July 21, 2004

MEMORANDUM TO: Luis A. Reyes
Executive Director for Operations

FROM: Annette L. Vietti-Cook, Secretary /RA/

SUBJECT: STAFF REQUIREMENTS - SECY-04-0102 - RESULTS OF THE STAFF'S EVALUATION OF POTENTIAL DOSES TO THE PUBLIC FROM MATERIAL AT THE KISKI VALLEY WATER POLLUTION CONTROL AUTHORITY SITE IN LEECHBURG, PENNSYLVANIA

The Commission has approved the staff's plan to take no further decommissioning actions at the Kiski Valley Water Pollution Control Authority site in Leechburg, Pennsylvania, subject to the following comments and attached edits. The staff should develop a comprehensive communications strategy that outlines how all of the stakeholders will be informed of this decision. The communications plan should provide for oral or written notification, as appropriate, to the primary stakeholders (including the site owner, the State of Pennsylvania, and Senator Santorum) of 1) the intended course of action, 2) the schedule for publishing the environmental assessment (EA), and 3) the fact that all stakeholders will be allowed to submit formal comments as part of the EA process before a final determination is issued. The staff should inform the primary stakeholders of the NRC's intended course of action soon after issuance of the SRM for this paper.

(EDO) (SECY Suspense: 8/5/04)

Attachment: As Stated

cc: Chairman Diaz
Commissioner McGaffigan
Commissioner Merrifield
OGC
CFO
OCA
OIG
OPA
Office Directors, Regions, ACRS, ACNW, ASLBP (via E-Mail)
PDR

**SECY NOTE: THIS SRM AND SECY PAPER WILL BE RELEASED TO THE PUBLIC AFTER THE STAKEHOLDERS HAVE BEEN INFORMED ABOUT NRC'S COURSE OF ACTION, AS DESCRIBED ABOVE**

ATTACHMENT

# OFFICE OF NUCLEAR MATERIALS SAFETY AND SAFEGUARDS
# DOSE ASSESSMENT
# RELATED TO
# KISKI VALLEY WATER POLLUTION CONTROL AUTHORITY
# INCINERATOR ASH LAGOON

In summary, two series of extractions were conducted according to the protocols described in Amonette *et al.* (1994) to test the leachability of uranium from the ash under different chemical conditions. In the first test a sequence of four batch extractions with acetic acid (pH 2.9) was used to extract the readily available uranium and a high pH (8.3) oxidizing sodium bicarbonate solution was then used to extract the slowly available uranium (SAU). The low fraction of readily available uranium (*i.e.*, 3%) was in agreement with the results from the previous RAU test (ESSAP, 1996). The results of the SAU test indicated that a limited fraction of the uranium (*i.e.*, 21%) would be expected to become environmentally available over an extended period of time. The second series of tests used a synthetic infiltrate (deionized water pre-equilibrated for 18 hours with a low activity ash sample) as the extractant for a sequence of four extractions and used the alkaline SAU extractant on the solid sample left after the water extraction. The results of the water leach test indicated that under expected conditions at the site, the uranium in the ash is expected to be relatively unavailable to environmental transport.

**The extractions conducted at pH 8.3 were conducted with an extractant containing 0.1 M sodium bicarbonate which is expected to lower the calculated distribution coefficient significantly as compared to distribution coefficients calculated from the results of extractions performed without added carbonate species.**

