February 15, 2006

Ms. B. Marie Moore, Vice President
Safety and Regulatory
Nuclear Fuel Services, Inc.
P.O. Box 337, MS 123
Erwin, TN 37650

SUBJECT: NUCLEAR FUEL SERVICES, INC. - AMENDMENT 69 - APPROVAL OF FINAL STATUS SURVEY METHOD FOR SUBSURFACE SOILS (TAC L31875)

Dear Ms. Moore:

In accordance with your application dated February 9, 2005, and supplements dated March 30, June 13, November 10, and December 14, 2005, and pursuant to Part 70 to Title 10 of the Code of Federal Regulations (CFR), Materials License SNM-124 is hereby amended to approve the new final status survey method added to the North Site Decommissioning Plan for subsurface soils. Accordingly, Safety Condition S-1 has been revised to include the dates of February 9, March 30, June 13, November 10, and December 14, 2005.

In addition, Safety Condition S-1 has been revised to clarify that Nuclear Fuel Services, Inc., may change its commitments without prior approval from the Nuclear Regulatory Commission (NRC) in accordance with 10 CFR 70.32 and 70.72. All other conditions of this license shall remain the same.

Enclosed are copies of the revised Materials License SNM-124 (Enclosure 1), and the Safety Evaluation Report (Enclosure 2).

If you have any questions regarding this matter, please contact Kevin Ramsey of my staff at (301) 415-7887 or via e-mail to kmr@nrc.gov.

This letter and its enclosures contain sensitive, unclassified information, and are therefore deemed Official Use Only. They will not be placed in the Public Document Room nor will they be publicly available in the NRC Agencywide Documents Access and Management System (ADAMS).

Sincerely,

/RA/

Gary S. Janosko, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
and Safeguards

Docket No.: 70-143
License No.: SNM-124
Amendment 69

Enclosures:
1. Materials License SNM-124
2. Safety Evaluation Report

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DOCKET: 70-143

LICENSEE: Nuclear Fuel Services, Inc.
Erwin, Tennessee

SUBJECT: SAFETY EVALUATION REPORT: APPROVAL OF FINAL STATUS SURVEY METHOD FOR SUBSURFACE SOILS (TAC L31875)

1.0 BACKGROUND:

By cover letter dated February 9, 2005, and supplements dated March 30, June 13, November 10, and December 14, 2005, Nuclear Fuel Services, Inc. (NFS), submitted a new final status survey method for assessing radioactivity in subsurface soils under the North Site Decommissioning Plan (DP). The existing methods in the plan are limited to the upper 15 centimeters of soil. The new method was proposed because, essentially all surface soil has been removed from the North Site.

2.0 DISCUSSION:

2.1 Performance Assessment

NFS proposes, for its North Site area, a new method to derive subsurface soil (greater than 15 cm below the ground surface) derived concentration guideline levels (DCGLs). These DCGLs are derived to demonstrate compliance with the 25 mrem/year dose criterion for unrestricted release of the area in accordance with 10 CFR 20.1402. Surface soil DCGLs (less than 15 cm) for this site have been previously approved in a separate licensing action.

The subsurface soil DCGLs are dependent upon the development of scaling factors, which will be used to modify the approved surface soil DCGLs. These scaling factors are products of two variable factors: 1) volume factors and 2) mixing volume factors. The licensee calculated volume factors using the same two land use scenarios that were used in the derivation of the approved surface soil DCGLs. However, the staff notes that in the technical basis document dated February 2005, the licensee initially derived the subsurface DCGLs from only a single scenario. Subsequently, in response to the staff's request for additional information (RAI), the licensee revised the derivation of volume factors and based the subsurface soil DCGLs on the two scenarios used to derive the surface soil DCGLs to maintain model consistency.

Enclosure 2

[redacted]

Using RESRAD version 6.21 for dose modeling, the licensee derived a volume factor for the radionuclide of interest by taking the ratio of the dose of a reference source term to the dose produced by a smaller volume source. To derive a range of volumes for each radionuclide, the licensee assumed a constant 0.5 meter disc-shaped source term and varied the area of the contamination zone in the RESRAD model while holding all other parameters constant. This method was used repeatedly to derive volume factors for each of the thirteen site-specific radionuclides for 25 different volumes ranging from 1 m^3 to 27,500 m^3.

