UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

January 16, 2002

NRC REGULATORY ISSUE SUMMARY 2002-02: LESSONS LEARNED RELATED TO RECENTLY SUBMITTED DECOMMISSIONING PLANS AND LICENSE TERMINATION PLANS

Addressees:

All U.S. Nuclear Regulatory Commission (NRC) licensees.

Intent:

To inform addressees of lessons learned from reviews of recently submitted decommissioning plans (DPs) and license termination plans (LTPs). No specific action or written response is required.

Background:

NRC is issuing this regulatory issue summary (RIS) to provide licensees with information that may help them develop more complete DPs and LTPs which should result in more effective and efficient use of both licensees' and NRC's resources.

This information is being provided to licensees as part of the NRC staff's effort to implement the NRC Strategic Plan, specifically, our performance goal of making NRC activities and decisions more effective, efficient, and realistic.

Summary of Issue:

On July 29, 1996, Title 10 of the U.S. Code of Federal Regulations (10 CFR) 50.82 was revised to define a new process for decommissioning power reactors [61 Federal Register (FR) 39301]. This new process included a requirement for licensees of power reactors to submit LTPs, rather than DPs, when they wanted their facility licenses terminated. On July 21, 1997, 10 CFR Part 20 was revised to include criteria for determining the adequacy of remediation of residual radioactivity (62 FR 39088). This revision to Part 20 affects most licensees. As a result of these revisions to the regulations, certain licensees are required to submit either DPs or LTPs to have their facility licenses terminated. These revisions to the regulations require new information or different types of information than previously required.

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Since the implementation of these revisions to the regulations, several licensees have submitted either the required DPs or LTPs for NRC review. As a result of these reviews we have found common areas that have resulted in NRC issuing several requests for additional information (RAIs) and licensees performing additional analyses to address those RAIs. These additional activities result in delays in completing these reviews. Further, these additional RAIs resulted in increased costs to licensees, either because of the costs associated with responding to these RAIs, or NRC charges for additional staff time to complete these reviews.

The staff has reviewed, or is in the process of completing reviews of several DPs or LTPs. As a result of these reviews, the staff has learned the following lessons. A detailed discussion of each of these lessons learned is provided in Attachment 1.

1. **Communications -** Early and frequent discussions between NRC staff and licensees are encouraged during the planning and scoping phase supporting the preparation of the DPs or LTPs.

2. **Groundwater -** Additional environmental monitoring data may be needed because there may not be enough operational environmental monitoring of groundwater for adequate site characterization and dose assessments.

3. **Data Quality Objectives -** The data quality objectives process is encouraged in planning and designing the final status survey plan.

4. **Inspections -** In-process inspections are more efficient than one-time confirmatory surveys.

5. **Flexibility -** Continued communications between NRC staff and the licensee during the staff's review is encouraged to help the licensee take full advantage of the inherent flexibility in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual," and NUREG-1727, "NMSS Decommissioning Standard Review Plan."

6. **Modeling Issues -** Submittal of assumptions and justification for parameters used in developing site-specific derived concentration guideline levels (DCGLs) and application of those DCGLs is encouraged.

7. **Decommissioning Cost Estimate -** The discussion should include a clear relationship between the planned decommissioning activities and the associated updated cost estimate.

8. **Records -** Old records should not be used as the sole source of information for the historical site assessment/site characterization, because these old records may be inadequate or inaccurate.

9. **Environmental Assessments -** Some environmental submittals have not provided sufficient information addressing non-radiological impacts of the proposed action, as required by the National Environmental Policy Act.

10. **Classifications of Survey Units -** DPs and/or LTPs should be submitted only after sufficient site characterization has occurred.

11. **Embedded Piping -** Some LTPs and DPs have not adequately described the methods the licensee plans to use when surveying the embedded piping planned to be left behind.

12. **Minimum Detectable Concentrations -** Some LTPs and DPs have not adequately described the methodologies the licensees plan to implement to scan minimum detectable concentrations of mixtures of radionuclides that may remain in given survey areas/units.

As a result of these findings, the staff has expanded its acceptance review process for DPs and LTPs (typically an administrative review) to include a limited technical review before a DP or LTP will be accepted for detailed review. An expanded acceptance review facilitates the identification of significant technical deficiencies early in the review process. This limited technical review focuses on those areas in which experience has shown technical deficiencies in licensees' submittals. In general, these areas are:

- Site characterization (hydro-geological and radiological);
- Dose modeling;
- Final radiation survey;
- Cost estimate; and
- Institutional controls (applicable only to restricted release).

