ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

March 18, 2009

Bruce Watson, CHP
U.S. Nuclear Regulatory Commission
Two White Flint North
11545 Rockville Pike
Mail Stop: T-8F37
Rockville, MD 20852-2738

SUBJECT: **COMMENTS ON NUCLEAR SAFETY ASSOCIATES CALCULATIONS TO REFINE THE ESTIMATE OF THE RESIDUAL MASS OF U-235 ASSOCIATED WITH PIPING REMAINING IN THE HEMATITE FACILITY DECOMMISSIONING PROCESS BUILDINGS FOR THE HEMATITE DECOMMISSIONING PROJECT, HEMATITE, MISSOURI (DOCKET NO. 070-036, RFTA NO. 08-004) DCN:1768-TR-02-0**

Dear Mr. Watson:

Enclosed are comments from the Oak Ridge Institute for Science and Education (ORISE) technical review regarding Nuclear Safety Associates (NSA) calculations for estimating the holdup of U-235 in the process buildings of the Hematite Decommissioning Project (HDP). If you have any questions, please direct them to me at 865.241.3907 or Tim Vitkus at 865.576.5073.

Sincerely,

Mark G. Jadick
Asst. Project Leader
Independent Environmental
Assessment and Verification

MGJ:bf

Enclosure

cc: T. Patterson, NRC/FSME/TWFN 8A23
T. Carter, NRC/FSME/DWMEP T-8F5
W. Snell NRC/Region III
M. McCann NRC/Region III
E. Abelquist, ORISE
T. Vitkus, ORISE
S. Roberts, ORISE
File/1768

Distribution approval and concurrence:	Initials
Technical Review	

P. O. Box 117
Oak Ridge, TN 37831

Voice: 865.241-3907 Fax: 865.241.3248 E-mail: Mark.Jadick@orau.org

General Comments:

Overall, the calculational method used by NSA is technically defensible. There are however, a few technical issues with the implementation. The main issue is the use of the Ludlum Model 19 for the survey. The Model 19 uses a 1"x 1" sodium iodide (NaI) detector that is calibrated to read out in μR/h based on a given photon energy. The report did not indicate what radionuclide was used to calibrate the Model 19. The NaI detector has a very energy dependent response. This means that the response will vary based on the photon energy. For the material in question, low enriched uranium (LEU), the majority of the photon emissions will be from the 186 keV photons emanating from U-235. The problem is that the flux from the U-235 emission is heavily attenuated by the pipe material and more importantly by self absorption of the photon in the UO_2. The extent of self absorption is heavily dependent on the thickness of the deposit in the pipe. This means that the photon flux becomes hardened and composed mostly of higher energy photons, namely the 1001 keV photon from Pa-234m which is in equilibrium with U-238. While the MCNP model will calculate this effect when determining the photon flux in air and hence the exposure rate in air, it does not account for the energy response of the NaI detector. The NaI detector is calibrated using Cs-137 with a photon energy of 661 keV. The response of a NaI detector to photons of 1001 keV will have fewer counts than for the Cs-137 due to the higher energy photon not being as readily absorbed in such a relatively small crystal. This lower absorption would result in a lower μR/h reading than the actual photon flux present. Conversely, the response of a NaI detector that has been calibrated to Cs-137 will have more counts for the 186 keV photons. This makes it difficult to correlate the response of a NaI detector in μR/h to the actual gram amount of U-235 in the pipe.

Recommendations:

The information from the MCNP models can be used in conjunction with an in-situ gamma spectroscopy system that can identify the photon energies detected, specifically the 1001 keV photon. A U-235 gram quantity can then be determined by performing an energy specific factor to determine the amount of U-238 based on the 1001 keV photon then calculating the amount of U-235 based on an assumed 5% enrichment.

Comments on Section 3.3.4:

The justification for the 50% reduction in the amount of uranium in a bend is not clearly stated. Figure 3-2 and the accompanying text appear to indicate that there is no difference in detector

response if the deposit length is 15 cm or 30 cm. Since the detector response in μR/h is the same for a 15 cm or 30 cm deposit length this would indicate a large uncertainty in the amount of holdup in a 1 foot section of pipe. Since the model gives the same response in μR/h regardless of whether the deposit is 15 cm or 30 cm in length the true size of the deposit cannot be confidently ascertained. This would not justify a 50% reduction of the amount but would indicate that the methodology is not sensitive enough to determine the actual deposit length in a full foot length of pipe.

Recommendation:

See the above recommendation under the general comments section.