The 18th JAIF ANNUAL CONFERENCE

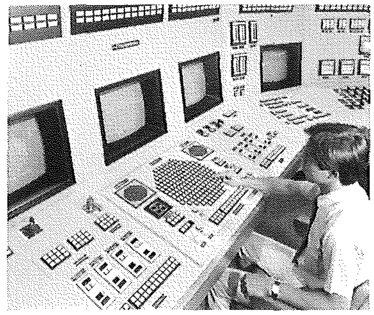
ABSTRACT

9-11 April 1985

Nissho Hall, Tokyo

JAPAN ATOMIC INDUSTRIAL FORUM, INC.

TOSHIBA,
Committed to Leading the Nuclear Industry, Committed to Quality.



Toshiba has made a committed effort to develop the nuclear energy industry in Japan, including the following activities:

- Toshiba has been engaged in the planning, design, manufacture, installation, and preoperation of nuclear power plants.
- Toshiba has operated a large research and development program.
- Toshiba has gained extensive nuclear steam supply system technology and nuclear fuel technology from nuclear power plants in operation or under construction.
- Further, Toshiba has trained many nuclear power station operators.

Toshiba's responsibility to provide safe, reliable, and economical nuclear energy is shared by everyone in the company.

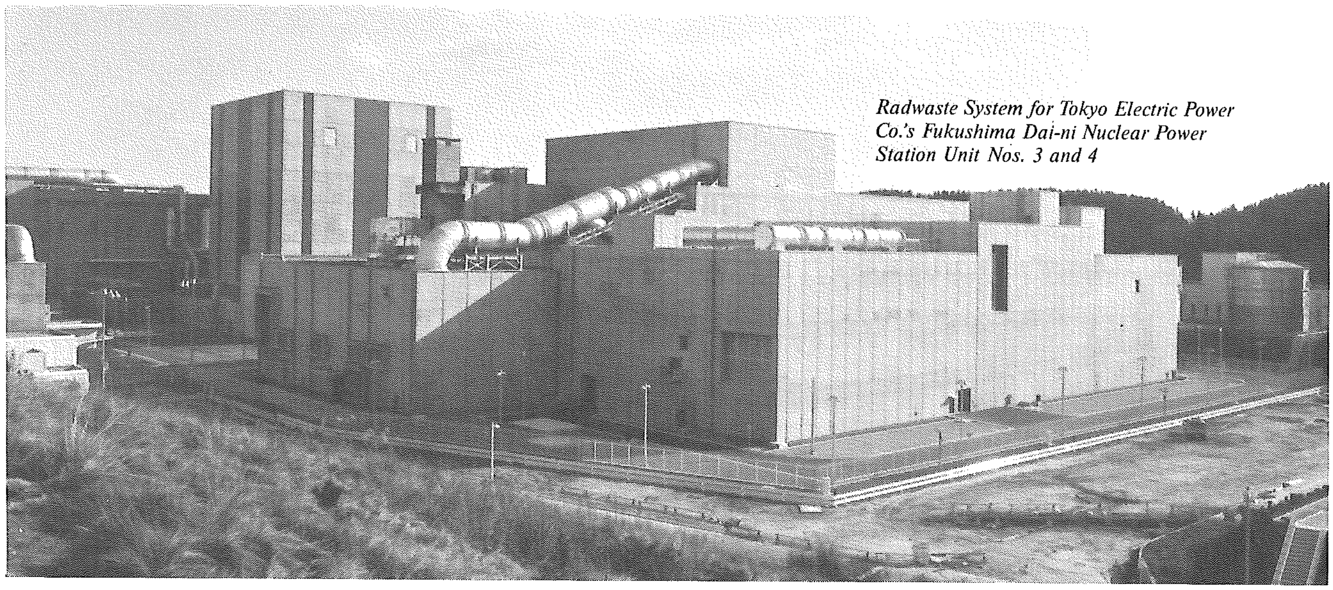
From manufacturing, design, research and development to customer service, we are aware as both employees and citizens that progress must be coupled with a thorough and on-going commitment to quality.

Fukushima Daiichi Nuclear Power Station is the world largest Nuclear Power Station of total 4,696 MWe capacity owned by Tokyo Electric Power Co. Inc.

Toshiba has been involved in design and construction works and various kinds of maintenance works at this station in these more than 15 years.

TOSHIBA TOSHIBA CORPORATION

NECLEAR ENERGY GROUP 1-6, Uchisaiwaicho 1-chome, Chiyoda-ku, Tokyo, 100 Japan
PHONE: (03) 597-2068 CABLE: TOSHIBA TOKYO TELEX: J22587, J24681 TOSHIBA



Radwaste System for Tokyo Electric Power Co.'s Fukushima Dai-ni Nuclear Power Station Unit Nos. 3 and 4

Specialists in Nuclear Plants.

We're the specialists in engineering, procurement and in the construction of nuclear plants.

Our activities in the field of nuclear energy cover radioactive waste management, nuclear fuel reprocessing and architect engineering services for nuclear power plants.

Some of our accomplishments: Japan's first Nuclear Fuel Reprocessing Plant at Tokai, Radwaste Systems for the Tokyo Electric Power Co.'s Fukushima Unit No. 6 and for Fukushima Dai-ni Nuclear Power Station Unit Nos. 3 and 4, and for Japan Atomic Power Co.'s Tokai Dai-ni Nuclear Power Station, eight Radwaste Bituminization Plants for Kansai Electric Power Co.'s Ohi Nuclear Power Station and others.

Utilization of nuclear power today and tomorrow calls for increased safety with the light-water reactor, establishment of the nuclear fuel cycle, advancement in radwaste management techniques, and development of superior power reactors such as the fast-breeder reactor. Beyond that, nuclear utilization should be compatible with the environment and backed up by public support.

At JGC we put every one of our fifty years of experience in engineering and construction to work for you every minute. When it comes to nuclear plants and facilities, we are the specialists.

Total Engineering and Construction . . . Worldwide

JGC CORPORATION

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The 18th JAIF ANNUAL CONFERENCE

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Nissho Hall, Tokyo

BASIC THEME
TOWARDS CULMINATION OF NUCLEAR INDUSTRY

Nuclear Power supplies 20% of the total electricity generated. For several years it attained a high availability factor of about 70%. Nuclear Power's share of the electricity produced is increasing, and it is expected to play a major role as one of the main sources of electricity in the future.

In order for nuclear power to play this role, we should not be satisfied with the results we have. We should direct our attention to further advancement of LWR's reliability and economy, so that we can maintain its superiority over conventional power plants.

Another urgent task in Japan is to establish the nuclear fuel cycle and develop a sound nuclear fuel cycle business. Then we can see the real value of nuclear power.

In order to maintain the viable development of the nuclear industry under stable economic growth in the future, we should strengthen the technological and economical foundation of the industry. To do that, we should consistently apply advanced technologies and make the nuclear industry the locomotive of industrial technologies.

With this situation in mind, the basic theme of the Conference is "Towards Culmination of Nuclear Industry."

MEMBERS OF THE PROGRAM COMMITTEE FOR THE 18TH JAIF ANNUAL CONFERENCE

(in Alphabetical Order)

Chairman	Hirokichi Yoshiyama	Chairman Hitachi, Ltd.
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	Shigebumi Aoki	Professor Emeritus Tokyo Institute of Technology
	Yumi Akimoto	Managing Director Mitsubishi Metal Corporation
	Mamoru Akiyama	Professor The University of Tokyo
	Kozo Iida	Executive Vice-President and Director The Kansai Electric Power Co., Inc.
	Yotaro Iida	Executive Vice-President Mitsubishi Heavy Industries, Ltd.
	Tomiei Igarashi	Editorial Writer The Nihon Keizai Shimbun
	Hiroshi Ishikawa	Vice-President Japan Atomic Energy Research Institute
	Kazuo Kamiya	Executive Director The Japan Development Bank
	Koichi Kawakami	Professor Kanagawa University
	Genzo Sasaki	Executive Vice-President Sumitomo Atomic Energy Industries, Ltd.
	Hiroshi Takahashi	Advisor for Research The Institute of Energy Economics
	Yoshio Tanaka	Executive Vice-President The Japan Atomic Power Co.
	Kazuo Toda	Senior Executive Vice-President and Director The Hokkaido Electric Power Co., Inc.
	Masatoshi Toyota	Managing Director The Tokyo Electric Power Co., Inc.
	Goro Nagane	Executive Vice-President Power Reactor and Nuclear Fuel Development Corporation
	Hisashi Nagahashi	Executive Director The Federation of Electric Power Companies
	Masao Nakamura	Editorial Writer The Yomiuri
	Masataka Nishi	Executive Vice-President and Director Hitachi, Ltd.
	Akio Nomura	Executive Vice-President Japan Nuclear Fuel Service Co., Ltd.
	Masayoshi Hayashi	Executive Vice-President and Director The Chubu Electric Power Co., Inc.
	Hiroshi Murata	President Nuclear Safety Research Association
Observers	Moritaka Nakamura	Director-General Atomic Energy Bureau Science and Technology Agency
	Yasushi Matsuda	Councillor, Director-General's Secretariat Agency of Natural Resources and Energy Ministry of International Trade and Industry
	Yoshifumi Matsuda	Director-General for Scientific and Technology Affairs Ministry of Foreign Affairs

18TH JAIF ANNUAL CONFERENCE

PROGRAM

TUESDAY, APRIL 9

9:30 — 10:40
OPENING SESSION

Chairman: Isamu Yamashita — Chairman, Mitsui Engineering and Shipbuilding Co., Ltd.

Remarks by Chairman of Program Committee
Hirokichi Yoshiyama — Chairman, Hitachi, Ltd.

JAIF Chairman's Address
Hiromi Arisawa — Chairman, Japan Atomic Industrial Forum, Inc.

Remarks by Chairman of Atomic Energy Commission
Reiichi Takeuchi — Chairman, Atomic Energy Commission; Minister of State for Science and Technology

10:45 — 17:30
SESSION 1: WORLD ENERGY SITUATION AND FUTURE PROSPECTS OF NUCLEAR POWER

Chairman: Seiichi Tanaka — President, The Chubu Electric Power Co., Inc.

International Cooperation in the Utilization of Nuclear Energy and the Role of the IAEA
Hans Blix — Director General, International Atomic Energy Agency

Future of American Nuclear Industry
J. Bennett Johnston — U.S. Senator (Democrat, Louisiana); Ranking Minority Member; Committee on Energy and Natural Resources

(Intermission: 12:05 — 14:00)

Chairman: Tsuneo Fujinami — President, Japan Atomic Energy Research Institute

Energy Plan and Nuclear Industry Policy in France
Martin Malvy — State Secretary for Energy, Ministry of Redeployment of Industry and Commerce

Atomic Power Development in Japan — Roles and Challenges
Sho Nasu — President, The Tokyo Electric Power Co., Inc.

(Intermission: 15:20 — 15:30)

Chairman: Toshio Itoh — Chairman, Japan Atomic Power Co.

Chinese Nuclear Power Program and International Cooperation
Shu-Lin Liu — President, China Nuclear Energy Industry Corp.

The Energy Situation and Nuclear Energy Policy in Indonesia
Djali Ahimsa — Director General, National Atomic Energy Agency

The Nuclear Industry in Australia
David G. Walker — Chief Executive Officer, Australian Atomic Energy Commission

18:00 — 19:30
JAIF CHAIRMAN'S RECEPTION

Room "AKEBONO"
HOTEL OKURA (South Wing, 2nd Basement)

WEDNESDAY, APRIL 10

9:30 — 12:00
SESSION 2: OPERATIONAL EXPERIENCE OF LWRS AND DIRECTION OF IMPROVEMENT

Chairman: Yoshitsugu Mishima — Professor Emeritus, The University of Tokyo

Keynote address: Japan's Experience in the Operation of LWR and Future Tasks
Masatoshi Toyota — Managing Director, The Tokyo Electric Power Co., Inc.

Panelists:
- Jacques Leclercq — Senior Vice-President, Electricite de France
- Herbert Schenk — President, Kernkraftwerk Obrigheim GmbH (KWO); Chairman, Reactor Safety Commission (RSK)
- Yotaro Iida — Executive Vice President, Mitsubishi Heavy Industries, Ltd.
- Masatoshi Toyota — Managing Director, The Tokyo Electric Power Co., Inc.
- Yasushi Matsuda — Councillor, Director-General's Secretariat, Agency of Natural Resources and Energy, Ministry of International Trade and Industry
- I-Hsien Chu — Vice President, Nuclear Energy Group, Taiwan Power Co.

12:20 — 14:15
LUNCHEON

Room "HEIAN"
HOTEL OKURA (Main Building, 1st Floor)

Remarks: Minister for International Trade and Industry
Lecture: Japanese Source of Beauty
by Kaii Higashiyama (Famous Nihonga Landscape Painter)

13:00 — 14:10
FILMS

Most recent films dealing with nuclear energy development will be shown. (Conference Hall)

14:30 — 18:00
SESSION 3: FRONTIERS OF NUCLEAR INDUSTRY TECHNOLOGIES

Chairman: Shigeru Kimura — Manager
Research Analysis Center
Asahi Shimbun

Nuclear Power Generation and Automation Technology
Yoshiaki Korei — General Manager
Nuclear Power Generation Division
Hitachi, Ltd.

Seismic Proving Test on Reliability for Nuclear Power Plants
Toshiji Omori — Director
Nuclear Power Engineering Test Center

Shippingport Atomic Power Station Decommissioning Program and Applied Technology
R. E. Skavdahl — Manager
Waste Management Service Operation Division
General Electric Co.

Future Prospects of Uranium Enrichment Technologies
John R. Longenecker — Deputy Assistant Secretary
U.S. Department of Energy

Introduction of New Technologies for the Development of Fuel
Kunihiko Uematsu — Executive Director
Power Reactor and Nuclear Fuel Development Corporation

Safe Transport Technology of Nuclear Fuel Material
Shigebumi Aoki — Professor Emeritus
Tokyo Institute of Technology

Storage and Management of Radioactive Wastes in Sweden
Sten Bjurström — President
Swedish Nuclear Fuel and Waste Management Co. (SKB)

Radioactive Waste Management in Canada
R. B. Lyon — Director
Waste Management Division
White Shell Nuclear Research Establishment
Atomic Energy of Canada, Ltd.

Construction of JT-60 and Its Impact to Future Technology Development
Shigeru Mori — Executive Director
Japan Atomic Energy Research Institute

THURSDAY, APRIL 11

9:30 — 12:30

SESSION 4: TASKS TOWARD INDUSTRIALIZATION OF NUCLEAR FUEL CYCLE

Chairman: Kenzaburo Kobayashi
President
Japan Nuclear Fuel Service Co.

Problems in Establishing Nuclear Fuel Cycle Industry in Japan
Hiroshi Murata — Vice Chairman
Japan Atomic Industrial Forum, Inc.

Present Status and Program of the Back-End of the Nuclear Fuel Cycle in France
Maurice Delange — Director, Industry
COGEMA

System for Establishment of Reprocessing Enterprise in F. R. Germany
Hermann Shunck — First Counselor, Scientifc
Embassy of F. R. Germany

Reprocessing Business in the U.K.
W. L. Wilkinson — Director
British Nuclear Fuels, Ltd.

