Web-Based Training Related to NRC Staff Review of Dose Modeling Aspects of License Termination and Decommissioning Plans*

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ABSTRACT

NRC licensees at decommissioning nuclear facilities submit License Termination Plans (LTP) or Decommissioning Plans (DP) to NRC for review and approval. To facilitate a uniform and consistent review of these plans, the NRC developed training for its staff. A live classroom course was first developed in 2005, which targeted specific aspects of the LTP and DP review process related to dose-based compliance demonstrations or modeling. A web-based training (WBT) course is being developed in 2006 to replace the classroom-based course. The advantage of the WBT is that it will allow for staff training or refreshers at any time, while the advantage of a classroom-based course is that it provides a forum for lively discussion and the sharing of experience of classroom participants.

The training course consists of the core and advanced modules tailored to specific NRC job functions. Topics for individual modules include identifying the characteristics of simple and complex sites, identifying when outside expertise or consultation is needed, demonstrating how to conduct acceptance and technical reviews of dose modeling, and providing details regarding the level of justification needed for realistic scenarios for both dose modeling and derivation of DCGLs. Various methods of applying probabilistic uncertainty analysis to demonstrate compliance with dose-based requirements are presented. These approaches include 1) modeling the pathways of radiological exposure and estimating doses to receptors from a combination of contaminated media and radionuclides, and 2) using probabilistic analysis to determine an appropriate set of input parameters to develop derived concentration guideline limits or DCGLs (DCGLs are media- and nuclide-specific concentration limits that will meet dose-based, license termination rule criteria found in 10 CFR Part 20, Subpart E). Calculation of operational (field) DCGL's from media- and nuclide-specific DCGLs and use of operational DCGLs in conducting final status surveys are addressed in the WBT. Realistic case examples are presented and analyzed including the abstraction of a realistic site into a conceptual model and computer model. A case history is also used to demonstrate development of NRC review documents such as requests for additional information (RAIs).

To enhance the web-based training experience, audio, animations, linked documents, quizzes, and scripts are being integrated with a commercial web-based training package that supports simple navigation. The course is also being integrated into both existing and state-of-the-art learning management systems. A testing group is being utilized to identify and help resolve training issues prior to deployment of the course. When completed, the course can be accessed for credited training with required modules dependent on the job category of the training participant. The modules will also be accessible to NRC staff for review or refresher following initial course completion.

WBT promotes consistency in reviews and has the advantage of being able to be used as a resource to staff at any time. The WBT will provide reviewers with knowledge needed to perform risk-informed analyses (e.g., information related to development of realistic scenarios and use of probabilistic analysis). WBT on review of LTP or DP dose modeling will promote staff development, efficiency, and effectiveness in performing risk-informed, performance-based reviews of decommissioning activities at NRC-licensed facilities.

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INTRODUCTION

When a nuclear plant or facility is closed for operations, the owner must prepare a Decommissioning Plan (DP) to submit for review to the U.S. Nuclear Regulatory Commission (NRC). The plan includes procedures for safely removing the plant or facility from service and ensuring that the remaining (residual) radioactivity has been reduced so that the property can be released. The NRC has strict rules to protect both workers and the public during the decommissioning process.

In 2002, the NRC staff consolidated the existing guidance documents to complete development of NUREG-1757 [1,2]. NUREG-1757 provides an overall framework for dose assessment and decision making at sites undergoing decommissioning. This guidance provides NRC staff with a description of the contents of specific DP or License Termination Plan (LTP) modules, as well as evaluation and acceptance criteria to use when it reviews DPs or LTPs and other information submitted by licensees to demonstrate that a facility is suitable for release in accordance with NRC requirements. In addition, the guidance addresses the release from regulatory control of buildings and soil and describes methodologies that could be used by licensees and others to comply with the LTR requirements in 10 CFR Part 20, Subpart E.

The objective of this course is to train NRC staff at the Headquarters and Regional Offices to review the sections of a licensee's DP or LTP that pertain to dose modeling. The DP generally refers to the decommissioning of nonreactor facilities, while the LTP refers specifically to the decommissioning of reactors. This review is part of the NRC's licensing process, in which the NRC determines if a licensee has (1) provided a suitable basis to support the derived concentration guideline levels (DCGLs) or dose modeling for the licensed facility that the licensee has proposed, and (2) demonstrated that the facility is suitable for release in accordance with NRC requirements.

