UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

September 22, 2011

The Honorable Gregory B. Jaczko
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: PROPOSED RULEMAKING TO INTRODUCE A SITE-SPECIFIC PERFORMANCE ASSESSMENT AND HUMAN INTRUSION ANALYSIS REQUIREMENT TO 10 CFR PART 61

Dear Chairman Jaczko:

During the 586th meeting of the Advisory Committee on Reactor Safeguards (ACRS), September 8-10, 2011, we completed our review of the staff's proposed rulemaking on the Commission's commercial low-level waste (LLW) disposal regulation. This rulemaking is intended to introduce both an explicit site-specific performance assessment as well as a human intrusion analysis requirement to 10 CFR Part 61. We were also briefed on this topic during our 585th meeting, July 13-15, 2011. Our Subcommittee on Radiation Protection and Nuclear Materials discussed this matter during its meetings of June 23, and August 17, 2011. During these meetings we had the benefit of discussions with representatives of the NRC staff. We also had the benefit of the documents referenced.

CONCLUSIONS AND RECOMMENDATIONS

1. 10 CFR Part 61 should not be amended in accordance with the staff's recommendations. Rather, the staff should develop a risk informed, performance based LLW site assessment methodology using realistic characterizations of disposed radioactive materials; the features, events, and processes that can disrupt disposed waste; natural and engineered barriers; environmental transport mechanisms; and subsequent human exposure scenarios.

2. Implementation guidance for 10 CFR Part 61 should not specify an a priori period of performance. Rather, the performance assessment should develop a period of performance based on the features, events, and processes specific to the geohydrological features of a candidate site; the technologies used to isolate wastes; and the controls used to isolate wastes from the environment and humans.

3. The approaches in Recommendations 1 and 2 are equally applicable to the disposal of depleted uranium (DU) as well as other LLW.

4. Compliance with performance objectives of the disposal system after the institutional control period ends, as well as the possible doses to hypothetical intruders, should be evaluated considering the natural features, events, and processes for a given site for a period of time commensurate with the risk for a specific facility and site.

BACKGROUND

The U.S. Nuclear Regulatory Commission (NRC) promulgated its commercial LLW disposal regulation in 1980. 10 CFR Part 61 sets forth the standards and criteria for the disposal of commercial LLW in near-surface facilities. To complement the regulation, the staff prepared a standard format and content guide for license applications (NUREG-1199) as well as a license application standard review plan (NUREG-1200) for 10 CFR Part 61. Neither NUREG-1199 nor NUREG-1200 makes reference to the use of performance assessments to demonstrate compliance with 10 CFR Part 61. Instead, those documents make reference to the use of "technical analyses" for the purpose of the requisite compliance demonstrations.

In 1995, the Commission issued, "Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities," encouraging the increased use of probabilistic risk assessment (PRA) methods in its regulatory processes. This policy statement sets forth the basis for the risk-informed, performance-based (RI/PB) regulatory principles used by the NRC in its regulatory decision-making. About the same time, the staff began to explore the use of performance assessment (a stylized type of PRA applied to the evaluation of waste management systems) to its national LLW program. In connection with these efforts, the staff developed a hypothetical test case to evaluate certain LLW design assumptions as well as the efficacy of the performance assessment methodology itself. The culmination of these efforts resulted in the identification of certain LLW performance assessment policy issues summarized in SECY-96-103 and the ultimate publication of NUREG-1573, which documents the application of performance assessment methods to 10 CFR Part 61.

In NUREG-1573, the staff states, "Finally, consistent with the Commission's views regarding the use of probabilistic risk assessment, the application of the performance assessment techniques to LLW disposal facility designs outlined in the technical report should be tempered according to the complexity of the disposal system, uncertainties surrounding system performance, and the estimated risks due to the types and kinds of wastes being disposed."

DISCUSSION

In commenting on this proposed rulemaking, there are three issues that merit discussion. What should the regulatory time period of performance (POP) be for a commercial LLW disposal facility under 10 CFR Part 61? Should DU be an acceptable waste form for disposal in a LLW disposal facility licensed under 10 CFR Part 61? How should the issue of hypothetical intruders into LLW disposal facilities be treated?