Radioactive Waste Management — An International View
Pierre Strohl — Deputy Director General
OECD Nuclear Energy Agency

14:00 — 17:00

SESSION 5: NEW APPROACHES TO PROMOTION OF PEACEFUL USES OF NUCLEAR ENERGY AND THE ROLE OF NPT

Chairman: Keichi Oshima — Professor Emeritus
The University of Tokyo

Keynote address: Peaceful Utilization of Nuclear Energy and Nuclear Non-Proliferation — Past and Future
Masahiro Nishibori — Commissioner
Atomic Energy Commission

Panelists:
- Jean-Bernard Ouvrieu
  Director, International Affairs
  Commissariat a l'Energie Atomique
- Masahiro Nishibori — Commissioner
  Atomic Energy Commission
- Pil-Soon Han — Commissioner
  Korea Atomic Energy Commission
- Munir Ahmad Khan
  Chairman
  Pakistan Atomic Energy Commission
- James L. Malone — Assistant Secretary for Oceans and International Environment and Scientific Affairs
  U.S. Department of State

Tuesday, April 9

10:45 am - 5:30 pm

SESSION 1: WORLD ENERGY SITUATION AND FUTURE PROSPECTS OF NUCLEAR POWER

During periods of stable economic growth, industrial nations strive to diversify energy sources, with the aim of securing more stable and economical energy. This is, for the present, "the age of multiple or complex energies;" but countries with scarce domestic energy resources, such as Japan, must make every effort to ensure that nuclear power forms the principal part for the future.

In this session, surveys will be given on the roles of nuclear power in countries with different energy situations and national policies, in order to get a view of the future direction of nuclear power development and the way international cooperation should operate.

International Cooperation in the Utilization of Nuclear Energy and the Role of the IAEA

Hans Blix

Director General

International Atomic Energy Agency

In the 43 years that have elapsed since the first constrolled chain reaction took place, both aspects of nuclear energy - its peaceful and its military applications - have had a profound and rapid effect on the world and on international cooperation in the nuclear field. It is only 40 years since the first atomic bomb was tested and 32 years since the first nuclear power plant came into operation. Today there are 344 such plants with a capacity of 220 GW(e) producing about 13 percent of the world's electricity. Although the history of the nuclear industry has been brief and intense, it is still only in its early stages. If there are to be any later stages, international cooperation must be expanded. This applies particularly to nuclear disarmament, but also to peaceful nuclear development.

While it is theoretically possible for a state to conduct work in the nuclear field without any international cooperation, in practice international cooperation is involved in or is an essential part of almost every use of nuclear energy. Nuclear power differs drastically from hydroelectric power in this respect. There must, for example, be universally accepted rules to regulate the international transportation of nuclear material. Trade in nuclear materials between countries would hardly be feasible without the safeguards system, a system which enables non-nuclear-weapon states to use nuclear power without arousing fear or suspicion among neighbours. The safe operation of nuclear installations is of international interest. An accident anywhere will affect nuclear power everywhere. The dumping of nuclear waste in the high seas is a concern of the whole international community and the proper disposal of high-level waste, like other big environmental issues, is of interest to all mankind.

There are many channels for international cooperation in the above areas: scientific, technical and industrial associations, regional fora, private and public institutions. They all have their role to play. The IAEA is the instrument which governments have created to promote worldwide cooperation in the nuclear field. One important way in which it seeks to fulfil this objective is by providing a forum for the exchange of information. The IAEA's General Conference provides government officials with an annual opportunity to exchange experience and establish informal contacts. However, the bulk of contacts between states within the framework of the IAEA take place in the hundreds of scientific meetings which the Agency organizes each year.

Other mechanisms are also employed for exchanging information: the IAEA's international nuclear information system (INIS) is a computer-based bibliographic information system which now contains over 880,000 items. The power reactor information system (PRIS) contains data collected from member states on experience from about 2,500 reactor years and some 14,000 nuclear power plant outages.

In the area of technology transfer, the IAEA constitutes an important multilateral channel for the provision of technical assistance. Some 30 million dollars were used for this purpose in 1984. Currently, the Agency's largest technical cooperation activity in the Asia Region is a regional project on industrial applications of isotope and radiation technology. The main objective is to transfer product-specific nuclear technology to selected industries in participating developing countries.

Nuclear trade is one area in which more cooperation is needed in order to allay the concerns of both suppliers and buyers. The IAEA has set up a Committee on Assurances of Supply (CAS) to tackle the problems of supply assurance and nuclear trade.

In the field of safety, a set of internationally agreed guidelines, recommendations and standards for nuclear power plants with thermal reactors has been established over the last ten years by the IAEA under its nuclear safety standards (NUSS) programmes. Increased attention is now being given to implementing these and radiation protection recommendations. Operational Safety Review Teams (OSARTS) and Radiation Protection Advisory Teams (RAPATS) are sent on request to provide advice to member states in these fields. The Agency's latest initiative regarding safety is the establishment of an International Nuclear Safety Advisory Group whose main function will be to examine current and evolving safety issues which could have an international impact.

The establishment and implementation of measures to prevent the proliferation of nuclear weapons and the diversion of nuclear materials from peaceful to military activities represent a vital component of international nuclear cooperation. Under its statute, the role of the IAEA is to implement "International Safeguards". Since 1960, when the first IAEA safeguards agreement was concluded in connection with a small Japanese research reactor, the number of safeguarded installations has increased to about 840. Close international cooperation has been an essential part of the establishment and development of the IAEA's safegurads system.

ENERGY PLAN AND NUCLEAR INDUSTRY POLICY IN FRANCE

by Martin Malvy
State Secretary for Energy
Ministry of Redeployment of
Industry and Commerce

The French energy policy is tream-lined along three basic principles namely : highest possible national independance, diversification of energy resources, energy conservation.

In 1974, after the first oil shock, it was felt that the dependance on oil was too big for a safe energy policy. That is the reason why it was decided to launch a large nuclear power program to develop nuclear energy instead of other sources for the supply of electricity. To day, the total national primary energy which is expected to be on hand around 1990 is roughly 31 % nuclear, 33 % oil, 11 % coal and 25 % from other sources.

The nuclear power program which is now in full development was meant to be comprehensive and include the full mastery of reactor manufacture and fuel cycle facilities.

The reactor construction program was based on a highly standardised PWR, with two power levels 900 and 1300 MWe. As of february 1985, 32 400 MWe were on line with more to come which will put the total installed capacity at more than 55 000 MWe by 1990. At that date, nuclear energy will account for about 75 % in the electricity production.

The operational performances of the plants have been improving constantly with an availibility factor of 76 % in 1984. The load factor was 70,2 % due to the use of load following. The cost of the generated electricity is also very attractive since it is about 30 % cheaper than the electricity produced by coal fired power plants in the same conditions.

These good performances do not preclude R & D work to enhance these performances. On the contrary, schemes like extended cycles, reduction of maintenance down periods, are researched.

For the longer term, there is a strong belief in France that the Fast Breeder Reactor will be needed in the future and hence that the technological development should be pushed forward. The experience we have gathered so far, and that which will be gained with Super Phénix are very precious and will help us decide upon the follow up of the program.

In any case this program will be dealt with on a european basis and we are quite ready to expand it outside the boundaries of Europe.

In the field of the fuel cycle, the same comprehensiveness has been followed : All the items of the cycle from naturel uranium to reprocessing and waste disposal have been developed and mastered.

This mastery has led french fuel cycle companies to become strong and reliable suppliers on the international market for natural uranium, enrichment services and reprocessing services.

In the latter field, the performances of the existing plant have been remarkable and the construction of the new plants is going forward very swiftly. All these programs benefit of course from a strong R & D program which will allow us to incorporate at each level of the development, the latest technology.

This is also true for enrichment activities with the development of new enrichment technologies using laser.

Finally, the end of the fuel cycle is also actively taken care of. A second site for low level waste disposal is in the process of being selected. Possible geological formation for high level waste disposal will be investigated by the means of an underground laboratory.

It can be said, to conclude that the lack of domestic energy resources in France, which is quite similar to the situation in Japan, has led us to develop a program which gives us the maximum independance. This does not preclude international cooperation but on the contrary we work at fostering it.

THE ENERGY SITUATION AND NUCLEAR ENERGY POLICY IN INDONESIA

by

Djali Ahimsa

Director General
National Atomic Energy Agency

A b s t r a c t

In Indonesia the past 15 years have seen economic development being stressed, as opposed to the preoccupation with political developments during the 15 years prior to it. As a result the standard of living has improved. However, reliance had to be placed on wood and oil, especially on oil for both domestic commercial energy supply and domestic revenues as well as foreign exchange earnings. Currently Indonesia is endeavoring to diversify to natural gas for export earnings and to coal to substitute for oil in domestic energy consumption.

Bearing in mind possible future constraints in domestic coal production and the undesirability of coal imports, and also the fact that nuclear power is competitive in many countries including developing countries, and likely to be so for many years ahead, the nuclear option is considered important. To prepare for eventual introduction of nuclear power, it is imperative to begin early and lay ground for the future. Towards this end, a new nuclear research center is being built near Jakarta. In the meantime work has already begun on updating the feasibility study for the construction of the first nuclear power plant.

JAPAN ATOMIC INDUSTRIAL FORUM

18TH ANNUAL CONFERENCE

THE NUCLEAR INDUSTRY IN AUSTRALIA

D G WALKER

ABSTRACT

Australia has been involved in the mining and sale of uranium concentrates for almost forty years. During this time there have been various attempts to expand domestic nuclear industry activities to include power production and other areas of the fuel cycle. For various reasons such expansion has not occurred except in fields such as radioisotopes applications, and the Australian nuclear power industry today remains restricted to the export of yellowcake. Current programs and policies are discussed against this historical background.

Wednesday, April 10

9:30 am - 12:00 am

SESSION 2: OPERATIONAL EXPERIENCE OF LWRS AND DIRECTION OF IMPROVEMENT

(Panel Discussion)

Operations of light water reactors in Japan have recently given excellent results by world standards, and further efforts by government and industry are necessary for continued improvement in reliability and economcs. In this session, LWR operating experience gained over many years and results of various demonstation tests will be reviewed. Tasks for making nuclear power generation more encomical by taking productive steps on safety issues will then be discussed. In addition, projections of nuclear power will be made, taking into consideration improvement and sophistication of design, construction, installation and operation of LWRs. The operational experience overseas including international cooperation will be discussed for this purpose.

Keynote address:

JAPAN'S EXPERIENCE IN THE OPERATION OF LWR AND FUTURE TASKS

Masatoshi Toyota, Managing Director
The Tokyo Electric Power Co., Inc.

In Japan, 28 commercial nuclear power plants are in operation, with a total output of 20,560MW, which account for 13% of the total installed capacity and supply 20% of the electricity consumption. Additional 20 nuclear plants of 20,130MW are currently under construction or in preparation stage. All of these facilities are equipped with light water reactors, either BWRs or PWRs, with the single exception of a 166MW gas-cooled reactor.

The introduction of a nuclear generating unit from the United States of America was indeed the very starting-point for the LWR nuclear power plants.

Because of vigorous efforts made since then to develop our own domestic technology, backed by technical tie-ups with reactor manufacturers in the United States of America, nearly 100% of our nuclear generating stations are now built of domestically manufactured equipment and systems.

In the early days before reaching this level of nuclear technology, there were many troubles with nuclear power plants, such as stress corrosion cracks in the primary stainless steel piping or thermal fatigue cracking in the feedwater spargers in the BWRs, steam generator tube leaks and stress corrosion cracks in control rod support pins in the PWRs.

To find the cause of these failures and establish countermeasures, the plants were shut down for a considerable period of time, which eventually led to a substantial drop in their capacity factor to about 40% between 1975 and 1977.

In subsequent years, a set of countermeasures have been taken to prevent the recurrence of troubles and improve reliability, so that the average operating reactor scram occurrence rate was reduced below 0.5 per reactor year.

Reductions in time required for periodic inspections were achieved by employing automated, remote control or robotic systems. Critical-path work was streamlined and many works came to be performed concurrently. The operating cycle was extended from 9 months to 12 months. These improvement have been discussed in the improvement and standardization program, established by government, utilities and manufacturers, with achievements being incorporated not only into newly built plants but also into existing facilities wherever possible.

The capacity factor of nuclear plants has climbed to 70% or more over the past two years, and it is expected to reach some 75% in a few years' time.

The latest data show that the Fukushima Daiichi nuclear power station, with six units, has been operating with no scrams since November 1983, and the Genkai 2 unit has set records of 60 days in periodic inspections and 415 days in continuous operation.

Efforts to provide greater safety in nuclear power generation were stepped up in the wake of the TMI nuclear plant accident. Subcooled water meters and high-range radiation monitors in containment vessel were installed. Alarm lamps on the main control panel have now been arranged in order of urgency and made identifiable by color. The color idehtification scheme was also adopted in important instruments. CRT-computer system of advanced control panels has improved man-machine interface.

An attempt has been made to reduce radiation doses for on-site workers through measures such as decreased radiation sources, improved reliability of equipment, automated and remote-controlled periodic inspections, improved arrangement of equipment and systems and improved work environment.

Large amount of reductions in various categories of radioactive waste have also been given serious attention. While efforts have been made to cut down the release of gaseous and liquid waste, plans are under way to reduce the amount of solid wastes from, for example, the yearly level of 4,000 drums per unit down to 1,000 drums in case of BWR.

Despite good operating performance, however, recently because of "escalation," site conditions and stringent requirements for safety and reliability, construction costs have been rising at the rate of 5% per year. In addition, the economic advantage of nuclear over coal-fired generating units has been shrinking because of a decline in coal prices.

In my opinion, nuclear power will continue to have cost advantages because of the expected rise in prices of fuels in the long term. Still, given the capital cost amounting to as high as about 70% of the generating cost, a cut in construction costs is one of the essential prerequisites to enhanced economic advantages of nuclear plants in the years ahead.

The Japanese electric utilities are now trying hard to lower the construction cost of the nuclear plant through a set of measures, such as: a) standardization that could produce "repeatability" effect; b) rationalization of design; c) a reduction in the construction period; and d) a review of the purchasing practice.

Tokyo Electric Power Co., Inc. has already made some success in its work to cut down construction costs. For major equipment, the Kashiwazaki-Kariha Nos. 2 and 5 units cost over 15% less than its No. 1 unit did.

In addition, ways of bringing down costs for civil work are under review. Moreover, efforts are being made to come up with a rational design for the A-BWR to achieve around 15% lower costs than the conventional design.

Another important consideration is the improved capacity factor and decreased fuel costs through enhanced fuel burn-up efficiency.

Three of the tasks we have set before ourselves to achieve a much higher capacity factor are to make failures in the operating plants fewer, make the length of periodic inspections shorter, and make the operating cycle longer.

To cope with trouble in the operating plants, continued efforts will be made to gather data and information both at home and abroad, making the most of the Central Research Institute of Electric Power Industry's Nuclear Information Center and in close cooperation with the U.S. INPO and Europe's USERS. This data and information will be analyzed and used to find measures against recurring troubles for exsisting and under construction plants.

In addition, studies will be initiated to work out some remedies against degradation with time and develop diagnostic techniques for preventive purposes to further lower the failure rate at nuclear plants. Education and training programs for operating, maintenance and repair workers using simulators and equipment models will also be carried out extensively.

Currently, it takes about 92 days to complete standard periodic inspections of a 1,100MW class facility, not including special improvement work. Plans are conceived to reduce the length of this process to 70 days for units under the 2nd improvement and standardization program and to 45 - 60 days for plants under the 3rd program.

In addition, we need to make a review of the present items and intervals of periodic inspections drawing on precedents of other countries as well as on the operating experiences of our own, so that inspection periods can be shortened to the average of 60 days including existing nuclear facilities.

