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U.S. Support for Nuclear Energy Safety and Cooperation in the Asian Pacific Basin

INTRODUCTION

I am very pleased to have the opportunity to discuss with you today the vital role that nuclear safety may play in the dynamic Asian Pacific Rim countries. As your economic engines continue to gain speed, lifting the quality of life and expectations of your societies, the demands for electrical energy will continue to expand more rapidly than anyplace else on earth.

ECONOMIC GROWTH AND ENERGY DEMAND IN THE PACIFIC RIM

For the Pacific Rim as a whole, economic growth is expected to generate a doubling of electricity demand during the present decade, with *annual* increases in demand on the order of 20 Gigawatts. Of the twelve countries listed by the U.S. Department of Energy as major markets for U.S. energy exports, six are on the Asian Pacific rim: China, Thailand, Indonesia, the Republic of Korea, Hong Kong and Taiwan. The area has the largest population in the world, with an enormous absorptive capacity for technology and development, and a pent-up demand for energy.

Per capita energy consumption is presently low in the region -- it was only 515 kWh in China in 1989, for example (compared with over 10,000 kWh in the USA) -- but demand is strong and growing. In China, again, to support a 10% annual economic growth rate in the past decade, total installed electrical generating capacity has more than doubled, reaching 150 GWe in 1991. This is far short of demand, however, and China alone will require 12 to 15 GWe of new capacity *each year* through the end of the century. In fact, Guangdong Province alone hopes to add approximately 18 GWe by 2010.

In Indonesia, generating capacity has doubled in the last decade, and would have to double again by the year 2000 to meet an estimated 10% annual increase in demand. By 2015 this island nation will need 35 GWe of additional capacity. Malaysia's demand for electricity is also projected to almost triple by the end of the decade (from 5 GWe to 13 GWe). The Republic of Korea's rapid annual electricity demand growth rate of 14% over the last several years will decline, but to a still respectable 5-6% over the next decade. Some estimate that, even without counting Japan, Asian Pacific unmet needs will reach 180 GW for the decade of 1993-2002, with a regional annual growth rate of 6.2% of installed capacity.

These demand projections are matched by parallel gaps in supply. Several Asian countries depend heavily on imported fuel. Oil supply problems in the 1970's led Japan, Korea, and Taiwan to develop well-planned nuclear power programs to ensure the long-term availability of energy. Even Indonesia, an oil exporting country, could become a net importer by the end of the decade, based on growing domestic demand. At the same time there is mounting awareness of the environmental consequences of burning soft coal and other fossil fuels, leading many to favor other sources of electricity.

THE ROLE OF NUCLEAR POWER IN THE PACIFIC RIM

The region already boasts the world's most dynamic nuclear power programs. In Japan, Korea, and Taiwan, the nuclear share of total electricity generation was 27.7%, 43.2%, and 35.4% respectively, in 1992. Worldwide, new starts began on only four nuclear power reactors in 1991 and 1992; all are in Asia, specifically in Japan and Korea.

Japan's utilities have announced plans for starting construction on 10 new nuclear units in the next two years, and a Ministry of International Trade and Industry (MITI) report has called for an additional 40 GW of nuclear power by 2010, effectively doubling Japan's capacity. Korea is planning 18 new nuclear units in the next 12 years, hoping to reach 23 GW nuclear by 2006. Taiwan is also expanding, inviting bids for its fourth nuclear installation which it hopes to complete by 2000.

At the other end of the spectrum are countries such as Indonesia, Thailand, and Malaysia, which presently do not have nuclear power programs but are considering them. Indonesia has completed a favorable feasibility study for 600 MW nuclear power plants in Java, and hopes to have a nuclear power plant operating by the year 2003. Thailand has tentative plans to study the feasibility of constructing 6 GW of nuclear capacity, the first two of which would be scheduled for completion in 2006.

THE U.S. NUCLEAR PROGRAM

The U.S. has not abandoned nuclear power as a viable option for future energy needs. On the contrary, the U.S. nuclear program is on schedule. Our new construction program is quiescent while those in Asia are so vibrant precisely because the U.S. has already undergone this type of growth within the past few decades and we don't yet have an increased need for baseload power. Nuclear power now generates about 22% of our domestic electricity -- more than double the contribution from nuclear power in 1975. The U.S. produces more nuclear-generated electricity than anyone else in the world -- in fact, the U.S. generates almost one-third of the world's nuclear electricity. It appears that our plant life extension program, which will help the U.S. continue to reap the full benefit of existing nuclear plants, will be a success.

