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Innovation, Adaptability, and Collaboration: Keys to Success for Small and Medium Sized Reactors

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Let me begin by thanking the Government of Egypt for hosting this Seminar on the Status and Prospects of Small and Medium Sized Reactors. With the advent of telecommunication and the global marketplace, the world has become a much smaller place, and the demand for a higher standard of living is increasing everywhere — yet an estimated two billion people still lack access to electricity. Dramatic increases in electricity demand are expected over the next several decades — with the growth rate in developing countries expected to be three times faster than in industrialized countries. The World Energy Council has concluded that to meet this growth — inevitable for economic and social development — a total reliance on fossil fuels and large hydroelectric facilities is not sustainable, and an expanded future role of nuclear power must be considered. In this context, it may be useful to provide you with a brief overview of key issues that will influence the future of nuclear power, with a particular focus on the role of small and medium sized reactors, the subject of this seminar.

The Current Picture

Nuclear power currently provides about 16% of global electricity, with about 83% of nuclear capacity concentrated in industrialized countries. Around the world, over the past decade, the average availability of nuclear power plants has increased sharply, from 72.5% to 80.5%, due to improved efficiency — the effective equivalent of commissioning 28 new 1000 megawatt units at relatively minimal cost — making existing nuclear power plants economically more effective competitors with other energy sources. This increased efficiency has occurred simultaneously with extensive safety upgrades and improved overall safety performance.

But the overall picture is mixed. Public sentiment against nuclear power remains strong in some countries. Concerns about safety and waste management have led some countries to enact national policy restrictions against the use of nuclear power. Only in East and South Asia are there clear plans for expansion of nuclear power, particularly in China, India, Japan and the Republic of Korea.

On the other hand, the global effort to reduce greenhouse gas emissions and the increase in gas and oil prices has stimulated a renewed consideration of nuclear energy. In this context, a number of leaders have begun to speak out in favour of the nuclear alternative. The Secretary General of the OECD, Donald Johnston, said late last year, "Having examined the best evidence available to me, I have concluded that, if we are to hand to future generations a planet that will meet their needs as we have met ours, it can only be done by incorporating the nuclear energy option." In January, the Vice-President of the European Commission, Mrs. Loyala de Palacio, stated, "the nuclear option should be examined in relation to its contribution to our prime concerns of security of supply and reduction in CO_2 emissions." And just this month, U.S. President George W. Bush, in unveiling a new national energy policy, voiced strong support for reconsideration of investment in nuclear power, and speculated that the number of nuclear plants in the U.S. could double in the coming decades.

In my view, the future of nuclear power may depend upon success in meeting four basic challenges:

- The first challenge will be to develop clear national and international strategies for the disposal of high level nuclear and radioactive waste. Final repositories for low level waste have been licensed and are already operational in many countries. High level waste, however, is more controversial. While experts generally believe geological disposal to be safe, technically feasible and environmentally responsible, the public at large remains sceptical, and the volume of waste continues to build. This dichotomy will only be resolved by demonstrating the feasibility of siting, constructing and operating geological respositories. Some ground for optimism exists: the proposed U.S. facility at Yucca Mountain could receive approval later this year as the site for a geological repository, and just this month the Finnish Parliament, by an overwhelming vote of 159 to 3, ratified the decision to construct a deep disposal facility for spent fuel at Olkiluoto.
- The second challenge is to remain vigilant in ensuring the continued safety of operations at nuclear facilities. While safety is a national responsibility, international co-operation on safety related matters is indispensable. The international safety regime consists of three major components: (1) international

conventions that prescribe basic safety norms; (2) a body of detailed safety standards; and (3) mechanisms for applying these standards — including peer reviews and other Agency led safety review services that have proven extremely useful in validating safety performance and recommending safety improvements.

