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01-EQD-021

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504

*TWRS / Treatment Permits /
Dangerous waste Permit
Risk Assessment*
Central Files _____
File Name: _____
Cross Reference: _____

Dear Mr. Wilson:

COMMENT RESPONSES FOR THE FINAL WORK PLAN FOR WASTE TREATMENT
AND IMMOBILIZATION PLANT SCREENING LEVEL RISK ASSESSMENT

Reference: Ecology letter from J. Yokel to B. Cornaby, Science Applications International Corporation, "Hanford River Protection Privatization Project Review of BNFL Risk Assessment Work Plan Revision 0, April 28, 2000, Technical Review Comments," dated July 26, 2000.

Attached are the responses to the State of Washington Department of Ecology (Ecology) comments provided in the above Reference on the Final Work Plan for Screening Level Risk Assessment for the River Protection Project - Waste Treatment and Immobilization Plant (RPT-W375-EN00001), dated April 28, 2000. These responses also include the outcome of meetings held November 1 through November 2, 2000, in Seattle, Washington, between staff from the U.S. Department of Energy, Office of River Protection, CH2M HILL Hanford Group, Inc., U.S. Environmental Protection Agency Region 10, and Ecology.

If you have any questions, please contact L. A. Huffman, (509) 376-0104.

Sincerely,

WJ Taylor
William J. Taylor
Acting Assistant Manager
for Project Delivery

EQD:LAH

Attachment

cc w/attach:
See page 2

Tracking # RAWP-003 / G-003

Comment

The methods developed by Martin Marietta Energy Unit A, Inc., for Loring Air Force Base (cited in reference sections as HAZWRAP 1994) are cited several times in the write-up of the ERA methods. Presently, the applicability of this information is unknown. Information from HAZWRAP (1994) and the methods and assumptions for collecting it and evaluating it must be discussed in the next iteration of the work plan.

Response

Agree. We intend to continue using the HAZWRAP values which, in turn, are taken from well-respected sources. EPA's SLERAP has transfer factors for 30 chemicals, and the melter work requires COPC analysis of an additional 440 chemicals. For that reason alone, we must depend on other data sources, such as the HAZWRAP. The primary sources used in the HAZWRAP compilation will be cited and described, and any assumptions made by HAZWRAP about methods to provide data that are not covered in the SLERAP will be described and used.

Tracking # RAWP-004 / G-004

Comment

Section 3.2 must be amended to provide sufficient information on the pretreatment system to document its capabilities to address organics, inorganic, radionuclides, and acid gases and to generate emission estimates for these constituents from the pretreatment system for input to the PRA and FRA. (See RPP-WTP DWPA Supplement 2 Comment Response Preliminary Draft (10 March 2000), Comment No. 3.) The work plan will not be considered complete until emission estimates are included and their development basis documented.

Response

Emission data and the basis for the data, will be provided. The emission estimate will address the 470 organic, inorganic, and radionuclide constituents of potential concern (COPCs) to undergo analysis during the risk assessment process.

Comment

Section 3.3.2.2 and 3.4.2.2, the projected operating temperature for the thermal catalytic oxidation unit continues to be an issue of concern. Though particulate is expected to be efficiently removed by the HEPA filters it is not expected to be zero and the combustion efficiency in this unit is not expected to be 100%. The system should be designed and operated to achieve an organic DRE of at least 99.99% and be designed and operated to minimize formation of dioxin. Information supporting the ability to meet this DRE and to minimize dioxin should be provided and emission data generated based on design and expected operation. (See RPP-WTP DWPA Supplement 2 Comment Response Preliminary Draft (10 March 2000), Comment No. 5.). The work plan will not be considered complete until emission estimates are included and their development basis documented.

Response

Clarification. An emissions estimate report is being prepared to document the emission rates as well as the methods and assumptions used to estimate emission rates for all 470 COPC/ROPCs. This emissions estimate report will be used to support the Preliminary Risk Assessment as well as two air permitting Notices of Construction (a radiological NOC and an air toxics NOC) and a Prevention of Significant Deterioration (PSD) permit application. The emissions estimate report will be available with the RAWP and will reference the information used to estimate emission rates including:

- pilot studies used to estimate PIC emission rates (including dioxins);
- assumed removal efficiencies for air pollution control equipment and their basis;
- source of COPC/ROPC concentrations in waste feed; and
- the plant equipment configuration

The emission estimate being prepared to support the PRA and other permitting requirements is based on conservative waste feed and treatment assumptions to ensure that the WTP will not present a risk to human health or the environment. Consistent with the proposed Subpart X permitting approach for vitrification units described in 65 FR 42937, the recently-promulgated hazardous waste incinerator MACT standards will be considered for the RPP-WTP melter. The necessary research and technology testing to determine whether the RPP-WTP melter systems can achieve these standards has not yet been performed. The regulatory agencies will be provided with the data when it is available.

The RPP-WTP and DOE recognize that Ecology and EPA want the best treatment train available for the WTP. To facilitate Ecology/EPA's evaluation of the treatment system, the following will be provided:

- Fate of Hazardous Organics Report (10/99).
- Equipment Selection Document.
- Research and Technology development test plan for future pilot testing.
- Briefing by design engineers on selection of treatment equipment.
- Briefing on pilot testing that has been and will be performed.

The RPP-WTP and DOE recognizes that periodic re-testing of the DRE may be required by the regulatory agencies.

Comment

Section 3.3.2.4, page 3-9, provide basis for ten year frequency for general power failure.

Response

Three basic reference sources of data were used in estimating the loss of site power (LOSP) frequency data:

1. Losses of Off-Site Power at U.S. Nuclear Plants (EPRI NSAC-194)
2. Analysis of Power Loss Data for the 200 Area Tank Farms in Support of the K Basin SAR Work, WHC-EP-0811, M. V. Shultz.
3. Evaluation of Loss of Offsite Power Events at Nuclear Power Plants 1980-1996, NUREG/CR-5496, C.L. Atwood et al.

Site specific LOSP data collected during the period from 1972 through 1992 was the preferred source of information. Additional data for the derivation of LOSP event frequencies for RPP-WTP were as follows:

- Data for very short-term LOSP events [≤ 5 minutes] were derived primarily from the Hanford Tank Farm data provided in WHC-EP-0811.
- Data for short-duration LOSP events [≤ 1 hour] were derived from a combination of Hanford site specific information and commercial nuclear power plant data taken from EPRI NSAC-194 (Reference 1). This was assumed appropriate because the power feed configurations, testing requirements and maintenance protocols for RPP-WTP are expected to be comparable to those used to support a nuclear power plant.

Data for long duration events [≥ 1 hour] was derived using non-recovery probabilities extracted from NUREG/CR-5496 (Reference 3). The grid system non-recovery curves from NUREG/CR-5496 were extrapolated to provide estimates of non-recovery probabilities for specific post-initiator time intervals. Combination of this information with the established short-term LOSP frequencies provided occurrence frequencies for LOSP events lasting several days.

Comment

Section 4, the first paragraph purports to delineate the purpose of the SLRA. The purposes listed do not comport with those expected by the regulating Agencies.

- a) The first purpose listed is "meeting EPA guidance specifications." This is not a purpose; the use of guidance is a means to an end, not an end in itself.
- b) The second purpose listed is "providing risk information for additional stakeholders, including Native American tribes and other public members." It is not clear what the word "additional" refers to. Additional to whom? Also, it is inappropriate to refer to Native American tribes that have direct interests in the SLRA (either because they are potentially directly impacted or own or have rights to some of the land upon which the proposed activities will take place) as "stakeholders." Such tribes should be referred to and considered as regulatory entities, inasmuch as they constitute sovereign nations with certain authorities regarding the activities contemplated by the permit application, including the SLRA. In other words, Native Americans should not simply be grouped with interested parties or the potentially affected public.
- c) The third purpose listed is "identifying potential financial risk associated with building and operating the River Protection Project-Waste Treatment Plant (RPP-WTP)." Financial risks are not addressed in the SLRA and are not a reason for requiring it. Perhaps USDOE and/or its contractor can utilize information concerning risk to make adjustments to financial projections, but this should not be listed as a primary reason for conducting the SLRA.
- d) The fourth purpose listed is "providing the information necessary to determine what, if any, additional permit conditions are necessary for the operation of the RPP-WTP to be protective of human health and the environment." This is a reasonable purpose, secondary only to the determination of whether the RPP-WTP can be operated within acceptable risks to human health and the environment.

This paragraph should be rewritten to more reflectively delineate the purposes of conducting a risk assessment prior to and after constructing the RPP-WTP

Response

Agree. The paragraph will be revised to read: "The SLRA must serve several purposes including: (1) identify any potential risks to human health or the environment that may result from emissions from the River Protection Project - Waste Treatment Plant (RPP-WTP); (2) provide the information necessary to determine what, if any, additional permit conditions are necessary for the operation of the RPP-WTP to be protective of human health and the environment; and (3) provide risk information to Ecology, USEPA, DOE, Native American Tribes, and interested public stakeholders."

Tracking # RAWP-008 / G-008

Comment

Section 5.2.1.1., page 5-4, system capability to achieve at least 99.99% DRE for organics must be provided and documented in the work plan and used to generate emission estimates. The work plan will not be considered complete until emission estimates are included and their development basis documented. (See RPP-WTP DWPA Supplement 2 Comment Response Preliminary Draft (10 March 2000), Comments No. 5 and 25.) .

Response

Clarification. An emissions estimate report is being prepared to document the emission rates as well as the methods and assumptions used to calculate these emission rates for the WTP. An early version of the emission estimate that supports the Spring 2001 Preliminary Risk Assessment will be provided to the regulatory agencies when it is completed. The final emissions estimate report will be cited in the RAWP and will be available to Ecology and EPA along with the RAWP.

See response to comment RAWP-005 for additional information on the emissions estimate report.

Tracking # RAWP-009 / G-009

Comment

The RAWP does not provide estimates of COPC emission rates, which are normally calculated in the work plan phase of a combustion risk assessment. Estimates should be calculated for each potential source, based on best available information. Description of emissions estimates should list each source at the RPP-WTP, relevant assumptions, information used to perform calculations, including sample calculations. EPA's HHRAP provides information for making these calculations.

Response

Clarification. An emissions estimate report is being prepared to document the emission rates as well as the methods and assumptions used to estimate emission rates for all 470 COPC/ROPCs from all three stacks (pretreatment, LAW vitrification, HLW vitrification). An early version of the emission estimate that supports the Spring 2001 Preliminary Risk Assessment will be provided to the regulatory agencies when it is completed. The final emissions estimate report will be cited in the RAWP and will be available to Ecology and EPA along with the RAWP.

See response to comment RAWP-005 for additional information on the emissions estimate report.

Tracking # RAWP-010 / G-010

Comment

The RAWP does not clearly identify the exposure scenario locations within terrestrial and aquatic habitats to be evaluated in the ERA. For exposure scenario locations within aquatic habitats, an associated watershed contributing to COPC loading to the water body being evaluated should also be defined. The methodology and results of the selection of receptor grid nodes as exposure scenario locations should be clearly presented and discussed in the work plan. Procedures described in the SLERAP should be used in the selection of receptor grid nodes as exposure locations.

Response

Clarification. Because this is a screening level risk assessment, there will not be separate exposure locations for each receptor or habitat. Instead, transport and deposition modeling will be used to identify the locations of maximum air concentration and maximum deposition from each stack. All food webs will be evaluated using media concentrations at those maximum locations. All receptors will be assumed to be exposed at the points of maximum deposition and maximum airborne concentration, as well as at the maximum deposition location in the Columbia River, and at two administratively important locations, the Hanford Site boundary and Gable Mountain, which is of particular interest to the Native Americans. If there are no unacceptable risks at the points of maximum deposition and air concentration, additional information about exposure at points with lower soil, air, or water concentrations will not be necessary.

Tracking # RAWP-011 / G-011

Comment

Figures presenting the terrestrial and aquatic food webs developed for the ecological risk assessment should indicate which exposure pathways are represented mathematically in equations for exposure assessment and which exposure pathways are not.

Response

A legend will be added to indicate which exposure pathways are represented mathematically.

Tracking # RAWP-012 / G-012

Comment

The risk to local populations of Chinook salmon and steelhead, protected fish species regulated by the National Marine Fisheries Service, should be evaluated separately from 'aquatic life.' These receptors are protected species, and the results from the risk assessment of 'aquatic life' may not provide sufficient detail about the potential risk to these species. The problem formulation section of the ERA should discuss the need to evaluate these receptors separately, and also provide other required information, including exposure scenario locations, assessment endpoints, and measurement endpoints. The exposure assessment for these receptors is the same as the one for "aquatic life." Toxicity reference values in ATG, Inc.'s risk assessment for these receptors should be suitable for this analysis.

Response

Agree. An additional analysis of risks to salmonids will be added to the analysis of aquatic life, noting the protected status of some of the salmonids. Specific published toxicity data for salmonids, including those in the ECOTOX database, will be used whenever possible. Toxicity values in ATG's risk assessment will be reviewed and used as appropriate. We request that Ecology provide the latest or approved copy of the ATG risk assessment, including the data appendices.

Tracking # RAWP-013 / G-013

Comment

The work plan should include an ecological effects evaluation for COPCs/ROPCs evaluated in the ERA that are not listed in EPA's combustion ERA guidance (cited as EPA 1999b in reference section).

Response

Agree. Summary tables of ecological effects for COPCs/ROPCs that are not in the SLERAP will be added to the RAWP, and sources of data will be cited by use of references to the reference list. Complete toxicity profiles will not be provided. SLERAP guidance for selecting values will be used, as outlined in Sect. 5.4.1 of the SLERAP. Specifically, the hierarchy of sources will be:

- standards, criteria, guidance, or benchmarks established by a government agency,
- toxicity values published in scientific literature and evaluated for inclusion in the RAWP (chronic reproductive endpoints will be preferred, and studies with both a NOAEL and a LOAEL will be preferred over those with only a NOAEL or a LOAEL),
- for nonpolar organic COPCs in sediment, toxicity values calculated by using equilibrium partitioning, or
- toxicity values for surrogate chemicals that have been identified by EPA.

Methods for choosing among alternative TRVs are presented in more detail in RAWP-015. If multiple values with the same standing in the hierarchy are found, the lowest (i.e., most conservative) will be used. Sources of data will be explicitly identified in the data tables, and full citations will be provided.

Comment

The work plan does not clearly define NO_x release scenarios, risk analysis of melter offgas, risk from pretreatment chemicals and vitrification chemicals. These elements must be addressed in the PRA and the environmental performance demonstration? The contaminants of concern list is not complete in this version and should be addressed prior to the PRA. Many hazardous chemicals are not listed that have been identified for pretreatment and vitrification. (see handouts from DOE RU-BNFL Topical Meeting 4/25/2000) [Ecology].

Response

Clarification. Section 2.2.1 of the HHRAP states "...emission rates used to complete the risk assessment will be (1) long-term average emission rates adjusted for upsets, or (2) reasonable maximum emission rates measured during trial burn conditions in order to assure the risk assessments are conservative." For purposes of this risk assessment, long-term average emission rates from pretreatment and LAW and HLW vitrification, adjusted for upsets will be used. Because no process-upset data are available for the melters, default process upset factors presented in Section 2.2.5 of the HHRAP (2.8 for organics, 1.45 for inorganics and radionuclides) are applied to the vapor phase emissions estimates.

The entire pretreatment and vitrification processes are contained within buildings designed such that the only exits for air and emissions are through one or more HEPA filters. When the process is operating normally all air and emissions will pass through numerous air pollution control devices. However, even if the process experiences an upset condition or shuts down, and all of the active pollution control devices operate poorly or fail completely, the only way for air and emissions to pass out of the facility is through the HEPA filters. According to manufacturers specifications (references will be provided in emissions estimate report), 2 HEPA filters in series will remove > 99.999991% of all particles (99.97% removal for each filter; thus, $(1 - (0.0003 \times 0.0003)) \times 100 = 99.999991\%$). To account for upset conditions that may result in reduced efficiency of the HEPA filters it is assumed that the filters will remove 99.999% of all particles (i.e., 99.9% removal efficiency by the first filter and 99% removal efficiency for the second filter). This reduced removal efficiency is equivalent to applying an upset factor of 111 times over optimal conditions. Therefore, no additional upset factor will be applied for particulate and particulate-bound constituents.

The ATG risk assessment work plan proposes a routine total HEPA efficiency of 99.9999% (99.9% removal for each filter) combined with an upset factor of 2.8 (organics) and 1.45 (inorganics). These upset factors assume emissions from the air pollution control system including the HEPA filters are increased by a factor of ten times 20% of the time for organics and 5% of the time for inorganics. A ten times greater emission rate would result from a reduced total HEPA removal efficiency of 99.999%. By contrast, the RPP-WTP approach assumes the HEPA filters have a removal efficiency of 99.999% 100% of the time (rather than just 20% or 5% of the time). Therefore, the proposed RPP-WTP approach is more conservative than the ATG approach.

Consistent with the risk assessment approach developed during two years of discussions with EPA and Ecology, 470 radionuclide, organic, and inorganic COPCs/ROPCs are being addressed in the risk assessment. These 470 COPCs/ROPCs include NO_x. Emissions associated with pretreatment and vitrification process chemicals are addressed in the stack emissions estimate when these process chemicals are used in the waste treatment process.

Comment

Documentation on the basis of selecting specific parameter values is inadequate. The text should describe the hierarchy used to select parameter values when they are available from two or more sources. The tables should include a column for briefly describing the basis of each value. This deficiency is most pronounced for the values proposed for evaluating the ecological risk of the chemicals.

Response

Clarification. The method for choosing among alternative TRVs will be clarified as follows:

- For freshwater TRVs, the hierarchy will be values from the SLERAP, National Ambient Water Quality Criteria, the Final Chronic Values, then Great Lakes Tier II Secondary Chronic Values, then toxicity values from published literature. If there is no toxicity value for a COPC, a surrogate with a similar structure will be sought from Ecology and EPA. If there is no surrogate, no TRV will be listed, and this lack of data will be handled as an uncertainty.
- For sediment TRVs, the hierarchy will be values from the SLERAP, then No Effect Levels and Lowest Effect Levels from Persaud et al. (Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. Ontario Ministry of the Environment and Energy.), then Apparent Effects Thresholds from Washington State Department of Ecology (Washington State Department of Ecology. 1994. *Creation of Freshwater Sediment Quality Database and Preliminary Analysis of Freshwater Apparent Effects Thresholds*. June.), then values published by Ingersoll et al. (Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, and N.E. Kemble. 1996. Calculation and evaluation of sediment effect concentrations. *J. Great Lakes Res.*: 22:602-623). For COPCs whose values are not available from those sources, values and methods found in Jones et al. (1997) will be used. If there is no TRV in these sources, no TRV will be listed, and this lack of data will be handled as an uncertainty.
- For terrestrial plant TRVs, the hierarchy will be values from the SLERAP, then values from Efroymson et al. (1997a), then values in the Phytotox database, then surrogate values from structurally similar chemicals obtained from Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.
- For terrestrial invertebrate TRVs, the hierarchy will be values from Efroymson et al. (1997b), then values in published literature, then surrogate values from structurally similar chemicals obtained from Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.
- For terrestrial mammal and bird TRVs, the hierarchy will be values from Sample et al. (1996), then values from the ECOTOXicology Database System (EPA 1996, URL <http://www.epa.gov/ecotox>), then surrogate values for structurally similar chemicals provided by Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.

The rationale for choosing bioconcentration factors is presented in the response to Comment RAWP-128.

Tracking # RAWP-016 / G-016

Comment

It appears there are four sources of values for the parameters used to assess the ecological risk of chemicals. These sources include (1) "SAIC values," (2) EPA values (from the Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities [SLERAP]), (3) site-specific field-derived values, and (4) "unknown" values. The basis for sources 1, 3, and 4 should be discussed as an introduction to each parameter in Appendix C.

Response

Clarification. The TRV tables in Appendix Section C3 will be revised so that they present a single TRV for each COPC. The preferred value will be the one presented in the SLERAP. SLERAP guidance for selecting values will be used for COPCs not found in the SLERAP, as outlined in Sect. 5.4.1 of the SLERAP. Specifically, the hierarchy of sources will be:

- standards, criteria, guidance, or benchmarks established by a government agency,
- toxicity values published in scientific literature and evaluated for inclusion in the RAWP (chronic reproductive endpoints will be preferred, and studies with both a NOAEL and a LOAEL will be preferred over those with only a NOAEL or a LOAEL),
- for nonpolar organic COPCs in sediment, toxicity values calculated by using equilibrium partitioning, or
- toxicity values for surrogate chemicals that have been identified by EPA.

Methods for choosing among alternative TRVs are presented in more detail in RAWP-015. If multiple values with the same standing in the hierarchy are found, the lowest (i.e., most conservative) will be used. A table will be presented in the text to describe the hierarchy used to select the preferred value if more than one is available. Sources of values will be identified in the data tables, and full citations will be provided.

Tracking # RAWP-017 / G-017

Comment

The information in the appendices is difficult to find because there is no table of contents and the table locations are not tabbed. Add a table of contents at the beginning of each appendix, and tab the location of each table so the reader can easily locate each table. Most of the references cited in the appendices are not listed in the respective reference lists. Some of them are crucial for readers to know how the parameters values were derived. Without knowing actual titles of these references, it will be difficult to know the sources of the values. In some cases, it would be impossible for readers to conduct this review quantitatively. Include all references cited in each appendix in the respective reference lists.

Response

A table of contents will be added at the beginning of each appendix. Standard Hanford Site document formatting (e.g., table of contents font, figure call outs, tabs, etc.) will be used throughout the RAWP Rev. 2. All references cited in each appendix will be included in the reference lists.

Tracking # RAWP-018 / G-018

Comment

The explanation of the derivation of "default" values in the various sections of Chapter 8 is lacking. For example, what kind of an evaluation of "available published values" (in Section 8.2.4.4) was performed to derive the default values.

Response

Clarification. The explanation of how default values are derived will be expanded to state that published values for chemicals similar to those with no published values will be included in the selection process. For example, benzo (a)pyrene is used in the SLERAP as a surrogate for all PAHs for soil invertebrates. No surrogate values for classes of compounds will be used if surrogates were not used in the SLERAP, i.e., for compounds other than PAHs, unless the surrogate is a compound with similar structure. The exception to this is when Ecology and/or EPA provides a surrogate value.

Tracking # RAWP-019 / G-019

Comment

Table C3-7 lists the derivation of inhalation TRVs for mammals, but there is no corresponding table listing the derivation of inhalation TRVs for birds. The same applies to the derivation of Ba values. Present tables for TRVs and Ba values for birds.

Response

Clarification. Ba values for birds calculated according to methods presented (but not validated) in the SLERAP will be added to Table C2-5. Consistent with the SLERAP and your comment stated in RAWP-114, the inhalation pathway for ecological receptors will not be evaluated.

Tracking # RAWP-020 / G-020

Comment

It would be helpful if all equations were sequentially numbered and a more detailed Table of Contents would be helpful for Section 7 and 8 to facilitate locating specific information.

Response

The equations both in location in the document and number continue to change. Once this active period of equation development passes, the equations can be numbered.

Tracking # RAWP-021 / S-001

Comment

Section 3.1, Engineering Description, Page 3-1; and Figure 3-1, Location of RPP-WTP on the Hanford Site, Page 3-17. The plan begins by describing the process and effluents after the waste arrives at the WTP. The plan does not describe the interface between the underground storage tanks and the WTP; i.e., how will the waste be put into a form that will allow it to be pumped to the WTP, and what provisions have been made to assure no leaks?

Recommendation: Mention the BNFL document that describes the methodologies that will be used to mobilize the waste in the tanks and deliver it to the WTP. Provide the full reference

Response

Mobilization of Hanford tank waste and its delivery are not addressed in the RPP-WTP Dangerous Waste Permitting activities because there are activities associated with another Hanford Site TSD unit. A reference to the Double Shell Tank RCRA Part B Permit Application will be made.

Tracking # RAWP-022 / S-002

Comment

Section 4.0, Screening Level Risk Assessment and Constituents of Potential Concern, Page 4-1. The statement that the "FRA will utilize real emissions data" is somewhat misleading, as other sources of information will also be incorporated.

Recommendation: This statement should be caveated with references to approaches which will be used to minimize underestimating emissions that could result due to some of the limitations posed in collecting and evaluating real emissions data (i.e., sampling and analysis limitations, representativeness of waste feed processed during the emission testing, etc), as well discussing the incorporation of other data based on engineering calculations (i.e., fugitive emissions) and application of adjustment factors (i.e., upset factor, etc.).

Response

The statement will be changed to read: "the FRA will use data gathered during the environmental performance demonstration."

Tracking # RAWP-023 / S-003

Comment

Section 4.1.4, Page 4-4, first paragraph, this gives a reference of EPA, 1999. There is no such reference in Chapter 11 (References)

Recommendation: Clarify which of the EPA 1999 communication references is meant here (d,e or f).

Response

Agree. The correct reference is EPA 1999e. The reference will be corrected to read, "EPA 1999e. Personal communication with US Environmental Protection Agency, Region X, on September 15 and 16, 1999."

Comment

Section 4.1.4 and Table A-5, The implication in both the narrative and the table is that all of the chemicals listed are of low toxicity. If some simply do not have quantitative toxicity values available, this should be so stated and indicated. It is not clear why the three paragraphs comprising lines 27-47 on page 4-4 and lines 1-9 on page 4-5 were included, since they explain the evaluation of low toxicity chemicals, yet the first paragraph in this section states up front that EPA Region 10 does not agree with screening of chemicals based on toxicity. The three paragraphs serve to add confusion. It should also be noted that though Table A-5 lists dibenzo[a,i]pyrene and dibenzo[a,h]pyrene as non-detected chemicals previously eliminated due to "low toxicity", the CalEPA assigns a TEF of 10 to both of these PAHs, indicating that their carcinogenic potency is 10 times that of benzo[a]pyrene.

Recommendation: The three paragraphs should be eliminated. EPA does not agree with the apparent definition of "low toxicity" employed in the assessment, but because this will not be a criterion for eliminating COPCs, there is no point in enumerating the disagreements chemical by chemical for Table A-5, for example. This section should be rewritten to discuss any screening of chemicals done for reasons other than "low toxicity".

Response

This section of the text describes the process for which chemicals associated with the Hanford tank waste were screened. The approach, described in detail in Regulatory Data Quality Objectives Supporting Tank Waste Remediation System Privatization Project (PNNL-12040, Rev 0) was approved by the Washington Department of Ecology and DOE. Consistent with the agreed-upon approach, some chemicals were removed from the regulatory DQO because of "low toxicity," a phrase discussed in the Regulatory DQO document.

Because EPA did not agree to the removal of these "low toxicity" chemicals, the "low toxicity chemicals" removed from the Regulatory DQO process were added into the screening level risk assessment process resulting in a suite of 470 COPCs requiring analysis. The three paragraphs will be deleted and the tables in Appendix A revised.