While we have extended an operation cycle to 12 months, we intend to extend it to 15 - 18 months by longer fuel burn-up and improvement of equipment reliability. We expect that these measures will improve the capacity factor up to 80 - 85%.

Fuel failures have decreased considerably because of improvements in fuel design, fabrication process and operational control. Currently, about one in 100,000 fuel rods have experienced a failure.

In the future, "barrier" fuel will be used to improve the integrity, load following performance and operating performance and further minimize electricity loses when the power level goes up. In addition, a sophisticated core design will be adopted to achieve higher levels of fuel burn-up. Combining this with the enrichment increase, the degree of burn-up will be made higher to allow us to reduce the fuel cost.

We are also feeling the need to let us have a nuclear plant with a longer life, for increasing electricity the plant generates during its operating life is an important factor conducive to improved economy, by developing the forecast technique for plant life and the technology for life extention of the critical components.

Efforts are being made to reduce radiation doses for on-site workmen as well as to make solid wastes more compact, setting the goal at the annual amount of 200 - 400 drums per unit.

At present, A-BWR and A-PWR development projects are under way, aimed to achieve such objectives as higher economic efficiency that combines safety and reliability, large capacity units, improved burn-up efficiency through advanced core, shorter periodic inspection periods, and reduced radiation doses.

I am confident that we will achieve the above goals and the nuclear power will be a leading role in future development of electric power generation.

Wednesday, April 10

2:30 pm - 5:30 pm

SESSION 3: FRONTIERS OF NUCLEAR INDUSTRY TECHNOLOGIES

The direction of development of nuclear technologies in each country is toward a system with high level of economics, safety and reliability, by improving exisiting practical technologies and developing new technologies. In this session, creative nuclear technologies which have recently been put to practical use or are expected to be of practical use in the near future will be introduced by use of a large-sized video projector. This session will be distinguished by explanation of nuclear technologies and efforts for their sophistication, appealing through the eyes.

Nuclear Power Generation and Automation Technology

Yoshiaki Korei

General Manager
Nuclear Power Generation Division
Hitachi, Ltd.

In the recent years automation technology has become one of the most essential part of nuclear power generation technology. Numerous automatic devices have been developed and are being applied to operating plants. I would like to speak to you today the current status of automation technology application in nuclear power generation using slides and movie, and indicate to you the trend of development in future. I am here to speak on behalf of three reactor suppliers, Toshiba Corporation, Mitsubishi Heavy Industry Co. Ltd. and Hitachi,Ltd.

The proportion of nuclear power generation in this nation's total electric power generation is increasing annually and the need for stable supply of electricity by nuclear plants is growing rapidly. For the greater growth of nuclear power generation, it is essential that we maintain its economic advantage, its greatest merit, and gain wider public acceptance as stable source of electric energy.
In order to attain these essential goals, various automation technologies are applied to nuclear power generation system that permits higher reliability, greater man-power saving, and lower radiation exposure.

The large size and complexity of nuclear power provides wide scope of application for automation to achieve savings in man-power and time. There is great necessity for increased reliability by automation in the nuclear power plant to meet stringent safety requirements. And application of remort-control technology is essential for maintenance operation under radiation environment. As mentioned above, there are increasing needs for automation in our nuclear industry.

In responce to these needs, application of automation technology assisted with modern computer technology covers essentially all aspects of nuclear power technology from design, manufacture, construction, operation and plant maintenance.

To illustrate, present level of automation application is shown in the following slides;

1	Design	:	CAD
2	Manufacture, Construction	:	Orbital TIG Welding Machine
3	Operation	:	Central Control System
4	Maintenance	:	Automatic Maintenance Equipement -Automatic CRD Handling Mchine, -Automatic ISI Equipment, -Steam Generator Maintenance Robot

Most of the automation application to date had been limited to frequent and routine work where the effect of automation was greatest. At present, therefore, specialized automatic devices have been developed in limited areas.

In view of the fast growth of automation technology and greater needs for such technology in the nuclear power generation field, it is natural to assume that the current level of automation will be expanded to include complex and infrequent work and to cover advanced judgement function and autonomous function to reduce the burden of plant operator and maintenance personnel. From these, we can establish a future target of highly sophisticated automation technology which is multi-purpose and highly intelligent.

In view of such future target, we can summarize the development trend in the following;

-Automation of intelligent judgement and engineering for design assistance
-Automation of complex and infrequent work for manufacture and construction
-Automation by intelligent judgement for operation, and
-Multi-purpose intelligent robot for plant maintenance.

Among these, development of multi-purpose intelligent robot would have the highest priority due to increasing needs for work under radiation environment with the steady growth of nuclear power plant construction.

It is now evident that there is urgent need to develop an multi-purpose intelligent robot for nuclear power plant application. In response to such needs, the development of robots for work in nuclear power plant is now vigorously conducted as a part of Large-Scale R&D Project "Advanced Robot Technology" under the sponsorship of Agency of Industrial Science and Technology,Ministry of International Trade and Industry.

In the following movie, we would like to show 3 examples of intelligent multi-purpose robot development conducted at each of the three reactor suppliers independently from the national project;

Autonomous Mobile Robot (Hitachi)
Maintenance Robot (AMOOTY) (Toshiba)
Quadruped Walking Robot (Mitsubishi)

As already described in the presentation above, we can expect that the automation technology of today will gradually shift to intelligent and multi-purpose systems development. And future nuclear power plant technology would be expected to integrate all of these individual automatic devices under a more sophisticated system design and improvement of plant design for automation. All of these development activity must be done with careful cost-benefit control so that the most optimum system may be developed to achieve a more mature automated plant system.

We, as manufacturers, intend to do all we can to attain maturity in automation technology as applied to nuclear power generation.

SEISMIC PROVING TEST ON RELIABILITY FOR NUCLEAR POWER PLANTS

Nuclear Power Engineering Test Center

Toshiji Omori

SUMMARY

For the purpose of proving the seismic safety and reliability for nuclear power plants, the Ministry of International Trade and Industry has entrusted the Nuclear Power Engineering Test Center to conduct the seismic proving tests on the reliability for large components and equipment of nuclear power plants by using the world's largest vibration table. Now I will introduce the outline of this large-scale vibration table and the progress of the seismic proving tests. The basic idea of seismic proving tests is to prove experimentaly the reliability for nuclear power plants from the view point of strength and functional capability, by means of performing seismic tests on large structures and equipment with full or close to full scale models and with the same materials as used for actual ones and under equivalent stress level to be applied on actual. For this purpose, an extremely large-scale and high-performance vibration table is required. To meet these needs, the gigantic basic specifications of this vibration table that can mount the test specimens were determined to be the following.

Table size	15m x 15m
Maximum loading capacity	1,000 tons
Maximum exciting force	3,000 tonf (Horizontal)
	3,300 tonf (Vertical)

With a grant-in-aid from the Ministry of International Trade and Industry, the large vibration table facility was completed at the Tadotsu Engineering Laboratory, in Tadotsu-cho, Kagawa Prefecture, in 1982. The Tadotsu Engineering Laboratory is in the vicinity of Tadotsu Port facing the Inland Sea of Japan and is extremely well situated for transporting large test specimens with the weight of several hundred tons. The vibration table facility mainly consists of a vibration table, horizontal and virtical actuators that excite this table, a hydraulic power supply system to produce highly pressured oil for driving the actuators and a control system that controls the actuators. Data aquisition system is capable to store 300 channels of data simultaneously at every 1 ／1000 second.
As for the incidental facilities there are experimental house with over head traveling cranes, operating house, electric substation and so on.

With respect to the seismic proving tests for nuclear power plants, two tests using the following models have already been performed.

1 ／3.7 scale model of PWR reactor containment vessel

full scale model of BWR primary loop recirculation system

At present, the seismic proving test using a full scale model of PWR reactor core internals is being performed. In implementing the seismic proving tests, the basic design earthquake ground motions are used to carry out a seismic response analysis of reactor building. As the result, the vibration (floor response wave) which could occur where equipment is installed is generated and the same wave (input wave for seismic proving test) is input to excite the vibration table with the test model. When a test model with a reduced scale of 1 ／X is used, the input wave is modified to the wave with X times enlarged in acceleration, and 1 ／X times shortened in time axis. In this way the stress equivalent to the actual stress can be added to the test specimen.

SEISMIC PROVING TEST FOR PWR REACTOR CONTAINMENT VESSEL

This test was initially carried out by using the large vibration table installed at the Tadotsu Engineering Laboratory. The test model was the 1 ／3.7 scale model of 800MWe class PWR steel containment vessel. It had the diameter of 10.8 m, the height of 19.4 m, and the weight of about 350 t including its supporting structure. The input waves for seismic proving test based on the basic design earthquake ground motions S1 and S2 were applied to the vibration table mounting the specimen, and the seismic safety for strength proved to be sufficient. Leak rate tests were conducted by pressurizing the the test model with air before and after exciting the vibration table, and no significant difference was observed, proving the airtight capability of the containment vessel. The test specimen was subsequently vibrated by the exciting force equivalent to 1.5 times greater than S2 so that the safety margin could be confirmed. At this test, the vibration table was vibrated to its limit performance.

SEISMIC PROVING TEST FOR BWR Primary Loop Recirculation System

The test specimen was a full scale model of the primary loop recirculation system of BWR 1100MWe improved standard plant. The piping was directly or indirectly connected by supports to the supporting structure that imitated the pressure vessel and gamma radiation shielding. The height of the specimen was 12.3 m, the weight of the piping about 110 tons, the weight of the supporting structure about 555 tons, and the total weight about 665 tons. The specimen was vibrated with the input waves for seismic proving test based on the basic design earthquake ground motions S1 and S2, and the seismic safety for strength was proved. Further, a marginal test was performed with the input wave which the maximum intensity of was 1.1 times greater than that of S2, and the margin of safety agaist earthquake was recognized.

SEISMIC PROVING TEST FOR PWR REACTOR CORE INTERNALS

A full scale model of the core internals of PWR 1100MWe improved standard plant is now being tested. The test specimen has the height of about 17.5 m, and the weight of about 555 tons. The characteristic of this test is to confirm the soundness of inserting function of control rods during earthquake.

The soundness of insertion of control rods into fuel assemblies already was confirmed by applying the input waves for seismic test based on the basic design earthquake ground motions S1 and S2.

SHIPPINGPORT ATOMIC POWER STATION
DECOMMISSIONING PROGRAM AND APPLIED TECHNOLOGY

F. P. CRIMI AND R. E. SKAVDAHL

NUCLEAR ENERGY BUSINESS OPERATIONS
GENERAL ELECTRIC COMPANY
SAN JOSE, CALIFORNIA, USA

The Shippingport Station Decommissioning Project will be the first decommissioning project of a large-scale, commercial nuclear power plant. The Shippingport Station, which is owned by the U.S. Department of Energy, is also the first nuclear power plant to be decommissioned which has had a long period of power operation, having operated and produced electricity for 25 years. Nuclear facilities which have been decommissioned to date have operated for much shorter time periods and have been small in comparison to commercial power reactors. The experience which has been gained from the maintenance and modification of nuclear power plant radioactive systems and components as well as the experience gained from decommissioning smaller nuclear facilities have helped to establish the technology and cost basis for Shippingport.

This paper describes the current status of the preparations being made by the General Electric Company, its integrated sub-contractor, Morrison-Knudsen, and the U.S. Department of Energy for starting the decommissioning phase of the project. One of the significant technical features of the project will be the one-piece removal of the irradiated reactor pressure vessel and neutron shield tank (RPV/NST). It is estimated that this approach will save about $7 million, reduce personnel radiation exposure by more than 100 man-rem and reduce the total decommissioning schedule by about one year compared to segmentation of the irradiated vessel and internals. A favorable size comparison of the Shippingport RPV/NST to an 1100 MWe PWR pressure vessel is also shown.

The technology that will be used at Shippingport has evolved from many years of experience gained during reactor plant maintenance and modification work. An overview of the technology which will be used during the Shippingport Station Decommissioning Project is presented. Current applied decommissioning technology discussed in this paper include remote metal cutting, decontamination, concrete removal, liquid and solid waste volume reduction, and robotics.

As the first commercial nuclear power plant to be decommissioned, the Shippingport Project is expected to set the standard for safe, cost-effective reactor decommissioning technology. By confirming techniques for removing, handling, and transporting radioactive components and materials, the technology and work procedures employed at Shippingport will provide guidelines to the nuclear industry for the future decommissioning of other nuclear plants.

Introduction of New Technologies for the Development of Fuel

K. Uematsu
Executive Director
Power Reactor and Nuclear Fuel Development Corporation

The Power Reactor and Nuclear Fuel Development Corporation (PNC) is actively engaged in the development of advanced technologies in the area of nuclear energy, and intends to positively adopt new technologies which are valuable fuel development activity of the Corporation, observing the trends in the development of new technologies in related fields of industry.

From this viewpoint, the Corporation has fully investigated technologies to be introduced in the development of facilities in the nuclear fuel cycle, placing the emphasis on the development, demonstration and commercialization of advanced technologies. It is matter of course that any new technology should aim an economically viable enterprise and mass treatment.

The technologies for the development fuel, as equipment industry technologies which handle radioactive substances, should be able to take advantage of new technologies in the following areas, resulting in reduction of labor, radiation dose and costs; (1) simplification of process, (2) utilization of remote control, and (3) automatization. Furthermore, it would be reasonable to hope that new technologies could contribute to extension of lifetime of equipment, reduction of time needed for maintenance and repair, reduction of volume of wastes produced, and efficient protection of nuclear material.

Here, we will introduce the following new technologies which have been already adopted or in preparation.

(1) microwave technology and its application;

(2) high quality TV camera technology and its application;

(3) tomography technology and its application;

(4) fiber optic technology and its application;

(5) robot·manipulator technology and its application.

Safe Transport Technology Of Nuclear Fuel Material

Professor Erimitus
Tokyo Institute of Technology
Shigebumi AOKI

Japan now has 31 nuclear plants in operation and pre-operation, with a total installed capacity of 23,631 MW. Having achieved an average capacity of 72.3% in 1984, their operation is clearly satisfactory. Under these circumstnces the accident of August 25th,1984, which sank the ship"Mont Louis" with a load of uranium hexafluoride,had repercussions that swept through the continent of Asia to Japan. In addition to this situation, as it got coverage in mass communication that plutonium extracted from soent fuel from Japanese LWRs after being reprocessed in France would be transportd and returned to Japan, public interest has now shifted to the transport of nuclear materials.

In order to ensure the safety during transportation in Japan,packagings specified in the International Atomic Energy Agency(IAEA)Regulation for the safe transport of radioactive material have been used only and also twenty years of technical research and development have gone into assuring their integrity. In Japan, in which the overland transport of fresh fuel amounts to 600 tons (uranium) a year now,and there have been some 100 cases of spent fuel being transported by sea in the past few years, not the slightest accident has ever been reported. When seen in the world perspective, there have not been more than ten serious accidents in these 10 years. Only three of them involved any leakage of their contents and none has had any bearing on spent fuel. Also in the future, taking account of technical improvements based on the 1985 edition of IAEA Regulation and strict control for transport of nuclear fuel, the probability of occurance of accident in transit may be estimated to be extremely small.

