

**DRAFT** Technical Basis  
For  
Prompt Remediation, Rev. 3

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1. Introduction

On December 10, 2007, the Commission issued the Staff Requirements Memorandum (SRM) for SECY-07-0177, "Proposed Rule: Decommissioning Planning (10 CFR Parts 20, 30, 40, 50, 70, and 72; RIN: 3150-AH45)." In SRM-SECY-07-0177, the Commission directed the staff to address "remediation of residual radioactivity during the operational phase with the objective of avoiding complex decommissioning challenges that can lead to legacy sites." To accomplish this, the Commission instructed the staff to:

"... engage stakeholders to develop a technical basis, possible dose limits, criteria for applying the dose limits to address this matter, or alternatives to the dose limits to address the intent of this objective. The technical bases will be a precursor to a proposed rule to include requirements for licensees to remediate residual radioactive contaminated areas and thereby minimize the creation of legacy sites."

In response to this Commission direction, the staff has developed this draft technical basis. The document presents the staff's preferred approach to address prompt remediation of residual radioactivity. This draft technical basis discusses the existing regulatory framework, the regulatory issue, the basis for the regulatory change, the alternatives considered, backfit considerations, and stakeholder interactions. It also references other pertinent documents.

## 1.1 Existing Regulatory Framework

This analysis considers the sufficiency of the U. S. Nuclear Regulatory Commission's (NRC's) current regulatory framework as it relates to the prompt remediation of residual radioactivity during the operational phase of NRC-licensed facilities.

### 1.1.1 Commission Authority

The Commission has statutory authority under the Atomic Energy Act of 1954 (AEA), as amended, (e.g. Section 161(b)) to promulgate rules and take other actions necessary to protect health and minimize danger to life or property. The Commission has regulatory authority under 10 CFR Section 20.2401 to take legal action to prevent violation of the AEA, other related Acts, or regulations pursuant to those laws. Requiring remediation of radiological contamination is not explicitly identified, but it is clearly within the Commission's stated authority to public protect health and safety.

Sections 20.1201 and 20.1301 establish dose limits to individuals from operating nuclear facilities. These regulations require that all licensees control doses below these limits, but do not explicitly require remediation during operation as a means to do so.

Section 20.1101 requires all licensees to "...use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA)." Again, remediation during operation is not explicit to achieving this requirement.

Appendix I to Part 50 establishes design objectives for power reactors to “Define and initiate a program of corrective action ...” if in any calendar quarter the “... design objective exposure, would exceed one-half the design objective annual exposure ....” These are generally incorporated in the operating license as requirements. As above, physical remediation is not specified as part of the corrective action.

### 1.1.2 Financial Assurance Requirements

In 1988, NRC promulgated “General Requirements for Decommissioning Nuclear Facilities” (53 FR 24018). This rule “... set[s] forth technical and financial criteria for decommissioning licensed nuclear facilities.” In general, the rule requires each licensee authorized to possess more than the quantities of radioactive material listed in Appendix C of Part 20 to develop a decommissioning cost estimate, or use an approved value, and to assure those funds are available for decommissioning activities at the time of license termination.

### 1.1.3 License Termination Rule

In 1997, the NRC promulgated Subpart E to 10 CFR Part 20, called the License Termination Rule (LTR) (62 FR 39088; July 21, 1997). This regulation establishes dose limits as the criteria for NRC license termination. The LTR also requires applicants for NRC licenses to demonstrate how facility design and procedures for operation will minimize contamination of the facility and the environment, and facilitate eventual decommissioning. In 2003, in response to Commission direction, staff reviewed the implementation of the LTR and summarized its findings in SECY-03-0069 “Results of the License Termination Rule Analysis”. In this review, staff identified

potential changes to the regulatory environment to minimize the potential for legacy sites<sup>1</sup>. The NRC staff conducted a detailed review of information about the then existing complex decommissioning sites. The staff made two specific observations from the information about these sites: (1) the sites had chronic releases of radioactive material to the subsurface environment during the operation phase of plant life; and (2) the NRC did not recognize the extent of existing contamination until near cessation of operations, when it reviewed site characterization survey results. Facilities that process large quantities of material, especially in liquid or gaseous<sup>2</sup> form, have the potential for significant environmental contamination. Experience shows that during operations large amounts of chemical and long-lived radioactive contamination can be released to the subsurface environment over an extended period of time from these facilities, and at very low release rates. However, the doses from these releases are generally below the radiation dose limits for operational facilities in 10 CFR Part 20 that would initiate regulatory action. Additionally, the cost to dispose of radioactive material, even with relatively low concentrations, can be very high due to limited disposal capacity. Therefore, staff identified potential changes to the regulatory environment to minimize the potential for legacy sites and made recommendations for action, including rulemaking. One recommendation was to strengthen certain aspects of financial assurance to better ensure the availability of decommissioning funds, especially in case of financial duress of licensees. Another recommendation was rulemaking to require additional operational activities to identify, control, and document radioactive contamination throughout the site, especially in the subsurface. Upon approval by the Commission, staff initiated the Decommissioning Planning Rule (DPR).

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<sup>1</sup> A legacy site is one at which the licensee is unable to complete decommissioning because of technical or financial issues.

<sup>2</sup> Heavier-than-air gases and entrained particulates can precipitate to elevated concentrations.

#### 1.1.4 Decommissioning Planning Rule

The staff developed the DPR to extend the minimization of contamination requirement of the LTR to operating licensees, and to strengthen some financial assurance requirements. Specifically, the DPR added a new § 20.1406(c) to require licensees to minimize the introduction of residual radioactivity into the site, and revised § 20.1501(a) to require licensees to perform surveys to determine the extent of contamination throughout the facility, including in the subsurface. The DPR also added a new § 20.1501(b) to require licensees to document surveys describing the location and amount of subsurface residual radioactivity. As a result, licensees perform surveys to identify and record the extent of significant residual radioactivity in the subsurface, including soil and groundwater contamination, particularly if the subsurface contamination is a significant amount that would require remediation during decommissioning to meet the unrestricted use criteria.

