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Make HLW Disposal Sites More Friendly to Local Residents

The way it stands now, the siting of high-level radioactive waste (HLW) disposal facilities is even more difficult than that of nuclear power plants. Given that municipal governments are having such a hard time building garbage dumps and regular industrial disposal sites, owing to opposition from local residents, the case for HLW disposal sites is all the more shaky, unless as they undergo a radical image change and efforts are made to gain further public acceptance. After all, what they are storing is highly radioactive, and their safety must be ensured over an very-long period. Although one could try to argue that the massive cost of constructing such disposal sites bestows economic benefits to the local community, that effort will come to no avail if the people reject them as undesirable.

Japan's policy is to take spent fuel extracted from NPPs, then reprocess it into both reusable fuel that is recycled, as well as residue (HLW) that is disposed of. The nuclear fuel cycle policy of the country is to take U-238 — which makes up 99% of natural uranium — and use it as fuel as well. In the future, when the world's population will double and environmental concerns become even more pressing, humankind will have to pull back on the use of fossil fuels and promote nuclear power generation, which emits no CO_2. For that reason, the policy to utilize uranium to the fullest extent possible is the logical course for Japan to take, with its lack of energy resources. It also takes global considerations into account.

If the nuclear power would supply half of the electricity generation in Japan, the amount of HLW produced in this country, per person, over a normal life span of 80 years is just the size of three golf balls. During the process of disposal, HLW is mixed with glass — the most stable substance on earth — and placed in stainless steel containers that are further wrapped on the outside and buried deep underground. Needless to say, HLW disposal sites emphasize safety to a degree unheard of in regular disposal sites.

Naturally, such sites cannot be maintained and operated for long periods of time if their economy is neglected. In the case of NPPs, the economic benefits to the local community are most marked during the short time of construction, but those wear off once operation begins. If disposal sites are organized the same way, the future can only be dark for local residents, as they have to live with such sites for several hundred years.

I would like to recommend the application of the knowhow of mining companies to the construction, operation and maintenance of disposal sites. The only difference between mining companies and disposal sites, broadly speaking, is that resources are taken out of the earth, on the one hand, and glass solids containing HLW are back into the earth, on the other. Mining companies have to place top priority on the safety of their employees and the local environment, while holding costs down so as to maintain profitability. The central tenet of their management, thus, is how to mine resources in the most efficient and cheap manner. If disposal sites fail to sufficiently reflect such a philosophy in their own management, their burgeoning costs will only serve to boost electricity rates.

As far as the construction of disposal sites is concerned, moreover, the 40,000 glass solids they entail are not produced in one fell swoop, but are rather produced over time as the reprocessing plant operates. That means that the construction of the pit to store the glass solids can be carried out as the need arises. The disposal site can thus be managed in a way that

construction and operation are carried out simultaneously, which will be important to the local economy.

When considering the safety of disposal sites vis-a-vis the environment, one naturally thinks of the necessity to bury wastes deep in the earth. However, it is also necessary to secure the safety of the workers at the site, no matter how safe it may be for other people (and how far it may be away). The safety of the disposal site can be ensured at depths of even less than 1km. Leaving a broader range of choices open in this way can help in the selection of sites.

Nuclear power facilities are often big sightseeing spots for the areas in which they are situated. One would hope that disposal sites, too, will be made available for public viewing, thereby helping them maintain an "open" image. They should also include a facility for visitors to handle and bury their "own" three golf-ball-sized pieces of HLW, impressing them with the fact that disposal sites are where the wastes, produced by their own electricity usage, are both buried and managed. Disposal sites ought to be set up in such a way that emphasizes the link between the consumer. ■

Editor

TEPCO Asks for Approval of MOX-use Program

On February 24, the Tokyo Electric Power Co. (TEPCO) submitted requests to local authorities for preliminary consent to its MOX-use plan at Unit 3 (BWR, 1100MW) at the Kashiwazaki-Kariwa NPS. The submissions, required under existing safety agreements with the municipalities, were presented on the same afternoon by Mr. Hiroshi Araki, TEPCO president, who visited Governor Ikuo Hirayama of Niigata Prefecture, Mayor Masazumi Saikawa of the Kashiwazaki City, and Mayor Minoru Kato of Kariwa Village. Gov. Hirayama said, "The prefecture will come to a final conclusion after the prefectural assembly (now in session), the city and other authorities give their opinions." After receiving these approvals, TEPCO will submit an application to the central government to change its reactor facilities. After that, it expects to implement the program in 2000.

This was the second time TEPCO had made a request for MOX-use preliminary consent, following that for its Fukushima-I-3 NPS.

In their meeting, Gov. Hirayama told Pres. Araki: "Although we had asked that electricity charges be discounted for our residents, that fact has not been realized. The prefecture will make its decision taking wishes of the people into account. And at the moment, some people are clamoring for a citizens' referendum."

At a press conference following the meeting with the governor, Pres. Araki expressed TEPCO's desire to commence the program sometime between December 1999 and April 2000, when a periodic inspection at Unit 3 is slated to take place. Concerning regional development measures, he said: "We will naturally consider further efforts, in the sense of returning something to the local people, but not in the sense of a quid-pro-quo payback for the MOX program."

On February 11, Mr. Yasuhiro Inagawa, director general of the Agency of Natural Resources and Energy, part of the Ministry of International Trade and Industry (MITI), visited the prefectural office to personally explain the MOX program to the governor and others, and to ask them for their support.

TEPCO has already received preliminary consent from local authorities for the Fukushima-I-3 NPS, where the MOX program is scheduled to start this year. A safety review there is currently under way.

TEPCO Strives to Implement MOX Program as Early as Possible

On February 24, Pres. Hiroshi Araki of the Tokyo Electric Power Co. (TEPCO) released a statement on the utility's request for preliminary consent for the use of MOX fuel at its Kashiwazaki-Kariwa-3 NPS:

"The MOX-use program is now the best and most efficient way to use valuable uranium resources. Given the shortage of energy resources in Japan, early implementation is required to steadily use the plutonium recovered from reprocessing overseas. We are continuing to strive to gain further understanding and support from the local people, as well as to secure safety."

Move for Citizens' Referendums

TEPCO has presented its plan to use MOX fuel at its Kashiwazaki-Kariwa-3 NPS to local authorities, having already done so for its Fukushima-I-1 NPS. In January and February this year, residents of Kashiwazaki City and Kariwa Village collected signatures for a petition calling for the enactment of ordinances authorizing citizens' referendums on the MOX-use program. Signatures collected in both the city and the village easily exceed the 2% of voters required for a direct request for enactment of ordinances. The City and Village assemblies will take up the question, and heated discussions are expected before voting takes place. The company's requests were thus made in a rather tense atmosphere.

TEPCO took a wait-and-see attitude, calling the campaign to collect signatures "a proper right under the Local Government Act, of the same nature as lobbying or petitioning."

Governor Ikuo Hirayama of Niigata Prefecture and Mayor Masazumi Saikawa of Kashiwazaki City both said they would make a decision before the end of the current fiscal year (i.e., March 31, 1999). As the City and Village assemblies had been scheduled to meet in

February and March, respectively, TEPCO made its requests accordingly. The Kashiwazaki City assembly session began on February 22, and that of Kariwa Village on March 8. As a result of the timing of the requests, the assemblies will probably discuss not just the referendum proposals, but also the MOX use program itself.

In Niigata, TEPCO held an explanatory meeting on MOX use in Kashiwazaki on July 28, 1998, and carried out dialogues with local residents at the citizens' hall and 30 other places around the city in August 1998. The central government was also active in obtaining people's understanding, cosponsoring, with the prefecture, a forum on MOX use on October 19, 1998.

According to the group seeking citizens' referendums, 26,690 signatures were collected in Kashiwazaki (38% of the eligible voters), and 1,354 in Kariwa (32%). The Kashiwazaki percentage was more than the one-third required to force a vote on recalling the mayor. The Kashiwazaki city assembly was scheduled to debate the issue and vote on a referendum ordinance on March 23. No dates have been set yet in Kariwa.

The number of signatures collected clearly means a great many people are concerned. Mayor Saikawa has, however, said for some time: "National issues, which cannot be resolved locally, are not appropriate questions for citizens' referendums."

TEPCO's Nuclear Power Generation Surpasses Thermal Power

Nuclear power's share of the total electricity generated by Tokyo Electric Power Co. (TEPCO) set a new mark of 49.5% for the current fiscal year so far (as of January 31). Given the continued high average capacity factor at TEPCO's NPPs — 84.0% in February — the nuclear share will certainly have risen to around 50% by March 31, the end of FY98. Nuclear power is expected to account for the highest ratio of the company's power sources in the whole year, outstripping that of thermal power, whose share stood at 44.8% at the end of January. Thermal power had accounted for the largest share for almost four decades.

At 17,308 MW, nuclear power only accounts for some 27% of TEPCO's total installed capacity. Unit 7 of Kashiwazaki-Kariwa NPS, which started

commercial operation in 1997, contributed to the increase in total nuclear electricity generation for the current fiscal year. One reason that the use of thermal power — which supplies peak electricity — has come down somewhat is because of last summer's unseasonably cool weather. The average nuclear capacity factor for the first half of the fiscal year (April-September 1998) was 82.4%, down one point from the year before, due to a shutdown of the reactor at Unit 3 in the Fukushima Daiichi NPS for shroud replacement work. The average nuclear capacity for the first five months of the second half (i.e., through February) reached 83.5%, up 8.7 percentage points. That shows that thorough safety measures have contributed to the excellent performance of nuclear power generation at TEPCO over the year.

TEPCO's nuclear share has increased steadily over the years: 38.8% in FY93 (compared with 54.9% for the thermal share), 39.1% in FY94, 42.9% in FY95, 46.3% in FY96, and 46.5% in FY97. Nuclear power generation, with superior running costs and a light burden on the environment, has thus become the main power source of the company.

N-Power Likely to Be Included in Policies Against Global Warming

Promoting nuclear power generation is likely to be included in the basic policies for the government's measures to combat global warming. On March 3, the Central Environment Council's subcommittee on basic policies on global warming measures, under the Environment Agency, completed a report that will soon be presented to the minister of the Agency. The report should have been submitted to the Cabinet for its decision by the end of March.

The basic policies indicate actions to deal with global warming to be taken by the national and municipal governments, as well as private industry, under the global-warming law enacted last October. By law, the basic policies must be approved by the Cabinet.

Nuclear power generation was not specifically mentioned in the draft of the basic policies released in December 1998, as it was already included in the fundamental principles for actions to achieve reduction targets for greenhouse gas emissions, promulgated by the government's headquarters for promoting global warming measures. When the public was asked by the council, however, 899 (87%) of the 1,036 people responding said the promotion of nuclear power generation should be clearly stated.

According to informed sources, some members of the subcommittee indicated that it would "strange not to include the promotion of nuclear power generation, which does not emit CO_2." The subcommittee premised its inclusion on three points: fulfilling the treatment and disposal of radioactive waste; securing the nuclear safety; and obtaining national understanding through discussions among the people.

Interview with AEC's Acting Chairman Fujiie

As a result of the streamlining of Japan's government structure, the Atomic Energy Commission (AEC) will be moved to the Cabinet Office. With the 21st century just around the corner, serious discussions are starting concerning the role of the AEC and the significance of nuclear development itself. Prof. Fujiie was asked about these and other points.

Q: Looking back at nuclear development, what are your thoughts?

Prof. Fujiie: I have often wondered, "What made Japan, in the mid-1950's, turn to nuclear power generation and the of use radiation in its search for peace and prosperity?" I think there is something unique about Japan. Of course, part of it is being the only nation to suffer an atomic bombing. There has always been a strong "anti-A-bomb" awareness here. At the same time, looking at why World War II occurred, we see a strong motivation to obtain needed natural resources. Later, on reflection, the Japanese chose nuclear energy as the means to secure an energy supply without restrictions. I think the terms "anti-A-bomb" and "peaceful use" have the same origins.

Since then, the Japanese people have actively supported nuclear power generation. From a different perspective, there is also the use of radiation and radioisotopes, such as in medicine.

Prof. Fujiie

Yet there persists a certain fear of

anything nuclear. Even after the end of the Cold War, nuclear disarmament has not proceeded as fast as had been hoped. India and Pakistan have carried out nuclear tests, and nuclear suspicions remain or have emerged about Iraq and other countries. Moreover, there have been problems at Monju and at other nuclear facilities in the country. The Japanese, then, have grown anxious about and distrustful toward nuclear energy. Even though nuclear energy's development has been rather smooth to date, present-day Japanese do not think that it should be handed down to the next generation in its current state.

Q: What do you see as the future of nuclear energy?

Prof. Fujiie: In developing nuclear energy, I think we should be aware that we are building a system of science and technology. There are basically four things civilization expects from science and technology: information, technology, materials, and energy.

Light, for example, has been recognized as a source of information since humans appeared on earth. The electron, radiation and X-rays were discovered at the end of the 19th century, and people learned that they could be sources of information as well. What do I mean? Well, they can be used to clarify the structure of atoms and the birth of the cosmos.

Examples of technology include lasers, accelerators and so much more. Energy, too, is clear: we have nuclear power generation. The term "materials" is harder to understand, but the nuclear fuel cycle can be seen as a case of a "material" — a change in the nature of materials. Nuclear energy in the 21st century should be nuclear energy from a macro point of view — nuclear energy as a comprehensive technology.

Q: What do you think AEC's role will be?