At the end of the course the staff should be able to (1) identify the characteristics of a simple site; (2) identify technical areas where expertise is needed by the NRC; (3) conduct acceptance reviews of the dose modeling performed at both simple and complex sites; (4) perform a technical review of the dose modeling conducted for building, soil, and groundwater contamination at simple sites; (5) evaluate the need for consultation with the U.S. Environmental Protection Agency (EPA); (6) understand some specific technical interpretations, such as the 10% rule and the sum of fractions approach; and (7) understand the differences between the dose modeling approach conducted for compliance purposes and the DCGL approach.

APPROACH

The course material is primarily based on guidance provided in Volumes 1 and 2 of NUREG-1757, *Consolidated NMSS Guidance on Decommissioning* [1,2]. However, the course emphasizes the practical aspects of license evaluation and addresses a spectrum of technical issues that are not addressed in NUREG-1757. The goal is to give NRC staff insight on the technical basis for the license review and acceptance review and also for the Request for Additional Information (RAI), should further information be needed to complete the review. The course is designed to enable the NRC staff to perform a confirmatory review of a licensee's submittal and conduct an independent analysis at its discretion.

For the course to be most effective, the students must be familiar with the NRC rules and guidance on decommissioning, particularly with regard to issues discussed in NUREG-1757. Dose modeling and the development of DCGLs rely on computer models that relate radionuclide concentrations to doses. The emphasis of the course is on using three computer codes—DandD, RESRAD, and RESRAD-BUILD—for site-specific dose modeling and DCGL development. However, many of the discussions are generic in nature and not specific to any particular computer model. Thus students must focus on specific licensing issues in order to formulate a strategy for conducting a satisfactory modeling analysis.

The course covers NRC processes after the licensee has submitted a DP or LTP to the NRC. The major steps are as follows:

1. Preliminary review and acceptance of the DP or LTP by the NRC;
2. Detailed technical review by the NRC, including (a) issuance of an RAI, (b) Safety Evaluation Report (SER), and (c) National Environmental Policy Act (NEPA) documentation;
3. Approval of DP or LTP and license amendment by the NRC;
4. Remediation activities by the licensee and inspections by the NRC;
5. Final status surveys by the licensee and confirmation by the NRC; and
6. License termination or modification by the NRC.

This course focuses on the first three steps. The level of technical review (Step 2) will depend on the site's complexity.

Upon receipt of the DP or the LTP, the NRC staff conducts a preliminary review to ensure that the plan contains, at a minimum, the information on the checklist that the NRC staff and licensee had previously agreed on. (Appendix D of Volume 1 of NUREG-1757 provides a checklist that the NRC staff and licensees can build on to develop a specific checklist for the facility undergoing decommissioning review.) The preliminary review is a limited technical review of the DP or LTP. It is intended to determine (1) if there is enough information in the DP or LTP, and (2) if the level of detail appears to be adequate for the NRC staff to perform a detailed technical review. If both questions are answered "yes," the DP or LTP is accepted. The process then moves to the next step, in which the NRC places a notice in the *Federal Register* and the detailed technical review begins. If either answer is "no," the DP or LTP is rejected.

After the DP or LTP is accepted, the NRC conducts a detailed evaluation from an environmental (NEPA) and safety perspective. If the information in the plan is not sufficient to enable the NRC to conduct the environmental and safety review, the NRC asks for an RAI. Upon receiving an RAI, the licensee revises the plan. The revised plan is reviewed by the NRC, and the process continues as described above until sufficient information is provided by the licensee.

One important element in the evaluation of the proposed license termination is the preparation of the RAI. Often during the review process, the NRC finds that the materials submitted by the licensee in the form of a DP or LTP are inadequate or insufficient or require further clarification. Under these circumstances, the NRC must prepare an RAI to get needed information from the licensee. Preparation of the RAI is an

integral part of the licensing evaluation process. The RAI process not only helps bridge information gaps found in the review process but can also provide specific guidance to the licensee.

