Fuel Cycle Facilities Forum

Chairman
David G. Culberson

July 12, 2000

Mr. Dominick A. Orlando
U.S. Nuclear Regulatory Commission
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
11545 Rockville Pike
Rockville, MD 20852-2738

Subject: **Fuel Cycle Facilities Forum Comments on the NRC's Technical Basis for Dose Modeling Evaluation to Support Decommissioning**

Dear Mr. Orlando;

The Fuel Cycle facilities forum is pleased to provide comments on the NRC's *Technical Basis Document for Dose Modeling to Support Decommissioning*.

The Nuclear Regulatory Commission (NRC) recently developed a technical basis document[1] to provide supporting technical information to be used by the Staff, along with the SRP[2], in reviewing a licensee's dose modeling analysis at the time of decommissioning. This document presents detailed technical approaches, methodologies, criteria, and guidance for review of dose modeling for demonstration of compliance with the dose criteria in 10 CFR Part 20, Subpart E. The document was developed through dialogue with members of the public and other stakeholders including licensees, Federal agencies, States, and interest groups, and was the subject of several NRC workshops.

Fuel cycle facility sites are among those that will present the most challenging technological issues, and highest resultant costs, at the time of decommissioning. Consequently, this technical basis document is of particular interest to companies with such sites.

The Fuel Cycle Facilities Forum (FCFF) is a consortium of licensees whose purpose is to provide a forum for addressing technical and regulatory issues that will impact decommissioning of sites and facilities within the fuel cycle industry. The FCFF represents a broad range of source material and special nuclear material licensees, including many who are actively involved in the remediation and/or decommissioning of portions of their sites. The FCFF represents fuel cycle companies at public workshops and meetings, seeks to involve the fuel cycle industry in the development of proposed rulemaking and draft regulatory guidance by offering comments on issues that will impact industry, and facilitates dialogue between regulatory agencies and affected licensees.

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[1] "Technical Basis Document for Dose Modeling Evaluation". Appendix C to the "Standard Review Plan for the Review of Decommissioning Plans and Other Information Submitted to Support the Release of Nuclear Facilities". Rev. 0, dated May 12, 2000.
[2] Draft NMSS Decommissioning Standard Review Plan. June 1999.

Distribution
NMSS-07
Dominick Orlando
Baby Abu-Eid
James Danna

NMSS07

Dominick A. Orlando
July 12, 2000

The FCFF is pleased to provide the attached comments on the technical basis document. Our comments generally pertain to the high degree of conservatism that seems to be built into dose modeling, the need for balancing uncertainties in dose modeling with the compounding of conservatisms in the models when evaluating dose models and dose assessments, and an apparent expectation that, prior to submitting the decommissioning plan, a licensee must both derive a residual radioactivity concentration limit that would not result in a dose greater than the dose limit, *and*, predict a potential future dose, on the basis of residual radioactivity levels that will generally not be known until after cleanup, for comparison with a dose limit.

We request your careful consideration of these comments. A representative of the FCFF would be pleased to meet with you to discuss any of these issues further. If you have questions or comments, please feel free to call me at (423) 283-7035, or Mr. Jeff Lux, at (405) 270-2694.

Sincerely,

David G. Culberson, Chairman

Attachment: FCFF Comments Related to the NRC Standard Review Plan Technical Basis for Dose Modeling Evaluation

cc: Mr. John T. Greeves, Director
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852-2738

Mr. Larry Camper, Chief
Low Level Waste and Decommissioning Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852-2738

FCFF member companies

FCFF COMMENTS RELATED TO NRC STANDARD REVIEW PLAN TECHNICAL BASIS FOR DOSE MODELING EVALUATION

1. GENERAL COMMENTS

Testing Compliance with Radiological Criteria for Decommissioning

Documents supporting the radiological criteria for license termination regulation should be clear and consistent with respect to demonstration of compliance. In one instance,[1] the Technical Basis Document seems to indicate that either of two alternatives for the licensee to demonstrate compliance seems to be acceptable. Either:

1. Develop derived concentration guideline levels (DCGLs) commensurate with demonstrating compliance with the dose-based release criterion, and then demonstrate through final status survey that residual radioactivity concentrations at the site are below the DCGLs; or,
2. Assess dose associated with actual concentrations of residual radioactivity distributed across the site[2] to determine whether the concentrations will result in a dose below the regulatory dose criterion.

