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June 13, 2005

Director
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Reference:
1) Docket No. 70-143; SNM License 124
2) Letter from B. M. Moore to NRC, Final Status Survey Method for Assessing Subsurface Soil, dated February 9, 2005 (21G-05-0023)
3) Email from NRC to J.S. Kirk, Focus Group Issues for May 19, 2005, dated May 12, 2005
4) Email from NRC to J.S. Kirk, Discussion Topics for May 19, 2005 NFS Meeting, dated May 10, 2005

Subject: Response to Focus Group Questions Concerning Alternate Final Status Survey Methods

Dear Sir:

Nuclear Fuel Services, Inc. (NFS) hereby submits a response to the focus group questions concerning alternate Final Status Survey (FSS) Methods. Specifically, these responses are a result of a meeting between NFS Staff and Nuclear Regulatory Commission (NRC) Staff in Rockville, Maryland, on May 19, 2005, to discuss the license amendment request to allow use of alternate FSS Methods supporting decommissioning of the North Site.

If you or your staff have any questions or need further information, please contact me, or Mr. Rik Droke, Licensing and Compliance Director, at (423) 743-1741. Please reference our unique document number (21G-05-0122) in any correspondence concerning this letter.

Sincerely,

NUCLEAR FUEL SERVICES, INC.

B Marie Moore

B. Marie Moore
Vice President,
Safety & Regulatory

CSM/rrm-pdj
Attachment

Copy:

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Attachment

NFS Response to NRC Focus Group Questions Concerning Alternate Final Status Survey Methods

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Questions from NRC Performance Assessments Group

NRC Comment:

1. ***The approved [surface soil] DCGLs were based on two land use scenarios. However, the 'volume factors' are derived from the [single] suburban [resident] scenario. Provide clarification, specifically addressing the absence of the recreational worker scenario in the derivation of volume factors.***

NFS Response to the Comment:

NFS's consultant did not understand that NFS surface soil Derived Concentration Guideline Levels (DCGLs) had been individually derived from more than one scenario. Since it has been NFS's intent from the start to derive subsurface soil DCGLs that are conceptually consistent with the basis and assumptions used to derive the surface soil DCGLs, NFS has reconstructed the entire volume factor dose modeling to be consistent with that used to derive the surface soil DCGLs. This involved two principle changes. The first is that the two scenarios from which surface soil DCGLs were derived were used. The second is that uranium solubility specific to the NFS site was used.

NFS has revised the derivation of the volume factors based on the two controlling scenarios (as opposed to a single scenario) used to derive the surface soil DCGLs. The surface soil DCGLs were selected for individual isotopes from the scenario that yielded the lowest DCGL for that single isotope. The DCGLs for the americium and plutonium isotopes (Am-241, Pu-238, Pu-239/240, Pu-241, & Pu-242) were derived from the Recreational Worker (Groundskeeper) scenario. Surface soil DCGLs for Tc-99 and the thorium and uranium isotopes derive from the Suburban Resident scenario. This approach in itself is more conservative than the regulation and guidance calls for. New subsurface soil modeling has been performed for each isotope for each isotope for which a surface soil DCGL is approved using the scenario from which the associated surface soil DCGL was derived. The new modeling is used to derive volume factors for each isotope such that the scenario used to derive volume factors is consistent with the scenario used to derive its associated surface soil DCGL.

For Th-232, the controlling isotope, there was no practical change in the volume factor curves resulting from the revised dose modeling. This result is expected since the previous volume factor dose-modeling was designed around the scenario from which the Th-232 surface soil DCGL was derived. The new volume factors for Am-241and the plutonium isotopes are slightly more conservative than those than those previously derived, owing to the fact that the most conservative scenario (the groundskeeper scenario) was used. The new volume factors for the uranium isotopes are slightly less than those previously presented owing to the fact that the NFS site-specific uranium solubility factors were used, whereas the previous modeling assumed that the uranium was from a single (more conservative) solubility class. Also each of the new modeling results were re-fit to curves using multi-variate ratio fit analysis (See HP/Surveys Discussion Topic 3).

The revised volume factor curves (fit equations) have been provided to the NRC and are electronically provided with this communication. The RESRAD files used to derive the curves are provided with this communication.

