

July 28, 2000

James A. Lake, President
American Nuclear Society
555 North Kensington Ave.
La Grange Park, IL 60526-5592

SUBJECT: ACCELERATOR BASED TRANSMUTATION OF WASTES

Dear Dr. Lake:

I am responding to Dr. Andrew Kadak's May 5, 2000, letter to Chairman Meserve summarizing the American Nuclear Society's (ANS) review of the Department of Energy (DOE) Report, "A Roadmap for Developing Accelerator Transmutation of Waste (ATW) Technology," DOE/RW-0519. The NRC's Office of Nuclear Regulatory Research (RES) staff have been following the development of the "Roadmap" Report by attending and participating in the various meetings and have reviewed the final report. As you are aware, DOE is in the very early planning stages on ATW technology research and development, and it is not clear at this time which of several system combinations will be chosen, or whether any of the options will eventually be implemented.

The ANS ATW Review Team has performed a thorough review and has raised a number of important questions concerning the research, development, and implementation of the ATW technology to reduce the toxicity and potential hazards of high-level waste (HLW). However, because the mission of the NRC is in the regulatory arena, I will confine my responses accordingly. Our own limited review of the report and associated documents suggests a number of potential areas of regulatory interest as pointed out by the ATW Review Team:

ATW Facility

- Regulation of such an elaborate facility, as envisioned in an ATW design, would require the development of a coordinated regulatory structure with the participation of several regulatory agencies in addition to the NRC. Depending upon how this technology is implemented, it may be necessary to clarify regulatory jurisdiction through legislation.
- As presently envisioned, the ATW complex would consist of a combination of high power accelerators, subcritical reactors, and isotope separation and fuel fabrication facilities. Although the NRC has dealt with the regulation of some of the individual facility types that would comprise an ATW complex, the NRC staff will need to be engaged early to understand where the integrated system may be challenging the designs and the associated safety margins.

- Although it is difficult to predict at this time, there will likely be some impact on the cost and scheduling of the ATW complex associated with regulatory activities including developing the necessary technical bases for ensuring the safety of the integrated system. Such costs would be expected to be small relative to the total lifetime cost of \$280 billion. Any schedule delays associated with the regulatory process itself, however, could be costly. NRC staff should monitor the research and development program to ensure that regulatory issues are identified and resolved early in the process. This early review would reduce unnecessary delays related to cost and time to develop the technology, and allow the NRC to identify any confirmatory research that may be needed.
- The ATW complex would consist of subcritical reactors. However, because the ATW facility will be operating at power densities and decay heat levels similar to today's commercial nuclear power plants, safety analyses will need to be performed to address potential accident conditions such as a loss-of-coolant accident.
- Modifications to both nuclear and thermal-hydraulic computer codes, and upgraded data (e.g., material properties, neutron cross-sections, decay heat tables) may be required to analyze accident situations. Major code modifications are not envisioned at this time.
- There will be a number of new material related issues, such as Lead-Bismuth-Eutectic technology, that will have to be resolved. It is possible that help could be obtained from international collaboration. But, as pointed out by the ATW Review Team, it will be important to establish early whether the existing or developing data will be of sufficient quality and scope to provide a basis for regulatory decisions. Separate and special research programs may be needed to fill any technical gaps that are identified.

HLW Repository

- Transmutation reduces the long-term hazards and toxicity, and reduces the challenge to the geologic setting if the containers and engineered barriers degrade. By removing the transuranics and long-lived fission products (Tc-99 and I-129), the radioactive toxicity is reduced from thousands to hundreds of years. The implication is that uncertainty in the performance of the HLW repository could be substantially reduced. Questions raised by the ATW Review Team concerning how Tc-99 and I-129 will be handled in the transmutation process will need to be addressed by DOE during the initial ATW technology research and development phase. How these and other questions are addressed will be monitored by the NRC.
- Transmutation removes the Pu and other fissile material from the waste stream, thereby reducing the incentives for future retrieval from the waste repository.
- The changes in the radioactive source term composition could reduce uncertainties in areas such as the probability and consequences of a criticality accident, radiation shielding, and thermal-hydraulic behavior in dry storage at the ATW facility and shipping

casks sent from the ATW facility. Reduction of uncertainties in the above technical areas would also apply to the design of the final repository casks. However, the amount of time that the spent fuel remains in dry storage at the nuclear power plant, as well as risks involved in shipping it to the ATW facility will probably not change, so the net benefit is unclear. Uncertainties related to the cost and time to develop this technology would impact public confidence if disposal of existing wastes are delayed.

According to the DOE ATW Roadmap, there will be a 6-year research and development program with the goal of producing a "technical viability-assessment" report. I strongly agree with the ANS recommendations that part of this report should deal with the safety aspects of the integrated system. It would be desirable for the NRC to be involved early in monitoring the research and development process with the DOE to assess the overall safety of any technology path. Due to limitations in NRC staff resources, however, only minimal NRC involvement is to be expected during the development stage. A reassessment of staff resources will be needed once an option has been chosen for implementation, and the planning stage matures. I will explore such a role for the NRC with DOE at that time.

We thank the ANS for undertaking the technical review concerning the ATW technologies, and for identifying areas of potential concern to the NRC licensing processes. I hope that we have addressed the areas of concern within the purview of the NRC. If you have any more questions in this regard, please feel free to contact me.

Sincerely,

/RA/

Ashok C. Thadani, Director
Office of Nuclear Regulatory Research

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