BACKFIT DISCUSSION

This RIS requests no action or written response and is, therefore, not a backfit under 10 CFR 50.109, 72.62, nor 76.76. Consequently, the staff did not perform a backfit analysis.

FEDERAL REGISTER NOTIFICATION

A notice of opportunity for public comment was not published in the Federal Register because this RIS is informational and requires no action or written response by addressees.

PAPERWORK REDUCTION ACT STATEMENT

This RIS does not request any information collection.

This RIS requires no specific action nor written response. If there are any questions about this matter, please contact the person listed below, the appropriate project manager, or the appropriate regional office.

/RA/
David B. Matthews, Director
Division of Regulatory
Improvement Programs
Office of Nuclear Reactor Regulation

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John T. Greeves, Director
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Attachments:
1. "Discussion of Lessons Learned"
2. List of Recently Issued NRC Regulatory Issue Summaries

Technical Contact: Stewart W. Brown, NMSS
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DISCUSSION OF LESSONS LEARNED

The staff has reviewed, or is in the process of completing reviews of several decommissioning plans (DPs) or license termination plans (LTPs). As a result of these reviews the staff has learned the following lessons:

1. **Communications -** Early and frequent consultations between U.S. Nuclear Regulatory Commission (NRC) staff and licensees are encouraged during the planning and scoping phase supporting the preparation of the DPs or LTPs. In this context, a licensee may schedule a meeting with the NRC Project Manager assigned to the site to discuss the planning and content of the LTP or DP. The discussions would address, among other topics, past and current licensed operations; types and quantities of radioactive materials used or stored; activities (current or past) that may have an impact on decommissioning operations; decommissioning goals (restricted vs. unrestricted license termination); basis for cleanup criteria and development of site-specific derived concentration guideline levels (DCGLs), or commitment to use NRC default DCGLs; potential impact on public health and safety or the environment; funding plan and financial assurance; and the minimum information required to be contained in the LTP or DP. Regarding the aforementioned topics, licensees are encouraged to review NUREG-1727 ("NMSS Decommissioning Standard Review Plan," September 2000). The principal purpose of NUREG-1727 is to provide guidance on review of DPs. However, the guidance in NUREG-1727 supplements that in NUREG-1700 ("Standard Review Plan for Evaluating Nuclear Power Reactor License Terminations Plans") in such areas as site characterization, dose modeling, final radiation survey, and institutional controls. NUREG-1727 provides a structure, using 16 modules, with which to provide information for staff review. With the exception of the executive summary, each module addresses very specific elements of the decommissioning process and related data and information needs. Given that NUREG-1727 presents the information in a generic context, it is the responsibility of the licensee to go over each module and determine which technical elements or regulatory requirements apply to the facility. Appendix A of NUREG-1727 provides a checklist ("Acceptance Review Checklist") to facilitate this process. Given that the checklist is a brief summary of the material presented in each module, it is recommended that each module be reviewed to gain a full understanding of the requirements as the checklist is being prepared.

   Before meeting with the NRC staff, a licensee is encouraged to prepare a checklist that identifies technical elements that are applicable (based on a preliminary review); areas that require clarifications from the NRC staff before decisions can be made as to their applicability to the site or facility; and scope and level of technical details addressing technical elements and regulatory requirements. In addition, the licensee may wish to make a brief presentation describing the past and current use of the facility and its most current radiological status. During the meeting, the NRC staff and licensee representative would go over each item of the checklist and address specific questions. NRC would present an overview of its review process, including discussions of the time line and major milestones. The end product of the meeting is a marked-up checklist that defines the technical elements and regulatory requirements to be covered in the DP or LTP submittal. The staff believes that this process will result in a better understanding

of the type of information to be included in either document and to familiarize the licensee with the process that the staff will use to evaluate the information contained in the DP or LTP. This approach is expected to minimize the need for requests for additional information, reduce the number of iterations and submittals, and expedite the staff's technical review.

2. **Groundwater -** Operational environmental monitoring of groundwater, although adequate for its intended purpose, may not be adequate for site characterization and to support dose assessments. As noted in NUREG-1727, "NMSS Decommissioning Standard Review Plan," Section 4.6, "Groundwater," "[T]he information supplied by the licensee should be sufficient to allow the staff to fully understand the types and movement of radioactive material contamination in groundwater at the facility, as well as the extent of this contamination." The actual number, location, and design of monitoring wells depend on the size of the contaminated area, the type and extent of contamination, the background quality, hydrogeologic system, and the objectives of the monitoring program. For example, if the objective of monitoring is only to indicate the presence of groundwater contamination, relatively few downgradient and upgradient monitoring wells are needed. In contrast, if the objective is to develop a detailed characterization of the distribution of constituents within a complex aquifer as the design basis for a corrective action program, a large number of suitably designed and installed monitoring wells may be necessary. Power reactors normally have groundwater monitoring programs as part of their radiological environmental monitoring programs (REMPs). Although data derived from a REMP may provide useful information, the data still tend to be insufficient to allow the staff to fully understand the types and the movement of radioactive material contamination in groundwater at the facility, as well as the extent of this contamination. Therefore, a licensee may need to gather additional data to understand the types and movement of radioactive material contamination in groundwater at the facility, as well as the extent of this contamination.

