July 12, 2006

Mr. Joe Lynch, Regulatory Affairs Manager
Yankee Atomic Electric Company
49 Yankee Road
Rowe, MA 01367

SUBJECT: YANKEE (ROWE) NUCLEAR POWER STATION - REQUEST FOR ADDITIONAL INFORMATION RE: FINAL STATUS SURVEYS (TAC NO. L52675)

Dear Mr. Lynch:

By letters dated February 20, 2006, March 30, 2006, and April 17, 2006, Yankee Atomic Electric Company submitted the Final Status Surveys for survey areas TBN01, NOL01, and WST01, at the Yankee (Rowe) Nuclear Power Station. The Nuclear Regulatory Commission staff has reviewed the information provided and has determined that additional information is required as identified in the Enclosure.

We discussed these questions with Yankee staff on June 21, 2006, and it was agreed that you would provide a response to this RAI within 30 day of receipt. Please contact me at (301) 415-3017, if you have any other questions on these issues.

Sincerely,

/RA/

John B. Hickman, Project Manager
Decommissioning Directorate
Division of Waste Management
and Environmental Protection
Office of Nuclear Material Safety
and Safeguards

Docket No. 50-029

Enclosure: Request for Additional Information

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DATE	07/ 12 /2006	06 / 5 / 2006	07/ 10 /2006

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REQUEST FOR ADDITIONAL INFORMATION

REGARDING THE USE OF *IN SITU* GAMMA RAY SPECTROSCOPY

FOR FINAL STATUS SURVEYS

YANKEE (ROWE) NUCLEAR POWER STATION

DOCKET NO. 50-029

Background:

Yankee Atomic Electric Company, has used *in situ* gamma ray spectroscopy (ISGRS) as an alternative to traditional hand-held survey instruments to complete the 100% surface scan requirement for Class 1 areas at the Yankee Nuclear Power Station (Yankee) site. The use of ISGRS (with Canberra's ISOCS system) was justified in the technical basis document (TBD) YA-REPT-00-018-05 (Ref 1).

The U.S. Nuclear Regulatory Commission guidance endorses the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (Ref 8) methodology for performance of final status surveys.

- MARSSIM uses a combination of statistical samples and scan surveys to demonstrate compliance with the 25 mrem (or other target value) Total Effective Dose Equivalent (TEDE) criteria.
- MARSSIM is based on the assumption that activity is evenly distributed, and concentrations are spatially independent.
- MARSSIM does not address discrete ("hot") particles.
- The purpose of scans is to detect any areas with activity concentrations above an investigation level, typically set at the $DCGL_{emc}$ in Class 1 areas.

General use of ISGRS for 100% scans of Class 1 areas:

Assume for the discussion of this topic that there are no discrete particles. The scope is restricted to a situation where the activity is fairly uniformly distributed over even the smallest area of interest (defined by YR as 1-m^2).

Yankee's approach to using ISGRS for scans is:

- Using a set height (2 m), and a collimated viewing angle (90 degrees), perform a 100% scan looking at a 12.6 m^2 field of view (FOV) for each measurement. Overlap the FOVs such that 100% coverage is achieved.
- Determine an effective investigation level that accounts for the possibility that, while looking at a 12.6 m^2 FOV, the activity may actually be located (worst case) in a single 1 m^2 at the edge of the FOV.
- The effective investigation level is an observed value that correlates to what 1 m^2 at the edge of the FOV, containing activity at the 1 m^2 $DCGL_{emc}$, would "look like" while in fact measuring a 12.6 m^2 area.

- The effective investigation level is thus calculated as the $DCGL_{emc}$ for a 1 m^2 area,

Enclosure

multiplied by the ratio of the 12.6 m^2 minimum detectable concentrate (MDC) to the 1 m^2 MDC.

Comments:

1. The documentation and discussion of the current TBD should be expanded. Some of the assumptions are not immediately obvious, and the discussions are difficult to follow.

2. Several suggested requirements for successful application of the ISGRS in this manner are:
   a. The use of accurate and representative values in the determination of an "effective" investigation level.
   b. Ensuring that the system is applied in a manner consistent with the TBD values and assumptions, such as:
      i. MDC values under actual operating conditions are at or below the effective investigation level for each radionuclide of concern.
      ii. Adequate correction factors are used, such as for moisture self-attenuation.

   These requirements should be addressed in greater detail, either in the TBD, in quality control documents, or operating procedures.

3. In general, the TBD method of determining investigation levels results in effective investigation levels below the $DCGL_w$. If contamination is routinely present in the survey unit below the $DCGL_w$, such that the survey unit should pass, but above the effective investigation level, many unnecessary investigations may result. As a result, use of ISGRS will likely be limited operationally to situations where the average concentration is well below both the $DCGL_w$ and the effective investigation level.

4. In section 1.2.7, the rational for the correction for soil moisture should be expanded to include correction factors for other conditions that were encountered at the Yankee Rowe site, such as ice and/or snow cover, varying soil types, etc.

