

## **NRC STAFF ANALYSIS OF LICENSE TERMINATION RULE ISSUES**

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### **ABSTRACT**

The U.S. Nuclear Regulatory Commission's (NRC's) experience and lessons learned from using the License Termination Rule (LTR) since it was finalized in 1997 has revealed some important implementation issues impacting the decommissioning of NRC licensed sites. As a result, NRC conducted an analysis of LTR issues, with particular emphasis on resolving the institutional control issue so that the restricted release and alternate criteria provisions of the LTR would be more available for licensee use. In addition to the institutional control issue, NRC also evaluated issues dealing with the relationship of the LTR release limits to other release limits, realistic exposure scenarios, measures to prevent future legacy sites, and intentional mixing. For each issue, NRC evaluated a range of options that could resolve the issue and then recommended a preferred option for Commission decision. For example, NRC is planning on using the following options to resolve the institutional control issue: 1) a risk-informed, graded approach for selecting institutional controls; 2) NRC monitoring institutional controls after license termination using a legal agreement and deed restriction; and 3) NRC long-term control possession-only license. For the realistic exposure scenario issue, NRC is planning on using reasonably foreseeable future land uses, as opposed to defaulting to very conservative scenarios such as the resident farmer. Finally, many of the existing decommissioning sites that NRC regulates are complex and difficult to decommission for a variety of financial, technical, or programmatic reasons. NRC evaluated the lessons from these existing "legacy" sites and plans on changes to financial assurance and licensee operations to minimize or prevent future legacy sites.

NRC is planning a variety regulatory actions to address these issues including: 1) a rulemaking for measures to prevent future legacy sites (changes to financial assurance and licensee operations); 2) revised guidance to support the rulemaking and to clarify institutional controls for restricted use, on-site burials, and realistic exposure scenarios; 3) revised inspection procedures and enforcement guidance to enhance monitoring, and reporting; and 4) a Regulatory Issue Summary to inform a wide range of stakeholders about the LTR analysis of each issue, Commission direction, and actions planned to resolve each issue.

The outcomes of NRC's actions will affect both existing decommissioning sites and future decommissioning sites. For existing decommissioning sites, particularly the complex sites with long-lived radionuclides, the outcomes should facilitate decommissioning by addressing key challenges facing the sites, such as selecting exposure scenarios for dose modeling and selecting institutional controls. For future decommissioning sites, specific measures are recommended for financial assurance, licensee operations and reporting, and on-site disposal, that should reduce or mitigate the potential for future legacy sites.

### **INTRODUCTION**

NRC's experience and lessons learned from using the License Termination Rule (LTR) since it was finalized in 1997 has revealed some important implementation issues impacting the decommissioning of NRC licensed sites. As a result, NRC conducted an analysis of LTR issues, with particular emphasis on resolving the institutional control issue so that the restricted

release and alternate criteria provisions of the LTR would be more available for licensee use. In addition to the institutional control issue, NRC evaluated issues dealing with the relationship of the LTR release limits to other release limits, realistic exposure scenarios, measures to prevent future legacy sites, and intentional mixing. On October 1, 2002, completed an initial analysis that described the scope of each issue and the staff's plans for evaluation [2]. The results from NRC's evaluation of each issue were completed on May 2, 2003 [3], and on November 17, 2003, the Commission approved implementation, but with comments to be addressed during implementation.

This paper summarizes NRC's LTR Analysis [3] with an emphasis on the following issues: institutional controls, realistic exposure scenarios, and measures to prevent future legacy sites. The LTR Analysis [3] is publically available on NRC's web site at [www.nrc.gov/reading-rm/doc-collection/commission/secys/2003](http://www.nrc.gov/reading-rm/doc-collection/commission/secys/2003).