Prof. Fujiie: As I've said, there are extensive areas, covered by eight ministries, where nuclear energy can be applied even after the government is restructured. It is important to think about nuclear energy for the future in terms of whether it will help us get out of our mass-consumption, mass-disposal orientation. Yes, nuclear power is a source of energy and a means to protect the environment, but the technology must be understood comprehensively, including how to deal with security in its peaceful applications, and a more complete understanding of radioactivity. These matters should not be addressed in isolation by "energy committees" or "science and technology committees." In this respect, I view the transfer of the AEC to the Cabinet Office as an opportunity.

Q: What do you think about the expected revision of the long-term nuclear program?

Prof. Fujiie: The new Long-term Program for Research, Development and Utilization of Nuclear Energy will prescribe AEC's role after it moves to the Cabinet Office. It will not be just a revision, but an entirely new vision of nuclear energy for the 21st century, with practical policies from a long-term perspective. The terms of two AEC commissioners will expire at the end of December 2000. We hope to complete the new program by that time and pass it to the next commission.

Q: What do you expect from the secretariat system?

Prof. Fujiie: From now on, Japan should take the initiative in addressing both domestic and international issues. Seen in international terms, especially, Japan's role has been expanding, and there will be more and more situations that should be handled by professionals. In such circumstances, we think it would be better to have a chairman who is a professional in the field, and we have made that request. Also, given the importance of the AEC, we think there should be a minister in charge of it. I think it is desirable that the AEC be led by both its chairman and a minister, who will share responsibilities. As the Atomic Energy Bureau of the Science and Technology Agency (STA) will not be supporting us any longer, the new secretariat system will be important. Coordination among eight or ten ministries will be required, and we very much hope that the new secretariat will be staffed by competent personnel.

(Reproduced from JAIF Weekly)

Tomari NPS Prevails in Court

On February 22, the Sapporo District Court handed down a decision in a case brought by 988 plaintiffs, some from the city of Sapporo and some living near Units 1 and 2 of Tomari NPS, belonging to the Hokkaido Electric Power Co. Their suit, which alleged danger from radioactivity emitted during normal operations as well as the risk of accidents, sought to halt operations and further construction at the station. The presiding judge rejected the claims, saying a specific risk of danger could not be ascertained. The judge then created quite a stir when he also said: "Nuclear power reactors produce radioactive waste. One option is to reduce our consumption of electricity and stop using them. We should make wise choices for the sake of our children."

The plaintiffs were part of a larger group of approximately 42,000 who had responded to an appeal by the Sapporo District Labor Union. Claiming that they had a right to prevent future radioactive contamination, based on their personal and environmental rights derived from Article 25 (Right to Live) of the Constitution, the plaintiff group made two arguments: (1) a high level of radioactivity is emitted during both normal reactor operations and the treatment of radioactive waste; and (2) the strong possibility exists of a major accident occurring.

In explaining the ruling, the presiding judge said, "While claims under the concept of 'personal rights' are recognized, 'environmental rights' cannot be grounds based only on concerns about possible damage occurrence. Rather, the essence of the plaintiffs' environmental-rights claim is basically a claim of personal rights." Turning to the question of radioactivity during normal operations, he said, "The level of radiation emitted from the Tomari NPS is much less than exposure to natural radioactivity, and well below statutory levels." On emissions during disposal of radioactive waste, he said: "There is no danger in the cement solidification at the Tomari NPS."

As for the occurrence of a major accident, the judge stated, "Measures are in place to prevent accidents and the emission of radioactive materials, and operators and engineers are fully trained to handle emergencies. Based on that, we cannot recognize a specific risk of an accident harmful to life or health." He went on to say, however: "We cannot completely deny the possibility of an accident, nor have issues of high-level radioactive waste (HLW) been resolved. One option is to promote nuclear energy as a means to prevent further global warming, but it can also be suspended. Further public discussions are needed from a wider point of view."

In Japan, plaintiffs' claims have been rejected across the board in lawsuits seeking suspension of NPP operations. But a ruling by the Kanazawa Branch of the Nagoya High Court concerning the Shika NPS (Ishikawa Prefecture), belonging to Hokuriku Electric Power Co., pointed out that "public confidence in the safety of nuclear power reactors has been shaken, and a 'negative legacy' cannot be denied, including HLW disposal issues." The ruling by the Sapporo District Court seems to be part of a judicial trend toward expressing opinions of nuclear issues.

Tomari NPS of Hokkaido Electric

TEPCO to Replace Shroud at Units 1 and 5 of Fukushima I

Tokyo Electric Power Co. (TEPCO) has been carrying out shroud replacement work at Unit 2 at its Fukushima Daiichi NPS, as previously scheduled, following similar work at Unit 3. The company has now announced the schedule for the next replacement work, to be done on Units 1 and 5.

According to TEPCO, shroud replacement work will be undertaken during the periodic inspections of each unit, namely, starting in December 1999 at Unit 5 and November 2000 at Unit 1. The actual date when the periodic inspection begins, however, may differ by one month earlier or later from the original schedule, depending on the status at the time.

Shrouds are cylinder-type walls that surround fuel assemblies in reactor pressure vessels (RPVs). They secure the place where cooling water flows upwards from the lower part to the center core by a jet pump. Because stress corrosion cracking (SCC) had been found in the body of an old shroud, TEPCO replaced the core shroud at Fukushima I-3 last year. It has been operating smoothly since being connected to the grid in July 1998.

TEPCO's Fukushima Daiichi NPS

Moderators for Nuclear Roundtable Conference Make Proposal

On March 4, the moderators for the Roundtable Conference on Nuclear Energy Policy, under the Atomic Energy Commission of Japan (AEC), held a meeting in Tokyo. They agreed on their proposal to AEC, including the disclosure of information and regional development, after considering the discussions of the five previous rounds of the conference, held from September 1998 to January 1999. They planned to submit the proposal to AEC in March. The moderators also confirmed that the next round of the Roundtable Conference for FY99 would start in June.

The previous five rounds of the Roundtable Conference dealt with the following topics: (1) "Why Is the Nuclear Energy Issue Being Discussed Now?" (Tokyo) (2) The same topic (Tokyo); (3), "How Should Nuclear Siting Be Treated in the Future?" (Fukui); (4) "How Should the Nuclear Management System Be Treated in the Future?" (Osaka); and (5) the same topic (Yokohama). The moderators drew their conclusions about the proposal after holding a series of meetings since early February.

The proposal contained four points: (1) information disclosure, (2) regional development, (3) public participation in the policy-making process, and (4) the establishment of a third party to make proposals and reviews concerning nuclear policy. As mentioned above, they planned to finalize the proposal and submit it to AEC by the end of March, though it will be an interim one because the subjects have not yet been fully discussed from every point, requiring further discussions. They hope to include the deliberations in Fukui under the heading of regional development. They also plan to write the proposal in clear, easy-to-understand language.

The moderators intend to have the roundtable conferences resume in FY99

starting in June. They reached a consensus to hold six or seven conferences during the year regarding such subjects as the nuclear fuel cycle and Japan's future course of nuclear development.

JNC to Help Dispose of Pu from Dismantled Russian Weapons

The Japan Nuclear Cycle Development Institute (JNC) has decided to cooperate in a Russian project to dispose of plutonium from dismantled nuclear weapons. An agreement will soon be concluded under which, over the next five years, the JNC will help Russia remodel the core of its 600-MW BN-600 fast breeder reactor (FBR) into one that can be loaded with uranium and plutonium mixed-oxide (MOX) fuel. Three MOX fuel assemblies, to be fabricate using 20kg of plutonium from dismantled weapons, will then be loaded. The aim is to demonstrate, by 2003, the feasibility of using weapon plutonium in a fast reactor in this way. The JNC's experience in fabricating and using MOX fuel will thus make a major contribution to nuclear non-proliferation efforts.

The plan was explained by Mr. Yamato, a member of the JNC's board of directors, and Mr. Tsutomu Imamura, a deputy director general in the Science and Technology Agency (STA), at a JNC-sponsored international forum on February 23.

If the project is successfully demonstrated, Russia will change the core initially to a hybrid (20% MOX fuel), and eventually to full MOX. When that is done, 1.3 tons of plutonium will be consumed annually. Russia hopes to burn a total of 20 tons of excess plutonium in the reactor by 2020.

Fusion Mission Finds that Europe Expects Japan to Host ITER

On February 16, the Science and Technology Agency (STA) submitted to the Atomic Energy Commission (AEC) the report of its mission to Europe on nuclear fusion. The mission came away with the impression that Europe was basically positive about the International Thermonuclear Experimental Reactor (ITER), but that it expects Japan to take the initiative in building it in Japan, because of difficulties in doing so in Europe, including financing.

Headed by Professor Kenzo Miya of the University of Tokyo, the six-member mission visited the European Commission in Belgium, along with various administrative bodies, research institutes and private-sector companies in Germany, France, Britain and Italy. The tour lasted from January 1 to February 11.

As a result of the mission, the STA seems to have concluded that there is still a small possibility that ITER will be built in Europe, but that it would be difficult in current circumstances. It has also concluded that Europe expects Japan to take the initiative, and to make substantial financial contributions as well.

Back-end Views Aired at Rokkasho Meeting

On March 5, Agency of Natural Resources and Energy, part of the Ministry of International Trade and Industry (MITI) held a meeting in the village of Rokkasho, Aomori Prefecture, to exchange information and hear opinions from residents on back-end issues. It was the last in a series of meetings that started in the city of Kashiwazaki, Niigata Prefecture, for the purpose of reflecting public opinion in a draft report prepared in January by the Nuclear Power Subcommittee of MITI's Advisory Committee for Energy.

With Mr. Hiromi Nakamura, a science journalist, as coordinator, there were five participants representing the citizenry, selected from ten applicants on the basis of where they lived and the nature of their views. Some specialists also attended the meeting to answer questions, including Prof. Shunsuke Kondo of the University of Tokyo, who was also subcommittee chairman. More than 350 people attended the meeting despite its being held during weekday working hours.

At the meeting, many people called for greater efforts to implement the high-level radioactive waste (HLW) disposal business, saying that the government should be working on it now, even aiming to commence ahead of schedule. Some asked about the government's administrative responsibility. In the words of one person: "Why is Japan so far behind, when the problem of nuclear waste has been apparent all along?" Some other people insisted on greater information disclosure, saying, "The draft report

lacks mention of information disclosure and an understanding of residents in the siting area."

Responding to questions about the delay in clarifying legal aspects of the disposal business, an official said: "We are sorry about that. In an effort to establish a legal framework as early as possible, the government had asked the subcommittee to address the matter of an implementing entity and funds. We, however, need a bit more time to incorporate the opinions heard at this meeting." Regarding information disclosure, Chairman Kondo mentioned,: "The subcommittee will ask MITI to establish a system allowing people to find the information they want more easily. But the people, too, must make the effort to seek and obtain the information they want."

At the next meeting of the subcommittee, scheduled for March 23, a report was to be presented incorporating the results of the series of meetings, as well as comments received from the public over the course of about a month, in response to an invitation by the government.

AEC's Committee to Discuss Nuclide Separation and Transmutation

On February 9, the Atomic Energy Commission's Advisory Committee on Nuclear Fuel Cycle Back-end Policy, decided to set up a subcommittee consisting of 19 specialists to study nuclide separation and transmutation technology. Selected to chair the subcommittee is Prof. Hiroshi Sekimoto of the Tokyo Institute of Technology.

Nuclide separation and transmutation technology, as the name suggests, is a combination of nuclide separation and transmutation. The former separates radioactive elements included in high-level radioactive wastes (HLW) according to their half-lives or the aims of their utilization. The latter transmutes long-lived nuclides, such as transuranium elements, into short-lived nuclides or non-radioactive ones with an accelerator or nuclear reactor. The Long-term Program for Research, Development and Utilization of Nuclear Energy calls for R&D on this technology to be promoted. The Japan Atomic Energy Research Institute (JAERI), the Japan Nuclear Cycle Development Institute (JNC) and the Central Research Institute of Electric Power Industry (CRIEPI) have all been engaged in its fundamental research.

The last meeting to exchange information and hear opinions from residents on back-end issues was held in Rokkasho.

No Problem Found in Data on Spent Fuel Transport Containers

On February 22, the Science and Technology Agency (STA) announced that there was "no problem with the data" upon the inspection of 82 spent fuel transport containers by Japan's electric utilities (other than those with which the Genden Engineering Services and Construction Company had been involved).

The inspections were carried out at the request of the STA, after manufacturing data on some containers were found to have been falsified in October 1998. On the following day, February 23, STA announced a policy whereby quality-control guidelines will apply to examinations and inspections of production of such containers, in accordance with ISO9002 of the International Standardization Organization (ISO), so as to reinforce safety regulation. On the same day, the STA explained the new measures to Aomori Prefecture and

Rokkasho Village.

According to STA, parties applying to manufacture containers for spent fuel will be required to submit appropriate plans for quality control, so that the Agency can strictly examine and supervise the applicant's quality-control systems, including those of its contractors. Guidelines will be issued in accordance with ISO9002. In addition to improving methods for examining technical capabilities for producing containers, the inspection system will be improved to include implementation of on-site inspections by the central government.

On February 22, the Nuclear Fuel Transport Co., Ltd., submitted a report to the STA on the results of the re-inspection that it had conducted on 43 spent fuel transport containers, whose neutron shielding materials were produced by the Genden Engineering Services and Construction Company — data on 39 of which were falsified. According to the report, analysis showed that the materials had "sufficient safety tolerances" judged against the lowest limits set by the Study Committee on Spent Fuel Transport Containers.

On February 24, then, the company submitted an application to STA for permission to change the design - changing at the same time the amount of spent fuel (radiation quantity) to be placed in the containers. The application was for NFT-type containers. The company had to return the previously issued approval and also withdraw an earlier application in December 1998, due to falsification of data on this type.