As part of the safety evaluation, the NRC staff reviews the technical information provided by the licensee to ensure that the licensee used defensible assumptions and models to calculate the potential dose to the average member of the critical group. The staff also verifies that the licensee provided (1) enough information to allow an independent evaluation of the potential dose that could result from residual radioactivity after a facility's license is terminated, and (2) reasonable assurance that the proposed decommissioning options would comply with all applicable regulations. After completing its safety evaluation, the NRC staff prepares an SER to document the methods used in the evaluation and the conclusions reached. The dose assessment, which is the subject of the training course, provides the basis for developing the focus of the overall DP or LTP evaluation in the SER. Much of the discussion on radiological dose modeling and related subjects provided in the course focuses on support of the NRC SER preparation.

After conducting a detailed technical review of the DP or LTP, the NRC staff must determine whether to approve the respective plan and allow the decommissioning process to move forward with the actual remediation activities. If the DP or LTP is approved but the decommissioning is not part of the original license, the NRC first needs to amend the license to allow decommissioning to take place as provided in the DP or LTP. There are other factors in addition to dose modeling that the NRC staff must consider before approving the DP or LTP. The factors can include financial assurance, adequacy of institutional controls under restricted release conditions, and others. These additional factors are not discussed in this course.

As mentioned previously, licensees that are planning to decommission their facilities are required to demonstrate to the NRC that their proposed methods will ensure that the decommissioning can be conducted safely and that the facility, at the completion of decommissioning activities, will comply with NRC requirements for license termination. Two approaches can be used to demonstrate the compliance of each source at a site with the dose-based decommissioning criteria in Subpart E of 10 CFR Part 20. One is a DCGL approach, and the other is a dose modeling approach. The two approaches are not completely independent. While the dose modeling approach is a direct method for demonstrating compliance with the prescribed dose criteria, the DCGL method relies on the concentration guidelines derived from the dose assessment approach. Thus, the DCGL approach is an indirect method for demonstrating compliance with the dose-based criteria. It is used when field surveillance is required to certify the site cleanup.

DEVELOPMENT

A web-based training (WBT) course is being adapted from an existing classroom training course that targets specific aspects of the LTP and DP document review process related to dose-based compliance demonstrations made by site licensees. The core course consists of nine modules as listed in Table I and shown in Fig. 1. Realistic case studies are presented and analyzed, including the abstraction of a realistic site into a conceptual model and computer model. A case history also is used to demonstrate development of review documents such as RAIs.

To enhance the WBT experience, audio, animation, linked documents, quizzes, and scripts are being integrated into a commercial WBT package (Articulate®) that supports simple navigation (Fig. 2). The course is also being integrated into both existing and state-of-the-art learning management systems.

Table I: Course modules and short descriptions.

Core Modules
0. Articulate Introduction The course format is explained: functionality, buttons, and format are described.
1. Course Introduction How to use the course and its objectives.
2. Overview of Evaluation Process A brief outline of the full evaluation process is presented with a focus on how the dose evaluation fits in. Terms are introduced for comparison of approaches for demonstrating compliance.
3. Overview of Radiological Dose Assessments Issues in radiological dose assessment are reviewed. An example is followed to demonstrate expectations of source term, environmental transport, and receptor exposure.
4. Approaches to Demonstrating Compliance The DCGL and dose modeling approaches to demonstrating compliance are reviewed and compared. Examples are given for each method, highlighting the potential concerns and issues.
5. NRC Policy Issues NRC policy issues regarding plans and working with other regulators are discussed.
6. Contamination Considerations This module discusses types of contamination and features of a complex site.
7. Realistic Scenarios Provides NRC guidance on realistic scenarios, e.g., how to develop realistic scenarios and modify pathways?
8. Probabilistic Analysis Concepts associated with a probabilistic dose assessment for 10 CFR 20 Subpart E compliance. Ways to develop DCGL with probabilistic dose assessments
9. Summary The summary module will highlight some important points of the full set of modules.
Advanced Modules
A1. Application of DCGLs The need, development, and implementation for operational, gross, and surrogate DCGLs.
A2. Elevated Regions This module explains elevated regions, handling of elevated regions in dose modeling, and DCGL approach. This module also explains area factor and its derivation.
A3. Potential Modeling Issues Several contamination situations require special modeling approaches as they are more complicated than the typical soil or building contamination situation discussed in previous modules.
A4. Sequence in an Actual Complex Site Case The events surrounding the Connecticut Yankee site will be reviewed, along with the sequence of communications and resolutions.
A5. Sequence in an Actual Regional Example The events surrounding a regional material site will be reviewed, along with the sequence of communications and resolutions.
A6. Development from Realistic to Conceptual to Software Models Detailed material in the course guide will highlight the processes of developing software models through assumptions in conceptualizing the real case.
A7. Examples of Processing RAIs Real Requests for Additional Information are developed after identifying gaps in the licensee's plan.