Additionally, in deriving subsurface soil DCGLs, the licensee developed mixing volume factors, which are calculated by taking the ratio of the total thickness of the soil column considered for excavation to the thickness of the same subsurface soil structure. As stated by the licensee, the mixing volume factors describe the variability in dose-response with respect to the vertical position of the subsurface soil strata considered for excavation. The licensee also notes that these factors are independent of the radionuclide of interest, as well as the volume of subsurface soil material that could be potentially excavated.

Using RESRAD version 6.22, the staff independently performed analyses and confirmed the licensee's volume factor results for the site-specific radionuclides. The staff also reviewed the mixing factor calculations provided in the technical basis document and believes the method to be acceptable. Thus, for the North Site area of NFS, the staff finds the methodology used to derive subsurface soil DCGLs to be adequate and reasonable to demonstrate compliance with 10 CFR 20.1402 for unrestricted release.

2.2 Decommissioning Health Physics

For the North Site area of the NFS site, the licensee proposes a new method for performing final status surveys (FSS) for subsurface soils. The method is proposed for incorporation into the existing DP as an Appendix B to Chapter 5. The method is based on obtaining soil samples from boreholes (the licensee uses the term corehole). The method proposed includes commitments for determining the number of samples per survey unit and conducting the statistical tests, including elevated measurement comparisons. Of significant importance is the method proposed to determine the spacing of coreholes to obtain the subsurface samples.

2.2.1 Reasonable Maximum Concentrations for Determining Corehole Density

Section 3.3 of the licensee's proposed Appendix B to its DP, describes the method proposed to adjust corehole sampling density in each survey unit, to account for potential elevated areas and comply with local area average DCGLs. The general method proposed is to estimate maximum concentrations for a given survey unit. The licensee developed volume factor curves, which are curves plotting the soil concentrations versus volume that would result in a given dose (described in Section 2.1.1 of Appendix B). The maximum concentration would then be used to determine a corresponding volume of significance, based on the volume factor curves. Finally, the corehole density (or grid

[redacted]

[redacted]

spacing) would be adjusted based on the volume of significance, to provide a high likelihood that volumes of significance at the maximum concentration would be located during the FSS sampling.

Initially (in the February 2005 version of Appendix B), the licensee proposed to determine the "reasonable maximum concentration" by the 90th percentile value from among existing data for that survey unit. In the response dated June 13, 2005 to the NRC staff questions, the licensee committed to using the 90th percentile value or the mean value, whichever was greater. Then that single reasonable maximum concentration would be used to determine the volume of significance and the corehole density or spacing. The NRC staff still had a concern that a corehole density calculated on the mean or 90^{th} percentile may be insufficient to locate all significant volumes of higher concentrations. While the proposed approach appeared to the NRC staff to be protective against potential exposures to small volumes with typical or average concentrations, the staff questioned whether it would be protective against potential exposures to small volumes at the highest concentrations. The staff asked the licensee, in the RAI dated September 15, 2005, question 3.(a), to provide an explanation of how the approach would protect against potential exposures to the highest concentrations, including: (1) the likelihood of, and (2) the dose consequences of potential exposures to small volumes at concentrations higher than the "reasonable maximum concentration."

In the revision of Appendix B (submitted December 14, 2005), the licensee revised this approach, to use two different estimated maximum concentrations. Section 3.3 of Appendix B was revised, and now describes use of the "reasonable maximum concentration," based on the 90th percentile of the existing data, and the "expected maximum concentration," based on the maximum observed concentration in the existing data. The licensee then determines two corresponding volumes of significance, or "critical volumes" (terminology in the December 14, 2005, revision of Appendix B). The reasonable maximum concentration is used with the volume curve based on 25 mrem/year dose to determine the first critical volume. The expected maximum concentration is used with a volume factor curve based on 100 mrem/year dose to determine the second critical volume. The licensee committed that the smallest of the two critical volumes will be used to adjust the corehole density, with sampling density increased, if necessary, so that each sample represents a volume equal to the smallest critical volume.

