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STATE OF WASHINGTON  
DEPARTMENT OF HEALTH  
DIVISION OF RADIATION PROTECTION

*Industrial Center, Bldg. 5 • P.O. Box 47827 • Olympia, Washington 98504-7827*

April 5, 1995

Mr. Randall F. Brich  
U.S. Department of Energy  
Richland Operations Office  
P. O. Box 550  
Richland, Washington 99352



Dear Mr. Brich:

The following are the Department of Health's (DOH) comments regarding the draft Identification of Contaminants of Concern document. The DOH review is limited in scope to radionuclides as the toxicity of chemicals does not fall under our purview.

1. The Hanford Site Risk Assessment Manual (HSRAM) is stated as the reference for exposure scenarios. This raises questions regarding the goals of this study and the use of previous efforts. Significant effort, both in development and review, has been spent on the Hanford Site Risk Assessment Manual, yet the CRCIA is planning to produce a document covering analysis scenarios (which are included in HSRAM). Substantive changes in the analysis scenarios from those presented in HSRAM may necessitate the need to revise the screening criteria used in this document.
2. Specific details regarding the exposure scenarios should be listed. For example, this publication uses 10 mg/day as the sediment/soil ingestion rate. Further substantiation for the use of this value should be made, i.e. is the target individual an adult and not a child, were average soil ingestion parameters used, etc. HSRAM recommends 200 mg/day. This value clearly applies to a child. The NRC recommends 50 mg/day as a maximum for an adult and 100 mg/day as a maximum for a child (Kennedy 1992). Kennedy also summarized that "soil intake by children is generally less than 100 mg/day (except for children who exhibit unusual soil ingestion habits)." In light of the locations for exposure (Hanford Reach), an adult exposure scenario may be more appropriate (limitations to river access, number of times on the river, etc.). The DOH recommends a 50 mg/day ingestion rate for an adult scenario and screening value.
3. A further explanation of all exposure parameters should discuss the type of scenario, such as recreational, occupational, or residential. If recreational parameters are used, then pathways such as dermal absorption and inhalation of resuspended materials should be addressed. If residential parameters are used, then the food ingestion pathway should also be identified.

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4. This document analyzes contaminants by equating their concentration in a given media to the concentration in the surface water. The impression created through this method is that the document is modeling concentrations as opposed to using real data. A more detailed explanation of the modelling process should alleviate this confusion.
5. A suggested test for validating this model would be to compare the current contaminants of concern list to those developed by applying this model to each media (sediment, groundwater, soil, etc.). The model should yield the same contaminants of concern list for every media.
6. The inhalation pathway is not listed as a pathway of consideration in the screening criteria yet it was concluded as the most limiting pathway in Section 5 for discrete particles. The radionuclide screening should be updated to include this pathway.
7. The Scope of Work states that only soil within 150m of the river are included in the review, yet the 200 areas are evaluated and included. The scope of work should be updated to accurately reflect this information.
8. More detailed data should be included to support the summation that Sr-90, Cs-137 and Co-60 contamination from the 200 Areas will decay prior to reaching the river. This specific point was a major stumbling block during discussions at the last CRCIA meeting of the three parties.
9. Further quantification of the probabilities of inhaling discrete particles should be included as "remote" means different things to different people. A DOH letter sent to EPA characterized the probabilities of contact and impact of discrete particles along the Hanford Shoreline. This letter is attached in order to aid in the quantification of probabilities.
10. More accurate data regarding the exposure rate along the 100N shoreline exists. The 100  $\mu\text{R/hr}$  exposure rate referenced is probably from a  $\mu\text{R}$  meter and will over-respond to the low energies observed at 100N shoreline near the Liquid Waste Disposal facilities. The hourly average of the maximum TLD result would be a more accurate as an upper bound. The DOH surveyed the 100N shoreline in 1994 with a  $\mu\text{Rem}$  meter. The maximum result indicated by this instrument was 32  $\mu\text{R/hr}$  near the 1304-N Emergency Dump Tank. The highest exposure rate recorded near the disposal facilities was 28  $\mu\text{R/hr}$ . Both of these values include background which DOH determined to be 8  $\mu\text{R/hr}$ . A DOH publication discussing the contribution from significant individual sites within the 100N area and the estimated dose should be available by the end of April.
11. More specific data should be included regarding the relative contribution of Cs-137 from the Hanford Site, and the relative contribution of fallout. For example, the McNary pool sediments are approximately 75% from fallout and the remainder from Hanford origins (Wells, 1994).