The DPR also made several changes to the decommissioning financial assurance requirements. One new requirement reflects the proposed changes being made to the § 20.1501(a) survey requirements. If these surveys detect residual radioactivity at a site at levels that would, if left uncorrected, prevent the site from meeting the § 20.1402 criteria for unrestricted use, licensees, except power reactor licensees, must submit a revised decommissioning funding plan (DFP) within one year of when the survey is complete. Power reactor licensees are governed by the requirements of Part 50; guidance is in RG 1.159. Each DFP that licensees submit for review and approval must contain a decommissioning cost estimate (DCE) based on three cost components. Two of the cost components, a dollar amount adequate to cover the cost of an independent contractor to perform all decommissioning activities, and an adequate contingency factor, are described in existing guidance. The newly

added third cost component is an estimate of the cost to remediate onsite subsurface material containing residual radioactivity that would require remediation to meet decommissioning criteria. Additionally, the DCE must be based on the cost of meeting the § 20.1402 criteria for unrestricted use unless the licensee obtains NRC approval and demonstrates it meets all of the requirements of § 20.1403. Another new provision requires the licensee to identify and justify the basis for all key assumptions underlying the DCE.

On June 17, 2011, NRC promulgated the final DPR (76 *FR* 35512), that requires licensees to conduct radiological surveys throughout the site, including the subsurface, to identify the concentrations or quantities of residual radioactivity of radioactive contamination. If these surveys identify subsurface residual radioactivity, the licensee is required to enter the results into records important for decommissioning. It also requires licensees to estimate the cost to remediate remaining contamination and include it in revisions to the decommissioning cost estimates required by licensing regulations. The NRC provides implementation guidance for the rule in DG-4014 and NUREG-1757, Vol. 3, Rev. 1.

Within SRM-SECY-07-0177 that approved the proposed DPR, the Commission addressed the issue of prompt remediation, as discussed above. To respond to Commission direction, the staff developed this draft technical basis to facilitate discussion with stakeholders in developing a technical basis document as a precursor to a proposed rule.

## 1.2 Remediation of Contaminated Sites

On November 7, 1994, the NRC published a notice of availability (59 *FR* 55497) of a Branch Technical Position (BTP), "When to Remediate Inadvertent Contamination of the Terrestrial Environment" (ML093240400). As stated in the BTP, the primary actions staff expects are that the licensees implement existing stabilization and remediation plans, as a part of the licensees' operational program to keep the dose impact to a level that is as low as reasonably achievable (ALARA), and to document the occurrence and subsequent actions, in accordance with decommissioning recordkeeping requirements. In addressing remediation, staff expects that when the contamination is in a restricted area, or in an unrestricted area where the radionuclides of concern do not have established remediation criteria for contaminated soil or groundwater, the licensee will describe a process to demonstrate ALARA residual contamination levels. NRC staff will then evaluate the proposed process by considering potential doses to individuals from exposure to the contamination. However, because this guidance is not a requirement it was not widely implemented.

## 2. Regulatory Issue

### 2.1 Limitations Of Existing Regulations

While the DPR does require licensees to perform surveys, including the subsurface, that are reasonable under the circumstances to evaluate concentrations or quantities of residual radioactivity, it does not require licensees to conduct remediation during the operational phase of plant life, regardless of the concentration or physical extent of the contamination. During the time between discovery of contamination and license termination, the contamination has the



potential to spread to significantly larger volumes in surrounding media. The staff believes that it is important for licensees to consider the need for prompt remediation in order to avoid future problems resulting from delayed cleanup of contaminated facilities (e.g., increased decommissioning costs, and dose impacts). Staff experience in the decommissioning of nearly 100 sites demonstrates that un-remediated contamination, especially in the subsurface, can, over time, migrate and contaminate large volumes of the surrounding area and resources. This has potential to increase costs and increase the potential for legacy sites. In addition, bankruptcy, corporate restructuring, or other unforeseen changes in the company's financial status may create complex decommissioning challenges that could further delay remediation or lead to legacy sites. For example, relocation of personnel means loss of institutional memory, particularly of spill and on-site disposal locations, which can increase costs to identify them and delay cleanup. As a result, the NRC staff has explored policy options to require licensees to promptly remediate contamination when certain criteria are triggered.

## 2.2 Need For A Rule

Staff evaluated existing regulatory requirements to determine if sufficient requirements existed to prevent legacy sites. In summary, the Commission has statutory and regulatory authority to require licensee action when it is necessary to protect health and safety. Regulations at 10 CFR Part 20 define dose limits to members of the public and workers from nuclear facilities. While these regulations set limits on exposure, they do not explicitly require remediation of radiological contamination. Licensees could limit exposure to the public and workers by imposing time or distance limits to the contaminated areas. By the principle of ALARA, licensees endeavour to keep doses below regulatory limits. However, there is no regulatory requirement during operations to remediate significant levels of residual radioactivity that

exceed the regulatory requirements at the time of decommissioning. Only when a licensee seeks to terminate the NRC license does the License Termination Rule specify that residual radioactive contamination must be reduced – remediated – to limit calculated doses. Having large volumes of residual radioactivity at the time of license termination could lead to a legacy site. The following table summarizes arguments for and against the need for a new prompt remediation rule.