3. **Data Quality Objectives -** In developing the final survey design, the licensee needs to identify all appropriate data quality objectives (DQOs) in planning and designing the final status survey plan. The process of identifying the applicable DQOs ensures that the survey plan requirements, survey results, and data evaluation are of sufficient quality, quantity, and robustness to support the decision on whether cleanup criteria have been met using statistical tests. In brief, the major elements of the DQO process are:

   a. A clear statement of the problem (i.e., a full understanding of the radiological status of the facility and extent and magnitude of the contamination);

   b. The identification of all related decision statements and alternative actions, including selection of the most appropriate scenario for the site and objectives (i.e., how will compliance be demonstrated?);

   c. The identification of the information needed to support the decision-making process, such as radionuclide distributions and concentrations, methods used to obtain the data, etc.;

d. The definition of the site physical, temporal, and spatial boundaries for all environmental media and structures, including reference areas, that will be covered by the decision process and modeling;

e. The development of a decision rule in defining action levels [e.g., DCGL-Wilcox rank ($DCGL_W$); DCGL- elevated measurement comparison ($DCGL_{EMC}$); minimum detectable concentrations (MDCs)]; grid size and layout; statistical tests; and hypothesis;

f. Specifying limits for Type I and II decision errors in support of the null hypothesis and impacts on sample size and use of prospective and retrospective power curves; and

g. Optimization of the data collection process and updating the design of the survey plan, while meeting all DQOs.

In purpose and scope, the DQO process can include a flexible approach in planning and conducting surveys and for assessing whether survey results support the conclusion that release criteria have been met. The DQO process can be an iterative process that continually reviews and integrates, as needed, new information in the design of the final survey plan and decision-making. Finally, the selection and optimization of DQOs will facilitate the later evaluation of survey results and decision-making processes during the data quality assessment phase. The NRC staff has observed that licensees have had difficulties in developing DQOs and have not taken full advantage of the DQO process, especially the optimization step. Experience has shown that the process is often rigidly structured by relying too much on characterization data and not being readily open to the possibility of incorporating new information as it becomes available. This approach makes the implementation of any changes difficult and is an inefficient use of resources, since it imposes time delays while determining how to implement any changes.

4. **Inspections -** In-process inspections are more efficient than one-time confirmatory surveys. In one case, the confirmatory survey was conducted after the licensee had completed most of the final survey and many of the staff supporting the final survey were no longer available to address questions and issues that were discovered while conducting the confirmatory survey. Simply put, the confirmatory survey was conducted too late in the process.

   The in-process approach has allowed the licensee and NRC to take side-by-side measurements, compare instrument readings and sensitivity, and address survey issues early in the process rather than at the end of the process. The in-process approach has resulted in significant savings in cost, assured a more accurate survey, and helped the licensee in maintaining its release schedule.

5. **Flexibility -** Continued communications between NRC staff and the licensee during the staff's review is to help ensure that the licensee is able to take full advantage of the inherent flexibility in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM) and NUREG-1727, "NMSS Decommissioning

Standard Review Plan." In reviewing LTPs and DPs, the staff has observed that licensees are often boxing their approaches into rigid structures and formats, thereby locking out any operational flexibility in implementing MARSSIM and negating cost savings. This approach may reflect, in part, the interpretation of NRC guidance as regulatory requirements. However, it is possible to meet NRC requirements, while instilling operational flexibility into the overall decommissioning process. For example, large waste volumes alone do not necessarily make a remediation project a complex one, assuming that adequate resources are available to accommodate the higher disposal cost. What makes a decommissioning project complex includes such considerations as groundwater contamination; the presence of hard-to-detect and transuranic radionuclides (TRU); heterogeneous distributions of contaminants; the presence of mixed waste; onsite disposal using engineered features; and reliance on institutional controls to maintain doses within NRC limits under restricted-release scenarios, among others. Even under such conditions, there still is an opportunity to simplify the process, maximize operational flexibility, and benefit from economies of scale.