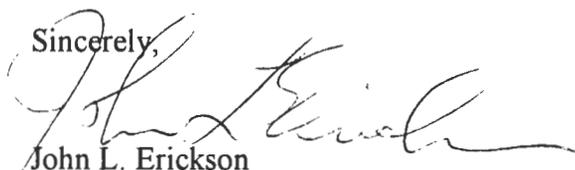
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12. If localized effects of seeps/springs are considered in subsequent revisions, probability estimates of the likelihood of encounter should be included in addition to the estimated dose.

13. HSRAM provides a succinct description of the dose that ecological receptors can safely receive (Table C-3). Further information can be gleaned from NCRP Report #109 on the Effects of Radiation on Aquatic Organisms. This information, in conjunction with the radionuclide screening process, should be utilized to summarize where predicted doses lie in relation to the levels where known effects occur.

DOH appreciates being allowed to submit comments after the stated deadline. If you have questions regarding any of the comments listed above please contact either myself at (360) 586-3306, or Drew Thatcher at (360) 586-8715.

Sincerely,



John L. Erickson  
Environmental Radiation Section  
Washington Department of Health

JLE:AHT:KP  
Enclosure

cc: Dave Holland, Ecology  
Jerry Yokel, Ecology  
Larry Gadbois, EPA

#### REFERENCES

Kennedy, W. E., Jr., Strenge, D. L., 1992, Residual Radioactive Contamination from Decommissioning, NUREG/CR-5512, Pacific Northwest Laboratory for the Nuclear Regulatory Commission.

Wells, D. P., 1994, Special Report: Radioactivity in Columbia River Sediments and Their Health Effects, Environmental Radiation Section, Washington Department of Health.



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STATE OF WASHINGTON  
DEPARTMENT OF HEALTH  
DIVISION OF RADIATION PROTECTION  
*Airustrial Center, Bldg. 5 • P.O. Box 47827 • Olympia, Washington 98504-7827*

October 25, 1994

Larry Gadbois  
Environmental Protection Agency  
712 Swift Blvd., Suite 5  
Richland, Washington 99352

Dear Mr. Gadbois:

The presence of  $^{60}\text{Co}$ -contaminated metallic specks in the Columbia River raises several difficult regulatory questions. Among these are what are the potential health effects of these particles and what protocols should be implemented for their remediation?

Potential health effects can be separated into those that are carcinogenic and those that are non-carcinogenic. The potential non-carcinogenic, or acute, effect is tissue damage in highly localized areas of the skin or respiratory tract. The short term effect of this damage would be a lesion, while the long term effect would be a scar.

The carcinogenic potential of these specks primarily stems from two pathways. These are "ground shine", or external exposure, and ingestion. The maximum potential dose from ground shine has been estimated to be 0.04 mrem/year in a recreational scenario [We94]. This dose rate yields an annual cancer risk of  $2.7 \times 10^{-8}$ , using BEIR V risk estimates. Cooper and Woodruff published dose estimates for the ingestion pathway in 1993 [Co93]. Their estimate implies that an individual would receive a dose of 83 mrem if that individual were to ingest a speck with the highest recently-measured activity of  $22 \mu\text{Ci}$ . The Department of Health has estimated that the probability that an individual would ingest a speck is less than  $0.31 \times 10^{-6}$ . The product of this probability and the risk of the above maximum dose leads to a cancer risk per year of  $0.23 \times 10^{-10}$ .