Period of Performance

A key element of a performance assessment conducted as part of regulatory decision-making is deciding on the duration (time span) of the calculation. During this period all the performance objectives for the facility, including dose limits to workers and the public, must be met. When determining a POP appropriate for 10 CFR Part 61, it is important to recognize that the magnitudes and durations of hazards posed by LLW are diverse. LLW consists of both short-lived and long-lived radionuclides in various chemical and physical forms. To provide licensees some flexibility in siting and designing disposal facilities, the current 10 CFR Part 61 LLW classification system is based on the half-lives and concentrations of those radioactive materials that can be expected in commercial facilities. Because of the long periods of time contemplated for the control of such materials, the regulation intentionally relies on passive rather than active systems to minimize and retard releases of radioactivity to the environment.

As noted in the recent IAEA Safety Standard No SSR-5, "Disposal of Radioactive Waste Specific Safety Requirements," Requirement 9:

> "The disposal facility shall be sited, designed and operated to provide features that are aimed at isolation of the radioactive waste from people and from the accessible biosphere. The features shall aim to provide isolation for several hundreds of years for short lived waste and at least several thousand years for intermediate and high level waste. In so doing, consideration shall be given to both the natural evolution of the disposal system and events causing disturbance of the facility."

The Advisory Committee on Nuclear Waste (ACNW) previously commented on whether the POP should be specified in 10 CFR Part 61 or whether the regulation should remain silent given the variable risk posed by commercial LLW. In a February 11, 1997, letter, the ACNW recommended a two-part approach for establishing a time frame over which compliance with the LLW disposal regulation would be demonstrated. The first part relied on a site-specific time span derived from a performance assessment to determine the time at which the more mobile radionuclides produced some peak dose to a designated receptor group. The second part was a qualitative evaluation, not requiring a specific measure of compliance, which identified any significant deficiencies in disposal system overall performance.

The staff's proposed amendments to 10 CFR Part 61 require that a detailed performance assessment be made demonstrating compliance with facility performance objectives (including protection of inadvertent intruders) for no less than 20,000 years. This major change to the existing rule is driven primarily by the intent to permit disposal of long-lived waste such as DU in LLW facilities. This time period is excessive and inconsistent with IAEA guidance cited above. It is also inconsistent with the practices of the Department of Energy (DOE) in their LLW facilities. DOE's Office of Environmental Management commented on the proposed amendments to 10 CFR Part 61 in a letter of June 21, 2011, noting that their POP is 1000 years.

There is an obligation to avoid the potential for catastrophic consequences from LLW disposal on future generations. This obligation has been articulated by the National Academy of Public Administration (NAPA) in its 1997 report, "Deciding for the Future: Balancing Risks, Costs, and Benefit Fairly Across the Generations" and by DOE, which stated, "The principles developed by NAPA suggest that when looking far into the future, the major concern should be to avoid the possibility of catastrophic consequences. Current disposal standards specify dose limits, which are equivalent to a few medical x-rays, to people in the vicinity (or to a single, reasonably maximally exposed individual)".

Avoiding catastrophic consequences for a facility, rather than complying solely with operational dose limits to hypothetical individuals, should be the focus of assessments designed to assess facility performance over a period longer than a few hundred years.

We recommend that the POP be developed based on the approach outlined in the February 11, 1997, ACNW letter, i.e., the POP should be a site-specific time span derived from a performance assessment to determine the time at which the more mobile radionuclides produced some peak dose to a designated receptor group. Beyond the POP, a qualitative evaluation not requiring a specific measure of compliance should be performed to identify any significant deficiencies in disposal system overall performance that could lead to catastrophic consequences.

Depleted Uranium

DU waste from the nuclear fuels and weapons programs began accumulating in the early 1950s. More recently, the DU inventory has increased as a result of commercial enrichment activities in the United States.

The NRC staff included DU waste streams in its initial technical analysis during development of 10 CFR Part 61 (NUREG-0738). The proposed 10 CFR Part 61 rule included waste classification Table 1, which set a maximum concentration of DU in Class C waste of $0.05\mu Ci/cm^3$. The final 10 CFR Part 61 classification Tables 1 and 2 did not include a concentration limit for DU. The NRC decided that because there would not be a significant quantity of these wastes disposed at commercial shallow land facilities, no concentration limit would be needed. Thus, when it was decided that significant quantities of DU might be disposed in shallow land facilities, DU was, by default, classified as Class A LLW.

