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COMPARISON OF VAULT 4 SOIL SAMPLING RESULTS TO EXISTING UNREVIEWED DISPOSAL QUESTION EVALUATION SRS-REG-2007-00041

An Unreviewed Disposal Question (UDQ) Evaluation was performed [SRS-REG-2007-00041] utilizing calculation N-CLC-Z-00020 to evaluate the potential impact of material weeping from the exterior walls of Vault 4 at the Saltstone Disposal Facility during operations. The UDQ concluded that there was no significant impact due to an assumed release inventory of 1000 liters of undiluted salt solution. During 2008, soil samples have been obtained in areas below the weep locations and the radiological concentrations in the soil have been determined [ERD-EN-2008-0056, ERD-EN-2008-0083]. Therefore, the purpose of this comparison is to ensure that the soil concentrations observed are within the inventory assumptions included in the calculation supporting the UDQ Evaluation.

Based upon the comparison presented in the following discussion, the soil sample results indicate that the existing UDQ Evaluation does bound the soil concentrations observed. There is also no indication from the existing data that further soil sampling to obtain additional radionuclide concentrations is warranted based upon the comparison of salt solution concentration to soil concentration ratios.

Discussion

Based upon the soil sampling analyses [ERD-EN-2008-0056, ERD-EN-2008-0083], the principal radionuclide present in the soil near Vault 4 is Cs-137. This is expected based upon the salt solution concentrations presented in Table 3 of N-CLC-Z-00020 which indicates the concentration of Cs-137 is at least approximately three orders of magnitude higher than any other radionuclide. The results in Table 1 of ERD-EN-2008-0083 are the soil concentrations from two different soil sampling efforts. Table 1 indicates that the maximum Cs-137 concentration found was 209,000 picocuries per gram (pCi/g) and that this concentration was localized to directly under one of the weeping locations. Only two other samples are within the same order of magnitude of this maximum sample with other concentrations being orders of magnitude lower.

To conservatively compare the soil concentrations observed to the evaluated inventory in N-CLC-Z-00020, one can determine the soil volume necessary at the maximum concentration in order to reach the evaluated inventory. The Cs-137 inventory evaluated in N-CLC-Z-00020 was 37.2 Ci as presented in Table 3 of the calculation. This inventory can be converted to pCi to be consistent with the soil sampling concentration results. The 209,000 pCi/g can be converted to a pCi/cc concentration by using the soil density of 1.62 g/mL per N-CLC-Z-00020. The volume that would need to be contaminated to the highest concentration can be determined by dividing the evaluated inventory by the highest observed concentration which yields a soil volume of approximately 1.1E+8 cc. If it is assumed that the soil is contaminated uniformly to the highest concentration to a one foot depth and three feet from the side of the vault, the length of this contaminated area would be almost 1300 feet (or approximately twice the length of Vault 4) in order to equal the inventory evaluated in the UDQ. The following are the calculations supporting this comparison and the results clearly indicate that the UDQ evaluated inventory is bounding of the existing conditions observed during soil sampling.

$$37.2\ \text{Ci}\left(\frac{1\text{E}+12\ \text{pCi}}{\text{Ci}}\right) = 3.72\text{E}+13\ \text{pCi}$$

$$209000\ {}^{\text{pCi}}\!/_{\text{g}}\left(1.62\ {}^{\text{g}}\!/_{\text{cc}}\right) = 3.3858\text{E}+5\ {}^{\text{pCi}}\!/_{\text{cc}}$$

$$\frac{3.72\text{E}+13\ \text{pCi}}{3.3858\text{E}+5\ {}^{\text{pCi}}\!/_{\text{cc}}} = 1.099\text{E}+8\ \text{cc}$$

$$1'\ \text{deep} * 3'\ \text{wide} * ?\ \text{long} = 1.099\text{E}+8\ \text{cc}$$

$$30.48\ \text{cm} * 91.44\ \text{cm} * ? = 1.099\text{E}+8\ \text{cc}$$

$$? = 3.943\text{E}+4\ \text{cm} = 1294\ \text{feet}$$

To evaluate the need to do further soil sampling for I-129 as suggested in ERD-EN-2008-0056, a comparison was be made between the concentration ratios of Cs-137 and Tc-99 in undiluted salt solution versus the soil samples. Since Tc-99 was detected in two samples (albeit at levels close enough to the detection limit to identify them as uncertain concentration) [ERD-EN-2008-0083, Table 1], the ratio to Cs-137 in salt solution and in soil was examined. The ratio of Tc-99 to Cs-137 in the salt solution is approximately 4.95E-4 [N-CLC-Z-00020, Table 3]. The ratio of Tc-99 to Cs-137 in the soil sample at Cell E is approximately 3.2E-4 and at Cell F is approximately 4.6E-4. The following are the calculations supporting this comparison and the results indicate that the ratios of radionuclides in the soil samples are similar to the ratios of radionuclides in the salt solution. Therefore there is no reason to suspect that the ratio of I-129 or any other specific radionuclide would be any different than in the salt solution thus eliminating the need to do further soil sampling.

$$\frac{\text{Tc}-99\ \text{concentration}}{\text{Cs}-137\ \text{concentration}} = \frac{1.84\text{E}-5\ {}^{\text{Ci}}\!/_{\text{L}}}{3.72\text{E}-2\ {}^{\text{Ci}}\!/_{\text{L}}} = 4.95\text{E}-4$$

$$\text{Cell E}: \quad \frac{66\ {}^{\text{pCi}}\!/_{\text{g}}}{209000\ {}^{\text{pCi}}\!/_{\text{g}}} = 3.16\text{E}-4$$

$$\text{Cell F}: \quad \frac{79\ {}^{\text{pCi}}\!/_{\text{g}}}{171000\ {}^{\text{pCi}}\!/_{\text{g}}} = 4.62\text{E}-4$$

References

ERD-EN-2008-0056, *Z-Area Vault 4 Phase 1 Soil Sample Analytical Data Report*, Revision 0, July 2008.

ERD-EN-2008-0083, *Z-Area Vault 4 Phase 2 Soil Sample Analytical Data Report*, Revision 0, December 2008.

N-CLC-Z-00020, *Saltstone Vault 4 Weeping Radionuclide Screening*, Revision 0, April 2008.

SRS-REG-2007-00041, *Unreviewed Disposal Question Evaluation: Evaluation of Liquid Weeping from Saltstone Vault 4 Exterior Walls*, Revision 1, April 2008.

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