Some people say that the test procedure required by IAEA Regulation is insufficient. Considering such opnions, various experiments have been carried out under severe conditions beyond IAEA Requirement. For example, Oak Ridge National Laboratory installed a 80m high drop test facility and Sandia National Laboratory has 56m and 91m high drop test towerts. Impact experiments of trucks of 130 km/h velocity loading 60 tons spent fuel cask against large concrete block wall and on a railroad crossing have been carried out by Sandia National Laboratory, and the analytical metods for such accidents and the comparison between full-size cask and reduced scale models experiments have been discussed. On July 17th, 1984,CEGB (England) performed a crash demonstration test of a full size locomotive hauling three carriages and travelling at around 160km/h against a staying flatrol, loading a 48 tons magnox spent fuel flask Mark2c, and the integirty of flask was verified successfully.

In the case of Japan, basic developmental studies on packagings for the transport of spent fuel have produced many results since they began in 1966. Under nine years program which started in 1977 with budgetary of ¥ 6 billion, the TAKEYAMA Testing and Research Center of the Central Research Institute of Electric Power Industry is conducting"proving test for reliability of spent fuel transport packaging." Two types of operational casks,weighing respectively about 50 tons and 100 tons, are in use for drop test,immersion test, spray test, fire test, leak test and shielding test. Drop tests, with a fall of more than nine meters, are also planned. Following the lead of other countries in actual tests, Japan has carried out head-on collision tests for trucks loaded with radioactive materials in transit to collect data for the establishment of tie-down method. Flank collision tests are soon to be carried out,using actual trucks. Containers for the transport of uranium hexafluoride will also be tested for resistance to high pressure. In connection with the transport of plutonium being returned, the next step will be to develop and test air transport packaging to ensure physical protection,and to develop containers for the transport of high- and medium-level wastes.

STORAGE AND MANAGEMENT OF RADIOACTIVE WASTES IN SWEDEN

Sten Bjurström, President, SKB
(Swedish Nuclear Fuel and Waste
Management Company), Stockholm, Sweden

In 1984 around 120 TWh of electricity was produced in Sweden, mainly by hydro and nuclear power stations. The Swedish programme of nuclear power production comprises twelve reactor units with a total capacity of 9.500 MW. There are four plants, all situated along the coast of Sweden. As from 1985 they will generate 45-50% of the electricity produced in Sweden.

The Swedish system of transportation and storage of spent nuclear fuel and radioactive waste from nuclear energy production has been based on the principles of interim storage and direct disposal of the spent fuel without reprocessing.

After intense discussion during the 70's and the referendum in 1980 on the nuclear issue the Swedish Parliament decided that no more reactors are to be built in Sweden and that the existing ones should not be operated beyond the year 2010.

The total quantity of radioactive waste - with full utilization of the twelve reactor programme till the year 2010 - is calculated to be equivalent to 7.500 tonnes (calculated as uranium) of spent fuel, 90.000 m^3 of low and medium level operational waste and 115.000 m^3 of decommissioning waste.

The Swedish nuclear fuel managemenet programme consists of two parts; one part already in operation or under implementation with systems and technology designed to meet the requirements for an uninterrupted nuclear production up til the year 2010, and another part, where research and development work are being carried out, dealing with the optimization of different disposal methods for the remaining problem of final disposal of the highly active waste. A repository is planned to be operative around the year 2020.

The following systems and facilities are currently in operation and under implementation.

1. A sea transportation system for all kinds of nuclear waste with a specially built ship for the transport of casks was commissioned in 1982. In 1985 the ship will annually transport around 250 tonnes of spent fuel from the power plants to the central storage facility (CLAB) for interim storage. From 1988 the ship will also be used for the transport of operational waste to a final repository (SFR).

2. A central facility for interim storage of spent fuel, CLAB is under construction and is scheduled to be operative in 1985. The facility consists of underground storage pools for 3.000 tonnes of fuel in a first phase and can be expanded as needed up to 9.000 tonnes. The storage period for the spent fuel is planned to be approximately 40 years.

3. A central underground repository for final disposal of low and medium level reactor waste, SFR is under construction. The repository is situated in crystalline rock. Construction work started in 1983 and the facility is scheduled to be operative in 1988.

For the remaining steps - final disposal of highly active and longlived radioactive residues - a concept, KBS-3, has been developed and approved by the government in accordance with the Swedish nuclear legislation.

The main characteristics of the so called KBS-3 concept are:

- encapsulation of the fuel elements in copper canisters with a wall thickness of around 10 cm and
- final storagae of the canisters in drifts at a depth of about 500 m in crystalline rock. The canisters are deposited in vertical depositions holes, one canister in each hole and then surrounded by buffer material consisting of highly compacted bentonite clay.

Although a feasible method for final disposal of the highly active residues has been shown, the Swedish legislation requires that a broad research programme be carried out to reach the best possible base for the final decision around the year 2000. Thus, geoscientific investigations of the properties of the bedrock and the groundwater, including nuclide migration, chemical conditions as well as studies of spent fuel as a waste form and copper and other canister materials are carried out.

In parallell with this broad geological investigation programme is carried out to find a suitable site for a final repository. The final site selection is foreseen at the end of the 1990's.

Under Swedish legislation the nuclear utilities have the primary responsibility for the necessary development and realization of the entire nuclear waste programme, including the financing of the total cost. The nuclear power utilities have delegated to their jointly owned company, SKB, (Swedish Nuclear Fuel and Waste Management Company) the coordination, planning and execution of the investigation and measures required to realize a safe management system for nuclear waste.

The supervision and control of the power industry by the State, that the waste is disposed of in a manner satisfactory to society is undertaken by three different authorities dealing with safety, radiation and financing respectively.

The costs of the back end fuel cycle activities in Sweden are financed through a fee on the nuclear power production. The fee should cover all transportation of spent fuel and radioactive waste, intermediate storage and final disposal of spent fuel and waste decommissioning and dismantling of twelve power reactors after the year 2010. The total cost for this is calculated to 45 billion SEK (9 GUS$) or about 2 öre/kWh (2.1 mills/kWh).

Radioactive Waste Management in Canada

R. B. Lyon
Director
Waste Management Division
White Shell Nuclear Research
Establishment
Atomic Energy of Canada Limited

The overall objective of Canadian radioactive waste management programs are to ensure that there will be no significant effects on man and the environment from such wastes. At present, the major effort is directed towards developing technologies for the permanent disposal of:

(1) Highly radioactive nuclear fuel waste, and

(2) Low-and intermediate-level radioactive wastes.

The presentation will deal primarily with nuclear fuel waste and will describe some of the advanced technology and test facilities being used in the Canadian research program.

Responsibilities for nuclear fuel waste management are defined in the 1978 agreement between the Governments of Canada and the Province of Ontario. Under this agreement, the provincially owned utility, Ontario Hydro, is responsible for developing technologies for interim storage and transportation of used fuel, while the Federal Crown Corporation, Atomic Energy of Canada Limited, is responsible for coordinating and managing the research and development program for the immobilization and safe disposal of nuclear fuel waste.

The Canadian concept for nuclear fuel waste disposal is focussed on interim storage of used fuel, followed by immobilization and subsequent disposal of fuel waste deep in stable plutonic rock in the Canadian shield. Technologies are being developed for the immobilization of both used fuel and fuel recycle wastes.

Used fuel is currently stored in water-filled storage bays at the reactor sites. Present facilities allow adequate time for developing an integrated disposal strategy. Several storage alternatives are being evaluated, including high-density wet storage, convection vaults, concrete canisters and concrete casks.

The major components of the immobilization and disposal program are: Fuel immobilization, waste immobilization, and geoscience research.

Fuel immobilization studies involve the development of durable containment for the disposal of intact used-fuel bundles, and the characterization of used fuel as a waste form. Prototypes of several container design have been fabricated from stainless steel or grade-2 titanium and subjected to tests in a hydrostatic test facility at pressures up to 10 MPa and temperatures of up to 150 degree C.

The objectives of the waste immobilization studies is to develop processes and products for immobilizing the waste that would arise if the used fuel from CANDU reactors were recycled. Glasses, ceramics and glass-ceramics are being evaluated as possible waste forms. A waste immobilization process experiment facility, consisting of a rotospray calciner and a ceramic electromelter, designed to produce 10 kg. H-1 of sodium borosilicate glass is in operation.

An immobilized fuel test facility (IFTF) provides an environment for a wide range of multicomponent experiments designed to characterize radioactive waste forms and materials proposed for engineered barriers under conditions that could exist in a disposal vault. Seven concrete canisters for experiments with highly radioactive materials have been constructed and instrumented. Experiments in the IFTF will last up to two years.

The emphasis of the geoscience research is on the evaluation of large plutonic rock masses in the Canadian shield as potential hosts for immobilized nuclear fuel waste.

An underground research laboratory (URL), is being constructed below the water table in a previously undisturbed portion of a granitic pluton. The URL project has been underway since 1979, when field studies commenced to identify a suitable study area and location for the laboratory. The objectives of the URL project are to study the correlation between surface and subsurface features, hydrogeological and geochemical systems in plutonim rock, excavation damage in rock, the effect of heat on plutonic rock (including the effect on mass transport), and the effect of heat on the buffer/backfill/ rock interactions.

CONSTRUCTION OF JT-60 AND ITS IMPACT TO FUSION TECHNOLOGY DEVELOPMENT

S. Mori
Executive Director
Japan Atomic Energy Research Institute

Nuclear fusion research and development has progressed to a stage that scientific feasibility of fusion will be demonstrated shortly by four "Large Tokamaks", i.e. TFTR of USA, JET of EC, JT-60 of Japan and T-15 of USSR. The Tokamaks will achieve break-even condition (plasma temperature $\sim 10^8$°K, density $\sim 10^{20}$ions/m^3 and confinement time 1 s), and will be used for testing the control of plasma in break-even condition or reactor-grade plasma, improved performance of tokamak such as steady operation, and so forth.

The Large Tokamaks, being charged with such advanced objectives, had to be scaled up for two to three times compared to existing devices at that time. As the result, a part of the specifications of the Tokamaks surpassed the state of the art of the technologies necessary for its construction; the examples are toroidal coils, magnetic limiter coils, vacuum technology, control systems, plasma heating devices and cryogenics. Most of them were so demanding that development of new technologies became necessary as well as conciderable extention of the existing technologies.

The basic design of JT-60 had been performed by the Japan Atomic Energy Research Institute (JAERI), and its major manufacturing contracts were shared by five Japanese nuclear industry groups (Hitachi, Toshiba, Mitsubishi, Fuji and Sumitomo), the central coordinator being Hitachi. Although JAERI and industries were identified as a customer (obligee) and contractors (obligors), they have collaborated very closely in solving problems emerged during the manufacturing design and even manufacturing itself, and in integrating needs from plasma experiment and actual construction. By these joint efforts the highest level of Japanese technologies has been crystalized in JT-60. The construction has been finished in the begining April 1985, and the plasma experiment has been commenced immediately. Although TFTR and JET began to operate about two years ago, JT-60 is the most advanced among the four Large Tokamaks in attaining its full performance as an electric device; full performance without plasma was reached in March 1985.

Devices for heating up the plasma by neutral beam injection and RF with total power of 30 MW will be completed and intalled at JT-60 by the end of 1986, and the reactor-grade plasma will be demonstrated in 1987.

During the construction of JT-60, expriences and know-how's in designing and manufacturing of large fusion devices are accumulated, spin-offs of technologies are larger than expected at the begining of the project, and fusion technology has advanced remarkably. Based on this advance, we could reach a conclusion that construction and operation of a next engineering device (reactor) after JT-60 is technologically feasible, if adequate technology development programmes should be performed before the design and construction.

The JT-60 project had been conceived as a scientific programme to demonstrate and study reactor-grade plasmas. In addition to the scientific role, a new finding after the construction of JT-60 is that it has provided a powerful vehicle to promote fusion technology from a physics experiment device level to the fusion reactor level.

Thursday, April 11

9:30 am - 0:30 pm

SESSION 4: TASKS TOWARD INDUSTRIALIZATION OF NUCLEAR FUEL CYCLE

In Japan, a concrete program for the back-end of the nuclear fuel cycle has been worked out and is expected to be carried out smoothly. Though fundamental technologies related to the nuclear fuel cycle have already been established, cooperation of R & D organizations, private industries and local residents and the establishment of institutions are essential for the promotion of the nuclear fuel cycle as an enterprise. In this session, various problems, in building the nucleqr fuel cycle industry, with provision of countermeasures against radioactive waste, will be made clear, and programs and experiences in major countries will be reported, to assist in planning future policies.

Problems in Establishing Nuclear Fuel Cycle Industry in Japan

by Hiroshi MURATA
Vice Chairman
Japan Atomic Industrial Forum

Since the establishment of a domestic nuclear fuel cycle is a basic policy in Japan, technological bases necessary and sufficient for that purpose should be settled, and thus, the industrialization of the fuel cycle should be propelled in accordance with our basic policy.

Industrialization project should be carried out in a consistent and harmonized way throughout the fuel cycle: enrichment, fabrication, reprocessing, usage of recovered plutonium and uranium, and storage, treatment and disposal of wastes.

From this basic point of view, including international aspects, it is important to grapple seriously with and solve or overcome the various problems. Not only the main body of the enterprise but also government and private organizations should do their best according to their respective roles and cooperate with one another for the acomplishment of our purpose, which I truly hope for the future of peaceful use of atomic energy in Japan.

