U.S. Nuclear Regulatory Commission Role and Activities Related to U.S. Department of Energy Incidental Waste Determinations

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ABSTRACT

Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA) requires the U.S. Department of Energy (DOE) to consult with the U.S. Nuclear Regulatory Commission (NRC) for certain non-high level waste (HLW) determinations. Under the NDAA, NRC performs consultative technical reviews of DOE's waste determinations and monitors DOE's disposal actions for such waste, but the NRC does not have regulatory authority over DOE's waste disposal activities. The NDAA provides the criteria that must be met to determine that waste is not HLW. The criteria require that the waste does not need to be disposed of in a geologic repository, that highly radioactive radionuclides be removed to the maximum extent practical, and that the performance objectives of 10 CFR 61, Subpart C, be met. The performance objectives contain criteria for protection of the public, protection of inadvertent intruders, protection of workers, and stability of the disposal site after closure. This paper describes NRC's approach to implementing its responsibilities under the NDAA, as well as similar activities being performed for sites not covered by the NDAA.

INTRODUCTION

The concept of incidental waste is that certain wastes can be managed based on their risk to human health and the environment, rather than based on the origin of the wastes. With respect to waste resulting from the reprocessing of spent nuclear fuel, such as the waste in tanks at certain U.S. Department of Energy (DOE) sites, some waste is highly radioactive and needs to be treated and disposed of as high-level waste (HLW) in a geologic repository while other waste does not. Incidental waste or waste-incidental to reprocessing (WIR) does not pose as large of a risk to human health and the environment and therefore does not need to be disposed of as HLW in order to manage the risks that it poses. DOE uses assessments referred to as "waste determinations" to evaluate whether reprocessing waste is HLW or incidental waste. Potential incidental waste is located at four sites that are managed by DOE: 1) the Savannah River Site (SRS) in South Carolina, 2) the Idaho National Laboratory (INL) in Idaho, 3) Hanford in Washington, and 4) West Valley in New York. The cost and schedule for the decontamination and decommissioning of these sites could be greatly affected if the waste requires disposal as HLW rather than low-level waste (LLW).

Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA) requires DOE to consult with the U.S. Nuclear Regulatory Commission (NRC) for non-high level waste determinations made for waste in South Carolina and Idaho [1]. In its consultative role, NRC performs technical reviews of DOE's waste determinations and must monitor DOE's disposal actions for such waste, but the NRC does not have regulatory authority over DOE's waste disposal activities. The NDAA provides the criteria that must be met to determine that waste is not HLW (i.e., is incidental waste). The criteria require that the waste

does not need to be disposed of in a geologic repository, that highly radioactive radionuclides be removed to the maximum extent practical, and that the performance objectives of 10 CFR 61, Subpart C, be met. 10 CFR 61 is NRC's regulation for the licensing requirements for land disposal of low-level radioactive waste [2]. The performance objectives of Subpart C contain criteria for protection of the public, protection of inadvertent intruders, protection of the public and workers during operations, and stability of the disposal site after closure. The NDAA is applicable only to the States of South Carolina and Idaho (i.e., SRS and INL). However, the NRC is performing similar reviews for Hanford and West Valley using similar criteria.

HISTORY OF WASTE DETERMINATION CRITERIA

The concept of incidental waste was first recognized by the Atomic Energy Commission (predecessor agency to the NRC) in 1969 when it issued for comment a draft policy statement in the form of a proposed Appendix D to 10 CFR Part 50 which addressed a definition of HLW [3]. The draft policy statement provided that certain materials resulting from reprocessing could be disposed of in accordance with 10 CFR Part 20, which provides NRC's standards for protection against radiation. Although the draft policy statement did not use the term "incidental," the Commission proposed that the term HLW not include certain wastes that were incidental to reprocessing operations. However, when Appendix D was finalized as Appendix F, it did not include the paragraphs on incidental waste because the Commission wanted to preserve its flexibility as to how such material should be treated.