An inaugural ceremony of the Emergency Preparedness Technology Center was held in Rokkasho Village.

Emergency Center Starts Business at Rokkasho

On February 17, the Nuclear Safety Technology Center (NSTC) held an inaugural ceremony at its Emergency Preparedness Technology Center, set up in Rokkasho Village last October. Approximately 70 persons participated in the ceremony and visited the facility.

The Emergeney Center, started business on the same day. It was commissioned by the Science and Technology Agency (STA) to assist Aomori Prefecture, Rokkasho Village and other related sectors with measures to prevent nuclear disasters. It has been well equipped with nuclear disaster prevention implements and materials, and the inaugural ceremony was held to introduce them to the residents of Rokkasho and Aomori. The first training course in disaster prevention at the Center was to start on February 18 for firefighters to cope with reprocessing plant accidents.

MHI, WH and SEPI Set to Receive NPP Order from China

Mitsubishi Heavy Industries (MHI) announced that it had decided to cooperate with Westinghouse (WH) of the U.S. and the SEPI group of Spain to expand the business to receive an order from China for new NPPs. The three parties held a signing ceremony in Madrid on February 16, at which they delivered notes on the basic policy on the agreement and their respective roles in it. Attending the ceremony were representatives of the firms concerned, as well as those of the Chinese and the Spanish governments.

China is expected to adopt primarily PWRs in the future, because they are easy to construct domestically on the basis of actual operational experiences of the NPPs it has operated for several years. Therefore, MHI has actively urged

A signing ceremony by three parties was held in Spain.

China to adopt PWR-type power generation systems in cooperation with WH and SEPI group. MHI will take charge of the design and manufacture of the main PWR equipment.

U.S. NAC Selects Hitachi Zosen to Manufacture Transport Systems

On March 4, NAC International (NAC), the largest nuclear transportation and technology company in the U.S., awarded a contract to Hitachi Zosen, a leading Japanese manufacturer, to fabricate three nuclear spent-fuel transport container systems.

NAC specializes in nuclear fuel transport, spent fuel management technology, fuel cycle consulting and information technology. Its services include fuel procurement and performance evaluations, competitive assessments and knowledge management, utility restructuring, and regulatory and communications planning.

The approximately 5m-long, 24-ton NAC Legal Weight Truck (NAC-LWT) transport containers are used extensively in support of commercial operations, as well as the U.S. Department of Energy's research reactor fuel return program and other key nonproliferation initiatives. NAC, which maintains the largest fleet of transport containers in America, has been involved in over 3,500 nuclear materials shipments covering more than 6 million miles (10 million km).

The NAC-LWTs received approval from the U.S. Nuclear Regulatory Commission (USNRC) in 1989. The NAC-LWT system also meets International Atomic Energy Agency (IAEA) requirements and can accommodate commercial pressurized and boiling water reactor spent-fuel and research reactor-fuel assemblies.

The three NAC-LWTs will be manufactured at Hitachi Zosen's Ariake Works in Kyushu, Japan. Hitachi Zosen will deliver the transport systems in April 2000.

Hitachi Zosen, headquartered in Osaka, Japan, has U.S. offices in New York, Houston and Chicago. It is one of Japan's leading designers and manufacturers of spent nuclear fuel storage and transport casks. The company has delivered over 50 high-capacity transport and/or storage casks to Japanese, U.S. and European customers. Hitachi Zosen is NAC's exclusive spent fuel management technology licensee in Japan and is currently manufacturing an NAC-STC-type storage cask under license for Unit 2 of JAPC's Tokai NPS.

Hitachi Zosen is also a member of NAC's global technical team responsible for the development of that company's new Universal Multi-Purpose Canister System (UMS). The UMS, which is currently receiving USNRC licensing review, is capable of storing and transporting virtually all types of spent nuclear fuel at commercial nuclear stations.

<NEWS IN BRIEF>

JAERI Develops New Ion-producing Technique Using SF_6 Plasma

At the Takasaki Radiation Chemistry Research Establishment of Japan Atomic Energy Research Institute (JAERI), a new technique has been developed to produce ions of refractory materials (e.g., niobium, molybdenum, boron, silicon) by fluorinating them with SF_6 plasma in an ion source and extracting them from it. The stable extraction of refractory material ions is easily achievable with this technique, which is expected to contribute to the development of new functional materials, such as cor-

rosion-resistant materials and light-switching materials, by implanting boron or niobium ions.

Conventional methods for producing refractory material ions require toxic gases or a complicated metal evaporation system. The new technique, in contrast, only requires the SF_6 gas for plasma and a refractory material. The SF_6 plasma in the ion source includes fluorine ions that react with a refractory material to produce fluoride with a higher vapor pressure than the original materials. The vaporized fluoride resolves into fluorine ions, and the material ions into the plasma. Several dozen microamperes of refractory material ion beam can be extracted from the source.

JST Develops Wide-view, 3-D X-ray CT Equipment

The Japan Science and Technology Corporation (JST) has succeeded in developing wide-view, three-dimensional X-ray CT equipment. The practical research, commissioned by JST to Sony Corporation, was based on basic technology originally developed by Dr. Masahiro Endo, director of the Medical Physics and Engineering Office at the National Institute of Radiological Sciences of the Science and Technology Agency (STA), as well as by Dr. Naoki Suzuki, associate professor at the Institute for High Dimensional Medical Imaging at the Jikei University School of Medicine. They had worked on the development since FY93, running up costs as much as ¥800 million ($6.5 million).

Although CT (computed tomography) has been applied in diagnostic techniques, conventional X-ray CTs are inferior in terms of the resolving power in the direction of the longitudinal axis and the resolving power on the horizontal plane. Conventional CT images also suffer from containing discontinuous parts, meaning they may miss the diseased part, delaying its confirmation. Thus, one goal of scientists was to develop a new kind of CT that could obtain high-resolution, 3-D images a short period, particularly in the chest area.

With the new technology, an object is irradiated with X-rays in a conical extension, with 2-D dimensional projection images taken continuously in several directions by a CCD video camera over 360 degrees for 12 seconds. That results in a high-resolution, three-dimensional image. The technology may be widely used for diagnostic radiology and treatment planning of radiation therapy for such diseases as cancer and circulatory diseases.

Creation of Fullerene of Boron Nitride by Irradiating High Energy EB

The Advanced Beam Analysis Station of the National Institute for Research in Inorganic Materials (NIRIM), part of the Science and Technology Agency (STA), has succeeded in creating a boron nitride fullerene by irradiating specimens with high-energy electron beams. The fullerene is the second to be produced by the Institute; the first was a carbon-nitrogen-boron fullerene in 1997.

The NIRIM team clarified the structure of fullerene for the first time ever. Expected applications include semiconductors and catalysts. The Institute will investigate a method for its mass synthesis.

Report Released on National R&D Evaluation

The Science and Technology Agency (STA) has released a report on R&D evaluations practiced by governmental ministries and agencies, based on the National Guidelines for Government R&D Evaluation Methods (determined by the Prime Minister's Office in July 1998). The report describes first how R&D evaluation is conducted in general terms, then goes on to explain the individual efforts of the ministries and agencies concerned.

The ministries and agencies have made manuals for evaluation purposes, and are now working on more systematic evaluations. Since their efforts have only just begun, however, the report points out various areas of suggested improvements.

Research on Exactly Aligned High Magnetic Field Effects in Superconductors.

The Core Research for Evolutionary Science and Technology (CREST) of the Japan Science and Technology Corporation (JST), along with the Center of Excellence (COE) program of the Ministry of Education, have promoted research on exactly aligned high magnetic field effects in low-dimensional superconductors. Out of that research has arisen the discovery of a spin triplet superconductor, where electrons form pairs different from those of conventional superconductors.

The research was carried out jointly by a team from the Graduate School of Engineering Science at Osaka University led by Kenji Ishida, and a team from the Graduate School of Science at Kyoto University, led by Yoshiteru Maeno. Their findings were reported in the British journal of science, "Nature,' on December 17, 1998.

Conventional superconductors exhibit spin single superconductivity, where electrons pair with their spins in the opposite directions. Maeno and his team of researchers discovered ruthenium oxide superconductivity in 1994. By measuring the frequency of nuclear magnetic reso-

nance, they have now identified spin-triplet superconductivity, in which electrons pair with their spins in the same directions, Only one other example of the spin-triplet uranium compound has been reported, and the present discovery may pave the way to research on applications of new physical phenomenon of spin-triplet superconductivity.

Manufacturing Technology for High-performance Electrode Substrates for Secondary Batteries

The Japan Science and Technology Corporation (JST) has succeeded in developing manufacturing technology of electrode substrate for secondary batteries, which it had commissioned to Japan Metals & Chemicals Co., Ltd. in 1993.

The technology stems from research undertaken by Dr. Hiroshi Ishikawa, director of the Department of Energy and Environment at the Osaka National Research Institute of the Agency of Industrial Science and Technology, part of the Ministry of International Trade and Industry (MITI). Also researching the technology was Dr. Itsuki Uehara, manager of the Chemical Metallurgy Section at the same institute.

Since the technology can improve battery capacity, as well as the charging and discharging properties of batteries, and the cycle life of nickel-hydrogen batteries, etc., it is expected to be applied widely as secondary batteries for notebook computers, electric bicycles, electric automobiles and other devices.

The development of a long-life, high-performance secondary battery has long been sought, especially one that is small and lightweight, chargeable over a short time, and usable repeatedly over a long period. The new technology allows the manufacture of the porous electrode-substrate necessary for such a secondary battery.

The manufacturing process for a porous-structure nickel electrode substrate consists of the following steps: (1) A suspension slurry, composed of fine nickel particles and binders, is impregnated with foamed urethane resin. (2) The resin is then pyrolyzed and removed. (3) Finally the residue is reduced, and sintered in a hydrogen atmosphere. Since the substrate is more porous, with a heightened donation and acceptance of electrons by and between the active substances of the substrate and electrode, batteries using this substance can perform better than conventional batteries, with twice the expected lifetime.

Two Surveys on Strategic Promotion of Science and Technology

The Science and Technology Agency (STA) has wrapped up a survey on the strategic promotion of science and technology. With the 21st century soon upon us, people are pinning higher hopes on science and technology to solve the enormous problems facing Japan and the world as a whole. The surveys were carried out to establish future strategic science and technology policy in Japan. The report consists of two parts: a survey on how systems of science and technology policy are formed and executed in major countries abroad; and a survey on which science and technology areas should be selectively promoted by Japan.

<Survey One: How are systems of science and technology policy formed and executed abroad?>

The survey aimed at clarifying the implications for policy systems, focusing on strategic science and technology policy in the U.S., the U.K., Germany, France, the Netherlands, Sweden and the EU. Some 120 different science and technology policies were investigated and 176 people in executive organizations were interviewed, after which the characteristics of their structure and operation were categorized. Theories were also posited for evaluating these categories. In charge of conducting the survey was the Institute for Policy Sciences, Japan (IPS), commissioned by STA.

The survey revealed the following points to be instructive for Japan's system of administering science and technology:

1. Improvement of assistant functions and information collection functions for decision- makers: The U.S. Assistant to the President for Science and Technology has the opportunity to see the President every week. He or she is responsible for information collection functions through the common membership mechanism of the Office of Science and Technology Policy (OSTP), headed by the assistant.

2. Improvement of support systems in and out of the administrative organizations for strategy formation: In the U.S., a great variety of support functions are provided by exclusive support agencies performing investigation and analysis, such as the Science and Technology Policy Institute (STPI) and Congress Research Service (CRS), and universities.

3. Cultivation of policy-making technocrats and special advisers: Improved fellowship systems are set up to post talented people from academia to administrative agencies. Moreover, in the U.S., the Congress and grant systems help coordinate the acquisition of advisers.

4. Improvement of organizations (intermediate policy-execution organizations) positioned between the government and research organizations: In

Europe, diversified organizations with policy-execution functions have been developed to maintain a smooth relationship between the government and research institutes. These include the Deutsches Forschung Gemeinschaft (DFG), project agencies and Max Plank Society for Advancement of Science in Germany.

5. Improvement of multiple check systems and circulation-type evaluation systems: In the U.S., mutual checks are carried out on various levels, such as between the Congress, the Administration and academia, as well as between Congress and the Administration. Multiple decision-making systems are thus realized. In Europe, panels consisting of representatives from various sectors take responsibility for similar functions, helping to improve the objectivity of policy and reflecting various positions.

<Survey Two: Which science and technology areas should Japan promote selectively?>

The Institute for Future Technology, commissioned by STA, carried out a survey of the general public, as well as researchers and experts. It identified important areas for Japan to promote, pointing out areas to help promote R&D.

Both the public and expert respondents cited environmental protection as an important issue to be resolved by the country in the future (91.9% of all respondents). That was followed by 53.4% mentioning the development of a society comfortable for senior citizens to live in, and 49.8% pointing out the conquering of incurable diseases. However, most respondents did not think such problems could be solved by science and technology alone.

Science and technology was seen to be most effective in conquering incurable diseases (75%) and building disaster-resistant cities (57.4%), but the development of proper institutions, laws, ethics and education were considered more effective in developing a comfortable society comfortable for senior citizens, as well in developing a rich culture. Under such circumstances, both the public (58.8%) and experts (71.8%) saw environmental protection as the area that science and technology could make the most significant contribution.