1. The background and significance of the industrialization of nuclear fuel cycle, and the technological development
2. Japan's program of the nuclear fuel industrialization and its present status
3. Problems in establishing the fuel cycle industry
   - the ideal stand of thr relationship between the administration and civilian concerning partial charge and cooperation
   - the succession of the results and experience of technological development

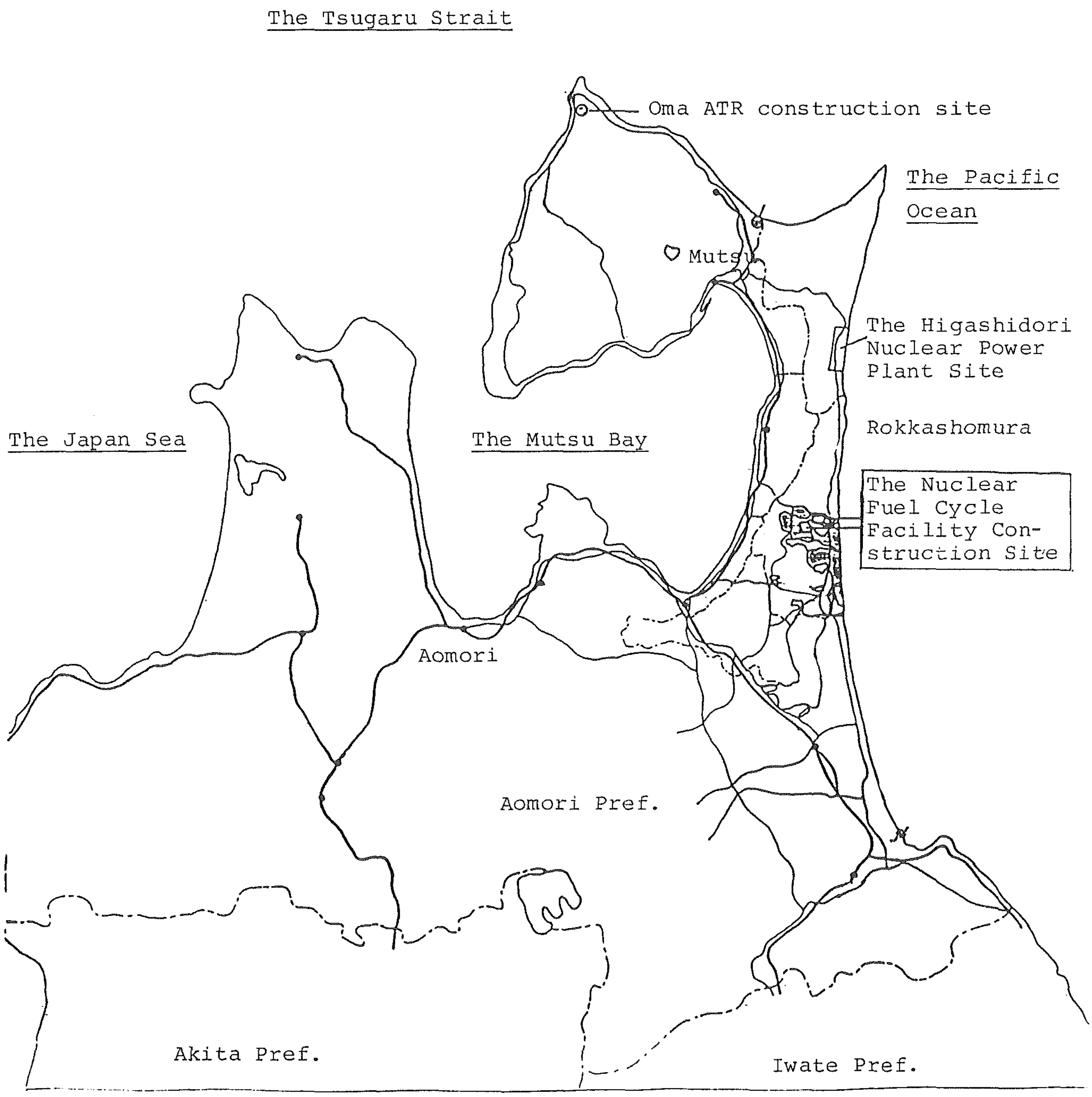
- ° the economy of the fuel cycle industry
- ° measures for the establishment of a harmonized fuel cycle
- ° Harmonization with the non-proliferation policy
- ° Problems in stiting fuel cycle facilities

An Outline of the proposal made by the Federation of Electric Power Companies

Concerning the Three Nuclear Fuel Cycle Facilities (July, 1984)

	Reprocessing facility	Uranium enrichment facility	Low level radioactive waste storage facility
Site	Iyasakatai-district, Rokkashomura, Kamikita-gun, Aomori Pref.	Oishitai-district, Rokkashomura Kamikita-gun, Aomori Pref.	
Company	Japan Nuclear Fuel Service Co., Inc. (Established on March 1, 1980)	Japan Nuclear Fuel Industries Co., Inc. (Established on March 1, 1985)	
Capacity	Reprocessing: 800tU/y (approx.1/2 of the spent fuel produced annually) Storage: approx. 3000tU	At first: 150tSWU/y Ultimately: approx. 1500tSWU/y (approx.1/6 of the domestic demand)	approx. 200,000 m^3 (equivalent to approx. 1,000,000 200ℓ-drums, 20-year quantity of waste) Ultimately 600,000 m^3 (equivalent to 3,000,000 drums)
Site area	approx. 3,500,000 m^2	approx. 3,000,000 m^2	
Consturction period	Preperation construction starts in about 1986		
	Start of Operation: Storage in about 1991 Reprocessing in about 1995	Start of Operation: in about 1991	Start of operation : in about 1991
Construction cost	approx. 700 billion yen	approx. 160 billion yen	approx. 100 billion yen
Personnel (1) at the highest stage of constuction	approx. 2000	approx. 800	approx. 700
(2) for operation	approx. 1000	approx. 300	approx. 200

THE LOCATION OF THE NUCLEAR FUEL CYCLE FACILITIES



PRESENT STATUS AND PROGRAM OF THE BACK END OF THE NUCLEAR FUEL CYCLE IN FRANCE

M. DELANGE

INDUSTRIAL DIRECTOR
REPROCESSING BRANCH

COGEMA

Concerning industrial operations of the back end of the nuclear fuel cycle, the results already obtained and the developments currently under way, which place France today in a very favorable situation at the international level, represent the outcome of a consistent policy sustained uninterruptedly for many years by Commissariat à l'Energie Atomique (CEA) and its subsidiaries.

1. Since the CEA was formed, the principle of systematic spent fuel reprocessing was adopted. For the implementation of this policy and upon each arrival of new types of spent fuel, appropriate material and human resources were promptly set up in the areas of research and development, engineering and industrial operation. For each of these areas, and at each step of developing industrialization, the responsabilities were also clearly defined :
   - . CEA, holder of all the know-how, conducts process investigations and technological tests and prepares the process books,
   - . COGEMA, an industrial company and CEA subsidiary, is the clerk of works for plant construction,
   - . SGN, a COGEMA subsidiary specialized in engineering for reprocessing plants, performs engineering and is the contracting authority for plant construction,

- COGEMA, the industrial operator, regularly ensures information feedback from production to research and development and engineering.

2. Research and development studies conducted by the teams of the CEA, a public establishment, are funded partly by State budgetary grants for scientific research, and partly by fees paid by the operator COGEMA, the requester and recipient of the process books.
3. The continuity of the policy thus followed by the CEA group of companies for more than thirty years has helped to solve :
   - technical problems that have emerged on the arrival of each new type of spent fuel, as proved by the results achieved in the reprocessing of spent light water reactor and fast breeder fuels,
   - political and psychological problems in public opinion raised by the further industrialization of the back end of the nuclear fuel cycle : the La Hague expansion projects were not faced with serious opposition, and now enjoy a broad consensus : as for the Marcoule expansion projects, they have earned unanimous support from the local authorities and local public opinion.
4. Concerning relationships with industry, the organization set up in France aims to maintain, within the CEA Group, industrial ownership of the sensitive or essential processes and technologies as well as their marketing in France and abroad.

Synopsis for

JAIF 18th ANNUAL CONFERENCE

REPROCESSING BUSINESS IN THE UK

by

W L Wilkinson
Technical Director
BNF plc

A brief overview of the early experience in reprocessing nuclear fuel in the UK will be presented, leading up to the establishment of the large scale commercial facilities at Sellafield for the reprocessing of fuel from UK and overseas Magnox reactors.

The experience gained in the reprocessing of oxide fuels at Sellafield will also be reviewed and the new commercial thermal oxide reprocessing plant (THORP), now under construction, will then be discussed. The design features, the underlying development work and the status of the detailed engineering design and construction work will be presented.

RADIOACTIVE WASTE MANAGEMENT - AN INTERNATIONAL VIEW

by Pierre Strohl
Deputy Director General
OECD Nuclear Energy Agency

SUMMARY

Significant progress has been made over the last five years in the implementation of policies relating to the long-term management of radioactive waste. A number of OECD countries have adopted special legislation to cope primarily with the problem of storage and disposal of spent fuel and high-level waste; in particular, specialized agencies have been created and financing schemes have been set up for this purpose. The results of R&D and experimental work have also enabled progress in the demonstration of safe disposal of such waste, as required by law in several countries. This progress is reflected in the technical appraisal completed by the Radioactive Waste Management Committee of the OECD Nuclear Energy Agency - composed of senior officials and experts responsible in this field and which has recently concluded that "there is a high degree of confidence in the ability to design and operate disposal systems in deep geological structures which will assure long-term isolation of high-level waste or spent fuel and meet the relevant long-term safety objectives".

Furthermore, the role of governmental agencies or other public organisations responsible for long-term radioactive waste management and, in particular, the scope and effectiveness of institutional control associated with technical containment systems, is now being evaluated in a more realistic way. Developments in recent legislations of several countries show that Governments can provide for the necessary control mechanisms on the construction and operation of storage and disposal facilities in the regulatory framework set up for nuclear activities. After closure of these facilities, it is necessary in some cases to supplement the technical barriers which ensure the isolation of long-lived waste with an

institutional control which is limited in scope. National authorities should assess the maximum length of time during which such controls can be effectively applied on a continuous basis. Beyond this period - which could be, for example, of one to three centuries - no further action by man should be necessary on safety grounds.

It is also important, from the safety point of view, to make sure that financial means are available when required, even in a relatively distant future, for building and operating disposal facilities. Despite the uncertainties in evaluating the corresponding costs, the experience of the financial schemes which are already in operation seems to suggest that it is possible to collect the money required from the income of utilities or other industry producing radioactive waste and that it only represents a few per cent of the cost of production of nuclear electricity. The experience also demonstrates that various financing methods can be used to guarantee that the resources necessary for long-term waste management will be available.

The current international conventions and legislation on nuclear third party liability and insurance are appropriate to idemnify the victims of possible damage during the operational phase of radioactive waste management. In view of the technical solutions which are designed for disposal of radioactive waste, it is very unlikely that damage to man or to property can be caused after closure of a repository. However, it may be considered in due time to replace the insurance coverage by a system of compensation by the Governments.

Radioactive waste management - in particular when considering the long-term aspects - is not a purely technical problem and enough attention should be paid to questions raised by the public concerning possible implications for future generations. However, a proper equilibrium should be maintained between political considerations and conclusions based on scientific and technical evidence. International co-operation could help reaching such an equilibrium.

Thursday, April 11

2:00 pm - 5:00 pm

SESSION 5: NEW APPROACHES TO PROMOTION OF PEACEFUL USES OF NUCLEAR ENERGY AND THE ROLE OF NPT

(Panel Discussion)

It is about fifteen years since the Non-Proliferation Treaty of Nuclear Weapons (NPT) came into force in 1970. The third Review Conference on NPT will be held in September this year. Although the NPT has served as the core of international non-proliferation management, covering the greater part of the world, the NPT has not yet received sufficient consent from developing countries since it became effective. Developing countries have recently become concerned about problems relating to nuclear disarmament and the right to the peaceful uses of nuclear energy. International cooperation and trade relating to nuclear energy are expected to make greater and wider progress. It is urgent that the right balance between non-proliferation and peaceful uses be assured.

In this session, representatives of nuclear powers, non-NPT states, nuclear suppliers and recipient countries will discuss problems and tasks on non-proliferation management, in which the NPT plays a leading role, and will seek new approaches to international order and measures for progress in international cooperation.

Keynote address:

PEACEFUL UTILIZATION OF NUCLEAR ENERGY AND NUCLEAR NON-PROLIFERATION -- PAST AND FUTURE

Masahiro Nishibori
Commissioner
Atomic Energy Commission

Since the dawn of the nuclear age we have always been taxed with a persistent task of finding ways to promote peaceful use of nuclear energy without incurring dangers of proliferation. A variety of ideas were presented to tackle this task, but not realized. After all, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and the IAEA safeguards incorporated therein have now been established as the fundamental international regime of nuclear energy.

The NPT, however, is of an extremely discriminatory and unequal nature, as it sharply divides the countries of the world into two different groups arbitrarily by reason of the fact that some countries had, and the others had not, come to possess nuclear weapons by the end of 1966. In spite of this discrimination, a large number of non-nuclear weapon States, including Japan, have taken the sensible and judicious position of supporting the NPT system at the sacrifice of sovereign equality in the great cause of nuclear non-proliferation.

For Japan, which had already renounced the nuclear option as a peaceful nation, her participation in the NPT would have brought forth no substantive disadvantage in this regard. And yet it was not an easy task for Japan to sign and ratify the NPT. This fact should always be kept in mind. In particular, the nuclear weapon States, which are in a privileged position, should not and must not make light of this stern reality.

In order to mitigate, if not eliminate, its discriminatory character, the NPT assures the non-nuclear weapon States of the peaceful utilization of nuclear energy as their inalienable right on one hand, and demand on the other hand that the nuclear weapon States should exert sincere efforts for nuclear disarmament. Fortunately, the sixth nuclear weapon State has not emerged under the NPT system. That is to say, the non-nuclear weapon States have faithfully complied with the NPT. In contrast, the nuclear weapon States have not only failed to make advance towards nuclear disarmament, but they have been apt to take a negative attitude towards the peaceful use of nuclear energy by the non-nuclear weapon States.

To make matters worse, a non-member country of the NPT dared to conduct a nuclear explosion test for the so-called peaceful purposes, and the nuclear weapon States and nuclear material supplier countries have since stiffened their attitude and have, more often than not, taken a negative and restrictive position with regard to the peaceful use of nuclear energy. It was under these circumstances that we conducted the INFCE, International Nuclear Fuel Cycle

Evaluation, by mustering the wisdom of the whole world on nuclear energy. Out of this laborious work by the experts emerged a consensus that the peaceful use of nuclear energy and nuclear non-proliferation can well consist with each other. Despite this encouraging reassurance, the nuclear community of the world still languishes from uncertainties.

Why is it? It is probably due to the lack of sufficient understanding that nuclear non-proliferation is primarily a political issue and the technical and institutional aspects have only secondary importance in the problem of nuclear non-proliferation. Whether we can succeed in checking nuclear proliferation or not is, in the final analysis, an utterly political question in the sense that our successful efforts to prevent a country from proceeding with nuclear armament depend entirely on whether we can deprive the potential country of its political motive which induces the country to find it in its national interest to go nuclear, or whether we can dissuade the potential country from its political decision of nuclear armament by having it realize the rigor and severity of the possible political and economic punishment that its decision of nuclear armament would entail.

On the other hand, we must understand that, viewed from a purely technical standpoint, there would be no nuclear activities related to nuclear fuel cycle, for instance, which are completely free of the danger of nuclear proliferation. Nor would there be any technical device which can completely eliminate that danger.

It is, therefore, too naive a view to expect that the objective of non-proliferation can be achieved by simply increasing the severity of the technological system or technical means aimed at nuclear non-proliferation. Too rigorous systems or means might bring about adverse effects. Positive and cooperative measures, rather than restrictive and negative ones, would contribute better to depriving a country oriented towards nuclear armament of such a political motive or to reducing such a political will.

In saying so, nothing is further removed from my intention than to mean that the introduction and improvement of technical means and institutional devices aimed at nuclear non-proliferation are of little significance. All those efforts will have the effect of prompting all the countries to work out a sound and judicious policy in matters of nuclear energy. In this sense, it is very effective and significant to complement and strengthen the NPT system by establishing such institutions as the Committee on Assurances of Supply (CAS), International Spent Fuel Management (ISFM) and International Plutonium Storage (IPS), and by technically improving the IAEA safeguards.

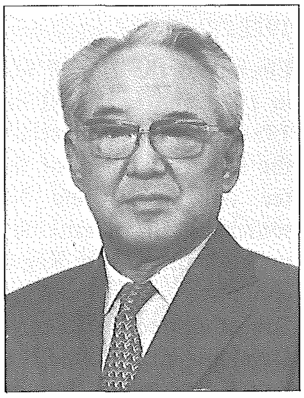
Viewed in this way, it is necessary, for the purpose of obviating the uncertainties now besetting the nuclear activities of the world, that all the nations of different categories, namely, nuclear weapon States, non-nuclear weapon States, nuclear material supplier countries, consumer countries, advanced industrial countries, developing countries and others, which differ from each other in their national interests, should first understand the respective positions of other countries, and then go beyond their own positions to reach international consensus in working out objective and rational standards, common systems and joint measures with regard to nuclear activities. In so doing and only in so doing, will a sound and wholesome international order of nuclear energy be established on the basis of harmonized solution of both the eminently political problem of nuclear non-proliferation and the extremely technical and economic problem of peaceful use of nuclear energy.

