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To: Dan Hughes, USNRC, c/o Document Control Desk
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From: Paul Benneche, University of Virginia Nuclear Reactor, Docket 50-62, License R-66

Date: June 30, 2005

Subject: "Official" response to questions received in an e-mail of May 18, 2005 from Dan Hughes (USNRC) to Paul Benneche (UVA), which were subsequently discussed in a conference call on May 19, 2005. Also answered is an additional question (#5 below) that arose during the conference call.

Question 1: Final Status Survey Data Sheets UVA-FS-039 and 079 contain the results of gamma and beta radiation scans measured by inserting a probe into bore holes in the reactor pool floor. How was this data used to demonstrate that the survey unit met release criteria? Bear in mind that the release criteria for soil is stated as a concentration of radioactivity. What does the "pre" and "post" labels signify?

Answer 1: Survey UVA-FS-79 is actually a combination of three survey and sampling actions. Measurements at locations 1 through 7, inclusive, were performed on 8/13/2003 in conjunction with collection of soil samples from these locations. The readings labeled "Pre" and "Post" were collected at the top of cuts through the floor before and after the sampling event with a LMI 2221/44-10 rate meter and 2"x2" NaI detector. The sample numbers UVA-FS-138 through UVA-FS-144 are the 0-6" soil samples collected from these locations.

Locations 8 through 12, inclusive, were performed on 7/30/2003 in conjunction with collection of soil samples from these locations. The readings labeled "opening", "1 meter", "2 meter", "3 meter" are down hole readings made with a LMI 2221/44-2 1"x1" NaI detector. Location 10 is the location at which ORISE measured 34,000 cpm using a Victoreen 489-55 1.25"x1.5" NaI detector

The third sampling event is the collection of 1 meter soil column composite samples on 9/4/2003 from locations 2, 7 and 9. The corresponding sample numbers are UVA-FS-149, UVA-FS-150, and UVA-FS-148 respectively. Analytical data for each of the locations and samples is attached. Field log book entries documenting the sequence of activities are attached.

It appears that differences between ORISE measurements and Final Status Survey results are due to a combination of instrument characteristics and the presence of non-uniform concentrations of naturally occurring radionuclides.

Instrumentation Response

Energy response data for the Victoreen 1.25"x1.5" NaI detector is published in NUREG 1507 (p. 6-27) as 350 cpm per uR/hr at 662 keVkev (Cs-137) and approximately half that between 1,000 and 1,500 keV.kev. Manufacturer's documentation lists the response of the Model 44-2 as 175

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cpm per uR/hr at 662 keVkev and approximately half that value at Co-60 energies (roughly 1250 keVkev). Consequently the ORISE measured value of 34,000 cpm with the 489-55 appears to be consistent with the range of down hole field measurements reported for location 10 of approximately 16,000 to 21,000 cpm on the 44-2.

Naturally Occurring Radionuclides

The analytical data is summarized in Table 4-23, attached, in the original Final Status Survey Report. Only Mixed Fission and Activation Products attributable to licensed activities were reported in this table. Complete analytical results for each sample are attached. Of note is sample UVA-FS-112 collected from the 66"-78" depth of location 10. Sample analysis indicates K-40 at 75.8±10.5 pCi/g. This value is approximately twice that seen in other samples taken from beneath the reactor pool floor. K-40 emits a 1,460 keV gamma. Ac-228 was also present in this sample at 10.7±1.2 pCi/g. A posting plot of Ac-228 concentrations reveals that concentrations are not uniform beneath the reactor pool floor. At locations 8, 10 and 12, Ac-228 concentrations are some two to three or more, times higher than those in other locations. A posting plot of Ac-228 concentrations is attached.

Applicable attachments by reference, included in email from Paul Benneche to Dan Hughes sent on June 9, 2005.