SUPPORTS A NEW RULE	DOES NOT SUPPORT A NEW RULE
<ul style="list-style-type: none"> <li>➤ Remediation during operations is not currently required. This can result in large volumes of contamination requiring remediation at the time of license termination that may exceed decommissioning funds.</li>   <li>➤ Some sites have large volumes of contamination from long-term leaks/spills and contaminant migration with insufficient resources to remediate to release criteria at license termination. Remediation during the operational phase could moderate this situation.</li>   <li>➤ A rule could explicitly require remediation to implement ALARA during operations. This could reduce the cost of remediation at license termination, thereby the likelihood of occurrence of legacy sites in the future.</li>   <li>➤ Prompt remediation could minimize the amount of contamination, and cost, to remediate.</li>   <p>Maintaining residual radioactivity at low levels during operations could reduce the likelihood of a legacy site in the event of early shutdown, especially where DFPs are not fully funded.</p> </ul>	<ul style="list-style-type: none"> <li>➤ Existing exposure limits provide adequate protection for public health and safety during operations. The DPR requires early identification of existing “significant residual radioactivity” and timely adjustment to decommissioning funding to remediate it at license termination.</li>   <li>➤ Current regulations are sufficient to ensure adequate site characterization and resources, including funding, to complete decommissioning at the time of license termination.</li>   <li>➤ Current financial assurance regulations are sufficient to ensure adequate resources to complete decommissioning. The DPR now requires licensees, except power reactors, to provide a new DFP within 1 year. No new legacy sites have been identified since the 1987 FA regulations. No power reactors have been legacy sites.</li>   <li>➤ Mandated remediation during operations could adversely impact operational safety and flexibility.</li>   <li>➤ Prompt remediation during operations may result in licensees remediating the same area multiple times during plant life, thereby increasing operational costs.</li> </ul>

While no legacy sites have occurred since institution of financial assurance rules in 1987, some sites have experienced decommissioning costs significantly greater than the value of the decommissioning fund; this condition has the potential to create new legacy sites. Therefore, the staff concludes that a rulemaking should be pursued to require an evaluation of remediation during the operational phase of facility life and establish a requirement to perform remediation when appropriate.

### 3. Alternatives Considered

SRM-SECY-07-0177 directs the staff to address remediation of residual radioactivity during the operational phase of plant life. Licensees are currently required to measure concentrations in soil and ground water by the Decommissioning Planning Rule, expressed in 10 CFR 20.1501, and to calculate doses to potentially exposed individuals to demonstrate compliance with the limits of §§20.1201 and 20.1301. This section discusses alternative methods to enhance these requirements to require prompt remediation of radiological contamination exceeding certain limits, identified below, during the operational phase of plant life.

#### 3.1 New Regulation to Require Prompt Remediation

Under this alternative, licensees would be required to promptly remediate the known radiological contamination to ALARA levels when the contamination exceeds certain levels. Two suitable measures of contamination are: i) calculated dose to individuals, and ii) measured concentration in soil or ground water. Prompt remediation is a logical extension of the existing requirement not to exceed these limits because it represents a “next step” for cases where the contamination presents a potential radiological hazard. While there may be some allowance for setting the time to perform the remediation, “prompt” means remediation should commence in the weeks-to-months timeframe.

Licensee actions for prompt remediation should include terminating the release, stabilizing the area to reduce or prevent contaminant migration, removal of the contaminants (e.g., extraction of ground water or excavation of soils), and initiating a corrective action plan. Additional monitoring or sampling of the area can be used to verify the effectiveness of corrective actions

and evaluate any migration that might occur. Physical excavation and off-site disposal of the contamination should be used as appropriate.

### 3.1.1 Require Prompt Remediation When Calculated **Dose** Exceeds Limits

The first action levels staff considered were calculated doses greater than existing regulatory limits. There are sets of two regulatory limits in Part 20 that could be used as action levels:

i) limits on individual exposure during operations, and ii) limits on exposure from residual radioactivity after license termination. If the calculated dose exceeds specified limits, licensees would be required to promptly remediate the contamination to ALARA levels.

#### 3.1.1.1 Dose Exceeds Public or Worker Exposure Limits

For this sub-alternative, the action level are the calculated dose limit from operating facilities for members of the public of 100 mrem/year in 10 CFR 20.1301 or the occupational limit of 5 rem/year in 10 CFR 20.1201. In general, dose to the public is the dose people outside the licensed area could receive from contamination inside the licensed area and from authorized effluent releases. The licensee would be required to promptly remediate the contamination to ALARA levels if either of these dose limits were exceeded. This would control exposure during operations and reduce the likelihood of costs exceeding decommissioning funding at the time of license termination.

### 3.1.1.2 Dose Exceeds Limits for License Termination Under Restricted Conditions

For this sub-alternative, the action level is the calculated dose limit for license termination under restricted conditions of 100 mrem/year in 10 CFR 20.1403<sup>3</sup>. This would be the calculated dose from “on-site” residual contamination, after the access controls were removed, and institutional controls failed to control access. The licensee would be required to promptly remediate the contamination to ALARA levels if the calculated dose exceeded this limit. This would reduce the likelihood of a legacy site in the future.

### 3.1.2 Prompt Remediation When **Concentrations** Exceed Limits

Under this alternative, licensees would be required only to measure concentrations. If the concentrations exceed specified limits, given below, licensees would be required to promptly remediate the known contamination to ALARA levels. These concentrations could potentially result in either an immediate risk threat to public health and safety, or would likely exceed unrestricted use criteria at the time of decommissioning. Although concentrations are straightforward to measure and provide simplicity, they do not allow for consideration of actual exposure pathways and associated parameters. As noted above, “prompt” means remediation should commence in the weeks-to-months timeframe.

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<sup>3</sup> Dose from residual radioactivity when the site institutional controls are no longer in effect.