BRIEF PERSONAL HISTORY

OF

CHAIRMEN, SPEAKERS AND PANELISTS

OPENING SESSION



ISAMU YAMASHITA

Born on Feb. 15, 1911 in Tokyo
1933 Graduated from the University of Tokyo (Mechanical Eng.)

Occupation:
1933 Entered Mitsui & Co., Ltd., Shipbuilding Department
1955 Director of Mitsui Engineering & Shipbuilding Co., Ltd.
1962 Managing Director
1966 Senior Managing Director
1968 Vice President
1970 President
1979~ Chairman

Public Position:

Vice Chairman of Federation of Economic Organization (=Keidanren)

A member of the Council of Science and Technology

A member of The Industrial Structure Council

Chairman of Basic Technology for New Industries Committee, The Industrial Technology Council

A Member of Fiscal System Council, Ministry of Finance

Chairman of Nuclear Material Control Center

Chairman of the Expert Committee on Science & Technology, The Promoting Committee for Administrative Reform

HIROKICHI YOSHIYAMA

Born on Dec. 1, 1911
1935 Graduated from the Department of Electrical Engineering, the University of Tokyo
Joined Hitachi, Ltd.
1961 Director and General Manager, Power Generation & Transmission Group
1968 Senior Executive Managing Director and Chief of Planning Office
1971 President
1981~ Chairamn O

Other Positions:
1978~ Vice-President, Association for the Promotion of International Trade, Japan
1978~ Vice President, Japan Machinery Federation
1980~ Vice Chairman, Federation of Economic Organizations (Keidanren)

HIROMI ARISAWA

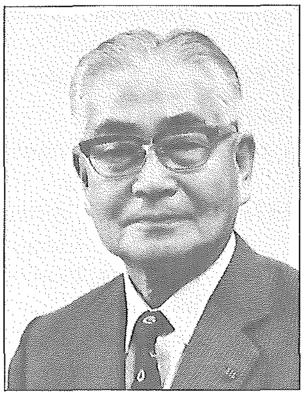
Born on Feb. 16, 1896 in Kouchi Pref.
1922 Graduated from the University of Tokyo (Economics)
1945 Professor, the University of Tokyo
1956 Commissioner, Atomic Energy Commission (~'72)
1956~ Professor Emeritus, the University of Tokyo
1973~ Chairman, JAIF
1974~ President, University Alumi Association
1980~ President, Japan Academy

Public Position:
1964~ Member, Industrial Structure Council
1978~ Chairman, Advisory Committee for Energy
1979~ Chairman, Employment Policy Council
1980~ Chairman, Price Stabilization Council

REIICHI TAKEUCHI

Born on Aug. 18, 1926 in Aomori Pref.
1948 Graduated from the Faculty of Economics, the University of Tokyo
After serving as political reporter of the Mainichi and secretary of Minister for Transport, he was elected Member of the House of Representatives in 1963.
1973 Parliamentary Vice-Minister for Economic Planning
1979 Director, Treasury Bureau, Liberal-Democratic Party (LDP)
1980 Director, General Affairs Bureau, LDP
1982 Chairman, Committee on Foreign Affairs, House of Representatives
1984~ Minister of State for Science and Technology
Chairman, Atomic Energy Commission

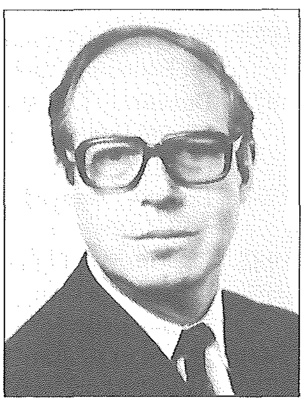
SESSION 1



SEIICHI TANAKA

Born on Apr. 26, 1911 in Tokyo
1934 Graduated from the Faculty of Law, Keio University
1934 Entered the Toho Electric Power Co., Inc.
1942 Transferred to the Chubu Electric Power Distribution Co., Inc.
1951 Transferred to the Chubu Electric Power Co., Inc.
1962 Director
1966 Managing Director
1972 Vice President
1977~ President

Other Positions:
1981~ Vice Chairman, Chubu Productivity Center
1981~ Vice Chairman, the Japan Electric Association
1982~ Chairman, Chubu Economic Federation
1984~ Chairman, Chubu Atomic Industrial Conference



HANS BLIX

Dr. Hans Blix was born in 1928 in Uppsala. He studied at the University of Uppsala, at Columbia University and he received his Ph.D. at Cambridge.

In 1959 he became Doctor of Laws at the Stockholm University and in 1960 was appointed associate professor in international law.

From 1963 to 1976 he was Head of Department at the Ministry of Foreign Affairs (MOFA) and served as Legal Adviser on International Law. In 1976 he became Under-Secretary of State at MOFA in charge of international development co-operation. He was appointed Minister of MOFA in October 1978. In Spetember 1979 he was again appointed Under-Secretary of State at MOFA in charge of international development co-operation.

Since 1961 he has been a member of Sweden's delegation to the United Nations General Assembly, and from 1962 to 1978 a member of the Swedish delegation to the Conference on Disarmament in Geneva.

He has written several books on subjects associated with international and constitutional law and was leader of the Liberal Campaign Committee in favour of retention of the Swedish nuclear energy program in the referendum in 1980.

J. BENNETT JOHNSTON

Born on June 10, 1932 in Shreveport, Louisiana

Senator Bennett Johnston received his undergraduate education at Washington & Lee University. He graduated fifth in his class from the Louisiana State University Law School in 1956.

In 1962 he was elected Chairman of the Young Lawyer section of the Louisiana Bar Association. He served in the Louisiana House of Representatives from 1964-1968 and in the Louisiana State Senate from 1968-1972.

Elected to the United States Senate in 1972 and re-elected in 1978 and 1984, Bennett Johnston is one of the senior members of the Committee on Energy and Natural Resources. He is ranking Democrat on both the Energy Regulation Subcommittee and the Appropriations Subcommittee on Energy and Water Development. United Press International has called him simply, the Senate's "Mister Energy."

For the past four years, Senator Johnston has served on the Senate Budget Committee and during that time has been one of the leading advocates of fiscal restraint and a balanced federal budget.

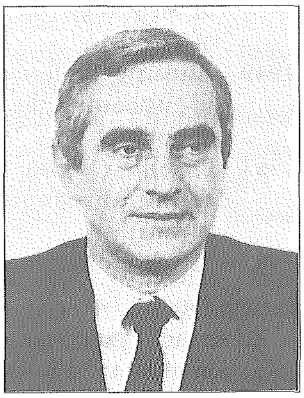
The widely respected journal Congressional Quarterly has referred to Senator Johnston as "one of the Senate's more skilled negotiators and a key power broker ...." Syndicated columnist Jack Anderson has identified him as one of the Senate's "most effective members."

TSUNEO FUJINAMI

Born on Oct. 4, 1917 in Tokyo
1940 Graduated from Department of Engineering, the University of Tokyo
1955 Director, Research Division, Public Utility Department (PUD), Ministry of International Trade and Industry (MITI)

1960 Director, Facilities Division, PUD, MITI
1965 Director, Electric Power Technology Division, PUD, MITI
1967 Director-General, Atomic Energy Bureau, Science and Technology Agency (STA)
1968 Vice-Minister for Science and Technology, STA
1972 General Director, Central Research Institute of Electric Power Industry
1976 President, Nuclear Power Engineering Test Center
1980 President, Japan Atomic Energy Research Institute

Other Positions:
President, Atomic Energy Society of Japan



MARTIN MALVY

Maire de FIGEAC depuis 1977, Député du Parti Socialiste à l'Assemblée Nationale depuis 1978, Martin MALVY est nommé Secrétaire d'Etat chargé de l'Energie auprès du Ministre du Redéploiement Industriel et du Commerce Extérieur en juillet 1984.

A ce titre, il assure la tutelle des organismes et établissements publics qui exercent leurs activités dans le domaine de l'énergie, et particulièrement de:

- CdF (Charbonnages de France)
- EdF (Electricité de France)
- GdF (Gaz de France)
- SNEA (Société Nationale ELF-AQUITAINE)
- CEA (Commissariat à l'Energie Atomique)
- AFME (Agence Française pour la Maîtrise de l'Energie)

Au sein de Gouvernement et en liaison avec le Ministre du Redéploiement Industriel et du Commerce Extérieur, il est associé à la définition et à la mise en oeuvre des actions de recherche scientifique, technique et industrielle dans le domaine énergétique.

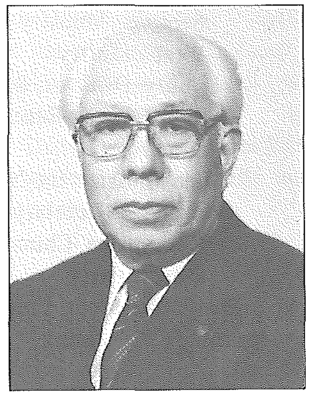
Devant le Parlement (Assemblée et Sénat), il est compétent pour défendre tous les textes de loi qui relèvent de l'Energie.

SHOH NASU

Born on Sep. 19, 1924
1948 Graduated from Political Science Course of Law Department, the University of Tokyo

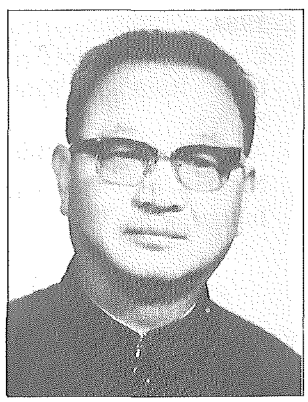
Professonal Carreer:
1948 Entered Kanto Electric Power Distribution Co.
1951 Above company name changed to the Tokyo Electric Power Co., Inc. was continuously on the staff.
1964 Manager, Research Div., General Planning Dept.
1966 Manager, General Affairs Div., General Affairs Dept.
1974 General Manager, General Affairs Dept.
1977 Director (in charge of General Affairs Dept.)
1979 Managing Director
1982 Executive Vice President
1984~ President

Other Positions:
1984~ Chairman, Committee on Energy, Federation of Economic Organizations (Keidanren)



TOSHIO ITO

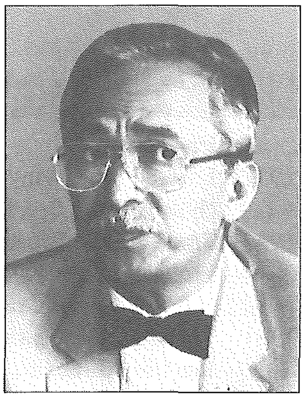
Born on Feb. 14, 1909 in Kouchi
1931 Graduated Department of Electric Engineering, Kyoto University
1931 Entered the Sanyo Central Hydroelectric Co., Inc.
1939 Transferred to the Japan Electric Power Generation and Transmission Co., Inc.
1951 Transferred to the Kansai Electric Power Co., Inc. (KEPCO)
1956 Manager, Thermal Power Dept., KEPCO
1960 Director in charge of Thermal and Nuclear Power, KEPCO
1964 Managing Director, KEPCO
1968 Senior Managing Director, KEPCO
1974 Executive Vice President and Director, KEPCO
1981 Advisor, KEPCO
Chairman, Japan Atomic Power Company (JAPCO)



SHU-LIN LIU

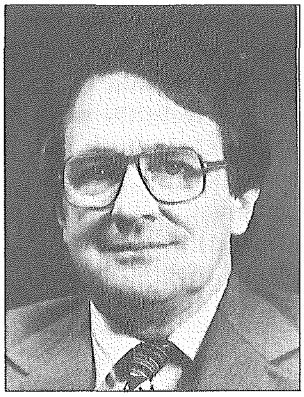
Born in 1924 in Ding Xian, Hebei Prefecture
Since 1949, Mr Shu-Lin Liu has filled various posts, such as:
Deputy Manager, Personnel

Section, Ministry of South-West Industry
Deputy Director, Beijing Atomic Energy Research Institute
Vice-Minister for Nuclear Industry Secretary, Central Committee, China Communist Party
At present: President, China Nuclear Industry Corporation



DJALI AHIMSA

Born on May 31, 1931
- Graduated from Institute of Technology, Bandung 1957 with MSC degree.
- Attended International Inst. of Nuclear Engineering, Argonne Natl. Lab. USA 1958.
- Project Leader for Construction of Bandung Reactor Research Center 1961–1964.
- Director of Bandung Reactor Research Center 1964–1968.
- Dept. of Safeguard, IAEA, 1968–1984.
  Country Officer for Far East Area. Later Head of Standardization Section.
- At present, Director General, National Atomic Energy Agency, Indonesia.



DAVID G. WALKER

Dr. Walker joined the Australian Atomic Energy Commission in 1961 from the Metallurgy Department, University of Melbourne, where he was Senior Lecturer in Physical Metallurgy.

During 1968 and 1969, he was a visiting scientist at the Chalk River Nuclear Laboratories, AECL, Canada, where he worked on radiation damage in alternative CANDU fuel materials. On returning to Australia in 1970, he was appointed Chief of the Materials Division.

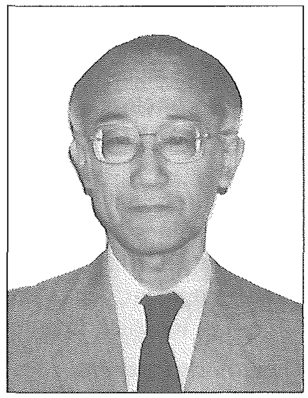
In 1974, Dr. Walker took the post of Counsellor (Atomic Energy) at the Australian Embassy in Washington, DC, a position which he held until 1977. Following this, he spent a year as Assistant to the General Manager at the AAEC's Head Office, working in the field of non-proliferation and safeguards, particularly in respect to the AAEC's involvement in the International Nuclear Fuel Cycle Evaluation.

On returning to the AAEC Research Establishment in 1978, Dr. Walker became involved in planning the AAEC's commercial scientific services, for example, radioisotope production. In 1979, this role was broadened to cover the planning of all AAEC Research Establishment programs, including research and development, his position being designated Chief Scientist, Planning.

In May 1982, the AAEC appointed Dr. Walker Acting Director and Chief Executive Officer. He was appointed a Commissioner of the AAEC in May 1983.

Dr. Walker was born in Bendigo, Victoria in 1929.

SESSION 2



YOSHITSUGU MISHIMA

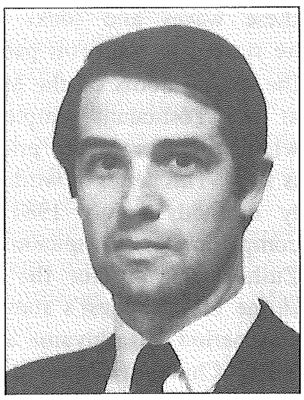
Born on Aug. 5, 1921 in Tokyo
1944 Graduated from Department of Metallurgy, the University of Tokyo
1949 Associate Professor, Faculty of Engineering, the University of Tokyo
1963 Professor (Nuclear Fuel Engineering, Fundamental Engineering)
1982~ Professor Emeritus

Present Post:
- Chairman, Committee on Examination of Reactor Safety, Nuclear Safety Commission
- Chairman, the Committee for Investigation on High-Performance Fuel Realization, MITI
- Technical Advisor, JAERI
- Councillor, PNC
- Director, JAIF
- Managing Director, Nuclear Safety Research Association
- Director, Nuclear Power Engineering Test Center
- Japanese Representative, Experts Meeting on Nuclear Fuel, IAEA & OECD

MASATOSHI TOYOTA

Born on June 26, 1922 in Okayama Pref.