## 2 Dose Assessment

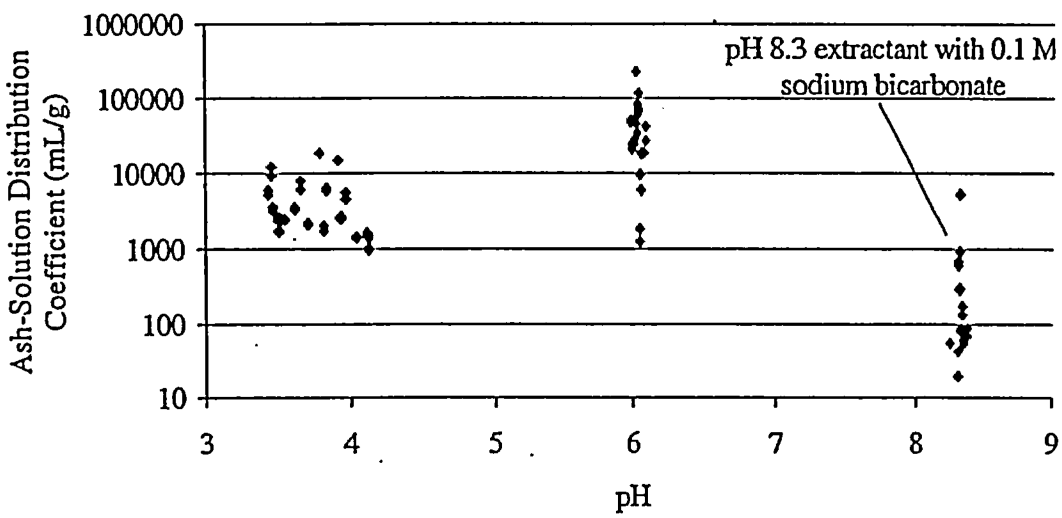


**Figure 2:** Relationship between leachability-based distribution coefficient and pH for KVWPCA ash (calculated using the final ratio method from results in ESSAP, 2004).

In order to capture an adequate range of future scenarios, dose assessments were performed for both an onsite no action scenario and an ash removal scenario. The onsite scenario was based on an unrestricted release (*i.e.*, no credit was taken for institutional measures such as land use restrictions or groundwater monitoring). No remedial action (*e.g.*, capping, partial removal of ash to an off-site location) is presumed to be performed in the onsite scenario. The onsite scenario includes a recreational use case, in which the property is converted into a

The distribution coefficient of uranium in the unsaturated layer was represented with a triangular distribution. The minimum value was chosen to represent uranium mobility in a clay layer with a relatively high fraction of sand, but without an interconnected high conductivity pathway through the unsaturated zone. Three $K_d$ values for "clayey sand" (i.e., 58 to 78% sand, 6 to 8% silt, and 19 to 36% clay) from the data compilation of Thibault *et al.* (1990) were averaged to yield a $K_d$ of 680 mL/g (data originally from Neiheisel, 1983). This value is believed to be a conservative lower bound because the unsaturated layer at the KVWPCA is primarily clay whereas the samples of "clayey sand" for which the $K_d$ values were measured were primarily sand. A distribution coefficient of 1600 mL/g was used as the upper end of the distribution to represent uranium adsorption in clay (Sheppard and Thibault, 1990). No independent information was available to develop a central tendency of the distribution, which was estimated as the mean of the upper and lower bounds (*i.e.*, 1140 mL/g).

### 2.1.4 Selection of Input Parameters

The sensitivity of the predicted dose to the input parameters was tested using the probabilistic features of RESRAD 6.2 with the RESRAD default parameter distributions. Initial sensitivity analyses indicated that the dose was sensitive to the distribution coefficient of uranium isotopes in the contaminated zone. To reduce the uncertainty in this parameter, leaching tests were used to determine the partitioning of uranium in the ash (Section 3.1.3). A range of distribution coefficients for uranium in the unsaturated zone was determined from literature values based on site-specific soil type information.

After ranges were determined for the distribution coefficient of uranium in the contaminated and unsaturated zones, an additional sensitivity analysis was conducted with the new parameter distributions for the uranium distribution coefficients and with default RESRAD distributions for the remaining parameters. The results of the second sensitivity analysis indicated that the dose was most sensitive to the erosion rate of the cover layer, the erosion rate of the contaminated zone, and the thickness of the unsaturated zone. Because no site-specific information was available for the erosion rate of the cover layer or the contaminated zone, the recommended RESRAD probabilistic distributions were used to represent these parameters (Yu *et al.*, 1993). The thickness of the unsaturated zone was conservatively chosen at the lower end of the range of unsaturated zone thicknesses recorded in well boring logs from the site (IT Corp., 2002). Because of the importance of the plant and milk ingestion pathways to the predicted dose and the lack of site-specific information about plant and milk transfer factors, distributions were used to represent the plant and milk transfer factors (Yu *et al.*, 1993).

Because the dose was relatively insensitive to other parameters, the recommended values in NUREG/CR-5512 Volume 3 (Beyeler *et al.*, 1999) or the mean values of distributions recommended in NUREG/CR-5512 Volume 3 were used. In cases in which no parameter recommendation was available in NUREG/CR-5512 Volume 3, the mean of the RESRAD probabilistic distribution (Yu *et al.*, 1993) was used. In the few cases in which recommended values were not available in either of these sources, the RESRAD default values were used. The input parameter values and the bases for parameter selection are summarized in the Appendix.