Another example involves how final surveys are structured and designed around survey units, in recognition that some sites may have literally hundreds of survey units, with licensees perceiving that NRC needs to approve the final status survey design of each one. NRC expects that licensees will group survey units into a manageable number of categories, taking into account the types of buildings, rooms, areas, built-in equipment, and other specific features. This approach is expected to provide the means to identify and address survey unit features and design requirements that are specific for each category, while treating all other common aspects of the survey design in a generic and systematic manner. The staff suggests that the descriptions identify and address, as is applicable, specific survey design requirements, data quality objectives, sampling methodology, applicable plans and procedures, quality assurance requirements, and data analysis and interpretation for each category. This approach will relieve NRC of having to review and approve each survey design package, before its implementation, and will expedite the final phases of the remediation work, while leaving the development and implementation of each final survey design package subject to periodic regional inspection and enforcement actions. Finally, in structuring the final status survey report, licensees are expected to identify and summarize the specific characteristics of each survey unit and discuss their relevance in the analysis of all survey results and interpretation supporting the conclusion that each survey unit meets the cleanup criteria.

6. **Modeling Issues -** The derivation of DCGLs should include the assumptions and justification for parameters used, and justification for how these DCGLs will be applied to various survey units on site. DCGLs will be captured by license condition as part of the LTP approval process, and will require NRC approval for changes to the approved DCGLs.

Area Factors

Area factors are needed in the final status survey to determine the required scan MDCs and to develop $DCGL_{EMC}$ values that are needed to identify small areas that may need further investigation. However, area factors are typically not provided for residual radioactivity on building surfaces. The primary reason for this is that such factors cannot be calculated by using the DandD computer code. Therefore, when screening DCGL values are used, which were derived from DandD, an alternative approach must be used to calculate area factors for residual radioactivity on building surfaces.

One approach that has been successfully used is to develop the area factors by using the RESRAD-BUILD computer code and adjusting these derived area factors to account for the fact that RESRAD-BUILD typically gives less conservative dose estimates. With this approach, the screening DCGL values are converted into the appropriate concentration unit for RESRAD-BUILD (i.e., from "disintegrations per minute per 100 square centimeters" to "pico-curie per square meter"). Area factors calculated by RESRAD-BUILD can then be adjusted by the ratio of the dose from RESRAD-BUILD to 25 milli-roentgen equivalent man per year (i.e., the equivalent dose from DandD).

Volumetric Contamination

Nuclear power plants often have volumetric contamination (e.g., contamination below the surface) in the containment structure from activation products. Because the contamination occurs within a building structure, some licensees have assumed that it is appropriate to use DCGL values developed for building surface contamination for these areas, without additional justification regarding the appropriateness of their use. However, DCGL values developed for building surface contamination may not be appropriate for areas with volumetric contamination, because the potential future exposure routes may be different, especially if the structure is later torn down.

It is advisable for licensees to develop specific DCGL values, for volumetric contamination, which consider the potential routes of exposure for residual radioactivity in the material if the structure is eventually torn down. As an alternative, licensees can demonstrate that the DCGL values developed for surface contamination will bound the possible effects from exposures for other configurations of the building structure.

Model Results

Licensees using RESRAD, DandD, or other computer codes to generate DCGL values or perform dose analyses often do not include the printout from these codes as part of the decommissioning submittal. This information is typically omitted because the output results tend to be voluminous. However, without this information it is difficult for staff to undertake confirmatory analyses (if needed) or to complete its review of the licensee's analyses.

It is advisable for licensees to provide output results from any analyses used to develop DCGL values or used to perform dose analyses. If the output results do not provide an echo of the inputs used in the analyses, it may be necessary to also provide copies of the input files.

Nondispersion vs. Mass Balance Models

In using the RESRAD computer code to develop DCGL values or to perform dose analyses, licensees often use a nondispersion model for evaluating the groundwater pathways. This model is commonly used because it is the default in RESRAD and therefore will be used unless specifically changed. However, the nondispersion model makes certain assumptions about the location of the future hypothetical well and will generally give lower estimated doses than the mass balance model (if the groundwater is an important pathway).

It is advisable for licensees to either use the more conservative mass balance models or provide justifications for using nondispersion models. Specific guidance on justification for using the nondispersion model can be obtained from NUREG-1727 (pages C47-C50).

Parameters

Licensees often use a combination of default and site-related parameters in their analyses to develop DCGL values or in dose analyses. In many cases, little or no justification is provided for the reason for using the specific parameter values used in the analysis. This can lead to uncertainties in assessing the appropriateness of the DCGL values or calculated dose in demonstrating compliance with the standard.