In 1990, the States of Oregon and Washington petitioned the Commission to amend 10 CFR Part 60 to redefine HLW. The petition concerned whether Hanford tank waste was subject to NRC licensing jurisdiction. The original incidental waste criteria were approved by the Commission in its denial of the petition [4]. The criteria were:

(1) The waste has been processed (or will be processed) to remove key radionuclides to the maximum extent that is technically and economically practical;
(2) The waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste (LLW) as set out in Title 10 of the Code of Federal Regulations (10 CFR) Part 61;
(3) The waste is to be managed, pursuant to the Atomic Energy Act, so that safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, are satisfied.

10 CFR 61 contains the NRC's requirements for the near-surface disposal of LLW. The performance objectives of Subpart C include provisions for protecting the public, the worker, and the intruder, as well as provisions for site stability.

In July 1999, DOE issued DOE Order 435.1, "Radioactive Waste Management." DOE Order 435.1 and the associated manual and guidance require that all DOE radioactive wastes be managed as HLW, transuranic (TRU) waste, or LLW. The Order states that waste determined to be incidental to reprocessing is not HLW and shall be managed in accordance with the requirements for TRU waste or LLW if it meets appropriate criteria. DOE Order 435.1 discusses DOE's WIR evaluation process and the criteria for determining that waste is incidental.

In a Staff Requirements Memorandum on SECY-99-0284, "Classification of Savannah River Residual Tank Waste as Incidental" issued in May 2000, the Commission indicated that a more generic, performance-based approach should be taken in regard to reviewing WIR

determinations. In effect, the Commission indicated that cleanup to the maximum extent that is technically and economically practical and demonstration that there is reasonable assurance that performance objectives would be met (consistent with those which the Commission demands for the disposal of LLW) should serve to provide adequate protection of the public health and safety and the environment. In the "Final Policy Statement for the Decommissioning Criteria for the West Valley Demonstration Project at the West Valley Site," dated February 1, 2002, the Commission took this same performance-based approach and stated the criteria that should be applied to the incidental waste determinations at West Valley:

(1) The waste should be processed (or should be further processed) to remove key radionuclides to the maximum extent that is technically and economically practical; and
(2) The waste should be managed so that safety requirements comparable to the performance objectives in 10 CFR Part 61, Subpart C, are satisfied.

In February 2002, the Natural Resources Defense Council (NRDC) filed suit against DOE, stating that the Nuclear Waste Policy Act did not allow DOE to reclassify HLW and dispose of it anywhere except in a geologic repository. In July 2003, the U.S. District Court for the District of Idaho granted summary judgment to NRDC and declared DOE's WIR process, as described in Order 435.1, to be invalid. The DOE appealed the decision and, in November 2004, the U.S. Court of Appeals for the Ninth Circuit vacated the lower court's decision on ripeness grounds.

In October 2004, the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA) was enacted. Section 3116 of the NDAA states that the term "high-level radioactive waste" does not include radioactive waste resulting from reprocessing of spent nuclear fuel if the Secretary of Energy, in consultation with the NRC, determines that:

(1) The waste does not require permanent isolation in a deep geologic repository for spent fuel or high level radioactive waste;
(2) The waste has had highly radioactive radionuclides removed to the maximum extent practical;
(3)(A) The waste does not exceed concentration limits for Class C low-level waste as set out in 10 CFR 61.55 and will be disposed of in compliance with the performance objectives in 10 CFR 61, Subpart C; or
(B) The waste exceeds concentration limits for Class C low-level waste as set out in 10 CFR 61.55 but will be disposed of in compliance with the performance objectives in 10 CFR 61, Subpart C, and pursuant to plans developed by the Secretary of Energy in consultation with the NRC.

These criteria are similar to those established by the NRC in its Final West Valley Policy Statement in 2002. The NDAA is applicable only to the States of South Carolina and Idaho and does not apply to waste transported out of those States. The NDAA also requires that the NRC, in coordination with the affected State, monitor DOE's disposal actions for this waste for the purpose of assessing compliance with the performance objectives of 10 CFR 61, Subpart C. NRC must report any findings of noncompliance to DOE, the State, and Congress as soon as practicable after discovery of the noncompliant conditions.