Also, please note that EPA said the DQO process was probably appropriate for its intended use, i.e., tank waste characterization.

Tracking # RAWP-025 / S-005

Comment

Section 4.2, Preliminary Radionuclides of Potential Concern (ROPCs), Page 4-5. The text states that the screening process used to select the 46 ROPC captures 99% of the potential risk and 99% of the activity associated with the tanks. This process resulting in a premature elimination of ROPCs from further evaluation.

Recommendation: A complete list of all the radionuclides in the tanks should be provided and evaluated in this risk assessment. Compounds should not be prematurely eliminated based on capturing 99% of the risk or activity. See RPP-WTP DWPA Supplement 2 Comment Response Preliminary Draft (10 March 2000), Comment No. 10" ..

Response

Clarification. The radionuclides included in the screening level risk assessment comprise the entire list of radionuclides that may be in the tank waste. This list of ROPCs was derived from the best-basis global inventory estimate and include 16 radionuclides identified as contributing >99.99% of the radioactivity in the tank waste plus an additional 30 radionuclides included due to their toxicity (*Kupfer, M.J., et.al., Standard Inventories of Chemicals And Radionuclides In Hanford Site Tank Wastes, HNF-SD-WM-TI-740, Rev.0, 8/28/97*). Information used to establish the global radionuclide inventory originated from key historical records, various chemical flowsheets used in reprocessing of irradiated Hanford Site reactor fuels, and from calculations of radionuclide isotope generation and decay. Additionally, the 46 ROPCs are the same radionuclides used for Clean Air Act permitting of activities associated with the Hanford Waste Tanks.

Tracking # RAWP-026 / S-006

Comment

Section 4.3. Page 4-6, line 23. This refers to toxicity data for organic COPCs being available in Appendix C. Appendix C is "Chemical-Specific Parameters for Ecological Risk Assessment."

Recommendation: The reference should be corrected.

Response

This new summary table will be referenced accurately in the next version of the work plan.

Tracking # RAWP-027 / S-007

Comment

Section 4.3.2, Page 4-8, lines 11-12. The ROPCs that will be evaluated for non-radioactivity health effects are not identified.

Recommendation: Identify these ROPCs and how they will be evaluated.

Response

Agree. Eight ROPCs (antimony, barium, cadmium, nickel, selenium, strontium, tin, uranium) have human health reference values available and are included in the list of inorganic COPCs. The estimated COPC emission rates for these 8 metals will include all stable and radioactive isotopes; therefore, a separate evaluation of the radioactive isotopes is not necessary because the radioactive isotopes are included in the COPC evaluation of these metals.

Tracking # RAWP-028 / S-008

Comment

Section 4, Table 4-1, Human Health Chemical Toxicity Values for Organic Constituents of Potential Concern, Page 4-11. The Oral Cancer Slope Factor (CSF) for benzene was updated in IRIS in January 2000. According to the references for Table 4-1, the oral CSF for benzene was obtained from IRIS in 1998. The value in Table 4-1 should be updated to reflect the latest IRIS value.

Recommendation: Update the oral CSF for benzene to reflect the current value reported in IRIS.

Response

All human health toxicity values will be checked and updated as appropriate, prior to use (and prior to the next issuance of the work plan) to ensure that the most up-to-date values are used to assess COPCs and ROPCs.

Tracking # RAWP-029 / S-009

Comment

Section 4, Table 4-1, Human Health Chemical Toxicity Values for Organic Constituents of Potential Concern, Page 4-12. The oral reference dose (RfD) for acetonitrile has been withdrawn from IRIS, and a new reference concentration (RfC) has been published in IRIS (6.0E-02 mg/m3).

Recommendation: The RfD and RfC for acetonitrile should be updated reflecting the latest changes in IRIS.

Response

All human health toxicity values will be checked and updated as appropriate, prior to use (and prior to the next issuance of the work plan) to ensure that the most up-to-date values are used to assess COPCs and ROPCs.

Tracking # RAWP-030 / S-010

Comment

Section 4, Table 4-1, Human Health Chemical Toxicity Values for Organic Constituents of Potential Concern, Page 4-19. An oral CSF is listed for ethylene glycol monobutyl ether and referenced in IRIS (1998); however, IRIS does not list an oral CSF for ethylene glycol monobutyl ether.

Recommendation: The oral CSF for ethylene glycol monobutyl ether should be removed from the table or the citation should be corrected to reflect the correct source for the information presented.

Response

All human health toxicity values will be checked and updated as appropriate, prior to use (and prior to the next issuance of the work plan) to ensure that the most up-to-date values are used to assess COPCs and ROPCs.

Tracking # RAWP-031 / S-011

Comment

Section 4, Table 4-3, Page 4-25. The table is incomplete with respect to external radiation from soils and missing slope factors.

Recommendation: Revise the last column to include external radiation from soils and fill in blank entries or provide an explanation as to why they are blank. Also correct footnotes b and c to reference EPA(1999c) not EPA (1999b).

Response

Reasonably-available data has been included in Tables 4-3 on page 4-25 Footnotes b and c will be corrected to reference EPA 1999c instead of EPA 1999b. Another search of any updated sources will be made to determine if any additional data are available. Any remaining entries for which data are not available will be identified as such. If EPA, Ecology, or their contractors have reasonably-available data to fill in our data gaps, please provide the data and the source of the data.

Tracking # RAWP-032 / S-012

Comment

Section 5.0, Quantification of Emissions, Page 5-1, the term "environmental performance demonstration results" is not a standard term nor defined in the text.

Recommendation: Define this term.

Response

Because the melters are miscellaneous units and are not combustion units, the RPP-WTP will use an environmental performance demonstration in lieu of a trial burn or risk burn to obtain actual emissions data. Thus, instead of using the phrase "trial burn results" the phrase "environmental performance demonstration results" is used instead. Details regarding the environmental performance demonstration are provided in Environmental Performance Demonstration Plan (PL-W375-EN00003, Rev. 1). The term will be defined in the text.

Comment

Section 5.1, Emission Sources, Page 5-1. Routine emissions generally refer to emissions from the gaseous effluent treatment unit A plus emissions from the buildings housing the process equipment. The former reflects the efficiency of the two treatment trains, while the latter reflects leakage from the processing unit A into the buildings housing the processing unit A. It is not clear whether the latter has been evaluated.

Recommendation: EPA guidance requires that fugitive emissions, including those from building ventilation unit A, be included as part of the source term and how these emissions will be estimated. Please revise this section so it is clear that emissions from building ventilation unit A will be evaluated. Also provide a clearer definition of the context of the use "accidental release" (i.e., catastrophic versus upset scenarios that will be evaluated, stack versus nonstack, etc.).

Response

Consistent with HHRAP sections 2.2.3, 2.2.6, and 2.2.7, the screening level risk assessment will address: stack emissions, emissions from process upsets, and RCRA fugitive emissions. The text will be clarified that emissions from these three sources will be evaluated consistent with HHRAP guidance.

Comment

Section 5.2, Emission Assumptions for the Preliminary Risk Assessment, Page 5-1. Section 5.2 states that a combination of data from other facilities, process and design information, model data, laboratory studies, and default assumptions will be used to estimate the emission rates for (COPCs) at the PRA. The work plan should include a table that specifically lists the surrogate emissions data that is being considered for evaluation in the PRA.

Recommendation: EPA's combustion risk assessment guidance recommends the following information be included for new facilities lacking emissions data:

- Descriptions of how the combustion data used represent similar technology, design, operation, capacity, auxiliary fuels, waste feed types, and air pollution control unit A.
- Demonstrate that the data used to develop the emission rate estimates was collected according to the appropriate EPA sampling and analysis procedures.
- The range of data obtained, and values used, in to complete the risk assessment

Response

Clarification. Estimated emission rates will be published in an emission estimate report currently being prepared. This emission estimate report will be referenced in the RAWP and provided to the agencies along with the RAWP. The emission estimate report will document the emission rates as well as the methods and assumptions used to estimate emission rates for all 470 COPC/ROPCs from all three stacks (pretreatment, LAW vitrification, HLW vitrification). This emissions estimate report will be cited in the RAWP and will be available along with the RAWP.

The emissions estimate report will reference the information used in calculating emission rates including:

- pilot studies used to estimate PIC emission rates (including dioxins);
- assumed removal efficiencies for air pollution control equipment and their basis;
- source of COPC/ROPC concentrations in waste feed; and
- the plant equipment configuration.

Actual emissions data obtained during the performance demonstration will be obtained using methodology from SW-846, or other methods described in the *Environmental Performance Demonstration Plan* (PL-W375-EN00003) and approved by Ecology.

See response to comment RAWP-005 for additional information on the emissions estimate report.

Tracking # RAWP-035 / S-015

Comment

Section 5.2, Page 5-1, lines 41-42. This states that assumptions for emissions data "when available, will be published in the Work Plan." Without this data the Work plan is incomplete.

Recommendation: Provide the surrogate emissions data that is being considered for evaluation in the PRA (i.e., MACT rule data or data from a similar facility) in the Work plan.

Response

Clarification. An emissions estimate report is being prepared to document the emission rates as well as the methods and assumptions used to calculate these emission rates for the WTP. This emissions estimate report will be cited in the RAWP and will be available along with the RAWP.

See also response to comment RAWP-034.

Tracking # RAWP-036 / S-016

Comment

Section 5.2.1.1, Page 5-6, line 6. This sentence is inconsistent with the default assumptions regarding speciation of mercury stack emissions given in the table preceding it.

Recommendation: Delete this sentence. Also recommend that other studies on HG methylation (besides the EFPC study near Oak Ridge) be reviewed and presented.

Response

The default assumptions will be corrected. Also, EPA's default values will be used, and this should obviate any need to justify a lower number based on actual measurements.

Tracking # RAWP-037 / S-017

Comment

Section 5.2.1.1, Page 5-6, lines 6-8. Soil methylation rate assumption are misstated in this sentence.

Recommendation: Revise to read: "The fraction of methylmercury is assumed to be 2% in non-wetlands soils and 15% in wetlands soils and sediments."

Response

The sentence in Section 5.2.1.1, p. 5-6, lines 6-8 will be revised as suggested.

Tracking # RAWP-038 / S-018

Comment

Section 5.2.1.1, Page 5-6, lines 19-21. The determination of whether the default rates of methylation of mercury will be used will require regulatory Agency approval.

Recommendation: Revise language to state that the default rates of methylation of mercury may be changed only if reliably representative Hanford media sampling results are available; and only with the review and approval of the regulatory Agency.

Response

The sentence will be rewritten to state that EPA default values will be used unless reliable site-specific measurements of methyl-mercury and total mercury in surface water are found and approved by the regulatory agencies.

Tracking # RAWP-039 / S-019

Comment

Section 5.2.1.2, Pages 5-7, lines 6-24. These paragraphs speak in terms of parts-per-quadrillion (or per-trillion) for human health and in micrograms/liter for ecological receptors, even though they are being compared.

Recommendation: They should be rewritten such that both types of units are given for each reference. The agricultural land-use PRGs and the analytical detection limits for solid media should be specified in order to make this discussion understandable. All of the exposure pathways for which it will not be possible to achieve adequate detection limits relative to acceptable risk should be listed. 10E-6 microgram/L is more appropriately denoted at 1E-5 microgram/L (i.e., 10 ppq).

Response

Although EPA's description of the method for detection of dioxins in water uses "parts per quadrillion" language, the units in Sect. 5.2.1.2 will be given both as parts per quadrillion and micrograms/L. The work plan does not call for confirmatory sampling, so it is not necessary to state which pathways have PRGs that are below quantitation limits.

Agree. The following discussion will be added to Section 5.2.1.4. "As explained in Section 5.2.1.1, the non-PIC organic COPCs in the waste feed will be conservatively estimated using an approach that relies upon historical total organic carbon (TOC) measurements and recent organic analytical data from double-shell tanks. The percentage of TOC that cannot be accounted for by complexants (e.g., EDTA, HEDTA) and low molecular weight acids (e.g., formic, glycolic, and citric acids) that were historically used in Hanford processes was assumed to be comprised of the organic COPCs in the feed. The actual detected hazardous organic analyte concentrations (or the detection limit for undetected compounds) from recent analyses of double-shell tanks 241-AN-107 and 241-AW-101 were scaled upwards such that they totaled the unaccounted fraction of TOC in the similar tanks. This approach results in an approximate 1200-fold increase of volatile and semivolatile compounds that were detected (or are assumed to be present at the detection limit) and will be conservative from the standpoint of risk assessment."

The estimated concentration of each COPC in the waste feed is calculated using a number of steps. Details regarding the organics calculation may be found in the attached memorandum, "Bounding the Hazardous Organic Concentrations of Incoming Feed Streams" (CCN 005049). The steps of estimating the concentration of each COPC in the waste feed are as follows:

- Measured concentrations of organic COPCs were obtained from analysis of samples from tanks 241-AN-107 or 241-AW-101. Compounds that were not specifically targeted for analysis are assumed to be present at the method detection limit.
- The resulting concentrations are converted to their equivalent concentration in mg carbon/L and then ratioed such that their sum equals the bounding organic concentration of 29,700 mg carbon/L (which represents that portion of the bounded TOC in the Hanford waste tanks not accounted for by complexants and low molecular weight acids).
- The resulting concentrations of the COPC in mg carbon/L are then readjusted to reflect their actual concentrations in the waste feed in mg COPC/L.

This may be expressed as follows:

$$EC_{COPC} = [MC_{COPC}] \cdot \left[\frac{(\text{Carbons}) \cdot (MW_C)}{MW_{COPC}} \right]$$

$$REC_{COPC} = \left[\frac{\text{Total Ratioed Equivalent Carbon Concentration}}{\text{Total Equivalent Carbon Concentration}} \right] \cdot [EC_{COPC}]$$

$$RC_{COPC} = [REC_{COPC}] \cdot \left[\frac{MW_{COPC}}{(\text{Carbons}) \cdot (MW_C)} \right]$$

Where

EC_{COPC} =	Equivalent concentration of a COPC in mg carbon/L
MC_{COPC} =	Measured concentration or Detection limit of a COPC in mg COPC/L
Carbons =	Number of carbons in the COPC molecule
MW_C =	Molecular weight of Carbon
MW_{COPC} =	Molecular weight of COPC
REC_{COPC} =	Ratioed equivalent concentration of the COPC in mg carbon/L

Thus, for CAS number 100-00-5, p-Nitrochlorobenzene, the following calculation is made:

$$EC = [0.3] \cdot \left[\frac{6 \cdot 12}{158} \right] = 1.4E-01 \text{ mg carbon/L}$$

$$REC = \left[\frac{29,700}{23.9} \right] \cdot [1.4E-01] = 1.7E+02 \text{ mg carbon/L}$$

$$RC = [1.7E+02] \cdot \left[\frac{158}{(6) \cdot (12)} \right] = 372 \text{ mg p-Nitrochlorobenzene/L waste feed}$$

Calculations for the other organic COPCs follow similarly. The table in the attached memorandum identifies the waste feed concentrations for the other organic COPCs.

The PIC COPCs will be estimated using available bench-scale testing data from the Vitreous State Laboratory of Catholic University for representative feed envelopes that included organic spikes.

Tracking # RAWP-042 / S-022

Comment

Section 5.2.3, Fugitive Emissions, Page 5-9. The RAWP states that processing facilities will be under negative pressure, which will preclude fugitive emissions to the building atmosphere and discharge via the building HVAC system. The implication is that each of the components in Figure 3-3 will always be at negative pressure relative to the ambient conditions in the buildings housing the equipment. However, the write-up on the bottom of page 5-9 seems to indicate that there is potential for leakage since the building ventilation unit A have been designed to flow from areas of low to high potential for contamination prior to discharge. In addition, is this category of emission referred to as "fugitive emissions" in the plan?

Recommendation: Clarify the types, sources, and methods for estimating fugitive emissions, including those from the building ventilation unit A. It should also be clarified that fugitive emissions are only accounted for as they are related to Dangerous Waste Units.

Response

Clarification. Emissions from the cell ventilation system are not abated in the same manner as the offgas treatment system. A source of abated fugitive emissions exists from equipment bulges, cabinets, etc. The estimated values for the various abated fugitive emissions sources will be calculated, and these abated fugitive emissions will be included in the quantitative risk assessment. Abated fugitive emissions values will, however, not be included as part of the Spring 2001 preliminary risk assessment activities.

Methodology outlined in the HHRAP Section 2.2.6.1 step 4 will be used to the extent possible. The WTP may develop an alternative method to calculate abated fugitive emissions. If methods and/or emissions data other than those published by EPA are used, the methods and/or data will be referenced and documented.

Tracking # RAWP-043 / S-023

Comment

Section 5.2.3, Fugitive Emissions, Page 5-9. This section does not provide enough detail concerning the source of fugitive emissions data (i.e., MACT rule data) for the PRA and how the calculations will be performed in accordance with the HHRAP. In addition, actual emissions estimates are not provided.

Recommendation: Please review the HHRAP and provide the recommended information on fugitive emissions. Specifically, clarify the types, sources, and methods for estimating fugitive emissions, and provide the emissions estimates. For an example of the information of fugitive emissions, see the ATG documents provided by Ecology.

Response

Clarification. Emissions from the cell ventilation system are not abated in the same manner as the offgas treatment system. A source of abated fugitive emissions exists from equipment bulges, cabinets, etc. The estimated values for the various abated fugitive emissions sources will be calculated, and these abated fugitive emissions will be included in the quantitative risk assessment. Abated fugitive emissions values will, however, not be included as part of the Spring 2001 preliminary risk assessment activities.

Methodology outlined in the HHRAP Section 2.2.6.1 step 4 will be used to the extent possible. The WTP may develop an alternative method to calculate abated fugitive emissions. If methods and/or emissions data other than those published by EPA are used, the methods and/or data will be referenced and documented.

Tracking # RAWP-044 / S-024

Comment

Section 5.3, Measured Emission Rates for the Final Risk Assessment, Page 5-10. This section does not include a discussion on how tentatively identified compounds (TIC) will be evaluated. EPA's HHRAP recommends calculating emission rates for TICs based on performance test results or trial burn results. However, risk calculations are not performed for TICs where there are no available toxicity values or fate and transport parameters.

Recommendation: Section 5.3 should be revised to include a discussion on how emission rates will be calculated for TICs and how they will be evaluated qualitatively and quantitatively in the FRA.

Response

Agree. The requested discussion about TICs will be added. The evaluation of TICs will follow the methods recommended by HHRAP. Per guidance, the 30 largest TICs identified during the environmental performance demonstration will be addressed first. TICs which have toxicity information, or for which appropriate surrogate toxicity values can be provided by Ecology and/or EPA will be evaluated quantitatively. TICs with no appropriate toxicity information available will be evaluated qualitatively in the uncertainty analysis.

Tracking # RAWP-045 / S-025

Comment

Section 6.1.1, Model Selection, Page 6-1. The most recent version of the ISCST3 model is incorrectly listed as Version 98226. The most recent version of ISCST3 is Version 99155.

Recommendation: The most recent version of the ISCST3 model (Version 99155) should be used in the modeling analysis. The text should be corrected as necessary.

Response

EPA has issued another version of ISCST3 since this comment was written, on April 10, 2000. Therefore, the most current release is identified as ISCST3 Version 00101 (An ISCST3 version is identified by the last two digits of the year plus the Julian date of that year). The text in the RAWP will be corrected to address this issue.

Tracking # RAWP-046 / S-026

Comment

Section 6.1.1, Model Selection, Page 6-1. The last sentence of the paragraph indicates that fugitive emissions from the RPP-WTP will be small and that only a qualitative analysis of impacts is necessary. However, Section 6.1.1.6 describes a quantitative analysis of re-suspended fugitive particulate matter from the site. The discussion of fugitive emissions in Section 6.1.1 is vague, and appears to contradict the discussion in Section 6.1.1.6.

Recommendation: The text should be modified to address fugitive emissions quantitatively. In addition, a detailed discussion of all the potential fugitive emissions and modeling analysis for fugitive emissions should be presented.

Response

Clarification. Emissions from the cell ventilation system are not abated in the same manner as the offgas treatment system. A source of abated fugitive emissions exists from equipment bulges, cabinets, etc. The estimated values for the various abated fugitive emissions sources will be calculated, and these abated fugitive emissions will be included in the quantitative risk assessment. Abated fugitive emissions values will, however, not be included as part of the Spring 2001 preliminary risk assessment activities.

Methodology outlined in the HHRAP Section 2.2.6.1 step 4 will be used to the extent possible. The WTP may develop an alternative method to calculate abated fugitive emissions. If methods and/or emissions data other than those published by EPA are used, the methods and/or data will be referenced and documented.

Tracking # RAWP-047 / S-027

Comment

Section 6.1.2.1, Emissions Source Information, Page 6-2. It is unclear whether calculations of decay will be applied within the ISCST3 model, or as a post-processing step.

Recommendation: The text should be revised to clarify whether decay will be evaluated in the air modeling or as a post-processing step.

Response

Radiological and biological decay will not be evaluated in the air dispersion modeling step, but will be addressed in the post-processing analyses. The text will be revised to make this more clear.

Tracking # RAWP-048 / S-028

Comment

Section 6.1.2.1, Emissions Source Information, Page 6-2. The use of radiological and chemical decay calculations with the air dispersion modeling may not be appropriate without additional data. Use of a decay term should only be used with chemical- and radionuclide-specific data. It appears from the equation that uniform exponential decay is proposed for the analysis, regardless of the COPC or ROPC.

Recommendation: Justification should be provided for the proposed decay term, along with references for the decay term equation. In addition, documentation should be provided of COPC-specific and ROPC-specific data for use in the calculations. The text should include an example of how the decay term will be applied for a given COPC/ROPC.

Response

Radiological and chemical decay of COPCs and ROPCs will be addressed in calculations performed on the output of the air dispersion modeling (concentrations and deposition rates). The text will be revised accordingly, and examples of the proposed approach will be provided.

Tracking # RAWP-049 / S-029

Comment

Section 6.1.2.1, Emissions Source Information, Analysis of Multiple Stacks, Page 6-2 and 6-3. The discussion indicates that if multiple stacks at the site are located close together and have identical characteristics, they may be evaluated as an individual stack. This procedure is primarily used in screening modeling analyses using dispersion models that can only evaluate one emission point. Furthermore, combining the stacks in the modeling analysis would create problems with evaluating model output in the risk analysis. EPA's HHRAP recommends that each stack be modeled separately to allow evaluation of risk on a stack or source-specific basis.

Recommendation: The method for combining multiple stacks should not be used for the air dispersion modeling for the RPP-WTP. The text should be changed indicating that each source will be modeled separately.

Response

The discussion in Section 6.1.2.1 on multiple stacks was originally developed when the number and location of stacks for the facility was being designed. Now that the project is much better defined, it is clear that each stack must be modeled separately. The text will be revised accordingly, and the discussion on combining the stacks for dispersion modeling purposes will be deleted.

Tracking # RAWP-050 / S-030

Comment

Section 6.1.2.2, Meteorological Data, Page 6-3. Use of several meteorological variables from the main Hanford meteorological station is proposed for the modeling analysis. The text states that the main station is located approximately 5 miles west-northwest of the RPP-WTP, but no further characteristics of the station is provided.

Recommendation: Additional information about the meteorological station should be presented to sufficiently demonstrate that data collected from it are appropriate for modeling emissions from the RPP-WTP. The information should include the exact location of the meteorological tower, all meteorological variables that will be used from the station, and the heights of the measurement equipment. The text should state the heights of wind measurement equipment on the Hanford main meteorological station. In addition, it would be helpful if the location of the meteorological station is plotted on the figures.

Response

The text will be revised to provide the additional requested information about the main Hanford meteorological station.

Tracking # RAWP-051 / S-031

Comment

Section 6.1.2.2, Meteorological Data, Page 6-3. The use of meteorological data from a 10-meter tower is usually adequate for modeling analyses. However, if the emission stacks are much higher than the height of the wind measurements, use of wind data closer to plume height may be warranted.

Recommendation: After the stack heights for the RPP-WTP have been established, the adequacy of the proposed wind data should be re-evaluated.

Response

As recommended, the adequacy of the proposed wind data will be reviewed once the stack heights for the RPP-WTP have been established.

Tracking # RAWP-052 / S-032

Comment

Section 6.1.2.2, Meteorological Data, Page 6-3. The upper air meteorological data proposed for the dispersion modeling is collected in Spokane, Washington, about 125 miles northeast of the Hanford site. This data set was selected even though it is recognized that mixing height data from the Hanford site would be preferable.

Recommendation: The text should discuss the availability of mixing height data from Hanford and, if applicable, why these data will not be used in the modeling analysis. If valid mixing height data from Hanford are available, they should be used for the modeling analysis rather than Spokane data.

Response

A detailed review of the mixing height data from Hanford was conducted, and it was determined that the data, which is collected by an older acoustic sounder, is not adequate for the modeling analysis. Accordingly, mixing height data was obtained from the Spokane, Washington National Weather Station, which is the nearest representative upper air meteorological station. The text will be revised to more clearly present this information.

Tracking # RAWP-053 / S-033

Comment

Section 6.1.2.2, Meteorological Data, Page 6-4. In the event that the ISCST3 model results produce unacceptable risk estimates, use of a more comprehensive model such as CALPUFF is proposed. CALPUFF can produce more refined model results than ISCST3, but also requires additional input data, especially with respect to meteorological data. Because the CALPUFF model is input data intensive, the availability of the required data should be established.

Recommendation: The paragraph should be expanded to discuss the additional data requirements for the CALPUFF model, and if these data are currently available if needed

Response

The ISCST3 air dispersion model will be used for the initial SLRA. ISCST3 is currently listed by EPA in the *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W) as a "preferred air quality model" for specific regulatory applications. It is therefore generally considered to be the default model for use in risk assessments. However, EPA has recently proposed to include the CALPUFF model in the list of preferred air quality models, and it may be used in subsequent risk assessments if more site-specific data are available. CALPUFF has the ability to use meteorological data from a number of monitoring stations, so it may produce more representative results in specific cases such as stagnant atmospheric conditions or for determining long range impacts (at distances greater than 50 km). For the SLRA, ISCST3 will be used for air dispersion modeling. CALPUFF will only be used if sufficient site-specific data sets are available, and site-specific risk assessment factors warrant using the model.

Tracking # RAWP-054 / S-034

Comment

Section 6.1.1.4, Calculation of Deposition Rates, Pages 6-6 and 6-7. This section discusses the deposition calculations that will be performed in the dispersion model. Several input parameters required for the calculations will be estimated from available literature. These parameters are discussed, but not presented in the RAWP.

Recommendation: The estimated values for the following parameters should be added to the RAWP: liquid particle scavenging coefficients, frozen particle scavenging coefficients, liquid gas scavenging coefficients, and frozen gas scavenging coefficients. Provide the units for dz (i.e., meters).