## **EVALUATION PROCESS**

NRC conducted the evaluations for the eight issues in the LTR Analysis and identified one new issue and associated plans for future evaluations. The issues evaluated were:

- Restricted release/alternate criteria and institutional controls
  - Relationship between LTR release limits and other release limits
    - Unimportant quantities under 10 CFR 40.13(a) [1]
    - Appropriateness of developing a separate uranium/thorium unrestricted release standard
    - On-site disposal under 10 CFR 20.2002 [1]
    - Controlling the disposition of solid materials
- Realistic exposure scenarios
- Measures to prevent future legacy sites
  - Changes to financial assurance
  - Changes to licensee operations
- Appropriateness of allowing intentional mixing

The staff's evaluations considered a wide range of relevant information and experience from other NRC programs and regulations, as well as external sources, such as the U.S. Environmental Protection Agency (EPA); U.S. Department of Energy (DOE); Agreement States; and National Research Council reports. Similarly, extensive coordination among NRC staff was conducted to gain further information and perspective, as well as to identify interrelationships among the individual issues.

The staff's evaluations also identified options to resolve the issues, evaluated their pros and cons, and used these results to recommend specific options. The full range of regulatory tools to implement the options was considered, including: rulemaking; guidance; inspection procedures; enforcement policy; and informational tools such as a Regulatory Issue Summary.

## **SUMMARY OF RESULTS**

Results for three issues are summarized below.

### **Restricted Release/Alternate Criteria and Institutional Controls**

Institutional control requirements that are necessary for the viability of both the restricted release and alternate criteria provisions of the LTR (i.e., 10 CFR 20.1403 and 1404, respectively) [1] have been difficult for licensees to implement, particularly for those sites contaminated with long-lived radionuclides such as uranium and thorium. Although only a few NRC licensed decommissioning sites are considering restricted release at this time, resolving this issue, so that the restricted release provision is more viable, may allow decommissioning progress at these few sites. At this time no sites are considering license termination using alternate criteria.

The staff evaluated information and experience from other NRC regulations, EPA, DOE, Agreement States, National Research Council reports, and an American Society for Testing Materials (ASTM) standard, to gain insights about how others are addressing this issue. Key insights from these evaluations include: 1) many organizations recognize the potential for eventual failure of institutional controls, particularly over the long term; 2) appropriately selecting, implementing, monitoring, and enforcing institutional controls will help minimize or mitigate the potential for failure of institutional controls; 3) in some cases, an ongoing Federal role is critical to assure long-term effectiveness of institutional controls; and 4) flexibility is needed to implement institutional controls that address site-specific characteristics.

NRC evaluated several options and plans on implementing the following options.

#### **Clarify the LTR Risk-Informed, Graded Approach for Restricting Use.**

The existing restricted release requirements of the LTR in 10 CFR 20.1403, discussions in the LTR "Statement of Considerations" [1], and the decommissioning guidance (NUREG-1757, September 2002, [4]) provide a basis for a risk-informed graded approach for using institutional controls to restrict site use. However, this approach can be clarified and more completely explained in revised guidance to improve both understanding and use by licensees and NRC. This clarification applies to the restrictions that would be used for license termination with restricted release under 10 CFR 20.1403 or for license termination with the alternate criteria in 10 CFR 20.1404 [1].

The clarification would address the following two parts of the risk-informed graded approach: 1) general risk framework and grades of institutional controls; and 2) specific grades of institutional controls determined by site-specific factors that could affect overall risk to public health and safety. Each of these two parts of the graded approach is summarized below, and revised guidance would provide further details and examples.

The general risk framework can be defined by the hazard level and likelihood of hazard occurrence. The hazard level is established in the LTR (10 CFR 20.1403 (e)(ii)) [1] as the dose level of 100 mrem/yr., calculated without institutional controls restricting site use. This dose

level is the public dose limit. The LTR also defines the general grades of controls: sites below the 100 mrem/yr dose level require legally enforceable institutional controls and sites above the 100 mrem/yr dose level require both legally enforceable and durable institutional controls. Thus, the LTR requires that institutional controls provide more reliable or sustainable protection over the time period needed (i.e., durable) for sites that could exceed the public dose limit, assuming no restrictions. As noted below the LTR "Statement of Considerations" [1] also provides for durable controls for long-lived radionuclides regardless of the dose limit.