Given the large number of parameters that may have to be justified in an analysis to develop DCGL values or a dose analysis, NUREG-1727 (Section 7 of Appendix C) discusses an approach for focusing on those parameters most important to the results. This approach entails classifying parameters as either behavioral, metabolic, or physical, as defined in NUREG/CR-5512, Volume 3. Licensees may use default values for behavioral and metabolic (primarily those prescribed for DandD) as long as the values are consistent with the generic definition of the average member of the critical group, and the screening scenarios are used. Site-specific physical parameter values should be used and justified. The level of justification needed is dependent on the significance of the parameter to the results. The relative significance of parameters to the results can be determined through a sensitivity analysis. In the sensitivity analysis, the default statistical distributions provided in RESRAD 6.0 and RESRAD-Build 3.0 should be used, supplemented with what is known about the site (*note: default distributions should not be used as a substitute for known information*). Known parameter values should be treated as a constant in the sensitivity analysis. The relative significance of the various parameters can be determined based on the ranks listed in the regression and correlation results in the uncertainty report. The default surface contamination values for alpha-emitting radionuclides are rather low, and in some cases below the detection limit. This results from a conservative resuspension factor (RF) used in the DandD code. Therefore, the licensee may wish to consider using a more realistic RF value for site-specific analyses.

7. **Decommissioning Cost Estimate -** There needs to be a clear relationship between the planned decommissioning activities and the associated cost estimate. At the license

termination stage, the Commission must make decisions on the proposed actions described in the LTP. The Commission typically considers: 1) the licensee's plan for assuring sufficient funds will be available for final site release; 2) radiation release criteria for license termination; and 3) the adequacy of the final survey required to verify that the site release criteria have been met. 10 CFR 50.82(a)(9)(ii)(F) requires the licensee to provide, in part, an updated site-specific decommissioning cost estimate. If little decommissioning has been completed, and inflation and disposal costs have not changed, the cost estimate required by 10 CFR 50.82(a)(8)(iii) may be acceptable. NRC is not requiring the licensee to submit any contractual documents/agreements that exist between the licensee and its decommissioning contractor, and the cost estimate should not be impacted by the election of the licensee to decommission the facility, or contract to decommission the facility. However, for NRC to be able to make a finding that sufficient funding is available to complete decommissioning, the updated cost estimate of the remaining site dismantlement activities, and the remediation plan that outlines how the decommissioning will be conducted, must correlate. The updated cost estimate should be based on the remaining activities and the plans on how the actions will be completed. The updated site-specific cost estimate must address the remaining activities necessary to complete decommissioning, to assure sufficient funds are available, because the financial assurance instrument required under 10 CFR 50.75 must be funded to the amount of the cost estimate, and during decommissioning, the licensee has been allowed to withdraw the funds set aside for decommissioning.

8. **Records -** Old records may be inadequate or inaccurate for the purpose of developing either the historical site assessment (HSA) or site characterization. The staff suggests that these records not be relied on as the sole source of information for the HSA or site characterization. Interviews with current and former staff and contractors play an essential role in formulating the HSA. Experience has shown that old records and results of operational surveys and post-shutdown scoping surveys have been submitted as substitutes for characterization surveys. For example, the results of operational surveys may represent radiological status, describing conditions over a limited time span, or may have been conducted to address specific events (i.e., post-spill cleanup assessment). In a few instances, the results of personnel interviews and information, which can only be considered as anecdotal, have been presented in the HSA. It could not be determined whether this information, in fact, was part of an unbroken chronological history of the site or contained time gaps for which operational milestones or occurrences were missing. Although NRC encourages licensees to review old records and conduct personnel interviews (past and current employees and key contractors), there is a need to present this information in its proper context and qualify its usefulness and how it might be supplemented (e.g., via additional data searches or characterization surveys). To achieve the purpose of the HSA, a complete history of the residual contamination is needed. Given their importance, the staff suggests that characterization surveys be developed only after the licensee has conducted a thorough evaluation of the information collected during the site historical assessment.

Based on the review of several LTPs and DPs, the staff has found that licensees have generally done extensive characterizations of facilities slated for decommissioning. A review of selected characterization files (in support of decommissioning and turnover

surveys) revealed that a wealth of information is indeed available, but that it is not conveyed or presented clearly in LTPs and DPs. The information NRC seeks can be drawn from existing characterization records or supplemental analysis of existing samples, thereby avoiding the need to conduct additional surveys and to send workers into radiation areas -- all while minimizing costs. The type of information that is needed to support the preparation of LTPs and DPs focuses primarily on residual levels of contamination remaining on building surfaces or in soils (surface and subsurface), after the remediation work has been completed. The characterization of elevated contamination levels typically found in radiation areas is of no concern in addressing the design of final status surveys, since these areas are contaminated at levels that obviously exceed any realistic $DCGL_W$. NRC is seeking a better presentation, and perhaps evaluation, of existing data supporting specific DQO elements and justification for the approach proposed in developing survey designs. In most instances, it is not a question of generating more data -- rather, it is a question of making use of all existing data. There may be some exceptions where additional characterizations might be warranted. Such exceptions might apply to the characterization of subsurface soils, ground water, and TRU, since these may present unique challenges, but can be resolved without unnecessary radiation exposures.