The pathways of inhalation and direct contact with the skin are the means of the non-carcinogenic potential effects of specks. This is a deterministic, or nonstochastic, effect which will occur if the localized dose exceeds a threshold value and will not occur if the threshold value is not exceeded. The National Council on Radiation Protection has suggested that the contact exposure limit of  $75 \mu\text{Ci-hrs}$  [NCRP89] is the exposure threshold above which lesions will occur.

Cooper and Woodruff suggest that the maximum reasonable time a speck would remain directly on the skin is 48 hours, which implies that a speck with an activity of  $1.6 \mu\text{Ci}$  greater could exceed the  $75 \mu\text{Ci-hr}$  limit. Cooper and Woodruff also estimate that the localized dose equivalent to  $75 \mu\text{Ci-hrs}$  could be

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exceeded by the use of clothing containing a 1.6  $\mu\text{Ci}$  speck in 300 hours, and in a sleeping bag in 440 hours. These longer potential exposure times are plausible because it has been shown that specks are not easily washed out of clothing [NCRP89]. The Department of Health has conservatively estimated that the probability per year of an individual "picking up" a speck on their skin or clothing is  $1.6 \times 10^{-6}$  and  $5.8 \times 10^{-6}$  respectively.

Cooper and Woodruff also assume a 48 hour retention time for the inhalation pathway. They estimate that the dose limiting scenario for this pathway is uptake and retention of a speck in the nose. In this scenario, as in the case of direct skin exposure, specks with activities larger than 1.6  $\mu\text{Ci}$  will exceed the 75  $\mu\text{Ci-hr}$  limit. The Department of Health has estimated that the maximum probability for inhalation of a speck is  $1.2 \times 10^{-9}$ .

The calculations of these probabilities can be found in the Appendix, and the dose estimates are contained in the publications of Cooper and Woodruff [Co93] and the Department of Health [We94].

The maximum carcinogenic risks that have been calculated here are all several orders of magnitude below the  $10^{-4}$  level and the maximum lesion probabilities are all approximately  $10^{-6}$  or less. Thus the Department of Health does not believe that the human-health risks of radioactive specks in the Columbia River are sufficient to justify further surveys to locate and remove them. Nevertheless, when specks are found in the course of cleanup actions the Department recommends that they be removed. This is consistent with other environmental radiological cleanups, such as uranium mills, where "hot spots" are always remediated when they are found. This recommendation does not apply to the remediation of reactor effluent pipes in the Hanford Reach of the river because it is not clear to the Department if these pipes are a significant repository of radioactive specks.

If you have any questions, please call me at 206-586-3306 or Doug Wells at 206-586-3585.

Sincerely,



John L. Erickson, Head  
Environmental Radiation Section  
Division of Radiation Protection

JLE:DPW:KP  
Attachments

cc: Chuck Cline, Ecology  
Dave Holland, Ecology  
Jerry Yokel, Ecology

## References

[Co93] A.T. Cooper and R.K. Woodruff, "Investigation of Exposure Rates and Radionuclide and Trace Metal Distributions Along the Hanford Reach of the Columbia River", Pacific Northwest Laboratories document number PNL-8789, Richland, WA (1993).

[We94] D.P. Wells, "Radioactivity in Columbia River Sediments and their Health Effects", Washington Department of Health, Olympia, WA (1994).

[EPA91] T. Fields and B. Diamond, "Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors", Washington, DC (1989).

[HSBRAM] "Hanford Site Baseline Risk Assessment Methodology", US Department of Energy publication number DOE/RL/-91-45, Richland, WA (1992).

[NCRP89] "Limit for Exposure to Hot Particles on the Skin", NCRP report number 106, National Council on Radiation Protection and Measurements, Washington, DC (1989).

[Sc93] R.G. Schreckhise *et al.*, "Recommended Environmental Dose Calculations Methods and Hanford Specific Parameters", Pacific Northwest Laboratories document number PNL-3777, Richland, WA (1993).

[Sh92] B. Shleien, Editor, "The Health Physics and Radiological Health Handbook", Scinta Press Inc., Silver Spring, MD (1992).

[Su80] M.J. Sula, "Radiological Survey of Exposed Shorelines and Islands of the Columbia River between Vernita and the Snake River Confluence", Pacific Northwest Laboratories document number PNL-3127, Richland, WA (1980).