Response

The discussion on deposition calculations in the RAWP will be expanded to include estimated values for model input parameters, such as liquid and frozen particle scavenging coefficients. The units for dz will be provided.

Tracking # RAWP-055 / S-035

Comment

Section 6.1.2.2, Acute Output, Page 6-9. The text states, "The highest 1-hour average concentration will be calculated for the worst-case year." It is unclear whether this statement refers to the year with the worst-case 1-hour concentration, or the worst-case year established for chronic effects.

Recommendation: The text should clarify that the worst-case year for acute effects will be established based on maximum 1-hour modeled concentrations, and will be analyzed separately from the worst-case year for chronic effects.

Response

Agree. The text will be revised to read: "The highest 1-hour average concentration will be calculated for the worst-case year (i.e., the year with the worst-case 1-hour concentration not the worst-case year for chronic effects)."

Tracking # RAWP-056 / S-036

Comment

Section 6.1.3.3, Page 6-9, Section 7.1.7, Page 7-15, and Section 8.2.1, Page 8-25. This section is inconsistent with the discussion on page 6-6 with respect to dry gas deposition, The revised (May 15, 1999) ISCST3 model issued by EPA in June 1999 now includes a gas dry deposition algorithm, and consequently the analysis for dry deposition, will be extended to gases through the application of the enhanced ISCST3 model.

Recommendation: Revise to include vapor phase dry deposition rate.

Response

The latest EPA Model Change Bulletins, available on EPA's Technology Transfer Network (TTN) web site, state that there is potentially some anomalous behavior in the dry deposition algorithm. This problem has not yet been resolved, so we are somewhat reluctant at this time to use this option. More information about this problem has been requested from technical staff at EPA. We will use their guidance in this modeling application, and will revise the discussion in the RAWP on dry gas deposition accordingly.

Tracking # RAWP-057 / S-037

Comment

This section is inconsistent with the discussion on page 6-6 with respect to dry gas deposition, The revised (May 15, 1999) ISCST3 model issued by EPA in June 1999 now includes a gas dry deposition algorithm, and consequently the analysis for dry deposition, will be extended to gases through the application of the enhanced ISCST3 model.

Recommendation: Revise to include vapor phase dry deposition rate.

Response

As explained in RAWP-056, the latest EPA Model Change Bulletins, available on EPA's Technology Transfer Network (TTN) web site, state that there is potentially some anomalous behavior in the dry deposition algorithm. This problem has not yet been resolved, so we are somewhat reluctant at this time to use this option. More information about this problem has been requested from technical staff at EPA. We will use their guidance in this modeling application, and will revise the discussion in the RAWP on dry gas deposition accordingly.

Tracking # RAWP-058 / S-038

Comment

This section discusses the removal coefficient for soil. Line 4 on page 6-12 presents the equation for the deposition rate for contaminants on soil. However, the term for buildup in soil over time $(1 - \exp(-Lt))/L$ is missing. This term is needed in order to model the concentration in soil at the end of the operation of the facility (time t).

Recommendation: Calculate external exposures using surface deposition dose conversion factors in Federal Guidance Report No. 12 as opposed to the volume dose conversion factors. Define term "Tx" used on page 6-10.

Response

The equation on page 4-12 is for a deposition term, which is used in the calculation of soil concentrations. The equations to calculate soil concentrations are shown at the beginning of Section 6.2; these equations do have a term to account for buildup in soil over time (see the second and third equations presented in section 6.2, on page 6-10). For the first equation in Section 6.2 (on page 6-10), the designation of Tx will be corrected to T2.

Tracking # RAWP-059 / S-039

Comment

The statement on line 21 is incorrect. The sentence as written states that "the dry deposition velocity and COPC emission rate will be provided by the air deposition modeling". The emission rates are not part of the air modeling output, rather they are estimated using available information.

Recommendation: Correct the statement and add a section that explains how the available information will be used to estimate COPC and ROPC emission rates (in grams per second).

Response

The text will be modified to indicate that the emission rates (in grams per second) are estimated from available information, not as an output of the air dispersion modeling. Text will be added to explain how the emission rates are derived.

Comment

This section addresses the buildup of radionuclides in plants and animals for the purpose of modeling the doses to man through the food chain and also for the purpose of assessing ecological impacts of the emissions. Different methods should be used for evaluating these two related but distinctly different issues. For the food chain, we are concerned with the buildup of radionuclides in the edible portions of the organisms. For radioecological assessments, we must consider the relative biological effects of alpha emitters on sensitive tissues of ecological receptors. The methods described here are appropriate for food chain modeling but not for radioecological investigations. This issue is discussed further in comments on Section 8.

Recommendation: Discuss the issues associated with the models for assessing radioecological impacts, including critical organ issues, relative biological effectiveness of alpha emitters and microdosimetric issues associated with external exposures of root hairs in soil and fish eggs and developing fish embryos in sediment.

Response

Clarification. The International Council on Radiation Protection (ICRP. 1977. Recommendations of the International Commission on Radiological Protection. Publication 26. Pergamon Press, New York.) screening benchmarks, 0.1 rad/day for terrestrial animals and 1 rad/day for aquatic receptors, do not take into account critical organ effects, relative biological effectiveness, and microdosimetry issues. These issues are currently being investigated by the scientific community and will be discussed in the uncertainties section.

Possible synergistic effects of multiple radionuclides and microdosimetry to root hairs, eggs, embryos, etc. are currently being investigated and developed by researchers. They will be discussed in the uncertainties discussion.

Comment

The default values for the ROPC parameters in Table 6-1 are reasonable and consistent with the published literature and other EPA and NRC guidance. We assume that the half-life referred to in the equation on line 20 (sic) of page 6-14 is the radiological half-life. If so, this may be an overly conservative assumption, since there is evidence that the weathering half-life for radionuclides deposited on plant surfaces is 14 days (see NRC Regulatory Guide 1.109). As a result, over the growing period, the buildup of radionuclides on plant surfaces will be significantly overestimated if no credit is taken for weathering.

Recommendation: Review NRC Regulatory Guide 1.109, evaluate whether the proposed radiological half-life assumption is appropriate, and, if necessary, revise the equation accordingly.

Response

Clarification. A weathering half-life of 14 days for radionuclides deposited onto plant surfaces will be used. This results in a surface loss coefficient of 18 (1/year) for ROPCs. The text will be adjusted accordingly.

Comment

The following table compares the fresh water fish bioaccumulation factors for ROPCs in the RAWP with the range of values in the literature. The comparison here is more favorable than it is for the plant and beef transfer factors. However, the RAWP does not adequately discuss the basis for the selected values.

Recommendation: Discuss the basis for the selected fish bioaccumulation factors.

Response

Clarification. It is not clear what section of the work plan this comment refers to. We assume it refers to Section 6.4. BCFs referred to in that section are listed in Table B-1, but no range of published BCF values is given in that table (April version). The text states that the source of equations to calculate BCFs is the HHRAP for hazardous waste combustion facilities (EPA 1998).

Tracking # RAWP-063 / S-043

Comment

It is unclear how the radiological decay and ingrowth of ROPCs is accounted for in surface water if Ltransform is set to zero.

Recommendation: Provide a discussion on how this issue is being addressed including whether the use of toxicity factors for ROPCs that include daughters will be sufficient.

Response

Agree. The Columbia River flows at a rate of over 1.8 ft/s (0.55 m/s) at the gaging station just upstream of the Hanford Site (Personal communication, Rick Rupert, USGS Pasco Office, 4/4/2000), the equivalent of nearly 30 mi/d. At that rate, radionuclides deposited from airborne emissions into water per se will remain in the assessment area for only a few days. The risk assessments and workplan text will be revised to include this assumption and note that the residence time of Columbia River water in the assessment area is not expected to be long enough for significant ingrowth of daughter radionuclides, unlike soil, which is assumed to remain in place for 30 years. However, radionuclides in the water may become attached to suspended particles and be deposited at the sides and bottom of the river.

Radionuclide doses from sediment will be calculated by using a combination of methods described by Baker and Soldat (*Methods for Estimating Doses to Organisms from Radioactive Materials Released into the Aquatic Environment, PNL-8150/UC-602, 1992*) and methods in the SLERAP. The concentration of radionuclides adhering to suspended sediment will be calculated as the difference between total and dissolved ROPC concentrations calculated by using the surface water equations in Appendix B of the SLERAP. These equations are found in Tables B-2-1 through B-2-19 of the SLERAP and are not repeated here. Sediment deposition rates developed by Baker and Soldat (1992) for the Columbia River will be used to calculate the buildup of sediment.

The SLERAP is silent on methods to calculate doses from radionuclides in sediment, so a supplementary source is needed, such as Baker and Soldat. Therefore, ROPC doses from sediment will be calculated by the following equation from Baker and Soldat (1992):

$$R_{sed} = F_{sed} \times F_{ruf} \times F_{exp} \times C_{w,p} \times 1000 \times (1 - \exp(-\lambda \times t \times 365.25)) / \lambda,$$

where

- R_{sed} = ROPC external dose in sediment (rad/d),
- F_{sed} = sediment deposition transfer factor (0.07 pCi/m²-d per pCi/m³),
- F_{ruf} = geometry-roughness factor (0.2, unitless)
- F_{exp} = fraction of time receptor is exposed to sediment (1.0 for sediment biota),
- $C_{w,p}$ = concentration of particle-bound ROPC in water (pCi/L), 1000 = conversion factor (L/m³),
- DF_{grnd} = dose conversion factor, rad/d per Ci/m²,
- λ = radioactive decay constant, 1/days (= 0.693/half-life),
- t = time of deposition (30 years), and
- 365.25 = days per year.

We will look at decay products for radionuclides that may sink to the sediment. If radionuclides remain in place for a period of time, decay products can accumulate. Sometimes they are radioactive and cause exposure to receptors, so they should be accounted for. Sixteen of the ROPCs have stable decay products. However, the rest of the ROPCs decay to form daughter radionuclides. It is assumed that production of the first daughter radionuclide at levels below 1% of the parent's activity will be negligible to risks. The half-life required for decay to reduce parent activity by 1% in 30 years is about 2640 years, which means that at least 1% of parent activity with a half-life below 2640 years is converted to daughters within the 30-year lifetime of the treatment facility. The fifteen ROPCs that have radioactive decay products that would accumulate to at least 1% of initial parent activity are Ac-227, Am-241, Sb-125, Cs-137, Cm-242, Cm-243, Cm-244, Eu-152, Sr-90, Pu-238, Pu-241, Ra-226, Ra-228, Ru-106, and U-232. The remaining fifteen radionuclides have such long half-lives that less than 1% of their activity would be converted to daughter products in 30 years.

To facilitate computations, concentrations of daughter radionuclides in sediment at 30 years will be calculated in 60 successive half-year steps, using the following equations for the first two daughters as examples:

$$R_{d1(n)} = R_{d1(n-1)} \times (\exp(-\lambda_{d1} \times 365.25/2)) + R_{p(n-1)} \times (1 - \exp(-\lambda_p \times 365.25/2)) \text{ and}$$

$$R_{d2(n)} = R_{d2(n-1)} \times (\exp(-\lambda_{d2} \times 365.25/2)) + R_{d1(n-1)} \times (1 - \exp(-\lambda_{d1} \times 365.25/2))$$

where

- $R_{d1(n)}$ = concentration of 1st daughter at the nth time step (pCi/m²),
- $R_{d1(n-1)}$ = concentration of 1st daughter at the previous time step (pCi/m²),
- λ_{d1} = radioactive decay constant of 1st daughter (1/d),
- 365.25/2 = days per half-year time step,
- $R_{p(n-1)}$ = concentration of parent at the previous time step (pCi/m²),
- λ_p = radioactive decay constant of parent (1/d)
- $R_{d2(n)}$ = concentration of 2nd daughter at the nth time step (pCi/m²),
- $R_{d2(n-1)}$ = concentration of 2nd daughter at the previous time step (pCi/m²), and
- λ_{d2} = radioactive decay constant of 2nd daughter (1/d).

The concentration of each daughter radionuclide after 30 years will be added to the deposited concentration of the same isotope, and concentrations of both parent and daughter radionuclides after 30 years will be used for the risk assessment.

Tracking # RAWP-064 / S-044

Comment

Section 6.4, Page 6-21, lines 8-21. Because a justification is provided for calculating fish tissue COPC/ROPC concentration using either Cdw or Cwtot, it is not entirely clear which alternative will be followed.

Recommendation: Please clarify which alternative will be used and why it was selected.

Response

Agree. The SLERAP and HHRAP state that dissolved phase water concentrations should be used to calculate tissue concentrations in fish. The risk assessments and the text of the RAWP will be revised to state that dissolved phase concentrations, determined as described in Sect. 6.4 of the RAWP, will be used. Dissolved phase concentrations for human health and ecological risk assessment will be calculated by using the total concentrations, soil-water disassociation constants, and suspended sediment concentration recommended in the respective guidance documents. For example, methods are described in Sect. 3.11.2 and in Appendix B, Tables B-2-1 through B-2-19 of the SLERAP.

Equations and parameters to calculate COPC and ROPC dissolved phase concentrations from total water body concentrations are the same in the HHRAP and the SLERAP. Therefore, the same concentrations will be used for both the human health risk assessment and the ecological risk assessment. In contrast, we will use different soil/food chain and different water/food chain concentrations factors for the HHRA and the Ecological RA; these will be the values specified in the respective guidance.

Tracking # RAWP-065 / S-045

Comment

Section 6.5, Page 6-23. It is stated that fish tissue concentration will be calculated with BAFs and whole-water concentrations for COPCs with moderate Kows. However, methodology on page 6-20 (as well as EPA 1998 guidance) recommends using Cdw, rather than Cwtot.

Recommendation: Clarify and justify what approach is being proposed

Response

Agree. The SLERAP and the HHRAP state that dissolved phase water concentrations should be used to calculate tissue concentrations in fish. The text of the RAWP will be revised to state that dissolved phase concentrations, determined as described in Sect. 6.4 of the RAWP, will be used. Dissolved phase concentrations for human health and ecological risk assessment will be calculated by using the total concentrations, soil-water disassociation constants, and suspended sediment concentration recommended in the respective guidance documents. For example, methods are described in Sect. 3.11.2 and in Appendix B, Tables B-2-1 through B-2-19 of the SLERAP.

Equations and parameters to calculate COPC and ROPC dissolved phase concentrations from total water body concentrations are the same in the HHRAP and the SLERAP. Therefore, the same concentrations will be used for both the human health risk assessment and the ecological risk assessment. In contrast, we will use different soil/food chain and different water/food chain concentrations factors for the HHRA and the Ecological RA; these will be the values specified in the respective guidance.

Tracking # RAWP-066 / S-046

Comment

Table 6-1, Specific Variables for Plant Uptake Modeling, Page 6-31. The value of 0.932 for Interception Fraction (RP) is incorrect, probably a typo. The HHRAP reports a value of 0.982.

Recommendation. Change RP to 0.982.

Response

The interception fraction (Rp) for vegetables will be changed from 0.932 to 0.982 in Table 6-1.

Tracking # RAWP-067 / S-047

Comment

Section 7.1.2, Identification of Exposure Scenarios, Page 7-4. The RAWP states that the risk assessment approach used is designed to protect human health, including special subpopulations. However, special subpopulations (i.e. daycares, hospitals, nursing homes) in the area surrounding the Hanford site are not defined. EPA's HHRAP recommends that the risk assessment include the identification and /or mapping of the locations of special subpopulations at potentially higher risk, focusing on the characteristics of the exposure setting to ensure that selected exposure scenario locations are protective of the special populations.

Recommendation: Identify the type and location of special subpopulations in the assessment area. We recommend mapping the locations.

Response

Clarification. Special subpopulations at potentially higher risk due to characteristics of the exposure setting are identified in the RAWP as:

- Hanford Site Industrial Worker due to their close proximity to the emission source.
- Native American Subsistence Resident due to (1) their presence at locations with high emissions concentrations resulting from proximity to the facility or elevation (e.g., Gable Mountain), (2) their potential for above-average consumption of exposed biota (e.g., wild-grown plants, subsistence fishing) and (3) their potential exposure via exposure pathways not included in "standard" scenarios (e.g., sweat lodge exposures).

A map will be added to the RAWP identifying the locations of daycare centers, schools, hospitals, and nursing homes near the modeled receptor areas. Calculation of risks to such other special populations will be considered as appropriate, following the public comment period.

The following text will be added to Sect. 7.1.2 of the RAWP to clarify that all potential receptors are protected: "The exposure scenarios included in the quantitative risk assessment are designed to cover a wide range of possible receptor activities, age groups, and lifestyles. The exposure assessment and risk characterization results for these receptors can be extrapolated to other special subpopulations of interest. For example, if a school or daycare center is located near the facility, potential exposure to children is being evaluated in the residential scenarios for concentrations at various locations, including ground maximum, site boundary maximum, Gable Mountain, and Columbia River maximum. Evaluation of a child resident at the location of ground maximum COPC/ROPC concentrations will overestimate risks at a school or daycare center because the residential scenario includes ingestion of homegrown produce and assumes the child is at home all day and all night."

Tracking # RAWP-068 / S-048

Comment

Section 7.1.4, Page 7-6. External exposure to radionuclides in soil should include volatile ROPCs.

Recommendation: Add volatile ROPCs to external exposure to radionuclides in soil.

Response

Clarification needed. Per 5th bullet in section 7.1.4, external exposure to radionuclides in soil applies to all ROPCs.

Tracking # RAWP-069 / S-049

Comment

Section 7.1.5, Quantification of Exposure, Page 7-8 through 7-15. All of the equations shown in these sections for calculating the average daily COPC intake for each media appear correctly presented. In addition, all of the exposure parameter values presented for these equations are consistent with the references cited. However, for each intake equation presented in Chapter 7 there should be a reference back to the equation in Chapter 6 that was used to calculate media concentration in Chapter 6.

Recommendation: For each daily intake equation in Chapter 7, a reference to the appropriate media equation in Chapter 6 should be added. The reference should be added for the C_x exposure parameter as follows. Also address for the equation for ROPC intake via ingestion of produce on page 7-9 whether the Pr would be Pr_{bg} where multiplied by CR_{bg} :

C_x = total COPC concentration in medium X ($\mu\text{g}/\text{m}^3$).

Response

Agree. For ease of following the discussion, EPA has requested in RAWP 20 that all equations be numbered. Because of the magnitude of the effort required, it was agreed to number all of the equations at the time of the final RAWP and to make more specific references in the text to the pertinent equations while the RAWP is in draft. For example, for each equation presented in section 7.1.5, a reference to an equation in Chapter 6 will be added to the definition of the exposure concentration for the COPCs/ROPCs. Thus, in Section 7.1.5.2 the definition of " C_s " will read as follows:

" C_s = average soil concentration of COPC/ROPC over exposure duration (mg COPC/kg soil for chemicals; pCi ROPC/g soil for radionuclides); see equations for calculating soil concentrations in Section 6.2." As stated above, the final document will have numbered equations; in the final RAWP prepared for regulatory agency approval, these and other equations will be numbered to increase the ease of following the discussion.

The equation for ROPC intake via ingestion of produce on page 7-9 will be corrected to indicate that Pr_{bg} is multiplied by CR_{bg} , not Pr multiplied by CR_{bg} .

Tracking # RAWP-070 / S-050

Comment

Section 7.1.5, Quantification of Exposure, Pages 7-9 through 7-13. The produce ingestion equation on Line 18 of page 7-9 is correct, but it is unusual to express ingestion rate in units of dry weight. Are the soil-to-plant transfer factors in Appendix C fresh wet or dry weight? Also, for radionuclide exposures, the use of intake per unit body weight and then correcting for body weight is not standard procedure.

Recommendation. Clarify whether the soil-to-plant transfer factors are expressed on a fresh (wet) weight or dry weight basis. Correct the equation on line 18 if a conversion factor is required.

Response

The consumption rates are shown in dry weight units, which is consistent with the Human Health Risk Assessment Protocol (HHRAP) document (EPA 1998a). Consumption rates are shown in the HHRAP with units of "kg/kg-day DW" (see Table C-1-2).

Soil-to-plant transfer factors from Appendix B-1 (not Appendix C) are used to quantify plant concentrations. As shown in the column headers of Table B-1, the plant uptake factors are in dry weight units (e.g., the units for Brforage are (ug/g DW plant)/(ug/g soil)).

We agree that for radionuclide exposures, the use of intake per unit body weight followed by a correction for body weight is not standard procedure. However, since the HHRAP (EPA 1998a) presents consumption rates in terms of amount consumed per day per unit body weight (kg/kg-day), the adjustment/correction for body weight is necessary for radionuclides, in order to obtain the proper units for intake of produce.

Tracking # RAWP-071 / S-051

Comment

Section 7.1.5, Quantification of Exposure, Pages 7-9 through 7-13. The equations for external exposures for radionuclides in soil and for air on Lines 27 and 43 of page 7-12 are incorrect. For soil, the equation should start with the contamination on the ground in units of pCi/m², and for the air, the starting point should be pCi/m³ in air, not intake. In the equation for infant ingestion of breastmilk on page 7-12, for ROPCs, EFI should be EF. Regarding the definitions on page 7-12 of Iirs and Iira, external exposure is not really an "intake," since the radionuclides are in environmental media (rather than inside the body).

Recommendation: Please check the indicated equations with regard to the above observations and make corrections as necessary.

Response

As per the response to Comment RAWP-069, the concentration in soil presented in the equation for external exposure to radionuclides in soil (section 7.1.5.8) is shown in pCi/g and will be referenced by equations presented in Chapter 6. Within Section 6.2 (Soil Accumulation Modeling), equations will be shown that indicates how the radiological concentration in pCi/g is derived from air dispersion modeling data. Similarly, the ROPC air concentration in pCi/m³ will be referenced by equations presented in Section 6.1 (Air Dispersion Modeling), which will indicate how the ROPC air concentration in pCi/m³ is derived.

The designation of exposure frequency in the radiological equation for infant ingestion of breast milk (section 7.1.5.7) will be corrected to EF (as opposed to its current incorrect designation of EFI).

The external exposure definitions will use a term other than "intake" to describe Iirs and Iira.

Tracking # RAWP-072 / S-052

Comment

Section 7.1.5.10, Page 7-13, Inhalation of Vapors in Sweat Lodge Scenario. The ROPCs that are considered volatile are not identified and the rationale for excluding a sweat lodge dermal absorption pathway for ROPCs is not addressed.

Recommendation: Amend this section to address the above identified deficiencies.

Response

Agree. Initially, volatile ROPCs were considered to be Sb-125, C-14, Cs-134, Cs-137, I-129, Ru-106, Tc-99, and H-3. John Mauro of Sandy Cohn & Associates is confirming which ROPCs may be volatile. Per John Mauro's preliminary evaluation I-129, H-3, and C-14 are considered volatile and will be evaluated in the sweat lodge scenario. Sb-125, Ru-106, and Tc-99 may also be volatile; if these ROPCs are volatile, they will also be evaluated in the sweat lodge scenario. The final list of ROPCs identified as potentially volatile under sweat lodge conditions by SAIC and John Mauro of Sandy Cohn & Associates will be included in this assessment.

The dermal absorption pathway is not evaluated separately for ROPCs because dermal absorption is included in the inhalation dose conversion factor and inhalation slope factor for radionuclides with significant dermal absorption (e.g., for tritium approximately 50% of the inhalation dose is actually dermal).

Tracking # RAWP-073 / S-053

Comment

Section 7.1.5.12, Page 7-14. A conversion factor of 1000 g/kg is defined but does not appear in the equation for inhalation of resuspended soil.

Recommendation: Add conversion factor to the equation.

Response

The conversion factor of 1000 g/kg is not needed for this equation. Therefore, its definition will be removed.

Tracking # RAWP-074 / S-054

Comment

Section 7.2, Toxicity Assessment, Page 7-16. Special models are required for the assessment of the doses and risks associated with the release of H-3 and C-14 to the atmosphere. These models are not addressed in the report. See NRC Regulatory Guide 1.109 for a description of the models.

Recommendation: Please describe the methods that will be used to evaluate the radiation risks associated with tritium and C-14 emissions. We suggest you consider the models described in U.S. NRC Regulatory Guide 1.109 (see Attachment 2).

Response

Agree. We will evaluate and use the models in NRC Regulatory Guide 1.109.

Tracking # RAWP-075 / S-055

Comment

Section 7.2.2, Page 7-19. Note that slope factors for ROPCs in HEAST are central estimates of lifetime cancer risk (not upper-bound estimates, as for most COPCs)

Recommendation: Amend this section to reflect the above for ROPCs.

Response

Agree. The paragraph will be revised to read: "Chemical slope factors represent an upper-bound estimate of the probability of developing cancer per unit dose (expressed as risk per mg/kg-day) of a chemical over a lifetime (EPA 1989b). Radionuclide slope factors represent central estimates of lifetime cancer risk. ..."

Tracking # RAWP-076 / S-056

Comment

Section 7.2.3, Page 7-21. TCDD should be listed as 2,3,7,8-tetrachlorodibenzo-p-dioxin (not "3,4,7,8-tetrachlorodioxin").

Recommendation: Amend to reflect this correction.

Response

The change to full and correct spelling of TCDD will be made.

Tracking # RAWP-077 / S-057

Comment

Section 7.2.4, Page 7-23, lines 12-13. The term "significant emissions" is used as a basis for determining future action, but is not defined.

Recommendation: Revise the work plan to state what would constitute "significant emission" for purposes of including additional PAHs in the risk assessment.

Response

Agree. Significant emissions will be defined in the text as emissions that result in risks greater than the target risk level of 1E-5 and those that are primary contributors to total risk greater than 1E-5. This threshold is provided in the HHRAP.

Tracking # RAWP-078 / S-058

Comment

Section 7.2.4, Page 7-23, lines 15-16. The process for evaluation and acceptance of surrogate toxicity values for PAHs is not included to support the statement that they may be considered.

Recommendation: Revise to include the identification and evaluation process to be followed for proposing surrogate PAHs for the review and approval of the regulatory Agencies before incorporation in the risk assessment. Also, list out the CalEPA RPFs for additional potentially carcinogenic PAHs.

Response

Clarification: The WTP will quantitatively evaluate risk for PAHs with published carcinogenic and toxicity values. When PAHs do not have these published values, risk will be evaluated qualitatively in the uncertainty section. The WTP does not intend to develop surrogate carcinogenic and toxicity values for PAHs. If Ecology develops such surrogates, the surrogate will be used in this risk assessment process as appropriate.

A list of CalEPA RPFs will be added to the text.

Tracking # RAWP-079 / S-059

Comment

Section 7.2.5, Page 7-23. It is not clear that TEQs calculated for dioxin-like PCBs will be considered additive to TEQs calculated for PCDDs/PCDFs for purposes of estimating cancer risks from dioxin-like compounds.

Recommendation: Expand to make clear.

Response

Cancer risks will be calculated (1) separately for each COPC, (2) combined for coplanar PCBs and dioxins, and (3) combined for all COPCs.