- The third challenge involves outreach to civil society — engaging the public and decision makers in a fair evaluation of the relative merits of the different energy options. Improving public understanding of radiation and nuclear issues is essential — creating a more mature awareness of the comparative risks and benefits of different energy sources, the impact of each option on sustainable development, and the range of societal benefits provided through nuclear applications. In the same context, the public must be given credible assurance that nuclear technology and materials will be used exclusively for peaceful purposes, with a strong, adequately financed, and universally supported international verification system.

Keys to Innovation

I would like to take a more detailed look at the fourth challenge, which entails the development of new, innovative reactor and fuel cycle technologies. To be successful, these new technologies should incorporate inherent safety features, proliferation resistant characteristics, and reduced generation of waste. They must also be capable of generating electricity at competitive prices while satisfying both regulators and investors. On the technical side, this implies a greater reliance on passive safety features, as well as design features that will allow reduced construction times and lower operating costs. But the innovation must be more than purely technical; the new design aspects must be complemented by a re-evaluation of technology policy issues. A high level of confidence must be achieved in the reliability of construction schedules, licensing review procedures, liability issues, and other factors that affect the cost of design, construction, startup, operation and maintenance.

Small and medium sized reactors, within a power output of less than 700 MW(e), are receiving increased consideration in this effort to meet changing market requirements. Smaller plants allow a more incremental investment, which can be used to hedge against demand uncertainty. They are more suitable for standardization and prefabrication, which in turn encourages enhanced quality control and stimulates rapid development of expertise and shorter construction schedules. They provide a better match to grid capacity in developing countries. And they are more easily adapted to a broad range of industrial settings and applications, such as district heating, heavy oil recovery, or the production of hydrogen and other chemical fuels.

Sea water desalination is an application for which smaller reactors hold a particular advantage. Nuclear powered desalination is a proven technology: Japan has accumulated over 100 reactor years of desalination experience at nine reactors — although not for commercial use — and the BN-350 plant in Kazakhstan was used for many years for both electricity production and sea water desalination. But many countries most in need of freshwater also have limited industrial infrastructures and electrical grids, which has inhibited the feasibility of accommodating large scale reactor facilities. In such cases, a nuclear desalination plant becomes much more feasible if it can be built in the range of 50 – 150 MW(e).

Here in Egypt, the IAEA has been supporting the Nuclear Power Plant Authority (NPPA) in considering the feasibility of a dual purpose nuclear power plant for electricity and desalination. This co-operative project is examining the range of energy and water needs, candidate reactor types and desalination processes, local participation capabilities, cost comparisons and financing options. This is a sound strategy. Even for countries with strong oil and gas producing capacities, research and development in innovative energy technologies — including nuclear technologies — is becoming a prudent investment, as a strategy for improving the long term availability, quality and competitiveness of their oil and gas reserves. This investment produces its best return through partnerships and alliances.

Collaboration has become a key feature of the global effort to develop new reactor and fuel cycle designs. Some 20 to 30 innovative designs are under development, with all of the principal reactor concepts — water, liquid metal, or gas cooled — being addressed in one or more of these projects. One major initiative is the International Project on Innovative Nuclear Reactors and Fuel Cycle Concepts (INPRO), an international umbrella project under the auspices of the IAEA. The key to the success of this effort is co-operation and collaboration — promoting technical information exchange, sharing safety and non-proliferation insights, leveraging research dollars, and — perhaps most important — enhancing our understanding of user needs and requirements. Clearly, at some point in the development of a given technology, collaboration gives way to commercial competition; however, even after these technologies become competitive, collaboration will continue to be beneficial for new designs with enhanced features to reduce costs, improve safety and promote non-proliferation.

Conclusion

Clearly, we live in an era in which our society faces many difficult economic, environmental and social issues associated with sustainable development and energy demand. Against

that backdrop, nuclear power is a mature technology that deserves careful consideration as a contributor to solving some of these issues. The development of innovative small and medium sized reactors will play a key role in helping to match state-of-the-art technology to user needs. I hope this seminar will provide a fruitful exchange of information and ideas as a step towards further progress.