In recognition of this designation, NRC's principal LLW technical assistance contractor at the time, the Sandia National Laboratories (Sandia), performed a 10 CFR Part 61-driven performance assessment of a hypothetical LLW disposal facility with a waste inventory dominated by DU. The disposal scenario was based on a humid, near-surface setting. Two intruder analyses (at three different time intervals) were also performed using the same assumptions found in the 10 CFR Part 61 Draft Environmental Impact Statement. The Sandia analyses found that offsite doses to receptors, due to the inhalation daughters of radon, were conservatively estimated to be three rem after 1000 years. A very significant finding of the Sandia analyses is that the chemical toxicity of DU imposes a greater limitation on its disposal than radiological doses. Significant toxic effects to the kidney are observed even for contaminant intake levels that pose negligible radiological risk.

The Sandia analyses concluded that the acceptability of near-surface disposal for large quantities of DU depends upon the chemical form considered and the time frame applied to the analysis. Radiological risks associated with the disposal of DU will increase in proportion to the ingrowth of the progeny in the uranium decay series. Full equilibrium takes millions of years. The Sandia analysis found that truncation of the analysis prior to that time will not capture the potential peak doses. In this regard, the Sandia analyses did note that extrapolation of current conditions in a LLW performance assessment to 2 million years was of "dubious merit" for a near-surface facility owing to the uncertainties in predicting future system states. In particular, the Sandia analyses noted that the potential exists for other adverse conditions to manifest themselves apart from trying to determine the time at which the peak dose to a hypothetical individual from the radiological hazard occurs.

In 2008, the staff was directed by the Commission to revisit the DU disposition issue to better understand the impacts of near-surface disposal of large quantities of DU, such as those expected to be generated at uranium enrichment facilities. The technical analysis, described in SECY-08-0147 addressed whether amendments to 10 CFR Part 61.55(a) would be necessary to assure that large quantities of DU could be disposed in a manner that meets the Subpart C performance objectives of 10 CFR Part 61.

The analysis described in SECY-08-0147 focused on a hypothetical site located in an arid geographic setting. This analysis concluded that near-surface disposal of large quantities of DU may not be appropriate under all site conditions. Even in arid settings, the disposal depth needs to be "large" and a robust radon barrier installed. In this case, the staff found that the 10 CFR Part 61 Subpart C performance objectives could be met as long as the water supply was not potable. The staff's SECY-08-0147 analysis also reached the same conclusions as the 1992 Sandia analyses, namely, that the shallow disposal of large quantities of DU or disposal at humid sites with a potable groundwater pathway would likely result in the Part 61 performance objectives not being met. However, unlike the 1992 Sandia analysis, the SECY-08-0147 analysis failed to evaluate the chemical risks associated with the disposal of DU in an arid geographic setting.

We agree with the conclusions of SECY-08-0147 that under some circumstances DU can be an acceptable waste form for disposal in a LLW facility licensed under 10 CFR Part 61. The POP should be determined through a performance assessment based on the features, events, and processes specific to the geohydrological features of a candidate site; the technologies used to isolate wastes; and the controls used to isolate wastes from the environment and humans.

Inadvertent Intruders

The use of overly conservative scenarios for inadvertent intrusion into presumably abandoned, unmarked, and unsecured LLW disposal facilities can change the focus of the facility design from the protection of the health and safety of the public during the period of operation of the facility (and a reasonable period thereafter), to the protection of hypothetical intruders many thousands of years in the future. During the period over which LLW facilities are in operation,

and for hundreds of years after closure, the many geotechnical and hydrologic, as well as climate and materials degradation variables that must be evaluated to assure health and safety are amenable to measurement and analysis. If the focus of current regulations is changed to the protection of inadvertent intruders many thousands of years in the future, great uncertainty is introduced into the performance assessment.

A range of more realistic scenarios for inadvertent intrusion should be developed to avoid the introduction of needless burden and uncertainty.

In summary, 10 CFR Part 61 should not be amended in accordance with the staff's recommendations. We look forward to working with the staff on the development of a risk-informed performance-based framework for safe disposal of LLW.

ACRS Member, Dr. D.A. Powers, did not participate in the discussions of the Sandia study of LLW disposal facilities.

Sincerely,

/RA/

Said Abdel-Khalik
Chairman

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ML# 11256A191

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