Tracking # RAWP-080 / S-060

Comment

Section 7.2.6, Page 7-24, lines 38-40. This states that the FRA may assume that chromium exists in its trivalent form, and that "rationale will be provided at that time." This is not acceptable. Chromium must be assumed to be in its hexavalent form for purposes of direct exposure pathways unless site-sampling or process-specific information is provided (EPA 1998a).

Recommendation: This section should be clarified to indicate the options for making measurements (for direct exposure) or assumptions (for indirect exposures) for the speciation of chromium for the FRA.

Response

Clarification. Chromium will be assumed to be present in its hexavalent form unless site-sampling or process-specific information is provided to justify the trivalent form (or a combination of hexavalent and trivalent). The facility design is not far enough along to determine whether there will be an engineering reason to justify the assumption of trivalent chromium and stack testing has not yet been conducted. Therefore, if the results of the PRA indicate that chromium may be significant, the potential form of chromium will be re-evaluated in the FRA.

Tracking # RAWP-081 / S-061

Comment

Section 7.2.8, Page 7-24, Nickel. Evaluation of nickel as only noncarcinogenic for exposure pathways other than inhalation does not address the many uncertainty inherent in understanding the contribution of soluble nickel salts to the carcinogenicity of certain forms of nickel such as that found in nickel refinery dust. In other words, even if the emissions are entirely in the form of soluble nickel, both noncancer and cancer effects may be manifested. [See the review article on soluble nickel at Toxicological Excellence for Risk Assessment web page, <http://www.tera.org>, for further explanation of this issue].

Recommendation: Evaluate nickel as both a carcinogen and as a non-carcinogen.

Response

Clarification. As noted in the text, nickel will be evaluated as both a carcinogen (via inhalation using the SF for nickel refinery dust) and a noncarcinogen (via ingestion and dermal contact using the RfD for soluble salts).

Tracking # RAWP-082 / S-062

Comment

Section 7.2.9, Page 7-25, Particulate Assessment. PM2.5 which is pertinent to combustion facilities is not addressed.

Recommendation: PM2.5 should also be modeled and compared with the corresponding NAAQS 24 hr and annual average standards.

Response

Agree. Comparison to PM2.5 will also be considered.

Tracking # RAWP-083 / S-063

Comment

Section 7.2.11.1, Page 7-26, PCBs. It is not clear that coplanar PCBs will be evaluated additively with PCDD/PCDF TEQs for the nursing infant assessment.

Recommendation: Revise to reflect that the background concentration of coplanar PCBs intake in terms of pg TEQ/kg/day.

Response

Cancer risks will be calculated (1) separately for each COPC, (2) combined for coplanar PCBs and dioxins, and (3) combined for all COPCs. Coplanar PCBs and dioxin exposures (i.e., doses) will be evaluated separately because separate background exposure information for nursing infants is available for PCBs and dioxins, and because PCBs and dioxins may have different sources and need to be evaluated separately to ensure the proper controls are applied, if necessary.

Tracking # RAWP-084 / S-064

Comment

Section 7.2.11.2, Estimated Cancer Risk, Page 7-26. This section states that background radionuclide concentrations are not available. Given the amount of environmental radiological surveillance performed at and in the vicinity of the Hanford Reservation, there is certainly data on background levels of tritium, plutonium, radium, thorium, uranium, and cesium in soil, water, plants, and aquatic organisms probably in the annual environmental radiological surveillance reports issued by DOE for Hanford. Also, note that EPA (1998) guidance discusses the uncertainty of projecting cancer risk, associated with AT=1 for infant exposures to dioxin via breastmilk.

Recommendation: Amend the section to include background concentration of radionuclides in the environment, both naturally occurring and ubiquitous manmade radionuclides so that the incremental increase in contamination and risk from the facility can be understood within this perspective.

Response

Agree. The text of Section 7.2.11.1 will be modified to make it clear that background concentrations of radionuclides are not available for *breast milk*. Background exposures are used to evaluate the nursing infant exposure because of the high uncertainty, and potential inappropriateness, of evaluating cancer risk from a brief early-life exposure. Background concentrations in other exposure media will not be included in the RAWP because they are out of the scope of the SLRA and dangerous waste permit application. In previous comments the USEPA requested that we not include the language from the HHRAP regarding the uncertainty associated with estimating a lifetime cancer risk using an AT of 1 year for an infant exposure.

A discussion of the uncertainty associated with calculating cancer risks for an infant exposure and the potential for over-estimating lifetime cancer risks by using an averaging time of one year will be included in the RAWP.

Tracking # RAWP-085 / S-065

Comment

Section 7.2.11.2, Page 7-27, lines 4-11. As mentioned previously, it is not clear that cancer risk from PCDDs/PCDFs and coplanar PCBs will be considered and calculated in an additive manner.

Recommendation: Make it clear.

Response

Cancer risks will be calculated (1) separately for each COPC, (2) combined for coplanar PCBs and dioxins, and (3) combined for all COPCs.

Comment

Section 7.2.12, Acute Effects Assessment, Page 7-27. This section addresses acute effects. There seems to be some ambiguity regarding the acute effects analyses provided in this plan and accident analyses, which will apparently be addressed in other documents. Also, AEGL-2 values are not addressed.

Recommendation: Some clarification is required regarding the distinction between these two sets of analyses and compliance issues. Where do CAA requirements, DOE Orders, DNFSB recommendations, and NRC requirements fit into the picture? Explain why the DACs and ALIs are used as the criteria for acute exposures as indicated on line 44 of page 7-27?

When an AEGL-1 value is unavailable, but an AEGL-2 value is available, the AEGL-2 value should be used unless a more conservative value is available from one of the other sources in the hierarchy. This should be included in this discussion of toxicity values for acute effects.

Response

The hierarchy of toxicity values will be revised to read:

1. Values from NCEA (as provided by EPA Region X)
2. Acute Exposure Guideline Levels (AEGL-1). If an AEGL-1 value is not available but an AEGL-2 value is available, the AEGL-2 value will be used unless a more conservative value is available from one of the other sources in the hierarchy
3. Emergency Response Planning Guidelines (ERPG-1)
4. Acute Reference Exposure Levels (ARELs) from California EPA
5. Temporary Emergency Exposure Limits (TEEL-1)
6. Subcommittee on Consequence Assessment And Protective Actions (SCAPA) toxicity-based approach (DOE 1997)"

The following text will be added to Section 7.1.3.4 to clarify that the acute scenario is not an accident scenario: "This acute scenario is designed to evaluate the worst-case air concentration resulting from normal emissions combined with short-term meteorological conditions that result in higher than normal air concentrations. The acute scenario is not an accident (e.g., fire, explosion) scenario. Accident scenarios are evaluated in separate documents to support nuclear licensing requirements."

The WTP is currently evaluating the potential for an additional acute scenario to address an acute upset scenario (e.g., pressure relief valve or rupture disk actuation and bypass of pollution control equipment). If such an event could occur routinely (i.e., monthly or yearly) it will be evaluated as a second acute scenario. If the only acute upset that can be identified is an accident which has a very low probability of occurring, this scenario will not be evaluated because accidents are not included in the SLRA but are evaluated as part of other licensing requirements.

A discussion of the uncertainty associated with calculating cancer risks for an infant exposure and the potential for over-estimating lifetime cancer risks by using an averaging time of one year will be included in the RAWP.

Tracking # RAWP-087 / S-067

Comment

Section 7.2.12, Page 7-28. A reference for the 50 mrem limit for an one hour period regarding acute rad exposure is not provided.

Recommendation: Provide reference.

Response

The acute toxicity value for ROPCs will be changed to 1 rem. The following text will be added to Section 7.2.12 to replace the existing discussion of acute ROPC toxicity: "For acute exposures to ROPCs, derived air concentrations (DACs) of the radionuclide in air that under continuous exposure for a one-hour period would produce a total effective dose equivalent of 1 rem." John Mauro of Sandy Cohen and Associates agreed to provide the reference for this value.

Tracking # RAWP-088 / S-068

Comment

Section 7.3, Page 7-28, Risk Characterization. The statement that ROPCs will only be evaluated for carcinogenic effects is inconsistent with statement on page 4-8.

Recommendation: Revise to be consistent with page 4-8.

Response

The text will be modified to note that ROPCs with chemical/noncancer effects will be evaluated.

Tracking # RAWP-089 / S-069

Comment

Section 7.3.1, page 7-28, lines 40-42 and Page 7-29, lines 1-2. It is incorrectly stated that the HHRAP recommends an HQ goal of .25. The HHRAP is silent on this issue.

Recommendation: The text should indicate that the use of an HQ of 0.25 as being considered to represent a concentration at which no adverse affect is expected is a risk management determination made by the regulatory Agencies for this risk assessment, consistent with other thermal treatment facility risk assessments in Region 10.

Response

The text will be modified to recognize the HQ of 0.25 as requested.

Tracking # RAWP-090 / S-070

Comment

Section 7.3.1, Page 7-29, lines 2-3. This states: "Additive noncarcinogenic health effects can be evaluated when exposure to more than one chemical occurs by using the HI approach (see Section 7.2.1)." This is not discussed in Section 7.2.1, but is instead discussed in the following paragraph, i.e., beginning on line 5 on page 7-29.

Recommendation: This should be corrected.

Response

The text will be modified as requested.

Tracking # RAWP-091 / S-071

Comment

Section 7.3.1, Page 7-29, lines 15-16. The process for segregation of HI by toxicological endpoint is not proposed.

Recommendation: This discussion should be clarified to indicate that any segregation of the HI by toxicological endpoint must be proposed on a chemical-specific basis to the regulatory Agencies before being incorporated into the risk assessment.

Response

Agree. The text will be revised to read: "If the target HI is exceeded, a segregation of the HI by toxicological endpoint will be considered. If segregation by toxicological endpoint is used, chemical groupings by endpoint will be assigned with approval by Ecology and USEPA."

Tracking # RAWP-092 / S-072

Comment

Section 7.3.2, Page 7-30, lines 12-16. In addition to the oral and inhalation slope factors, dermal (for COPCs) and external (for ROPCs) slope factors are also presented in the cited tables.

Recommendation: Revise discussion to more accurately the contents of the Tables.

Response

The text will be modified as requested.

Tracking # RAWP-093 / S-073

Comment

Section 7.3.2, Page 7-30, lines 23-25. The discussion of negligible and de minimum (sic) risks are not relevant, and neither is a discussion of a risk range. Ecology and EPA have determined that the maximum acceptable excess cancer risk for this project is 1E-5.

Recommendation: The sentence beginning "[the theoretical excess cancer risk may be compared to..." should be deleted.

Response

Just as it is important to understand what an HI of 1 means to understand the target HI of 0.25, it is important for a reader to understand that the target cancer risk selected by Ecology and EPA (1E-05) is consistent with other regulatory actions.

Comment

Section 7.4, Uncertainty Assessment, Pages 7-30 and 7-31. This section does not provide a discussion of uncertainties known to be associated with the PRA at this time.

Recommendation: All uncertainties known to be associated with the PRA at this time should be included in this work plan. For example, there should be an identification of the lack of ability to assess potential endocrine disruption effects of PCBs, dioxins, and furans as a nonconservative uncertainty. The uncertainties associated with the assumptions concerning future land use should be identified. The uncertainties associated with omitted exposure pathways such as dermal exposure should be identified. In other words, this section must be expanded upon to identify every uncertainty known to be associated with the PRA, and where known, with the FRA. There should be a discussion of what uncertainties could be reduced in the PRA and/or FRA, and how such a reduction might be accomplished; or why it would not be significantly beneficial to attempt such reduction. The uncertainty assessment is one of the most important aspects of risk assessment, and as many details as possible should be provided in the work plan so that the reviewing Agencies can comment on them prior to the submittal of the PRA. Also, recommend that the qualitative summary table proposed for inclusion in the PRA be included in the work plan.

Response

The discussion of uncertainty in the RAWP will be expanded to provide more examples of the types of uncertainties that may impact the risk assessment, what approaches are included in the RAWP to minimize these uncertainties, and what additional steps can be taken to minimize these uncertainties. The risk assessment report will include a complete list of potential sources of uncertainty with a more detailed discussion of uncertainties important to the results of this risk assessment. The uncertainty analysis will include discussions of:

- the difference between unknown and variable data and how each is dealt with in the risk assessment process;
- steps that could be taken to reduce uncertainty (e.g., site-specific measurements);
- steps taken in the risk assessment to minimize the impact of the uncertainty (e.g., use of conservative exposure and toxicity assumptions);
- alternative methods (e.g., alternative air models) and their impact on risk estimates; and
- recognition of cutting edge science of exposure and toxicity that may change the way risk assessments are performed in the future.

At the comment resolution meeting held November 1-2, 2000, a suggested outline for classifying uncertainties in the RAWP and PRA was presented. This outline divided uncertainties into three main categories with subcategories as follows:

Types of Uncertainty (from EPA guidance for screening-level human health and ecological risk assessment for hazardous waste combustion facilities)

- Model uncertainty
- Parameter uncertainty and variability
- Effects uncertainty and variability
- Decision rule uncertainty

Sources of Uncertainty (from the work plan for the screening level risk assessment for the RPP-WTP)

- Quantification of emissions
- Air modeling
- Environmental fate and transport modeling
- Human health risk assessment
- Ecological risk assessment

Estimates of Direction and Magnitude of Uncertainty

- Minor impact: +, o, -
- Major impact: ++, oo, --

Per a suggestion from Ecology, effects parameters and non-effects parameters will be discussed separately. To emphasize the distinction, under Types of Uncertainty, the second and third bullets will be changed to:

- Non-effects parameter uncertainty and variability
- Effects parameter uncertainty and variability

An example table for presenting uncertainties was also discussed. This example table included columns for the potential magnitude and direction of the impact of the uncertainty on the risk results. A version of this table will be used in the RAWP (in addition to a text discussion) and the column labeled "unknown" impact will be changed to "Either over- or under-estimate risks."

Tracking # RAWP-095 / S-075

Comment

Section 7.5, Summary for Screening Human Health Risk Assessment, Page 7-31, lines 29-30. This states the following: "The FRA will focus on COPCs and ROPCs that exceed risk goals in the PRA and may utilize additional site-specific emission, fate and transport, and exposure data collected after completion of the PRA." This does not indicate that operating and/or design conditions might be reconsidered and changed after the results of the PRA are available. Rather the implication seems to be that the input to the PRA will be manipulated to ensure that the COPCs and ROPCs that exceed risk goals in the PRA will not exceed them in the FRA. This is not appropriate. Exceedance of risk goals in the PRA must be addressed prior to making a final permit decision.

Recommendation: The work plan must state that COPCs or ROPCs that exceed risk goals in the PRA will be revisited to determine whether unreasonable characteristics were assigned to them in the PRA; however, it must be recognized that it may be necessary to alter operational and/or design characteristics of the unit to be permitted in order to be within acceptable risk limits.

Response

Agree. The work plan will be revised to include the recommendation.

Tracking # RAWP-096 / S-076

Comment

Table 7-3, Summary of Exposure Parameters for the Native American Scenarios, Page 7-46. The value listed for the soil ingestion exposure frequency (EF) is 365 days per year; however, Harris and Harper (1997), recommends using 180 days per year for the exposure frequency for the Native American receptor.

Recommendation: Change the value for EF to 180 days per year for Native American soil ingestion EF or provide the basis for the value provided.

Response

Agree. The Harris & Harper soil ingestion exposure frequency will be used, unless new information is made available by the Native Americans.

Tracking # RAWP-097 / S-077

Comment

Table 7-3, Summary of Exposure Parameters for the Native American Scenarios, Page 7-52. The statement for note "c" is very confusing.

Recommendation: We recommend that note "c" read: The default inhalation rates of 20 m³/day for adults and 10 m³/day for children (EPA 1989b) were converted to m³/hour by dividing by 24 hours/day.

Response

Footnote c will be revised to read as stated in the recommendation.

Comment

Section 8.1.1, Ecological Conceptual Exposure Model, Page 8-1, Line 11, and Figure 8-1, Page 8-59. We offer the following comments about the ecological conceptual exposure model (presented in Figure 8-1). Appropriate revisions should be made to Figure 8-1 and the associated text.

- The conceptual exposure model should outline separately the exposure pathways for all feeding guilds (trophic levels 1 through 4) included in the aquatic food web (as is presented for terrestrial feeding guilds). The feeding guilds presented in Figure 8-1 that are specific to the aquatic food web appear to be incomplete. The following feeding guilds should be added in the conceptual exposure model: aquatic biota, benthic invertebrates, water invertebrates, herbivorous and planktivorous fish, omnivorous fish, and carnivorous fish. The potential exposure pathways for each feeding guild should be delineated in the figure. Exposure pathways that are characterized as complete should be evaluated quantitatively in the ecological risk assessment.
- A statement clarifying that exposure due to external radiation will be assessed only for ROPCs should be noted in Figure 8-1 and the associated text.
- Exposure to the terrestrial carnivore guild due to incidental ingestion of soil contaminated by COPCs should be considered a complete exposure pathway and should be evaluated quantitatively in the ecological risk assessment.
- Exposure to terrestrial measurement receptors included in the freshwater food web due to incidental ingestion of sediment should be considered a complete exposure pathway and should be evaluated quantitatively in the ecological risk assessment.

Response

Bullet 1: Agree. Feeding guilds to be analyzed will be consistent with the SLERAP approach identified in EPA guidance and will include a herbivorous bird feeding guild.

Bullet 2: Agree. The statement will be added to the figure and explained in the text.

Bullet 3: Agree. Exposure of terrestrial predators to ingested soil will be included for all predators for which soil ingestion data are found. Where ingestion data are not found, soil ingestion rates will be estimated from life history information. If necessary, food and water ingestion rates will be calculated by using conservative (i.e., smallest) body weights along with allometric equations found in footnotes to Table 5-1 of the SLERAP. For example, ingestion rates for herbivorous mammals are calculated as $IR (g/d) = 0.577 \times Wt^{0.727} (g)$, and ingestion rates for rodents are calculated as $IR (g/d) = 0.621 \times Wt^{0.524} (g)$. Ingestion rates will be used to calculate BCF values for mammals and birds. According to SLERAP guidance, the BCF for uptake of inorganics by a given species is found by multiplying the ingestion-to-beef biotransfer factor by the daily food ingestion rate: $BCF = Ba \times IR$ (SLERAP Appendix D, Equations D-1-1, D-1-2). Because ingestion rates for soil and water are different from each other and from food ingestion rates, there are separate BCFs for each medium ingested, as reflected in the tabulation of BCFs in SLERAP Appendix D, Tables D-1, D-2, and D-3. The methods and data presented in SLERAP Appendix D will be used in the RAWP in place of the method described in the first draft of the RAWP.

Bullet 4: Agree. Ingestion of sediment by terrestrial predators of aquatic biota will be included in the exposure evaluation and will be based on published life history data. If necessary, ingestion rates for food and water will be calculated by using allometric equations found in footnotes to Table 5-1 of the SLERAP. For example, the ingestion rate for birds is calculated as $IR (g/d) = 0.648 \times Wt^{0.621} (g)$. Ingestion rates will be used to calculate BCF values for mammals and birds. According to SLERAP guidance, the BCF for uptake of inorganics by a given species is found by multiplying the ingestion-to-beef biotransfer factor by the daily food ingestion rate: $BCF = Ba \times IR$ (SLERAP Appendix D, Equations D-1-1, D-1-2). Because ingestion rates for soil and water are different from each other and from food ingestion rates, there are separate BCFs for each medium ingested, as reflected in the tabulation of BCFs in SLERAP Appendix D, Tables D-1, D-2, and D-3. The methods and data presented in SLERAP Appendix D will be used in the RAWP in place of the method described in the first draft of the RAWP.

Tracking # RAWP-099 / S-079

Comment

Section 8.1.2.2, Regional Ecology, Pages 8-2 through 8-7. This section is well written and provides a thorough overview of the ecology at the Hanford Reservation. However, the discussion about the Columbia River receptors is limited to the Hanford reach only. A combustion risk assessment is performed on receptors in the assessment area, not just those at Hanford.

Recommendation. Discuss relevant ecological information for all reaches of the Columbia River that are inside the assessment area. If the ecology of the Hanford reach is representative of the other reaches, please mention it.

Response

The discussion of the Hanford Reach is applicable to all portions of the Columbia River within the study area. The text will be modified to clarify this aspect of the study.

Tracking # RAWP-100 / S-080

Comment

Terrestrial Receptors, Page 8-10. The herbivorous bird guild is missing from the exposure assessment.

Recommendation. Evaluation of the risk to the herbivorous bird guild should be added to the RAWP.

Response

Agree. A herbivorous bird feeding guild will be added.

Tracking # RAWP-101 / S-081

Comment

Section 8.1.2.3, Aquatic Ecosystems, Pages 8-7 through 8-8. The Columbia River provides critical habitat for salmon and steelhead trout, special status species. For this reason, it is important to evaluate these receptors in addition to "aquatic life." This reach (the portion of the Columbia River closest to the site) should be evaluated as an exposure scenario location for the ERA, and therefore the air modeling should include an adequate number of grid nodes over the reach.

Recommendation. Discuss the basis for the Chinook salmon and steelhead trout being listed as protected species. Also, please review ATG's procedures for screening risk to these fish.

Response

Agree. An analysis of risks specific to salmonids will be added, noting the protected status of some of the salmonids. Specific published toxicity data for salmonids will be used whenever possible. See also the response to comment RAWP-012.

Tracking # RAWP-102 / S-082

Comment

Section 8.1.2.5, Sensitive Environments, Pages 8-9 and 8-10. The text discusses only sensitive environments on the Hanford Reservation, whereas the risk assessment is performed for the assessment area. Also, please note that EPA's SLERAP refers to these areas as "special ecological areas."

Recommendation. The special ecological areas in the assessment area should be listed. Areas that merit specific analysis in the ERA should be discussed. See EPA's SLERAP for more information on the evaluation of special ecological areas.

Response

The discussion of special ecological areas will be expanded to include parts of the assessment area outside of the Hanford Reservation, as appropriate.

Tracking # RAWP-103 / S-083

Comment

Section 8.1.3, Receptor Identification, Page 8-10. The first sentence of paragraph two is incomplete. We assume the text is in reference to Figure 8-7.

Recommendation. Please complete the sentence.

Response

We will insert " shown in Figure 8-7" between "is" and the period of the first sentence, second paragraph of Sect. 8.1.3.

Comment

Section 8.1.3, Receptor Identification, Pages 8-10 and 8-11. The vegetation map (Figure 8-3) indicates the terrestrial ecosystem at Hanford is composed of many types of terrestrial habitats, including grassland, agricultural, and shrub/scrub. Each habitat should be separately evaluated in the ERA, unless information indicates these habitats are populated by generally the same receptors with similar diets. See EPA's SLERAP for detailed information for identifying, selecting, and evaluating the risk to different terrestrial habitats.

Recommendation. Determine if the terrestrial ecosystem should be divided into major habitats for separate evaluation. If so, prepare food webs, identify representative receptors, and select assessment endpoints and measures of effect for each habitat. If not, provide supporting discussion.

Response

Clarification. Because this is a screening level risk assessment, there will not be separate exposure locations for each receptor or habitat. Instead, transport and deposition modeling will be used to identify the locations of maximum air concentration and maximum deposition from each stack. All food webs will be evaluated using media concentrations at those maximum locations. Therefore, exposure through all food webs will be modeled at the points of maximum deposition. All receptors will be assumed to be exposed at the points of maximum deposition and maximum airborne concentration, as well as at the maximum deposition location at Columbia River, and at two administratively important locations, the Hanford Site boundary and Gable Mountain, which is of particular interest to the Native Americans. If there are no unacceptable risks at the points of maximum deposition and air concentration, additional information about exposure at points with lower soil, air, or water concentrations and deposition rates will not be necessary. Please also see the response to RAWP-010

Tracking # RAWP-105 / S-085

Comment

Sections 8.1.3.1 and 8.1.3.2, Terrestrial Receptors and Aquatic Receptors, Pages 8-10 and 8-11. The listed mammal and bird measurement receptors have no information describing the basis for their selection. In addition, measurement receptors do not need to be selected for plants, invertebrates, and aquatic life (except for fish, as mentioned above) because risk to these communities is evaluated using community-based endpoints. In regard to the fish, the Chinook salmon and steelhead trout would be the measurement receptors if these receptors are evaluated separately, as recommended.

Recommendation. Discuss the basis for the mammals and birds selected as measurement receptors and the two species of fish as well, if they are evaluated apart from other aquatic life. The spotted sandpiper and bald eagle on Figure 8-10 need to be bolded for consistency with text.

Response

Agree. The spotted sandpiper and bald eagle will be bolded. The discussion of rationale and selection process of assessment and measurement endpoints will be revised to conform to the discussion in the SLERAP.

The following text will be added to Section 8.1.2.3 of the RAWP: The spotted sandpiper resides along the shores of the Columbia River, where it preys on aquatic and terrestrial invertebrates and small fish. It represents the guild of carnivorous shorebirds, which are exposed to contaminants in aquatic biota, benthic organisms, and water.

The following text will be added to Section 8.1.2.4 of the RAWP: The bald eagle nests along the Columbia River, but most eagles leave the area before laying eggs (WHC 1994). Resident eagles are exposed to contaminants in fish as well as waterfowl, small mammals, and carrion, on which it preys. It is a threatened species and therefore deserves special attention. It is also the best representative of top predators of aquatic biota on the Hanford Reservation.

Tracking # RAWP-106 / S-086

Comment

Section 8.1.4, Assessment and Measurement Endpoints, Page 8-11. The discussion about assessment endpoints and measurement endpoints should include information about how the assessment endpoints were selected. In addition, the assessment endpoints and measures presented in Table 8-1 are consistent with EPA's Superfund ERA guidance, but not EPA's SLERAP. Please note that EPA's SLERAP does not use measurement endpoints, rather only measures of effect.

Recommendation. Review EPA's SLERAP, reformulate the assessment endpoints and measures of effect, and provide documentation about how the assessment endpoints were selected.

Response

The discussion of assessment and measurement endpoints will be revised to conform to the SLERAP guidance. For example, the term of measures of effects, not measurement endpoints, will be used.

Comment

Section 8.1.3, Receptor Identification, Species Profiles, Pages 8-12 through 8-22. The profiles are very useful and are a creative way to present information about their ecological relevance and information needed for the quantitative exposure assessment. We have two comments about information in the files. First, area use factors (AUF), which are used to assess exposure, are missing. Second, the basis of the temporal use factors (TUF) is not clear. Are they based on the size of the Hanford Reservation, the size of the assessment area, or the size of a specific habitat?

Recommendation. Please add AUF values to the profiles. Note that AUFs should be based on the assessment area, not just the Hanford Reservation. Also discuss the basis of the TUFs.