9. **Environmental Reviews -** Environmental assessments need to address non-radiological impacts of the proposed action. In accordance with the provisions of the National Environmental Policy Act[1] all agencies of the Federal Government are required to assess the environmental impact of any major Federal action that may significantly affect the quality of the human environment. As part of NRC's approval of either a DP or an LTP, NRC is required to determine if that approval is a Federal action. Therefore, the impacts on the human environment associated with NRC approving either a DP or an LTP must be assessed. Further, this assessment must include both radiological and non-radiological impacts. Although most licensees normally provide sufficient information for the staff to assess the radiological impacts on the human environment, some licensees have not provided sufficient information related to current site-specific non-radiological impacts.

   Because actions associated with NRC's approval of a DP are different than those associated with NRC's approval of an LTP, the information required to assess the impacts on the human environment are different. That is, when NRC approves a DP, NRC is approving the licensee performing the activities necessary to remediate radiological contamination at a site.

   Therefore, a DP should include information addressing non-radiological impacts on the human environment associated with these proposed activities. Non-radiological impacts include, but are not limited to the following: land use; water quality; transportation; air quality; ecological; historical and cultural resources; hazardous material/waste; noise; visual/scenic quality; socioeconomics; and public and occupational health. However, under the provisions of 10 CFR 50.82, most if not all activities necessary to complete

[1] Public Law 91-190.

site remediation can be completed under the provision of 10 CFR 50.59. Therefore, these activities will not require prior NRC approval. Consequently, unless certain site-specific issues exist, NRC, when it approves an LTP, is approving only: (1) the adequacy of the decommissioning funding plan to assure that sufficient funding is available to complete the remaining radiological remediation activities; (2) the radiation-release criteria for license termination; and (3) the adequacy of the design of the final survey to verify that the release criteria have been met.

10. **Characterization Surveys and Classifications of Survey Units -** The staff recommends that submittal of the DP or LTP occur only after sufficient site characterization has occurred. The staff suggests that the LTP or DP provide sufficient information demonstrating the characterization of the radiological conditions of site structures, facilities, surface and subsurface soils, and groundwater. The staff has observed that some LTPs and DPs have been submitted with incomplete or inadequate characterizations of radiological conditions. A review of such LTPs or DPs has shown that the lack of information makes it difficult to agree with the rationale justifying the proposed classification of survey units. The staff suggests that the following issues related to the use of characterization survey results and classification of survey units be considered when developing either a DP or an LTP:

    a. *Use of operational, post-shutdown scoping, or turnover surveys as characterization surveys* - Characterization surveys are the most comprehensive of all surveys, yield the most information, provide the basis to design the final status survey plan, and are used for dose modeling as well. Characterization surveys are conducted to determine the current extent and magnitude, and variability (as surface and depth profiles) of the contamination, and radionuclide distributions and concentrations. Characterization survey results are used to guide remediation efforts, provide information with which to update waste volume and cost estimates, and develop DCGLs. Given their importance, the staff recommends that characterization surveys be developed only after the licensee has conducted a thorough evaluation of the information collected during the HSA, and the results of operational surveys and post-shutdown scoping surveys. Accordingly, it is not appropriate to use the results of past operational and post-shutdown scoping surveys as substitutes for characterization surveys conducted using the guidance of MARSSIM. For example, the results of operational surveys may represent radiological status describing conditions over a brief operational time span or may have been conducted to address specific occurrences (i.e., post-spill cleanup assessment). Moreover, the results of both operational and post-shutdown scoping surveys may be of limited use unless it can be shown that data quality, instrument calibration methods, and detection sensitivities (fixed and scan measurements) for the anticipated radionuclide mix are comparable to those defined for the characterization surveys based on MARSSIM guidance. These limitations also apply to turnover surveys conducted after the completion of remediation. In all three instances, this approach is also a departure from the MARSSIM methodology in that it defeats the statistical basis intended to confirm that survey units meet the release criteria. As is noted in MARSSIM (Sect. 5.5.2.5), "*Measurement locations based on professional*

judgement violate the assumption of unbiased measurements used to develop the statistical test described in Chapter 8" (of MARSSIM). If a licensee were to use turnover survey data for part of the final survey, statistical samples and/or measurements would need to be identified in addition to the turnover survey data. Also, the samples and/or measurements would need to be collected or made in compliance with MARSSIM guidance (i.e., random start and systematic sampling/measurements using an established grid). If not, such results can only be used as qualitative information and the related areas must be surveyed using the objectives of the proposed characterization survey plan using MARSSIM.