### 3.1.2.1 Measured Concentrations Exceed Screening Values Corresponding to Criteria for Unrestricted Use

To risk inform decommissioning of licensee sites, NRC developed a screening approach to demonstrate compliance with license termination requirements. This approach includes the use of look-up tables that, using conservative models/codes with parameters and generic scenarios for default site conditions, equate to release for unrestricted use criteria of 10 CFR 20.1402 for single radionuclides. For radionuclides in mixtures, the “sum of fractions” rule should be used. Table B.2 of Volume 1 of NUREG-1757 gives screening values for common radionuclides in soil. In a 2009 Memorandum of Understanding between NRC and the Environmental Protection Agency, NRC agreed that if, during review of license termination plans or decommissioning plans, “... there is radioactive ground-water contamination in excess of EPA’s MCLs ... NRC will seek EPA’s expertise to assist in NRC’s review ....” Therefore, MCLs can be considered the ground water equivalent of the screening values for soil.

### 3.1.2.2 Measured Concentrations Exceed “Effluent Concentrations”

To control dose to the public during facility operations, NRC limits radioactive release from licensed sites. These limits are in Table 2 of Appendix B to Part 20. The effluent concentration values in Column 2 of Table 2 are equivalent to the radionuclide concentrations which, if ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 millirem or 0.5 millisieverts). These values are defined as the action limits for ground water for this alternative. Using a calculated dose of 50 mrem/year to exposed individuals as the reference point, the equivalent value for soil concentrations can be estimated as two (2) times the soil screening values in Table B.2 of Volume 1 of NUREG-1757.

SUMMARY OF CONCENTRATION OPTIONS		
ACTION LEVEL \ MEDIA	SOIL VALUES	WATER VALUES
SCREENING LIMITS (25 mrem/y)	Table B.2, Vol. 1, NUREG-1757	EPA MCLs
EFFLUENT LIMITS (50 mrem/y)	2x Table B.2, V.1 NUREG-1757	Col. 2 Tab 2 App. B 10 CFR 20

### 3.1.3 Considerations for Requiring Prompt Remediation

In evaluating its course of action, staff considered the following:

- Prompt remediation has the potential for causing unplanned disruption, even shut down, of normal operations because of inadvertent damage to peripheral equipment. This could exacerbate the original condition.
- Dose is a calculated value that is a function not only of the concentration and mix of isotopes present, but also of the location of the receptor, the time and duration of exposure, and the exposure pathway(s). Therefore, this alternative introduces a level of complexity that is neither necessary nor desirable for evaluating each spill or leak.
- Concentrations are straightforward to measure and provide simplicity. They do not, however, allow for consideration of actual exposure pathways and associated parameters.
- The occurrence of contamination levels that would approach regulatory dose limits would be from such serious events that other existing regulations are sufficient and already require licensee action. No such events have occurred in the U.S. nuclear power industry to date.



### 3.2 Require ALARA Analyses and Remediation Schedule

As an alternative to strictly mandating remediation, staff considered requiring licensees to perform formal ALARA type analyses when doses or concentrations reach any of the above limits. This approach would allow reasonable flexibility and risk inform actions required of the licensees. To justify delaying remediation, licensees would be required to perform supporting analyses, such as risk assessment, cost-benefit, or other analyses, and make the analyses available for the NRC's review. If they so wish, licensees could also perform site-specific dose analyses, in lieu of performing prompt remediation, based on exceeding the action levels. The NRC staff envisions licensees performing these analyses to assess a variety of factors. For example, the analyses could include: (1) risk to human health and safety, (2) facility operational impact and safety; (3) contaminant characteristics, and (4) cost of remediation and lost production. Analyses addressing the risk to human health and safety would include factors for assessing the human health and safety risks associated with spills or newly identified contamination found on a site. The results would identify situations that could require prompt remediation, and other situations in which delayed remediation may be justified. In evaluating risk to human health and safety, for the first factor, risk may be potential short-term exposure based on radionuclide half-life and total source term (e.g. curies). A second factor would be the potential impacts on facility operational safety by remedial activities. A third factor would be quantity of residual radioactivity and its potential effects at the time of decommissioning. A fourth factor would be the cost-effectiveness of prompt remediation; the licensee could compare the future cost of any required future cleanup to the §20.1402 radiological criteria cost to the cost of an immediate cleanup, with the lower value deemed to be more cost-effective.

### 3.3 Other Alternatives

Staff considered the following other alternatives to rulemaking.

#### 3.3.1 Issue Site-Specific License Conditions

Develop a written policy that following identification of contamination above some specified volume and concentration, NRC would issue license conditions concerning remediation and allowable levels of residual contamination. This approach uses a case-by-case evaluation to determine if licensees should remediate promptly following spill or leak events. This approach could result in inconsistencies in remediation actions, and it would create a regulatory burden by requiring the licensees to develop a detailed evaluation of all identified leaks and spills, and requiring staff review to determine if ordering license conditions would be warranted. Imposing license conditions also affords licensees the opportunity to object, which could result in protracted legal proceedings and decrease the emphasis on prompt remedial action. Staff did not pursue this alternative because it is also not directly responsive to the SRM.

#### 3.3.2 Issue Guidance

Under this alternative, staff would issue guidance rather than conduct rulemaking. This guidance would rely on new interpretations of existing regulations to identify desired licensee actions. Guidance cannot impose new requirements on licensees, and new interpretations of existing rules are subject to backfit analysis for those licensees that have backfit provisions in the licensing regulations. Staff notes that there have not been any new legacy sites since

implementation of the 1987 financial assurance regulation. Also, because it cannot mandate licensee action, this alternative is not fully responsive to the intent of the SRM.