Response

Clarification. Regarding AUFs, it is not appropriate to include AUFs in a table of properties of a receptor, because the AUF depends also on the size of the habitat in which exposure occurs. Per RAWP-110, the regulators prefer use of a TUF of 1 for all screening work. Although some animals, e.g., birds and fish species may be migratory, a TUF of 1 will be used for all receptors.

Comment

Section 8.2, Exposure Assessment, Pages 8-23 and 8-24. The description of the procedures for modeling stressor concentrations in prey of measurement receptors are not consistent with the procedures recommended in EPA's SLERAP, which uses simplifying assumptions [(bioconcentration factor (BCF) multiplied by a trophic level-specific food chain multiplier (FCM)]. Please note that the appropriateness of all BAF and BSAF values proposed must be thoroughly documented.

The exposure assessment does not discuss how COPCs and ROPCs without bioaccumulation data will be handled. Will surrogate information be used? Will these stressors not be quantitatively evaluated?

Recommendation. We recommend this ERA use methods in EPA's SLERAP. Also, provide an overview of how COPCs and ROPCs with insufficient exposure information will be handled in the assessment.

Response

Agree. The FCM approach will be used to calculate BCF_{fish} values for aquatic receptors and BAF-T values for terrestrial receptors. The FCM method for aquatic receptors uses the published BCF as a point of departure and multiplies it by a factor that accounts for greater bioaccumulation with trophic distance from the primary receptors. In contrast, the FCM method for terrestrial receptors uses BCFs for ingested soil, ingested water, and ingested prey separately: for ingested soil and ingested water it applies the BCF multiplied by the receptor's FCM, and for prey it applies the ratio of the receptor's FCM to the prey's FCM multiplied by concentration in the prey. The FCM for inorganics is assumed to be 1.0. The FCM for organics varies with K_{ow} and is based on empirical observations of the relationship of BCF to K_{ow}.

Bioconcentration factors published in the SLERAP will be used whenever they are present. The COPCs listed in the SLERAP comprise about thirty of the 470 COPCs/ROPCs for the SLRA. Published BCF and BAF data for COPCs and ROPCs that are used but are not found in the SLERAP will be fully referenced. For inorganics with no published BAF values, except methyl mercury and selenium, the BCF will be 1.0 unless guidance recommended values are available. For organics with no published BCF and BAF values, empirical equations will be used as presented in the SLERAP, Appendix C. Equations are given for soil invertebrates, plants in soil and sediment, aquatic invertebrates, algae, fish, and benthic invertebrates in sediment. For example, the equation presented in the SLERAP for sediment invertebrates ($\log \text{BAF} = 0.819 \times \log \text{Kow} - 1.146$) will be used for organic COPCs in sediment. In the absence of data for the few organics with neither SLERAP published uptake factors nor K_{ow}s, surrogates will be needed. Surrogates will be provided by the Agencies during the RAWP review process. Uncertainties about the use of aquatic food chain multipliers for terrestrial biota will be discussed in the uncertainties section.

Tracking # RAWP-109 / S-089

Comment

Section 8.2, Exposure Assessment, Pages 8-23 and 8-24. The context of the discussion about evaluation of both the exclusive diet and equal diet scenarios in the exposure assessment presented in Section 8.2 is not accurate. Rather that (sic) representing the worst-case (exclusive) versus standard (equal) diets of selected measurement receptors, the evaluation of different diet scenarios constitutes the most complete evaluation of exposure potential for a measurement receptor. Also, it identifies which pathways are driving risk specific to a stressor and measurement receptor, and allows risk management efforts to be prioritized.

Recommendation. Revise the discussion, omitting references to "worst-case" and "standard" scenarios.

Response

Clarification. Dietary exposures were discussed in a meeting of the IPT Subworking Group on Ecological Risk Assessment on Sept. 30, 1999. Ecology and EPA were represented at that meeting. It was concluded at that meeting that "both exclusive and equal, but not normal diets will be used". Discussion of diet scenarios in the workplan text will be revised to conform to the terminology in the SLERAP.

Tracking # RAWP-110 / S-090

Comment

Section 8.2, Exposure Assessment, Use of TUFs, AUFs, and Assimilation Efficiencies in Exposure Assessment. Please note that documentation of the basis of TUFs and AUFs < 1, must be discussed. Assimilation efficiencies (AEs) must be receptor-, COPC-, and ROPC-specific, and must be documented as well. TUF and AE information is not used in EPA's SLERAP guidance because of the paucity of this information in the literature, and all AUFs are assumed to be equal to 1 because it is a screening assessment.

Recommendation. Consider following EPA's SLERAP procedures for estimating exposure to mammals and birds. At a minimum, document the basis of TUF, AUF, and AE values less than 1.

Response

Agree. We intend to treat all AUFs and TUFs as 1 to be consistent with the screening level risk assessment described in the SLERAP. AEs will also be assumed to be 1, in accordance with guidance in the SLERAP.

Comment

Section 8.2, Use of Bioaccumulation Factors. Please note that the basis of all BAFs must be discussed. To address the issue of insufficient bioaccumulation data for wildlife, EPA's SLERAP uses a BCF x FCM approach, which EPA's Great Lakes National Program Office developed for estimating water quality criteria for aquatic mammals and birds. The SLERAP also applied it to terrestrial exposures because of the general lack of wildlife bioaccumulation data.

Recommendation. To facilitate the completion of the ERA, consider using the approach discussed in EPA's SLERAP.

Response

Agree. It is our intention to use the 30 or so transfer factors offered by EPA's SLERAP. In addition, other published BAFs will be used. The sources of these BAFs will be fully cited. For the remaining chemicals, we plan to use the BCF x FCM approach, although we question the validity of applying aquatic FCMs to terrestrial food chains, absent sufficient data to support doing so.

Tracking # RAWP-113 / S-093

Comment

Section 8.2.2.1, Ingestion Exposure Calculations (Soil to Wildlife), Page 8-27; and Table 8-2, Soil Ingestion Rates for Hanford Receptors, Page 8-74. While most top predators have insignificant direct soil ingestion, the burrowing owl may ingest relatively high amounts of soil because they use their beaks for digging their burrows. The average daily dose equation for top predators should account for direct soil ingestion by the burrowing owl.

Recommendation: Modify the equation accordingly, or present a separate equation for the burrowing owl and any other top carnivores that have significant levels of soil ingestion.

Response

As noted in the response to Comment RAWP-098, exposure of terrestrial predators to ingested soil will be included for all predators for which soil ingestion data are found.

Tracking # RAWP-114 / S-094

Comment

Section 8.2.2.2, Inhalation Exposure Calculations (Air to Wildlife), Page 8-28. We appreciate the goal of evaluating inhalation risk for wildlife. Please note that EPA's combustion ERA guidance provides no explicit procedures for evaluating this pathway because of the lack of inhalation exposure models and lack of inhalation toxicity data. Exposure models have not been developed for the array of respiratory unit A in wildlife. In developing the SLERAP, EPA concluded that extrapolating from the available exposure assessment and toxicity information to cover the different receptors would result in vast uncertainty that would not meet any standard of reasonableness, even for a screening level risk assessment.

Recommendation. For this reasons discussed above, we recommend not evaluating the inhalation pathway for ecological receptors. If the inhalation pathway will be pursued in the ERA, the basis of the equation in Section 8.2.2.2 should be discussed. In addition, the work plan should discuss and present quantitative methods for extrapolating from the available inhalation models and toxicity data to estimate risk to wildlife, and should propose uncertainty factors for the extrapolations.

Response

Agree. Consistent with the SLERAP, and your comment, we will not evaluate the inhalation pathway for ecological receptors.

Comment

Section 8.2.2.3, Radioecological Exposure Equations, Pages 8-28 and 8-29. The plan indicates that the same models and parameters used for modeling the buildup of radionuclides in the food chain will be used to model the buildup of radionuclides in organisms other than man for the purpose of assessing radioecological effects. Models are available for assessing radioecological impacts, and there are recommended No Observed Adverse Radiological Effect Levels (NOREL) for organisms other than man. Specifically, radionuclide concentrations in water and sediment corresponding to a NOREL of 1 rad/day have been recommended for aquatic organisms (see "Radiological Benchmarks for Screening Contaminants for Potential Concern for Effects on Aquatic Biota at oak (sic) Ridge National laboratory, Oak Ridge Tennessee," BJC/OR-80, July 30, 1998.) A review of this and other supporting documents has revealed that a NOREL of 0.1 rad/day for the aquatic environment may be more appropriate screening. In addition, food chain models designed to assess doses to man may not be appropriate for assessing radioecological impacts because the food chain models do not address critical organs and tissue, relative biological effectiveness, and microdosimetry of alpha particles. The external alpha dose issue is especially relevant to this site due to concern over exposure of salmon eggs and developing embryos.

Recommendation: The section on radioecological impacts should explicitly address the NOREL that will be used for terrestrial and aquatic environments and the models and parameters that will be used to derive screening levels for water, soil, and sediment, taking into consideration critical organ, relative biological effectiveness, and alpha microdosimetric issues.

Response

Clarification. The International Council on Radiation Protection (ICRP. 1977. Recommendations of the International Commission on Radiological Protection. Publication 26. Pergamon Press, New York.) screening benchmarks, 0.1 rad/day for terrestrial animals and 1 rad/day for aquatic receptors, do not take into account critical organ effects, relative biological effectiveness, and microdosimetry issues. Uncertainties will be discussed in the uncertainties discussion.

Comment

Section 8.2.2.4, Internal Exposure (Terrestrial Receptors), Page 8-29, and Section 8.2.3.4, Page 8-35. This section presents the model for assessing internal exposures to organisms other than man. In the equation of the internal dose rate on pages 8-29 and 8-35, it may be more appropriate to assign QF in the range of 5-10 for alpha radiation (e.g., Kocher and Trabalka, in press), rather than 20. The starting point for deriving the radionuclide reference dose is the radionuclide concentration in the various organs of the organism. For plants and invertebrates, empirically determined soil-to-plant transfer factors are used, and, as long as the factors are representative of the site, this approach is valid. For organisms higher in the food chain, such as mammals and birds, the equation on line 18 of page 8-30 is used. It appears that equation is trying to state that the radionuclide concentration in an organism (pCi/g) from ingestion is the product of the radionuclide concentration in its food (pCi/g) times the ingestion rate g/day times an empirically determined transfer factor (day/pCi). The units seem to be incorrect, and reference is made to Table C.2-2 which presents soil-to-plant transfer factors, not feed-to-beef transfer factors.

Recommendation: Please recheck the equation and reference to Table C.2-2.

Response

Clarification. Analysis of the accumulation of inorganic chemicals ingested by mammals and birds has revealed that the fraction of ingested inorganic chemical that is retained varies with body weight of the receptor. The equation on line 18 of page 8-30 has units and operations of $(\text{pCi/g}) \times [\text{pCi}/(\text{pCi/d})] \times \text{g}/(\text{g BW} \times \text{d}) = \text{pCi/g BW}$, which are appropriate. Nevertheless, in keeping with Comment RAWP-127, bioaccumulation of inorganic chemicals ingested by mammals will be calculated as described by the SLERAP - bioconcentration factors will be derived for each inorganic chemical and each receptor by multiplying the biotransfer value from Baes et al. (1984) by the food ingestion rate. Tissue concentrations in carnivores will be calculated by multiplying the tissue concentration in prey by the ratio of food chain multipliers for predator and prey.

A quality factor of 5 will be used for all alpha emitters.

Table references will be corrected.

Comment

Section 8.2.2.5, External Exposure (Terrestrial Receptors), Page 8-31. This section addresses methods for calculating external exposures to organisms other than man. The equation for above ground exposure (line 31 page 8-31) is correct, but it uses the volumetric dose conversion factor (Sv/sec per Bq/m³) in Federal Guidance report No. 12. It should use the area dose conversion factor (Sv/sec per Bq/m²), which is more appropriate for deposited radioactivity.

The equation for external exposure from below ground sources of contamination is correct, but it neglects the external exposure of root hairs to alpha emitters in soil. This pathway is likely to be the limiting exposure pathway for radionuclides in soil.

Recommendation: Please use the area dose conversion factor instead of the volumetric dose conversion factor.

Response

Clarification. Regarding the first point, volumetric dose conversion factors will be used. All exposures will be calculated for soil volumes 1 cm or 20 cm deep. The stated exposure assumption is that the radionuclides are assumed to be mixed into the upper 1 cm of untilled soil and the upper 20 cm of tilled soil. The equations in Sect. 6.2 are used to calculate ROPC concentrations for 1-cm and 20-cm depths. Radionuclide exposures for untilled soil (radionuclides distributed between the surface and 1 cm deep) will be calculated by using dose conversion factors in Federal Guidance Report 12 for a volume from the surface to 1 cm deep. Radionuclide exposures for tilled soil (radionuclides distributed between the surface and 20 cm deep) will be calculated by using dose conversion factors in Federal Guidance Report 12 for a volume from the surface to 15 cm deep, the closest match in Federal Guidance Report 12 to a volume from the surface to 20 cm deep. See the note to Comment RAWP-058.

Regarding the second point, the SLERAP calls for a screening assessment of radionuclide risks. Although it does not specify a screening level, it implies that a screening dose of 0.1 rad/day is appropriate for terrestrial receptors other than pine trees and mammalian embryos; no mention is made of root hairs. The International Council on Radiation Protection (ICRP. 1977. Recommendations of the International Commission on Radiological Protection. Publication 26. Pergamon Press, New York.) recommends screening levels of 0.1 rad/day for terrestrial animals and 1 rad/day for aquatic receptors. The National Council on Radiation Protection and Measurement also recommends a screening level of 1 rad/day for aquatic biota (NCRP. 1991. *Effects of Ionizing Radiation on Aquatic Organisms*. NCRP Report No. 109, National Council on Radiation Protection and Measurements, Bethesda, MD). The International Atomic Energy Agency has stated that a chronic dose of 0.1 rad/day is unlikely to be harmful to populations of terrestrial animals and a chronic dose of 1 rad/day is unlikely to be harmful to populations of terrestrial plants and invertebrates (IAEA 1992). Given the screening nature of this assessment, it seems appropriate to use the bioaccumulation and exposure models in the workplan and screening levels for whole-organism doses of 1 rad/d for aquatic organisms and terrestrial vertebrates and 0.1 rad/day to other terrestrial organisms.

As requested by Ecology/EPA, the following will be inserted before the last sentence of Sect. 7.2.10 of the RAWP: "For exposure of humans to external radiation from untilled soil, the slope factor from the HEAST table will be adjusted by multiplying it by the ratio of (dose conversion factor for 1cm)/(dose conversion factor for infinite depth)." Discussion will be added to the text of Section 7.2.10 of the RAWP to explain the use of the modified slope factor.

Tracking # RAWP-118 / S-098

Comment

Section 8.2.2.5, Page 8-32, External Exposure. Reference to Table C-2-4 for h_i appears incorrect. The potential for including the contribution from external alpha radiation in the equation for external dose rate from below ground exposure should be considered.

Recommendation: Correct the reference and address inclusion of this additional factor in the equation.

Response

Clarification. The source citation for h_i values will be corrected. Blaylock et al. (1993) state that external alpha radiation should add only insignificantly to the whole-body dose for organisms the sizes of small and large insects and their larvae and small and large fish. It seems reasonable that external alpha radiation is of a similar low significance for terrestrial soil organisms.

Tracking # RAWP-119 / S-099

Comment

Section 8.2.3.5, External Exposure (Aquatic Receptors), Page 8-35. This section presents the model that will be used to derive the external doses to aquatic receptors. No consideration is given to external exposures to alpha emitters in sediment. Line 16 on page 8-36 states that external exposure to alpha emitters is not important. Our review of the literature (see Attachment 2) revealed that external exposures to alpha emitters could be significant for fish eggs and larvae that do not have a thick outer protective layer; this is similar to the root hair issue in soil. Also it appears that the equation should be divided by 1000 mL/L, rather than multiplied by this term.

Recommendation: Review relevant references listed in Attachment 2 and other information provided by Ecology, and revise the ROPC exposure assessment procedures to include exposure to alpha emitters.

Response

Clarification. EPA guidance for the SLERAP states that Barnhouse (1995) and Blaylock et al. (1993) should be used as sources for radiological effects information. Barnhouse (1995) affirms the screening levels suggested in the SLERAP (0.1 rad/day for mammals and birds, and 1 rad/day for aquatic biota). The evidence cited in Barnhouse suggests that an upper limit of 1 rad/day is protective of plant populations. Microdosimetry issues are currently being investigated by the scientific community and will be discussed in the uncertainties section.

Barnhouse does not address alpha radiation to fish eggs and larvae. Blaylock et al. (1993) state that external alpha radiation should add only insignificantly to the whole-body dose for organisms the sizes of small and large insects and their larvae and small and large fish. The potential impact of omitting alpha radiation will be discussed in the uncertainties section, but adherence to recommendations in the SLERAP would not include external alpha radiation.

The equation will be corrected, i.e., divided by 1000 ml/L rather than multiplied by that term.

Tracking # RAWP-120 / S-100

Comment

Section 8.2.3.5, External Exposure (Aquatic Receptors), Page 8-36. This section also refers to the DOE benchmarks. We have reviewed the benchmarks and have determined that, as a screening tool, the DOE benchmarks may not be adequately conservative because they are based on 1 rad/day (consideration should be given to using 0.1 rad/day), do not address RBE issues, do not address the microdosimetry of external exposure to alpha emitters, and are based on bioaccumulation factors that are not always at the upper end.

Recommendation: Review the information in Attachment 2 and determine if these benchmarks should be lowered to 0.1 rad/day. Provide discussion in support of your conclusion. It appears that "TRU" on line 23 should be "TRV".

Response

Clarification. The SLERAP calls for a screening assessment of radionuclide risks. Although it does not specify a screening level, it implies that a screening dose of 1 rad/day is appropriate for aquatic receptors. As a source for dose limits and methods, the SLERAP cites Blaylock et al. (1993), which uses the 1 rad/day benchmark established by DOE as recommended by NCRP Report No. 109 (NCRP. 1991. *Effects of Ionizing Radiation on Aquatic Organisms*. NCRP Report No. 109, National Council on Radiation Protection and Measurements, Bethesda, MD). We believe the benchmark of 1 rad/day is appropriate because it is specified in the SLERAP, which we plan to use as guidance. Uncertainty about the protectiveness of the 0.1 rad/d and 1 rad/d benchmarks will be discussed in the uncertainties section. Microdosimetry issues are currently being investigated by the scientific community and will be discussed in the uncertainties section.

"TRU" will be corrected to "TRV".

Tracking # RAWP-121 / S-101

Comment

Section 8.2.4.2, Uptake Variables, Pages 8-37 and 8-38. This section provides an overview of procedures for determining uptake parameters for the ingestion and inhalation pathways for ecological receptors. No detailed procedures on specific logic that will be followed are provided.

Recommendation. The sources of data, decision logic, and procedures for identifying uptake variables must be documented to support proposed uptake variables.

Response

Clarification. The section on uptake variables will be expanded to include full citations for uptake variables not present in the SLERAP. A general discussion will be added to the text of the RAWP to describe the hierarchy for selecting values to be used if they are not in the SLERAP. Guidance is provided in Appendix C of the SLERAP. For example, Sect. C-1.0 states that BCF values "were selected from empirical field and/or laboratory data generated from reviewed studies that are published in the scientific literature...If two or more BCF values...were available in the published literature, the geometric mean of the values was used."

Please see the response to RAWP-086 for a discussion on the hierarchy of selecting toxicity values.

Tracking # RAWP-122 / S-102

Comment

Section 8.2.4.3, Bioaccumulation Factors for Calculating Terrestrial Exposures, Pages 8-38 through 8-44. This section discusses technical procedures for calculating bioaccumulation factors for various pathways.

Recommendation. The sources of data, decision logic, and procedures for calculating bioaccumulation factors must be documented. Also, since may (sic) environmental variables appear to be log-normally distributed, might it be more appropriate to use a geometric mean, rather than an arithmetic mean, for estimating SP for inorganic COPCs and ROPCs

Response

Clarification. Regarding the use of mean values for SP as a surrogate for no data on inorganics, the SLERAP specifies that the arithmetic mean of all available values is used (Sections C-1.1, C-1.3, C-1.5, and C-1.6). For example, no measured soil-to-soil invertebrate bioaccumulation factors for selenium, silver, and thallium are presented in the SLERAP. As a substitute for missing values, the arithmetic mean of values for all inorganics for which there are values in the SLERAP was used for each of the missing values. SPs are presented for all of the inorganics except hydrogen, helium, carbon, and oxygen in Baes et al. (1984).

Tracking # RAWP-123 / S-103

Comment

Section 8.2.4.3, Page 8-39, Air-to-plant transfer factors. For APvj in units of L or m³/kg, is the "kg" tissue wet weight? No rationale is provided for why APv for organics (calculated by Bacci et al, 1992) were reduced by a factor 100.

Recommendation: Amend the section to clarify the above.

Response

Agree. The text and tables will be revised to clarify that APv values taken from the SLERAP and from other sources are in units of m³ air/g dry plant; SLERAP and other values will be converted to those units.

Sect. C-1.7 of the SLERAP specifies that the calculated APv values should be reduced by a factor of 100 for all organics other than PCDDs and PCDFs. These reductions adjust for empirical observations that the Bacci et al. (1992) formula incorrectly predicts the uptake factor. The explanation for EPA's recommendation to reduce the Bacci et al. values will be added to the text.

Comment

Section 8.2.4.3, Bioaccumulation Factors for Calculating Terrestrial Exposures: Soil-to-Soil Invertebrate Transfer Factor, Page 8-39. The text states that site-specific lead and calcium concentrations will be used to calculate a lead BAF-S. However, the text has no discussion on the specific types of data that will be used and why the data were originally collected.

Recommendation: Discuss the type and origination of the lead and calcium data that will be used to calculate a lead BAF-S.

Response

Clarification. The SLERAP BAF of 0.03 will be used in place of the stated method that accounts for potential inhibition of lead uptake by calcium.

Comment

Section 8.2.4.3, Bioaccumulation Factors for Calculating Terrestrial Exposures, Tissue-to-Tissue Transfer Factor, Pages 8-40 through 8-43. The method for estimating tissue-to-tissue transfer factors differs from the method presented in EPA's SLERAP. The quantitative approach is rather difficult to follow, and it appears to be incomplete in a few areas. We have several comments about the proposed approach.

- The approach is not referenced. Has it been used in other ERAs? Please provide all references.
- The nomenclature in the second equation should be clarified so it is clear that the BAF-T value is a predator-prey transfer factor. "Animal" is vague, as both predator and prey are animals.
- Please discuss evidence supporting the assumption that the ratio of contaminant taken up per unit body weight to the rate of contaminant ingested per unit body weight is constant. Does the evidence show that the depuration rate constant is the same for similar species, or is this assumed to hold true? Also, does the rate constant vary by COPC?
- Check the accuracy of the equations, as some of them appear to be incomplete.
- The basis and accuracy of data and methods used in the RPP-WTP ERA that are not presented in EPA's SLERAP must be fully documented.

Recommendation. Please address the comments mentioned above. Evaluate the impact on resources and schedule of collecting, evaluating, and documenting data and methods besides those in EPA's SLERAP.

Response

This comment contains several points, and they will be addressed in the order in which they were given.

Clarification. The approach was developed for this risk assessment and was based on analysis of published data, mostly compiled by Ng et al. (Ng, Y.C., C.S. Colsher, D.J. Quinn, and S.E. Thompson. 1977. "Transfer Coefficients for the Prediction of the Dose to Man via the Forage-Cow-Milk Pathway from Radionuclides Released to the Biosphere." Lawrence Livermore Laboratory, UCRL-51939. July 15, and Ng, Y.C. 1982. "A Review of Transfer Factors for Assessing the Dose from Radionuclides in Agricultural Products." Nuclear Safety 23:57-71). The method has not been published. The method will be replaced by the methods described in the SLERAP. In this method the uptake factor is adjusted by multiplying by the food ingestion rate to derive a tissue-concentration to food-concentration ratio.

- Agree. The nomenclature will be revised to clarify that BAF-T is a prey-to-predator transfer factor.
- Clarification. Discussion of empirical findings about uptake of contaminants is no longer necessary because the method stated in the draft will be replaced by the methods described in the SLERAP. This involves the biotransfer factor that is adjusted by multiplying it by the food ingestion rate and the ratio of food chain multipliers for predator and prey to derive a tissue-concentration to food-concentration ratio.
- Clarification. The equations for bioaccumulation by terrestrial receptors will be replaced by equations from the SLERAP.
- Clarification. The methods for calculating bioaccumulation factors will be made consistent with the SLERAP, as described in the preceding bullets.

Comment

Section 8.2.4.3, Bioaccumulation Factors for Calculating Terrestrial Exposures: Tissue-to-Tissue Transfer Factor, Page 8-43, Line 25. The text states that the table of BAF-T values is located in Appendix C2, however, no such table is located therein. The closest thing is the Ba table (Table C2-5).

Recommendation: Either create a table with the BAF-T values, or be more specific as to the location in Appendix C2.

Response

Clarification. Section 8.2.4.3 and Table C2-5 will be modified to describe BAF-T values calculated according to the methods in the SLERAP. For example, biotransfer factors for movement of COPCs and ROPCs from food to mammalian tissue will be multiplied by the daily food, soil, or water ingestion rate for each receptor (SLERAP Appendix D, Section D-1.0). Biotransfer factors for inorganic COPCs and for ROPCs not found in the SLERAP will be taken from Baes et al. (1984). Mammalian biotransfer factors for organic COPCs that are not found in the SLERAP and have no published biotransfer factors will be calculated by using the equation

$$\log(\text{Ba}) = 7.6 - \log(\text{Kow})$$

where

Ba = biotransfer factor, and
Kow = octanol-water partitioning coefficient.

Comment

Section 8.2.4.3, Bioaccumulation Factors for Calculating Terrestrial Exposures, Abiotic Medium-to-Vertebrate Tissue Transfer Factor, Page 8-43. The method for estimating abiotic medium-to-vertebrate tissue transfer factor is different from the method recommended in EPA's SLERAP. The text states that it is the same as the method for estimating tissue-to-tissue transfer factors. Please review the comments presented above. In addition, does this method assume that assimilation efficiencies (AE) for contaminants in tissue are the same as AEs for contaminants in media?

Recommendation. See recommendation for preceding comment. Clarify whether for BAF-T_{ij}, is the denominator "kg" tissue weight. Also, determine if the assumption about AEs holds true. If so, please explain the basis for the assumption.

Response

Clarification. Section 8.2.4.3 and Table C2-5 will be modified to describe BAF-T values calculated according to the methods in the SLERAP. Absorption efficiencies for chemicals in abiotic media will be added to Table C2-5; the absorption efficiency for chemicals in ingested tissue is assumed to be 1.0.

Comment

Section 8.2.4.4, Bioaccumulation Factors for Calculating Aquatic Exposures, Water-to-Plant Transfer Factor, Page 8-44. The text describes how water-to-plant transfer factors will be estimated. We have several comments.

