July 29, 1996

Dr. W. Alexander Williams
EM-421
Cloverleaf Building
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

SUBJECT: DOE DRAFT SOIL CLEANUP GUIDELINES

Dear Dr. Williams:

This is in response to your letter of March 22, 1996, requesting NRC comments on DOE's draft report entitled, "Derivation of Guidelines for Cobalt-60, Nickel-63, and Uranium Residual Radioactive Material in Soil at the Combustion Engineering Site, Windsor, Connecticut." This report was prepared by Argonne National Laboratory for remedial action as a part of the Formerly Utilized Site Remedial Action Program. The NRC staff has reviewed this document and our comments are enclosed.

The DOE draft report presented approaches and methods, in derivation of radionuclide soil guidelines, similar to those used by the NRC in decommissioning and cleanup activities of the Site Decommissioning Management Plan sites. However, in this report DOE has adopted different dose criteria from those used by NRC, and selected incomparable exposure pathways, scenario parameters, and site physical parameters. These differences could result in significantly less conservative dose limits.

If you have any question on this matter, please call Mr. Sean Soong of my staff at (301) 415-8155.

Sincerely,

Original signed by:

Robert C. Pierson, Chief
Licensing Branch
Division of Fuel Cycle Safety
and Safeguards, NMSS

Enclosure: As stated

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NRC Comments on
DOE's Draft Report Entitled,
"Derivation of Guidelines for Cobalt-60, Nickel-63,
and Uranium Residual Radioactive Material in Soil at the
Combustion Engineering Site, Windsor, Conneticut"

Background:

The U.S. Department of Energy (DOE) designated a portion of the Combustion Engineering Inc. (CE), Windsor, Connecticut, site for remedial action as a part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). That portion of the site was used previously for production of high-enriched uranium fuel and is currently under DOE's jurisdiction. Other portions of the CE site were used for commercial nuclear activities and are currently licensed by the U.S. Nuclear Regulatory Commission (NRC).

Prior to developing its remedial action plan, DOE typically establishes soil cleanup guidelines for FUSRAP sites as an initial step. Pursuant to DOE Order 5400.5., Chapter IV, DOE uses the **RES**idual **RAD**ioactivity (**RESRAD**) computer code to determine soil cleanup guidelines for FUSRAP sites.

DOE sponsored a study by Argonne National Laboratory (ANL) on derivation of soil guidelines for Co-60, Ni-63, and uranium (natural/enriched) radionuclides at the CE site. In this study, ANL employed RESRAD code to derive soil guidelines using three different scenarios. ANL reported the results of the study in a draft technical report entitled, "Derivation of Guidelines for Cobalt-60, Nickel-63, and Uranium Residual Radioactive Material in Soil at the Combustion Engineering Site, Windsor, Connecticut."

DOE requested NRC (in a letter dated March 22, 1996) to provide comments on ANL's draft report. DOE stated in its letter that "it is possible that the draft guideline report might be useful to NRC in addressing regulatory issues at the site." In other words, DOE contemplated a possible use of the ANL report in establishing residual activity guidelines for the NRC's licensed portions of CE site.

This report presents a brief comparative outline of NRC's approach in developing site specific guidelines versus DOE's approach. It also provides staff comments on the draft ANL document regarding the use of multiple scenarios and RESRAD analysis in derivation of guidelines for Co-60, Ni-63, and U in soil at the CE site.

Enclosure

General Comments:

1. Similarities Between NRC and ANL Approaches Employed In Derivation of Soil Activity Guidelines:

Currently, NRC uses interim radionuclide residual soil contamination limits (e.g, soil activity concentration pCi/g) from existing guidance documents to demonstrate adequacy of site decommissioning actions. In some situations, however, the residual soil contamination limits for certain radionuclides have not been established yet.

In other situations, an NRC licensee may attempt to justify alternate criteria (above or below the existing interim criteria) on the basis of "as low as is reasonably achievable" (ALARA) or on the basis of a unique site-specific condition. The NRC staff commonly evaluates the acceptability of alternate residual contamination levels in such situations by considering potential doses to individuals from exposure to the contamination. In this context, NRC staff commonly uses the exposure scenarios in Policy and Guidance Directive P&GD-8.08 (NRC, 1994) that are applicable to the site. Subsequently, the staff conducts pathway analysis and dose impact assessment to derive soil concentration limits. The derived soil concentration limits are typically based on a peak annual dose to an average member of the exposed critical group at the specific site. The critical group typically has a life style and diet habits compatible with the selected scenario. The annual peak dose is evaluated over a period of 1000 years after waste placement. In most cases, the derived guideline peak dose, for unrestricted use, represents a small fraction of the public dose limit in 10 CFR 20.1301 (e.g., 10 mrem/y). NRC staff commonly uses several dose assessment codes in its risk impact analysis. The RESRAD code is one of the computer codes frequently used in dose assessment and in derivation of soil concentration limits.