- LMI 44-2 Technical Data
- LMI 44-2 Response Curve
- UVAR - FS - 138 to 147
- UVAR - FS - 148 to 150
- Field Notes & Source Checks
- Reactor Pool Survey, UVA-FS-079
- Ac-228 Posting Plot

Question 2: Survey FS-039 has a table that lists 16 soil (labeled as "B" to "T") samples of Reactor Room fill soil but no analytical results. Where are the results?

Answer 2: This information is contained in the Final Status Survey Report, Tables 4-24 and 4-25, page 4-66.

Question 3: FSSP Addendum 007 Section 3 reports a reactor pool subsurface soil sample reading 16.3 pCi/g of Co-60. (Note: the cobalt-60 DCGL is 3.4 pCi/g in this survey unit.) The text states that this result was due to analytical error or cross contamination. What follow-up was done to check the validity of the sample analysis? What changes were put in place to prevent a similar recurrence in the future? What laboratory performed the analysis?

Answer 3: This soil sample was not a sample taken during the final status survey. After this sample was taken the area was decontaminated, a new hole was drilled in the pool floor and resampled. This sample came back as below DCGL and we concluded we had contaminated the first sample with some material from the beam port removal. The laboratory was Eberline. No further actions were taken. Final status survey sample results for the area below the reactor pool can be found in Table 4-23 of the FSSR, with an explanation of the findings on page 4-64.

Question 4: The Decommissioning Plan identified 51 survey units for the project but there were 81 survey units by the end of the project. What is the reason for this disparity?

Answer 4: The Decommissioning Plan anticipated that much of the buried piping would be able to be treated as a very few survey units. Once that surveying was initiated it was clear that the multiplicity of different types, diameters and locations of the piping would require that these few survey units would need to be divided into a number of additional units. There was no decrease in the amount of surveying performed by adding more survey units.

Question 5: (verbal, during conference call) An "elevated" Co-60 concentration was found in one sample taken by the ORISE team in the former reactor pond. Explain what, if anything, should be done about it.

Answer 5: The sampling and analysis methodology was different between the ORISE sample and the samples collected during the pond characterization and final status surveys. This difference in methodologies accounts for the ORISE sample appearing to be elevated while the characterization and FSS samples indicated the pond met the release criteria. Specifically the ORISE verification sample was collected from the surface layer of pond sediments. The final status samples were collected and composited over the length of the sample core up to a depth of approximately one meter. The process of compositing effectively physically averages the concentration over the one meter soil column.

This method of soil sample treatment was anticipated during the design of the final status survey plan and was identified in Section 7.10.5 of the approved Master Final Status Survey Plan. It was not explicitly identified in the text of the final version of FSSP Amendment dealing with pond sediments, however, characterization data reported in FSSP Amendment 3 indicate that the data was, in part, averaged over the soil column. The characterization and FSS consisted of gamma scan walkover surveys, coupled with 16 systematic samples, and 18 judgmental or "biased" sample locations. Aliquots were collected on the surface (0-15 cm) and, in soft sediments, at depths of 15-45 cm, 45-75 cm and 75-105 cm, where the thickness of the sediments allowed. The sample columns were scanned for beta and gamma activity and were analyzed on-site for gamma activity. Based on the results of the surface scans, borehole logging, sample core scans, and on-site analysis, samples from 6 locations were sent to an off-site laboratory for gamma spectrometry and "hard-to-detect" nuclide analysis.

The 16 systematic samples were the primary basis for the final status decision. These were analyzed off-site by a commercial laboratory. That data (Eberline "generic data report 03-04092") was for composite samples representing the complete thickness of the sediment at each sampling location.

All results were below the Cs-137 surrogate DCGL of 5.9 pCi/g and therefore demonstrated the established project criterion was met without need for further statistical evaluation. Since the project DCGL's were based on NRC Default Screening Values which in themselves are considered ALARA levels and as all results were below project DCGL's, no further action is necessary.

I declare under penalty of perjury that the foregoing is true and correct.

Paul E Benneche

Paul E. Benneche
Acting Director, Univ. of Va. Reactor Facility
June 30, 2005