

# DECOMMISSIONING STRATEGIES BEING IMPLEMENTED IN THE USA

## Dominick A. Orlando, USNRC

### BACKGROUND

Decommission is defined in the U.S. Nuclear Regulatory Commission's (USNRC) regulations at 10 CFR 20.1003 as "to remove a facility or site safely from service and reduce residual radioactivity to a level that permits 1) release of the property for unrestricted use and termination of the license; or, 2) release of the property under restricted conditions and the termination of the license."

On July 21, 1997, the USNRC published the final rule on Radiological Criteria for License Termination (the License Termination Rule or LTR) as Subpart E to 10 CFR Part 20. This rule authorized two different sets of cleanup criteria—a concentration-based criteria (referred to as the Site Decommissioning Management Plan criteria or SDMP Action Plan criteria), and a dose-based criteria. In addition, the rule provided for the remediation of sites and license termination for unrestricted use and for release with restrictions on future site uses.

### USNRC'S DECOMMISSIONING APPROACHES AND CRITERIA

Under the provisions of 10 CFR 20.1401(b), any licensee that submitted its decommissioning plan (DP) before August 20, 1998, and received NRC approval of that DP before August 20, 1999, could use the SDMP Action Plan criteria for site remediation. In 1999, the Commission granted an extension of the DP approval deadline, for 12 sites, to August 20, 2000. In September 2000, the staff notified the Commission that all 12 DPs were approved by the deadline. All other sites must use the dose-based criteria of the LTR. In addition, Agreement States were expected to adopt equivalent dose criteria by August 20, 2000. As of June 30, 2002, 25 States had adopted the LTR, or other legally binding requirements, and 7 States had not.

#### Unrestricted Use

The current USNRC dose-based unrestricted release limit is 0.25 milliSieverts per year (0.25 mSv/a) (Total Effective Dose Equivalent) to the average member of the critical group from all exposure pathways and demonstration that the residual contamination levels are As Low as Reasonably Achievable (ALARA).

#### Restricted Use

Prior to the promulgation of the LTR, USNRC regulations did not contain a provision for releasing sites for other than unrestricted use. Experience with decommissioning facilities has indicated that for certain sites, achieving the unrestricted use criterion might not be appropriate because: (1) there may be net public or environmental harm in achieving unrestricted use; (2) expected future use of the site likely would preclude unrestricted use; or, (3) the cost of cleanup and waste disposal to achieve the unrestricted use criterion would be excessive compared with achieving the same dose criterion by restricting the use of the site and eliminating exposure pathways.

Similarly, for certain difficult sites with unique decommissioning problems, 10 CFR 20.1404 includes a provision by which the USNRC may terminate a license using alternative dose criteria. The USNRC expects the use of alternative criteria to be confined to rare situations. This provision was included in 10 CFR 20.1404 because the USNRC considered it is preferable to codify provisions for these difficult sites in the rule rather than require licensees to seek an exemption process outside the rule.

The USNRC still considers unrestricted use to be the preferable method to decommission licensed facilities and terminate radioactive materials licenses. However, in recognition that there may be a limited number of sites where license termination with restrictions may be appropriate, the USNRC included provisions for terminating the licenses for these few sites in the LTR.

License termination under restricted conditions will be permitted pursuant to 10 CFR 20.1403 if all the following requirements are met:

1. The licensee can demonstrate that further reductions in residual radioactivity necessary to release the site for unrestricted use: (1) would result in net public or environmental harm; or, (2) were not being made because the residual levels are ALARA (10 CFR 20.1403(a)).
2. The licensee has made provisions for legally enforceable institutional controls that would limit dose to the average member of the critical group to 0.25 mSv/a (10 CFR 20.1403(b)).
3. The licensee has provided sufficient financial assurance to enable an independent third party to assume and carry out responsibilities for any necessary control and maintenance of the site (10 CFR 20.1403(c)).
4. The licensee has submitted a decommissioning plan or a license termination plan to the USNRC that indicates the licensee's intent to release the site under restricted conditions and describes how advice from individuals and institutions in the community who may be affected by the decommissioning has been sought and incorporated, as appropriate, following analysis of that advice (10 CFR 20.1403(d)). In seeking this advice, the licensee would have conducted the activities for seeking advice required by 10 CFR 20.1403(d)(2), including providing for participation by a broad cross-section of community interests who may be affected by decommissioning; providing an opportunity for a comprehensive collective discussion of the institutional controls and financial assurance specified in 10 CFR 20.1403(d)(1) by the affected parties; and providing a publicly available summary of all such discussions.
5. The residual radioactivity levels have been reduced so that, if the institutional controls were no longer in effect, the annual dose to the average member of the critical group would not exceed either 1 mSv/a or, under certain conditions, 5mSv/a. If the 5 mSv/a value is used, the licensee must: (1) demonstrate that achieving 1 mSv/a is prohibitively expensive, not technically achievable, or would result in net harm, (2) make