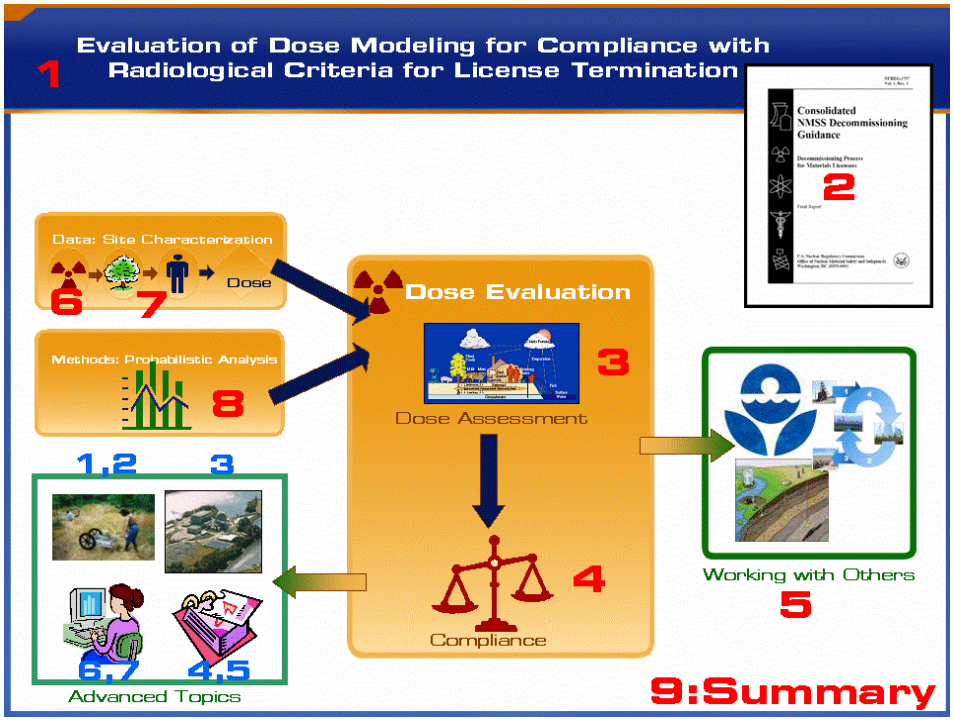

Fig. 1. Relationship of modules as presented in the course introduction.