The likelihood of hazard occurrence can be simply defined by the hazard duration based on the half-life of the radionuclide contamination. Longer durations associated with longer half-lives, increase the likelihood of institutional control failure and hazard occurrence. The 100-year time period can be used as a simple way to define the likelihood of hazard occurrence. This approach is derived from the LTR "Statement of Considerations" [1] about the durability of institutional controls and the 100-year time period, which notes that short-lived nuclides, such as Cobalt-60 or Cesium-137 (half-lives 5.3 and 30 years respectively), would decay to unrestricted use levels in about 10 to 60 years, and, therefore, fall below the 100-year period. Discussions also note that "In a limited number of cases, in particular those involving large quantities of uranium and thorium contamination, the presence of long-lived nuclides at decommissioning sites will continue the potential for radiation exposure beyond the 100-year period. More stringent institutional controls will be required in these situations...." Thus, in NRC's view, the longer the duration of the hazard, the greater the likelihood of institutional controls failing and, therefore, the need for using controls that are more reliable and sustainable for the duration of the hazard (i.e. durable). The 100-year time limit is reinforced by the low-level waste disposal regulations, that require institutional controls for up to 100 years, which is described as a time period that would allow Class A and Class B low-level waste to decay to a level that will present an acceptable hazard to an intruder. For the above reasons, NRC could consider using 100 years to generally separate lower likelihood from higher likelihood of hazard occurrence.

Grades of institutional controls are not discussed in the LTR and the LTR does not define the term "durable" institutional controls as used in 10 CFR 20.1403 (e)(ii) [1]. However, section 3.3 of the LTR "Statement of Considerations" [1] gives some insight by discussing the durability of institutional controls and noting that more stringent controls will be required for exposures beyond the 100-year period. Furthermore, the guidance in NUREG-1757 [4] indicates that institutional controls must be durable for sites exceeding the 100 mrem per year calculated dose, but less than the 500 mrem per year dose and for sites with long-lived radionuclides. Durable is described as meaning controls that must be expected to last in perpetuity. Thus, the staff could explain that durable institutional controls would be needed for sites with a hazard level above the 100 mrem/yr value, or sites with a higher likelihood of hazard occurrence (i.e., hazard duration of greater than 100 years).

Based on these discussions, NRC could define two general grades of institutional controls: a) legally enforceable and b) durable and legally enforceable. The first grade of legally enforceable could use conventional institutional controls that are enforceable, such as a restrictive covenant. A few examples of durable and legally enforceable institutional controls: a) layering of legally enforceable institutional controls that includes a government control (e.g., deed restrictions giving authority to Federal or State governments for monitoring and corrective action); b) State or Federal ownership and control; c) legally enforceable institutional controls monitored and enforced by NRC (new recommended option); and d) NRC long-term control possession-only specific license (new recommended option).

Specific grading of institutional controls can be selected within the two general grades defined above. This approach recognizes that the site-specific factors affecting risk are highly variable from site to site. As a result specific grading recognizes the need for flexibility to tailor institutional controls to achieve the desired effectiveness. Specific grading involves evaluating and balancing numerous site-specific factors such as: a) physical characteristics of the site that limit future land use; b) land uses that could be adverse and therefore should be prohibited; c) land uses that are acceptable and could result in productive reuse of the site; d) dose assessment results (including low probability, alternate land use scenarios); e) engineered barriers and related maintenance; f) cost of monitoring controls and maintenance used as the basis for financial assurance; g) jurisdictional limitations on enforceability and long-term effectiveness of institutional controls; and h) advice from affected parties, such as local governments and the public. Particular attention might be needed to evaluate and tailor the durable institutional controls for specific sites that are well below the 100 mrem/yr value (lower hazard) but have long-lived radionuclides.

It is important to note that the few decommissioning sites considering restricted release at this time have either uranium or thorium contamination or both, and thus, would need some form of durable institutional controls, based on the duration of hazard.