provisions for durable institutional controls, and (3) provide sufficient financial assurance to allow an independent third party to carry out rechecks of the controls and maintenance at least every 5 years and carry out any necessary controls and maintenance (10 CFR 20.1403(e)).

The USNRC staff review and evaluate the DP and solicit public input to determine whether the above requirements are satisfied, pursuant to 10 CFR 20.1405. Once the USNRC determines that they have been met, the USNRC license is terminated and the USNRC no longer regulates or oversees the site, except in the circumstances indicated in 10 CFR 20.1401(c). Specifically, 10 CFR 20.1401(c) indicates that the USNRC could require additional cleanup after license termination if it determines that, based on new information, the criteria in Subpart E of 10 CFR Part 20 for release of a site were not met and residual radioactivity remaining at the site could result in a significant threat to public health and safety. The Commission has explicitly chosen not to define what constitutes “new information” or “significant public risk,” because this determination will be made on a case-by-case basis.

In some instances a licensee planning license termination with restricted conditions under an approved decommissioning plan or license termination plan may find, during remediation, that the site can be cleaned up to a level that would not require restricted conditions. Additionally, a licensee that had planned unrestricted release may find during remediation that unrestricted release is not practical. In these instances, the licensee would be expected to submit an amended decommissioning plan or license termination plan to USNRC as soon as possible.

The restricted conditions would be expected to be limited to the smallest portion of the site that is appropriate. However, all areas that will be subject to restricted conditions would be expected to be contained within one or occasionally two areas. Complicated checkerboard patterns of areas with restricted conditions would be avoided.

### **Alternate Criteria**

Under 10 CFR 20.1404, the USNRC may consider terminating a license using alternate criteria that are greater than 0.25 mSv/a with restrictions in place found at 10 CFR 20.1403. However, licensees requesting license termination under the alternate criteria provisions of 10 CFR 20.1404 would still need to ensure that potential doses from residual radioactivity are less than 1 mSv/a with restrictions in place. In addition, the USNRC will limit the conditions under which a licensee could apply to the USNRC for, or be granted use of, alternative criteria to unusual site-specific circumstances subject to the following provisions:

1. The licensee has provided assurance that public health and safety will continue to be protected and that it is unlikely that the dose from all man-made sources combined, other than medical, would be more than 1 mSv/a. A licensee proposing to use alternative criteria would have to provide a complete and comprehensive analysis of such possible sources of exposure;

2. The licensee has employed, to the extent practical, restrictions on site use for minimizing exposure at the site, using the provisions for institutional controls and financial assurance in 10 CFR 20.1403;
3. The licensee has reduced doses to ALARA levels, based on a comprehensive analysis of risks and benefits of all viable alternatives;
4. The licensee has sought advice from affected parties regarding the use of alternative criteria at the site. In seeking this advice, the licensee would have conducted the activities for seeking advice required by 10 CFR 20.1404(a)(4), including providing for participation by a broad cross-section of community interests that may be affected by decommissioning; providing an opportunity for a comprehensive collective discussion of the issues related to the alternative criteria by the affected parties; and providing a publicly available summary of all such discussions. As part of this process, the licensee would submit a decommissioning plan indicating how advice of individuals and institutions in the community that may be affected by the decommissioning has been sought and addressed;
5. The licensee has obtained the specific approval of the Commission for the use of alternative criteria. The Commission will make its decision after considering the USNRC staff's recommendations that would address any comments provided by the EPA and any public comments submitted regarding the decommissioning plan pursuant to 10 CFR 20.1405.