## Appendix - Probability Estimates

A complete risk assessment of radioactive specks in sediments includes both an estimate of the carcinogenic and non-carcinogenic effects if an individual is exposed and the probability of exposure. The Department of Health calculates this probability for each pathway by dividing the volume of sediments that the "maximally exposed individual" is exposed to each year by the minimum sediment volume that is likely to contain one speck. The latter quantity is the inverse of the maximum speck density as measured by Sula [Su80] on D-Island.

Sula found that the maximum number of specks per unit area was  $5.6 \times 10^3 \text{ m}^{-2}$ . Since all of these specks were found to be in the top 15 cm, this yields a volume density of  $3.7 \times 10^2 \text{ m}^{-3}$ . The inverse of this yields the minimum single-speck sediment volume of  $2.7 \times 10^7 \text{ cm}^3$ .

To estimate the volume of sediment ingested per year by the maximally exposed individual the Department of Health assumed a consumption rate of 200 mg/day [HSBRAM] for 63 days per year. This is a 500 hours-per-year recreational scenario [Sc93], which is approximately ten times more conservative than the Hanford Site Baseline Risk Assessment Methodology. This yields an annual consumption rate of 12.6 grams per year, or assuming a sediment density of  $1.5 \text{ g/cm}^3$ ,  $8.4 \text{ cm}^3$  per year. Thus the annual probability of consumption is  $8.4 \text{ cm}^3$  divided by  $2.7 \times 10^7 \text{ cm}^3$ , or  $0.31 \times 10^{-6}$ .

The mass of sediment inhaled per year is given by the product of three factors: the breathing rate (approximately  $1 \text{ m}^3/\text{hr}$ ), the number of hours spent recreating on the river (500 hours) and the mass-loading of suspended sediment in the air ( $0.0001 \text{ g/m}^3$ ) [Sc93]. The latter factor is twice as conservative as EPA's guidance [EPA91]. This yields an annual inhalation of 0.05 g, or assuming a sediment density of  $1.5 \text{ g/cm}^3$ , an annual inhalation of  $0.033 \text{ cm}^3$  of sediment. Thus the annual probability of inhalation is given by  $0.033 \text{ cm}^3$  divided by  $2.7 \times 10^7 \text{ cm}^3$ , or  $1.2 \times 10^{-9}$ .

The mass of sediment that annually adheres directly to the maximally exposed individual's skin is given by the product of three factors: the adherence rate ( $0.0002 \text{ g/cm}^2$  per day) [HSBRAM], the area of uncovered skin ( $5,000 \text{ cm}^2$ ) [HSBRAM] and the number of days per year (63 days). This yields an annual mass of 63 g, or  $42 \text{ cm}^3$ . Thus the probability of a speck adhering to the skin is  $42 \text{ cm}^3$  divided by  $2.7 \times 10^7 \text{ cm}^3$ , which yields an annual probability of  $1.6 \times 10^{-6}$ .

To calculate the probability of a speck adhering to clothing, the Department follows the calculation for adherence to skin, with the area of  $5,000 \text{ cm}^2$  replaced by the area of a "reference man" [Sh92] ( $18,000 \text{ cm}^2$ ). This yields an annual probability of  $5.8 \times 10^{-6}$ .

These estimates utilized many conservative assumptions; however, it is important to keep several potential modifications in mind. Most of the specks are found in rocky areas where sediments are only found in the spaces between the rocks. Thus the above estimate of the density of specks in sediments available for uptake may be too low. Inclusion of this effect would reduce the minimum single-speck volume and raise the above probabilities. However, in rocky locations most of the surface area that is available for contact, ingestion or resuspension is taken by the rocks and not the sediments. Inclusion of this effect would reduce the above probabilities. Further, the density of specks is approximately three times that of a sediment "grain". This causes specks to sink below the surface, further reducing the probability of contact. The net result of these effects tends to cancel. Thus the Department of Health is confident that the probabilities calculated here are conservative estimates.