### 2.1.5 Model Results

The assumption of a recreational exposure scenario results in an peak mean annual total effective dose equivalent of approximately 0.011 mSv (1.1 mrem) over the next few centuries,

Assessments, Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Limited. Pinawa, Manitoba, Canada.

USGS (2004). US Geological Survey Real-Time Data Website (http://waterdata.usgs.gov/pa/nwis/dv/?site_no=03048500&PARAmeter_cd=00060,00065). Last accessed 27 February 2004

Williams, R. A. (1977). Letter from Robert A. Williams, Babcock and Wilcox, to Donald Brewer, KV Water Pollution Control Authority, confirming the connection of BWNMD liquid waste streams to the KVWPCA (ADAMS ML993360198)

Yu, C., and others (1993). Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil, Argonne National Laboratory, Argonne, Illinois.

Yu., C., and others (2001/2002). User's Manual for RESRAD Version 6 (ANL/EAD-4) Environmental Assessment Division, Argonne National Laboratory, Argonne, IL, July 2001. Version 6.21 (September 2002) available for download at web.ead.anl.gov/resrad/home2/resrad.cfm.

## 5 Appendix: Input Parameters

The selection of input parameters is discussed in Section ~~3.1.5~~ 3.1.4

**Onsite Scenario Cases**

| | Agricultural case Recreational case[i] | | Intrusion case | | Intrusion into Hotspot | |
|---|---|---|---|---|---|---|
| | Surface | Buried | Surface | Buried | Surface | Buried |
| Total U (pCi/g) | 25 | Distribution [ii] | Distribution [ii] | 92.9 | 275 | 92.9 |
| Co-60 [iii] (pCi/g) | 0.129 | Distribution [ii] | Distribution [ii] | 0.478 | 1.42 | 0.478 |
| Area ($m^2$) | 4000 | 4000 | 700 | 4000 | 700 | 4000 |
| Thickness of Contaminated layer (m) | 1 | 2 | 0.9 | 2 | 0.9 | 2 |
| Cover layer (m) | 0 | 1 | 0 | 1 | 0 | 1 |
| Mass loading for foliar deposition ($g/m^3$) | 0.0001 | 0.0001 | 0.0001 | 0.0 | 0.0001 | 0.0 |
| Pathways | | | | | | |
| External gamma | On | On | On | Off | On | Off |

| | | | | | | |
|---|---|---|---|---|---|---|
| Inhalation | On | On | On | Off | On | Off |
| Plant ingestion | On (Off) | On (Off) | On | On | On | On |
| Meat ingestion | On (Off) | On (Off) | Off | On | Off | On |
| Milk ingestion | On (Off) | On (Off) | Off | On | Off | On |
| Aquatic foods | Off | Off | Off | Off | Off | Off |
| Drinking water | On (Off) | On (Off) | Off | On | Off | On |
| Soil ingestion | On | On | Off | On | Off | On |
| Radon | Off | Off | Off | Off | Off | Off |

(i) Values for the recreational scenario, where different, are given in parentheses

(ii) See Section ~~3.1.2~~ 2.1.2

(iii) Co-60 concentrations are set as a function of Total U. See Section ~~3~~2.1.2

**Subsurface Parameters**

| Zone | Thickne ss (m) | Bulk Densit y (g/cm³) | Total porosit y | Effectiv e porosit y [g] | Field capacit y [h] | Hydraulic conductivi ty [f] (m/yr) | B paramet er [f] |
|---|---|---|---|---|---|---|---|
| Cover | 1[a] | 1.48[c] | 0.44[e] | 0.20 (silt) | 0.24 | 65 (silt) | 3.8 (silt) |
| Contaminat ed | 2 [a] | | | | | | |
| Unsaturated | 3.5 [b] | 1.64[d] | 0.38[f] (sandy clay) | 0.06 (clay) | 0.32 | 47 (sandy clay) | 6.09 (sandy clay) |
| Saturated | not used | 1.51[d] | 0.43[f] (sand) | 0.32 (sand) | 0.11 | 10,850 (sand) | not used |