- In the third paragraph, the text states that Hanford field-measured water-to-plant transfer factors are preferred. Second choice is laboratory-measured data, however the work plan does not describe the decision logic for collecting, evaluating, and selecting these transfer factors.
- The basis for calculating a phytoplankton transfer factor from sediment is not discussed. Specifically, please elaborate on the technical basis for calculating a phytoplankton transfer factor from the sediment-to-plant transfer factor and K_d .
- The fourth sentence in the third paragraph mentions that the Southworth et al (1978) regression equation in the pre-peer review draft of EPA's combustion ERA guidance will not be used to develop transfer factors. The facility should consult the EPA's peer review draft for guidance on calculating contaminant concentrations in phytoplankton.
- The text states that if no data are available, a value of 1 will be assigned. Please discuss the reasoning behind this decision. In instances like this, where data are insufficient to estimate risk, we recommend not quantitatively evaluating risk. Instead, discuss these data gaps as uncertainties in the ERA.

Response

Clarification. Section 8.2.4.4 will be revised to conform to methods in the SLERAP. This comment contains several points, and they will be addressed in the order in which they were given.

- It does not appear that Hanford-specific field data will be available, so reference to field data will be removed. Laboratory-measured values would comprise published information. The text will be revised to state that evaluation procedures for published transfer factors not included in the SLERAP will be those used in the SLERAP, i.e., either single published BCFs or BCFs calculated from collocated media and organism concentrations or the geometric mean of multiple BCFs.
- Text describing the calculation of sediment-to-plant transfer factors will be removed and replaced with the statement that soil-to-plant transfer factors will be used, as specified in the SLERAP.
- The text will be revised to state that the empirically derived Southworth equation for uptake of contaminants from water by daphnids will be used to calculate uptake by phytoplankton, as specified by the SLERAP.
- The SLERAP presents empirically derived equations to calculate surrogate BCF values for uptake of organics by soil invertebrates, terrestrial and aquatic plants, aquatic invertebrates, algae, fish, benthic invertebrates, mammals, and birds. Surrogate BCFs for inorganics are calculated as the arithmetic mean of all available BCFs for inorganics except for animals and birds, for which no surrogates are used. The RAWP text will be revised to state that the SLERAP recommendation will be used for the RPP-WTP risk assessments.

Tracking # RAWP-129 / S-109

Comment

Section 8.2.4.4, Bioaccumulation Factors for Calculating Aquatic Exposures: Water-to-Fish Tissue Transfer Factor, Page 8-47. The values for BCF_{fish} are located in Table C2-9 of Appendix C2, not Table C2-3.

Recommendation: Please correct this typo.

Response

The typo will be corrected.

Tracking # RAWP-130 / S-110

Comment

Section 8.3.1.1 Toxicity Reference Values for Terrestrial Receptors, Single Chemical TRVs, Pages 8-48 and 8-49. The RAWP proposes to use benchmarks developed by DOE's Environmental Sciences Division at the Oak Ridge Reservation. We are very familiar with these benchmarks, however the basis of many of these benchmarks is often poorly documented.

Recommendation: Provide detailed rationale for TRVs adopted from Oak Ridge, and any other TRVs based on laboratory studies. Please review EPA's SLERAP for specific procedures for selecting toxicity values and for applying uncertainty factors.

Response

Clarification. Toxicity data for COPCs not found in the in the SLERAP will be fully referenced. A discussion will be added to the text to describe the process for choosing toxicity benchmarks from the data that are available, as outlined in Sect. 5.4.1 of the SLERAP. Specifically, the hierarchy of sources will be:

- standards, criteria, guidance, or benchmarks established by a government agency,
- toxicity values published in scientific literature and evaluated for inclusion in the RAWP (chronic reproductive endpoints will be preferred, and studies with both a NOAEL and a LOAEL will be preferred over those with only a NOAEL or a LOAEL),
- for nonpolar organic COPCs in sediment, toxicity values calculated by using equilibrium partitioning, or
- toxicity values for surrogate chemicals that have been identified by EPA.

Methods for choosing among alternative TRVs are presented in more detail in RAWP-015. If multiple values with the same standing in the hierarchy are found, the lower or lowest (i.e., more or most conservative) will be used. Sources of data will be explicitly identified in the data tables, and full citations will be provided.

Tracking # RAWP-131 / S-111

Comment

Section 8.3.1.2, Ingestion TRVs for Terrestrial Receptors, Page 8-49. The text mentions that an interspecies uncertainty factors may have to be applied to extrapolate from a test species to a measurement receptor. However, values for these uncertainty factors are not presented.

Recommendation: Provide and document uncertainty factors for taxonomic extrapolations.

Response

Clarification. Because an uncertainty factor for taxonomic extrapolations was not used, the sentence will be deleted.

Tracking # RAWP-132 / S-112

Comment

Section 8.3.1.3, Inhalation TRVs for Terrestrial Receptors, Pages 8-49 and 8-50. The text states that an acute-to-chronic uncertainty factor may be necessary to derive a chronic TRV from acute toxicity data. However, values for these uncertainty factors are not presented.

Recommendation: Provide and document uncertainty factors for taxonomic extrapolations.

Response

Clarification. Consistent with the comment RAWP-114 and the SLERAP, we will not evaluate the inhalation pathway for ecological receptors.

Tracking # RAWP-133 / S-113

Comment

Section 8.3.1.6, Radionuclide Benchmarks, Page 8-52. We have reviewed the benchmarks proposed in the RAWP and have determined that, as a screening tool, the DOE benchmarks may not be adequately conservative because they are based on 1 rad/day (consideration should be given to using 0.1 rad/day), do not address RBE issues, do not address the microdosimetry of external exposure to alpha emitters, and are based on bioaccumulation factors that are not always at the upper end.

Recommendation: Review the information in Attachment 2 and determine if these benchmarks should be lowered to 0.1 rad/day. Provide discussion in support of your conclusion.

Response

Clarification. The SLERAP calls for a screening assessment of radionuclide risks. Although it does not specify a screening level, it implies that a screening dose of 1 rad/day is appropriate for aquatic receptors. As a source for dose limits and methods, the SLERAP cites Blaylock et al. (1993), which uses the 1 rad/day benchmark established by DOE as recommended by NCRP Report No. 109 (NCRP. 1991. *Effects of Ionizing Radiation on Aquatic Organisms*. NCRP Report No. 109, National Council on Radiation Protection and Measurements, Bethesda, MD). We believe the benchmark of 1 rad/day is appropriate because it is specified in the SLERAP, which we plan to use as guidance. Microdosimetry issues are currently being investigated by the scientific community and will be discussed in the uncertainties section.

Tracking # RAWP-134 / S-114

Comment

Table 8-3, Page 8-75. The definition for IRf is incorrectly stated.

Recommendation: Revise definition for IRf to read ratio of kg/d to kgBW (not kg/d to kg/BW).

Response

The unit will be corrected.

Tracking # RAWP-135 / S-115

Comment

Table 8-4, Page 8-75. The last column should include a definition of Sa. Also, several of the IR and IS values differ from those presented in EPA (1999) guidance. For example, EPA (1999) lists IR as 0.185 kg WW/kg BW-d and IS as 0.00995 kg DW/kg BW-d for the red-tailed hawk (Table 5-1, p.5-8), while the RAWP lists these values as 0.105 and 0.0004, respectively.

Recommendation: Provide the definition of Sa . Use the IR and IS values from the EPA (1999) guidance.

Response

Agree. A definition of Sa will be added to the footnotes to Table 8-4 (page 8-76). The choices of life history parameters made by EPA (1999b) from the data in EPA's Wildlife Exposure Factors Handbook (EPA 1993b) will take precedence over other possible alternative choices of data from that source.

Tracking # RAWP-136 / V-IV, S-001

Comment

Appendix B, Appendix B1, Tables B1-1 and B1-2, Physical/Chemical Parameters for Exposure Point Concentration Modeling for Organic/Inorganic COPCs, Pages B1-3 through B1-149. Following a review of the Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (HHRAP) (peer review draft, EPA530-D-98-001, Volumes A, B, and C) dated July 1998, the EPA issued an Errata that included changes and corrections to the list of chemical and physical properties in the HHRAP. After reviewing Tables B1-1 and B1-2, it does not appear that the changes set forth in the Errata were included in this work plan. The Errata is available on line at <http://www.epa.gov/epaoswer/hazwaste/combust/risk.htm>.

Recommendation: The appropriate changes should be made to Table B1-1 and B1-2 based on the Errata.

Response

The Errata to the HHRAP will be reviewed and compared with Tables B1-1 and B1-2 and these tables will be modified accordingly.

Tracking # RAWP-137 / V-IV, S-002

Comment

Appendix B, Appendix B1, Table B1-1 and B1-2, Physical/Chemical Parameters for Organic/Inorganic COPCs, Pages B1-3 through B1-149. For some of the COPCs that are presented in these tables, values from HHRAP; however, not in all cases. There is no explanation as to why another source was chosen in place of HHRAP.

Recommendation: Provide some explanation as to why values from other sources were used in place of chemical and physical properties recommended by HHRAP. This could be explained easily by presenting a hierarchy of the references used to complete the chemical and physical properties database.

Response

Values from the HHRAP will be used as the first choice when other sources of data are available. The values will be updated accordingly.

Tracking # RAWP-138 / V-IV, S-003

Comment

Appendix B, Appendix B1, Table B1-2, Physical/Chemical Parameters for Inorganic COPCs, Page B1-210. The values for aluminum are not found in HHRAP.

Recommendation: Correct the source column in Table B1-2 for aluminum to reflect the appropriate reference source.

Response

The sources of the values shown for aluminum will be corrected in Table B1-2.

Tracking # RAWP-139 / V-IV, S-004

Comment

Appendix B, Appendix B1, Table B1-3, Physical/Chemical Parameters for ROPCs, Pages B1-150, 152, 154, and 156. The CAS number for americium-241 is incorrect. It should be 86954-6-1.

Recommendation: Correct the CAS number for americium-241.

Response

After more detailed research is completed, the correct CAS number for americium-241 will be shown in the work plan. Preliminary research reveals that the CAS number used in the work plan (14596-10-2) is shown on the Health Effects Assessment Summary Tables (HEAST) web site (<http://www.epa.gov/radiation/heast/docs/tab4.pdf>), while chemfinder.com (<http://www.chemfinder.com/>) lists the CAS number shown in this comment (86954-36-1).

Tracking # RAWP-140 / V-IV, S-005

Comment

Appendix B-2, Equation for fraction of total water body COPC concentration in the water column, Page B2-4 and Page B2-5. The symbol for bed sediment porosity is listed differently in the equation and in the parameters list. The symbol for Bed sediment porosity should be " β_s ;" however, it appears on page B2-4 as "2bs."

Recommendation: The symbol should be changed in on page B2-4 and on Page B2-5.

Response

Corrections will be made so that the correct symbol is used to designate bed sediment porosity on pages B2-4 and B2-5.

Tracking # RAWP-141 / V-IV, S-006

Comment

Appendix B, Appendix B1, Table B1-3, Calculations of the diffusivity in air, D_a and the diffusivity in D_w . In Table B1-3, the diffusivity in air, D_a and the diffusivity in water, D_w are calculated using the equation A3-2a and equation A3-2b, respectively in Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. However, this EPA guidance explicitly points out that these equations are applicable to organic materials. Since almost all of the radioactive elements are in inorganic form, these equations may not be applicable to calculating D_a and D_w for these radioactive materials.

Recommendation: More suitable values of D_a and D_w for radioactive materials should be found.

Response

Another search for a method to determine diffusivity values in air and water for radionuclides will be made. If EPA, Ecology, or their contractors know of such methods or values, please provide the method/data and the sources.

Tracking # RAWP-142 / V-IV, S-007

Comment

Appendix B, Appendix B1, Table B1-3, Partitioning Coefficients. The data for the partitioning coefficients for radionuclides are taken from the single source Baes et al. The Bases et al. report is generic in nature. More site-specific values are recommended for the risk assessment. If the site-specific data are not available, these values should be chosen from data that have similar soil type and chemical composition, or reasonably conservative values should be selected. Attachment 1 contains comparisons of the partitioning coefficient values between those currently used in this draft report and other values found in the literature that are widely used:

Recommendation: Further evaluation should be performed for selecting appropriate partitioning coefficient values for radioactive materials.

Response

Agree. Further evaluation will be performed before selecting appropriate partitioning coefficients for radionuclides. We will seek partitioning coefficients for soil types similar to Hanford Site soils. The comment recommends reference to "Attachment 1" but it was not stated where that attachment is to be found.

Tracking # RAWP-143 / V-IV, S-008

Comment

Appendix B, Table B1-3, page B1-152, Radioactive half-life. Although those numbers may not play any important roles in the risk assessment, the half-life values for some of the radionuclides are incorrect (see comparison of the values between the work plan and EPA Federal Guidance Report #13):

Half-life for Protactinium-231 should be 1.2E+7 days not 1.36+07 days.

Half-life for Niobium-93 should be 4.97+03 days, not 5.33E+03 days.

Half-life for Nickel-63 should be 3.51+04 days, not 3.65+04 days.

Recommendation: Correct these values in the work plan.

Response

The discrepancy between half-life values presented in HEAST (the source of values for the work plan) and Federal Guidance Report No. 13 will be evaluated and the half-life values corrected, as appropriate, in the work plan.

Tracking # RAWP-144 / V-IV, S-009

Comment

Appendix B-2, Equation for fraction of total water body COPC concentration in the water column, Page B2-6. The symbol for the temperature correction factor is listed differently in the equation and in the parameters list.

Recommendation: The symbol should be changed on page B2-6.

Response

Corrections will be made to the definitions so that the correct symbols are used to designate all parameters used in the equation for the overall COPC transfer rate coefficient.

Tracking # RAWP-145 / V-IV, S-010

Comment

Appendix B-2, Equation for the liquid phase transfer coefficient, Page B2-6. The symbols for the density of air and the density of water are listed differently in the equation and in the parameters list. The symbol for density of air should be "a" and the symbol for density of water should be "w," however, it appears on page B2-6 as "a" and "w." Also, the symbol for dimensionless viscous sublayer thickness should be changed to "z."

Recommendation: The symbols should be changed on page B2-6.

Response

Corrections will be made to the definitions so that the correct symbols are used to designate all parameters used in the equation for the liquid phase transfer coefficient.

Tracking # RAWP-146 / V-IV, S-011

Comment

Appendix B-2, Equation for the gas phase transfer coefficient, Page B2-7. The symbols for the dimensionless viscous sublayer thickness, viscosity of air corresponding to air temperature, and density of air are incorrect in the list of parameters. The symbol should be changed to z_a , μ_a , and ρ_a for dimensionless viscous sublayer thickness, viscosity of air corresponding to air temperature, and density of air, respectively

Recommendation: The symbols should be changed on page B2-7.

Response

Corrections will be made to the definitions so that the correct symbols are used to designate all parameters used in the equation for the gas phase transfer coefficient.

Tracking # RAWP-147 / V-IV, S-012

Comment

Appendix C, Appendix C-2, Table C2-1, Terrestrial Soil-to-Plant Transfer Factors (SPv) for Ecological Receptors. If the SAIC Compiled Value is never used, why include it in the table? It is used in other tables, but why put the values in this table if there is no need? There is no explanation of when, if ever, this value would be used. Also the values of this column are just same as those in the column titled "Calculated from EPA (1999)," except for Nickel-59. The SPv values for Nickel-59 is 6.4E-03 while this values for Nickel-63 is 1.2E-02. They should have the same values.

Recommendation: Remove this information from the table, or provide an explanation of why it is included. Correct the values for Nickel.

Response

Values given in the SLERAP or derived by SLERAP methods will be presented, along with any available data for chemicals not listed in the SLERAP. The SPv for nickel-63 will be corrected to the SLERAP value for nickel.

Tracking # RAWP-148 / V-IV, S-013

Comment

Appendix C, Appendix C-2, Table C2-2. The column titled "Calculated from EPA (1999)" and the column titled "SAIC Compiled SPv" both cite "Baes and others," but they have quite different values. Also, it appears that all recommended SPr values are taken from the "SAIC Compiled SPv" column. In all cases (except Nickel-59), the recommended values are less conservative. Unless we have good reasons to select more liberal values, conservative values should be used. Again, the value for Nickel-59 is not consistent with Nickel-63.

Recommendation: To explain the methodology of the "SAIC Compiled SPv" and why they are different values of "Calculated from EPA (1999)". Unless the "SAIC Compiled SPv" is proved to be more site-specific, the more conservative values from the "Calculated from EPA (1999)" should be used for the risk assessment.

Response

Clarification. Values given in the SLERAP for soil-to-plant uptake do not distinguish between vegetative and reproductive tissue, whereas Baes et al does. For the PRA, the SPv values will be used for all plant tissues. If ecological risks are predicted by the PRA, then the distinction between seed/fruit-eaters and consumers of leaves and stems may be made. For example, the use of SPr values will be considered for the FRA when the receptor's food is mainly reproductive tissue. This would make the calculated exposures more realistic for seed- and fruit-eaters.

Tracking # RAWP-149 / V-IV, S-014

Comment

Appendix C, Appendix C-2, Table C.2-2, Soil-to-Plant Transfer Factors for ROPCs. Table C.2-2 presents the soil-to-plant transfer factors recommended for screening. The following table compares the values in the plan with the values recommended by EPA and NRC, and those reported in the literature. As indicated in the table, the values recommended in RAWP seem to be at the low end of the range of available transfer factors.

Recommendation: Attachment 2 provides a list of references on radioecology. Evaluate relevant information, and discuss the process and rationale for selecting the proposed soil-to-plant transfer factors.

Response

Clarification. The rationale for choosing the recommended value for an ROPC was to use the EPA value for the corresponding COPC when it was based on data. However, the number of COPCs evaluated in the SLERAP was very small. In many cases, the value calculated by EPA methods was the average of values for other COPCs. Data about a COPC from a source other than EPA was preferred over taking the average of values for other COPCs and ROPCs. Therefore, if the recommended value was lower than the EPA value, it was because EPA's substitution for no data resulted in a higher value than data available elsewhere. When no other value was available, the EPA value (the average) was used. The text will be revised to clarify this rationale.

Tracking # RAWP-150 / V-IV, S-015

Comment

Appendix C, Appendix C-2, Table C2-4, Terrestrial Soil-to-Invertebrate Transfer Factors (BAF-S) for Ecological Receptors, Page C2-68. The BAF-S values for Heptachlor are 1.40 X 100 and 1.00 X 100, and the recommended value is 1.26 X 100. However, there is no explanation of the basis of the recommended value.

Recommendation: Explain and properly cite how the number was derived.

Response

The recommended value appears to be a typo. It will be revised to the EPA value of 1.40.

Tracking # RAWP-151 / V-IV, S-016

Comment

Appendix C, Appendix C-2, Table C2-4, Terrestrial Soil-to-Invertebrate Transfer Factors (BAF-S) for Ecological Receptors, Pages C2-69 and C2-70. The text does not explain why the SAIC values were selected over the EPA values. In the text, it is stated that preference will be given to EPA values, but no mention is made of using SAIC values in any instance.

Recommendation: Discuss the reasoning behind the selection of BAF-S values.

Response

Clarification. The rationale for choosing the recommended value for a COPC was to use the EPA value when it was based on data. However, the number of COPCs evaluated in the SLERAP was very small. In many cases, the value calculated by EPA methods was the average of values for other COPCs. Data about a COPC from a source other than EPA was preferred over taking the average of values for other COPCs. Therefore, if the recommended value was lower than the EPA value, it was because EPA's substitution for no data resulted in a higher value than data available elsewhere. When no other value was available, the EPA value (the average) was used. The text will be revised to clarify this rationale.

Tracking # RAWP-152 / V-IV, S-017

Comment

Appendix C, Appendix C-2, Table C.2-5, Feed-to-Beef Transfer Factors for ROPCs. Table C.2-5 presents the feed-to-beef transfer factors that will be used to model the uptake of radionuclides in beef. The following table compares these values to the values reported in the literature. The comparison reveals that in many cases the risk assessment for this pathway will be based on low-end values.

Recommendation: Attachment 2 provides a list of references on radioecology. Evaluate this additional information, and discuss the process and rationale for selecting the proposed feed-to-beef transfer factors.

Response

Clarification. The rationale for choosing the recommended ingestion-to-beef biotransfer value for an ROPC was to use the methods presented in the SLERAP. For ROPCs, the biotransfer values in the SLERAP were the values presented by Baes et al. (1984), converted to a wet-weight basis. Higher values that have been published elsewhere will not be used, because doing so would be inconsistent with the SLERAP.

The rationale for choosing parameter values from among more than one reported value will be clarified in the text. The comment recommends reference to "Attachment 2" but it was not stated where that attachment is to be found. The recommendation of Attachment 2 may be rendered moot by the requirement to use values from Baes et al. (1984), because that was done in the SLERAP.

Tracking # RAWP-153 / V-IV, S-018

Comment

Appendix C, Appendix C-2, Table C2-5, Terrestrial Animal-to-Animal Transfer Factors (Ba) for Ecological Receptors. Table C2-5 lists Ba values for mammals. Will Ba values for birds be listed?

Recommendation: Clarify whether Ba values for birds will be listed or whether Ba values for mammals will be used for birds.

Response

A table of BAF-T values for birds, calculated by SLERAP methods, will be added to Appendix C.

Tracking # RAWP-154 / V-IV, S-019

Comment

Appendix C, Appendix C-2, Table C2-6, Aquatic Water-to-Plant Transfer Factors (WP) for Ecological Receptors, Page C2-95. For Carbon tetrachloride, dioxins, and furans (except dibenzofuran), PCBs, bis(2-ethylhexyl)phthalate, n-dioctyl phthalate, benzo(a)anthracene, and numerous others, the EPA value will be used instead of the Hanford field-measured information. The text in Section 8.2.4.4 states that EPA values will be used only if no Hanford information is available.

Recommendation: Please reconcile this inconsistency. Explain the hierarchy used to identify WP values.

Response

Clarification. No Hanford field-derived WP values are presented in Table C2-6.

Tracking # RAWP-155 / V-IV, S-020

Comment

Appendix C, Appendix C-2, Table C2-6, Aquatic Water-to-Plant Transfer Factors (WP) for Ecological Receptors, Page C2-96. For 2,2',3,3',4,4',5-heptachlorobiphenyl, 2,2'3,4,4',5,5'-heptachlorobiphenyl, 2,3',4,4',5-pentachlorobiphenyl, 3,3',4,4',5,5'-hexachlorobiphenyl and numerous other PCBs, the "default" value was used instead of the value calculated by EPA methods. According to Section 8.2.4.4, the default value was only to be used in the absence of any other "preferred values." Also, when both EPA and SAIC computed values are available and are compared they are very different. For example, the WP value for Antimony-125 is 1.48E+03 from EPA 1999 and 1.8 from the SAIC calculation. This is a difference of three orders of magnitude. Also, all EPA values are much more conservative than the values calculated by SAIC. This comparison brings into question the methodology used by SAIC to arrive at these values.

Recommendation: Please reconcile this inconsistency. Explain the hierarchy used to identify WP values. Provide additional information on the SAIC derivation process and its appropriateness.

Response

Clarification. The rationale for choosing the recommended value for a COPC was to use the EPA value when it was based on data. However, the number of COPCs evaluated in the SLERAP was very small. In many cases, the value calculated by EPA methods was based on an equation for uptake and depuration of chemicals from water by daphnids. Because of the preference of regulatory agencies to use the SLERAP methods, the text and tables will be revised to use SLERAP methods exclusively.

Tracking # RAWP-156 / V-IV, S-021

Comment

Appendix C, Appendix C-2, Table C2-7, Aquatic Sediment-to-Plant Transfer Factors (WP) for Ecological Receptors, Page C2-108. The SAIC values are used instead of the value calculated by EPA methods. According to Section 8.2.4.4, preference was to be given to EPA values.

Recommendation: Please reconcile this inconsistency. Explain the hierarchy used to identify WP values.

Response

Clarification. Table C2-7 and the associated text will be revised to use SLERAP methods exclusively.

Tracking # RAWP-157 / V-IV, S-0xx

Comment

Appendix C, Appendix C-2, Table C2-8. Per footnote k, the BCF values for radionuclides that have no BCF value available in EPA 1999 are calculated by averaging values for other inorganics. However, comparing the BCF values for the radionuclides that have BCF values available in EPA 1999, the calculated values for all other radionuclides are greater than any one of the EPA 1999 values. This comparison again brings into question the methodology used to arrive at these values.

Recommendation: Provide additional information on method used to derive BCF values and its appropriateness.

Response

Clarification. The method discussed is consistent with SLERAP guidance. To calculate uptake values for radionuclides for which there were no data, the SLERAP method calls for calculating the arithmetic mean of all uptake factors that are available for inorganics. That method was used in the RAWP. To calculate BCFs for radionuclides that had no published values, all of the available values for inorganics were averaged. Radionuclides were combined with other inorganics because radionuclides are expected to have bioaccumulation properties similar to those of other inorganics. The average was indeed higher than any of the available BCFs for radionuclides, because some non-radionuclide inorganics had BCFs high enough to raise the mean above the largest published radionuclide BCF.

Tracking # RAWP-158 / V-IV, S-022

Comment

Appendix C, Appendix C-3, Table C3-1, Toxicity Reference Values for Plants, Page C3-14. In the "Recommended TRV" cell, the value for selenium appears to be in the cell for rhodium.

Recommendation: Please correct the typo.

Response

The typo will be corrected.

Tracking # RAWP-159 / V-IV, S-023

Comment

Appendix C, Appendix C-3, Table C3-1, Toxicity Reference Values (TRVs) for Plants, Page C3-14. No mention of the Dutch Soil Cleanup Interim Act values for selenium and rhodium can be found in the text of Section 8.3.1.1.

Recommendation: Explain why Dutch Soil Cleanup values are proposed as TRVs for plants.

Response

Clarification. The Dutch soil cleanup values were applied in the absence of any other toxicity data. The values were established by the Dutch Soil Cleanup Interim Act of 1983 and were replaced by risk-based levels in the National Soil Protection Act of 1995. The interim values were not based specifically on toxicity to plants, and they may not be valid criteria for plant toxicity. Therefore, they have been removed from Table C3-1. In the absence of other toxicity values, potential toxicity to plants will be handled qualitatively in the uncertainties section.

Tracking # RAWP-160 / V-IV, S-024

Comment

Appendix C, Appendix C-3, Table C3-3, Derivation of toxicity Reference Values for Bird Test Species, Page C3-35. There are studies listed in the table for several COPCs that are the same as in the EPA SLERAP document, but the value and other information (such as exposure duration) are different. There are also COPCs listed in the table as having "no data" when there are data listed in the EPA SLERAP document.