NRC Comment:

2. ***Provide the basis for selecting the 0.5 meter thick disc-shaped post excavation geometry.***

NFS Response to the Comment:

The 0.5 meter thickness was selected on the basis that this thickness results in the more efficient thickness for producing exposure to a hypothetical receptor exposed at the site. For a given volume of soil, two factors (pathways) compete to determine the maximum dose producing potential. For the isotopes and scenarios used to model the prospective future dose at the NFS site, the external penetrating gamma pathway competes with the intake driven pathways. Intake pathways are more potent when the source is distributed over a larger area, but in a thinner layer. The penetrating gamma radiation pathway is more potent when the source is distributed over a smaller area, but in a thicker layer. For the NFS site, Th-232, is consistently the isotope that contributes most significantly to the sum-of-fractions for soil. Consequently, among the isotopes encountered, the thickness assumptions for the NFS site are most sensitive to variability in the Th-232 concentration. NFS, therefore, assessed the appropriateness of a range of thickness assumptions in the post-excavation geometry using Th-232 (plus progeny).

The RESRAD model used to derive the Th-232 DCGL was set up to perform a series of calculations in which the volume and radionuclide concentration were constants. The area and thickness of the source term were varied over a series of calculations designed to assess the thickness that produced the greatest exposure potential. What was revealed in this assessment was that source term thicknesses less than about 12" produce significantly lower doses than the same source term spread out in a 0.5 meter lift. Alternatively, source terms spread out thicker than 0.5 meters produced less (but not significantly less) dose than the same source term spread to a thickness of 0.5 meters. Essentially, and thickness between 0.33 and 2 meters thick produces equivalent dose (with a peak observed at 0.5 meters).

It is worthy to note that the appropriate thickness is specific to the scenarios, model assumptions in support of the scenario, and the isotopes involved. As a result, it is clear that this parameter is highly site- and isotope-specific.

The spreadsheet used to assess the sensitivity of the modeling assumptions to post-excavation geometry thickness is provided with this communication.

NRC Comment:

3. ***More discussion is needed regarding the selection of the 90th percentile estimate as a reasonable maximum concentration expected in a given layer.***

NFS Response to the Comment:

NFS appreciates the concerns expressed by the NRC regarding the appropriateness of the 90th percentile as a reasonable maximum concentration benchmark for survey design. As we have discussed, the potential for left skewness in the data presents a challenge to the use of any single percentile estimate. In response to this concern and in accordance with our discussions on this topic in May 2005, NFS commits to using the greater of the 90th percentile and arithmetic mean (average) as the appropriate design parameter for determining the need to adjust the corehole density to improve the likelihood of detecting locally elevated concentrations, should they exist. This approach was presented and demonstrated in the sample calculation performed at our focus group meeting.

It is noteworthy to consider that subsurface soil sample design for elevated measurement comparisons using percentile (or mean) estimates based on characterization and remediation control surveys are already conservative. The subsurface soil DCGLs assume that the subsurface soil in question will be excavated and brought to the surface where exposure occurs. There is a substantial likelihood that soils with concentrations higher than the 90th percentile (or mean) will be diluted with surrounding soils having lower concentrations during the excavation process.

NRC Comment:

4. ***An example calculation/case study should be performed to clearly demonstrate the derivation of the subsurface soil DCGLs.***

NFS Response to the Comment:

NFS performed a sample calculation for the NRC at the May 19, 2005 focus group meeting. In addition, with this communication NFS is providing the spreadsheet entitled "SSDCGL-COMPLY" (Demo) for the NRC's benefit. The "demo" version of the spreadsheet accommodates only a 3 x 3 x 3 cell survey unit, but offers the significant advantage of dramatically fewer calculations and therefore process time. It serves well in the performance of "what-if" calculations and reveals the underlying formulas used to make the calculations.