The draft ANL report presented generic approaches for establishing soil residual activity guidelines at the CE site similar to those approaches commonly used in developing residual soil contamination limits for NRC sites listed under the Site Decommissioning Management Plan (SDMP). The similar approaches included the following aspects:

(a) The use of dose impact analysis is based on specific scenarios applicable to the site. For example, the ANL study employed dose assessment exposure scenarios A (industrial worker), B (resident), and C (subsistence farmer), in a similar fashion to NRC staff use of scenarios A, B, and C listed in P&GD-8.08.

(b) The ANL study used the RESRAD code in a dose impact assessment and in derivation of soil guidelines at the CE site. This approach is similar to current NRC staff practices of using the RESRSAD code in the dose impact analysis and in the derivation of alternate interim soil guidelines for decommissioning sites. Further, ANL used the peak dose over a period of 1000 years to derive soil guidelines which is similar to NRC's current decommissioning practice.

Based on the above discussion, the generic ANL approach (e.g., with respect to use of scenarios, pathway analysis, peak dose in 1000 years, and the use of the RESRAD code) is in harmony with NRC's common approaches and practices used in decommissioning.

2. Inconsistencies With NRC's Dose Analysis and Derivation of Guidelines:

Although the generic scenario and dose assessment approach outlined in the ANL report appear to be consistent with those of NRC, there are significant differences between the ANL and NRC approaches. These differences include the following aspects:

(a) Selection of the dose limit: The dose limits selected by ANL (e.g., 30 mrem/y for scenarios A and B and 100 mrem/y for scenario C) are inconsistent with current NRC dose criteria for the unrestricted site release (e.g., a significant fraction of the public dose limit, in 10 CFR 20.1301, which is approximately 10 mrem/y).

(b) Selection of multiple scenarios for the site: NRC staff commonly selects the "residential farmer scenario" for derivation of soil activity guidelines under the unrestricted site release conditions. In the case of a licensee's request for exemption from the unrestricted site release criteria, the staff may select an alternative scenario based on the type of restrictions to be imposed upon site release. Therefore, typically, a scenario is selected which is applicable to site specific conditions and to future land use. The dose assessment and pathway analysis are typically performed based on the applicable scenario using site specific conditions. Certain environmental pathways might be eliminated when selecting the applicable scenario. However, the estimated dose to the public, using the applicable scenario, still remains a small fraction of NRC's public dose limit (e.g., approximately 10 mrem/y). In some cases selection of soil activity guidelines may be dependent on cost/risk analysis. For example, if the cost of cleanup is prohibitive, compared to the potential risk, the staff may select an alternate scenario for the remedial action. In such a case, the site may be qualified for an exemption from the unrestricted release criteria. Subsequently, the site may go through the National Environment Policy Act process for selection of an appropriate decommissioning alternative.

In its dose impact analysis, ANL selected scenarios A, B, and C. ANL reported that scenarios A (Industrial Worker), and B (Resident, without water use) were selected because they are consistent with the current land use and are likely future use scenarios. The ANL report indicated that scenario C is a less likely scenario; however, the report emphasized that it is a plausible future scenario. As was indicated above, ANL selected two dose limits (e.g., 30 mrem/y for scenarios A and B and 100 mrem/y for scenario C) for the same site. Thus, ANL selection of more than one dose limit may not be consistent with the current NRC approach for decommissioning. Staff

suggests that DOE should select a prudently conservative scenario based on analysis of an exposed critical group which is consistent with the site specific conditions and its surrounding environs.

(c) Scenario Pathways: The applicable exposure pathways selected by ANL for scenario A and B are inconsistent with NRC's scenario A and B of P&GD-8.08. Under scenario A, the NRC accounted for three pathways, external exposure, inhalation, and radon. ANL's A scenario, however, accounted for a soil ingestion pathway in addition to the three pathways listed under NRC's A scenario. Concerning scenario B, the NRC accounted for three more pathways (e.g., water ingestion, vegetable ingestion, and soil ingestion) in addition to those pathways listed in NRC's scenario A. ANL, however, included only plant ingestion, and fish ingestion pathways, in addition to the four exposure pathways listed under its A scenario. Therefore, it is apparent that there is a lack of consistency between NRC and ANL in selecting exposure pathways. The lack of inconsistency could result in significant differences in dose calculations.

