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Robert F. Bonito
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November 29, 2007

Raymond K. Lorson, Chief
Decommissioning Branch
Division of Nuclear Materials Safety
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

SNM-368

Subject: Former UNC Manufacturing Facility, Docket 07000371

Dear Mr. Lorson:

This letter provides the responses to your comments on the Final Status Survey Plan for the former UNC Manufacturing Facility in New Haven, Connecticut. The survey plan was provided to your staff on October 4, 2006.

Please let me know if you have any questions regarding this plan or the decommissioning effort proposed for the site in New Haven, Connecticut. I look forward to hearing from you regarding this project.

Sincerely,

Robert F. Bonito
General Manager

Cc: J. Uruskyj
L. Kauffman
B. Thomas
W. Songer

Responses to Request for Additional Information
Final Status Survey Plan
Former UNC Manufacturing Facility

Page 5. Release Criteria: The release criteria for the UNC site is 30 pCi/g enriched uranium averaged over 100 m^2. The FSSP states that "No single value greater than 90pCi/g is permitted for unrestricted release." Please justify the acceptability of exceeding the release criteria of 30pCi/g.

1. The release criteria established in the Branch Technical Position by the USNRC is 30 picocuries per gram (pCi/g) averaged over 100 square meters (m^2).[1] As stated in the Final Status Survey Plan (FSSP), localized concentrations of impacted material, less than 100 m^2 in area, may be encountered and will be evaluated using the approach described by MARSSIM (Chapter 8.5.1) as the elevated measurement comparison. Small areas of elevated activity are evaluated using a correction factor (i.e area factor) that accounts for the difference in area and the resulting change in dose. MARSSIM describes the derivation of an area factor or the magnitude by which the concentration within a small area of elevated activity can exceed the derived concentration guideline level while maintaining compliance with the release criteria. For the New Haven site, an area factor of 3 was selected. For the New Haven site, no single value in excess of 90 pCi/g is allowed AND the average of activity will be less than 30 pCi/g averaged over 100 m^2 in order to achieve unrestricted release.

Discrete samples will be collected in the survey unit and the results will be compared to the release criteria using the Sign Test as described in MARSSIM (Chapter 8.3). The Sign test is applied as outlined in the following steps, including:

List the survey unit measurements;
Subtract each measurement from the $DCGL_W$ to obtain the differences;
Discard each difference that is exactly zero and reduce the sample size by the number of such zero measurements; and
Count the number of positive differences.

The result is the test statistic S+. Large values of S+ indicate that the null hypothesis (that the survey unit exceeds the release criterion) is false. The value of S+ is compared to the critical values (MARSSIM Table I.3). If S+ is greater than the critical value in that table, the null hypothesis is rejected. This test demonstrates that the survey unit satisfies the release criteria.

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[1] NRC Branch Technical Position, *Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations*, SECY 81-576, October 23, 1981.

Page 7. Precision: The FSSP states, "Laboratory sampling precision will be checked by obtaining a minimum of one replicate sample for every 20 physical soil samples collected in a given survey unit." Explain this process.

2. The FSSP requires that at least eight (8) samples be collected in every 2,000 m^2 for a Class 1 land area or survey unit. The technician will collect a duplicate sample for every 20 samples collected, regardless of the survey unit where the sample is collected. The text in the FSSP will be revised to reflect that a duplicate is not required in every survey unit, especially those areas that are less than 6,000 m^2 in area. The field crew will identify the sample to be duplicated and the soil will be collected in an approved sample container. The soil will be homogenized in the field and placed in two (2) sample containers. Each sample container will be labeled with a unique sample number. The sample and its duplicate will be submitted for analysis by the radiochemistry laboratory. The results of the sample and its duplicate will be reported in the final status survey report.

Page 8. Sensitivity: The FSSP states, "Therefore, the required off-site analytical laboratory minimum detectable level (MDL) has been set at 5 pCi/g of U-238." Please explain how this value was determined. Will alpha surface scans be performed? If so, what instrumentation will be used? Please describe how sensitivity will be determined.