## **USNRC'S DECOMMISSIONING PROCESS**

### **Materials Sites**

USNRC regulations at 10 CFR Parts 30, 40, 70, and 72 require that a DP be submitted by a materials licensee to support the decommissioning of its facility when it is required by license condition, or if the procedures and activities necessary to carry out the decommissioning have not been approved by the USNRC and these procedures could increase the potential health and safety impacts to the workers or the public. The objective of the DP is to describe the activities and procedures that the licensee intends to undertake to remove residual radioactive material at the facility to levels that meet USNRC criteria for release of the site and termination of the radioactive materials license.

For materials sites proposing unrestricted release, a full technical review of the DP will be initiated after the successful conclusion of the acceptance review. The staff's review is guided by NUREG-1757, "Consolidated NMSS Decommissioning Guidance," and its supporting references. The results of the staff's review will be documented in an Environmental Assessment (EA) and a Safety Evaluation Report (SER). The EA will be shared with the State where the site is located and State comments will be considered in finalizing the EA. The final EA must be summarized in the Federal Register in the form of a Finding Of No Significant Impact (FONSI). If the proposed decommissioning could result in environmental impacts an

Environmental Impact Statement (EIS) must be prepared describing these impacts, as well as any mitigation factors.

For materials sites proposing restricted release, the review will be conducted in two phases. The first phase of the review will focus on the financial assurance (FA) and institutional control (IC) provisions of the DP. The review of the remainder of the DP will be initiated only after the staff is satisfied that the licensee's proposed IC & FA provisions will comply with the requirements of the License Termination Rule (LTR) (10 CFR 20 Subpart E). The applicable portions of NUREG-1757 will be used to guide this phase of the review. Phase II of the review will address all other sections of the technical review as guided by NUREG-1757 and will include the development of an EIS. In parallel with the development of the EIS, the staff will develop a draft and final SER. The development of the draft SER will be coordinated with the development of the Draft Environmental Impact Statement (DEIS) so that any requests for additional information (RAIs) can be consolidated. Following publication of the FONSI (for a DP involving an EA) or the Record of Decision (ROD) (for a DP involving an EIS), a license amendment will be issued approving the DP along with any additional license conditions found to be necessary as a result of the EA/EIS and/or the SER. Following approval of the DP, the licensee must complete decommissioning in accordance with the approved DP within 24 months or apply for an alternate schedule. USNRC staff will inspect the licensee during decommissioning operations to ensure compliance with the DP. These inspections will normally include in-process confirmatory radiological surveys.

Currently one materials site has elected to decommission pursuant to 10 CFR 20.1403, and 2 additional sites have indicated that they are considering this option.

### **Power Reactors**

USNRC regulations at 10 CFR Part 50 require that, prior to, or within 2 years following permanent cessation of operations, reactor licensees provide USNRC with a post-shutdown decommissioning activities report (PSDAR). The purpose of the PSDAR is to provide USNRC and the public with a general overview of the proposed decommissioning activities. 10 CFR Part 50 also requires that nuclear power reactor licensees submit a License Termination Plan (LTP) at least 2 years before termination of the license. The purpose of the LTP is to describe the radiological condition of the site, provide a dose assessment for the site, identify the remaining decommissioning activities, and provide the final survey plan for the site.

Power reactors undergoing decommissioning may elect to use one of three different alternatives: DECON, SAFSTOR, or ENTOMB.

Under DECON (immediate dismantlement), soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the USNRC license.

Under SAFSTOR, often considered "delayed DECON," a nuclear facility is maintained and monitored in a condition that allows radioactivity to decay; afterwards, it is dismantled.

Under ENTOMB, radioactive contaminants are encased in a structurally sound material such as concrete and appropriately maintained and monitored until the radioactivity decays to a level permitting release of the property.

The plant owner may also choose to adopt a combination of the first two choices in which some portions of the facility are dismantled or decontaminated while other parts of the facility are left in SAFSTOR. The decision may be based on factors other than radioactive decay such as availability of waste disposal sites.

To be acceptable, decommissioning must be completed within 60 years. A time beyond that would be considered only when necessary to protect public health and safety in accordance with USNRC regulations.