NRC PROGRAMMATIC ACTIVITIES FOR THE NDAA

After passage of the NDAA, the NRC staff developed an implementation plan that described how it intended to carry out its new responsibilities under the NDAA. That plan was sent to the Commission in April 2005, and described the scope of the new responsibilities, the staff's

proposed approach to carrying out those responsibilities, the schedule, estimated resources, and expected interactions with stakeholders [5]. In general, the staff proposed using the same technical approach as was used for previous WIR reviews conducted for DOE. In June 2005, the Commission approved the staff's proposed approach and noted that the staff should ensure that the technical basis for its decisions are transparent, traceable, complete, and as open to the public and interested stakeholders as possible [6]. The Commissioners also noted that the staff should take the time necessary to complete its reviews to ensure the protection of the public health and safety.

As discussed above, the NRC has previously reviewed WIR determinations for DOE on an intermittent basis. Because of the enactment of the NDAA, the NRC expects to receive a larger number of waste determinations for review. In addition, the NDAA requires that NRC monitor DOE's disposal actions for this waste and the NRC had not previously conducted any such monitoring of DOE's disposal actions. Therefore, the NRC determined that it would need to increase the staff available for the review of waste determinations and the new monitoring activities. The NRC's Division of Waste Management and Environmental Protection, within the Office of Nuclear Material Safety and Safeguards, established a new Low-Level Waste Section. The LLW Section will conduct waste determination activities, as well as other LLW activities conducted by the NRC.

The NDAA required that the DOE reimburse NRC for its NDAA activities during FY05; therefore, NRC and DOE established an Interagency Agreement (IA) to provide a funding mechanism and a statement of work that described the activities that the NRC would be performing under the IA. After FY05, the NRC is required to request appropriations for NDAA activities through its normal budget process. For FY06, the NRC received $2.5 million for NDAA activities. The NRC and DOE are also currently in the process of establishing a Memorandum of Understanding that will delineate the roles and responsibilities of each agency for the waste determination review process.

Because the reviews of waste determinations are expected to become more frequent and require the involvement of a larger number of NRC staff, the NRC decided to develop a Standard Review Plan (SRP) for waste determination reviews. SRPs are a type of document often used by the NRC for other activities, such as decommissioning, and provide internal guidance for use by the NRC staff. The waste determination SRP will provide guidance on the types of information and analyses that the NRC staff should evaluate when assessing waste determinations. The SRP will provide consistency across different waste determination reviews and across different NRC reviewers. In addition, DOE may use the SRP to obtain insights on the types of information that the NRC expects to receive. The NRC held a scoping meeting in November 2005 to obtain public input on the contents of the SRP. The draft SRP is expected to be issued for public comment in 2006 and will apply to reviews performed by the NRC for SRS, INL, Hanford, and West Valley.

NRC'S PREVIOUS WASTE DETERMINATION REVIEWS

Prior to the passage of the NDAA, DOE had periodically requested that the NRC review select WIR determinations. These requests were initiated by DOE and NRC's reviews were performed in an advisory manner, on a reimbursable basis, and did not constitute regulatory approval. The NRC reviews provided DOE with independent technical input on its WIR determinations. For each review, NRC developed a Technical Evaluation Report (TER) that presented its findings, conclusions, and recommendations related to its review. DOE was not required to implement NRC's recommendations or inform the NRC as to whether the NRC's

recommendations were implemented. These WIR determination reviews were completed for waste planned to be removed from the tanks and disposed of in an on-site LLW disposal facility at Hanford (1997), in-place closure of HLW tanks with residual material at SRS (2000), sodium bearing waste planned to be removed from tanks at INL and disposed of at the Waste Isolation Pilot Plant (2002), and planned in-place closure of HLW tanks with residual material at INL (2003) [7, 8, 9, 10].