Survey participants were asked what areas they thought science and technology had made significant contributions in the past. The public pinned high hopes on areas close to their daily life, such as waste disposal (38.7%), health care and medical treatment (34.8%), and safety (31.6%), but those areas were not always those in which science and technology had made so many contributions so far. Meanwhile, creating a society amenable to senior citizens - viewed as a significant problem in the future - was not considered as an area where science and technology could contribute so much.

As for problems to be stressed in future R&D, a high percentage of the public (65.4%) cited "the assurance of safety in new technologies to be created," while the experts emphasized "more efficient R&D based on proper budgets." The public showed a high awareness of that problem as well (46.3%). Meanwhile, a high percentage of the public (75.8%) supported greater information disclosure on R&D, while only 55.1% of the experts felt that way.

Asked to give their opinions on how the streamlining of government bureaucracy would promote science and technology (specifically the integration of the Ministry of Education and the Science and Technology Agency), the survey respondents from the general public mentioned "the cultivation of increased scientific interest" (61.5%) and "greater collaboration between universities and national research institutes" (46.6%). On the other hand, the experts mentioned the "promotion of strategic science and technology policy by the whole nation" (70.5%), followed by the "promotion of important national projects" (51.3%) and the "proper allocation of budget and personnel" (50%).

Successful Non-contact Strain Measurement of Welded Sections

The National Research Institute for Metals (NRIM) recently succeeded in applying a technique — called laser-speckle strain measurement - which measures strain in sections being processed without touching them. Strains from heat at welded sections causes residual stress, and in turn, stress-corrosion-cracking and degradation of fatigue strength. With the new technique, a wide range of changes can be measured at stress locations throughout the entire process of heating a substance (from room temperature, to melting, solidification and cooling). Because measurements do not involve contact, stress can be measured simply and accurately in high-temperature welded sections - something that has always been complicated and difficult.

Laser-speckle strain measurement measures stress using the interference pattern produced between the laser beam striking a material's surface, and the reflection made, judging changes in the regularity of the surface's shape. The key to optimum measurement conditions during welding was found by observing the spot diameter on the measured subject and sample spacing.

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10th International Conference for Nuclear Cooperation in Asia Held in Tokyo.

On April 10, the 10th International Conference for Nuclear Cooperation in Asia (ICNCA) took place in Tokyo. Sponsored by the Atomic Energy Commission (AEC), the conference has been held here every year since 1990. Specific cooperation activities are then addressed, at the expert level, in the form of seminars in six specific areas under the auspices of the conference. Government ministers responsible for nuclear issues from five nations — the largest number of ministers participating so far — were present, along with other delegates from related ministries, agencies and research institutions.

At the start of the opening session, Chairman Akito Arima of the AEC (also State Minister for Science and Technology) said: "In Asia, there is an increasing need to develop and utilize nuclear energy, in order to cope with sharply increasing electricity demand and to prevent further global warming." Introducing a report on nuclear cooperation prepared last year, Prof. Arima emphasized the importance of the conference as a place to address nuclear policy questions, saying: "I sincerely hope international cooperation in the nuclear area will develop further in Asia." Mr. Hiroshi Murata, vice-chairman of the Japan Atomic Industrial Forum (JAIF), and Dr. Sueo Machi, deputy director general of the International Atomic Energy Agency (IAEA), made special presentations.

In the sessions that followed, delegates from the nine nations — Indonesia, Korea, Malaysia, the Philippines, Thailand, Vietnam, Australia, China and Japan — outlined the current state of nuclear development and utilization in their nations, and made proposals on the future of the conference. Each nation's presentation at the conference is introduced below:

AUSTRALIA

On September 3, 1997, the Australian Government announced that a $286 million facility would replace the Australian Nuclear Science and Technology Organization's (ANSTO) existing HIFAR research reactor. HIFAR, which began operating in January 1958, will be shut down and decommissioned once the replacement reactor is operational.

There are six main characteristics of the replacement reactor: (1) It will be a pool type, in which the core of the reactor is at the bottom of a pool of water at least six meters deep; (2) It will produce a higher neutron flux than available from HIFAR; (3) Neutron beams for research experiments will have a wider range of energies and be cleaner and of higher intensity than HIFAR; (4) It will use low enriched uranium fuel; (5) It will have flexible core and irradiation facilities;

and (6) Its isotope and other irradiation facilities will have a greater capacity than HIFAR, and be designed to meet current and future needs.

The state-of-the-art facility, to be commissioned in 2005, will produce the volume and comprehensive range of diagnostic and therapeutic radiopharmaceuticals needed to satisfy Australia's requirements in the coming decades. Demand for radiopharmaceuticals is predicted to double in the next five years, and it is expected that almost every Australian will require a nuclear medical procedure in their lifetime. In addition the replacement reactor will support ANSTO's nationally important work in such areas as environmental studies, agriculture and in assisting industry. It will also support scientific research and higher education through improved access to a modern, versatile neutron source.

As part of the stringent environmental assessment process already undertaken, the project's Draft Environmental Impact Statement (EIS) was issued for a three-month public comment period in August 1998. Some 935 submissions were received, and a Supplement to the Draft Environmental Impact Statement, which addressed the comments and issues raised in those submissions, was prepared and lodged with Environment Australia on January 18, 1999. Environment Australia prepared an assessment of the documents and submissions for the Minister for the Environment and Heritage, who is responsible for announcing the decision from this process.

Subject to a favorable outcome to this EIS process and approval by the Parliamentary Standing Committee on Public Works, the reactor facility will be provided through a turnkey contract.

A two-stage process is being used for tendering. Advertisements were placed in the worldwide press in June and July 1998, seeking expressions of interest from reactor vendors. The first stage of the tender selection process was completed in December 1998 with the prequalification of four consortia led by AECL, INVAP, Siemens and Technicatome, respectively. In the second stage, these prequalified reactor vendors will be invited to tender for the design and construct contract in their own right, or as members of joint ventures.

The replacement research reactor project's application for a site licence for the reactor facility is planned to be made soon to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), which is the new regulatory body established at the beginning of this year.

In 1997, the Australian Federal Government announced that it would combine the Australian Radiation Laboratory (ARL) and the Nuclear Safety Bureau (NSB) to establish the ARPANSA as a new regulatory body with underpinning legislation. ARPANSA was established in February 1999 and is the agency charged with responsibility for protecting the health and safety of people and the environment from the harmful effects of radiation.

There was no legislation that regulated Commonwealth radiation sources and practices nationally before the passing of the Australian Radiation Protection and Nuclear Safety Bill 1998 on December 10, 1998, and the establishment of the ARPANSA.

(Professor Helen M. Garnett; Executive Director, Australian Nuclear Science and Technology Organization)

CHINA

By the end of 1998, the total installed capacity of electric power in China exceeded 270GW, and electricity production 1,160TWh. Nuclear power accounted for 1.26% of the total.

During China's 9th Five-year-plan period, four nuclear power projects were initiated one after the other, namely, Qinshan Phase II, Guangdong Lingao, Qinshan Phase III and Lianyungang NPPs, consisting of eight units with a total installed capacity of 6,600MW. Qinshan Phase II consists of 2x600MW PWR units based on independent design and construction. The first concrete was poured in June 1996, and the containment dome has been already completed. It is expected that the first unit will be connected to the grid in 2002.

Guangdong Lingao NPP, 1km to the west of Daya Bay NPP, consists of 2x1000MW PWR units of French design. The first concrete was poured in May 1997, and the nuclear island was to be installed in January 1999 in advance of the schedule.

The project will be completed and begin commercial operation in 2003. Qinshan Phase III involves 2x700 MW CANDU-6 units, contracted to AECL as a turnkey project. The first concrete was poured in June 1998, and the plant is scheduled to be put into operation in 2003.

Lianyungang NPP includes two VVER-1000 Advanced-91 type PWR units introduced from Russia, with an installed capacity of 2x1060 MW. Russia supplied both the project design and the main equipment (both nuclear and conventional islands), while other countries supplied the rest of the equipment, including TXP/TXS digitized I&C system from Germany's Siemens. The first con-

crete is planned to be poured in October 1999, and the first unit will start commercial operation in 2004. Following the policy of combining self-reliance with the opening to the outside world, a relatively large-scale industry of the nuclear fuel cycle has been formed through 40 years of development.

There are abundant uranium resources in China, and a large amount of uranium reserves has been verified. In recent years, the focus of uranium exploration in China has shifted from the southern mountain areas to the vast basins in northwest and north China for sandstone-type uranium deposits suitable for in-situ leaching. This kind of deposit features large scale and low mining and milling costs. Great progress has been made in this process.

In addition to the existing diffusion capability, centrifuge enrichment facilities were imported from Russia in recent years, so that the enriched uranium production in China can meet the demand of PWRs for separate work early in the next century. Moreover, important progress has been made in independent R&D on subcritical centrifuges using new-type composite materials. Meanwhile R&D on laser uranium isotope separation is proceeding as scheduled.

The localization and serialization of nuclear fuel fabrication are realized in China, which boasts the independent production of nuclear fuel assemblies for 300-MW, 600-MW and 900-MW NPPs. Technical backfitting to the existing fuel production line is being carried out to meet the requirement of next-generation NPPs for extending fuel burnup and cycle length. At the same time, China will further increase the production capacity of PWR fuel elements, and prepare to produce the nuclear fuels for PHWR and VVER to meet the requirements of nuclear power development. It will also provide the NPPs introduced from Canada and Russia with domestically produced nuclear fuel.

In China, reprocessing policy is adopted for the spent fuel of NPPs. The pilot plant is under construction, and will be completed and put into use in 2000 as scheduled. Important progress has been achieved in the treatment and disposal of solid, liquid and gas radioactive wastes. Repositories for solid ILW and LLW are either ready for use or under construction.

To meet the need of nuclear power development, China is expending great efforts on nuclear R&D. Research on the self-developed AC-600 advanced PWR for the next century has made excellent achievements at different stages. Based on the preliminary design, the construction of the experimental fast reactor began in December 1998, and fuel loading and operation commencement are expected for 2003.

Satisfactory research results have been reached on the China Tokamak HL-1M, a controlled fusion device, and the construction of the HL-2A was started in January 1999. This project, when completed, will create favorable conditions for the study in nuclear fusion. In addition, active results have been obtained in the R&D work on nuclear heating systems and high-temperature gas-cooled reactors (HTGRs).

In radioactive waste management, Chinese specialists have explained to counterparts from other countries the status quo of radioactive waste management in China and technical development. They also keep abreast of the situation in other countries, which provides valuable reference for the present study and design of radioactive waste repositories in China. In nuclear agronomy, new progress has been made in the application of irradiation technology in agriculture through participating in exchange activities. In the past nine years, more than 150 mutant breeds of crops (such as rice, wheat, and soybeans) were developed. These new varieties have been introduced in about 135,000 hectares of land, with good social and economic benefits gained.

China is carrying out reform in its institutional system. China Atomic Energy Authority (CAEA) will, on behalf of the Chinese government, exclusively manage the industry for peaceful uses of nuclear energy and the international cooperation in this respect. The main duties of CAEA are: (1) studying and drafting the development principles, policies, laws and regulations relating to nuclear industry; (2) preparing the development programs for the nuclear industry; (3) organizing and implementing the management of the nuclear industry (such as nuclear power construction, isotope production, etc.); (4) promoting the development, research and uses of nuclear energy for peaceful purposes; (5) organizing the research and implementing the system reform of nuclear industry; and (6) taking charge of the international exchanges and cooperation in the field of nuclear on behalf of the Chinese government.

The present China National Nuclear Corporation will soon be transformed into a new business conglomerate. I am convinced that the successful accomplishment of reforming the atomic energy authorities will further promote the peaceful uses of nuclear energy and the development of external exchanges and cooperation.

(Mr. Li Donghui; Vice-chairman, China Atomic Energy Authority)

INDONESIA

In 1998, for the first time in three

decades, both energy consumption and electricity consumption decreased in Indonesia from the previous year. Peak demand in the Java-Bali system did not increase during the year, and some newly completed power plant projects may not be needed for the next few years. The Government and the State Utility Company expect to be able to undertake renegotiations on the power purchase agreements with the independent power producers.

The present economic crisis has had a significantly negative impact on the development in the area of nuclear energy and nuclear science and technology in Indonesia. The foremost reason is the budget cut experienced by our agency, in conformity with the austerity program pursued by the Government. The second primary reason is the collapse of rupiah value against hard foreign currencies. Therefore, we are undertaking a reorientation of some of our activities to address and to assist the concerns related to the social safety net program and the empowerment of technology-based cooperatives and small/medium-scale industries.

Under the Act No.10 of 1997, the regulatory function has been separated from BATAN and transferred to a newly established agency called the National Nuclear Regulatory Agency. BATAN itself has a new organizational structure, based on Presidential Decree No.197 of 1998.

The application of accelerators in medicine needs special attention, since the prevalence of new cancer patients in Indonesia is between 0.8 to one pro-mill per year, or around 200,000 new patients annually. New facilities for high efficacy and precision radiotherapy are therefore needed at the turn of the century. A new laboratory complex will be developed and established for the above purposes in the coming years, and will be located in Yogyakarta.

For the long-term, we will continue our preparations for the eventuality of the introduction of nuclear power in Indonesia. As you are well aware, studies have been undertaken lately on the feasibility of the construction of a nuclear power plant. These activities have now been hampered by the economic crisis.

We are now concentrating our efforts in the direction of strengthening the bases for nuclear power planning and implementation. This two-year program starting in 1998 has covered: (1) Environmental impact analysis and site data collection; (2) Geotechnical studies for foundation design; (3) Severe accident analysis; (4) Support for decision making, which will look into system and method for democratic decision-making process for NPP implementation.

We will also expand and intensify our activities in the public information and acceptance programs.