(d) Scenario Parameters: The ANL scenario parameters associated with the critical group life style, dietary habits, and site default values are different from those of NRC's. For example, the NRC considered the outdoor time fraction for scenarios A, B, and C, respectively, as five percent, 10 percent, and 21 percent. ANL however, considered outdoor time fractions for A, B, and C scenarios as six percent, 25 percent, and 25 percent respectively. NRC's indoor shielding factor was selected 33 percent whereas the ANL's shielding factor was selected 70 percent. The fraction of diet (e.g., vegetables, grains, and fruits) for NRC's scenarios B and C were selected 25 percent and 50 percent, respectively, whereas ANL's fractions of diet were approximately, 10 percent and 50 percent, respectively. Selection of physical parameters such as soil density, distribution coefficients, porosity, and hydraulic conductivity were also different. These differences in scenario physical parameters would also result in significant differences in the estimated doses.

Specific Comments:

1. Non-Conservative Selection of Erosion Rate:

The ANL source term model assumed having no cover above the contaminated zone. In addition, the model assumed no surface erosion activity exists at the site (e.g., zero surface erosion rate). This assumption is not technically defensible and non-conservative. The zero erosion rate assumption is non-conservative because it eliminates dust inhalation pathways and subsequently reduces the dose impacts in scenarios A and B. ANL should adopt a defensible and conservative assumption regarding the source term erosion conditions.

2. Distribution Coefficient:

ANL reported uranium distribution coefficients (K_d's) at the CE site in the range of 82 to 59,000. ANL selected the maximum K_d value (i.e., 59,000) representing the average site specific condition. ANL contemplated that such a value, based on sensitivity analysis, would result in more restrictive (conservative) guidelines. It should be noted that this assumption may be true for scenarios A and B because ANL disregarded groundwater pathways for these two scenarios. For scenario C, however, the high K_d value would tend to lower radionuclide releases and hence underestimate doses associated with drinking water and food ingestion pathways. The RESRAD manual listed typical uranium K_d values for different soils (Yu et. al. 1993). These values were in the range of 11 to 4,400, with a geometric mean of 45. Most K_d values for clay soils were in the range of 270 to 4,400. ANL indicated in its draft document that the soil type at the CE site is a sandy loam. Sandy soil is expected to have less radionuclide retention in the solid phase than clay soil. Based on the above discussion, ANL should review Table 6 data in the draft report and conduct a dose impact sensitivity analysis based on conservative K_d values accounting for the groundwater pathways for scenarios B and C.

3. The Derived Radionuclide Guidelines for the CE Site:

ANL listed in Table 7 the derived residual radioactive material guidelines for the CE site. These guidelines are inconsistent and less restrictive than NRC's interim guidelines and the NRC's proposed decommissioning guidelines (based on NUREG-1500 dose conversion factors). For example, the interim NRC guidelines for residual uranium (natural) in soil is 10 pCi/g for option 1 and 40 pCi/g for option 2. ANL derived guidelines were 700, 210, and 560 pCi/g, for scenarios A, B, and C, respectively. The proposed NRC's soil concentrations (pCi/g) corresponding to a total dose of 15 mrem/y were listed in NUREG-1500 as 22.1 pCi/g for the drinking water scenario (e.g., similar to P&GD-8.08 scenario B) and 19.3 pCi/g for the residential scenario (e.g., similar to PG-8.08 Scenario C). Comparison of NRC's interim and proposed soil guidelines with those of ANL indicates a significant difference between these two guidelines. Further, NRC staff conducted dose impact assessments using the RESRAD code for calculation of uranium residual activity (corresponding to 10 mrem/y) for unrestricted site release. In most cases, uranium soil guidelines, necessary to meet NRC levels for unrestricted release, were determined to be in the range of 10 to 20 pCi/g. Considering the "dose to source-concentration" ratio derived by ANL, it appears that the ANL dose assessment is significantly less conservative than NRC's. This may be related to the non-conservative ANL approach in selecting exposure pathways for each scenario and to the non-conservative parameters selected for the site. Therefore, NRC staff suggests that ANL revise the selection of the exposure pathways and the associated life-style, and physical parameters employed in the dose assessment.

Summary and Conclusions:

The draft ANL report presented approaches and methods, in derivation of radionuclide soil guidelines, similar to those adopted by NRC in decommissioning and cleanup activities of SDMP sites. In this context, ANL employed scenarios and codes similar to those used by NRC and selected a compliance time period which was identical to that used by NRC. However, ANL selected dose criteria, exposure pathways, scenario parameters, and site specific physical parameters that were inconsistent with those commonly used by NRC staff. Due to these inconsistencies the ANL derived guidelines are not directly comparable to NRC's cleanup guidelines for decommissioning of sites with residual soil contamination.