Each of these approaches has merit, and either should be acceptable for assessing compliance. Both should not be required.

In another instance,[3] SRP acceptance criteria expects *statistical evaluation* of the measured concentrations and "*... a statement that a given survey unit satisfied the* $DCGL_W$ *and the elevated measurements comparison if any sample points exceeded the* $DCGL_W$*.*" However, the conceptual framework[4] seems to expect determination of compliance by *dose assessment*. These alternatives should be reconciled to be clear that demonstration of compliance by either one, not necessarily both, of the methods would be acceptable. Demonstration of compliance by two separate methods is not required in other similarly low risk circumstances (*e.g.*, power reactor effluent[5] or environmental impact of the fuel cycle.[6])

Compounded Conservatism

During the workshop on dose modeling,[7] Norman Eisenberg pointed out that the Commission has time and again said it's not their intention to pile conservatism on top of conservatism. Mr. Eisenberg pointed out that the 25 mrem standard has conservatism built-in for protection of public health and safety. He said, "*... we are talking about a dose of 25 mrem here. We are not talking about a reactor core melt. We are*

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1 USNRC. Standard Review Plan, Appendix C, *Technical Basis for Dose Modeling Evaluation*. §3.3. rev. 0.
2 Actual radionuclide concentration might be measured by a final status survey.
3 USNRC. *Decommissioning Standard Review Plan*. §14.5, "Final Status Survey Report."
4 *Ibid.* §1.3 and Figure C1.1.
5 10 CFR Part 50, Appendix I.
6 40 CFR 190.
7 Public Workshop on Guidance for Implementing 10 CFR Part 20, Subpart E, Radiological Criteria for License Termination, Rockville MD, June 7 & 8, 2000.

not talking about prompt fatalities from an accident ... " "Under these circumstances, the consequences of exceeding that limit, say you go up to 30 millirem per year ... is not that great." "Incremental increase in the risk of cancer – it's very small, and I think the staff should bear that in mind when they're making decisions and using methodologies in this regard. One of my concerns is that we not invoke a – the huge machinery of probabilistic risk analysis, it attendant cost, to swat a fly."

The compounding of conservatism in the 25 mrem standard, in the values of parameters sought in dose modeling to derive DCGL, and the high degree of confidence sought in statistical demonstration of compliance of radionuclide concentration measurements with the $DCGL_W$ are, together, an example of *piling-on* that Mr. Eisenberg mentions. Discussion of these elements separately has compartmentalized their conservatism in ways that does not recognize this compounding. Yet, NRC-derived radionuclide concentrations for unrestricted release of buildings or land[8,9] are so low they are not useful for fuel cycle licensees. Additional conservatism of perhaps as much as 4 standard deviations (decision errors α=0.05 and β=0.05) on mean concentration sought for statistical compliance of measurements cannot differentiate $DCGL_W$ from natural background uranium series or thorium series.

Staff consideration of this compounding of conservatism is needed. The NRC's FY2000 radionuclide transport and decommissioning research program includes a plan to develop technical bases to allow reductions in unnecessary licensee burden. The issue of realism for assessing radiation exposure, including environmental transport and values of parameters, to reduce unnecessary conservatisms, should be pursued in that program.

Uncertainty Analysis

Atop all of this, the NRC evidently seeks to consider uncertainty and to require uncertainty analyses[10] in all dose assessments. SRP Appendix C, §8 discusses criteria for treating uncertainty in dose modeling, including input parameters. If an uncertainty analysis were to be done, it should consider all of the major components in the following diagram. Then the conservatism compounded among all the elements[11, 12, 13] could be weighed against the overall uncertainty in decision-making. Balancing overall uncertainty and compounded conservatism may be worthy deliberation for the agency staff to perform generically.