#### 3.3.2.1 Revise Existing Licensee Guidance

SRM-SECY-07-0177 approved publication of the DPR. Guidance for that rule is in Draft Regulatory Guide 4014, Regulatory Guide 4.22. Under this option, staff would revise DG-4014/RG-4.22 to include guidance on complying with a requirement to conduct prompt remediation. Staff did not pursue this alternative because the regulatory basis for the DPR states that the new rule does not require prompt remediation. Such a change in the interpretation of the rule is not justified by the existing bases of the rule. Also, implementation guidance cannot impose new requirements on licensees. Therefore, this alternative is not fully responsive to the intent of the SRM.

#### 3.3.2.2 Issue New Licensee Guidance

NRC could issue new guidance in the form of a new Regulatory Guide or a NUREG. Staff did not pursue this alternative because such documents describe methods that the NRC staff considers acceptable for use in implementing specific parts of the agency's existing regulations. As discussed above, there is not an existing regulation that requires prompt remediation and guidance cannot impose new requirements on licensees. This approach would not meet the goal of mandating that license promptly remediate contamination.

### 3.3.2.3 Issue New Generic Communication

There are six types of generic communications NRC could promulgate to discuss the issue of prompt remediation. Of these, Bulletins and Generic Letters require a licensee response. Both may request, but not require, licensee action or commitments. The other four generic communications are designed primarily to provide information to licensees. While they could be used to raise the awareness of the importance NRC attaches to prompt remediation, these communications cannot impose new requirements on licensees. Therefore, this approach would not be fully responsive to the intent of the SRM.

### 3.3.2.4 Issue New Staff Guidance

NRC develops staff guidance in the form of Standard Review Plans, Inspection Guidance, and Enforcement Guidance. The purpose of this guidance is to inform the staff on implementing existing regulations. Because the purpose of this proposed rulemaking effort is to develop new licensee requirements, this approach would not achieve the intent of the SRM, to mandate licensee action regarding radiological contamination.

### 3.3.3 No Action

Under this alternative, the NRC staff would not change its case-by-case approach, and would rely on existing regulations and guidance documents to encourage licensees to consider prompt remediation after spills or leaks. Because there are no regulations requiring prompt remediation, there would not be any improvement in managing radiological contamination. This alternative also would not meet the intent of the SRM.

#### 4. Preferred Approach

##### 4.1 General Description

NRC “Standards for Protection Against Radiation” specify dose limits for exposure to individuals during operations. However, as discussed in Section 2, there are currently no NRC regulations that require licensees to promptly remediate radiological contamination during operations, regardless of the volume or contaminant concentration levels. NRC regulations also require licensees to remediate their sites to approved release criteria as a condition for license termination. While there are about a half dozen sites, known as legacy sites, that have not been able to reach the release criteria, there have not been any new legacy sites created since implementation of the rule requiring financial assurance for decommissioning. There exists, however, the potential for future financial challenges, for example non-utility licensees do not have specific sources of funds for costs greater than the decommissioning trust fund, and improved detection of migrating contamination requiring larger-than-estimated volumes of waste to be disposed.

In order to improve overall site health and safety, facilitate decommissioning, and further reduce the likelihood of new legacy sites, NRC is proposing to establish prompt remediation requirements during the operations phase of plant life. NRC would not establish any new regulatory dose limits with this proposed rule. A new, risk-informed regulation would require prompt physical remediation as the corrective action only if licensees exceed an existing public or worker dose limit. At lower levels, but above background, the potential regulation would require licensees to evaluate site conditions and establish a risk-informed course of action.

Dose calculations begin with measured concentrations, but require substantial additional information regarding potential receptors, exposure pathways, and time and location of potential exposure. Therefore, NRC's preferred risk based approach to address this regulatory issue is a rulemaking to require licensees to promptly conduct a detailed ALARA analysis of the effects of radioactive spills and leaks when concentrations exceed certain threshold limits. Licensees would use the results of this analysis, that should include operational safety requirements to develop, and justify, a schedule for managing the contamination.

#### 4.2 Preferred Action Levels

An action level is not a regulatory limit. The purpose of an action level is to establish a threshold beyond which licensees would be required to perform an evaluation that may result in a requirement to perform prompt remediation. It should be readily available and with parameters that are uncomplicated to measure for comparison.

Staff identified two potential action levels to initiate licensee action: 25 mrem/yr and 50 mrem/yr calculated dose. Based on the discussion above and stakeholder comments, staff's preferred concentration levels are those approximately equivalent to 50 mrem/yr calculated dose.

Because this is greater than the 25 mrem/yr limit for release for unrestricted use, media with the proposed concentrations are likely to require some remediation for license termination.

Therefore, these thresholds are appropriate for initiating licensee action during operations.

Because measuring concentrations is less complicated than taking those measurements and then performing a dose calculation, staff decided to identify existing sets of concentrations to use for these thresholds. For ground water, staff selected the concentrations for effluents listed

in Appendix B to Part 20<sup>4</sup>. While effluents are not ground water, exposure to these liquid concentrations could cause a dose greater than the limits for release for unrestricted use in 10 CFR 20.1402. Therefore, these are appropriate surrogates. The equivalent concentrations in soil would then be two (2) times the screening values list in NUREG-1757<sup>5</sup>.

The risk-informed preferred approach would also allow licensees to delay remediation when the site meets certain conditions related to operational safety. Additionally, NRC would emphasize that it is prudent for licensees to perform sampling and monitoring efforts early on and regularly after discovery of a leak or spill.

