QUESTION 1:

In support of the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) process, radionuclide distribution profiles are necessary to ensure that survey and analysis techniques are appropriate and that dose assessments properly consider all the radionuclides that may be present. During the process of developing initial radionuclide profiles for characterizing commercial light water reactor sites and facilities, which radionuclides are considered and what resources and methodologies are appropriate?

ANSWER:

A unique radionuclide profile must be developed for each of the major types of materials expected to remain onsite after remediation. A commercial light water commercial power reactor facility will likely require profiles for contaminated soil/sediments, surface contaminated materials and activated materials. The licensee must consider that activation products in steels and concretes vary with the constituents and operational history. Concrete will also differ between facilities due to different trace elements. While one generic list cannot be developed that would be applicable to all power reactor licensees and materials, once radioactive decay has been considered to the time when final status surveys will be conducted, a set of radionuclides may be developed for surface contamination and for activated materials. The profiles listed below are not meant to be all-inclusive and other radionuclides may need to be added based on site-specific considerations.

Contamination Suite		Activation Suite
H-3	Sb-125	H-3
C-14	Cs-134	C-14
Mn-54	Cs-137	Fe-55
Fe-55	Eu-152	Ni-63
Co-57	Eu-154	Co-60
Co-60	Ce-144	Cs-134
Ni-59	Pu-238	Cs-137
Ni-63	Pu-239/240	Eu-152
Sr-90	Pu-241	Eu-154
Nb-94	Am-241	Eu-155
Tc-99	Cm-243/244	Mn-54, Ni-59, Zn-65

The licensee must confirm, by using characterization surveys and historical assessments, that the radionuclide lists developed are applicable to the facility and appropriate for each medium. Technical considerations and limitations are discussed in: NUREG/CR-3474, "Long-Lived

Activation Products in Reactor Materials"; NUREG-0130, "Technology, Safety and Cost of Decommissioning"; and NUREG/CR-4289, "Residual Radionuclide Contamination Within and Around Commercial Nuclear Power Plants." Characterization surveys conducted according to NUREG-1575, “MARSSIM,” provide information on the important radionuclides that must be considered. The licensee may also use (1) the radionuclide distributions developed for waste classification, to demonstrate compliance with requirements of 10 CFR 61, and (2) analyses such as ORIGEN computer code runs, to help determine which radionuclides to consider. It is important to recognize the limitations of such methods as they apply to the MARSSIM process. The licensee must also consider historical fuel performance, operational history, and time since shutdown. It is incumbent on the licensee to ensure that the list of radionuclides for each material type are developed according to NRC guidance (such as that in MARSSIM) and using good laboratory practices.

QUESTION 2:

When developing derived concentration guideline levels (DCGLs) for the final status survey, which radionuclides can be de-selected from further consideration?

ANSWER:

Guidance in NUREG-1727, "NMSS Decommissioning Standard Review Plan," Appendix E states, "…nuclides that likely contribute less than 10% of the total effective dose equivalent [TEDE] may be ignored." Therefore, during characterization of a facility, if a profile contains radionuclides that collectively contribute less than 10% of the TEDE, those nuclides may be de-selected from the list. Since DCGLs are developed to equate to the radiological criteria for license termination (25 mrem/yr TEDE to the average member of the critical group and ALARA, for unrestricted release in 10 CFR 20.1402), those radionuclides that collectively contribute less than 2.5 mrem/yr may be neglected, given all appropriate exposure scenarios and pathways are considered. It is incumbent on the licensee to have adequate characterization data to support and document the determination that some radionuclides may be de-selected from further consideration in planning the final status surveys. In addition, licensees should note that they are required to comply with the applicable dose criteria in 10 CFR 20, Subpart E. Thus, for facilities with an estimated dose approaching the criteria, the licensee and NRC staff may need to reconsider the acceptability of neglecting some radionuclides.

QUESTION 6:

What is an acceptable approach for the development of input distribution coefficient (k_d) values for soil or concrete when using site-specific dose modeling codes?

ANSWER:

K_d values for input into site-specific dose modeling codes may be determined by the following:

1. Use sensitivity analyses, which include an appropriate range of k_d values, to identify the importance of the k_d to the dose assessment and how the change in k_d impacts the dose (i.e., how dose changes as k_d increases or decreases). The range of k_d values that bound the sensitivity analysis may be obtained from (a) the literature, (b) default distribution in DandD, or (c) default distribution in the probabilistic code of RESRAD (please refer to the "Basis" section that follows).

2. Using the results of the sensitivity analysis, choose a conservative k_d value, depending on how it affects the dose (e.g., if higher k_d values result in the larger dose, an input k_d value should be selected from the upper quartile of the distribution, or if lower k_d values result in the larger dose, an input k_d value should be selected from the lower quartile of the distribution). For those isotopes where the k_d does not have a significant impact on the dose assessment (i.e., k_d is not a sensitive parameter), the median value within the range is an acceptable input parameter.

3. If the licensee feels that the k_d value is overly conservative, the licensee is encouraged to perform a site-specific k_d determination, so that the dose assessment reflects true site conditions.

BASIS:

Licensees are encouraged to use sensitivity analyses to identify the importance of the k_d parameter on the resulting dose, to demonstrate that a specific value used in the analysis is conservative, or to identify whether site-specific data should be obtained (if licensee feels k_d is overly conservative). The sensitivity analysis should encompass an appropriate range of k_d values. As noted above, the input range for the sensitivity analysis may be obtained from literature, DandD default distribution, or RESRAD probabilistic default distribution.

Literature

It is noted that k_d values commonly reported in the literature may vary by as much as six orders of magnitude for a specific radionuclide. Generally, no single set of ancillary parameters, such as pH and soil texture, is universally appropriate in all cases for determining appropriate k_d values. Although k_d values are intended to represent adsorption, they are in most cases a lumped parameter representing a myriad of processes. Given the above, the proper selection of a range of k_d values, for either soils or concrete, from the literature will require judicious selection.