3. Information regarding the radiation analysis by the off-site laboratory is defined in Section 8.6 and Table 7. The detection limit of 5 pCi/g was established for isotopes detected via gamma spectroscopy and is significantly less than the release criteria of 30 pCi/g. For analysis via alpha spectroscopy and the direct analysis of U-234, a MDL of 0.1 pCi/g is specified in the FSSP.

4. No alpha surface scans will be performed for purposes of compliance with the release criteria. 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.

Page 9. Relative Shift: The FSSP describes that the relative shift will be calculated using 141 as the limit. Please explain what 141 is and how this value was determined.

5. The equation provided in Section 4.1.3 should reflect the release criteria of 30 pCi/g of enriched uranium and the relative shift is calculated as follows,

$$\text{Relative Shift} = \Delta/\sigma = \left(30 - (0.5 \times 30)\right) / (0.3 \times 30) = 1.67 \approx 1.7$$

The relative shift is calculated to be 1.67. The equation will be revised.

Page 10. Number of Discrete Soil Sample Locations: The FSSP states that UNC will provide up to 33% coverage for soil samples in Class 2 survey units. Please describe how 33% was determined.

6. Section 5 of MARSSIM defines the design of the survey plan and describes the recommended survey coverage for land areas. For a Class 2 area, survey coverage is recommended to range from 10 to 100% of the surface area. Survey units exhibiting radiation levels close to background are suitable for a smaller portion (ie. less than 100%) to be surveyed. The analytical results provided in the Characterization Report confirm that the areas adjacent to the Class 1 areas (i.e. Class 2 areas) exhibit radiation levels close to background. For the UNC site, the FSSP describes the survey density to be approximately 33% of the survey unit.

Page 11. Preparation for Surveys: The FSSP describes a rectangular grid system. A rectangular grid system is not in accordance with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). Please provide a grid system description consistent with MARSSIM.

7. The proposed grid system is square as described in MARSSIM Chapter 5.

Page 12. Survey Design - Subfloor Soils: The FSSP states that after impacted soil is excavated and segregated, a Class 1 area will be established for the walls and floors of each excavation. Will separate survey units be established for the walls and floors?

8. No. The walls and floors of a single excavation will be assigned a single survey unit and square grids will be established for purposes of sampling.

Page 12. Survey Design - Trench Residues: The FSSP states that direct radiation measurements will be taken on accessible concrete surfaces. Will these direct measurements be fixed or scan measurements?

9. The surveys will be fixed, static measurements as described in Response 4 listed above.

Page 12. Survey Design - Sewer: The FSSP states that if the sewer tile is excavated during the remediation of the sewer, then radiation surveys and soil samples will be collected on the floor and walls of the excavation. It further states that this will be classified as a Class 1 area. Will separate survey units be established for the walls and floors?

10. No. The walls and floors of a single excavation will be assigned a single survey unit and square grids will be established for purposes of sampling.

Page 12. Survey Design - Soil Surrounding the Sewer Tile: The FSSP describes the soil around the sewer tile to be a Class 2 survey unit. Please explain how the criteria to obtain two samples every 50 feet along the length of the sewer was developed using MARSSIM.

11. As stated in Section 4.2 of the FSSP, eight (8) samples over 2,000 m^2 are required for a Class 1 land area and at least 3 samples for a Class 2 area. For the sewer tile, UNC proposes to collect two samples every 50 linear feet along the sewer. It is anticipated that at least 16 samples (8 locations with 2 samples for each location) will be collected along the length of the sewer tile, approximately 400 feet long. The proposed sampling exceeds MARSSIM requirements. The samples will be collected by boring from the surface, using a tool similar to a Geoprobe, and collecting discrete samples from the depth corresponding to that of the sewer tile.

