased by Tepco and Tohoku Electric Co. for future nuclear plant construction. "We are planning to build four units [there]—two each for Tokyo Electric and Tohoku," said Ikegame. But this site is not ready because the local fishermen's union is not satisfied with the compensation offer for the loss of their fishing rights near the site.

Ikegame said that "it's highly probable" that the two units to be built there by Tepco will be of the ABWR design.

ON LINE WITH VERNA

by Bernard J. Verna



Additional switchyard incidents—Part 1

As has happened many times in the past, while perusing literature in search of a subject for a new series of columns, I kept coming across a number of events that were similar to the ones described in my most recent column series. That series (*NN*, Jan. 1992, p. 36; Mar. 1992, p. 44; and May 1992, p. 38) described a March 1990 incident at the Vogtle station, in which a fuel-and-lubricant truck backed into a support pole for a phase insulator for a reserve auxiliary transformer. This caused an electrical fault and resulted in a loss of offsite power (LOSP). Described below and in the remainder of this new series are a number of other switchyard incidents, some of which resulted in a LOSP. The three incidents described in this column involved the use of cranes in switchyards and were summarized in Nuclear Regulatory Commission Information Notice 92-13.

Most of the following paragraph was taken from IN 92-13; entries in parentheses are from an earlier IN that included the same incident.

- During a March 1991 refueling outage at Diablo Canyon-1, the boom of a mobile crane was positioned about 3 ft from a 500-kV transmission line (transformer lead). The resulting flashover caused protective relaying to isolate the faulted line, and, as a result, offsite power to plant loads was interrupted. Offsite power was being supplied by backfeeding through the main output transformer (through the Unit 1 auxiliary transformers; the main generator had been disconnected from the main transformer to permit the backfeed) from the 500-kV switchyard. Two standby startup transformers (one transformer), which were the normal sources of offsite power, had been removed from service for preventive maintenance. All three diesel generators started and successfully loaded, and residual heat removal was restored in about one minute. Unit 2, which was at full power at the time, was not affected. (Offsite power was restored to the auxiliary buses five hours later by crosstying the Unit 2 standby startup transformer into the Unit 1 startup bus. The plant's accident prevention rules contained a minimum required clearance between mobile cranes and 500-kV transmission lines of 27 ft.)
- Palo Verde-3 was shut down and in hot standby in November 1991, and a 35-ton truck-mounted crane was being used to replace the A-phase bushing on the main output transformer. The original bushing had been damaged by lightning a day earlier. Before final installation and after high-voltage testing had been completed, the bushing was returned to its shipping cask. The crane operator shut down the crane motor and engaged one of several braking devices on the crane boom, and then exited the cab to discuss replacement procedures with other maintenance personnel. A wind gust caused the boom to rotate and contact one of the phases of the 13.8-kV feeder. The feeder was transmitting power from the startup transformer to various vital and non-vital loads in Train A. The electrical fault current that was generated was not large enough to cause protective devices to actuate, because the crane had not been grounded as required by plant procedure. Therefore, the feeder remained energized and the fault current initiated small asphalt fires in the areas where the crane's front outrigger pads made ground contact. The rear outrigger pads were not extended.

The maintenance foreman contacted the shift supervisor and incorrectly identified the Train B feeder as being faulted. The shift supervisor opened the supply circuit breaker for the Train B feeder before the foreman could correct his statement. Power was interrupted to nonvital loads, including two of four reactor coolant pumps. Power to vital Train B loads was interrupted, but was reestablished following the successful start and loading of the Train B diesel generator (DG). The correct train (A) was subsequently deenergized, resulting in the start and loading of DG A and a loss of power to the two remaining reactor coolant pumps. The reactor was cooled by natural circulation for 28 min until a reactor coolant pump was started. There were no injuries to personnel.

- Fermi-2 was in cold shutdown in December 1991 and preparing for replacement of the main output transformer. A self-propelled crane, with its boom extended, attempted to turn onto a roadway that was outside the protected area but inside the owner-controlled area of the plant. While the crane spotter was directing traffic, the crane operator proceeded to turn onto the roadway. A lifting strap dangling from the end of the crane boom made momentary contact with one phase of a 120-kV transmission line that was providing offsite power to the plant. The circuit breaker for the line opened and reclosed, interrupting and reestablishing the power supply in a matter of cycles. No LOSP occurred.

When the operator stopped the crane, it came to rest with the end of the boom extended above the transmission line and with the line passing between the boom and the lifting strap. The operator then backed up the crane, and a second contact occurred between the line and the strap. Again, the circuit breaker closed and reopened rapidly so that no actual LOSP occurred. The crane operator then informed his supervisor of the event. No personnel injuries, equipment damage, or challenges to plant safety systems occurred.

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