In the meantime, we have made considerable investments in manpower development in anticipation of the introduction of nuclear power. While it will be up to the next government to make the final decisions on our nuclear power program, we feel that we are justified in pursuing our course as we have done in the past. We will continue to maintain our manpower and even to continue to upgrade our capabilities. Therefore, the aims of our program are: (1) The realization of a long-term national energy plan which includes the nuclear option; (2) The development of capability in nuclear fuel technology in support of a future nuclear industry; (3) Optimal utilization of research reactors and related facilities for the benefit of both the energy and non-energy sectors; and (4) The establishment and achievement of a reliable and secure nuclear safety system.

(Prof. Ir. Zuhal; State Minister for Research and Technology)

KOREA

Since the first commercial operation of a nuclear power plant, Kori-1, in 1978, Korea's nuclear power programs have been steadily expanding, and nuclear energy has now become the main source of electric power. At present, 14 NPPs (11 PWR units and three CANDU units) are in commercial operation, generating about 42% of the total electricity produced in 1998.

The construction of a Korean Standard Nuclear Power Plant (KSNP), a PWR with 1,000MW capacity, was completed last year, which was developed as a result of an NPP design standardization project started in 1984.

Nuclear energy is making a great contribution to cutting down Korea's energy imports and saving hard foreign currencies. The total electricity generation by nuclear power reached 90TWh in 1998. If that amount had been produced by using liquefied natural gas (LNG), the fuel cost would have amounted to $4.3 billion. Therefore, by spending only $286 million on nuclear fuel, we were able to save about $4 billion in 1998 alone.

A total of 28 NPPs is now planned for operation by 2015, and their total installed capacity will amount to 27.7GW. In that case, it will be effective in saving about $8 billion per year.

In July 1994, the Korean government established the "Long-term Nuclear Energy Policy Directions toward 2030" to facilitate economic development and promote human welfare through the safe and peaceful uses of nuclear energy. The four basic goals of the Nuclear Energy Policy Directions are: (1) Provide a sta-

ble electricity supply through the development of nuclear energy as the primary source of electricity generation; (2) Achieve technological self-reliance in non-proliferation nuclear fuel cycle development; (3) Strengthen the international competitiveness and to foster the domestic nuclear industry; and (4) Expand the applications of nuclear technology to medical, agricultural, industrial areas for the promotion of public welfare.

To help achieve these goals systematically, the Medium-term and Long-term Nuclear R&D Program was launched in 1997 for the second phase of implementation, which will end in 2006. Also, the Nuclear R&D Fund was set up by the government to support this program. A fixed amount of 1.2 won per kWh of nuclear power generated is put into this fund by the utility company.

We all know that gaining the support of the public is a key factor in the successful implementation of any nuclear power program. In addition, all the programs concerning the peaceful uses of nuclear energy must be transparent to the international community as well.

Looking ahead over the next decade, I would welcome ICNCA's transformation into a forum for promoting the development of the entire region, with the active participation of countries which have still not joined this conference.

The Korean government supports Japan's proposal to change the name of this conference to the Forum for Nuclear Cooperation in Asia. I hope that this name change will mark the beginning of a new chapter in the conference's history and help the meeting serve as a framework for building practical cooperation and addressing issues of common interest through open discussions.

I also welcome the suggestion that the participating countries take turns in hosting the forums. This would provide an opportunity to have a clearer understanding of the current situation in each nation. Thus, I would like to propose that Korea host the forum in 2002, a year of special meaning, because Korea and Japan will co-host the 2002 World Cup. The holding of the forum in Korea will, I believe, symbolize the new expanded role of this conference and show that this is truly an Asian Forum.

(Mr. Kang Chang-Hee; Minister of Science and Technology)

MALAYSIA

Since nuclear power has been accorded as the last option in our national energy policy as a result of the discovery of huge reserve oil and gas in the mid-1970s, our nuclear science and technology development remained in the 'non-power' utilization of nuclear energy. In this regard, more than 20 agencies, including research institutes, universities, teaching hospitals, regulatory agencies and utilities, participated in the projects and have benefited from the program.

We are grateful to the Government of Australia for the assistance rendered to us during Malaysia's early stage of nuclear science and technology development. A memorandum of understanding (MOU) concerning Scientific and Technological Cooperation between the two countries was signed in 1982. It provided a framework for the two countries to promote cooperation in science and technology in areas of mutual interest, especially those relevant to industrial development, promoting the exchange of views in the formulation and application of science and technology policies and facilitating interaction between government officials and scientists of the two countries.

In addition to Australia, Malaysia has also embarked on a technical cooperation program with Japan. A memorandum of understanding was signed in 1989 for Japan to assist Malaysia in establishing the radiation application technology using the Electron Beam Machine (EBM), and to provide necessary technical advice on the radiation curing of surface coatings research and sterilization of medical products. Under this cooperation, the Government of Japan, through the Japan International Cooperation Agency (JICA), has contributed two electron beam machines, both for low and high energy, while the Malaysian government undertook the construction of building for EBM and associated radiation processing laboratories. In addition to training local counterparts both in Malaysia and in Japan, JICA also provided long-term experts to ensure the smooth operation and implementation of the project, which was successfully completed in 1994. The facilities are now used for research and services in areas such as surface coating and finishing, medical product sterilization, radiation cross-linking of wire and cables, heat-shrinkable tube and other radiation polymerization work.

In addition to that, bilateral research cooperation program began in 1987 between Malaysia and the Japan Atomic Energy Research Institute (JAERI) in the area of radiation processing technology. Initially, the research project was in the treatment of oil-palm waste for upgrading animal feeds. The project was completed in 1997 and now, under the third phase of the cooperation until 2002, the research cooperation is focusing on the area of the radiation processing of starch. In the implementation of this cooperation, close cooperation and networking was developed between researchers from MINT and the Takasaki Radiation Chemistry Research Establishment,

through the exchange of scientists between the two institutions. As a result of the earlier project, a pilot plant to process and convert oil-palm empty fruit bunch into animal feed was established in MINT to assess its technical and commercial viability before it could be transferred to the private sector.

(Mr. Datuk Law Hieng Ding; Minister of Science, Technology and the Environment)

PHILIPPINES

The Philippines, through the Department of Foreign Affairs and the Philippine Nuclear Research Institute (PNRI), has already initiated steps toward the cost-free shipment to the U.S. of spent fuel from the Philippine Research Reactor (PRR-1) under the U.S. fuel return policy. Currently, the PNRI is formulating the Administrative and Technical Preparation for the Shipment of the said PRR-1 spent fuels to the U.S., scheduled for spring 1999.

As we have consistently acknowledged, the key to the reintroduction of nuclear power to the Philippines in the future is a successful public information and education campaign. The Philippine Nuclear Power Steering Committee hence gives top priority to this activity. The ICNCA program on public acceptance of nuclear energy is in line with this Philippine priority, and it is our belief that the proposed establishment of a Speakers' Bureau would further enhance the regional character of this project.

The proposed Bureau is envisioned to be a resource bank of experts who are capable of communicating to the public the essential facts that should hopefully minimize, or outright eliminate, the negative perception of nuclear energy by the public.

In addition to this education campaign, a consensus was likewise made that accessibility and transparency of information, specifically through the ASIANNET (Asian Nuclear Network), continue to be vital and thus, merit continued support and expansion by way of hitching to the electronic information highways capable of providing accurate and real-time data concerning nuclear matters.

The move toward redefining the operation and management of the framework of cooperation thus warrants support. The proposed hierarchical refinement will hopefully improve the quality of our cooperation activities and facilitate enhanced linkages between and among the participating states. Further, the proposal to incorporate a new area on manpower development strongly merits our approval.

Cognizant of the fact that nuclear science and technology relies on the available quantity and quality of our manpower, we cannot overemphasize the need to develop and harness our human resource pool maximally. Toward that end, a project on nuclear education is hereby recommended.

The Philippine Government once more takes this occasion to reaffirm our commitment to regional nuclear cooperation. The new framework being put forth, which seeks to establish a Forum for Nuclear Cooperation in Asia, has our support.

Additionally, we deem it worthy to note that when a common cooperative project or research program is pursued by the cooperating countries, better output is obtained than when meetings, workshops or information exchanges are solely relied on. The results of the ICNCA regional cooperation activities on research reactor utilization and on medicine validate this observation. A mechanism that assures the relevance of our activities, the derivation of mutual benefits and the non-duplication of our efforts is hence necessary.

(Dr. Leopoldo LH. Lazatin, Undersecretary, Department of Science and Technology)

THAILAND

In recent years, the major new development has been the project to establish a new nuclear research center, the Ongkharak Nuclear Research Center (ONRC). A contract was awarded to General Atomics (GA) of the U.S., and three major facilities are to be designed and constructed with technology from three countries: GA's 10-MW TRIGA research reactor, a radioisotope and radiopharmaceutical production facility from the Australian Nuclear Science and Technology Organization (ANSTO), and central radioactive waste processing and storage facility from Japan's Hitachi. The work is currently in the basic design stage, and the preliminary safety analysis report (PSAR) for the construction permit has been submitted. When completed, the center will act as Thailand's major R&D center on nuclear science and technology, serving the country's entire science and technology community. It will also contribute to close cooperation on nuclear science and technology for peace and security with the international community.

A national program began in 1997 in conjunction with the Human Resource Development program under the JAERI-OAEP Cooperation Agreement (begun in 1994). The program will help develop and secure a sufficient and sustainable number of qualified personnel for radiation and nuclear safety control and enforcement in Thailand, both for safety inspectors and safety officers. The enhancement programs will be developed

together with the ongoing reorganization effort on regulatory enforcement of nuclear safety.

A consensus on nuclear power is becoming increasingly 'the important' issue to be decided by world leaders for saving humankind from natural disaster. The Kyoto Protocol on Climate Change and the additional plan of actions recently concluded at the fourth UN Climate Change Conference held in Buenos Aires, Argentina, are to be seriously implemented. On the other hand, a worldwide public information program, by nuclear organizations, is essential to raise the level of public understanding and confidence about nuclear power technology, International collaboration on these issues is necessary.

We welcome the new initiative to reorganize the ICNCA into two levels of consultation, namely, the annual Forum for Nuclear Cooperation in Asia for ministerial consultation and the annual Meeting of Coordinators for technical consultation.

In that connection, on behalf of the Royal Thai Government, I am pleased to announce that the Ministry of Science, Technology and Environment agrees to co-host with Japan Atomic Energy Commission the first ICNCA Forum for Nuclear Cooperation in Asia to be held in Thailand in November 2000.

(Mr. Suwit Khunkitti, Deputy Prime Minister and Minister of Science, Technology and Environment)

VIETNAM

The objective of Vietnam's feasibility study is to consult and advise to the Government on the development strategy and master plan for nuclear power in the country. The study has been conducted by experts of the VAEC, Ministry of Industry and the IAEA under the technical cooperation project, VIE/0/009. Besides, cooperation has also been received in this area from other countries, such as Japan, South Korea and Canada. The study consists of all aspects related to nuclear power projects, including planning, site selection, technology selection, safety analysis, environmental impact assessment, design, procurement, construction, installation, commissioning, operation, handover, maintenance, and, in particular, financial arrangements. Based on the study results, it can be concluded that Vietnam's first nuclear power units should be built by 2010 to 2012 to meet the energy demand for the national economy.

Together with the beginning of operation of the Dalat nuclear research reactor in March 1984, the first nuclear application exploited in Vietnam is the production of radioisotopes and the development of a national network of departments of nuclear medicine. In 1984, there were only two departments of nuclear medicine in the whole country, but now there are more than 20 such departments. The Dalat nuclear research reactor is producing and supplying about 20 radioactive preparations, mainly isotopes I-131, P-32, and the Tc-99m generator to the national network of nuclear medicine departments. These isotopes have been effectively used in the treatment and diagnosis of disease. Every year there are hundreds of thousands of patients treated and diagnosed by in-vivo and in-vitro techniques nationwide. Recently, brachytherapy equipment has been manufactured, installed and successfully brought into use at the service of disease treatment. In the future, the national network of departments of nuclear medicine will be further developed and expanded so that more patients can be receive the benefits of nuclear medicine in disease diagnosis and treatment.

In addition, another important focus of medicine is the application of irradiation techniques in the sterilization of medical products. The Center for Irradiation and Sterilization, with Co-60 source of 300 KCi, has been built in Ho Chi Minh City and was very recently put into operation.

Biological techniques in combination with irradiation have recently been used to produce new flower varieties. In particular, our noticeable achievements are the creation of two new rice varieties — the Tai Nguyen mutant and the Tep Hanh mutant — which feature a high yield and short cultivation time, and which are well-adapted to many types of soil, as well as being highly resistant to disease and having a high quality suitable for export. These two rice varieties are being planted on more than 200,000 hectares in the Mekong delta.

(Prof. Tran Huu Phat, Chairman of Vietnam Atomic Energy Commission)

IAEA

The most recent IAEA projections provide high and low estimates for global nuclear capacity up to the year 2020. In the low case, owing to the large number of units that will be shut down at the end of their scheduled operating lifetime and the slow pace of new capacity additions, nuclear capacity would start to decrease after 2010. In the high case, the total installed nuclear capacity worldwide will reach some 575GWe in 2020.

While nuclear capacity in industrialized countries and in the Eastern Europe region would decline in the low scenario, it is expected to increase in developing countries in both the high and low cases. In the low case, it would increase more than threefold — from about 23GWe in 1997 to some 70GWe in 2020. In the high case, the projected increase is more than sixfold — to a level of some 150GWe by 2020. Three highly populated and rapidly developing countries — China, Republic of Korea and India — account for most of that increase.