Page 17. Surface Soil: The FSSP states that a minimum detectible count rate (MDCR) of 1,352 counts per minute (cpm) is converted to an exposure rate using the detection sensitivity in Table 6. However, we noted that you only listed a conversion factor for uranium 238 (U-238). Please explain your reason for listing U-238 while your contaminants of concern are U-235 and U-234. Please indicate whether you plan to develop a conversion factor for U-234 and U-235 and provide a description of how you determined these values.

12. Table 6 in the FSSP was provided as examples of typical conversion factors. The conversion factors for enriched uranium, comprised of uranium 234 and uranium 235 are also provided in NUREG 1507.[2] Specifically, it is anticipated that a 2x2 inch sodium iodide detector can detect 107 pCi/g of enriched uranium (20%) while scanning with a background of approximately 10,000 cpm. Table 6 will be revised to reflect the conversion factors for enriched uranium, as listed below.

[2] U.S. Nuclear Regulatory Commission, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments For Various Contaminants And Field Conditions*, NUREG-1507, December 1997.

RADIONUCLIDE	SENSITIVITY cpm/μR/hour	CONVERSION FACTOR pCi/g/μR/hr
Enriched Uranium	4,900	260

13. The ratio of Uranium-234-to-235 (i.e., 27:1) was established by UNC and ORISE and used during the characterization portion of the project as a "fingerprint" for licensed materials.[3,4,5] For each sample, the activity of total uranium is calculated by adding the concentrations of U-238, U235 and the derived concentration of U-234. The sum is then compared directly to the release criteria.

Page 18. The FSSP describes your minimum detectable activity (MDA) equation. Please describe how the efficiency (E) was determined. Also, the FSSP does not show an equation for the scan minimum detectable concentration (scan MDC). Please describe how the scan MDC was determined. The efficiency and scan MDC do not appear to follow the MARSSIM Chapter 6 methodology.

14. The instrument efficiency (E) will be measured at the site using NIST traceable sources of alpha and beta isotopes. The background and efficiency will be recorded at the beginning of each shift before the instrument is used. The likely values for E are provided in Table 5. The value for E is also modified to account for self attenuation of the surface being surveyed. ISO-7503 recommends using a surface efficiency based on the type of radiation and radiation energy in the absence of experimentally derived values. A surface efficiency of 0.25 is recommended for alpha radiation and beta radiation with a maximum beta energy between 150 kev and 400 kev for contamination on concrete.[6] The text in Section 6.4.2 will be revised to reflect both the detector efficiency (E_i) and the surface efficiency (E_s).

15. As stated in previous responses, samples will be collected and analyzed to demonstrate compliance with the release criteria. One sample will be collected from each survey grid, representing 100 m^2. The samples will be analyzed on site using a calibrated sodium iodide detector and a single channel analyzer to

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[3] UNC Naval Products, *Radiological Characterization of the Former UNC Manufacturing Facility, New Haven, Connecticut*, Report Number 2002020/G-1269, May 31, 2005.

[4] The dominant gamma line from Uranium 235 (185 kev) is masked by the presence of radium 226 (186 kev). In addition, the activity of Uranium 238 (decay by alpha decay) is derived when using gamma spectroscopy, by assuming secular equilibrium with its progeny, Thorium 234. Alpha spectroscopy is the preferred method to identify enriched uranium, where the activity of Uranium 234, Uranium 235 and Uranium 238 can be clearly separated and quantified.

[5] Oak Ridge Institute for Science and Education, *Radiological Scoping Survey of Building 3H and 6H at the Former UNC Facility*, New Haven Connecticut, Final Report, January 17, 1997

[6] International Organization for Standardization (ISO), *Evaluation of Surface Contamination*, ISO 7503, 1988.

establish a region of interest, specific for uranium. Each sample will be counted for a period of time adequate to detect approximately 30 pCi/g of total uranium. A portion of the samples (8 samples per 2,000 m^2) will be submitted to an off-site radiochemistry laboratory to verify the results provided on-site. For the trench residues in Building 3H and 6H, direct radiation measurements will be made to demonstrate compliance with the release criteria. The exposed surfaces will be scanned for impacted soils and areas exhibiting elevated readings will be removed before the samples for the final status survey are collected. As stated in Response 12 of this letter, the detection limit for scanning the soil with a 2x2 sodium iodide detector is assumed to be 107 pCi/g of total uranium.