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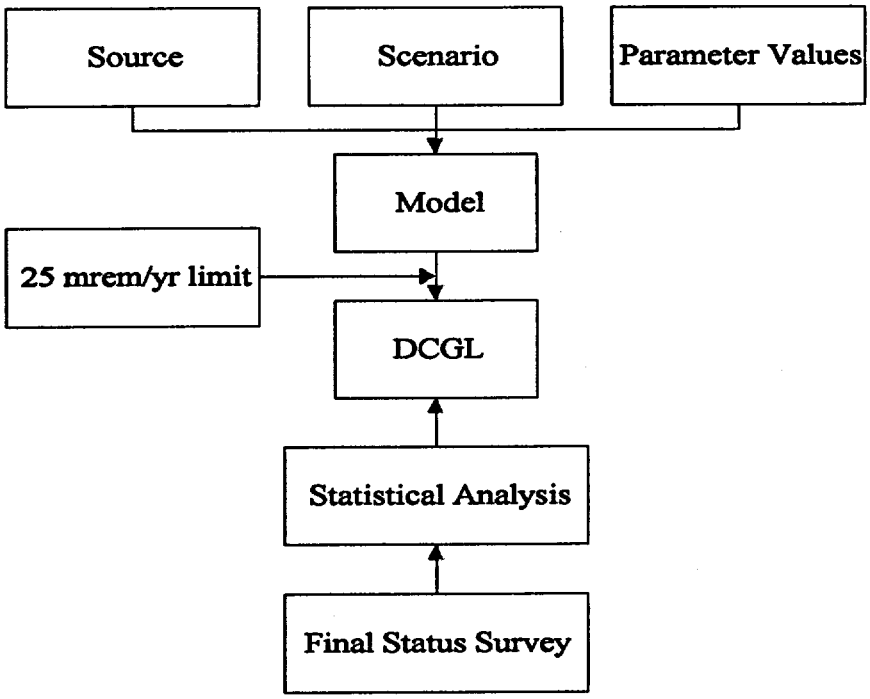
8 Fed. Reg. 64, no. 234, pp. 68395 – 68396, 12/07/99.
9 NRC. SECY-98-242, Attachment 2.
10 SRP, Appx. C, §8.0, ¶2.
11 Norman Eisenberg mentioned conservatism in selection of a 25 mrem/yr dose limit.
12 SRP, Appx. C, §8.3.1 mentions that default parameters of values of input parameters to NRC dose models would never cause the 90th percentile of the output dose distribution from a probabilistic dose analysis of dose distribution to be exceeded for any radionuclide.
13 MARSSIM statistical methodology wants the final status survey measurements to demonstrate compliance with the $DCGL_W$ by about 4 standard deviations of the mean plus an amount equal to the *gray region*.

However, it would seem burdensome beyond benefit for each licensee to have to do when the consequent dose standard is as low as 25 mrem/yr.



Interagency Coordination

That director Carl Paperiello favors reconciliation of separate Federal agency dose models was mentioned in the workshop. This concept seems desirable and should be pursued to promote consistency in cleanup of sites subject to cleanup or regulation by separate federal agencies, including the NRC, DOE, EPA, and Corps of Engineers.

Anticipating Residual Radioactivity After Decontamination

SRP §5 includes statements concerning dose modeling evaluations that relate to expectations of application of the Technical Basis for Dose Modeling Evaluation. The following statement from SRP §5 seems to express an expectation by the NRC that before submitting a decommissioning plan, a licensee will estimate residual radioactivity remaining after decommissioning and to use that as a basis for estimating potential dose after decommissioning:

> *"The staff will review residual radioactivity concentration values provided by the licensee for conditions both before and those projected after the decommissioning is complete."* [in the discussion of Residual Radioactivity Spatial Variability in SRP §5.3]

The SRP also seems to expect an estimate of potential future dose to be in a decommissioning plan.