#### **NRC monitoring and enforcement under a legal agreement.**

NRC would monitor and enforce under legal agreements or authority written into institutional controls. Monitoring could include the owner agreeing, as a condition to license termination and included in a restrictive covenant, to provide an annual letter certifying effectiveness of controls as a simple way to notify NRC and other parties. By including the annual letter in the restrictive covenant, future owners would be required to also provide an annual letter.

The licensee would need to establish sufficient financial assurance for the long-term cost of NRC (acting as an independent third party ) monitoring and other actions, as required under the LTR (10 CFR 20.1403(c) [1]. The licensee, as part of license termination, would need to agree to pay NRC annually for the activities NRC conducted, or provide a single payment at the time of license termination like NRC's uranium mill tailings sites. This option could be used for any site, including formerly licensed sites.

#### **NRC long-term control possession-only specific license after completion of remediation.**

This option would involve amending the existing specific license for decommissioning to a long-term control possession-only specific license, after completing remediation and after LTR dose criteria are met. For such sites, the long-term control license acts as an institutional control to maintain the restrictions necessary to meet the LTR criteria. NRC would monitor, inspect, and enforce under the license authority. For this option, required dose criteria, environmental reviews, advice from affected parties, and sufficient financial assurance would continue. Financial assurance would, for this case, be based on a cost estimate for NRC monitoring and inspection fees, as well as the licensees cost for surveillance and maintenance.

License conditions for site access and land use restrictions, monitoring, maintenance, reporting, and financial assurance would be specified in the long-term control possession-only license. A Long-Term Control Plan implemented under the license could provide the detailed plans for restrictions, monitoring, reporting, and maintenance similar to the Long-Term Surveillance Plans for uranium mill tailings sites.

If site ownership changes in the future, the long-term control license would be issued to the new owner. Therefore, an independent third party is not needed. However, a trust would need to be

established before license termination, in the event the licensee goes bankrupt. If this occurs, the trustee would arrange for continuing the site monitoring and maintenance that had been done by the owner/licensee, using funds from the financial assurance instrument.

At the end of the period of restricted site use, the long-term control could be terminated; however, for long-lived radionuclides, the license would likely be permanent.

This option could be used for sites that are: 1) higher hazard (above 100 mrem/yr cap); 2) longer duration (e.g., long-lived radionuclides such as uranium or thorium); or 3) unable to establish acceptable institutional controls using other available options.

NRC plans on implementing the above options by revising the Consolidated Decommissioning Guidance in NUREG-1757[4], after obtaining comments on the recommended actions from the public, Agreement States, licensees and any other interested stakeholders.

NRC's actions should result in the following outcomes: 1) in the near-term, make the restricted release provision more viable and available for licensee use by providing new options and clarifying the risk-informed and flexible graded approach to select options; 2) provide more effective restrictions that protect the public health and safety over the long-term; 3) become more consistent with EPA's approach and recommendations of the National Research Council and the ASTM Standard; 4) should increase public confidence and acceptance of restricted use under the LTR; and 5) allow productive reuse of some sites. All these outcomes will enhance the decommissioning of existing licensed sites. Although they could also pertain to future licensees, the potential for future licensees needing restricted release should be reduced by the recommendations for other LTR issues, including measures to prevent future legacy sites, on-site disposals, and more realistic exposure scenarios.

### **Realistic Exposure Scenarios**

NRC and licensee experience implementing the LTR has raised questions about perceived unnecessary conservatism in dose assessments. One significant source of potential conservatism is with selecting post-license termination land use scenarios. This issue focuses on how to select and justify land use scenarios for the 1000-year dose assessment time period for both the unrestricted release cases and restricted release (assuming failure of institutional controls) and whether more realistic scenarios can result.