The NRC used a similar technical approach for each of its WIR determination reviews, although it should be noted that different WIR criteria were used, as applicable. To initiate the process, DOE would request that NRC review a specific waste determination. The NRC staff would inform the Commission of the request, obtain Commission approval, and then establish an IA and MOU with DOE to provide funding and a description of the work to be performed. DOE would then submit a WIR determination document, which described DOE's basis for determining that the waste met the applicable WIR criteria (e.g., the waste had key radionuclides removed to the maximum extent technically and economically practical, and would meet the performance objectives of 10 CFR 61, Subpart C). Along with other supporting documents, a waste determination was usually supported by a performance assessment (PA) which would provide a site-specific assessment, the radionuclide transport mechanisms, the source term, and the possible resulting doses to the public and inadvertent intruders on the site for hundreds or thousands of years.

The NRC staff would review the waste determination, the PA, and the other documents and develop a Request for Additional Information (RAI). The RAI comprised NRC staff questions regarding on the waste determination information. For example, a question contained in the RAI could ask for the bases supporting various modeling assumptions or for additional information regarding site hydrology. DOE would then provide written responses to the RAI and would, in some cases, revise its waste determination and PA and resubmit them to the NRC. The NRC would review the RAI responses and any new corresponding information, and develop the TER, which was made publicly available. Once the TER was transmitted to DOE, the NRC did not conduct any follow up activities because the NRC was acting in an advisory manner.

WASTE DETERMINATION REVIEWS UNDER THE NDAA

General Approach

The NRC will conduct its technical reviews under the NDAA in a similar manner as used for previous WIR reviews. DOE will submit its draft determination and the NRC will assess the information to determine whether there is reasonable assurance that the criteria of the NDAA can be met. In its TERs, NRC will present its analysis and findings, and will also identify those factors that are important to meeting the performance objectives of 10 CFR 61, Subpart C. It is those factors that the NRC, in coordination with the State, will monitor to assess compliance with the performance objectives. For example, it may be found that estimated doses to the public are sensitive to the degradation of the waste form and that limited information to support the long-term degradation rates was provided to the NRC. In that case, NRC may determine that it will monitor the degradation rate of the waste form. This monitoring may be implemented by assessing any new studies on degradation performed by DOE or other organizations, reviewing environmental monitoring data to assess whether contamination is being detected in groundwater or other media, or reviewing future refinements of the PA and related sensitivity analyses. The NRC will conduct its monitoring in a risk-informed and performance-based

manner; in other words, the NRC will focus its monitoring activities on those factors that most strongly influence the estimated doses.

SRS Saltstone Waste Determination Review

In March 2005, DOE submitted its first draft waste determination under the NDAA to the NRC for review [11]. This draft waste determination was for low-activity salt waste that DOE plans to remove from the tanks at the SRS. SRS has limited free space available in its HLW tanks and this limited space will eventually impact DOE's ability to continue to vitrify high-activity waste in its Defense Waste Processing Facility; therefore, DOE believes it must remove the salt waste from the tanks as soon as possible. The salt waste will be managed using a two-phase, three-part process. The two-phase process is necessary to utilize more advanced treatment technologies as they are constructed and become operational. The three parts of the two-phase process are:

(1) In 2006, begin use of the Deliquification, Dissolution, and Adjustment (DDA) process to dissolve solidified salt waste and allow entrained sludge to settle;

(2) In 2007, begin use of an Actinide Removal Process and Modular Caustic Side Solvent Extraction Unit to process lower activity salt waste to remove strontium, cesium, and actinides; and

(3) In 2009, begin use of a much larger Salt Waste Processing Facility to remove strontium, actinides, and large amounts of cesium from salt waste with higher activity.

After treatment, the salt waste will be sent to a Saltstone Production Facility where it will be mixed with fly ash, cement, and slag to form a grout mixture. That grout mixture will then be pumped to large on-site vaults at the Saltstone Disposal Facility to solidify into large monolith waste forms. DOE expects to build approximately 14 of the vaults, which are currently planned to be approximately 200 m long, 60 m wide, and 8 m high.