> *"Nearly every licensee that submits a decommissioning plan will need to provide the NRC with estimates of the potential future dose that could be caused by the residual radioactivity remaining on the site after decommissioning activities are completed."* [SRP §5.0, Introduction]

Concerning acceptance of a decommissioning plan, SRP §5 also seems to be expecting evaluation of some decommissioning option based on projection of compliance derived by dose modeling. Indicative statements are:

> *"The staff will determine the acceptability of the licensee's projections of: (1) radiological impacts to future individuals from residual radioactivity, and (2) compliance with regulatory criteria. The information in the decommissioning plan is acceptable if it is sufficient to ensure a defensible assessment of the potential doses from the residual radioactivity.* [in Evaluation Criteria in SRP §5.3]
>
> *"The staff will review the information provided in the decommissioning plan pertaining to the licensee's assessment of the potential doses resulting from exposure to residual radioactivity remaining at the end of the decommissioning process.* [in Areas of Review in SRP §5.2], and,
>
> *"The licensee's projections of compliance with regulatory criteria are acceptable provided that the staff has reasonable assurance that:*
>
> - *The licensee has adequately characterized and applied its source term."* [in Compliance with Regulatory Criteria in §5.2]
>
> *"The staff concludes that the dose modeling completed for [option description] is reasonable and is appropriate for the exposure scenario under consideration. In addition, the dose estimate provides reasonable assurance that the average member of the critical group is not likely to result in impacts greater than the 0.25 mSv (25 mrem) annual dose criterion in 10 CFR § 20.1402. This conclusion is based on the modeling effort performed by the licensee and the independent analysis performed by the staff."* [in Sample Evaluation Findings in §5.2]

Thus, indications are that, before submitting a decommissioning plan, a licensee is expected to:

1. Estimate what residual radionuclide concentration will be after cleanup; and to
2. Estimate what the potential dose is expected to be after cleanup for comparison with a dose limit.

This would imply that in order to ensure acceptance, a licensee would first have to estimate the average concentration that will not produce more than the dose limit, presumably by the same modeling. **Yet, if decontamination is going to be necessary, it is not very useful to predict results of cleanup and final status survey on the basis of characterization survey data.** This is quite different from derivation of DCGL based on approximate radionuclide distribution because a sum-of-fractions expression makes the final adjustments using final status survey measurements.

These issues need to be resolved, along with following comments specific to the Technical Basis Document.

2. COMMENTS ON THE TECHNICAL BASIS FOR DOSE MODELING EVALUATION

2.1. GENERAL COMMENTS

Expectation that, before decontamination, a licensee will estimate radioactivity concentration anticipated after decontamination and will estimate potential dose on that basis, conveys into the Technical Basis document. Only in the event decontamination is not needed would it seem useful to project dose on the basis of characterization measurements and submit results in a decommissioning plan. Otherwise, if decontamination is expected to be necessary, a licensee should not be asked to project what the radiological dose will be after remediation on the basis of manipulation of characterization measurements.

2.2. COMMENTS ON SPECIFIC SECTIONS

§1.3 Dose Modeling and Decision Framework Methodology

Figure C1.1 does not identify either a decommissioning plan or final status survey step. A decommissioning framework should accept alternative approaches to decommissioning decision-making. They should include:

1. Comparing characterization data with the NRC's generic screening table to decide whether decontamination is necessary;
2. Calculating radiological dose to decide whether decontamination is necessary;
3. Decontaminating to an action level, calculating dose on the basis of final status survey data, and comparing with the dose limit; or
4. Deriving $DCGL_W$ and $DCGL_{EMC}$, decontaminating, performing a final status survey, and analyzing statistically whether final status survey measurements satisfy the DCGL.

While the actual process would be more detailed, the point to be made here is that calculation of dose and comparison with the dose limit should not be the only acceptable approach to deciding whether decommissioning criteria are satisfied.

§3.1 Introduction (of §3, Source Term Abstraction)

The introduction speaks of delineating the residual radioactive material source *"anticipated at the time of final status survey and site release,"* including concentration or areal density by radionuclide. In a straightforward dose calculation, the uncertainty in the computed dose would be correlated with the uncertainty in the source term. It will be very difficult to decontaminate to the very low radionuclide concentration limit required in decommissioning actinides in source, SNM, and 11.e.2-like byproduct materials. *A priori* projection of residual radioactivity after decontamination would be equally difficult and uncertain.