NRC evaluated NRC's existing guidance, licensee and NRC experience using this guidance, case studies that have resulted in selecting more realistic scenarios, and approaches used by EPA. Two options were evaluated to achieve more realistic scenarios. One was to improve the implementation of the current approach and guidance by training and sharing with licensees more realistic case studies. The other option was to allow justification of scenarios based on reasonably foreseeable future land use, as opposed to defaulting to very conservative scenarios such as the resident farmer. NRC plans on implementing the option of using reasonable foreseeable land use. This option includes identifying reasonably foreseeable land use scenarios that are likely within the foreseeable future (e.g., the next few decades and to possibly 100 years), considering advice from land use planners and stakeholders. This option would also identify less likely, alternate scenarios to the reasonably foreseeable scenarios, to understand the robustness of the analysis. Compliance would be based on a range of reasonably foreseeable scenarios, but evaluating less likely alternate scenarios would provide information to reach a risk-informed decision. This option is consistent with the LTR critical

group concept. NRC plans on implementing this option using revised guidance, staff training, sharing the approach with licensees, and a Regulatory Issue Summary.

The outcome of this recommendation would be a clearer approach and guidance to implement dose assessment exposure scenarios that are more realistic and risk-informed. Application of this approach might also result in fewer restricted release sites and less costly cleanup to unrestricted release levels.

### **Measures to Prevent Future Legacy Sites**

Many of the existing decommissioning sites that NRC regulates are complex and difficult to decommission for a variety of financial, technical, or programmatic reasons. These sites can be thought of as NRC "legacy" sites—those sites where past financial or operational events have created the existing problems that must now be overcome, in some way, to conduct sufficient cleanup and ultimately complete decommissioning and license termination. NRC evaluated the lessons from these existing legacy sites and plans on changes to financial assurance and licensee operations to minimize or prevent future legacy sites.

#### **Changes to financial assurance.**

A number of sites licensed before the financial assurance regulations were issued in 1988 now find that the full cost of decommissioning exceeds their projections and fund balances. Furthermore, NRC experience applying the financial assurance regulations has resulted in many lessons-learned that can be applied to improve the regulations and reduce the risks to decommissioning financial assurance. Based on this experience, NRC focused on specific risks that could cause shortfalls in decommissioning funding including: 1) restricted release assumption causes underestimation of decommissioning costs; 2) operational indicators of increasing costs; 3) unavailability of funds in bankruptcy; 4) inadequate financial disclosure; 5) reaching assets after corporate reorganization; 6) investment losses reducing trust account balances, and 7) increased decommissioning cost due to accidental release.

For each of these funding risks, NRC evaluated options for both existing and future licensees. To resolve the risk of underestimating decommissioning costs, the staff recommends requiring a licensee to obtain NRC approval of the decommissioning funding plan and prepare a cost estimate assuming unrestricted release, unless the licensee can demonstrate its ability to meet the restricted release requirements. NRC plans on using a risk-informed approach to identify high-risk operational indicators (e.g., spills, groundwater contamination, and facility modification) and requiring updates to decommissioning cost estimates and financial assurance coverage. New requirements are recommended for additional certification of financial statements; holding parent company and subsidiaries liable for decommissioning costs by license conditions and/or agreements; and for licensees to perform periodic evaluations of the impact of investment losses on their trust fund balances and sufficiency of financial assurance coverage. NRC plans on a new rulemaking and implementing new guidance.

The outcome of these recommendations should be to effectively reduce funding risks that could cause shortfalls in decommissioning funding, thus minimizing the potential for future legacy sites.

#### **Changes to licensee operations.**

NRC also evaluated the lessons-learned from decommissioning existing contaminated sites and identified specific risks during facility operations that could eventually lead to sites with decommissioning problems. NRC concluded that chronic releases and reporting deficiencies