[a] See section ~~3.1.1.2~~ 2.1.2
[b] Groundwater investigation (Chester, 1992)
[c] Upper end of range of densities for sewage sludge ash (REA, 1980)
[d] Calculated from total porosity based on assumed particle density of 2.65 $g/cm^3$
[e] Calculated from bulk density based on assumed particle density of 2.65 $g/cm^3$
[f] Recommended value or mean of the recommended distribution (NUREG/CR – 5512 Volume 3) for the soil type (IT Corp., 2002)
[g] Mean of recommended distribution (Yu *et al.*, 1993) for the soil type (IT Corp., 2002)
[h] Calculated from the effective porosity as demonstrated in Yu *et al.*, 1993

### Distribution Coefficients

*Correlation coefficients of 0.99 were used to correlate distribution coefficients for uranium isotopes in the same layer*

| | Ash | Unsaturated | Saturated[iv] |
|---|---|---|---|
| U (cm³/g) | Triangular distribution[i] | Triangular distribution[i] | 35 |
| Ac-227 (cm³/g) | 1740[ii] | 2400[iii] | 450 |
| Co-60 (cm³/g) | 1000[ii] | 550[iii] | 60 |
| Pa-231 (cm³/g) | 2040[ii] | 2700[iii] | 550 |
| Pb-210 (cm³/g) | 2400[ii] | 550[iii] | 270 |
| Ra-226 (cm³/g) | 3550[ii] | 9100[iii] | 500 |
| Th-230 (cm³/g) | 5890[ii] | 5800[iii] | 3200 |

(i) See section ~~2.1.3~~ 2.1.3
(ii) Mean of distribution recommended in NUREG/CR-5512 Volume 3
(iii) Recommended value for clay (Sheppard and Thibault, 1990)
(iv) Recommended value for sand (Sheppard and Thibault, 1990)

Onsite Scenario

| Parameter | Input | Reference |
|---|---|---|
| Contaminated zone area ($m^2$) | 4000 | IT Corp., 2002 |
| Length parallel to aquifer flow (m) | 100 | IT Corp., 2002 |
| Cover depth erosion rate (m/yr) | distribution | Yu *et al.*, 1993 |
| Contaminated zone erosion rate (m/yr) | distribution | Yu *et al.*, 1993 |
| Average annual wind speed (m/s) | 1.45 | Mean of distribution (Yu *et al.*, 1993) |
| Evapotranspiration coefficient | 0.625 | Mean of distribution (Yu *et al.*, 1993) |
| Precipitation (m/yr) | 0.96 | 30 year average for Pittsburgh (National Climatic Data Center) |
| Irrigation (m/yr) | 0.5 | Mean of irrigation rates for humid states (NUREG/CR-5512 V. 3) |
| Irrigation mode | overhead | Default |
| Runoff coefficient | 0.45 | Mean of distribution (Yu *et al.*, 1993) |
| Watershed area for nearby stream or pond ($m^2$) | 74,320 | IT Corp., 2002 |
| Inhalation rate ($m^3$/yr) | 12,260 | Median of distribution (NUREG/CR 5512 v.3) |
| Mass loading for inhalation (g/$m^3$) | 1.45E-5 | NUREG/CR 5512 v. 3 |
| Exposure duration (y) | 30 | Default |
| Shielding factor, inhalation | 0.4 | Default |
| Shielding factor, external gamma | 0.27 | Weighted average of indoor and outdoor shielding factors (NUREG/CR 5512 v.3) based on mean indoor and outdoor exposure times (NUREG/CR 5512 v.3) |
| Fraction of time spent indoors | 0.66 | Mean of distribution (NUREG/CR 5512 v.3) |
| Fraction of time spent outdoors (on site) | 0.11 | Mean of distribution (NUREG/CR 5512 v.3) |
| Hydraulic gradient | 0.01 | IT Corp., 2002 |
| Water table drop rate (m/yr) | 0.0 | Aquifer in communication with the river (see Section ~~2.2~~) 1.2 |
| Well pump intake depth (m below water table) | not used | Not used in mass balance model |
| Model: Nondispersion (ND) or Mass-Balance (MB) | MB | More conservative than ND |
| Well pumping rate ($m^3$/yr) | 214 | Three times the mean annual per capita water consumption rate for PA (NUREG/CR 5512 v. 3) |