Those performing remediation are more likely to want to know the radioactivity concentration to which they must decontaminate than a dose goal. Since the concentration required of individual radionuclides corresponding to a dose limit can be derived once other modeling and parameter values are agreed upon, the concentration or areal density required to satisfy a dose limit can be derived. However, the concentration or areal density that will actually be present after decontamination most likely cannot be estimated as well. For these reasons, it would be more useful to either:

1. Estimate a decontamination action level, survey after remediation, and calculate whether the dose limit is satisfied based on measurements of the residual source after remediation; or
2. Derive a concentration or areal density limit, survey after remediation aimed to clean below the limit, and test the residual source measurements statistically to determine whether the derived concentration limit is satisfied.

There is little benefit in "guesstimating", prior to decontamination, what the residual source concentration will be after decontamination and projecting the dose from that residual concentration that is anticipated.

§3.3.2 Dose Modeling Objective Two: Assess Dose

Page C.24, ¶1, asks for projection of residual radionuclide concentration based on characterization measurements. If decontamination is expected to be necessary, a decontamination action level or DCGL would need to be estimated in order to be able to predict the radionuclide concentration remaining after contamination greater than the DCGL is removed.

Again on page C.24, ¶1, the text proposes that, *"The licensee should statistically demonstrate that the radionuclide concentrations or contamination depth within an area will be relatively uniform, taking into account the spatial distribution of the data."* Similarly, the text asks that, *"Within the larger areas, the licensee should statistically delineate relatively small areas of projected elevated radionuclide concentrations or increased contamination depth."* After remediation, and in the presence of a background of the same radionuclides, the radionuclide concentration should be between background and the $DCGL_w$. Considering the low $DCGL_w$ anticipated for source, SNM, and 11.e.2-type byproduct materials, attempts to refine a projected spatial distribution or concentration distribution to that degree would not seem useful. Furthermore, at the low DCGL anticipated, it seems unlikely that one could, by design, leave a substantial, elevated area of contamination and still expect to satisfy statistical tests of compliance with the $DCGL_w$. Hence, when asked to conjecture why an area of elevated activity might remain after remediation, as is sought, the reason seems likely to be "unintentional" and or "not reasonably controllable."

On page C.24, the text suggests that, before decontamination, a licensee should anticipate a distinction between areas of elevated source and areas where the source will not elevated after remediation. In effect, it seems to suggest area-weighted dose assessment before remediation occurs. While this should be acceptable, it should alternatively be acceptable to average unbiased final status survey measurements,

subtract background, and enter the net residual radionuclide concentration or areal density as the source term for estimating dose for judging compliance with a dose limit.

§7.3.4 RESRAD Default Deterministic Parameter Set

On page, C.82, it is not clear whether the reference to the preceding section intend to refer to §7.3.3 or to §7.3.2.

§7.4.2 Modifying the RESRAD Default Probabilistic Parameter Set

If a licensee proposes to use the probability version of RESRAD or RESRAD-BUILD, it is not clear whether they will have to substitute D&D default values, including data tables such as bioaccumulation and biospheric transport factors, into RESRAD or RESRAD-BUILD themselves. It would be useful if such a version of RESRAD and RESRAD-BUILD would be prepared and made available by ANL. If licensees must make these substitutions themselves, then they will surely be discouraged from using RESRAD, RESRAD-BUILD, or any program other than D&D. Moreover, if a licensee is pressured to use D&D default parameter values because defense of an entire set of RESRAD or RESRAD-BUILD default parameters would be too burdensome, the consequence is likely to be that RESRAD or RESRAD-BUILD will generate $DCGL_w$ values as low as the uselessly low screening values generated by D&D for actinides of interest for source, SNM, and 11.e.2-like byproduct material users. A rational solution would be to accept either the default parameter values in a new version of RESRAD or RESRAD-BUILD developed by ANL, or more realistic values that the EPA has adopted to estimate the potential radiological dose associated with uranium series and thorium series in 10 CFR Part 192.