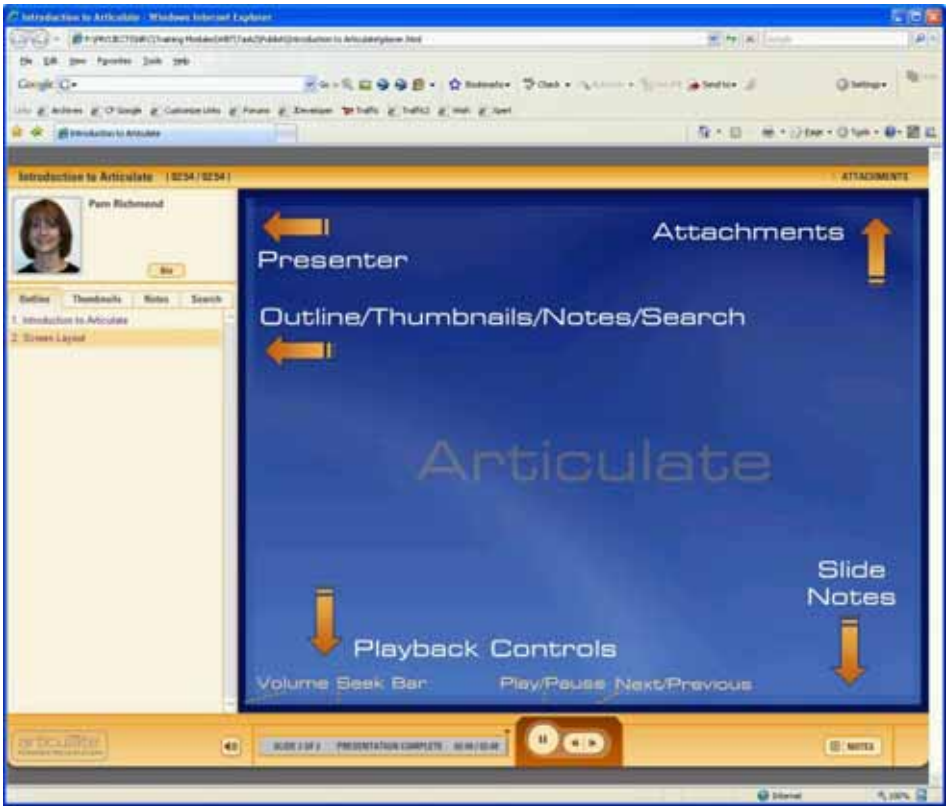

Fig. 2: The Articulate software package facilities integration of multimedia course content for integration with web-based learning management systems.

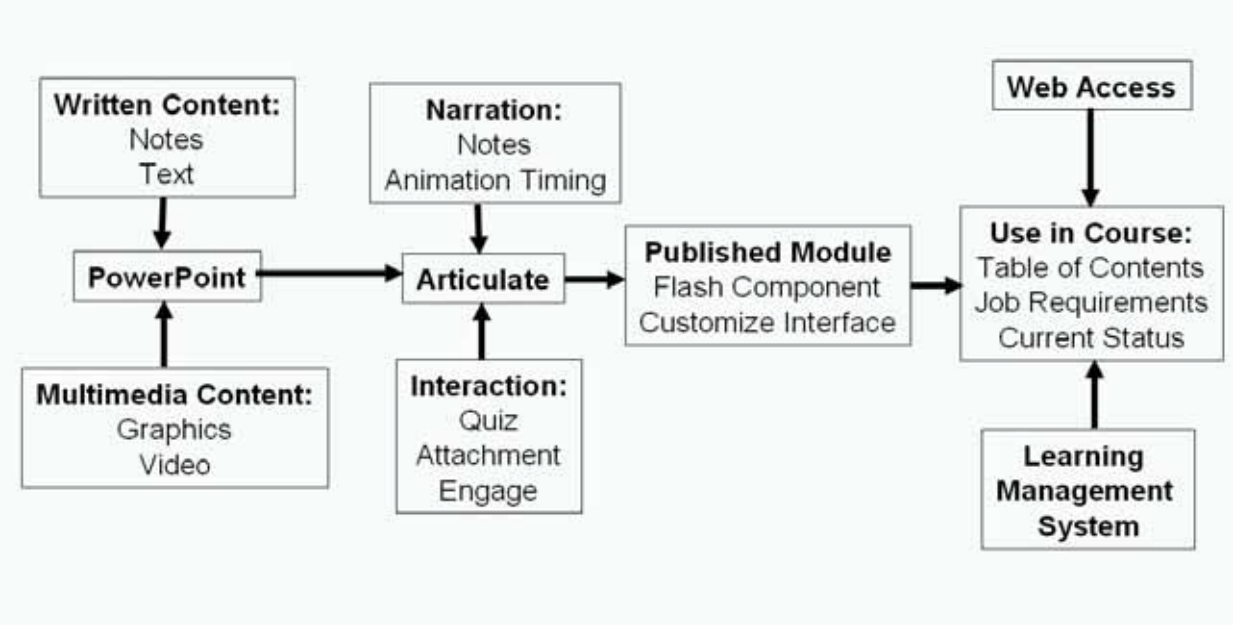

Fig. 3 The development process includes construction of course material, multimedia objects, interactive features, conversion to web format with Flash, and integration with the learning management system.

The development process (Fig. 3) includes construction of the content such as graphics, text, and notes into a PowerPoint file. Additional multimedia and interactive components can be added through Articulate, which is an add-in to PowerPoint. Articulate also supports additional quiz and interactive components. After the review and editing of the content, the notes were recorded for narration along with timings for animated slides. Articulate can then take the slide presentation with the multimedia objects and create an integrated Flash object for web, local network, or CD distribution.

The WBT offers the advantage of being available at any time for learning or review, whereas the advantage of the classroom-based training is that it facilitates lively discussion of issues and interpretations.

REFERENCES

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