Recommendation: Check the values listed for studies to ensure accuracy, and check the EPA SLERAP document for COPCs that have missing data. Explain why proposed TRVs taken from EPA's SLERAP differ from the TRVs in the SLERAP.

Response

Agree. There are discrepancies between the RAWP and SLERAP TRVs for birds. SLERAP data will be included in the RAWP. For terrestrial bird TRVs, the hierarchy of choice will be values from Sample et al. (1996), then values from the ECOTOXicology Database System (EPA 1996, URL <http://www.epa.gov/ecotox>), then surrogate values for structurally similar chemicals provided by Ecology and EPA. Specifically, the TRV for TCDD will be changed from 1.40E-5 to 1.0E-5 mg/kg/d; TRVs for PAHs will be added and a surrogate value of 1.4E-4 mg/kg/d will be used for all PAHs without specific toxicity data; the TRV for 1,3-dinitrobenzene will be added and the TRV for pentachlorodinitrobenzene will be changed; the duration conversion factor for BEHP will be changed to 0.1; and the TRV of 0.0064 mg/kg BW/d for methyl mercury will be added. COPCs with no surrogates will not be evaluated for toxicity. Instead, risks from those COPCs will be addressed in the uncertainties. See also the response to comment RAWP-015.

Tracking # RAWP-161 / V-IV, S-025

Comment

Appendix C, Appendix C-3, Table C3-5, Derivation of Toxicity Reference Values for Mammal Test Species, Page C3-67. There are studies listed in the table for several COPCs that are the same as in the EPA SLERAP document, but the value and other information (such as exposure duration) are different. There are also COPCs listed in the table as having "no data" when these data are listed in the EPA SLERAP document.

Recommendation: Check the values listed for studies to ensure accuracy, and check the EPA SLERAP document for COPCs that have missing data. Explain why proposed TRVs taken from EPA's SLERAP differ from the TRVs in the SLERAP.

Response

Agree. There are discrepancies between the RAWP and SLERAP TRVs for mammals. SLERAP data will be included in the RAWP. For terrestrial mammal TRVs, the hierarchy of choices will be values from Sample et al. (1996), then values from the ECOTOXicology Database System (EPA 1996, URL <http://www.epa.gov/ecotox>), then surrogate values for structurally similar chemicals provided by Ecology and EAP. Specifically, heavy PAHs for which there are no TRVs will be assigned the surrogate TRV of 0.1 mg/kg/d; the TRV for methyl mercury (0.032 mg/kg/d) will be added and the TRV for zinc will be changed to the EPA value of 10.4 mg/kg/d. The definition of "heavy PAH" was not readily apparent in the SLERAP. For the RPP-WTP risk assessment workplan, it is assumed to mean any PAH with a molecular weight above 200. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty. See also the response to comment RAWP-015.

Tracking # RAWP-162 / V-IV, S-026

Comment

Appendix C, Appendix C-3, Table C3-8, Sediment TRVs for Sediment Dwelling Biota, Page C3-121. There is no explanation in the text of the work plan that explains the method for choosing between the Ontario and NOAA numbers in this table when both are available. It is in the footnotes, but an explanation needs to be in the text.

Recommendation: Describe the hierarchy used to select TRVs from multiple sources.

Response

Agree. The text will be revised to reflect the method of choosing the recommended TRV. Specifically, for sediment TRVs, the hierarchy will be values from the SLERAP, then No Effect Levels and Lowest Effect Levels from Persaud et al. (Persaud, D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of the Environment and Energy), then Apparent Effects Thresholds from Washington State Department of Ecology (Ecology. 1994. Creation of Freshwater Sediment Quality Database and Preliminary Analysis of Freshwater Apparent Effects Thresholds), then values published by Ingersoll et al. (Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, and N.E. Kemble. 1996. "Calculation and evaluation of sediment effect concentrations." J. Great Lakes Res.: 22:602-623). For COPCs whose values are not available from those sources, values and methods found in Jones et al. (1997) will be used. If there is no TRV in these sources, no TRV will be listed, and this lack of data will be handled as an uncertainty. See also the response to comment RAWP-015.

Tracking # RAWP-163 / V-IV, S-027

Comment

Appendix C, Appendix C-3, Table C3-9, Surface Water TRVs for Aquatic Biota, Page C3-138. The NAWQC TRV values are used over the EPA value. These numbers, for the most part, are higher than the EPA numbers, which will have the effect of lowering the HQ.

Recommendation: Include an explanation of the rationale in choosing one group of values over another.

Response

Agree. The text will be revised to reflect the method of choosing the recommended TRV. For freshwater TRVs, the hierarchy will be values from the SLERAP, National Ambient Water Quality Criteria, the Final Chronic Values, then Great Lakes Tier II Secondary Chronic Values, then toxicity values from published literature. If there is no toxicity value for a COPC, a surrogate with a similar structure will be sought. If there is no surrogate, no TRV will be listed, and this lack of data will be handled as an uncertainty. See also the response to comment RAWP-015.



Meeting Minutes

CCN: 023430

Group Chair/ Secretary:

Meeting: *Date / Time 9/6-7/2001*

Location EPA Region 10, 1200 6th Avenue, Seattle, WA

Next Meeting: *Date / Time TBD*

Location TBD

Purpose: Discuss proposed final resolution of remaining open comments on the Risk Assessment Work Plan

Prepared by: Lee Bostic

The meeting began with introductions, a review of agenda items, overview of the technical issues to be discussed, and agreement on the scope of the discussions to occur over the two day period.

The RPP—WTP provided a package of Notice of Deficiency (NOD) comments, along with history of the previous resolution discussions and a proposal for reaching final agreement on the comment resolution. This package is attached to these minutes (Attachment 1). These minutes are organized to refer to the table of contents provided in the discussion package.

Day 1 September 6, 2001

- 1 Comment No. 72(a), 11/1-2/00 meeting minutes No. 3 and 24, Attachment 1, page 5 – Sweat Lodge Parameters

Discussion: The RAWP will address all 46 radionuclides of potential concern (ROPCs) (SR). Since all ROPCs are addressed, we should address all COPCs including all the inorganic COPCs in addition to the volatile and semi-volatile COPCs. Treating volatile and non-volatile radionuclides the same may be too conservative (JM, MB). Accentuated human physiological processes could increase exposure in the sweat lodge and this can be mentioned in the uncertainty section. (DD) *[Note: reference to initials used in the meeting minutes appear in the Attendance/Distribution list.]*

The RAWP needs to be clear that there are two different mechanisms that could lead to exposure, the volatiles are gases while the non-volatiles are aerosols. For the volatile ROPCs (H^3 and C^{14}) everything from all the water will go into the air. For non-volatiles becoming airborne as an aerosol, the limit is the amount of water in the air at any one time (the maximum is 100% humidity) (JM).

Conclusion: The accepted resolution is: Add inorganics to the evaluation; for volatiles, show all 4 liters go to air, for non-volatiles, use the air saturation point.

- 2 Comment No. 72(b), 11/1-2/00 meeting minute No. 24, Attachment 1, page 6 – Dermal Exposure in Inhalation Slope Factors to Radionuclides in the Sweat Lodge

Discussion: MB wanted to discuss why the dermal pathway isn't important for inorganics and radionuclides. JM performed a calculation for I^{129} and determined that a COPC/ROPC would

require a K_p of 122 cm/hr to contribute a dose equal to the inhalation dose. To do the calculation JM used the ingestion dose conversion factor corrected to remove F_1 . Based on the calculation JM felt the dermal pathway is miniscule and can be neglected.

Conclusion: Inorganic and ROPC K_p 's are well below 122 cm/hr; therefore, the dermal absorption component can be neglected. The dermal component will be considered for organics and H^3 . For H^3 , multiply the inhalation dose by 2. The discussion should include JM's 3/2000 letter, issue no. 4 and the inorganic K_p table from the new (draft) dermal guidance.

3 Comment No. 84, 11/1-2/00 meeting minute No. 25, Attachment 1, page 7 -- Background Concentrations of Radionuclides in Human Milk

Discussion: Limited data are available – we have cow milk data and human body burden data. Questions – Can cow milk data be used as equivalent to human milk data? Can human body burden be used to calculate human milk concentrations? (SR, BC) Are lipid concentrations the same? (MB) Using cows milk concentrations will overstate human milk concentrations due to foraging (JM). What's the impact of human consumption of beef and cow's milk? (SR) One option is use cow milk consumption instead of adjusting for lipid concentrations (MB, SR). We could employ bio-kinetic models (ICRP 30 & 60) to determine human milk concentrations (JM). The purpose of this effort was to collect background concentrations in human milk – similar to dioxin. There is a concern about performing calculations with little benefit. Make it clear that cow milk is not a surrogate; its just provided for comparison. (CM) We could do infant using cow milk as an alternate source of food. (MB) A possible source of additional data is the Environmental Measurements Lab in New York.

Action: JM will provide a phone number and possibly a contact name at the Environmental Measurements Lab.

Conclusion: Don't extrapolate cow milk to human milk using calculations. Use cow milk as an alternate food for infant; clarify that cow milk is not a surrogate. Convert the body burden data to human milk concentration.

4 Related Question – Guidance equations don't include inhalation for exposure of mother to radionuclides.

Discussion: Probably not included because the guidance equation was developed for dioxins. (MB) Inhalation exposure is similar to other indirect exposure pathways. (SR) Inhalation appears to have been deliberately excluded. (BC)

Conclusion: Include inhalation pathway. Agency appreciates having the information.

Action: MB investigate the reason inhalation was excluded from the nursing infant exposure pathway and report findings.

5 Comment No. 74, 11/1-2/00 meeting minute No. 4, Attachment 1, page 9 – Models for H^3 and C^{14}

Conclusion: Proposed resolution beginning on the Attachment 1, page 9 is accepted

6 Comments No. 86 and 87, 11/1-2/00 meeting minute No. 25, Attachment 1, page 11 – Acute Effects of Radionuclides

Discussion: One rem was incorporated into model as requested. (BC) Resolution is very responsive; wanted to confirm whether any other approaches might be appropriate. (CM) We could investigate how California addresses acute effects or describe the approach as similar to NOAEL. (MB)

Conclusion: Proposed resolution is accepted. Write up the approach very carefully so that is understood that we cannot equate the 1-hr radionuclide exposure to other 1-hr exposures. Clarify

that 1-rem is not an acute criterion. While it is possible that we may approach some of the acute criteria for some other COPCs and it is not a major concern; we will not approach the 1-rem criterion for ROPCs which would be reason for a great deal of concern.

- 7 Comment No. 117, 11/1-2/00 meeting minute No. 36, Attachment 1, page 19 – Depth Correction for HEAST Slope Factors

Conclusion: Proposed resolution on Attachment 1, page 19 is accepted.

- 8 Related Question – Attachment 1, page 20 – New Guidance for Evaluation of External Exposure from Soil

Conclusion: Proposed resolution is accepted with the following changes:

- Add more explanation of exposure time distribution (indoors and outdoors) for Native Americans.
- Add more justification for the percent of time spent outdoors by the Hanford worker; cite the EIS that estimates workers spend 100% of time indoors; give types of activities conducted outdoors and explain how the 50% outdoor value was estimated.
- Clarify the OSWER reference. Follow-up on 9/17/01 from SR; the document should be OSWER Directive 9355.4-16.

- 9 New Item – Attachment 1, page 22 – New HEAST Slope Factors

Conclusion: Proposed resolution is accepted; make adjustment for H³.

- 10 11/1-2/00 meeting minutes No. 3 and 23, Attachment 1, page 23 – Latest Slope Factor Data for 2,3,7,8 TCDD

Discussion: RPP—WTP needs to have a 9/30/01 cutoff date for new data – when might the new slope factor be approved? (BC)

Approval is not expected in the near term; the issue is being discussed at the Deputy Administrator level in EPA. (MB)

All agreed to the 9/30/01 cutoff date for the PRA. The public may want to know how the new slope factor would affect the results. Therefore, if dioxins are within a factor of 6 of the acceptance criteria, additional work may be required to address.

Note: we are running the PRA before Ecology approval of the RAWP. Toxicology numbers will require updating before the SLRA and FRA and run. (CM)

Conclusion: The proposed resolution is accepted for the PRA.

- 11 Comment No. 86, 11/1-2/00 meeting minute No. 7, Attachment 1, page 24 – Hierarchy of Acute Toxicity Values

Discussion: For the March 2001 proposed hierarchy, move value source priority number 4 (AREL) to priority number 2 behind NCEA values. Remove priority number 6 (SCAPA) because its not really used. Don't mix units in the hierarchy table; convert all values to the same units and provide a reference to the original (non-converted) values in an appendix. (MB)

Conclusion: Proposed resolution is accepted with changes noted in the discussion.

- 12 Comment No. 67, 11/1-2/00 meeting minute No. 1, Attachment 1, page 39 – Map of Day Care Centers

Discussion: Public input is post PRA but before Ecology approves the RAWP. We may use isopleths if public wants a large number of locations mapped.

Conclusion: Proposed resolution is accepted with changes noted in the discussion.

Note, the PRA referenced in the RAWP will be performed pursuant to Ecology's final review/approval of the RAWP. Ecology's approval process for the RAWP will include public input. The draft PRA that is referred to in these meeting minutes is an earlier risk evaluation performed to provide support for design purposes.

- 13 Comment No. 91, 11/1-2/00 meeting minute No. 9, Attachment 1, page 41 – Agency Input on Hazard Indices

Discussion:

Step 1

- Don't try to segregate all 470 constituents
- Where HI's are greater than 0.25, pick 1 or 2 drivers and see if they need to be added to other COPC values

Step 2

- Identify other COPCs with the same mode of action
- Work with Agency to reach agreement on method of addition.

Default position is that all HIs are additive. (MB)

Conclusion: Perform Step 1 above and then discuss with Agency as part of the technical review of the Preliminary Risk Assessment.

- 14 New issue – Attachment 1, page 42 – Exclusive Diet for Mammal and Bird Receptors

Conclusion: Proposed resolution is accepted.

- 15 Comments No. 13 and 15, 11/1-2/00 meeting minutes No. 38 and 39, Attachment 1, page 43 – Hierarchy for Ecological Effects Values

Discussion: Is the surface water hierarchy acceptable? (BC) Yes (All)

Is the soil hierarchy acceptable? (BC) Yes (All)

Is the sediment hierarchy acceptable? (BC) Yes, but clarify use of reference values as follows:

- Default to latest dated reference for lower values than SLERAP. If value is higher, revisit and explain it.

Conclusion: Proposed resolution is accepted with the use of references as described above.

- 16 Comment No. 130, 11/1-2/00 meeting minute No. 43, Attachment 1, page 46 – Documentation of ORNL Compiled Values

Conclusion: Proposed resolution accepted.

- 17 11/1-2/00 meeting minute No. 45, Attachment 1, page 48 – Sediment/Surface Water Transfer Models

Discussion: Confirmed that +D slope factors consider at secular equilibrium.

Conclusion: Proposed resolution accepted.

- 18 Comment No. 108, 11/1-2/00 meeting minute No. 32, Attachment 1, page 54 – Surrogate Values for BCFs, FCMs, Others

Conclusion: Proposed resolution is accepted with the following clarification. Treat C¹⁴ based on specific activity of C¹⁴O₂ dissolved in water. Use same treatment for atmosphere.

Action: BC find 2001 methyl mercury reference. BC provided a reference on 9/7/01 and provided an update shortly afterward:

Water Quality Criterion for the Protection of Human Health: Methyl Mercury, EPA-823-R-01-001, Office of Water, U.S. Environmental Protection Agency, Appendix A, Section 1, "Draft National Methyl Mercury Bioaccumulation Factors". The document can be found on the web at the following address – <http://www.epa.gov/water/science/criteria/methylmercury/mercappa.pdf>

- 19 Comments No. 12 and 101, 11/1-2/00 meeting minute No. 28, Attachment 1, page 57 – Salmonid Toxicity

Discussion: National Marine fisheries Service wanted to go beyond the SLERAP approach for the Kalama project.

Conclusion: Proposed resolution accepted – be aware that there is potential for change.

Actions:

CM provide the Kalama data.

LH discuss how recent EIS's dealt with endangered salmon; did the EIS gather baseline data?

- 20 Comment No. 116, 11/1-2/00 meeting minute No. 35, Attachment 1, page 59 – Reference from Agency on Ecological QF of 5.

Conclusion: The reference provided is correct.

- 21 New issue – Uncertainty

Discussion: DOE benchmarks of 0.1 rad/day terrestrial and 1 rad/day aquatic are acceptable. However, the benchmarks did not take into account egg exposure, immature life stages, etc. Make sure the uncertainty section acknowledges that certain life stages are not part of the benchmark. The possibility of biological effects from radiation doses below the thresholds will be discussed in the uncertainty section.

- 22 New issue – Schedule

Discussion: Proposed schedule as of September 6, 2001 (further schedule revisions are expected):

- Draft PRA available early February 2002
- RAWP revised by July/August 2002

There is a need for public input before Ecology approves the RAWP. There is a need to establish caucus points to review model output.

Note, the PRA referenced in the RAWP will be performed pursuant to Ecology's final review/approval of the RAWP. Ecology's approval process for the RAWP will include public input. The draft PRA that is referred to in these meeting minutes is an earlier risk evaluation performed to provide support for design purposes.

Day 2 September 7, 2001

The second day began with a review of the discussion on the preceding day and a presentation of the May 2001 emissions report. Presentation slides are attached (Attachment 2).

23 Emissions Estimate Report presentation and discussion

Discussion:

Does the revised report say that organic concentrations could exceed 4%, the contract limit? (CM) No. (LB) This lower value is a change from Rev. 0. There are no organic concentrations greater than 4% during the first 11 years of production assuming the scheduled tanks are processed (Emissions Report Section 8.2, page 15).

What do the detection limits in the report mean? (CM) To the extent possible the values generated during the "Fate of Hazardous Organic" testing at Vitreous State Laboratory are used. How do the detection limit values compare to those in the risk guidance? (CM) Tetra Tech believes the values used are higher. (TO) The method of dealing with detection limits is described in the RAWP which reflects the newer guidance on detection limits. (CM)

For the proposal to replace the caustic scrubber with the silver mordenite to reduce emissions of I¹²⁹, was the impact on acid gas releases and the release of other organic and inorganic constituents considered? (CM) Does the mordenite media become less efficient over time? (MB) Yes. (LB) How will the operators know if the catalyst is being degraded to the point where performance is impaired and media changeout is needed? (CM) Ecology is concerned about catalyst poisoning with compounds such as nitrates. (SS) What backup systems are available if the catalyst should fail; (the caustic scrubber could serve that function if it remained in the design). The general backup question could apply to other control devices and systems? (CM) Redundancies are better than monitoring instrumentation. (CM) The design engineers should look at the system design and provide answers to the above questions. (SS) If sufficient redundancies are not available, permit conditions may require feed shutdown until an inoperative or degraded control device is repaired or replaced. (CM) Because the RCRA requirements are much more detailed than the air permits, media change might be required more frequently.

Has the catalyst for the catalytic oxidizers been selected? (CM) Final decisions have not been made. (LB)

For the performance test, we should expect to have the system up and running and test conditions to represent the performance at the end of useful life of the control devices. WTP needs to evaluate how much catalyst is emitted from the stack. (CM)

Have mercury emissions been determined? (JY) WTP will have some; they are not expected to be methylated. (LB) The default methylated fractions in the guidance are 2% for dry soil and 15% for wetland soil; the values are very conservative. (BC)

MACT Standards:

- Mercury exceeds the limits; additional carbon units may be required to control emissions.
- Organics pass in total but some specific constituents exceed the limit, particularly volatiles.
- Particulates meet the limits

Action:

LB compare the detection limit values used in the emissions report with the risk assessment guidance.

BE provide CM a copy of the BACT/BARCT/T—BACT analyses. Documents provided.

24 Permit modification

Discussion: Because of the extensive permit modifications that will be required to keep abreast of the design, some attention needs to be paid to the modification process. An example is modifications to add the equipment design detail and design specifications. The ATG compliance schedule provides some guidance.

Additional Follow-up on the November 2000 Discussions

25 Comment No. 86, 11/1-2/00 meeting minute No. 7 – Ecology and EPA requested additional review of the acute/accident scenario

Discussion: WTP explained that they were not able to identify an acute release scenario and provided preliminary information on the efforts to do so. (LB) The acute scenario needs to be reviewed in more detail after the process review is completed. Explain in detail why an acute release scenario is not included. Discuss what WTP has done to evaluate the 1-hr acute scenario. WTP is not evaluating accident scenarios in the risk assessment and HEPA filters will treat any releases from any of the process equipment.

26 Comment No. 14, 11/1-2/00 meeting minute No. 19 – Upset factors

Discussion: WTP will use the EPA default upset factors for vapor phase emissions from the melters. (SR) The upset factor for particulates is built into the HEPA filter DF values which are more conservative than the ATG values.

Note: there are joint EPA/DOE efforts to evaluate HEPA filter efficiency degradation. They have a good understanding of what degrades HEPA filters but not the extent of degradation.

Conclusion: Clearly explain how the upset factors were determined.

27 Comments No. 42, 43, and 46 and 101, 11/1-2/00 meeting minute No. 18 – Fugitive Emissions

Discussion: There are no true fugitive emissions from the WTP. WTP is looking at the affect of abated fugitive emissions from valves, jumpers, etc. using EPA default values. The storage tanks and the transfer to the WTP should be considered. (CM) The storage tanks are included in the Double Shell Tank permit, a separate permit. Propose looking at transfers (e.g. the transfer pit) instead of tank operations (BE).

Conclusion: WTP will continue to look at potential sources of abated fugitive emissions and look at waste transfer as opposed to the storage tank operations.

28 Follow-up to 9/6/01 discussion – Comment No. 86 and 87, 11/1-2/00 meeting minute No. 25, Attachment 1, page 11 – Acute Effects of Radionuclides (refer to minute item no. 6 from 9/6/01 discussion)

Discussion: MB investigated using a protocol similar to chemical exposures for ROPCs. Using the California methodology, the following would be appropriate:

- Lowest levels where blood cell changes are observed 5—25 rem; use 10 rem (LOAEL)
- Reduce by a factor of 10 to get NOAEL of 1 rem

- Reduce by another factor of 10 to account for sensitive receptors to get acute scenario value of 0.1 rem
- Apply the 0.1 rem over the worst 1-hr meteorological period
- Discuss the facts that unless 5-25 rem are delivered in a very acute exposure, you don't get an effect; when using 100 mrem, one would not anticipate any effect

Conclusion: Explain why the methodology was used. Note that this value does not include the effect of intermittent exposures. Make sure we explain that adverse effects are not expected at the 100 mrem exposure levels developed using this methodology.

29 Follow-up to the 9/06/01 schedule discussion

Discussion: DOE, Ecology, and EPA observed that to proceed to produce a draft Preliminary Risk Assessment may cause difficulties when the Dangerous Waste Permit (DWP) is presented to the public. They think that a better approach would be to complete the RAWP, issue it for public comment, and incorporate the RAWP approval into the DWP.

The WTP staff acknowledged that accelerating the completion of the RAWP would be preferable. However an early production of the PRA is necessary because the results may drive requirements to make design changes. Because of time constraints, both documents cannot be produced concurrently and switching the focus to the RAWP will impact the completion dates.

Action:

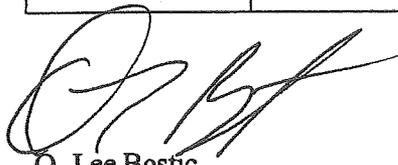
BNI and DOE will discuss and develop an approach and revised schedule proposal.

Action Table

Action Item	Responsibility	Due Date	Action to Close
3.1 Background Concentrations of Radionuclides in Human Milk	John Mauro		Provide telephone number and contact for Environmental Measurements Laboratory.
4.1 Inhalation of radionuclides	Marcia Bailey	Closed	Check on the logic for not including the inhalation exposure pathway for the mother. Inclusion of the inhalation pathway for a nursing mother (HHRAP Table C-1-6), should apply to both non-rad chemicals and radionuclides evaluated in the breastmilk pathway (not just radionuclides). Information provided by MB via email on 10/02/01.
18.1 Surrogate Values for BCFs, FCMs, Others	Barney Cornaby	Closed	Check on the 2001 reference for methyl mercury. Information provided on 9/7/01.

Action Table

19.1 Salmonid Toxicity	Catherine Massimino	Closed	Provide information from National Marine Fisheries Service related to salmon from the Kalama project. Information provided on 9/7/01.
19.2 Salmonid Toxicity	Lori Huffman		Talk to Paul Dunigan re: treatment of endangered salmon in recent EIS's; was baseline data gathered?
23.1 Emissions Estimate Report presentation and discussion	Lee Bostic		Compare the detection limit values used in the emissions report with the risk assessment guidance.
23.2 Emissions Estimate Report presentation and discussion	Brad Erlandson	Closed	Provide CM a copy of the BACT/BARCT/T—BACT analyses. Provided.



O. Lee Bostic
Environmental Lead

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Attachment 1 to CCN 023430

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FORMAT FOR TECHNICAL ISSUES

- Title of issue and orientation numbers
- The Comment (Summer 2000)
- Original Response (October 2000)
- Meeting Minutes (November 2000)
- Revised Response (March 2001)
- Proposed Resolution (August 2001)

**VOLATILE RADIONUCLIDES IN THE SWEAT LODGE - Meeting Minutes No. 3, No. 24;
Comment No. 72**

Comment no. 72 (Summer 2000):

Section 7.1.5.10, Page 7-13, Inhalation of Vapors in Sweat Lodge Scenario. The ROPCs that are considered volatile are not identified

Original Response (October 2000):

Volatile ROPCs will be identified as Sb-125, C-14, Cs-134, Cs-137, I-129, Ru-106, Tc-99, and H-3.

Meeting Minute no. 3 (November 2000):

Cesium was removed from the list of volatile ROPCs.

Meeting Minute no. 24 (November 2000):

John Mauro of Sandy Cohen & Associates said I-129, H-3, and C-14 are volatile in the sweat lodge scenario. Cs does not volatilize below 600°F so it will not be volatile in the sweat lodge scenario. It is appropriate to remove Cs-134 and Cs-137 from the list of radionuclides evaluated in the sweat lodge scenario. Sb-125, Ru-106, and Tc-99 become a residue when water is boiled off and could possibly become airborne. Rh and other transitional metals should be reviewed because they may be volatile under certain circumstances. John will review the entire list of 46 radionuclides for this scenario, and will provide more information.

Revised Response (March 2001):

Initially, volatile ROPCs were considered to be Sb-125, C-14, Cs-134, Cs-137, I-129, Ru-106, Tc-99, and H-3. John Mauro of Sandy Cohen & Associates is confirming which ROPCs may be volatile. Per John Mauro's preliminary evaluation I-129, H-3, and C-14 are considered volatile and will be evaluated in the sweat lodge scenario. Sb-125, Ru-106, and Tc-99 may also be volatile; if these ROPCs are volatile, they will also be evaluated in the sweat lodge scenario. The final list of ROPCs identified as potentially volatile under sweat lodge conditions by SAIC and John Mauro of Sandy Cohen and Associates will be included in this assessment.