In Section 3.3 of Appendix B to Chapter 5 of the DP (December 14, 2005, version), the licensee states that, in using the proposed method, it is less than 10% likely that localized deposits of residual radioactivity would result in doses in excess of 25 mrem/year. The 10% value presumably comes from the use of the 90th percentile concentration to derive the critical volume. However, a sampling grid with each sample representing the critical volume does not guarantee that all "hot spots" of critical volume at the 90th percentile concentration would be found in the sampling. The probability of actually locating the hot spots is also dependent on the type of sampling grid (the licensee plans a square grid, random start) and the shape of the hot spot. The NRC staff evaluated the probabilities of

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finding elliptical or circular hot spots (using methods from Gilbert 1987), and finds the chances of missing hot spots of the critical volume to be acceptably small. Thus, the NRC staff concludes that the chance of localized hot spots resulting in doses greater than 25 mrem/year is acceptably small.

This revised method provides additional bounds on the consequences of smaller volumes at higher concentrations that might remain in the subsurface soil. The NRC staff concludes that this revision of the approach, to include use of the two critical volume estimates, resolves the staff concern about the method's protectiveness for the highest concentrations that might be seen.

The NRC staff also evaluated the conditions under which the subsurface FSS plan would be used. The staff recognizes that the proposed method should be applied to areas with relatively homogeneous contamination, and may be inappropriate for areas with very inhomogeneous contamination, such as that from scattered discrete pieces of radioactive material. In the latter case, characterization may be insufficient to determine the extent of the inhomogeneous contamination, thus any conclusions about sample spacing for the FSS would be inappropriately determined. The licensee has addressed this issue in its response to RAI 3.(a) (November 10, 2005, submittal). The licensee acknowledges that the proposed method may not be appropriate in cases where significantly-radioactive, discrete sources are present. The licensee also indicates (in Section 3.3 of Appendix B to Chapter 5 of the DP, dated December 14, 2005) that for the determination of the reasonable maximum concentration, in addition to using pre-existing measured values, data from nearby areas, information from a historical site assessment, and professional judgment will be taken into account. The licensee's response to the RAI also indicates that this proposed method is site-specific to the NFS North Site area. Finally, the licensee indicates in the response to the RAI that survey unit boundaries will be developed using all information about the contaminated area, including unique history or processes, deposition mechanisms, and likelihood for presence of residual radioactivity, so that dissimilar areas will be segregated into separate survey units.

The NRC staff concludes that the licensee has taken reasonable account of the conditions under which the proposed method should be applied, and intends to use reasonable precautions in applying the method at the NFS North Site.

Based on this evaluation, the staff has determined that this aspect of the subsurface FSS Plan is adequate to determine sampling density for demonstrating compliance with the radiological criteria for license termination.

2.2.2 Information from Other Sources for Determining Corehole Density

The approach initially proposed by the licensee (in the February 9, 2005 submittal) for determining the maximum concentration and sampling density would only use data from the individual survey unit under consideration. The NRC staff had a concern, expressed in RAI 3.(b), that this approach would ignore other information, including data from

neighboring survey units and historical information, that may be relevant to the survey unit. In its response to RAI 3.(b) and its revised Section 3.3 of Appendix B to Chapter 5 of the DP, the licensee has committed to use other available and relevant data for the survey design (including determination of corehole density). The licensee also committed to demonstrate, in the FSS Report, that the survey design was robust enough to sample the critical volumes associated in the 90th percentile and maximum observed concentrations from the FSS. That is, the licensee will check after the FSS to ensure that the FSS design included enough sampling coreholes based on the FSS data obtained.

The NRC staff concludes that the licensee has made reasonable commitments to include all appropriate and relevant available data in designing the FSS, including data for determining the corehole density. Staff concludes that this aspect of the approach to subsurface FSS is acceptable.

2.2.3 Use of Reference Area Data from Multiple Layers for Wilcoxon Rank Sum test

The licensee's proposed approach to FSS for subsurface soils includes statistical average concentrations for many different subsurface volumes, and these averages are weighted based on layer thickness. The approach proposed initially by the licensee (in the February 9, 2005 submittal), for comparisons of survey unit data to reference area data, indicated that the weighted average data from survey units would be compared to individual data from the reference area. The NRC staff had a concern that individual samples from a single borehole in the reference area would not represent independent samples, and would be inappropriate for use in the statistical tests (RAI 2).