Along with the draft waste determination, DOE submitted approximately 60 references, including a performance assessment conducted in 1992 and a partial update of the PA completed in 1998. The draft waste determination presented DOE's evaluation of how each of the criteria of the NDAA would be met by DOE's proposed two-phase, three-part approach. NRC evaluated the draft waste determination and supporting information and transmitted a RAI in May 2005 [12]. The RAI consisted of 80 questions on topics such as possible fracturing in the waste form, infiltration rates, erosion control, sensitivity analyses, and removal efficiencies of highly radioactive radionuclides. DOE met with the NRC in two public meetings in June and July 2005 to discuss possible approaches to its RAI responses, and submitted its RAI responses in two parts, on July 1, 2005, and July 15, 2005, and also submitted approximately 150 reference documents [13, 14]. NRC and DOE met in two public meetings in July and August to discuss the RAI responses. During those meetings, the NRC indicated that some of the RAI responses did not provide adequate information in some areas such as sensitivity analysis and erosion barrier design. Subsequently, DOE submitted additional information on September 15 and September 30, 2005, including the results of 35 sensitivity runs and 50 additional reference documents [15, 16]. The sensitivity runs evaluated possible effects of variations in relevant factors. The NRC assessed DOE's submittal and issued its TER in December 2005 [17].

In the TER, the NRC concluded that there is reasonable assurance that DOE's proposed

approach for managing salt waste will meet the criteria in the NDAA. Criterion One of the NDAA is that the waste does not require permanent isolation in a deep geologic repository for spent fuel or HLW. This criterion allows for the consideration that certain characteristics of the waste may necessitate that the waste be disposed of in a deep geologic repository even though the other criteria of the NDAA can be met. In its draft waste determination, DOE indicated that it does not believe that the waste has any characteristics that would warrant disposal in a deep geologic repository. In the TER, the NRC staff agreed that there was reasonable assurance that Criterion One could be met.

Criterion Two of the NDAA is that the waste has had highly radioactive radionuclides removed to the maximum extent practical. In its draft waste determination, DOE stated that Criterion Two would be met because the radionuclides of concern would be removed to the maximum extent practical, given the need to create additional tank space and the large expected overall removal efficiencies for cesium, strontium, and actinides. To assess conformance with Criterion Two, the NRC's RAI contained questions regarding the estimated waste inventory, the identification of highly radioactive radionuclides, radionuclide removal efficiencies, and the selection of treatment processes and approaches. NRC's RAI stated that the NRC staff believes that "highly radioactive radionuclides" are those radionuclides that contribute most significantly to risk to the public, workers, and the environment. In its RAI response, DOE presented a similar interpretation and revised the list of radionuclides it evaluated. In addition, DOE used the results of its sensitivity analyses to add several radionuclides to its list of highly radioactive radionuclides for the saltstone waste determination. For these highly radioactive radionuclides, DOE presented information regarding removal efficiencies for the technologies being applied and its basis for stating that the radionuclides had been removed to the maximum extent practical.

In its TER, the NRC staff concluded that there was reasonable assurance that DOE could meet Criterion Two, primarily based on the following intermediate conclusions: (1) DOE used an appropriate process to identify highly radioactive radionuclides for SRS salt waste; (2) DOE predicted relatively high removal efficiencies for most of the highly radioactive radionuclides in the SRS salt waste; (3) DOE used appropriate processes to evaluate alternative technologies for removal of radionuclides from the waste; (4) the additional costs and radiological risks to workers associated with delaying salt waste treatment do not appear to be justified by the associated small reduction in the risk to an intruder or the public. Among other things, NRC staff recommended that DOE consider the practicality of additional removal of Se-79, Tc-99, and I-129 from SRS waste.