In October 1998, IAEA held an international seminar in India on the topic, "Nuclear Power in Developing Countries: Its Potential Role and Strategies for its Deployment." The message from developing countries at this seminar was that there is considerable interest in nuclear power as part of their future energy strategy. There was recognition that a considerable infrastructure needs to be in place for regulation, training, operations, public communications, and so forth. Technology transfer is vital in all these areas, as well as in the design and construction sectors. Waste management appears to be of importance primarily because of the public concern.

The biggest hurdle to implementing nuclear power programs in developing countries was identified as the high capital cost of nuclear projects. It seems that unless such costs can be reduced, there is little hope for nuclear power to make more than an incidental contribution to energy supply in developing countries. It was recommended that an international project should be established to develop an appropriately sized modular unit for mass production with improved economics, safety, non-proliferation and waste minimization.

It was felt that regional cooperation in reactor design and construction and in fuel cycle facilities could also play a key role in the deployment of nuclear power by developing countries. This would have the added advantages of easing difficulties in technology transfer as well as meeting the requirements of international safeguards against nuclear weapons proliferation. In that respect, in the Asia-Pacific region, developing countries with an advanced nuclear technology sector could play an important role in any regional or international efforts.

The future role of nuclear energy depends critically on improved public acceptance which requires, among other things, a consistent, demonstrated record of safety in all nuclear applications and in the safe management of radioactive waste.

Safety is a national responsibility but a global concern. The IAEA plays a fundamental role, but we have no power to enforce — only to recommend, advise and assist. Our approach has been to seek to establish a global nuclear safety culture compromising: legally binding international agreements, non-binding safety standards and the provision of safety services. In 1996, member states adopted the Convention on Nuclear Safety, which commits them to achieve and maintain high safety levels. They are obligated to meet international benchmarks in major areas of regulation, management and operation of nuclear power plants.

In the Asia-Pacific region, the IAEA established the extrabudgetary program on the safety of nuclear installations in 1997 to strengthen nuclear safety and enhance the technical competence of regulatory authorities and supporting technical organizations of member states. Several countries, including France, Japan, Korea, Spain, and the U.S. have committed cash and in-kind contributions to the program.

The scope of the program includes: (1) Training in nuclear safety; (2) Reinforcement of national regulatory framework and technical management capabilities including nuclear legislation, regulations, safety assessment, licensing, inspection and enforcement; (3) Emergency planning and preparedness; (4) Safe storage of research reactor spent fuel; (5) Promotion of safety culture concepts; (6) Preparation of information to decision makers and to the public to build up understanding and confidence in nuclear safety; (7) Preparation of country profiles and specific action plans for prioritizing IAEA assistance in nuclear safety matters related to NPPs and re-

search reactors; (8) Establishment of a regional forum to exchange information in order to harmonize nuclear safety concepts and actions.

The first phase, from 1997 to 1998, included preparation of country-specific nuclear safety profiles of the participating countries (China, Philippines, Malaysia, Indonesia, Vietnam) and the provision of some assistance on priority safety needs. Based on the needs identified in the country-specific nuclear safety profiles, the IAEA has initiated the second phase, from 1999 to 2000.

(Dr. Sueo Machi; Deputy Director General, International Atomic Energy Agency)

JAPAN

Japan's nuclear policy has been embodied in the Long-term Program, which is revised about once every five years. In consideration of the expanded use of nuclear power generation, the wider application of radiation in medicine and industry, and ongoing privatization, it is necessary for the next Long-term Program to set a clear vision of directions for the development and utilization of nuclear energy in the 21st century. Discussions have been held regarding the revision of the Long-term Program, and the Atomic Energy Commission has touched on the preparatory work for this revision.

It is important to provide direction in various issues and development programs which Japan is now facing, such as MOX fuel in light water reactors (LWRs), the interim storage of spent fuels as recycling resources, the repro-

Opening Address

Last November, the Atomic Energy Commission began preparatory work to revise the Long-term Program for Research, Development and Utilization of Nuclear Energy. In the coming revision, we will address the whole picture of nuclear policy, with a long-term perspective toward the 21st century, both domestically and internationally. Official deliberations to revise the Long-term Program will begin as soon as possible in the coming fiscal year.

With the new millennium soon upon us, the Government's program of ministry and agency reorganization will place the Atomic Energy Commission (AEC) in the Cabinet office. That should serve to strengthen the AEC in its issuance of policies, comprehensive coordination, evaluations, and dealing with public affairs. The new Ministry of Education, Science and Technology will be responsible for long-term R&D, and the Ministry of Economy and Industry will be responsible for the utilization of nuclear energy through measures under the AEC's comprehensive policies.

The AEC has been addressing nuclear cooperation in Asia through its Advisory Committee on International Nuclear Cooperation, which issued a report last September. It stated, "Geographically and economically, Japan has strong ties with its neighbors in Asia, and profound mutual influences exist. For the sound development of nuclear science and technology, it is important to carry out continued cooperation to establish infrastructures of human resources as well as research and technology systems, in close linkage with existing international organizations, based on the assurance of safety, nuclear nonproliferation, and enhanced transparency, taking into consideration the circumstances in each country."

The AEC expects the relevant ministries and agencies to develop specific cooperation activities according to that recognition. The report also specifically notes the necessity of policy dialogue. This international conference, which has met ten times since 1990, has provided a venue in which repre-

sentatives involved in nuclear policy-making in their own countries have gathered annually to perform a significant role in exchanging information, frankly sharing views, and enhancing mutual trust. I hope that the conference will be strengthened as a meaningful occasion for policy dialogue among the participating countries.

(Prof. Akito Arima; Minister of State for Science and Technology, Chairman, Atomic Energy Commission of Japan)

cessing of spent fuels, fast reactors, and the geological disposal of high-level radioactive waste (HLW). It is also important to respond flexibly to these issues with consideration for an appropriate sharing of roles between the government and the private sector.

After the sodium leakage accident at the prototype fast reactor Monju in 1995, the nuclear energy community has stepped up its efforts to build a nationwide consensus for nuclear energy development. The Atomic Energy Commission also has been making such efforts as inviting the public to take part in the policymaking process, opening its meetings and its committees to the public, and holding a series of roundtable conferences for the discussion of general matters of nuclear energy.

Japanese society appears to recognize the success of steady nuclear development such as nuclear power generation and radiotherapy. However, while society appreciates these achievements, it does not approve of continuing development without a reexamination and reaffirmation of the entire range of nuclear policy, including both R&D and utilization.

It is certainly true that the incidents at Monju and elsewhere were key events causing a reexamination of nuclear policy. However, such a review was clearly inevitable sooner or later. The Atomic Energy Commission insists that the main task of nuclear energy in Japan is the establishment of the nuclear fuel cycle as a means for using resources more efficiently and reducing the burden on the natural environment.

Completing the nuclear fuel cycle is not easy in Japan's current recession, along with the movement to deregulate the electricity business and efforts to reduce costs. My view is that the nuclear energy system expected to be in harmony with human society in the 21st century will have the ultimate goal of ensuring the full recycling of resources and zero release of radioactive waste, with no risk of nuclear proliferation. In relation to LWRs, strenuous and steady efforts are underway to ensure a flexible and sustainable nuclear fuel cycle in the use of MOX fuels, the on-site storage of spent fuel, interim off-site storage of spent fuel, and so on.

In addition, Japan releases information through the IAEA on the amount of its stock of plutonium and its plans for utilization, according to the international guidelines, with the policy of not holding any excess plutonium. In the nuclear fuel cycle, the treatment and disposal of radioactive waste remains a major challenge for the countries wishing to achieve nuclear power generation, and this will be one of the issues shared by Asian countries in the future.

(Prof. Yoichi Fujiie; Acting Chairman, Atomic Energy Commission of Japan)

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Japanese Manufacturers Step Up Environmental Efforts

Protecting the environment while achieving sustainable economic growth is one of the most critical issues confronting the world today. On the international level, extensive discussions have been going on to establish global standards for environmental protection. In the Japanese business community, the Federation of Economic Organizations (Keidanren) has compiled a list of voluntary environmental action plans that Japanese businesses have undertaken in line with international trends. Many firms have established numerical targets for reducing energy consumption and CO_2 emissions by the year 2000 or 2010.

Japanese companies are undertaking their efforts to protect the environment on three fronts: management, factory operation and production, and product development. These are described in further detail below:

1. Management

On the management front, companies' actions have focused on ISO-14000 certification, investment in environment-related facilities, and the training of environmental specialists and workers. Such efforts have bestowed two distinctive advantages: a higher awareness on the part of employees toward environmental issues, and a reduction in operational costs through energy conservation, material reductions, and recycling of used parts and products.

The enthusiasm of Japanese companies toward environmental protection is represented by the number or organizations that have already earned ISO-14000 series certification, which began in 1996. The total number of Japanese organizations obtaining ISO-14001 certification reached 1,174 as of August 1998: 48.3% in electric/electronics, 10.6% in machinery, 8.3% in chemicals, 6.8% in precision machinery, 4.8% in transportation, 2.7% in the service sector, and the remainder from various other industries.

The "green" mood is spreading to small and medium-sized companies as well, especially those with business ties with larger companies. As many Japanese companies operate on a global basis, which has led to sustained efforts to minimize the impact their business activities have on the environment worldwide.

2. Factory Operation and Production

A great deal of effort has been spent on preserving energy to reduce emissions of CO_2 and other greenhouse gases. For the past two decades, Japanese manufacturers have cut their energy consumption by 40%. The chemical industry has done the best, cutting its energy consumption by half.

3. Product Development

One of the main focuses of R&D carried out by Japanese manufacturers is the development of environment-friendly new products that consume less energy, offer clean operation with better environmental performance, and permit easy recycling.

Newly developed consumer electric and electronic products — such as TV sets, refrigerators, and room air-conditioners — have boosted energy efficiency and offered better environmental performance. New energy- efficient power generators and power transmission facilities offer a substantial reduction of transmission loss, also contributing to environmental protection.

Recycling of Used Products

In May 1998, the Japanese government passed new legislation — effective in 2001 — requiring manufacturers to collect and recycle all TV sets, refrigerators, washing machines and air-conditioners they produce.

The Japanese electric and electronics industry has been a pioneer in this regard, with several companies joining forces in a consortium to study the recycling of used products to decrease waste. A pilot plant has already been set up to recycle used models of the aforementioned appliances. Operators of the pilot plant aim to ascertain recycling costs and design new products that permit easy recycling.

Life-cycle Assessment

Environmental impact must be assessed on each stage of an industry's operation, starting from material fabrication, assembly and production (the upstream cycle), and moving on to use, maintenance, recycling and waste (the downstream cycle). This is called "life-cycle assessment." The automobile industry is representative of highly integrated industries that have both upstream and downstream facets. Life-cycle assessment has become one of the most important tools for environmental protection efforts.

The automobile industry faces two very serious issues: developing environment-friendly vehicles and discarding used vehicles. Most of the efforts of the Japanese automobile manufacturers to protect the environment have focused on the development of environment-friendly vehicles based on the following design parameters: Increased fuel efficiency, reduced emissions of pollutant gases, reduced noise, and an increased recycling rate. Toyota's hybrid car, Prius, and Mitsubishi's GDI (gasoline direct injection) engine- powered cars, are two recent examples of environment-friendly vehicles.

The recycling of used vehicles is important when applying the concept of life- cycle assessment to the automobile industry. Japan suffers from a shortage of landfills for waste, including shredder trash. The current automobile recycling rate is 75% in weight, with the remaining 25% mostly glass, ceramics and rubber. Efforts are being made to increase that rate, but the treatment of shredder trash presents a serious problem.