As for new reactors, a new streamlined licensing process is in place. The U.S. NRC is about to issue the design approvals for both evolutionary standard reactor designs -- the General Electric Advanced Boiling Water Reactor and the ABB-Combustion Engineering System 80+. In another two years, the rulemaking certification of these designs should be completed, in keeping with worldwide expectations.

Our review of the even newer generation of nuclear power plants is also well along. These novel designs employ passive safety features and modular construction. These features should make the reactors easier to construct and to operate, while retaining economic competitiveness. The NRC-certified designs for the passive reactors, achieved after an exhaustive analytic and experimental review process of unprecedented thoroughness, should be available later in this decade, well in time for those programs in the U.S. and abroad which are considering using these designs. In short, we believe U.S. designs will be very competitive in the growing energy markets of East Asia.

No one should doubt U.S. government support for electricity projects in the Region. The Department of Energy organized and led an electric power seminar in Taiwan last year, emphasizing nuclear technology. The U.S. Secretary of Energy was recently instrumental in lifting restrictions on the sale of U.S. balance of plant equipment for nuclear power facilities to China. This should open up the market for sales of U.S. turbine generators and associated components for future nuclear power plants there; it has already stimulated sales of turbines for fossil plants. Together with NRC's expected certification of the safety of advanced designs, Secretary O'Leary has assured me that U.S. Government support for advanced designs will be available for the rest of the Asian energy market.

As for nuclear power in the U.S., the overall outlook depends primarily on timing of future baseload demand and on the economic competitiveness of nuclear power, not on government action. In other words, the issue is one of economics -- there are no insuperable safety, regulatory, political, or environmental obstacles to new nuclear power plants in the U.S. We believe that this is as it should be -- that economics should determine the choices.

THE IMPORTANCE OF SAFETY PRINCIPLES TO SAFETY

One of the lessons the U.S. has learned after almost 2,000 reactor years of experience is that the safe use of nuclear energy depends on many conditions. Economic, scientific, industrial, institutional and legal elements must all be integrated to achieve high levels of safety. One of the most important of these elements is a nuclear safety culture derived from certain fundamental principles that are applicable worldwide. To prove this point, one only has to compare safety history in the G-7 countries with corollary developments in the Soviet Union and East Europe. This comparison will show that one key difference is the role a strong, independent regulatory authority has been able to play in monitoring the nuclear industry's commitment to safety.

Recently I was privileged to accompany U.S. Vice President Gore to Russia for the second meeting of the Joint U.S.-Russia Commission on Economic and Technological Cooperation. During this meeting, the United States and Russia signed a document which, while not making headlines, makes a potentially very significant contribution to legitimizing the regulatory authorities in Russia. The document commits both countries to a set of Joint Principles of Nuclear Reactor Safety. Let me quote one of the most important principles we agreed to:

> "REALIZING that the safe use of nuclear energy depends upon 1) the establishment of a vigorous safety culture among users of nuclear energy, based on a legal foundation which defines the activities of a strong and independent regulatory authority; 2) legal recognition of the need for adherence to agreed nuclear safety principles; and 3) an internationally-recognized system of legal liability and financial protection for providing adequate compensation for damage from nuclear accidents and appropriate limitations on third party liability."

We believe this was needed because of the absence of a strong safety culture in the Eastern European and the former Soviet states which did not allow for the development of a strong and independent regulator. It is significant that only three

months later, on the occasion of Ukrainian President Kravchuk's trip to Washington, an almost identical set of safety principles was signed at Ukraine's request. The message is getting through.

What I wish to point out is that countries in the Pacific Basin which are beginning to look toward nuclear power development would benefit from examining the course of nuclear safety regulation in G-7 countries. They will find, I believe, one key difference is the role a strong, independent regulatory authority has been able to play in monitoring the nuclear industry's determined commitment to safety.

With specific regard to the regulatory dimension, four elements are especially important in establishing and maintaining an adequate nuclear safety culture.

First, every nuclear nation must provide a firm legal foundation for a strong and independent regulatory authority to monitor and enforce high levels of safety. As we have seen in Russia and Ukraine, where regulators have not traditionally had the political authority to carry out their job effectively, when there is no effective oversight body with the power to close down nuclear power plants for safety violations, there is a tendency to cut corners in order to produce needed power as efficiently and as cheaply as possible.

Second, no amount of regulatory authority is going to be effective if the regulator does not have the resources at its disposal to get inside the nuclear power program. This normally means adequately paid personnel: on-site inspectors, licensing experts who can look at plants at all stages from design to decommissioning, and events experts who can analyze errors leading to operating problems and apply the lessons learned from these events to improve operations in the future. It also means a confirmatory research capability.