Currently, 11 power reactors have indicated their intent to use or elected to use the DECON option (2 of the 11 are proceeding with limited DECON), 9 have indicated their intent to use or elected to use the SAFSTOR option. An informal survey of reactor licensees (NRC does not require licensees to demonstrate why they chose a particular decommissioning strategy) indicated that the principal rationale for choosing the DECON option are concerns with potential access to waste disposal facilities in the US and the need to reduce/avoid potential future decommissioning costs. For one site, the licensee needed to build an ISFSI on site to house fuel from two other co-located sites and needed to remove one reactor from the site to build the ISFSI

The rationale for choosing SAFSTOR are varied. Three licensees indicated that they chose SAFSTOR because the decommissioning unit was co-located with continuing operational units and the licensee intended to decommission all reactors at the site at the same time. Two licensees indicated that they did not wish to build an ISFSI on site as it would deplete decommissioning funds and one indicated that they wished to stage the decommissioning of all of its nuclear facilities (the licensee owns several NPPs), to take advantage of the expertise that would be developed to support the decommissioning of the first facility.

## **ISSUES AFFECTING DECOMMISSIONING STRATEGY SELECTION**

As discussed below the staff experience using the LTR since it was finalized in 1997 has revealed some important implementation issues.

USNRC licensees are having difficulties arranging the institutional controls required by the restricted release and alternate criteria provisions of the LTR that ensure long-term effectiveness. Governments and Tribes are unwilling to accept transfer of ownership of private sites, because of long-term liability and funding concerns (e.g., potential future additional cleanup, potential failure of engineered barriers, and one-time payment to U.S. Treasury for Federal ownership). Lack of independent third party to ensure long-term effectiveness of ICs and, if needed, to provide control and maintenance if current owner/licensee abandons the site, goes bankrupt, or if a subsequent owner does not provide control and maintenance. Also, there is a concern over long-term continuity of an independent third party. Licensees are also having difficulties establishing legally enforceable ICs involving various types of "deed

restrictions” that “run with the land” to ensure effectiveness over long periods of time and if property ownership changes. The LTR has limited flexibility of the existing LTR graded approach to IC requirements for providing degrees of effectiveness based on dose levels and half-life. This includes the meaning of “enforceable” and “durable” controls, as well as use of engineered barriers, role of independent third party, and degree of public involvement.

In addition, there appears to be potential inconsistencies between the doses allowed by the LTR and other NRC regulations such as 10 CFR 40.13(a), 10 CFR Part 40, Appendix A, and 10 CFR 20.2002. In addition, the relationship is unclear between the LTR’s dose constraint of 0.25 mSv/a and ALARA for unrestricted release of a site, and existing guidance for controlling solid materials on a case-by-case basis, particularly for instances where residual contamination might be removed from an unrestricted release site after license termination.

Clear direction and guidance are needed for selecting more realistic exposure scenarios for both unrestricted release and restricted release that appropriately considers IC effectiveness and radiological risk. Specifically, what justifications are adequate to use scenarios other than the generic screening scenario of a resident farmer, in light of the 1000-year dose modeling time period.

Staff experience has also identified a number of financial assurance risks including initial underestimation of costs; increased costs after certain events (e.g., groundwater contamination); unavailability of funds in bankruptcy; inadequate financial disclosure; and corporate reorganization. A number of legacy sites have substantial contamination including subsurface soil and groundwater contamination. These sites were operating long before the current decommissioning regulatory infrastructure existed. While much has been done to prevent such future sites, staff is evaluating whether more could be done through rulemaking, guidance development, or in changes to existing operating licensees

On June 18, 2002, the Commission directed the staff to evaluate the status of the implementation of the LTR (Staff Requirements Memorandum (SRM)-SECY-01-0194). The staff provided its analysis and recommendations in May 2003 in SECY-03-0069. The staff proposes a variety of actions to address these issues including: 1) a rulemaking for measures to prevent future legacy sites; 2) revised guidance to support the rulemaking and to clarify restricted release, on-site burials, and realistic exposure scenarios; 3) revised inspection procedures and enforcement policy to enhance monitoring, reporting, and remediation to prevent future legacy sites; and 4) a Regulatory Issue Summary (RIS) to inform a wide range of stakeholders about the LTR analysis of each issue, Commission direction, and actions planned to resolve each issue.