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Michelle Beardsley
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475 Allendale Road
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SNM-368 (TERMINATED)

Re: Former UNC Manufacturing Facility, New Haven Connecticut, USNRC Docket 070-00371

Dear Ms. Beardsley:

Attached are the responses to the comments provided by the Oak Ridge Institute for Science and Education (ORISE) on September 27, 2007. The comments reflect potential changes to the existing final status survey plan that was prepared in 2006. Please let me know if you have any questions.

Sincerely,

Robert F. Bonito
General Manager

Cc: J. Uruskyj
B. Thomas

Response to Comments by ORISE regarding the Final Status Survey Plan for the Former UNC Manufacturing Facility New Haven, Connecticut[1]

General Comments

1. The final status survey plan (FSSP) lists the radionuclides of concern (ROCs) in Tables 2 and 3 (UNC 2006). The ROCs are U-238, U-234, U-235, Th-234, Th-230, Th-227, Pa-234m, Pa-231, Ra-226, Ra-223, Ac-227 and Pb-210. The text of the FSSP does not indicate that the primary contamination was from highly enriched uranium (HEU) as is mentioned in the decommissioning plan (DP) and the characterization plan (CP) (UNC 2005a and 1998). The CP indicates that the "Atomic Energy Commission (AEC) issued special nuclear material License No. SNM-368 ... (which was subsequently transferred to) ... United Nuclear Corporation Company" (UNC). This license authorized the use of enriched uranium (greater than 97% uranium-235) and other source materials to include natural uranium, depleted uranium and thorium for research and nuclear fuel fabrication. During a previous ORISE survey, alpha spectroscopy indicated a U-234 to U-235 ratio of 27 which indicates HEU at approximately 93% (ORISE 1997). It is ORISE's opinion that, throughout the FSSP, the physical characteristics of HEU were not addressed adequately for the detection and quantification of HEU contaminants.

Response:
The final status survey plan for the Former UNC Manufacturing Facility located in New Haven, Connecticut (Site) provides analysis of the uranium progeny emitting gamma radiation.[2] UNC and ORISE reported that a ratio of gamma radiation to alpha radiation is reproducible and can be used in order to provide an efficient analysis technique. UNC acknowledges that there are multiple methods for analysis.

2. The FSSP does not mention specifically if alpha scans will be performed on concrete trench or sewer surfaces. Since the major contaminant is HEU, the majority of the contamination activity present will be from U-234 alpha activity. Please clarify.

Response:
Direct alpha measurements will be performed on concrete surfaces in the South Trench following remediation. Static measurements (i.e. the detector in direct contact with the surface for a known period of time) for gross alpha radiation will be performed to demonstrate compliance with the surface release criteria described in Section 3 of the FSSP. Instrumentation is described in Table 4 of the FSSP. The detection limits for survey instruments is described in Section 6.4 of the FSSP.

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[1] Oak Ridge Institute for Science and Education, *Document Review- Final Status Survey Plan*, Docket 070-00371, September 27, 2007.
[2] UNC Naval Products, *Final Status Survey Plan for the Former UNC Manufacturing Facility, New Haven Connecticut*, Report No. 2002020/G-6315, September 6, 2006.

3. Upon successful remediation of the soil areas, gamma spectroscopy using a U-234 to U-235 ratio of 27 would greatly overestimate the total uranium concentrations within the remediated soil area. ORISE recommends alpha spectroscopy for the soil sample analysis.

Response:
The current analytical method, gamma spectroscopy, provides an efficient and conservative method for the remediation of the impacted areas of the Site. As stated in Section 8.6 and Table 7 of the FSSP, UNC will analyze selected samples for isotopic uranium via alpha spectroscopy to verify that the ratio of U234:U235 is consistent.