Third, both the industry and the regulators must apply rigorous nuclear standards which cover all safety-relevant aspects of the nuclear fuel cycle. One such set of principles has been developed for the International Nuclear Safety Convention, which we hope will be wrapped up in Vienna next month.

Fourth, by national law or international commitment, a state must put into place legal liability and financial protection arrangements which would provide adequate compensation for damage in the event of a nuclear accident, while setting appropriate limits on third party liability. Such protection holds both the nation and the nuclear power plant operators accountable to the paramount goal of protecting the public health and safety while assuring the public every right to redress through the courts any

injury it might suffer as a result of negligence or improper operation.

Where these principles have been adhered to, a culture of safety has permeated both nuclear operations and management, and this has produced a successful nuclear industry. Where these principles have *not* been followed, the goal of electricity production has frequently led the industry to override safety objectives when the two came into conflict.

THE ROLE OF AN INTERNATIONAL NUCLEAR SAFETY CONVENTION

In addition to strong national regulation, the NRC has supported placing the principal elements of nuclear safety regulation into the draft International Nuclear Safety Convention.

Many Pacific Rim states have participated actively in the development of this important Convention. Just as the international nuclear safeguards regime that was set up to prevent nuclear proliferation in the late 1960's helped inhibit the spread of nuclear arsenals, we believe formal agreement and wide adherence to an international nuclear safety regime will help assure a safer global environment.

Each party to the Convention is required to establish or designate a regulatory body that is entrusted with implementing the laws and regulations, and which is, quoting from the draft, *". . . provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities."* Moreover, it is required that the functions of this regulatory body be effectively separated from those of any other national "body or organization concerned with the promotion or utilization of nuclear energy."

Finally, it is the license holder, and *not the regulator*, who is ultimately responsible for the safety of the installation it is operating.

U.S. REGULATORY COOPERATION WITH PACIFIC RIM STATES

All legal systems, no matter how different, should be able to accommodate the basic principles outlined above in the draft nuclear safety convention. Accordingly, the U.S. NRC has long provided its support to other governments seeking to set up or improve nuclear regulatory programs and has established nearly thirty regulatory exchange arrangements.

During the past five years much of our recent effort has been concentrated on the countries of Eastern Europe and the former Soviet Union, largely as a result of revelations about

lack of adequate safety cultures in these countries in the wake of Chernobyl, and because the Soviet Union itself dissolved and the resulting independent states needed our assistance. Much of this aid has been focused on establishing a nuclear safety philosophy based on a strong and independent regulator. Parallel with this activity, we have also continued -- and even expanded -- our cooperation with Pacific Basin countries.

NRC's information exchange and cooperative programs in the Pacific Basin countries have focused primarily on providing training, participating in detailed discussions on nuclear safety and technical issues, and furnishing a full library of NRC safety and regulatory documents. Training has been provided through both formal coursework at our Technical Training Center in Chattanooga, Tennessee, and long-term on-the-job training assignments with NRC staff. Our more recent exchange agreements with those countries developing nuclear power programs have focused on the importance of a strong, independent nuclear safety and regulatory program - a dialogue NRC certainly supports and intends to further.

JAPAN

As one of NRC's most active partners in nuclear safety cooperation, Japan and NRC conduct cooperative research as well as information exchanges on regulatory programs, exchanges of personnel and training. Because nuclear regulatory responsibilities are split between two Japanese government agencies, NRC has regulatory information exchange agreements with both the Ministry of International Trade and Industry (MITI) and the Science and Technology Agency (STA). Since 1982 NRC has hosted one or two Japanese assignees each year, as well as having one NRC employee assigned to MITI in 1992. NRC also has extensive research agreements with Japanese agencies such as MITI's Agency of Natural Resources and Energy (ANRE), the Nuclear Power Engineering Test Center (NUPEC), and the Japan Atomic Energy Research Institute (JAERI). In fact, Japanese research institutions are playing a significant role in assisting the NRC in conducting confirmation research on passive-safety system performance.

THE REPUBLIC OF KOREA

NRC has engaged in an extensive program of cooperation with the regulatory authorities of Korea since 1976, when we first formalized an information exchange and cooperation arrangement with the Ministry of Science and Technology. Besides the elements in our basic exchange program, we have hosted one-to-two week advisory missions to Korea by NRC safety experts, and Koreans attended U.S. nuclear emergency field exercises, as we did theirs. Korea has also joined and become an active

participant in NRC's international cooperative research programs in such confirmatory safety research areas as severe accidents, thermal-hydraulic code application and maintenance, and piping integrity.