#### 4.3 Preferred Approach – Required Analyses

Staff generally expects that licensees of sites that exceed the action levels will promptly remediate to ALARA levels. However, staff also recognizes that prompt physical remediation may not always be effective or efficient. In these cases, licensees would identify, evaluate, and compare alternative courses of action. To justify delaying remediation, licensees would be required to conduct supporting analyses, such as risk assessment, cost-benefit, or other analyses, and make these analyses readily available for the NRC's review. Licensees may also perform site-specific dose analyses, if they so wish. The NRC staff envisions these analyses as assessing a variety of factors. For example, the analyses could include: (1) risk to human health and safety, (2) facility operational performance and safety; (3) contaminant characteristics, and (4) cost. The evaluation would include an assessment of the likely residual radioactivity concentrations and volumes of material likely to be present at the time of

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<sup>4</sup> 10 CFR 20 Appendix B Table 2

<sup>5</sup> NUREG-1757 Volume 2, Appendix H

decommissioning. The evaluation may consider the hydrogeological characteristics of the site, including the ground water flow and contaminant transport characteristics, to determine if the subsurface contaminants are mobile or not. Analyses addressing the risk to human health and safety could include factors for assessing the risk associated with spills or newly identified contamination found on a site. Examples of such factors are listed below. The results would identify situations that could require prompt remediation, and other situations in which delayed remediation may be justified.

In evaluating risk to human health and safety, for the first factor, risk may be divided according to site potential:

Lower hazard sites:

- Shorter hazard duration: shorter exposure persistence or shorter radionuclide half-life.
- Lower hazard level: calculated dose is less than an established public dose limit.

Higher hazard sites:

- Longer hazard duration: longer exposure persistence or longer radionuclide half-life.
- Higher hazard level: calculated dose is greater than an established public dose limit.

For the second factor (facility operational impact and safety), licensees would need to consider the potential impacts on facility operational safety by remedial activities. The licensee would need to assess the likelihood that digging or other activities related to remediating subsurface contamination could disrupt safe operations, e.g. by severing



essential electrical cables, rupturing piping containing radioactive fluids or impact other plants systems supporting safe operation.

For the third factor (contaminant characteristics), licensees would need to evaluate contaminant characteristics such as quantity of residual radioactivity and its potential effects, both during operations and at the time of license termination. Depending on the facility, there could be a spectrum of potential contaminants in a spill or leak.

For the fourth factor (cost), licensees would need to evaluate the cost of remediation. To evaluate the cost-effectiveness of prompt remediation, the licensee could compare the future cost of a cleanup, e.g. remediating to 10 CFR 20.1402 criteria at license termination, to the cost of an immediate cleanup, with the lower value deemed to be more cost-effective. If non-routine activities are necessary to maintain plant safety or continuing plant operations during prompt remediation, these costs should be included in the calculation. Licensees would need to determine the cost of prompt cleanup, the cost of the future cleanup, an interest rate to represent the weighted average cost of borrowing for the licensee, and the number of years in the future when the cleanup will occur.

These examples do not encompass all of the factors that affect the decision to promptly remediate contamination at a site. As the NRC staff further develops the rulemaking and associated implementation guidance, the factors to be analyzed and evaluated by the licensees will be specified.

#### 4.4 Preferred Approach – Expected Outcomes

The NRC preferred approach is to proceed with rulemaking that requires prompt remediation when warranted by an evaluation. The primary benefit of this rulemaking approach is to reduce the likelihood of a legacy site; it includes potential benefits to public health and safety and the environment. In addition, the NRC's preferred approach likely would result in enhanced administrative and regulatory effectiveness of the NRC, the regulatory authorities in the Agreement States, and the affected licensees. Expected benefits may accrue in the following areas:

- 1) decreased risk of a legacy site due to prompt remediation of significant residual radioactivity
- 2) decreased waste volumes for disposal at the time of decommissioning
- 3) potential cost savings from early remediation and disposal
- 4) decreased risk to the public health and safety resulting from the exposure to ionizing radiation caused by serious events or other inadvertent spread of contamination;
- 5) decreased risk to the health and safety of occupational workers resulting from reduced likelihood of inadvertent exposure to ionizing radiation in areas with radioactive materials spills or other contamination;
- 6) improved public trust and confidence;
- 7) improvements in regulatory and administrative efficiency;

Impacts of the rulemaking include possible additional costs to affected licensees and the NRC.

The following costs are expected to be incurred:

- 1) implementation costs to licensees (e.g., one-time costs to change policies and procedures);
- 2) implementation costs to the NRC (e.g., one-time costs to promulgate rulemaking, develop implementation guidance, Standard Review Plans, and other internal procedures);
- 3) operational costs to licensees:
  - a. conduct analyses when contaminant action levels are met;
  - b. remediate the same area multiple times
  - c. disrupt normal operations for remedial activities (e.g. temporary, unplanned shutdown); and
- 4) operational costs to the NRC (e.g., review analyses conducted by licensees).

The proposed regulations would clearly delineate licensees' responsibility to pursue timely evaluation of site conditions and responses, including remediation, in the event of significant leaks and spills. The rule language would define the basis for determining whether a leak or spill is significant. In addition, the proposed rule would place a limit on the time permitted to remediate and place the burden of proof directly on the licensee to demonstrate that a longer time is required for completing remediation.

The time requirements for completing remediation include the times for initiating the remediation process. In determining an appropriate requirement for initiating remediation, the following will be considered: (1) the benefit in terms of reduced volume of decontamination wastes produced, and possible reduced worker dose, which may be realized by delaying decontamination to await decay of short-lived radionuclides; and (2) determining the appropriate time requirements for

completing subsequent decommissioning-related activities, including the time needed to plan and safely carry out remediation.