Specific Comments

1. Section 3, page 5. Release Criteria: The FSSP states that the criteria for release, from the NRC Branch Technical Position (BTP), Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations, is 30 pCi/g for enriched uranium averaged over 100 m2 (NRC 1981). The BTP also states that " ... the criteria may be modified for "hot spots" or areas that exhibit localized concentrations of uranium over an area smaller than 100 m2." UNC uses the following formula to calculate the elevated measurement criteria:

$$ElevatedMeasurementCriteria = 30\,pCi/g \times (100/A)^{1/2}$$

where A is the area of the location of impacted soil, measured in square meters. The FSSP states that "no single value greater than 90 pCi/ g is permitted for unrestricted release.
However, Section 1.2 of the FSSP states that the sampling plan was " ... prepared in accordance with the protocols and methods established in the Multi-Agency Radiation Survey (and) Site Investigation Manual (MARSSIM) and the Decommissioning Plan for this site" (NRC 2000 and UNC 2005a). MARSSIM states that if the actual Scan MDC is less than the required Scan MDC, that" ... no additional sampling points are necessary for assessment of small areas of elevated activity." However, "if the actual Scan MDC is greater than the required Scan MDC (i.e., the available scan sensitivity is not sufficient to detect small areas of elevated activity), then it is necessary to calculate the area factor that corresponds to the

$$AreaFactor = {ScanMDC(actual)}/{DCGL}$$

Since the Scan MDC for enriched uranium is approximately 132 pCi/g (from Table 6.4 of NUREG-1507), and the derived concentration guideline level (DCGL) in this case is 30 pCi/g, the area factor can be calculated to be approximately 4.4 (NRC 1998). Please provide additional information pertaining to the determination of the actual Scan MDC

and the associated area factor. This information will help determine the actual sample spacing required based on MARSSIM guidance.

Response:
UNC agrees to change the FSSP to accommodate the MARSSIM guidance with regard to the elevated measurement comparison. UNC will scan 100% of the exposed surfaces in the excavations using calibrated gamma scintillation detectors to verify that no areas exceed the $DCGL_W$.[3] The scan MDC was established by NUREG 1507 to be 132 pCi/g for enriched uranium. Given the DCGL of 30 pCi/g, an area factor of 4.4 is derived. The area factor is the magnitude by which the concentration within the small area of elevated activity can exceed $DCGL_W$ while maintaining compliance with the release criterion. MARSSIM requires that the sample spacing be modified in the event that the scan MDC is greater than the $DCGL_W$.[4] The size of the area of elevated activity (94 m^2 for uranium-235) corresponds to an area factor of 4.4.[5] Consequently, in order to satisfy the elevated measurement comparison (EMC), a sample should be collected every 94 m^2 (22 samples every 2,000 m^2) rather than 1 sample every 250 m^2 (8 samples every 2,000 m^2).

2. *Section 4.1.1, page 8, Sensitivity: The FSSP states, " ... the required off-site analytical laboratory minimum detectable level (MDL) has been set at 5 pCi/g of U-238." The U.S. Nuclear Regulatory Commission (NRC) previously addressed this statement in a letter to UNC on July 2, 2007 (NRC 2007). It is ORISE's position that the off-site MDL of 5 pCi/g of U-238 is not adequate to detect contaminant concentrations at the 30 pCi/ g total uranium guideline given that there is up to 93% enriched uranium (as indicated in the General Comment #1). The U-238 activity will be a very small percentage (less than 1%) of the total activity of the enriched uranium. As an example, refer to page 34 of the CP where the U-238 concentration is 3.2 pCi/g and the total uranium concentration is 1,036 pCi/ g (U -238 is less than 0.4% of total uranium). Please clarify.*

Response:
After discussion with the radiochemistry laboratory, UNC proposes to change the analytical detection limit for gamma spectroscopy to less than 0.5 pCi/g for U-235 at 143 keV. The corresponding detection limit for Th-234 (progeny for U-238) is anticipated to be 2.0 pCi/g. As stated in the FSSP, the detection limit for isotopic uranium via alpha spectroscopy is 0.1 pCi/g.

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[3] The FSSP proposes to use 2x2 inch sodium iodide detectors to measure gross gamma radiation in contact with the soil surface, scanning at approximately 0.5 meters per second.
[4] US Nuclear Regulatory Commission, *Multi-Agency Radiation Survey And Site Investigation Manual*, Section 5.5.2.4, NUREG-1575, Revision 1, August, 2000.
[5] U.S. Nuclear Regulatory Commission, *A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys*, Interim Draft Report for Use and Comment, Table 8.1, NUREG 1505, June, 1998.