Remaining Issues

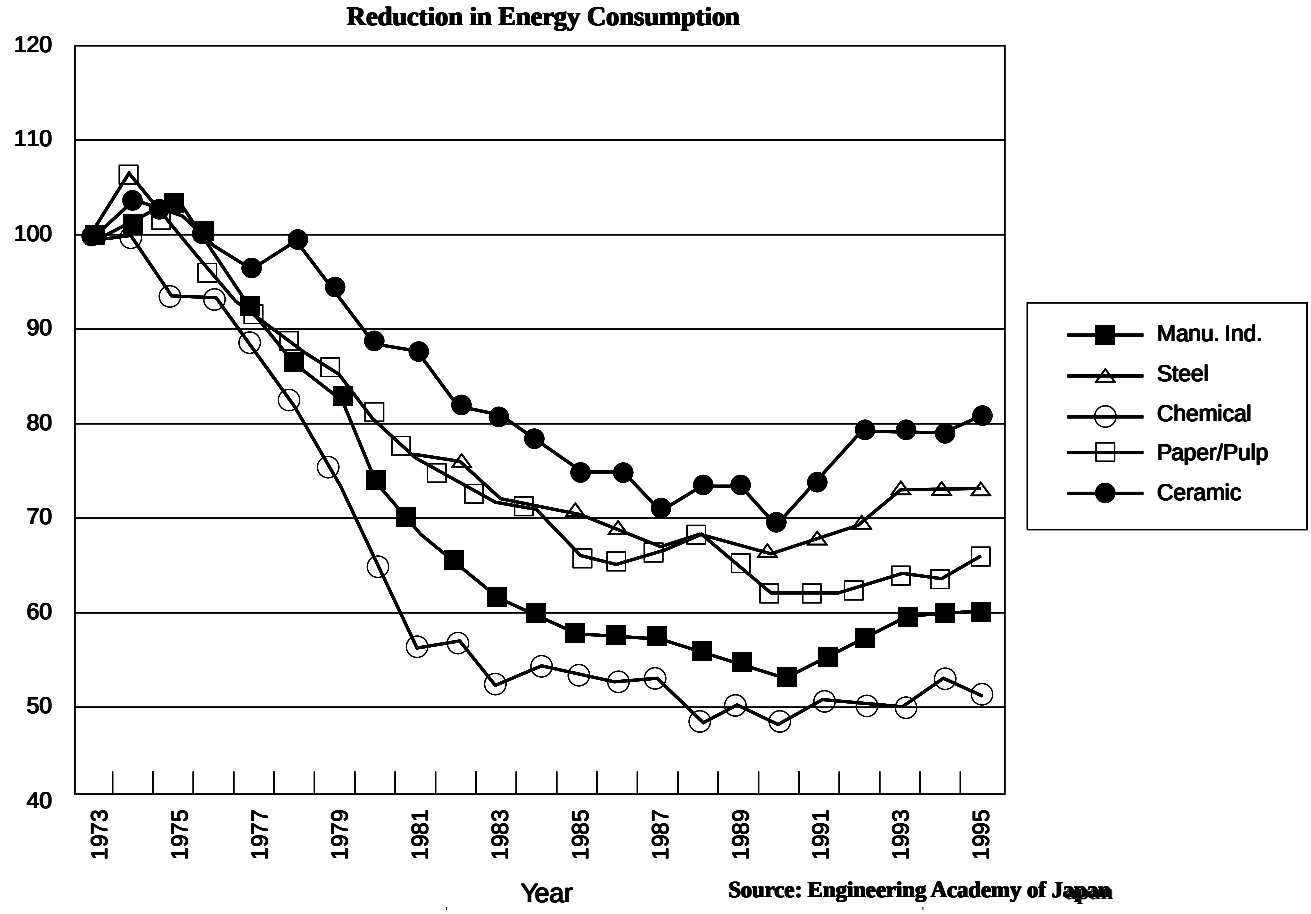
Private industry has only just begun to take steps to protect the environment. It is highly important to establish appropriate environmental performance indicators to measure individual company's achievements, including emissions of CO_2, greenhouse gases, particular pollutants, as well as energy consumption. There is a serious need for international cooperation in the collection and assessment of environmental performance indicators of different industries, the establishment of a relevant data base, as well as R&D on new environment-related technologies.

Companies Reduce Capital Spending

Japanese companies will reduce capital spending for the second straight year in FY99 (which begins on April 1). According to a recent survey of 1,711 major companies by the Nihon Keizai (Nikkei) Shimbun, the combined initial spending forecasts from all industrial sectors for FY99 is 8% below the projected levels for the year before. Telecommunications, the traditional growth leader, expects a 14.2% reduction. Major manufacturers, such as automobiles and electric machinery, foresee declines as they strive to reduce excess capacity.

For all industries, FY98 capital spending is now expected to slide 4.6% under the initial expectations. The protracted economic slump has prodded electric machinery and steel companies to slash their spending. A two-year capital-spending decline last occurred in the FY92-94 period. For FY99, capital spending by manufacturers is likely to shrink by 10.8%, making it the second consecutive year of double-digit declines. Except for ceramics, all 17 sectors expect capital spending for FY99 to fall below this year's projected levels.

Electric machinery makers are set to reduce their capital spending by 4.3%.



Investment is likely to remain flat at five major semiconductor manufacturers, but that amount is 50% below the peak level reached in FY95. Automobile and auto-parts manufacturers plan to lower capital spending by 4.9%. However, mass production of low-pollution engines and other environment- related investment are expected to provide support.

Non-manufacturers expect to curtail their capital outlays by 6.5% in FY99.

Among the 16 sectors, electric power, real estate, mining and nonbank financial institutions plan to spend more than in FY98, but big cuts are expected from telecommunications and air-transport companies.

Corporations are cautious about new investments in FY99, with manufacturers making excess-capacity corrections. The Japanese automobile industry has about 20-30% excess capacity. Domestic vehicle output for FY98 is expected to fall below 10 million units for the first time in two decades. Japanese automakers will be forced to adjust for excess capacity, estimated at three million vehicles a year. Excess capacity is also striking in the materials sector, except for Nippon Steel, which disposed of facilities on a large scale during the mid-1980s recession brought on by the strong yen.

Rapidly deteriorating earnings are also putting a freeze on capital spending. Because a growing number of electric machinery manufacturers will end up with losses for this fiscal year, they are forced to cut next year's capital spending in order to improve cash flow.

Looking at telecommunications firms, Nippon Telegraph and Telephone Corp. (NTT) plans to reduce its FY99 spending to ¥1.5 trillion ($12.8 billion), about ¥200 billion below the previous year's figure.

Electric utilities, the largest spenders, are expected to revise their 0.4% growth estimate downward because of stagnant sales growth, mainly in the area of large-lot industrial demand.

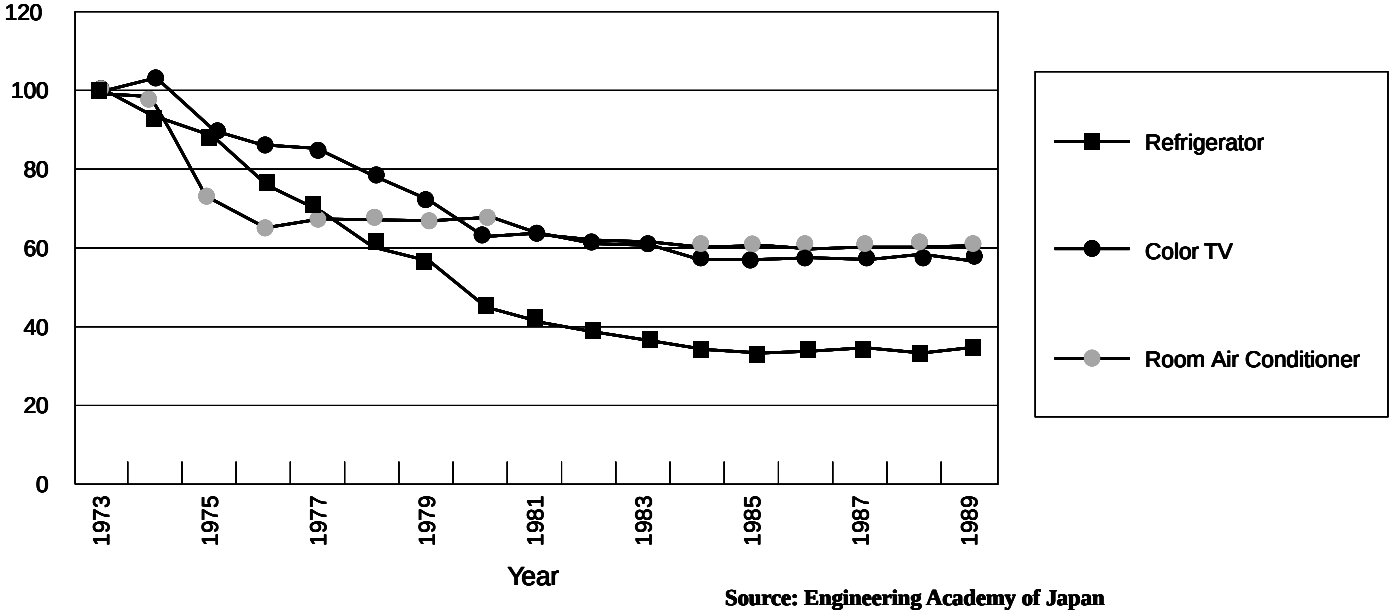
Expectations are focused on environmental measures. Environmental spending is expected to increase by 24.2% for all industries. The automobile, electric machinery and steel sectors expect 46-58% growth. Investment in information systems and automation is expected to be on the upturn at banks, insurance and securities companies.

Capital Investment Plans (¥ billions)

	Number of Companies	FY'98 Projection	Year-on-year change	FY'99 Projection	Year-on-year change
All Industries	1,711	15,543	–4.6%	14,296	–8.0%
All Industries (exc. electric power)	1,699	11,125	–7.3%	9,858	–11.4%
Manufacturers	935	5,583	–10.4%	4,983	–10.8%
Non-manufacturers	776	9,960	–1.0%	9,312	–6.5%

Source: The Nippon Keizai Shimbun

Reduction of Electricity Consumption



Source: Engineering Academy of Japan

Grim Earnings Expected for Japanese Manufacturers in Fiscal 1998

Japan's manufacturing sector is headed for a grim earnings decline in FY98 (ended March 31, 1999). Many representative companies have just reduced their earnings estimates. The sluggish domestic economy, the strong yen and economic turmoil in the rest of Asia and other emerging markets are the main reasons for the poor performances. Most electronics companies have lowered their forecasts. The slide in semiconductor chips prices ended, but the stronger yen hurt exports while domestic sales remained weak. NEC, Japan's leading computer maker, and Toshiba, the second-largest electric machinery manufacture (after Hitachi), were among those revising their forecasts downward.

NEC will post a ¥150 billion ($1.3 billion) group net loss for the current fiscal year. NEC's ailing U.S.-based computer company, Packard Bell NEC, once again posted huge losses. The firm is expected to record a $500 million pretax loss in 1998, forcing NEC to make ¥75 billion in restructuring costs. Group sales are expected to be ¥4.7 trillion, 4% less than the previous year. NEC's problems were compounded by a ¥30 billion loss in foreign exchange. The company now forecasts a group pretax loss of ¥220 billion for the year.

Toshiba also has been hurt by weakened sales and the strong yen. The company will incur a net loss of ¥17 billion. A group net loss would be Toshiba's first time in 25 years. Toshiba expects to post extraordinary losses totaling ¥82 billion due to a shortage in reserves for its corporate pension fund and to restructuring costs for its air-conditioner, household electronics and semiconductor businesses. At the same time, it expects extraordinary gains of ¥62 billion from selling to a subsidiary its stake in TimeWarner of the U.S., real-estate holdings and copier operations.

Hitachi recently raised its projected group loss for FY98 from ¥250 billion to ¥375 billion. Sony also joined the group of gloomy announcements, expecting its consolidated operating profit to be ¥340 billion, down from the earlier estimate of ¥370 billion.

Japan's five major integrated steelmakers have also slashed earnings estimates. Nippon Steel, Japan's largest steelmaker, trimmed its pretax profit forecast to ¥50 billion from ¥80 billion. Sumitomo Metal Industries is forecasting a ¥28 billion pretax loss, the first time it registered a loss since FY94. NKK and Kobe Steel also have raised their forecasts of pretax losses, due to a price decline and shrinking exports to the U.S.

Mitsubishi Heavy Industries (MHI) is expected to report a nearly 70% drop in pretax profit for FY98 to ¥40 billion. It is likely to incur a second-half pretax loss of about ¥10 billion. That would its first half-year loss since the company was established through a merger in 1964. Orders for industrial machinery have decreased in Japan and other Asian countries. MHI's FY98 sales are expected to decline by 6% to ¥2.5 trillion.

Meanwhile, Kyocera is expected to post a pretax profit of ¥48 billion for FY98, a 34% decline from the previous year.

Restructuring is the most important task that manufacturers face over the long term, with the gloomy profit picture for FY99. The manufacturing sector will probably face a 10% drop in pretax profit in the next fiscal year.

Council Releases Final Report Urging Fiscal Restructuring

The Economic Strategy Council (ESC), a panel of business leaders and scholars, submitted its final report to Prime Minister Keizo Obuchi. The ESC recommended that the government must restructure its deficit-ridden fiscal condition within the next decade, hopefully by the end of FY2008. The ESC also said that Japan still has the potential to attain 2% growth by FY2001 if sufficient structural reforms are taken.

After six months of discussion and surveying economists and business leaders in Japan, the 10-member panel, headed by H. Higuchi, chairman of Asahi Breweries, drew up a scenario for economic recovery using a three- step approach in its final report: — FY99-2000: rehabilitation period after the bursting of the bubble economy — FY2001-02: time to return to healthy economic growth — FY2003 onward: full-scale recovery, with the regaining of the nation's fiscal health and execution of various structural reforms.

During the first phase, the government should employ every possible macroeconomic stimulus and financial stabilization measure while trying to avert a deflationary spiral. In the second phase, the government should take a neutral fiscal policy stance with less spending and continue its eased monetary policy. In the final phase, the government should target fiscal health, and monetary policy should be neutral and not swayed by the economy.

One newly added proposal recommends that the central government and municipalities adopt a new accounting system by compiling a balance sheer themselves and announcing consolidated financial results with other state agen-

cies.

To resolve the bad-loan problem at financial institutions, the report says that real estate held as collateral must be liquidated. It also calls for securitization of assets held by government-affiliated financial institutions. To promote leading industries in the 21st century in areas like biotechnology, telecommunications, and distribution and finance, the report says that the government must draw up a strategic plan and implement drastic decontrols in these fields.

To tackle unemployment, the report recommends strengthening the safety net by introducing a voucher system to financially support people who wish to have vocational training, thereby promoting liquidity in the job market. However some experts point out that the government may fail to turn away from its traditional approach of public investment-led recovery in the face of rising unemployment in the future, delaying the process of rebuilding its fiscal condition.

The ESC insisted the establishment of an organization to monitor government efforts to carry out the proposal, but it would be difficult to establish such a body at present because the final report includes many politically sensitive proposals.

Summary of ESC's recommendations:

— Aim for a 2% growth rate in FY2001 and healthy, stable growth by FY2008.

— Give priority to economic stimulus and financial system stabilization through active fiscal spending in FY99-2000.

— Reduce public investment while launching drastic structural reforms in FY2001-02.

