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Closing the Fuel Cycle
A Regulator's Perspective

Dr. Peter B. Lyons, Commissioner
U.S. Nuclear Regulatory Commission
at the
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It is a great honor to speak to you during the 1st Global Nuclear Fuel Reprocessing & Recycling Conference. Chairman Dale Klein also extends his regards for a successful conference. I am extremely pleased to share my perspectives on the renewed global interest in nuclear energy and to discuss some of the U. S. Nuclear Regulatory Commission's (NRC) future challenges.

This first conference is not only timely but is making history by establishing a forum to explore global policy perspectives on developing nuclear fuel production and reprocessing and recycling partnerships and initiatives. In addition, conference participants will discuss emerging policies, issues, and developments associated with nuclear fuel production, reprocessing and recycling. I strongly encourage future conferences as these technical, political and regulatory challenges unfold. I especially want to recognize the efforts of the Conference Program Steering Committee in the planning and execution of this Conference.

Over the last year, I have had several opportunities to represent the Agency and our nation at international conferences and meetings. Such visits impress upon me the extent to which nuclear energy is a global enterprise, with countless contributions from a very wide range of countries. At the same time, such visits are a sobering reminder that, while the United States originated much of the nuclear technology in use around the world, there are many situations in which the most modern applications of these technologies are now abroad.

Answers to, or expertise in, all our technical challenge areas no longer reside totally within our country. We have a great deal to learn from the international community in areas ranging from construction techniques, to reactor safety experiments, to technologies applicable to new domestic plants. I don't mean to imply that we in the United States do not have much to contribute to the global community in these areas, however, the inescapable truth is that we have much to gain from interactions with the international community in terms of improving the safety and security of our nation's power reactors and nuclear materials.

As nuclear power expands around the globe, the NRC must constantly encourage that this expansion be accomplished with strict attention to safety. Through our global interactions, we can and do exchange regulatory practices and technical information that enable safer operations in other countries; and it is equally true that we obtain information and data in these exchanges that enhance the safety of plants in this country as well.

As many of you know, spent fuel is currently being reprocessed internationally but not in the United States. The United States had a reprocessing program but ceased activities subsequent to President Carter's 1977 decision to defer indefinitely the commercial reprocessing and recycling of plutonium produced in United States nuclear power programs due to the proliferation risk. Although President Reagan subsequently lifted this indefinite ban, further commercial reprocessing was not pursued, primarily due to cost considerations. As a result, there is limited domestic experience with commercial reprocessing and recycling.

During the next few minutes, I will provide a snapshot of the history of reprocessing in the United States. The Atomic Energy Commission (AEC) encouraged private organizations to become involved in past efforts in reprocessing. For military purposes, the United States used reprocessing during World War II in the Manhattan project. Commercial operation included the West Valley facility, which operated in the late 1960s and early 1970s, using the PUREX process. The facility reprocessed metal fuel from the Hanford N-Reactor and also performed a demonstration on thorium spent fuel. West Valley operations generally met regulatory requirements, although exposures were not as low as reasonably achievable (ALARA), and radiation protection was a significant problem. The operator planned an expansion of West Valley to quadruple its capacity. Seismic issues were raised as part of the regulatory review, and these issues increased the estimated costs by over an order of magnitude. Based on the increased costs and the potential for significant competition from other companies, the operator decided to cease operations.

GE designed and built in 1967 a reprocessing facility in Morris, Illinois, utilizing a dry process for the main separations. The process relied on the volatility of uranium hexafluoride and was successfully demonstrated in the laboratory. Pre-operational testing at the constructed facility was not as successful and would have required major renovations. Given the projected costs and competitive reprocessing market, the operator decided not to pursue reprocessing at the facility. It is currently used as an independent spent fuel storage installation (ISFSI) for wet storage of commercial spent fuel.

The Allied General Nuclear Services consortium constructed a third facility adjacent to the Savannah River Site in Barnwell, South Carolina. This facility planned to utilize an advanced PUREX technology. The facility conducted uranium testing but never operated due to President Carter's decision to indefinitely defer commercial spent fuel reprocessing. The facility is currently undergoing decommissioning. Other companies also planned reprocessing and recycle facilities. Two of them, recycling facilities, Exxon and Westinghouse, were shelved in the late 1970s and early 1980s.

Currently, the country's 104 commercial nuclear reactors produce more than 2,000 metric tons of spent nuclear fuel per year. Under the Nuclear Waste Policy Act of 1982, the Yucca Mountain repository is currently limited to 70,000 metric tons of spent nuclear fuel and DOE defense-related wastes. By DOE's estimate, by approximately 2010, the accumulated spent

nuclear fuel generated by reactors operating to date together with the defense-related waste will reach this limit.

New approaches to management of the fuel cycle are being proposed and may significantly challenge the NRC. The Global Nuclear Energy Partnership (GNEP) proposed by the DOE is intended to develop the systems, technologies, and policy regimes to allow recycling of used light water reactor fuel and, to a large extent, eliminate the actinides in fast-burner reactors in a way that enhances proliferation resistance. The resulting waste streams are envisioned to have characteristics that would lessen the volume and thermal challenges for a geologic repository. The GNEP initiative could involve several interconnected (and possibly co-located) facilities: (1) a Consolidated Fuel Treatment Center; (2) an Advanced Burner Reactor; and (3) an Advanced Fuel Cycle Facility. As currently envisioned, NRC would probably be the regulator for the Consolidated Fuel Treatment Center and the Advanced Burner Reactor as these would be commercial enterprises. In addition, the NRC would need to be involved in development and operations of DOE's research facilities, such as the Advanced Fuel Cycle Facility, to be able to understand issues that may affect its GNEP facility licensing process. However, as the DOE is formulating this program, it is not yet clear at what stage in its evolution the NRC will be participating.