## 5. Backfit Considerations

The NRC's backfit rules relate to the agency actions that impose new or revised staff positions or requirements on licensees. The current NRC regulations apply to backfitting nuclear power reactors and certain nuclear materials facilities. Generally, three types of backfits are recognized in the NRC backfit rules: i) compliance, ii) adequate protection (including defining and redefining the level of adequate protection), and iii) cost-justified substantial increase in safety. The first two types of backfits are termed as exceptions. They do not require findings of substantial safety improvements. Moreover, economic costs can never be a consideration in (a) either defining or redefining what is an adequate level of protection or in ensuring that an adequate level of protection is achieved and maintained or (b) requiring compliance with regulations that ensure adequate protection. Facility-specific backfit is the result of the staff's attempt to ensure that a particular facility provides public health and safety and common defense and security, or complies with the Commission rules, policies, or guidance that are consistently applied to other licensees. For all backfits required to ensure either adequate protection of public health and safety or common defense and security, or compliance with Commission regulations or order(s), or the facility license conditions or technical specifications, the staff must prepare a documented evaluation to justify the proposed agency action.

In general, licensees must respond to requests for information from the staff. NRC must prepare the reasons for the information request to ensure that the burden imposed on licensees is justified in view of the potential safety (or security) significance of the issue to be addressed.

Staff opinion is that the ALARA-type analyses identified in the preferred alternative is within the scope of information collection, and that it is justified.

Because of the breadth of the potential alternative actions, from maintaining the *status quo* to requiring analyses to requiring physical remediation, it is not possible at this time to make a detailed backfit evaluation. When the planned action is defined and the draft rule language is fully developed, the staff will do an evaluation to determine whether that action would satisfy the backfit regulations at 10 CFR 70.76, 10 CFR 72.62, and 10 CFR 76.76 for materials facilities or 10 CFR 50.109, 10 CFR 52.39, and 10 CFR 52.63 for power reactors.

## 6. Stakeholder Interactions

Early public participation is a key to success. In addition to the general public, other stakeholders may include representatives of licensee and trade organizations, Federal agencies, state regulators, and interested non-governmental organizations (NGOs). The NRC staff has identified stakeholders with keen interest in the issue of prompt remediation. For example, in addition to the NRC staff, there are other federal and state regulators, such as EPA and state departments of environment and health, which have important roles to play when licensees detect residual radioactivity. Another stakeholder group includes the range of potentially affected licensees of both the NRC and the Agreement States.

In order to solicit the stakeholders' input to inform the NRC's decision on how to implement the requirements of the SRM, staff issued a letter to stakeholders and conducted a Category 2 public meeting by "webinar" on July 25, 2011. Participants included stakeholders representing the broad spectrum of interests who may be affected by the outcome of the draft proposed technical basis. The staff requested feedback on the draft proposed technical basis, staff's

preferred approach and the potential criteria that could be used to compel licensee to take actions. Staff also asked participants to propose any alternatives they believe should be included to implement the SRM, to comment on the required analyses proposed by the NRC, and provide suggestions on how to improve the NRC's preferred approach.

The comments are available in <http://www.regulations.gov> at Docket NRC-2011-0162. There were ten commenters. Several opposed a new rule for various reasons, but principally they contended there were sufficient existing NRC regulations to address the issue. A few were in favour of a new rule based on belief that it could affect remediation of known contamination at certain sites and preclude occurrence of large volumes of contamination occurring in the future. Some types of licensees expressed the opinion that it would be acceptable to have a new rule so long as they were exempted because of low likelihood of occurrence of such conditions at their facilities, or because there had not been any previous credible threat to public health and safety from their facilities. One commenter presented a technical argument that any such rule should be based strictly on dose calculations, not on concentrations as was presented in the Draft Proposed Technical Basis. The commenter also argues that using NRC screening values for soil concentrations and EPA MCLs for water concentrations was not appropriate because they were developed for different purposes.

## Staff Response to Comments

Commenters argued that NRC should set any such requirement in terms of dose rather than concentration. Staff does not fully agree. The purpose of this action is not to have licensees demonstrate compliance with any regulatory limit, nor is it to set new regulatory limits. If any existing regulatory dose limits are approached, licensees are already required to respond. The bases of the DPR are to ensure licensees are fully aware of the residual contamination, and have sufficient funds to complete decommissioning and terminate licenses. The purpose of this proposed rule is to minimize the amount of residual radioactivity on-site during the operational phase of plant life, and when appropriate to remediate the contamination to reduce waste disposal volumes at the time of decommissioning.

Commenters argue that using the screening values in Appendix H to NUREG-1757 Vol. 2 and MCLs are not appropriate because this would require licensee to take action when they are not required to do so by the basis documents. Staff agrees. The NRC technical guidance for the use of the screening criteria is that they are applicable to Decommissioning Groups 1–3. By definition, these Groups do not have any sub-surface or ground water contamination. Therefore, screening values are not appropriate for determining the cost of remediating subsurface contamination. MCLs are not appropriate because they are for drinking water at the point of consumption, not subsurface residual radiological contamination at an operating facility that is not used for drinking water.

The staff uses the term “action level” to distinguish it from existing regulatory and compliance limits. The purpose of these action levels is to trigger licensee evaluation of site conditions and develop a plan of action. To reduce possible confusion with existing regulatory limits, staff uses

concentration measurements as action levels rather than doses, which are regulatory limits. Activities under this rule should be considered as actively pursuing ALARA during operations, thereby reducing the remediation burden at the time of license termination.

Staff considered the following concentration values for setting thresholds:

- Decommissioning screening values for soil and MCLs for water. Staff concluded that these values were too conservative for the purposes of planning for decommissioning during operations because residual radioactivity is limited to simple sites with building surface (i.e., non-volumetric) and/or with surficial soil [approximately 15 cm (6 in)]; the unsaturated zone and the ground water are initially free of residual radioactivity. Simple and conservative models/codes and parameters, under generic scenarios and default site conditions are used to define the limits of residual radioactivity.
- Existing effluent discharge limits of Table 2 of Appendix B to Part 20 for water (Table 2 could also be used for airbourne concentrations), which equate to about a 50 mrem/yr dose at the exposure point. The equivalent for soil is two times the screening values in Table B.2 of NUREG-1757 V. 1. These provide reasonable thresholds for decommissioning planning and ALARA.