INDONESIA

Because Indonesia is just taking its first steps toward a possible nuclear power program, NRC's cooperation with Indonesia has been much less extensive and is of more recent origin. We formalized our intent to cooperate in October 1992, when we signed an information exchange and cooperation arrangement with the Indonesian National Atomic Energy Agency (BATAN). This was preceded (since the mid-1980's) by at least annual contacts by delegations on both sides, usually under the auspices of the U.S.-Indonesia Nuclear Joint Steering Committee, where nuclear safety was always one of the agenda topics. We have made a commitment to help Indonesia train a core group of nuclear safety personnel and now host four BATAN staff members who are working within the NRC staff to learn the philosophy and practice of basic regulation in the U.S. They will carry their experience back to Indonesia next year and share what they have learned with others there, while we begin anew with four more trainees on the NRC staff.

THAILAND

Thailand initiated safety discussions with the NRC last year, after the Government's announcement that, although it was still examining all options, it was seriously considering approving construction of the country's first nuclear power plant. A delegation from the Thai Senate Committee on Science, Technology, and Energy visited NRC in July for briefings on the legal bases of our regulatory program, the creation and implementation of health and safety regulation, and waste management.

THE PEOPLE'S REPUBLIC OF CHINA

In January 1993 I visited the People's Republic of China and renewed the NRC-Chinese National Nuclear Safety Administration (NNSA) agreement, which was begun in 1981 with signature of the original five-year Protocol and first renewed in 1986. Through this protocol NRC continues the exchange of nuclear safety information on the design, construction, and operation of nuclear power plants in the U.S. and China. This renewal was particularly timely, as China's first nuclear power plant, the 300 MW(e) PWR at Qinshan, was commissioned in December 1991. NRC has provided technical lectures on power reactor, radiation protection, and nuclear material safety, and safety advice to

NNSA to assist in their safety reviews and evaluation of the Qinshan and Daya Bay nuclear power stations. In 1993 there were two high level PRC visits to U.S. nuclear power plants, with a particular focus on emergency preparedness techniques and procedures, and, in addition to my own visit, Commissioner Remick visited the People's Republic of China in the spring of 1993, Commissioner de Planque in the spring of 1994 for in-depth reviews of China's nuclear power program.

TAIWAN

Through the agreement between the Coordination Council for North American Affairs (CCNAA) and the American Institute in Taiwan, the Nuclear Regulatory Commission has carried out an extensive and quite active relationship with Taiwan encompassing technical, personnel and information exchanges. In cooperation with the U.S. Department of Energy and its associated laboratories, and under the CCNAA-AIT agreement, the NRC has developed a matrix of exchanges with the Taiwan Atomic Energy Agency, including work in, inter alia, such areas as severe accident and thermal hydraulic and kinetics research, instrumentation and controls, seismic research, and advanced reactors. In addition to my own and several of the Commissioners' visits to Taiwan, NRC has hosted several high level Taiwanese visitors to discuss cooperative activities, the status of the proposed new two-unit Lungmen nuclear power plant site, Taiwan's views on the proposed changes to NRC siting criteria (10 CFR Part 100), life extension of nuclear power plants, and low level waste management.

CONCLUSION

In conclusion, I wish to emphasize today our desire to continue to offer this cooperation to the citizens and institutions of the Pacific Rim countries, whether they have mature nuclear programs or they are just beginning their programs of nuclear power planning and installation.

Clearly nuclear power is not for everyone. Certain conditions need to be present to make it both economically and environmentally sound and physically and institutionally safe. Economic conditions are present in a number of the countries of the Pacific Rim for the expanded development of nuclear energy for the production of electrical energy. Several of these countries have established a very solid basis for committing to a safety culture. But the institutional bases for nuclear power in other countries in the region are only now being developed.

We want to work with the advanced regulatory regimes in the region, to exchange experience and strengthen both their programs and our own. We would like to help those countries which are new

to nuclear power, to develop their regulatory infrastructures from the ground up; both to help avoid the mistakes others have made, and to ensure the development of safe, and therefore economically sound, nuclear power programs.

Success is possible only if development and regulation move forward in tandem. As you stand on the brink of greater growth and prosperity, the U.S. Nuclear Regulatory Commission stands ready to share its accumulated experience in helping you develop a safety culture in which your energy needs can be met safely, efficiently and economically.

KEY WORDS

safety culture

regulatory infrastructure

International Nuclear Safety Convention

liability

Nuclear Regulatory Commission

Japan

Republic of Korea

Taiwan

People's Republic of China

Thailand

Malaysia

Indonesia