Questions from NRC Health Physics/Surveys Group

NRC Comment:

1. ***A critical issue may be the proposed use of the 90th percentile value of characterization data as the basis fro the expected maximum concentration, to be used in potentially increasing the core (sampling grid) density.***

    a. ***Justify the use of the 90th percentile (or other selected percentile value).***

NFS Response to the Comment:

See NFS's response above to same question raised by the NRC's Performance Assessment group (question 3)

NRC Comment:

b. ***How many characterization and remedial action support survey samples would be taken in each survey unit?***

NFS Response to the Comment:

Actually, there is no specific bound (either maximum or minimum) on the number of characterization or remedial action samples that are needed to design the sample plan for subsurface soils. One can base their estimate of the 90th percentile (or mean) on existing characterization and remedial control survey data or by making a good faith estimate based on professional judgment.

This is similar to the concept involved in calculating the minimum sample size for final status survey in which one makes an estimate of the true mean and sample standard deviation. Because the form of the null hypothesis used is based on the assumption that the survey unit exceeds the DCGL, a lack of power (because there are too few data points) will result in failure of the statistical test to overturn the hypothesis even if it should be overturned. If the 90th percentile (mean) for a given depth increment is based on judgment (as opposed to evaluation of pre-existing data derived metrics) and the final status survey, when evaluated, yields estimations of the 90th percentile or mean higher than those planned for, the survey design will have been shown to be insufficient to conclude that there was an acceptable probability of detecting locally elevated areas having concentrations with potential dose significance. In other words, an *a posteriori* assessment of the 90th percentile (and mean) from each depth increment will reveal whether the sample corehole density was sufficient. NFS will commit to the *a posteriori* calculation of the reasonable maximum concentration using the greater of the 90th percentile or mean.

NRC Comment:

c. ***What specific method would be used to calculate/determine the 90th percentile?***

NFS Response to the Comment:

NFS plans to use the standard percentile formulation used in Microsoft Excel and in most statistical evaluation software programs (e.g., NCSS).

The proposed Percentile Formula is: Ave X(p[n+1])

The proposed Arithmetic Mean Formula is: Sum X/n

NRC Comment:

d. ***NFS indicated they have a large amount of characterization and other data for some portions of the site that have already been cleaned up. It could be useful to this discussion to bring some of that data to show how this proposed use of the 90th percentile value would have worked in practice.***

NFS Response to the Comment:

NFS presented a demonstration calculation showing how the proposed use of the 90^{th} percentile metric coupled with the use of the arithmetic mean (to control for skewness) would work with actual site data.

NRC Comment:

2. ***Is there a consistent plan for how to address auger or sampling refusal? There may be an inconsistency [in the Appendix B subsurface soil DCGL proposal] regarding the action that would be taken is refusal is encountered.***

NFS Response to the Comment:

NFS agrees that the plan (as written) does not clearly describe the process to be followed in the event of auger/core sample refusal. The apparent discrepancy observed in the plan was actually trying to address two situations. The first situation is how to deal with auger/core refusal when it has not been shown that the vertical extent of residual radioactivity has been identified. In this situation, sample refusal results in a loss of potentially important data. The plan describes the process for the treatment of a sample cell for which data is unavailable. To reduce the potential for this situation occurring, NFS will commit to the use of coring techniques (e.g., roto-sonic drilling) that are not subject to the typical causes of auger refusal.

The second situation addressed is the acceptable termination point of a corehole sample. Here the plan describes the criteria for determining when the corehole has been advanced deep enough to have yielded the valuable data for the subsurface soil analysis. In this circumstance the plan describes "refusal" as one of the criterion for terminating a coreholes vertical advancement. What is intended is that a corehole could be terminated when it was determined that excavatable subsurface soil was not present in subsequently deeper layers. In other words, the geologic rock foundation material was encountered. A second criterion would alternatively apply. When it is shown that the vertical extent of residual radioactivity has been reached, deeper vertical core sampling is not necessary.

NRC Comment:

3. ***Page B-4 [of appendix B] indicates that the sampling density would be such that the non-conservative part of the volume factor curves would not be used. Is this discussed later, or is some commitment on maximum sampling "volume" made? Also, it appears that additional data points could have been used to improve the fit at larger volumes, where the volume factor should be essentially one.***

NFS Response to the Comment:

After re-constructing the dose response calculations as described in NFS's response to question 1 raised by the NRC's Performance Assessment group, NFS's contractor (MACTEC) performed goodness-of-fit statistical tests to determine the form of the multi-variate ratio curve that best fit the data for each individual isotope. This statistical treatment, while slightly more complicated to follow, results in the most precise fit of a volume factor curve to the data for each individual isotope. This essentially eliminates the "less than perfect" fit observed in some of the volume factor curves. The new curves fit to the newly modeled data are provided in the spreadsheet entitled "Test of Model vs. Mixed Scenario-Solubility curves.xls," provided with this communication.