In its response to RAI 2 (November 10, 2005, submittal), the licensee agreed that the comparison of individual data to the weighted average data would be inappropriate, but for a different reason. The licensee indicated that the reference area data and the survey unit data should be subjected to the same mathematical process if the two data sets are to be compared using the Wilcoxon Rank Sum (WRS) test. Thus, if the survey unit data is to be processed by calculating a weighted average concentration, the reference area data should similarly be a weighted average concentration. The NRC staff agrees with this reasoning, and withdraws the previous NRC staff reason for concern. The result is that the licensee revised the approach, in Section 5.3.1.2 of Appendix B of Chapter 5 of the DP (December 14, 2005, revision), to indicate that weighted average reference area data will be produced, using the same process used for the survey unit, for use in the WRS test comparisons. The NRC staff concludes that this change is acceptable.

2.2.4 Auger/Core Sample Refusal

The initial submittal (Section 4.2, Appendix B of Chapter 5 of the DP, February 9, 2005) indicated that soil cores for each of the soil "cubes" would be advanced to below the known depth of radiological impact or to refusal. The NRC staff raised a concern, that the plan did not describe what would be done in cases of refusal. In its response (June 13, 2005), the licensee committed to using coring techniques that are not subject to the

typical causes of auger refusal. In addition, in the revised Appendix B (December 14, 2005), the licensee now indicates that soil cores will be advanced to below the known depth of radiological impact (i.e., "or to refusal" was removed from the statement). The NRC staff concludes that this commitment, and change to the Appendix B of Chapter 5 of the DP is acceptable.

2.2.5 Conclusions

In terms of the health physics and surveying aspects, the NRC staff concludes that the subsurface FSS Plan, as described in the revised Appendix B to Chapter 5 of the DP (dated December 14, 2005) is adequate to perform FSS for subsurface soils in the North Site area for demonstrating compliance with the radiological criteria for license termination.

As described above, the subsurface approach proposed by the licensee is site specific, and should only be applied to the North Site area of the NFS site. Because of this, potential application to other areas or other sites must be considered carefully by licensees and by the NRC staff.

Also, because of the above considerations, and because the proposed approach is one not applied to NRC-licensed facilities previously, the NRC staff will carefully evaluate the results of these surveys as presented in the eventual FSS Reports. The staff may use geostatistical techniques, such as kriging and other techniques, including those provided in the SADA software.

2.2.6 Reference

Gilbert, R.O., *Statistical Methods for Environmental Pollution Monitoring*, Van Nostrand Reinhold, New York, NY, 1987.

3.0 ENVIRONMENTAL REVIEW

The staff has determined that the changes to the North Site Decommissioning Plan are considered administrative and procedural and does not affect the scope or nature of the licensed activity. The North Site Decommissioning activities were previously evaluated in an Environmental Assessment which was published in the *Federal Register* on May 16, 2001 (66 FR 27168). A categorical exclusion is authorized in accordance with 10 CFR 51.22(c)(11) if the following requirements are satisfied:

i. There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

ii. There is no significant increase in individual or cumulative occupational radiation exposure.

[redacted]

iii. There is no significant construction impact.

iv. There is no significant increase in the potential for or consequences from radiological accidents.

The new final status survey method is considered administrative in nature. There is no significant change in the types of effluents nor is there any significant increase in the amounts of any effluents. Occupational exposure is expected to remain the same. These changes involve no additional construction activity. There is no significant increase in the potential for or consequences from radiological accidents.

The staff has determined that the proposed changes do not adversely affect public health and safety or the environment and are categorically excluded from the requirement to prepare a site-specific environmental assessment. Therefore, in accordance with 10 CFR 51.22(c)(11), neither an environmental assessment nor an environmental impact statement is warranted for this action.

4.0 CONCLUSION:

Upon review of the North Site Decommissioning Plan changes, the NRC staff finds the methodology used to derive subsurface soil DCGLs to be adequate and reasonable to demonstrate compliance with 10 CFR 20.1402 for unrestricted use. In addition, the staff concludes that the health physics and surveying aspects of the changes are adequate to perform the FSS for subsurface soils in the North Site area for demonstrating compliance with the radiological.criteria for license termination.

Therefore, License Condition S-1 should be revised to add the dates of the submittals.

PRINCIPAL CONTRIBUTORS
Duane Schmidt
Anita Turner
James Shepherd
Kevin M. Ramsey

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