were two key operational risks. Facilities that process large quantities of material, especially in liquid form, have the potential for significant environmental contamination. These facilities often have limited controls on spills to minimize costs and maximize profit. Furthermore, because of increasing disposal costs, some facilities may rely on storing waste, perhaps in settling ponds, rather than in shipping waste to minimize on-site storage. NRC experience has shown that these operating conditions can lead to large amounts of chemical and long-lived radioactive contamination being released to the subsurface environment over an extended period of time. In addition, past regulatory oversight of processors of licensed material where there was no potential for nuclear criticality has historically been limited. This has allowed less serious, but, in some cases, chronic operational weaknesses to go unreported. The result has been low-level, but long-term, releases of radioactive material to the subsurface environment. Often, because of these past reporting deficiencies, NRC first becomes cognizant of the extent of the contamination as part of the review of the decommissioning plan, that includes a description of site conditions, including the extent of contamination. Finally, there are several existing regulations that provide NRC with the capability to become aware of subsurface contamination. These regulations, however, do not specifically address this issue, and need interpretation from the current focus on acute exposure to apply to long-term environmental conditions.

To address the operating risk of chronic releases, NRC plans on requiring existing operating facilities to minimize contamination, as is currently required for future licensees. To address reporting deficiencies, NRC plans on taking a risk-informed approach to identify sites with high risk of subsurface contamination and require increased licensee monitoring and reporting programs for these sites and high risk operating activities. Similarly, the same risk-informed approach would be used to focus NRC inspections.

### **Implementation Actions and Outcomes**

NRC plans on a variety regulatory actions to address all the LTR issues including: 1) a rulemaking for measures to prevent future legacy sites (changes to financial assurance and licensee operations); 2) revised guidance to support the rulemaking and to clarify restricted release, on-site burials, and realistic exposure scenarios; 3) revised inspection procedures and enforcement guidance to enhance monitoring, reporting, and remediation to prevent future legacy sites that might not have sufficient funds for cleanup and decommissioning; and 4) a Regulatory Issue Summary to inform a wide range of stakeholders about the LTR analysis of each issue, Commission approval, and actions planned to resolve each issue. NRC currently plans on completing the Regulatory Issue Summary in Spring of 2004. For measures to prevent future legacy sites, NRC plans on completing a proposed rule and draft guidance in FY 2006 and a final rule and guidance in FY 2007. For institutional controls, realistic exposure scenarios, and on-site disposal options, NRC plans on preparing draft guidance for public comment in FY 2005 and final guidance in FY 2006. Meanwhile, NRC has already started to implement the actions for institutional controls and realistic exposure scenarios at some sites where decommissioning plans are being developed.

The outcomes of NRC actions affect both existing decommissioning sites and future decommissioning sites. For existing decommissioning sites, particularly the complex sites with long-lived radionuclides, the outcomes should facilitate decommissioning by addressing key challenges facing the sites, such as selecting exposure scenarios for dose modeling and selecting institutional controls. For future decommissioning sites, specific measures are recommended for financial assurance, licensee operations and reporting, and on-site disposal, that should reduce or mitigate the potential for future legacy sites.



## CONCLUSION

NRC experience and lessons learned from using the LTR since it was finalized in 1997 has revealed some important implementation issues impacting the decommissioning of NRC licensed sites. NRC evaluated each of these issues and plans on beginning both rulemaking and guidance actions to implement the approved options. The outcomes of these actions should facilitate decommissioning at existing sites and should also reduce or mitigate problems at future decommissioning sites.

## REFERENCES

- 1 *Code of Federal Regulations*. 10 CFR Part 20, Subpart E, "Radiological Criteria for License Termination.", Sections 20.1401-1404.
- 2 Nuclear Regulatory Commission (U.S.), "Initial Analysis and Plan for Addressing License Termination Rule Issues," SECY-02-0177, U.S. Nuclear Regulatory Commission, Washington, D.C., October 1, 2002.
- 3 Nuclear Regulatory Commission (U.S.), "Results of the License Termination Rule Analysis," SECY-03-0069, U.S. Nuclear Regulatory Commission, Washington, D.C., May 2, 2003.
- 4 Nuclear Regulatory Commission (U.S.), "Consolidated NMSS Decommissioning Guidance: Decommissioning Process for Materials Licensees," NUREG-1757, Vol. 1, Rev. 1, September 2003.