NRC Comment:

4. ***The proposed approach to evaluating potentially elevated subsurface areas is to only evaluate single cell and four-cell volumes. The approach in MARSSIM is to evaluate each elevated measurement area (whatever it's size). Is there a justification for the different approach?***

NFS Response to the Comment:

First, it is not possible to evaluate elevated measurements observed in subsurface soil samples in the same way MARSSIM describes the evaluation of elevated measurement areas for surface soil. This is because scanning of surface soil can be used to flag and then delineate the areal extent of an elevated area (on the assumption that scanning can effectively detect locally elevated concentrations in surface soil). There is no analytical means that can be used to locate and flag subsurface volumes of soil that might have locally elevated concentrations of residual radioactivity. The approach proposed assumes that the entire volume of soil represented by a single sampling frame (cube) has residual radioactivity at the sampled concentration. This is justified on two counts. First, the volume of a single cube is controlled in the survey design by the adjustment of the grid spacing (based on the 90th percentile and arithmetic mean metrics). Smaller volumes are not sampled, but are progressively less likely to be involved in isolated excavations. Essentially, this means that the smaller the volume hypothesized as a potential "hot spot," the less likely it would be that that volume might be excavated in isolation. If the volume were excavated in the future, it is overwhelmingly likely that it would be excavated with and blended with surrounding soils in the process.

Larger volumes (those represented by more than one cube volume) are actually evaluated in many combinations of nearest neighbors both vertically and laterally. As can be seen from the volume factor curves (with Th-232 being the controlling curve for the NFS site), subsurface soil DCGLs for volumes larger than approximately 100 to 200 m^3 benefit very little from the volume factor curves themselves. Most of the benefit for volumes larger than single sample cube volumes is derived from the mixing factors associated with its depth increment.

As demonstrated in the sample calculations presented to the NRC in the May 2005 meeting, it is very difficult to 'hide' a single sample cell with a truly elevated concentration from the compliance metrics proposed. Single sample cubes with substantially elevated concentration might pass the EMC compliance metric if they are located at deeper depth increments, but are likely to result in failures of one or more of the local area average metrics (vertical column or nearest neighbor). Clusters of sample cubes even marginally above the wide area average limit for the respective depth layer invariably result in failure of the nearest neighbor average compliance metric or the wide area average compliance metric. In short, NFS is convinced (by observing and testing hypothetical sample results in the compliance test calculator) that the array of compliance metrics proposed and presented is conservative and appropriately controls for the continuum of volume possibilities that might exist.

NRC Comment:

5. ***Footnote 5 on page B-22 [of Appendix B] indicates it is unnecessary to produce weighted-average reference area data for use in the WRS test. However, this footnote and the associated text do not indicate how the reference area data would be used in the WRS test. There are multiple methods that we could imagine, so this should be clarified.***

NFS Response to the Comment:

NFS will clarify the language in Appendix B as to the use of the reference area data in the WRS test. In addition, as we discussed in our May 2005 meeting, NFS tested the response of the WRS test to the optional treatment of reference area data wherein the reference area layers are weighted in response to the weighting applied to the survey unit layer against which they are compared. To do this, it is necessary to transform the reference area data by calculating the columnar weighted average of the reference area data. This treatment results in fewer reference area data points available for use in the WRS test. However, because the vertical variability in the reference area data is quite small in the first place, there was no appreciable change in the variability of the reference area data set treated in either fashion. NFS found that vertically weighting the reference area data did result in lower statistical power to distinguish between background data and survey unit data. The loss of statistical power is, in NFS's opinion, a significant detriment to vertically weighting the reference area data for use in the WRS compliance calculation process. Therefore, NFS recommends that the originally proposed treatment of the reference area data be approved.