1945 Graduated from Department of Electrical Engineering, Faculty of Engineering, the University of Tokyo
1945 Entered the Japan Electric Power Generation and Transmission Co., Inc.
1951 Transferred to the Tokyo Electric Power Co., Inc.
1963 Deputy Superientendent, Kawasaki Thermal Power Plant Construction Offices
1965 Deputy Manager, Nuclear Power Department
1971 Manager, Fukushima Daini Nuclear Power Plant Construction Offices
1974 Manager, Nuclear Power Safety Control Department
1977 Director and Deputy General Manager, Nuclear Power Development Administration
1979 Managing Director and General Manager, Nuclear Power Development Administration



JACQUES LECLERCQ

Born on Sep. 7, 1942 at Ligny-en-Barrois (France)

Education:
- Graduate of Ecole Polytechnique, 1965
- Graduate of Ecole Nationale des Ponts et Chaussées, 1968

Experience:
- At Electricité de France (EDF)

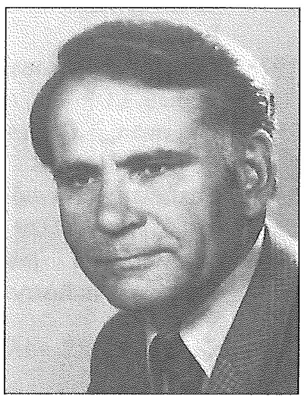
1984~ Senior Vice President and Group Executive responsible for all Fossil and Nuclear Generation
1979-83 Vice President responsible for the Regional Group for plant design and construction at Lyon
1977-79 Site Manager at Gravelines
1974-77 Site Manager at Blayais

- In the French Administration

1973-74 Technical Adviser in the Executive Staff of the Minister of Transportation, then the Minister of Industry.
1972-73 Technical Adviser in the Executive Staff of the Minister of State for Labor and Social Affairs.
1969-72 Technical Adviser in the Executive Staff of the Minister of Health and Social Security.

- Additional Positions

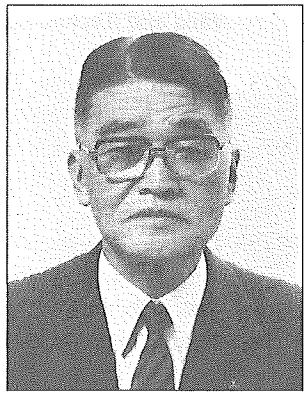
1983~ President of the Board of the Ecole Nationale Supérieure d'Hydraulique at Grenoble.



HERBERT J. SCHENK

Dr. Herbert J. Schenk, 57, married, studied physics on TH-Stuttgart, has got diploma in 1953 and graduation to Dr. rer.nat. in 1955. He is director of Nuclear Power Station at Obrigheim.

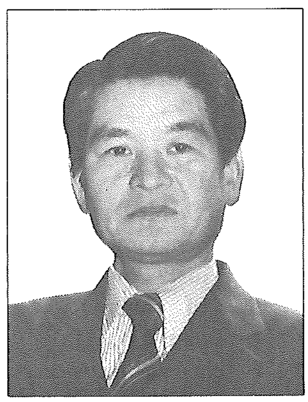
Dr. Schenk is member of Deutsches Atomforum, Kerntechnische Gesellschaft and American Nuclear Society. He is member of the German Reaktorsicherheitskommission; in 1980 the German Bundesverdienstkreuz was granted to him. 1985 he is chairman of this commission.



YOTARO IIDA

Born on Feb. 25, 1920

1943 Graduated from Faculty of Engineering, the University of Tokyo
1943 Joined Mitsubishi Heavy Industries, Ltd. (MHI)
1977 Director, Deputy General Manager of Power Systems Headquarters
1981 Managing Director, General Manager of Power Systems Headquarters
1983~ Executive Vice President, General Manager of Power Systems Headquarters



YASUSHI MATSUDA

Born on Nov. 24, 1928 in Tottori Pref.

1957 Graduated in Engineering, the University of Tokyo

1957 Entered Ministry of International Trade and Industry (MITI)
1973 Deputy Director-General, General Coordination Bureau, Bureau of Nagoya International Trade and Industry
1974 Director, Power Reactor Development Division, Atomic Energy Bureau (AEB), Science and Technology Agency (STA)
1975 Director, Reactor Regulation Division, AEB, STA
1976 Director, Reactor Regulation Division, Nuclear Safety Bureau, STA
1978 Director, Electric Power Technology Division, Public Utilities Division, Agency of Natural Resources and Energy (ANRE), MITI
1981 Senior Officer for Natural Research and Development Program, General Coordination Division, Agency of Industrial Science and Technology, MITI
1982 Councillor, Director-General's Secretariat, ANRE, MITI

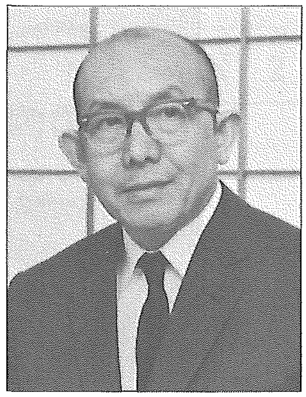
I-HSIEN CHU

Born in May 1925
1956 B.S. Mechanical Engineering, Chengkung University
1958 Fossil Power Plant Operation and Maintenance, Taiwan Power Co. (TPC)
1970 Nuclear Engineering, Oregon State University
1975 Superintendent, First Nuclear Power Station, TPC
1983 Chief Engineer, Nuclear Operation, TPC
1984~ Vice President, Nuclear Operation, TPC

LUNCHEON

KEIJIRO MURATA

Born on Feb. 12, 1924 in Aichi Pref.
1949 Graduated from the Faculty of Law, Kyoto University
1949 Entered Ministry of Home Affairs
1954 Chief, Financial Affairs Section, Tottori Pref.
1968 Manager, Department of Construction, Aichi Pref.
1969 Elected Member of House of Representatives (HR)
1975 Parliamentary Vice-Minister for Construction
1976 Deputy Director-General of Administrative Affairs in the Prime Minister's Office
1977 Director, Construction Division, Policy Affairs Research Council, Liberal-Democratic Party (LDP)
1978 Director, Personal Affairs Bureau, LDP
1981 Chairman, Committee on Construction, HR
1983 Chairman, National Campaign Headquarters, LDP
1984~ Minister for International Trade and Industry



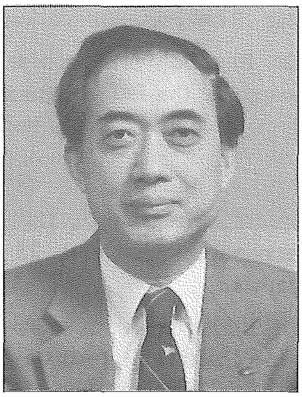
KAII HIGASHIYAMA

Born on July 8, 1908
1969 Awarded on Order of Cultural Merits

Kaii Higashiyama, a famous Nihonga landscape painter, will speak on Japanese perception of beauty. "The progress of science and technology is important, but the most important are the human beings who use science and technology," he said. He believes that nature is great because it fosters a sense of humanity. Greatly to be valued is the fleeting moment of fragile beauty.

He lived through a long period of obscurity, with various family troubles and little money. He emerged from this dark period and underwent an experience similar to zen satori or enlightenment. He thus achieved a "pellucid eye to view nature" and established his position as a landscape painter in such works as "Afterglow," "Road," "Twilight" and the Nordic series. In 1968 he painted the "Dawn tide" mural for the new palace building, beautifully expressing the rhythm and life-force of nature in Japan in these waves and rocks. In 1975 he started to work on paintings for the sliding doors of the Mieido hall at the Toshodaiji temple in Nara where a statue of the priest Ganjin is kept. This series of work was finally finished in July 1981 with the completion of "Auspicious light," a Zushi-e painting for the miniature shrine of this priest's statue. During this period Higashiyama also travelled to China, and opened up a new world of sumi painting. The nature of his art is based on his deep observation and appreciation of nature; he captures nature inside him and warmly expresses its essence in lyrical, plain, and spiritual way.

SESSION 3



SHIGERU KIMURA

Born on Oct. 17, 1932 in Kumamoto Pref.

Education:

1955 Graduated from History and Philosophy of Science Course of Department of Liberal Arts, the University of Tokyo

Occupation:

1955 Joined the Asahi Shimbun, stationed at the Mito Branch Office to cover mainly Japan Atomic Energy Research Institute.

1959 Transferred to the Science Department, Tokyo Head-Office

1964 Dispatched to the U.S. and Europe to cover nuclear energy and space project.

1969 Dispatched to the U.S.S.R. and the U.S. to cover man's first lunar landing.

1969 Associate Editor of the Science Department

1975 Science Editor

1981 Invited to the Woodrow Wilson International Center for Scholars as a guest scholar.

1982 Manager, the Analysis and Research Center

1983 Engaged in Space Experiments utilizing the U.S. Space Shuttle as the Payload Manager.

1984～Chief Researcher, Analysis and Research Center

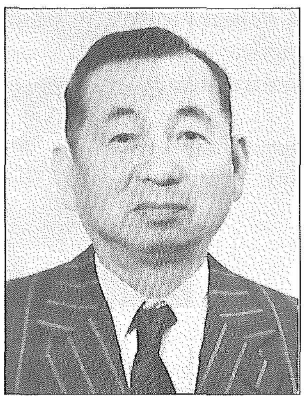
YOSHIAKI KOREI

Born in 1929 in Kyushu

He graduated from the University of Tokyo, Electrical Engineering Course in 1952 and joined Hitachi Works of Hitachi, Ltd. in the same year.

Through assignment to Hitachi New York, he became Department Manager of Nuclear Power Plant Department in 1970 and became General Manager, Nuclear Power Engineering Division, Power Generation & Transmission Group in 1970.

Since 1980, he has been General Manager, Nuclear Power Generation Division.



TOSHIJI OMORI

Born on Aug. 28, 1918 in Kobe

Education:

1939 Graduated from Department of Mechanical Engineering, Tokushima Higher Technical School in March 1939.

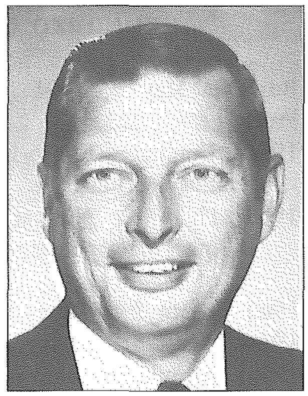
1961 Received a Doctor of Engineering from Kyoto University.

Occupation:

1951 Worked for Kobe Shipyard and Engine Works, Shin Mitsubishi Heavy Industries Ltd.

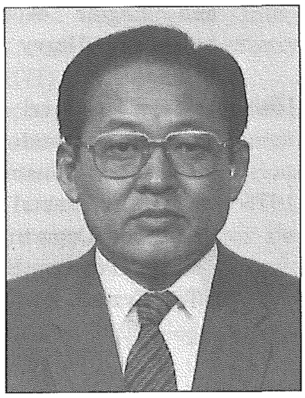
1968 Deputy General Manager, Takasago Laboratory, Mitsubishi Heavy Industries Ltd.

1976～ Director, General Manger of Seismic Department, Nuclear Power Engineering Test Center.



R.E. SKAVDAHL

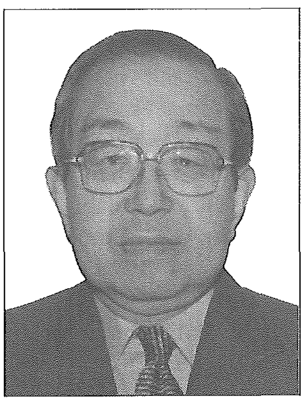
Dr. Skavdahl received his Bachelor's degree in Chemical Engineering from MIT, Master's degree in Nuclear Engineering from the University of Michigan, and Doctor's degree in Nuclear Engineering from MIT. He joined General Electric in 1962 at the Hanford Atomic Products Operation in Richland, Washington, in research and development of plutonium ceramic fuels. He transferred to the fast breeder reactor component (Sunnyvale, California) of GE's Nuclear Energy Operation in 1966, where he held positions in program and project management. After four years as Project Manager of General Electric's portion of the Clinch River Breeder Reactor Project, Dr. Skavdahl was appointed Manager of Domestic BWR 4/5 Projects in 1978. He assumed his present position as Manager – Waste Management Services Operation in 1984.



KUNIHIKO UEMATSU

Born on May 5, 1931 in Kagawa Pref.

1954 Graduated Kyoto Univ. (Civil Engineering)
1961 Ph. D. in Nuclear Engineering, Massachusetts Institute of Technology
1961 Lecturer of Kyoto Univ.
1964 Assistant Senior Engineer, Atomic Fuel Corporation
1968 Senior Engineer, Fast Breeder Reactor Project, Power Reactor and Nuclear Fuel Development Corporation (PNC)
1977 Senior Engineer, Department of Nuclear Fuels Development and Fast Breeder Reactor Development Project, PNC
1982 Director, Nuclear Fuels Development Division, PNC
1983~ Executive Director, PNC



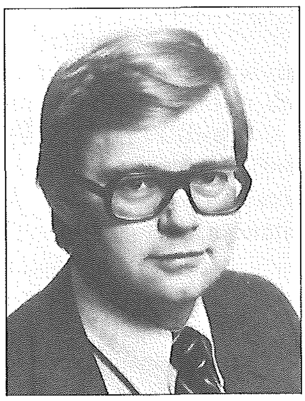
SHIGEBUMI AOKI

Born on Apr. 14, 1922 in Tokyo

Education:
1945 Finished the Course of Mechanical Engineering, Tokyo Institute of Technology (TIT)
1957 Doctor of Engineering, TIT

Occupation:
1945 Assistant, Dept. of Mech. Eng., TIT
1958 Assistant Professor, Research Laboratory for Nuclear Reactor (RLNR), TIT
1964 Professor, TIT (RLNR)
1975 Director of RLNR, TIT
1983~ Professor Emeritus, TIT

Additional Positions:
- A member of the Committee on Examination of Reactor Safety, Nuclear Safety Commission (NSC)
- Chairman of the Special Committee on Safe Transportation of Radioactive Materials, NSC
- A member of the Special Committee on Safety Standard of Reactors, NSC
- Chairman of the Study Group on Proving Tests on Reliability of Spent Fuel Transportation Casks
- Executive Director, Nuclear Materials Control Center
- Executive Director, Nuclear Safety Research Association
- Technical Adviser, PNC
- Research Adviser, CRIEPI



STEN BJURSTROM

Dr. Sten Bjurström is President of Swedish Nuclear Fuel and Waste Management Co., in short SKB, in Stockholm, Sweden.

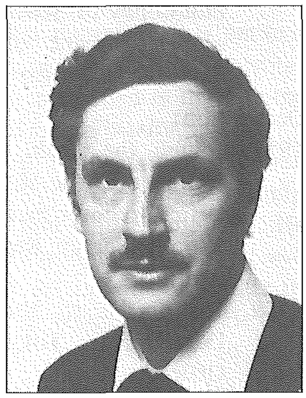
President Bjurström received in 1966 his M.Sc. degree in Mining Engineering from the Royal Institute of Technology in Stockholm, Sweden. He also obtained his D.Eng. in Rock Mechanics from the same institute in 1972.

From 1966 to 1971 he has worked as design- and research engineer for military underground construction within the Royal Fortification Administration.