## 7. References and Pertinent Documents

Branch Technical Position "When to Remediate Inadvertent Contamination of the Terrestrial Environment," October 1994. (ML093240400)

SRM-SECY-07-0177, "Staff Requirements – SECY-07-0177 – Proposed Rule: Decommissioning Planning (10 CFR Parts 20, 30, 40, 50, 70, and 72; RIN: 3150-AH45)," December 10, 2007. (ML073440549)

SECY-07-0177, "Proposed Rule: Decommissioning Planning (10 CFR Parts 20, 30, 40, 50, 70, and 72; RIN: 3150-AH45)," October 3, 2007. (ML072390153)

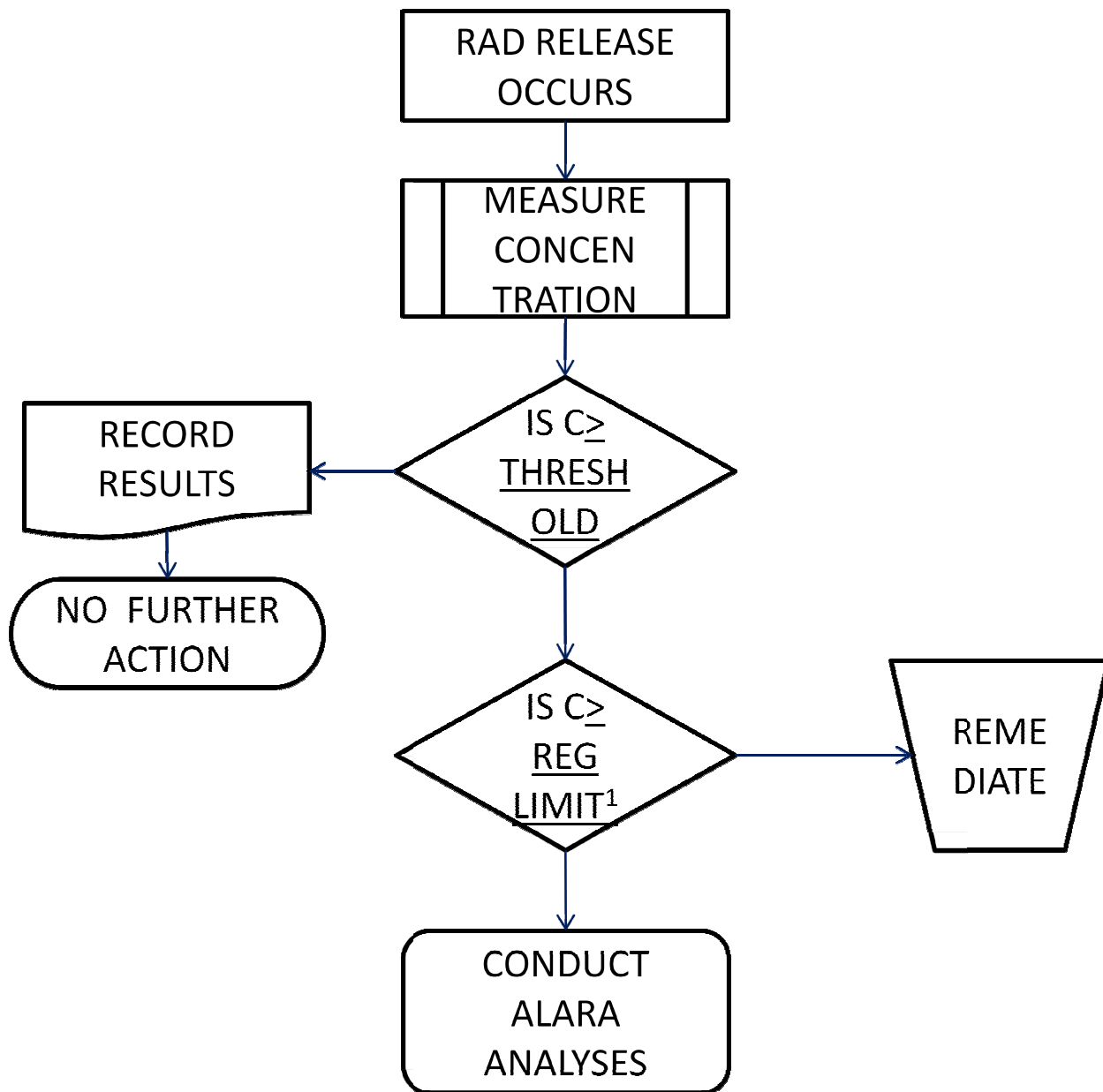
Final Rule: Revisions to 10 CFR Parts 20, 30, 40, 50, 70, and 72, Decommissioning Planning, 76 *FR* 35512, June 10, 2011. (ML103510117)

Draft Regulatory Guide DG-4014, "Decommissioning Planning During Operations," July 2011. (ML111590642)

NUREG-1757, Volume 3, Revision 1, "Consolidated NMSS Decommissioning Guidance," January 2012. (tbd)

SECY-11-0019, "Senior Management Review Of Overall Regulatory Approach to Groundwater Protection," February 9, 2011. (ML110050525)

DECISION TREE FOR ACTIONS  
FOLLOWING UNPLANNED RADIOACTIVE RELEASES



1: Regulatory limits are given in dose. If the measured concentrations exceed 4x the NRC screening values for soil or 2x Table 2 of Appendix B to Part 20 for water, conduct a dose analysis.