Page 21. Data Conversion: The FSSP describes how the total (fixed plus removable) contamination data will be converted to units of activity. Please describe how E was determined?

16. See response 14.

Page 22. Soil Sampling Locations: The FSSP states that the sample location strategy will utilize a stratified systematic unaligned sampling protocol. Please describe this protocol.

17. The process of establishing a square grid and collecting samples at the intersection of grid lines provides an unbiased method to collect samples evenly over the surface of the survey unit. This is a stratified systematic unaligned method compared to the biased sampling provided by collecting samples at the locations where maximum radiation levels are indicated.

Page 22 Soil Sampling Locations: The FSSP mentions the use of the following sample descriptions: duplicate, matrix spike/matrix spike duplicate (MS/MSD) samples, replicates. Please define these terms and describe the sampling protocols for each.

18. A duplicate sample is created in the field by the sample technician as described in response 2 of this letter. Specifically, a duplicate sample will be collected and analyzed for at least every 20 samples. The field crew will identify the sample to be duplicated and the soil will be collected in an approved sample container. The soil will be homogenized in the field and placed in two (2) sample containers. A replicate is the analysis of a sample previously prepared by the radiochemistry laboratory and counted a second time.

A matrix spike and matrix spike duplicate is created by the radiochemistry laboratory when analyzing the samples via alpha spectroscopy. The laboratory technician adds a known quantity of a selected radioactive isotope to the sample and completes the chemical extraction. The isotope is analyzed and the chemical yield of the extraction process is established. A matrix spike duplicate is a

duplicate sample, with the spike added and analyzed in a similar manner. Isotopes of uranium are analyzed using Method DOE A-01-R, which is a method to equivalent LANL ER290. The text will be revised to reflect these definitions.

Page 22. Sample Designation: The FSSP states that sample designations for subsurface survey units may not include a survey grid number because these survey units are expected to be less than 2,000 m^2 in area. Does this mean that sub-surface samples will have no reference system? Please clarify and provide a justification for not using a grid system for the sub-surface samples.

19. All subsurface samples will have a reference system in order to correctly locate the sample. A grid number may not be assigned for small areas, less than 2,000 m^2. A reference point will be established using existing permanent structures or easily recognizable locations.

Page 25. Conversion of Data to Release Criteria Units: The FSSP states, "A verification that the sample sizes determined for the tests are sufficient to achieve the DQOs set for the Type I (a) and Type II (b) error rates will be completed." Please describe the type of power curve that will be utilized.

20. As stated in Section 4.1.2 of the FSSP, the probability of a Type I error will be less than 5 percent (α <0.05). The probability of a Type II error will be less than 25 percent (β <0.25).

Page 36. Table 6. The table appears incomplete regarding the conversion factor for enriched uranium. Please provide specific information regarding the radioactive nuclides of Concern.

21. See response 12.

22. Additional Comments by UNC

In the cover letter of the Request for Additional Information (July 2, 2007), you stated "*Also, Oak Ridge Institute for Science and Education (ORISE) will conduct an independent confirmatory survey after your final status survey report has been received and reviewed.*"

UNC intends to excavate soil inside and potentially outside the buildings. We plan to fill in the excavations soon after the analytical work is completed and the final status survey verifies that the release criteria are satisfied. The excavations must be filled in order to maintain a safe work area for our employees, contractors, and members of the public who may trespass. The staff from ORISE is welcome to visit the site during the final status survey in order to collect samples and conduct surveys of the excavations as needed.

The USNRC made several observations about the figures in the FSSP during the conference call on September 5, 2007. The following changes will be made to the FSSP, including:

Figure 2 will be revised to label the north and south trenches; and
Figure 3 will be revised to show the location of Argyle Street and the fence surrounding Building 3H/6H.