I will let other panel members and conference participants expand on the technical and political challenges, but I want to offer my perspective on some possible regulatory challenges.

NRC's regulatory role will depend largely on DOE's and industry's participation and legislation. The interdependence of the facilities, that is, defining how each facility affects the safety, safeguards, quality, effectiveness, and efficiency of the others, will require involvement of multiple NRC program offices. We must ensure that a stable and reliable regulatory infrastructure is in place well before an application is submitted. Our challenge will be to (1) develop a regulatory framework for commercial GNEP facilities, (2) provide guidance to applicants, and (3) develop qualified NRC staff to support a timely NRC licensing review.

NRC staff has already begun to consider a path forward including modification of existing regulations to include spent fuel reprocessing and possible new rulemaking to address the safety and security requirements needed for the new technology. Also under consideration is development of specific GNEP regulations applicable to both fuel reprocessing and fast-burner "recycling" reactors.

As the NRC staff proceeds with development of a regulatory framework for possible reprocessing facilities and fast-burner reactors, policy issues will probably arise. Some examples are: (1) how defense-in-depth should be applied; (2) the level of safety necessary for the group of facilities; (3) the integration of safety and security; and (4) the site's emergency preparedness.

Addressing National Environmental Policy Act requirements will also be a challenge. One question will be whether to establish unique environmental impact statements for each facility or develop a generic environmental impact statement for the proposed fuel cycle management program.

Management of both high- and low-level waste from these facilities may challenge industry and

the NRC. We face a monumental task to review a license application for a potential Yucca Mountain waste repository. Nevertheless, we stand ready to initiate this review when DOE submits its license application. Low-level waste issues may also present challenges in the future. Without adequate low-level waste disposal sites, as highlighted by the recent planned closure of Barnwell in 2008 to out-of-compact states, the NRC would be faced, in all probability, with assuring that the absence of disposal capacity for such wastes does not translate into unsafe storage of such wastes by generating organizations.

When the price of uranium fell in the early 1980s, conventional uranium mining production in the United States dropped precipitously. Many conventional mills ceased operations or closed permanently and began decommissioning and reclamation. Although conventional mills will continue to contribute to the supply of uranium, in-situ leach (ISL) facilities are the predominant source of domestic uranium production in the foreseeable future for both economic reasons and because of reduced surface environmental impacts. Since the requirements in 10 CFR Part 40 were issued, there has been no corresponding regulatory change addressing this emerging technology. As a result much of the regulation for ISL facilities has been imposed by the NRC through license conditions.

There is currently one NRC-licensed, operating conventional mill and two mills that have ceased operation but expect to resume operation in the future. There are six ISL facilities that are operating or are licensed to operate. In addition, there are 14 conventional mills that have ceased operations and are in reclamation; two that have been reclaimed and transferred to DOE for long-term care; and one operating 11e.(2) byproduct material disposal cell. Based on discussion with the industry, the NRC expects a considerable increase in licensing activity, as many as 12 new applications, for both types of uranium recovery facilities into the foreseeable future.

Regulating ISL facilities in the absence of specific applicable regulations is becoming increasingly problematic and more complicated for the NRC. Examples of the issues include: (1) the potential impacts on the environment of groundwater from the uranium extraction operation; (2) the application of 10 CFR Part 40 by the NRC to ISL facilities; and (3) the use of performance-based licenses.

I also see the need for human capital as a significant issue for the future management of the fuel cycle. Nuclear technologies continue to benefit us in many ways and, therefore, will continue to be a critical focal point of many national security, foreign, energy, and environmental policies for the foreseeable future. With this assumption, it follows that we require an educated, well-trained work force. Although we are making some progress in this vital area, far more work is needed.

NRC has experts in many of the core technical areas needed for licensing reviews of facilities for a spent fuel recycling program, including chemical engineers and ceramic engineers with experience in waste vitrification. Some of these experts have recent experience in reviewing license applications for related fuel cycle facilities (i.e., the MOX fuel fabrication facility). We have had recent success in hiring experienced chemical engineers, however, the NRC needs additional expertise in several specialty fields that would be needed for reviewing the advanced technologies used in a limited recycling facility. Specifically, NRC needs additional chemical engineers (with a detailed knowledge of reprocessing), actinide chemists, plutonium chemists, and radiochemists. In addition, nuclear engineers with expertise in transmutation would be

required to review full recycling facilities. Further, NRC must also rebuild regulatory capabilities and the underlying scientific base to accomplish a future role in licensure of the fast-burner reactors.

NRC will also need to draw on the regulatory experiences in similar facilities, such as the LaHague, MELOX, Atalante, Phenix and Rokkasho and Monju in Japan. Other countries have significant operational experience with facilities similar to those proposed for GNEP.

In closing, for our part, the NRC must be a strong and independent Commission, and we will continue with the hard work of creating the needed framework of regulatory stability. In turn, we expect that the manufacturers, builders, and operators of current and future facilities will meet their obligations to the public as well. In this way, with all of us doing our jobs, nuclear energy may continue to play a valuable role in our nation's energy future.