DandD

The use of default k_ds in DandD Version 1.0 outside of the scope of DandD may not be justified, since the single set of default parameters derived for DandD was developed assuming

a specific set of exposure pathways and a specific source term. To take any single parameter value from the default set of parameters outside of the context of the given exposure scenario, source term, and other parameters has no meaning in terms of the original prescribed probability; therefore there is no basis to conclude that any default k_d value will give a conservative result. However, the range of default k_ds used in DandD (which can be found in NUREG/CR-5512, Volume 3, "Residual Radioactive Contamination From Decommissioning – Parameter Analysis," Table 6.86) can be used as the range of k_ds for the sensitivity analysis.

RESRAD

RESRAD default parameter values (including k_ds) should not be used. The defaults were included in the code primarily as place holders that enable the code to be run; it was assumed that site-specific values would be developed. However, it is appropriate to use the default parameter distribution, developed for RESRAD Version 6.0, as the range for use in the sensitivity analysis.

After performing sensitivity analysis with the appropriate k_d ranges, the k_d value at the upper or lower quartile of the distribution, resulting in the highest derived dose, is an acceptable value to input into the dose code, and no further justification is required. For those k_ds indicating overly conservative values, a site-specific k_d value may be determined by the direct measurement of site samples. Appropriate techniques for k_d determination include American Society for Testing and Materials (ASTM) and U.S. Environmental Protection Agency (EPA) methods[1].

[1]9-83, "Distribution Ratios by the Short-Term Batch Method"
ASTM D 4646-87, "24-h Batch-Type Measurement of Contaminant Sorption by Soils and Sediments"
"Understanding Variation in Partition Coefficient, K_d Values, Volumes I and II, EPA 402-R-99-004A, 8/99
http://www.epa.gov/radiation/technology/partition.htm#voli

QUESTION 8:

Using appropriate illustrative examples in the license termination plan (LTP), is it acceptable to define (1) the data quality objectives (DQO) process and (2) the acceptance criteria for demonstrating that radiation survey instrumentation, selected for use in the final status survey (FSS), is sufficiently sensitive for a given derived concentration guideline level (DCGL) and expected survey conditions?

ANSWER:

Yes, it is acceptable to define the DQO process and acceptance criteria using examples that demonstrate the appropriate selection of radiation survey instrumentation for the expected types of FSS surface conditions and radionuclides forming the basis of the DCGL.

For example, the selection of instrumentation may be grouped by category of surfaces with similar features and expected instrument responses over these surfaces. For each of the defined categories of survey instrumentation and methods presented in the LTP (e.g., soil scanning, surface scanning and surface fixed measurements), the licensee should provide the derivation of scan and fixed minimum detectable concentrations (MDCs). The derivation of the MDCs must take into account instrument efficiencies (surface and detector), scan rates and distances over surfaces, surveyor efficiency, and minimum detectable count rate, using the guidance in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual," and NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions."

Instruments, other than those provided as examples in the LTP, may be used for the FSS as long as the process approved in the LTP is used to show that the substitute instrument has equal or better performance. If a licensee were to use new technologies (e.g., in situ gamma spectroscopy) or different instrumentation than those that were considered at the time of the submittal of the LTP, the new technology or instrumentation must be shown to perform with sensitivities that allow detection of residual radioactivity at levels that correspond to an appropriate fraction of the DCGL and corresponding investigation levels, and are at least as efficient as examples of survey instrumentation provided in the LTP. A licensee must also demonstrate and document that conducting the FSS by this new method will also meet all related DQOs in demonstrating that survey units meet the site-established DCGLs.

QUESTION 9:

Is the collection of additional characterization data, beyond that available from periodic radiation protection surveys, required in the license termination plan for structures, components, and soils that will be removed from the facility prior to license termination?

ANSWER:

No. In general, radiological data obtained during characterization surveys are used to determine the radiological status of the site, including facilities, buildings, surface and subsurface soils, and surface and ground water. In turn, this information is used to support the planning and design of final status surveys (FSS). In addition to providing the basis of the design of FSS, characterization surveys are used to support the following:

- Identification of remaining site dismantlement activities
- Development of new (or revisions to existing) remediation plans and procedures
- Revisions to decommissioning costs and trust fund
- Identification of environmental aspects not previously considered
- Revisions to the Environmental Report

Since the license termination process is only concerned with the status of facilities after the completion of all remediation activities, radioactivity associated with structures, components, and soils that will be removed from the facility, and appropriately disposed of elsewhere, is not an issue as it cannot contribute to public dose controlled under 10 CFR 20.1402 - “Radiological Criteria for Unrestricted Use”; therefore, additional characterization data need not be collected.

QUESTION 10:

Is characterization data required to support initial classification of Class 1 areas?

ANSWER:

Areas classified as Class 1 do not require characterization data to support that classification.

Note: Characterization data are needed to support decommissioning activities for all areas including:

- Determination of radionuclide distribution profiles and identification of surrogate radionuclides
- Dose modeling and development of derived concentration guideline levels
- Final status survey design and instrument selection
- Structuring the data quality objectives
- Assessment of spatial variability of radioactive contaminants on building surfaces and in surface and subsurface soils
- Assessment of whether ground water is impacted, using the results of the surface and subsurface soil characterization surveys
- Initially defining and changing the boundaries of Class 1 survey units with bordering and adjacent survey units
- Re-classification of survey units (using guidance in NUREG-1757, "Multi-Agency Radiation Survey and Site Investigation Manual," and NUREG-1727, "NMSS Decommissioning Standard Review Plan")