— Streamline government by selling or efficiently using public assets and accelerating the government's 25% reduction in number of government employees.

— Establish a "system reform committee" under the prime minister to review Japan's various regulations, taxation and subsidy systems.

— Establish a vocational training system for people who want new skills, providing 50% tuition vouchers with a ceiling of ¥1 trillion.

— Improve the transparency of the fiscal investment and loan program and conduct a drastic review of the program including its possible abolition.

Japanese Banks to Receive Injection of Public Funds

The Financial Restructuring Commission has decided to inject ¥7.45 trillion ($64 billion) in public funds into 15 banks to strengthen their capital bases, after examining the banks' plans to write off bad loans and restructure their operations.

Fuji Bank topped the list at ¥1 trillion ($8.5 billion) for itself and its ailing affiliate Yasuda Trust & Banking Co. Next came Dai-Ichi Kangyo Bank (DKB) at ¥900 billion, followed by Sakura Bank at ¥800 billion, Sanwa Bank at ¥700 billion, and the Industrial Bank of Japan (IBJ) and Tokai Bank at ¥600 billion each.

Eight major money-center "city banks" are among the 15 banks to receive public money: besides Fuji Bank, Sakura Bank, Sanwa Bank, DKB, and Tokai Bank (all mentioned above), these include Asahi Bank (¥500 billion), Daiwa Bank (¥400 billion), Sumitomo Bank (¥500 billion). The beneficiaries also include five trust banks besides Yasuda Trust & Banking: Chuo Trust & Banking (¥200 billion), Mitsubishi Trust & Banking (¥300 billion), Mitsui Trust & Banking (¥350 billion) Sumitomo Trust & Banking (¥200 billion) and Toyo Trust & Banking (¥200 billion). The remaining two banks are IBJ (¥600 billion), a long-term credit bank, and the Bank of Yokohama (¥200 billion), the biggest regional bank. In addition to public money, the 15 lenders plan to raise a total of ¥1.7 trillion from the market and other companies through third-party allotments of new shares.

Under the government's banking-sector rehabilitation program, ¥25 trillion ($214 billion) in public funds has been set aside to recapitalize banks whose coffers have been depleted through the disposing of bad loans. PRC has been calling on banks to accept as much public money as possible to write off their bad loans. With the banking industry to be freed from the shackle of bad loans through the recapitalization scheme, attention is now shifting to a drastic realignment of top-ranking city banks. Moves toward mergers and tie- ups have surfaced among lower-ranking city banks and trust banks.

Current Account Surplus Rises to All-time High

Japan's current account surplus rose to an all-time high of ¥15.861 trillion in 1998, up 38.7% from the previous year. The previous record surplus was ¥14.669 trillion, set in 1993. In 1998, trade in goods and services resulted in a surplus of ¥9.590 trillion, up 66.3%. The surplus in merchandise trade totaled ¥15.993 trillion, up 29.9%, with exports down 1.3% to ¥48.867 trillion and imports down 11.7% to ¥32.873 trillion.

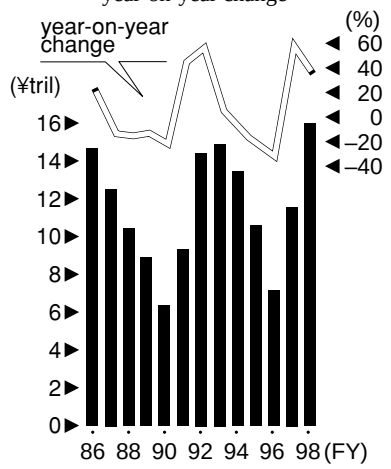
Exports in 1998 declined due to a 17.9% fall in shipments to the rest of Asia, compared with rises of 9.2% to the U.S. and 17.5% in the European Union.

Imports suffered a double-digit setback. Exports of semiconductors and other electronic parts fell 8.9%, auto parts 8.5% and office equipment 4.6%. Falling crude oil prices depressed overall imports to Japan, with shipments of crude oil sliding 30.6%, and those of petroleum products declining 36.4%. Crude oil averaged $13.93 per barrel in 1998, down 32.8%.

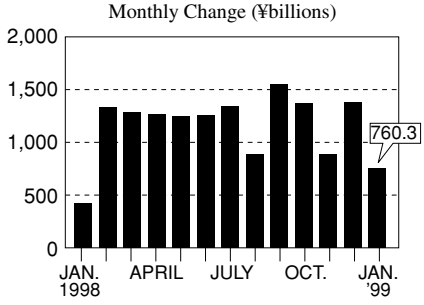
The deficit in services trade in 1998 narrowed to ¥6.404 trillion, down 2.1% from the previous year's ¥6.542 trillion. Income from Japanese investment in foreign securities saw a surplus of ¥7.415 trillion, up from ¥6.740 trillion the previous year.

The financial account portion of Japan's balance of payments showed the deficit ballooning 3.5 times, from ¥4.347 trillion to ¥15.204 trillion. The deficit in direct investment increased 3.0%, from ¥2.755 trillion to ¥2.838 trillion. The balance of portfolio investment ran ¥5.742 trillion in the red, a turnaround from a surplus of ¥8.721 trillion. Japan's surplus in merchandise trade in January rose 87% from a year earlier to ¥760.3 billion. Imports fell 22.1% for the 13th consecutive monthly decline to ¥2.69 trillion. Crude oil imports plunged 49.2%, because the unit price had fallen 46% from the previous year. Exports dropped 10.6% to ¥3.45 trillion, the fourth straight month of declines. Office equipment such as computers dropped 18.5%. Politically sensitive iron and steel exports to the U.S. fell 28.7% in value terms and 25.4% in tonnage terms.

Current Account Surplus
year-on-year change



Trade Surplus
Monthly Change (¥billions)



Source: Ministry of Finance

On a regional basis, Japan's surplus with the U.S. slipped 2.2% to ¥487.2 billion, the first drop in two months. Exports, including automobiles, fell 13.6% to ¥1.106 trillion. Imports decreased 20.8% to ¥619.2 billion. Electronics parts such as semiconductors shrank 22%, and optical instruments fell 29.1%. The trade surplus with the rest of Asia grew for the first time in 11 months to ¥120.8 billion. Exports declined 9.4% to ¥1.142 trillion, and imports plunged 21.3% to ¥1.021 trillion.

As for trade with the European Union, the trade surplus surged 31.1% to ¥275.1 billion, making for the second consecutive month of increases. Exports edged down 1.4% to ¥669.8 billion, and imports fell 16% to ¥894.3 billion.

Japanese Aircraft Manufacturers Joining Hands with Europe

The Japanese aerospace industry was totally committed to Boeing of the U.S. Now the industry is gradually seeing opportunities in Europe. Mitsubishi Heavy Industries (MHI) has decided to participate in Airbus Industries' project to develop the A3XX jet, the world's largest passenger jet with a capacity of 555 seats, being the first Japanese aerospace manufacturer to join with the European consortium in developing a new plane. The first plane will appear in the market in 2004, with development costs projected to exceed ¥10 billion ($85 million).

Mitsubishi Heavy Industries (MHI) and other four major Japanese aerospace companies — Kawasaki Heavy Ind., Fuji Heavy Industries, Shin Maywa Industries, and Japan Aircraft Manufacturing — earlier decided to take part in the development of Boeing's 747X, which will have 500-600 seats and counter the A3XX. They will be involved in the development of the Boeing planes' key component: the wings.

Japanese aerospace companies have been expanding mainly by exporting parts for the Boeing 767 and 777 jets and by participating in their development.

Industry sources are concerned that MHI's approaches to Airbus might offend Boeing and ruin that company's relationship with Japanese manufacturers. MHI, however, is scheduled to supply parts for Boeing's next-generation rocket project as well as its jumbo jet. MHI plans to supply an engine valve and a fuel tank for use in Boeing's two-stage Delta IV rocket series.

Japanese aircraft equipment manufacturers have suffered from Boeing's decision to phase out the civilian jets it inherited from McDonnell Douglas, including the MD-80 and MD-90. The MD-90 uses the V2500 engine, jointly developed by Japanese, U.S., U.K., German and Italian aircraft equipment manufacturers. Three top Japanese firms — Ishikawajima-Harima Heavy Industries, Kawasaki Heavy Industries and MHI — had a 23% stake in the project. ■

Operating Records of Nuclear Power Plants in March

Power Plant	Reactor Type	Gross Capacity (MWe)	Availability Factor		Capacity Factor		Remarks
			Operating hours [h]	[%]	Generated output [MWh]	[%]	
Tokai-Daini (II)	BWR	1100	744	100.0	781,205	95.5	
Tsuruga-1	BWR	357	744	100.0	265,608	100.0	
Tsuruga-2	PWR	1160	744	100.0	862,942	100.0	
Tomari-1	PWR	579	744	100.0	430,115	99.8	
Tomari-2	PWR	579	608	81.7	329,291	76.4	Shutdown due to periodic inspection (10. Jan.~6. Mar.)
Onagawa-1	BWR	524	744	100.0	389,856	100.0	
Onagawa-2	BWR	825	744	100.0	611,697	99.7	
Fukushima I-1	BWR	460	744	100.0	342,240	100.0	
Fukushima I-2	BWR	784	0	0.0	0	0.0	Shutdown due to periodic inspection (12. Aug.~)
Fukushima I-3	BWR	784	744	100.0	583,296	100.0	
Fukushima I-4	BWR	784	432	58.1	311,930	53.5	Shutdown due to periodic inspection (19. Mar.~)
Fukushima I-5	BWR	784	744	100.0	583,296	100.0	
Fukushima I-6	BWR	1100	744	100.0	818,400	100.0	
Fukushima II-1	BWR	1100	433	58.1	452,293	55.3	Shutdown due to periodic inspection (17. Dec.~14. Mar.)
Fukushima II-2	BWR	1100	744	100.0	818,400	100.0	
Fukushima II-3	BWR	1100	744	100.0	818,400	100.0	
Fukushima II-4	BWR	1100	744	100.0	818,400	100.0	
Kashiwazaki Kariwa-1	BWR	1100	744	100.0	818,400	100.0	
Kashiwazaki Kariwa-2	BWR	1100	744	100.0	818,400	100.0	
Kashiwazaki Kariwa-3	BWR	1100	744	100.0	818,260	100.0	
Kashiwazaki Kariwa-4	BWR	1100	744	100.0	818,400	100.0	
Kashiwazaki Kariwa-5	BWR	1100	744	100.0	818,180	100.0	
Kashiwazaki Kariwa-6	ABWR	1356	288	38.7	382,862	37.9	Shutdown due to periodic inspection (13. Mar.~)
Kashiwazaki Kariwa-7	ABWR	1356	735	98.7	991,430	98.3	Shutdown due to rising the indication of radiation monitor at the outlet of dehumidifier cooler in the off-gas treatment system. (31. Mar.~)
Hamaoka-1	BWR	540	438	58.9	234,385	58.3	Shutdown due to periodic inspection (19. Mar.~)
Hamaoka-2	BWR	840	744	100.0	624,958	100.0	
Hamaoka-3	BWR	1100	431	58.0	453,653	55.4	Shutdown due to periodic inspection (11. Jan.~14. Mar.)
Hamaoka-4	BWR	1137	744	100.0	845,926	100.0	
Shika-1	BWR	540	744	100.0	401,760	100.0	
Mihama-1	PWR	340	744	100.0	252,710	99.9	
Mihama-2	PWR	500	744	100.0	371,718	99.9	
Mihama-3	PWR	826	744	100.0	614,466	100.0	
Takahama-1	PWR	826	319	42.8	237,096	38.6	Shutdown due to periodic inspection (22. Jan.~18. Mar.)
Takahama-2	PWR	826	744	100.0	614,459	100.0	
Takahama-3	PWR	870	744	100.0	647,227	100.0	
Takahama-4	PWR	870	744	100.0	647,227	100.0	
Ohi-1	PWR	1175	0	0.0	0	0.0	Shutdown due to periodic inspection (19. Feb.~)
Ohi-2	PWR	1175	0	0.0	0	0.0	Shutdown due to periodic inspection (29. Aug.~)
Ohi-3	PWR	1180	744	100.0	877,820	100.0	
Ohi-4	PWR	1180	744	100.0	877,820	100.0	
Shimane-1	BWR	460	636	85.5	286,549	83.7	Shutdown due to periodic inspection (19. Jan.~5. Mar.)
Shimane-2	BWR	820	744	100.0	609,627	99.9	
Ikata-1	PWR	566	744	100.0	420,940	100.0	
Ikata-2	PWR	566	127	17.1	36,869	8.8	Shutdown due to periodic inspection (14. Jan.~26. Mar.)
Ikata-3	PWR	890	744	100.0	662,119	100.0	
Genkai-1	PWR	559	744	100.0	415,734	100.0	
Genkai-2	PWR	559	744	100.0	415,741	100.0	
Genkai-3	PWR	1180	542	72.8	555,520	63.3	Shutdown due to periodic inspection (21. Dec.~9. Mar.)
Genkai-4	PWR	1180	744	100.0	877,800	100.0	
Sendai-1	PWR	890	744	100.0	662,072	100.0	
Sendai-2	PWR	890	744	100.0	662,071	100.0	
Commercial Reactor Total/Average (Previous Month)		44917 (44917)	32,516 (27,020)	85.7 (78.8)	27,989,568 (23,807,352)	83.8 (78.9)	
Fugen	ATR	165	0	0.0	0	0.0	Shutdown due to periodic inspection (8. Jan.~)
Total/Average (Previous Month)		45082 (45082)	32,516 (27,020)	84.0 (77.3)	27,989,568 (23,807,352)	83.4 (78.6)	