From 1972 to 1983 Dr. Bjurström held a position as Research Director and head of Swedish Rock Engineering Research Foundation (BeFo).

Dr. Bjurström has been active in research in the field of tunneling support techniques and questions connected to energy conservation and storage by use of underground space. In this field Mr. Bjurström has published about 25 scientific papers.

Dr. Bjurström is a member of several geotechnical professional societies. In this capacity he is First Vice President and European President for International Society for Rock Mechanics, where he also is Chairman for its Commission on Research.



ROBERT B. LYON

Educated in England:
B.Sc. (Hons) Chemical Engineering (Leeds) 1964
M.Sc. Nuclear Reactor Physics and Technology (Birmingham) 1965

Joined Atomic Energy of Canada Limited (AECL) in 1965 in Chalk River Nuclear Laboratories. In 20 years with AECL has worked on small reactors (co-inventor of SLOWPOKE reactor), reactor physics, control and safety of reactors, various assessments and in particular the development of an assessment methodology for nuclear waste disposal.

Presently Director, Waste Management Division at Whiteshell Nuclear Research Establishment, with responsibility for the Canadian Nuclear Fuel Waste Management Program.

SHIGERU MORI

Born on Jan. 1, 1923 in Hiroshima
1947 Graduated Department of Physics, the University of Tokyo
1947 Assistant at the Faculty of Science, the University of Tokyo
1959 Lecturer at the Faculty of Science, the University of Tokyo
1961 Entered Japan Atomic Energy Research Institute (JAERI)

Untill now he has filled posts such as: General Manager, Fusion Research Office: Director, Department of Thermonuclear Fusion Research; Deputy Director General, Tokai Research Establishment

Present Post:
Executive Director, JAERI

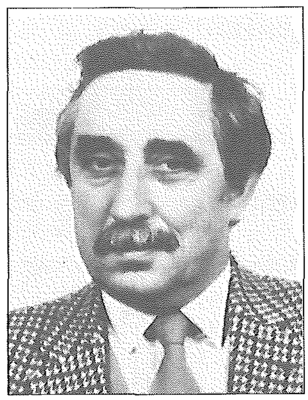
SESSION 4

KENZABURO KOBAYASHI

Born on Dec. 8, 1912 in Kouchi Pref.
1935 Graduated from the Department of Civil Engineering, Faculty of Engineering, Kyoto University
1935 Entered Kobe Municipal Office
1953 Entered the Tokyo Electric Power Co., Inc. (TEPCO)
1970 Director and Deputy General Manager, Environmental Pollution Administration, TEPCO
1977 Managing Director and General Manager, Transmission & Transformation Facilities Construction Administration, TEPCO
1980 Vice President, the Japan Nuclear Fuel Service Co. (JNFS)
1984~ President, JNFS

HIROSHI MURATA

Born on Mar. 10, 1915
1937 Graduated from Mechanical Course, Ryojun (Port Arthur) Institute of Technology
1958 First Secretary, Embassy of Japan in U.K.
1963 Director General, Resources Bureau, Science & Technology Agency (STA)
1964 Director General, Planning Bureau, STA
1964 Director General, Atomic Energy Bureau, STA
1967 Executive Director Power Reactor and Nuclear Fuel Development Corporation (PNC)
1968 Vice President Japan Atomic Energy Research Institute (JAERI)
1978 President, JAERI
1980~ Special Advisor, JAERI
1981~ President Nuclear Safety Research Association
1981~ Vice Chairman, JAIF
1983~ President Japan Radiation Safety Technology Center



MAURICE DELANGE

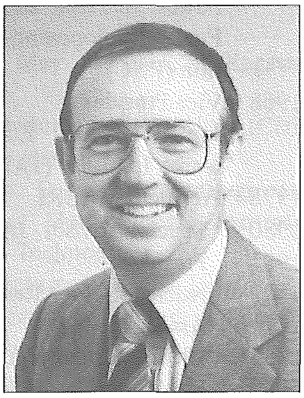
Mr. DELANGE is Industrial Director at the Reprocessing Branch of COGEMA.

He joined the French Atomic Energy Commission (C.E.A.) in 1953 at Le Bouchet Uranium Refining Plant to become in 1961 Head of the Uranium Fabrication Service.

In 1964 he moved as Head of the Production Services to the new Reprocessing Plant under construction at Cap La Hague.

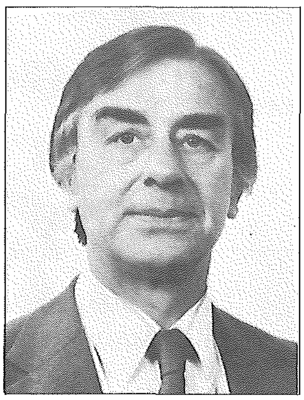
In 1974 he became General Manager of the La Hague Establishment and in 1982 he moved to the head office of COGEMA Company to assume his present position in charge of both Marcoule and La Hague Establishments.

Mr. DELANGE received his licence in Sciences in 1950 at Grenoble University and his diploma of Engineer of the "Ecole Nationale Supérieure d'électrochimie et Electrométallurgie" in 1951.



HERMANN SHUNCK

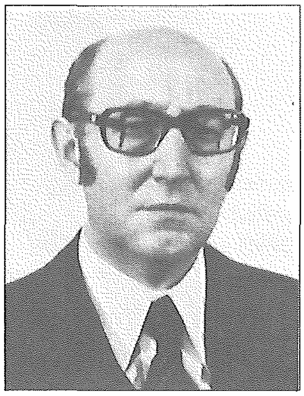
First Counselor, Scientific
Embassy of F.R. Germany



W.L. WILKINSON

Dr. Wilkinson is now the Technical Director of British Nuclear Fuels plc, and a member of the Main Board. Until June 1984 he was Director of Engineering for the Reprocessing Division with responsibility for the design and construction of major projects for the Reprocessing Division with a capital value of approximately £300M per year.

He studied Mechanical Sciences and Chemical Engineering at Cambridge. He is a Past-President of the Institution of Chemical Engineers and was elected to the Fellowship of Engineering in 1980.



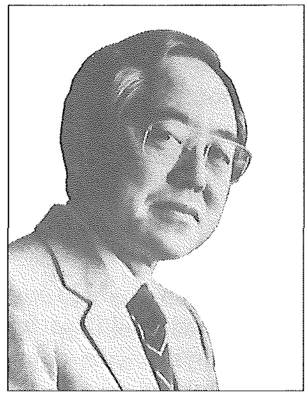
PIERRE STROHL

Born on Aug. 20, 1926 in Strasbourg (France)
Graduate in Law (Paris University)
School of Political Science (Paris)
1959 Secretary-General of the Eurochemic Company (Belgium)

Since 1965:
OECD Nuclear Energy Agency: successively Head of the Legal and External Relations Division, Deputy Director for Safety and Regulation, Deputy Director General.

Member of the French Society for International Law and of the International Nuclear Law Association.

SESSION 5



KEICHI OSHIMA

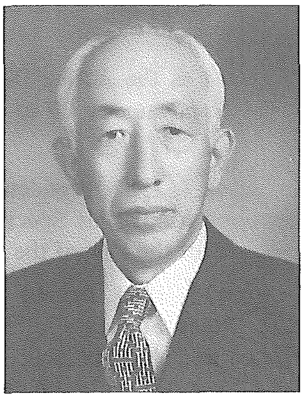
Born on Jan. 12, 1921 in Tokyo
1944 Graduated from Department of Applied Chemistry, the University of Tokyo
1959 Doctor of Engineering, the University of Tokyo
1950 Associate Professor (Applied Physical Chemistry), the University of Tokyo
1961 Professor (Reactor and Radiation Chemistry) Department of Nuclear Engineering, the University of Tokyo
1974 Director for Science, Technology and Industry, Organization of Economic Cooperation and Development (OECD), Paris
1981~ Professor Emeritus, the University of Tokyo
1981~ Vice Chairman, Industrial Research Institute, Japan

Other Major Professional Activities:

Government:
1961~ Member of Advisory Committee on Industrial Technology, MITI
1977~ Member of Advisory Committee on Overseas Economic Cooperation to the Prime Minister
1977~ Member of Council for Electric Utilities, MITI
1978~ Member of Economic Advisory Committee, Prime Minister's Office
1979~ Advisor, Science and Technology Agency, Prime Minister's Office

Others:

President, Cryogenic Association of Japan
Board Member, JAIF
Board Member, Japan Institute of Energy Economics
Board Member, Institute of Applied Energy
Member, ACSTD, UN
Japanese Executive Member, Trilateral Commission
Member, Club of Rome

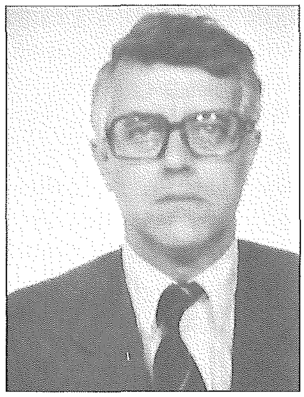


MASAHIRO NISHIBORI

Born on Nov. 14, 1918 in Hokkaido

Education:
1940 Passed the high class Diplomatic Service Examination
1941 Left Tokyo University of Commerce before graduation
A foreign research worker in U.S.A. for the Ministry of Foreign Affairs

Occupation record:
1941 Entered the Ministry of Foreign Affairs
1954 Director, Second Division, Treaties Bureau
1957 First Secretary, Embassy of Japan, in Thailand
1959 Counselor, Embassy of Japan, in U.S.A.
1962 Director, North America Division, American Affairs Bureau
1966 Minister for the Representatives of the Japanese Government for the International Agencies in Geneva, concurrently Consul-General, Consulate-General of Japan, in Geneva
1970 Director-General, United Nations Bureau
1972 Ambassador Extraordinary and Plenipotentiary of the Representatives for the Geneva Disarmament Conference
1976 Ambassador, Embassy of Japan, in Belgium, concurrently Ambassador of the Representatives for EC
1979 Ambassador for the Representatives of the Japanese Government for the United Nations
1983～ Commissioner, Atomic Energy Commission

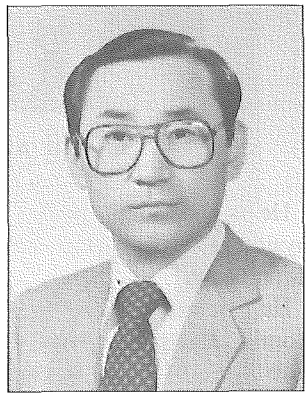


JEAN-BERNARD OUVRIEU

né le 13 mars 1939

Etudes:
Lycée Condorcet
Ecole des hautes Etudes Commerciales
Faculté de Droit
Institute d'Etudes Politiques de Paris

Carrière:
Elève de l'E.N.A. (1964-1966)
Service de presse du Ministère des Affaires Etrangères (66-69)
Chargé de mission au Cabient du Premier ministre (68-71)
Premier Secrétaire à la Représentation permanente de la France auprès des Communautés Européennes (71-74)
Chargé de mission à la Délégation à l'Aménagement du Territoire et à l'Action Régionale (74-75)
Deuxième conseiller à l'Ambassade de France, Bagdad (75-77)
Deuxième conseiller à l'Ambassade de France, Washington (77-79)
Directeur-Adjoint du Cabinet du Ministre des Affaires Etrangères (79-80)
Directeur des Relations Internationales au Commissariat à l'Energie Atomique (80-)
Gouverneur pour la France à l'Agence Internationale de l'Energie Atomique (80-)
Conseiller des Affaires Etrangères (80-)

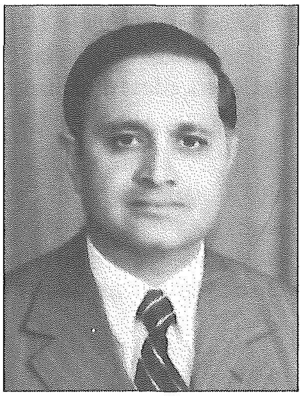


PIL-SOON HAN

Born on Feb. 20, 1933

Education:
1957 ROKAF Academy R.S.
1960 B.S. in Physics, Seoul National University
1964 M.S. in physics, University of Illinois
1969 Ph.D. in Physics, University of California at Riverside

Research and Work Experience:
1960 Instructor of Physics at ROKAF Academy
1970 Chief of 3rd Research Division at ADD
1982 Vice President of Daeduk Engineering Center at Korea Advanced Energy Research Institute (KAERI)
1983～ Chairman and President to Korea Nuclear Fuel Co., Ltd.
1984～ President of KAERI
Commissioner, Korea Atomic Energy Commission



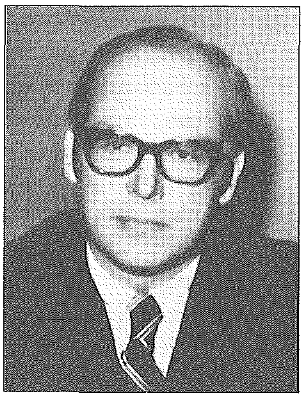
MUNIR A. KHAN

He is specialized in the field of physics, electrical engineering, and electric power.

He joined the International Atomic Energy Agency, Vienna, Austria in 1958 and was among the first scientists from developing countries to be appointed in a senior technical post. He worked in the Reactor Division from 1958-72 and headed Nuclear Power and Reactor Engineering Section. He made major contribution in the development of Agency's programme in the field of nuclear power, research reactor utilization, desalination.

In 1972, he was appointed Chairman of the Pakistan Atomic Energy Commission, the position which he has been holding for the last 13 years. He has guided the development of Pakistan's peaceful nuclear energy programme with great vigour. During the last 13 years, Pakistan has commissioned a nuclear power reactor, a large nuclear research and development centre, two training institutes for technical manpower and a number of centres for the application of atomic energy in agriculture and medicine.

He has been taking an active part in international forums dealing with nuclear energy and helped bring closer understanding between the less developed and the advanced countries. As Chairman Pakistan Atomic Energy Commission, he led Pakistan delegation to the IAEA General Conference and has been four times member of the Board of Governors of IAEA. He has made significant contribution to the shaping of the IAEA's programmes and policies relating to nuclear power and non-proliferation.



JAMES L. MALONE

James L. Malone is a native of California and graduated from Pomona College (B.A., magna cum laude, 1953) and Stanford Law School (J.D., 1959).

Before entering the government, he was an assistant dean and lecturer-in-law at the UCLA School of Law from 1961-67. He was the dean and professor of law at the Willamette University College of Law from 1967-68.

He entered the government in 1970 as a senior principal trial attorney for the Federal Maritime Commission. From 1971-73, Mr. Malone was Assistant General Counsel of the Arms Control and Disarmament Agency (ACDA) and from 1973-76, he was the General Counsel there. In 1976, he became Ambassador and U.S. Representative to the Conference of the Committee on Disarmament (CCD).

From 1978 to 1981 he practiced law in Washington principally in the areas of energy law and international business.

He served as the Acting Director of ACDA from January 20 to April 25, 1981.

On March 7, 1981, President Reagan appointed him as his Special Representative for the Law of the Sea.

On June 1, 1981, he was sworn in as Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs following his confirmation on May 21, 1981.

RECEPTION AND LUNCHEON

HOTEL OKURA (2 minutes walk from the Conference Hall)
10-4, Toranomon 2-chome, Minato-ku, Tokyo Tel. (03) 582-0111

- 2 min. walk from Toranomon St. (Subway)
- 5 min. by car from Shimbashi St. (Japanese National Railways, Subway)
- 10 min. by car from Akasaka-Mitsuke St. (Subway)