b. *Reclassification of Survey Units* - It may not always be appropriate to simply separate out an area of elevated activity, from a Class 2 or Class 3 survey unit, as an individual Class 1 survey unit since the initial basis for evaluating a Class 2 or 3 survey unit is based on specific criteria [i.e., 10 to 100 percent scan coverage for Class 2, and judgement (typically <10 percent) for Class 3 survey units]. Similarly, there is a need to provide the basis in delineating Class 3 survey units as buffer zones around Class 1 and 2 survey units and areas with insufficient justification to be classified as non-impacted. If survey results were to reveal elevated levels of contamination in an arbitrarily selected portion of a Class 2 or 3 survey unit, then the classification of the entire survey unit should be deemed suspect and re-evaluated, using MARSSIM guidance. In this context, the staff suggests first, that there should be considerations of: the assumptions made as to how the survey unit was initially classified; most likely or known causes of contamination; and the possibility that other similarly contaminated areas within the original survey unit might have gone undetected. The staff also suggests that a DP or LTP address these considerations and describe the method, consistent with MARSSIM, that will be used if a survey unit or portion of a survey unit must be upgraded to a higher classification level. In general, increasing the coverage of the scan is less expensive than finding areas of elevated contamination levels later in the process. Finding areas with elevated levels of contamination later in the process will require the conduct of additional surveys, lead to delays in reconsidering the initial classification of the survey unit, and will lead to additional regulatory scrutiny. The staff recognizes, in many instances, that LTPs or DPs are submitted at a time when some characterization work is still ongoing and that supplemental data may lead to the reclassification of some survey units. Accordingly, an LTP or DP should include the flexibility to accommodate changes in the classification of survey units as more characterization data are obtained and evaluated.

c. *Completeness of Characterization Survey Design and Results* - In some submittals, the NRC staff has noted that contamination results for plant structures, systems, and components; surface and subsurface soils; and groundwater are at times incomplete. For example, the review of data characterizing such areas or media has revealed that only limited information is being provided about the presence of TRU (e.g., plutonium-239, americium-241) and hard-to-detect radionuclides (e.g., hydrogen-3, carbon-14, nickel-63). In other instances, the data fail to provide sufficient information in determining the

fraction of surface radioactivity that is fixed and removable. Similar shortcomings were noted for removable alpha and beta radioactivity found in embedded piping, usually contained in residues, sediments, and internal film coatings. Although reporting histories of fuel cladding failures, some plants have not provided information on the presence of TRU in plant systems and at effluent discharge points. The characterization of neutron activation products in concrete and rebar is often limited in scope, and the presentation of the results fails to address the significance of the reported radionuclide concentrations and their applicability to other areas of the plant. In summarizing characterization results, there are instances when both the average and maximum surface beta activity results are below the stated MDCs. Such results are misleading since it is not clear if the stated MDCs are representative of all areas within a survey unit or whether there might be multiple MDCs that could be unique to distinct areas within each survey unit. Such results imply that the variability may apply to all areas within a survey unit, when perhaps the variability of the contamination might be multi-modal if it were evaluated by separate and smaller areas. This problem, in part, is attributed to how the data are edited for summarization. In other instances, licensees have proposed radiological results characterizing radionuclide distributions and concentrations using smears/wipes, air filters, and debris, with no rationale as to the relevance of the information. It should be noted that characterization survey results provide the most important information [i.e., the basis to design the final status survey plan; define radionuclide distributions and concentrations; identify hard-to-detect radionuclides and develop surrogate ratios; define survey area classifications; and assign the sigma characterizing the variability of the contamination (a key parameter in determining the number of samples in survey units)]. Accordingly, the planning and execution of any characterization surveys should be conducted in a manner that will generate technically defensible results with which to design the final status survey plan.

11. **Embedded Piping -** Nuclear power reactors and other types of nuclear facilities contain embedded piping that may become radiologically contaminated as a result of licensed operations. The staff suggests that LTPs and DPs include a discussion on the methodology for conducting surveys of embedded piping planned to be left behind. The staff suggests that sufficient justification for the assumptions considered in the computer modeling and dose analysis for embedded piping be described in the basis. Also, the staff suggests that copies of relevant computer code printouts be included for NRC evaluation.