Criterion Three(A) of the NDAA is that the waste does not exceed Class C concentration limits and that it will be disposed of in compliance with the performance objectives of 10 CFR 61, Subpart C. In its draft waste determination, DOE stated that Criterion Three(A) would be met for the salt waste. To assess conformance with Criterion Three(A), the NRC's RAI contained questions concerning, among other things, the performance assessment and related sensitivity analyses, the source term, infiltration and erosion control, and dose methodology. In its RAI response, DOE provided its bases for assumptions made in the performance assessment and also provided the results of 35 sensitivity runs to assess possible effects of variations in relevant factors, including oxidation of the waste, increased infiltration, and fracturing of the waste form. The doses calculated for some of the sensitivity runs greatly exceeded the applicable dose limits.

In its TER, the NRC staff concluded that there was reasonable assurance that DOE could meet Criterion Three(A) for SRS salt waste. The staff noted that: (1) the disposal facility, wasteform,

and engineered cap would need to be appropriately designed and implemented to satisfy the performance objectives of 10 CFR 61, Subpart C, (2) maintaining Tc-99 in the wasteform in a reduced form to limit its release to the groundwater is a key factor, and (3) the rates of degradation of, and infiltration through, the wasteform could greatly affect the estimated doses that result from the waste. Among other things, NRC staff recommended that DOE develop additional model support to justify several of the assumptions used in DOE's PA. The TER also identified those factors that are important to meeting the performance objectives and that need to be monitored as DOE proceeds with its disposal activities; for example, the rate of waste oxidation and extent of degradation of the wasteform and surrounding vaults.

Other Waste Determinations Submitted Under the NDAA for INL and SRS

DOE has submitted two other draft waste determinations for NRC review under the NDAA. On September 7, 2005, DOE submitted a draft waste determination for closure of a tank farm at INL [18]. This tank farm consists of 11 large and four small HLW tanks which will contain small amounts of residual waste at closure. DOE plans to remove as much waste as possible from all of the tanks and then close them in place by filling the tanks with grout. This is the same tank farm that was evaluated by the NRC during its WIR determination review in 2003.

On September 30, 2005, DOE submitted a draft waste determination for closure of two tanks at SRS [19]. DOE has completed waste removal from these tanks and plans to fill them with grout and close them in place. These tanks are adjacent to two other tanks that were operationally closed in 1997 and which were part of NRC's WIR determination review that was completed in 2000. The NRC staff is currently in the process of reviewing both of these draft waste determinations and expects to complete its reviews in 2006.

WASTE DETERMINATION REVIEWS NOT UNDER THE NDAA

As noted above, the NDAA is applicable only to the States of South Carolina and Idaho. However, the NRC is performing similar technical review activities for the Hanford site in Washington and the West Valley site in New York. At Hanford, DOE is required by agreement with the State and with the U.S. Environmental Protection Agency to interface with the NRC in those cases in which DOE cannot remove 99%, by volume, of the waste present in the single-shell tanks. In October 2004, DOE submitted a document that provided the basis for DOE's decision that it could not remove any additional waste from Tank C-106 at Hanford [20]. In August 2005, DOE submitted portions of a corresponding PA for the single shell tanks at Hanford [21]. The NRC is currently reviewing the PA and expects to issue RAIs in 2006.

At the West Valley site, DOE is currently decommissioning a defunct commercial reprocessing facility. Although the NRC license is currently in abeyance, the NRC was required by statute to establish decommissioning criteria for DOE. In the decommissioning criteria established in the "Final Policy Statement for the Decommissioning Criteria for the West Valley Demonstration Project at the West Valley Site," the NRC provided incidental waste criteria, as discussed above. The NRC expects the site's Environmental Impact Statement and Decommissioning Plan, both of which will be reviewed by the NRC, to address any waste determinations made for waste that will be disposed of on site.

CONCLUSIONS

The NRC and DOE have begun to implement their responsibilities under the NDAA. DOE's ability to decontaminate and decommission its sites in a cost-effective and timely manner could be greatly affected by its ability to determine that not all reprocessing waste is HLW. The NRC's consultation and monitoring responsibilities under the NDAA will provide an independent technical assessment of whether the disposition of incidental waste will be protective of public health and safety.

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