3. Section 4.2, page 10: The FSSP states that based on the relative shift of 1.7, Type I error of 0.05 and Type II error of 0.25, the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) " ... indicates that 8 samples are needed for 100 percent coverage of a 2,000 m2 survey area." According to MARSSIM, the number of data points required in the design of a Class 1 survey unit depends on the minimum concentration that is detectable using typical scanning instruments (scan MDC (MARSSIM 2000). It is not clear to the reviewer if UNC's collection of eight (8) soil samples from a Class 1 soil area of 2,000 m2 satisfies the MARSSIM-based "elevated measurement comparison (EMC)" area guidance. Please clarify that the required gamma scan MDC is less than the applicable $DCGL_{EMC}$ for an area of 250 m2 (refer to General Comment #1, and Specific Comment #6).

Response:
See response to Comment #1. UNC agrees to change the FSSP to accommodate the MARSSIM guidance. Consequently, in order to satisfy the $DCGL_{EMC}$, a sample should be collected every 94 m^2 (22 samples every 2,000 m^2) rather than 1 sample every 250 m^2 (8 samples every 2,000 m^2).

4. Section 5.3, page 12: The FSSP states that after remediation of the South Trench, " ... direct measurements will be completed on accessible concrete surfaces." This section also indicates that "UNC will conduct surface scans over 100 percent of the survey units ... " Please clarify if the direct measurements and surface scans will be performed to detect alpha radiation. If not, how will scans and measurements ensure compliance with the surface activity guidelines?

Response:
Gross alpha measurements will be performed on concrete surfaces in the South Trench following remediation. Static measurements (i.e. the detector in direct contact with the surface for a known period of time) for gross alpha radiation will be performed to demonstrate compliance with the surface release criteria described in Section 3 of the FSSP.

5. Section 5.6, page 13: The FSSP states that "Three (3) discrete soil samples will be collected for each survey unit (subsurface areas in the Decon pit, the rectifier room and the X-ray reading room) and analyzed to verify that the concentration of enriched uranium is less than the release criteria". Based on Specific Comment #3, please clarify if three samples will be sufficient in determining if the release criteria would be met for these survey units.

Response:
Section 5.6 refers to the soil that exists in the excavations after remediation by UNC in 1973. Clean soil was used to fill each of the three excavations. The soil inside of the excavation will be removed and segregated before the sidewalls of the excavations are remediated. Three (3) discrete samples will be collected from each pile of soil to verify the activity in the clean backfill.

6. Section 6.4.1, page 17, Surface Soil: The FSSP states that a minimum detectable count rate (MDCR) of 1,352 counts per minute (cpm) is converted to an exposure rate using the detection sensitivity in Table 6. The NRC stated in a letter dated July 2, 2007, that the main contaminants of concern are U-235 and U-234 and that Table 6 should include conversion factors for enriched uranium. Table 6.4 in NUREG-1507, indicates that the conversion factor for 75% enriched uranium is 5,030 cpm/(uR/hr) and that the scan MDC is 132 pCi/g (much greater than the 30 pCi/g guideline) for a 2"x2" NaI detector. Also, in this section, the FSSP states that the surveyor will be" ... scanning at a speed of 1 foot per second, with a background of 8,000 cpm ... " MARSSIM assumes a scan speed of 0.5 meters per second (m/s) when calculating scan MDC and determining the observation interval in the scan MDC equation. Scan MDC determination must also consider the gamma radiation emitted from the entire enriched uranium decay series. An example of how the scan MDC can be determined for enriched uranium is presented in Section 6.8.2 of NUREG-1507 (NRC 1998).

Response:
UNC agrees to use the criteria provided in NUREG 1507 (USNRC, 1998) to establish the scan MDC for enriched uranium in soil. Section 6.4 and Table 6 will be revised to reflect the detection sensitivity of 5,030 cpm/uR/hr and an instrument MDC of 132 pCi/g. See the response to Comment #1.