One approach that has been approved for surveys of embedded piping is to establish a separate site-specific dose criterion for external penetrating gamma radiation emitted from the internal surface of embedded piping present in structures (e.g., walls, floors, ceilings) which are also in the same survey unit. In this approach, the predominant radionuclide of concern from a dose perspective (e.g., colbalt-60) is determined by isotopic analysis of scale or residue samples collected within such piping during the licensee's radiological characterization program. The dose criterion should be based on bounding conditions developed from characterization data, computer modeling using a

radiation shielding computer code, and a detailed dose analysis of the exposure scenario. In the model, grit blasting of the internal surface of embedded piping may need to be considered to assess: (a) any gains from the removal of loose surface activity and (b) whether the application of grout to immobilize and encapsulate fixed residual surface contamination would reduce radiation exposures.

It is important to describe the mechanism in which the dose contribution from the embedded piping and the non-embedded piping portion in a given survey unit is evaluated, when the dose to either component is determined to be equal to/or greater than the respective established dose limit, to ensure that the entire survey unit does not exceed the release criteria. Further, the staff recommends that licensees discuss how adequate scan and static investigation levels will be implemented and further evaluated, as needed, in the final status survey. It is also advisable that radiation detectors used for embedded piping surveys be properly calibrated for this specific geometry [including the use of National Institute of Standards and Technology traceable radiation source(s)], which are appropriate for types, energies, and residual concentrations expected in the final status survey.

12. **MDCs -** The decommissioning process typically involves sites with multiple radionuclides present at the time the final status survey is conducted. Although individual radionuclides and their respective $DCGL_W$ values and initial-scan MDCs for the principal radionuclides of concern have been identified, LTPs and DPs should describe the methodology and basis on which to implement a scan MDC to account for a mixture of radionuclides that may remain in a given survey area/unit. The staff recommends that parameter values such as source (ε_s) and instrument (ε_i) efficiencies, surveyor efficiency (p), and performance criteria (d'), which determine the scan MDC, be evaluated before implementation; also, changes in the default parameter values (e.g., $p = 0.5$, $d' = 1.38$) need to be clearly justified in the LTP or DP.

In MARSSIM, decisions are made on selecting appropriate detection sensitivities or MDCs for radiological survey and laboratory instruments in the DQO process. Static MDCs within 10 to 50 percent of the $DCGL_W$ of the individual radionuclide are often readily achievable; however, the scan MDC involves a larger number of arbitrary assumptions and decisions. The NRC staff generally considers the ε_s values described in International Organization for Standardization (ISO) 7503-1 and ISO 7503-3 guidance for alpha- and beta-emitters to be acceptable estimates, absent site-specific information, for surface contamination detectors in the final status survey design. The staff suggests that, in situations where surface contamination measurements are planned on irregular and uneven surfaces such as scabbled concrete and embedded piping, licensees determine an appropriate site-specific ε_s value(s). Further, the staff recommends that the methodology and basis for the ε_s value(s) be provided for NRC review.

When multiple radionuclides are present in the survey area/unit, application of an ε_i value, the use of a representative, conservative, or beta-weighted average energy for the anticipated radionuclide mixture, has been acceptable to the NRC staff.

Because the estimated-scan MDCs for open land areas (soils) (Table 6.7 of MARSSIM) are premised on certain decisions and assumptions involving human factors and survey techniques, detector characteristics and performance, and computer modeling, it is advisable that licensees validate (e.g., *a posteriori*-scan MDC) the *a priori*-scan MDC used for design goals, as information is collected and assessed, so that an actual-scan MDC can be calculated for implementation in the final status survey, for demonstration of compliance.

LIST OF RECENTLY ISSUED
NRC REGULATORY ISSUE SUMMARIES

Regulatory Issue Summary No.	Subject	Date of Issuance	Issued to
2002-01	Changes to NRC Participation in the International Nuclear Event Scale	01/14/2002	All NRC licensees and certificate holders.
2001-25	NEI-099-02, Revision 2, Voluntary Submission of Performance Indicator Data	12/12/2001	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.
2001-24	Status of Receipt of NRC Mail Following the Closing of the Brentwood Postal Facility	12/06/2001	All NRC licensees
2001-23	Resetting Fault Exposure Hours for Safety System Unavailability Performance Indicators	12/03/2001	All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
2001-22	Attributes of A Proposed No Significant Hazards Consideration Determination	11/20/2001	All holders of operating licenses for nuclear power reactors, including those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel
2001-21	Licensing Action Estimates for Operating Reactors	11/16/2001	All power reactor licensees, including those that have elected to permanently cease operations and have submitted certifications pursuant to Title 10, Section 50.82(a)(1), of the Code of Federal Regulations (10 CFR 50.82(a)(1))

OL = Operating License
CP = Construction Permit