Questions:

1. Regarding requirement (2.b.i) above, the three final status summary (FSS) reports reviewed state that the ISOCS scan MDC was set at the 1 m^2 $DCGL_{emc}$ (Ref 3 page 8, Ref 4 page 26, Ref 5 page 13). It is unclear why the MDC was not set at the effective investigation level. If the investigation level is the value that will trigger further action, then it would intuitively require the equipment to be sensitive enough to detect that value. Please address this discrepancy between suggested requirement (2.b.i) and the FSS statements.

2. In sections 1.2.3 and 1.2.4, 1 m^2 is selected as the "smallest area of concern." Setting the area as small as 1 m^2 provides a comparatively large $DCGL_{emc}$ compared to traditional $DCGL_{emc}$ values based on the area between sampling points. Please provide further justification for the size of the area of concern.
3. In section 1.2.4, it appears that the investigation level being derived is an "effective" investigation level. Is it an observed value that correlates to the expected reading for a

1 m^2 offset area at the $DCGL_{emc}$?

4. In general, the MDC is a situation-dependent statistical value determined in part by the background count rate, the count time, and the efficiency. It is true the MDC must be below the value you are trying to detect. However, when using an effective reading X to infer an activity Y in a different geometry (and therefore different efficiency), the correction factor intuitive to use would be the ratio of the efficiencies.

   In section 1.2.4, when deriving the effective investigation level, why is the area correction factor (CF) determined by the ratio of the MDCs instead of the ratio of the 1 m^2 offset efficiency to the 12.6 m^2 direct-view efficiency?

5. In section 1.2.5, regarding the statement, “Count times will be adjusted as necessary…”, clarify what the criteria is. (i.e., count until the MDC is lower than what?)

<u>Impact of discrete particles</u>:

Discrete particles present (at least) two problems for Final Status Surveys. First, MARSSIM is based on the assumption that activity is evenly distributed within the area of interest, and is not equipped to deal with discrete particles. Second, ISGRS investigation levels and calibrations are based on far-field averaged measurements.

The TBD discusses discrete particles on page 10, Section 1.2.8. The approach taken at Yankee Rowe is to treat the activity as though it were evenly distributed over a 1 m^2 area. The evaluation is then no different than if the contamination did not include discrete particles.

Discrete particle detectability is considered for a theoretical Co-60 particle. If the activity from an entire 12.6 m^2 FOV at the investigation level were compressed into a single point, it would equate to 3.2 microcuries (3.2 µCi). Note the highest particle found by ORISE during prior verification surveys at Yankee Rowe was 1.4 µCi.

Comments:

1. Based on the information provided, it appears that ISGRS is capable of detection at levels low enough to meet the effective investigation level, and thus at the $DCGL_{emc}$ for activity in a 1 m^2 offset area. However, there is insufficient data to support the TBD statement in Section 1.2.8 that the activity of discrete particles will be readily detectable. There should be further evaluation of discrete particle detectability if unfavorable conditions are introduced (i.e geometry, isotope, environmental factors, etc.).

2. The modeling used to derive DCGLs does not directly apply to hot particles treated as distributed over an area. The exposure pathways are based on mobility and resuspension factors for an evenly distributed contaminant. In addition, when the area of concern becomes increasingly small, such as 1 m^2, the typical scenario of a resident farmer is no longer realistic. Further evaluation should be provided for future FSSs.

3. Given the limitations of the current method of determining DCGL values, it is beneficial to consider alternate risk scenarios when determining acceptable residual levels of discrete particles. Alternate scenarios provide a better approach than averaging the

activity over 1 m^2, and the *in situ* technical basis would need to be updated to reflect any changes in detection criteria. (See the NUREG-1757 guidance for alternate scenarios).

Questions:

1. The TBD makes a statement at the beginning of the second paragraph of section 1.2.8, that a discrete particle activity exceeding 3.2 µCi would be readily detected. Please provide more discussion and supporting data. Please address the cases that the 3.2 µCi particle is in the center of the FOV or edge of the FOV and if the particle in underneath 15 cm of moist, dense soil at the edge of the FOV?

2. What activity particle is likely to be detected for one of the radionuclides that is not Co-60? Co-60 appears to represent the optimistic case, since it has two photons per decay, with each emitted at a high energy.

References:

1. YA-REPT-00-018-05; Use of *In situ* Gamma Spectrum Analysis to Perform Elevated Measurement Comparisons in Support of Final Status Surveys
2. Yankee Nuclear Plant Station License Termination Plan, Yankee Atomic Electric Company, Rev. 1. (November 2004)
3. YNPS-FSS-WST01-00; Yankee Nuclear Power Station Final Status Survey Report. (April 13, 2006)
4. YNPS-FSS-NOL01-00; Yankee Nuclear Power Station Final Status Survey Report. (March 29, 2006)
5. YNPS-FSS-TBN01-00; Yankee Nuclear Power Station Final Status Survey Report. (February 21, 2005)
6. *In situ* (ISOCS) Gamma Spectrum Assay System Calibration Procedure; YNPS Procedure # DP-8869, Rev. 1. (July 2005)
7. Operation of the Canberra Portable ISOCS Assay System; YNPS Procedure # DP-8871, Rev. 2. (October 2005)
8. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575 Rev. 1. (August 2000)