PROPOSED RESOLUTION (August 2001):

Per the report received from Tetra Tech EM Inc. (a subcontractor to USEPA), dated March 27, 2001, it is likely that H-3 and C-14 are the only radionuclides that would become volatile in a sweat lodge. However, given the uncertainty in the evaluation and the potential for the generation of aerosols, Tetra Tech recommended that all 46 ROPCs should initially be evaluated. If this pathway results in an unacceptable risk, Tetra Tech recommends that further analysis of the potential behavior of radionuclides in the sweat lodge be conducted.

DERMAL EXPOSURE IN INHALATION SLOPE FACTORS TO RADIONUCLIDES IN THE SWEAT LODGE - Meeting Minute No. 4; Comment No. 72

Comment no. 72 (Summer 2000):

Section 7.1.5.10, Page 7-13, Inhalation of Vapors in Sweat Lodge Scenario. ... the rationale for excluding a sweat lodge dermal absorption pathway for ROPCs is not addressed.

Original Response (October 2000):

...Regarding the dermal absorption pathway, the RAWP states that dermal absorption will be analyzed. The equation for this is provided in Section 7.1.5.11 and will be used to analyze this pathway.

Meeting Minute no. 24 (November 2000):

For the dermal and air inhalation pathway, H-3 is the only candidate in the list provided in the comment 72 response. John [Mauro of Sandy Cohen & Associates] is hesitant on I-129; others are unlikely to have significant dermal absorption component. John will look more closely at I-129 for inhalation and to determine if it has a gamma or x-ray component which might make the external exposure significant.

John believes that the dose conversion values and HEAST slope factors include a dermal component for radionuclides that may have significant dermal absorption (e.g., H-3 which has 50% of the dose assigned to inhalation and 50% assigned to dermal absorption); he will review the Federal Guidance Report no. 14 and HEAST for confirmation. The C-14 is the same as H-3.

Revised Response (March 2001):

The dermal absorption pathway is not evaluated separately for ROPCs because dermal absorption is included in the inhalation dose conversion factor and inhalation slope factor for radionuclides with significant dermal absorption (e.g., for tritium approximately 50% of the inhalation dose is actually dermal).

PROPOSED RESOLUTION (August 2001):

Per the report received from Tetra Tech EM Inc., dated March 27, 2001, dermal absorption of tritium is included in the inhalation slope factor, and dermal absorption of and external exposure to I-129 is insignificant compared to inhalation. Based on this information dermal absorption of ROPCs in the sweat lodge does not need to be evaluated separately from inhalation.

BACKGROUND CONCENTRATIONS OF RADIONUCLIDES IN HUMAN MILK - Meeting Minute no. 25; Comment no. 84

Comment no. 84 (Summer 2000):

Section 7.2.11.2, Estimated Cancer Risk, Page 7-26. This section states that background radionuclide concentrations are not available. Given the amount of environmental radiological surveillance performed at and in the vicinity of the Hanford Reservation, there is certainly data on background levels of tritium, plutonium, radium, thorium, uranium, and cesium in soil, water, plants, and aquatic organisms probably in the annual environmental radiological surveillance reports issued by DOE for Hanford. Also, note that EPA (1998) guidance discusses the uncertainty of projecting cancer risks associated with the AT = 1 for infant exposures to dioxin via breast milk.

Recommendation: Amend the section to include background concentration of radionuclides in the environment, both naturally occurring and ubiquitous manmade radionuclides so that the incremental increase in contamination and risk from the facility can be understood within this perspective.

Original Response (October 2000):

The text of Section 7.2.11.1 will be modified to make it clear that background concentrations of radionuclides are not available for breast milk. Background exposures are used to evaluate the nursing infant exposure because of the high uncertainty, and potential inappropriateness, of evaluating cancer risk from brief early-life exposure. Background concentrations in other exposure media will not be included in the RAWP because they are out of the scope of the SLRA and dangerous waste permit application. ...

Meeting Minute no. 25 (November 2000):

The only radionuclide of significance in breast milk is K-40. There are some manmade radionuclides such as Cs-137 and Pu. John [Mauro of Sandy Cohen & Associates] will look for literature values in breast milk. The values can be compared with the Hanford annual reports of emissions. The emissions could be compared with the larger effort to get an idea of risk.

Revised Response (March 2001):

The original response was restated, and the following was added.

A discussion of the uncertainty associated with calculating cancer risks for an infant exposure and the potential for over-estimating lifetime cancer risks by using an averaging time of one year will be included in the RAWP.

PROPOSED RESOLUTION (August 2001):

The initial search for background concentrations of radionuclides has turned up limited data.

The National Council on Radiation Protection and Measurements (NCRP 1975) provides concentrations of Sr-90 and Cs-137 in cows' milk between 1958 and 1972. For example, the concentration of Sr-90 ranged from 4 pCi/L in 1972 to 26 pCi/L in 1964.

NCRP also provides human body burden data for Cs-137 from 1953 through 1971. Total body burdens ranged from 280 pCi in 1953 to 19000 pCi in 1964. This type of measured body burden data may be used to calculate radionuclide concentrations in human milk.

We are continuing to search the literature for additional information. We anticipate receiving results of the 1999 Hanford radiological surveillance data from EPA/Tetra Tech.

Reference:

National Council on Radiation Protection and Measurements 1975. *Natural background radiation in the United States: Recommendations of the National Council on Radiation Protection and Measurements.* Washington, D. C. : The Council, 1975.

MODELS FOR H-3 AND C-14 - Meeting Minute No. 4; Comment No. 74

Comment no. 74 (Summer 2000):

Section 7.2, Toxicity Assessment. Page 7-16. Special models are required for the assessment of the doses and risks associated with the release of H-3 and C-14 to the atmosphere. These models are not addressed in the report. See NRC Regulatory Guide 1.109 for a description of the models.

Recommendation: Please describe the methods that will be used to evaluate the radiation risks associated with tritium and C-14 emissions. We suggest you consider the models described in U.S. NRC Regulatory Guide 1.109.

Original Response (October 2000):

We will evaluate and use the models in NRC Regulatory Guide 1.109.

Meeting Minute no. 4 (November 2000):

Response was accepted as written.

Revised Response (March 2001):

No revised response.

PROPOSED RESOLUTION (August 2001):

Risk calculations for most ROPCs are based on the assumption that radionuclides are present as particulates or vapors. However, special consideration must be given to carbon-14 and tritium (hydrogen-3), as these ROPCs are processed by vegetation with natural carbon and hydrogen, respectively. Thus, the vegetation ingestion pathways for carbon-14 and tritium are dependent on the exchange of carbon and hydrogen between plants and the environment. For this assessment, guidance from Regulatory Guide 1.109 is used to account for the bioaccumulation of carbon-14 and tritium in plants that could lead to human exposure through ingestion of vegetation and other foodstuffs that consume vegetation (i.e., beef, venison, pork, poultry, and dairy products). This is achieved through the use of correction factors, along with the assumption that all carbon-14 is released by the RPP-WTP in oxide form (CO or CO₂) and tritium is released as water vapor. These correction factors are applied to the air concentration (e.g., pCi/m³) estimated at the point of exposure by the air model.

The concentration of carbon-14 in vegetation is calculated assuming that its ratio to the natural carbon in vegetation is equal to the ratio of carbon-14 to natural carbon in the atmosphere surrounding the vegetation:

$$C_{V,C-14} = C_{A,C-14} \times p \times (0.11 / 0.16)$$

where

- $C_{V,C-14}$ = concentration of carbon-14 in vegetation (pCi/g),
 $C_{A,C-14}$ = concentration of carbon-14 in the surrounding air (pCi/m³) from air dispersion modeling,
 p = ratio of the total annual release time (8760 hours) to the total annual time during which photosynthesis occurs (1440 hours),
0.11 = fraction of total plant mass that is natural carbon (dimensionless),
0.16 = concentration of natural carbon in the atmosphere (g/m³).

The concentration of tritium in vegetation is calculated based on the equilibrium between moisture in the air and water in plants:

$$C_{V,H-3} = C_{A,H-3} \times 0.75 \times (0.5 / H)$$

where

- $C_{V,H-3}$ = concentration of tritium in vegetation (pCi/g),
- $C_{A,H-3}$ = concentration of tritium in the surrounding air (pCi/m³) from air dispersion modeling,
- 0.75 = fraction of the total plant mass that is water (dimensionless),
- 0.5 = ratio of tritium concentration in plant water to tritium concentration in atmospheric water (dimensionless),
- H = humidity of the atmosphere (g/m³).

These methods will be added to the Risk Assessment Work Plan (RAWP) and used in the Preliminary Risk Assessment (PRA).

Reference:

USNRC 1977. *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Regulatory Guide 1.109*, Office of Standard Development, October.

ACUTE EFFECTS OF RADIONUCLIDES - Meeting Minute No. 25; Comment No. 86 And No. 87

Comment no. 86 (Summer 2000):

... Explain why the DACs and ALIs are used as the criteria for acute exposures as indicated on line 44 of page 7-27?

Comment no.87 (Summer 2000):

Section 7.2.12, Page 7-28. A reference for the 50 mrem limit for a one hour period regarding acute rad exposure is not provided.

Original Response to comment no.87 (October 2000):

The 50 mrem limit is for protection of a pregnant woman. This will be clarified in the text.

Meeting Minute no.25 (November 2000):

Comment 86 continued, discussion with John Mauro – For determining the maximum 1-hour exposure, the Derived Air Concentrations (DACs) based on the annual limit on intake (ALI) aren't applicable.

There is a 10 mrem/yr annual exposure limit to deliver a lifetime 10^{-4} risk. It is inappropriate to extrapolate to shorter time periods. A 1-hour acute exposure that would cause an effect would be significantly above the ALIs.

John was asked to provide some background information on exposure related to Japanese radiological weapon survivors. He explained that without medical care the LD-50 is 350 rem; with aggressive medical care, 500 rem. A 1-hour exposure of 1000 mrem would cause blood changes and might be similar to an acute chemical exposure. This value could increase detectable risk to the developing fetus. There are textbook references available supporting this value; John will provide a reference. It was generally felt that this did not match with the NESHAP requirements or safety documentation.

In the RAWP explain why acute effects aren't calculated or use 1 rem as an acute criterion; it is the choice of DOE and the WTP how to do it.

Revised Response to comment no. 87 (March 2001):

The acute toxicity value for ROPCs will be changed to 1 rem. The following text will be added to Section 7.2.12 to replace the existing discussion of acute ROPC toxicity: "For acute exposures to ROPCs, derived air concentrations (DACs) of the radionuclide in air that under continuous exposure for a one-hour period would produce a total effective dose equivalent of 1 rem." John Mauro of Sandy Cohen and Associates agreed to provide the reference for this value.

PROPOSED RESOLUTION (August 2001):

Acute effects from a 1-hour exposure will be calculated using 1 rem as a total acute exposure criterion. The complete write-up justifying an acute limit of 1 rem was provided by Tetra Tech EM, Inc. and Sandy Cohen and Associates. The value will be included as an attachment to the RAWP. For each of the ROPCs, Acute Radionuclide Exposure Criteria (AREC) corresponding to an acute dose of 1 rem are calculated by Bechtel/SAIC as described below and presented in Table A.

The Bechtel/SAIC calculated ARECs include two exposure pathways associated with submergence in a cloud of particulate and vapor phase radionuclides: external gamma exposure and inhalation. The following equations were used to calculate ARECs for external gamma exposure and inhalation:

External Gamma Exposure:

$$AREC_E = DL / (CDE \times CF_1 \times CF_2 \times ET \times CF_3 \times CF_4)$$

Inhalation:

$$AREC_I = DL / (CDE \times CF_1 \times CF_2 \times BR \times ET \times CF_4)$$

Total:

$$AREC_R = 1 / (1/AREC_E + 1/AREC_I)$$

where

AREC _E	=	acute radionuclide exposure criteria for external gamma ($\mu\text{Ci}/\text{cm}^3$),
AREC _I	=	acute radionuclide exposure criteria for inhalation ($\mu\text{Ci}/\text{cm}^3$),
AREC _R	=	total acute radionuclide exposure criteria ($\mu\text{Ci}/\text{cm}^3$),
DL	=	dose limit of 1 rem (1000 mrem),
CDE	=	committed dose equivalent for radionuclide i (see Table A) (Sv·m ³ /Bq·s for external gamma; Sv/Bq for inhalation),
CF ₁	=	conversion Factor (mrem/Sv),
CF ₂	=	conversion Factor (Bq/ μCi);
ET	=	acute exposure time (1 h),
CF ₃	=	conversion Factor (s/h),
CF ₄	=	conversion Factor (cm ³ /m ³),
BR	=	breathing rate of standard man (1.2 m ³ /h).

ROPC decay products are represented in the calculation based on their respective decay probabilities. Parent radionuclides are given the "+D" designation to indicate that decay products are considered. Table B lists the parent and decay products included in the calculations. The following equation was used to calculate the committed dose equivalent (CDE) for the combination of a parent and decay product radionuclides:

$$CDE_{+D} = \sum_{i=1}^n CDE_i \times f_i$$

where

(see	CDE+D=	committed dose equivalent for radionuclide i and its daughter products
		Table A),
	CDE _i	= committed dose equivalent for radionuclide i,
	n	= total number of radionuclides in the decay chain,
	f _i	= decay probability of radionuclide i.

The calculated ARECs shown in Table A result in a dose of 1 rem from each of the 46 ROPCs; therefore, when combined for all 46 ROPCs, these concentrations would result in a total dose of 46 rem. These concentrations will be adjusted based on the predicted air concentrations to ensure that the overall dose from all 46 ROPCs will not exceed 1 rem for an acute exposure of 1 hour. Results of air dispersion modeling will be used to adjust these single ROPC ARECs as shown below:

$$AREC_M = AREC_R \times (C_R/C_T)$$

where

- $AREC_M =$ acute radionuclide exposure criteria for ROPC i corrected for the presence of multiple ROPCs ($\mu Ci/cm^3$),
- $AREC_R =$ acute radionuclide exposure criteria for ROPC i as calculated above and presented in Table A ($\mu Ci/cm^3$),
- $C_R =$ predicted air concentration of ROPC i ($\mu Ci/m^3$),
- $C_T =$ total predicted air concentration of all 46 ROPCs ($\mu Ci/m^3$).

Table A will be added to the RAWP along with the above equations.

Table A - Acute Radionuclide Exposure Criteria (AREC)

Radionuclide of Potential Concern	External CDE ^a (Sv-m ³ /Bq-s)	AREC _E ^b (μCi/cm ³)	Inhalation CDE ^c (Sv/Bq)	AREC _I ^d (μCi/cm ³)	AREC _R ^e (μCi/cm ³)
Actinium-227+D ^f	1.9E-14	4.1E-03	3.6E-04	6.3E-10	6.3E-10
Americium-241	8.2E-16	9.2E-02	1.2E-04	1.9E-09	1.9E-09
Americium-243+D ^f	9.9E-15	7.6E-03	1.2E-04	1.9E-09	1.9E-09
Antimony-125+D ^f	2.0E-14	3.7E-03	3.7E-09	6.0E-05	5.9E-05
Cadmium-113	1.5E-18	5.2E+01	4.5E-07	5.0E-07	5.0E-07
Carbon-14	2.2E-19	3.4E+02	7.8E-13	2.9E-01	2.9E-01
Cesium-134	7.6E-14	9.9E-04	1.3E-08	1.8E-05	1.8E-05
Cesium-137+D ^f	2.7E-14	2.8E-03	8.6E-09	2.6E-05	2.6E-05
Barium-137m ^g	Included in acute radionuclide exposure criterion for Cesium-137				
Cobalt-60	1.3E-13	6.0E-04	8.9E-09	2.5E-05	2.4E-05
Curium-242	5.7E-18	1.3E+01	4.7E-06	4.8E-08	4.8E-08
Curium-243	5.9E-15	1.3E-02	8.3E-05	2.7E-09	2.7E-09
Curium-244	4.9E-18	1.5E+01	6.7E-05	3.4E-09	3.4E-09
Europium-152	5.7E-14	1.3E-03	6.0E-08	3.8E-06	3.8E-06
Europium-154	6.1E-14	1.2E-03	7.7E-08	2.9E-06	2.9E-06
Europium-155	2.5E-15	3.0E-02	1.1E-08	2.0E-05	2.0E-05
Iodine-129	3.8E-16	2.0E-01	4.7E-08	4.8E-06	4.8E-06
Neptunium-237+D ^f	1.0E-14	7.2E-03	1.5E-04	1.5E-09	1.5E-09
Nickel-59	0.0E+00	0.0E+00	2.5E-10	9.1E-04	9.1E-04
Nickel-63	0.0E+00	0.0E+00	6.2E-10	3.6E-04	3.6E-04
Niobium-93m ^g	4.4E-18	1.7E+01	8.7E-10	2.6E-04	2.6E-04
Plutonium-238	4.9E-18	1.5E+01	1.1E-04	2.1E-09	2.1E-09
Plutonium-239	4.2E-18	1.8E+01	1.2E-04	1.9E-09	1.9E-09
Plutonium-240	4.8E-18	1.6E+01	1.2E-04	1.9E-09	1.9E-09
Plutonium-241	7.3E-20	1.0E+03	2.2E-06	1.0E-07	1.0E-07
Plutonium-242	4.0E-18	1.9E+01	1.1E-04	2.0E-09	2.0E-09
Protactinium-231	1.7E-15	4.4E-02	2.3E-04	9.7E-10	9.7E-10
Radium-226+D ^f	8.9E-14	8.5E-04	2.3E-06	9.7E-08	9.7E-08
Radium-228+D ^f	4.8E-14	1.6E-03	1.3E-06	1.7E-07	1.7E-07
Ruthenium-106+D ^f	1.0E-14	7.2E-03	3.2E-08	7.1E-06	7.1E-06
Samarium-151	0.0E+00	0.0E+00	8.1E-09	2.8E-05	2.8E-05
Selenium-79	3.0E-19	2.5E+02	1.8E-09	1.3E-04	1.3E-04
Strontium-90+D ^f	2.0E-16	3.8E-01	6.7E-08	3.4E-06	3.4E-06
Yttrium-90	Included in acute radionuclide exposure criterion for Strontium-90				
Technetium-99	1.6E-18	4.6E+01	2.3E-09	1.0E-04	1.0E-04
Thorium-229+D ^f	1.5E-14	5.0E-03	4.7E-04	4.8E-10	4.8E-10
Thorium-232	8.7E-18	8.6E+00	3.1E-04	7.2E-10	7.2E-10
Tin-126+D ^f	9.6E-14	7.8E-04	2.7E-08	8.2E-06	8.1E-06
Tritium ^k	3.3E-19	2.3E+02	1.7E-11	1.3E-02	1.3E-02
Uranium-232	1.4E-17	5.3E+00	4.0E-06	5.6E-08	5.6E-08
Uranium-233	1.6E-17	4.6E+00	2.2E-06	1.0E-07	1.0E-07
Uranium-234	7.6E-18	9.8E+00	2.1E-06	1.1E-07	1.1E-07
Uranium-235+D ^f	7.7E-15	9.7E-03	2.0E-06	1.1E-07	1.1E-07
Uranium-236	5.0E-18	1.5E+01	2.0E-06	1.1E-07	1.1E-07
Uranium-238+D ^f	1.2E-15	6.4E-02	1.9E-06	1.2E-07	1.2E-07
Zirconium-93	0.0E+00	0.0E+00	2.3E-08	1.0E-05	1.0E-05

- ^a Committed dose equivalent (CDE) for external exposure from Federal Guidance Report no.12. CDE for +D radionuclides calculated as the sum of the product of the CDE and decay frequency for each daughter radionuclide in the decay chain.
- ^b Acute radionuclide exposure criteria for external exposure.
- ^c CDE for inhalation from Federal Guidance Report no.11. CDE for +D radionuclides calculated as the sum of the product of the CDE and decay frequency for each daughter radionuclide in the decay chain.
- ^d Acute radionuclide exposure criteria for external exposure.
- ^e Combined acute radionuclide exposure criteria for both external exposure and inhalation.
- ^f +D values include contributions from short-lived daughter products (see list of daughter products in Table B).
- ^g The "m" designates radionuclides in the metastable state.

Table B. Toxicity Values used in Human Health Risk Assessment: Radionuclide COPCs

ROPC	CAS no.	ICRP Lung Class ^a	Water Ingestion ^b (risk/pCi)	Food Ingestion ^b (risk/pCi)	Soil Ingestion ^b (risk/pCi)	Inhalation ^b (risk/pCi)	External Radiation to Soil ^b (risk/year per pCi/g soil)	External Radiation for Air Submersion ^c (m ³ /Bq-sec)	Isotopes used to Calculate Slope Factor ^d
Actinium-227+D ^e	14952-40-0	S	4.86E-10	6.53E-10	1.16E-09	2.09E-07	3.35E-07	1.34E-15	Ac-227, Th-227 (98.62%), Fr-223 (1.38%), Ra-223, Rn-219, Po-215, Pb-211, Bi-211, Tl-207 (99.73%), Po-211 (0.27%)
Americium-241	14596-10-2	M	1.04E-10	1.34E-10	2.17E-10	2.81E-08	1.36E-08	5.00E-17	Am-241
Americium-243+D ^e	14993-75-0	M	1.08E-10	1.42E-10	2.32E-10	2.70E-08	1.75E-07	6.83E-16	Am-243, Np-239
Antimony-125+D ^e	14234-35-6	M	5.13E-12	7.21E-12	1.32E-11	1.93E-11	3.71E-07	1.50E-15	Sb-125, Te-125m (22.8%)
Cadmium-113	14336-66-4	F	2.28E-11	2.90E-11	3.85E-11	1.12E-10	3.18E-11	3.29E-19	Cd-113
Carbon-14 ^f	14762-75-5	M	1.55E-12	2.00E-12	2.79E-12	7.07E-12	4.68E-12	3.66E-20	C-14
Carbon-14 ^f	14762-75-5	G	NA	NA	NA	1.99E-14	NA	3.66E-20	C-14
Cesium-134	13967-70-9	F	4.22E-11	5.14E-11	5.81E-11	1.65E-11	1.37E-06	5.68E-15	Cs-134
Cesium-137+D ^e	10045-97-3	F	3.04E-11	3.74E-11	4.33E-11	1.19E-11	4.97E-07	2.04E-15	Cs-137, Ba-137m (94.6%)
Barium-137m ^g	13981-97-0	Included in slope factor for Cesium-137							
Cobalt-60	10198-40-0	M	1.57E-11	2.23E-11	4.03E-11	3.58E-11	2.17E-06	9.63E-15	Co-60
Curium-242	15510-73-3	M	3.85E-11	5.48E-11	1.05E-10	1.51E-08	6.41E-11	2.59E-19	Cm-242
Curium-243	15757-87-6	M	9.47E-11	1.23E-10	2.05E-10	2.69E-08	1.05E-07	4.16E-16	Cm-243
Curium-244	13981-15-2	M	8.36E-11	1.08E-10	1.81E-10	2.53E-08	4.71E-11	2.15E-19	Cm-244
Europium-152	14683-23-9	M	6.07E-12	8.70E-12	1.62E-11	9.10E-11	9.94E-07	4.25E-15	Eu-152
Europium-154	15585-10-1	M	1.03E-11	1.49E-11	2.85E-11	1.15E-10	1.08E-06	4.63E-15	Eu-154
Europium-155	14391-16-3	M	1.90E-12	2.77E-12	5.40E-12	1.48E-11	4.29E-08	1.64E-16	Eu-155
Iodine-129 ^h	15046-84-1	F	1.48E-10	3.22E-10	2.71E-10	6.07E-11	5.24E-09	1.85E-17	I-129
Iodine-129 ^h	15046-84-1	V	NA	NA	NA	1.60E-10	NA	NA	I-129
Neptunium-237+D ^e	13994-20-2	M	6.74E-11	9.10E-11	1.62E-10	1.77E-08	1.87E-07	7.43E-16	Np-237, Pa-233
Nickel-59 ⁱ	14336-70-0	M	2.74E-13	3.89E-13	7.33E-13	4.66E-13	0.00E+00	0.00E+00	Ni-59
Nickel-59 ⁱ	14336-70-0	V	NA	NA	NA	2.41E-12	NA	NA	Ni-59

Table B. Toxicity Values used in Human Health Risk Assessment: Radionuclide COPCs

ROPC	CAS no.	ICRP Lung Class ^a	Water Ingestion ^b (risk/pCi)	Food Ingestion ^b (risk/pCi)	Soil Ingestion ^b (risk/pCi)	Inhalation ^b (risk/pCi)	External Radiation to Soil ^b (risk/year per pCi/g soil)	External Radiation for Air Submersion ^c (m ² /Bq-sec)	Isotopes used to Calculate Slope Factor ^d
Nickel-63 ¹	13981-37-8	M	6.70E-13	9.51E-13	1.79E-12	1.64E-12	0.00E+00	0.00E+00	Ni-63
Nickel-63 ¹	13981-37-8	V	NA	NA	NA	5.77E-12	NA	NA	Ni-63
Niobium-93m ^g	7440-03-1	M	8.03E-13	1.17E-12	2.31E-12	1.90E-12	3.84E-11	1.92E-19	Nb-93m
Plutonium-238	13981-16-3	M	1.31E-10	1.69E-10	2.72E-10	3.36E-08	5.65E-11	2.28E-19	Pu-238
Plutonium-239	15117-48-3	M	1.35E-10	1.74E-10	2.76E-10	3.33E-08	7.10E-11	2.56E-19	Pu-239
Plutonium-240	14119-33-6	M	1.35E-10	1.74E-10	2.77E-10	3.33E-08	5.51E-11	2.24E-19	Pu-240
Plutonium-241	14119-32-5	M	1.76E-12	2.28E-12	3.29E-12	3.34E-10	1.25E-12	4.89E-21	Pu-241
Plutonium-242	13982-10-0	M	1.28E-10	1.65E-10	2.63E-10	3.13E-08	4.77E-11	1.91E-19	Pu-242
Protactinium-231	14331-85-2	S	1.73E-10	2.26E-10	3.74E-10	4.55E-08	3.13E-08	1.24E-16	Pa-231
Radium-226+D ^e	13982-63-3	M	3.86E-10	5.15E-10	7.30E-10	1.16E-08	1.53E-06	6.74E-15	Ra-226, Rn-222, Po-218, Pb-214 (99.98%), At-218 (0.02%), Bi-214 (99.99%), Po-214 (99.98%), Tl-210 (0.02%)
Radium-228+D ^e	15262-20-1	M	1.04E-09	1.43E-09	2.29E-09	5.23E-09	8.45E-07	3.61E-15	Ra-228, Ac-228
Ruthenium-106+D ^e	13967-48-1	M	4.22E-11	6.11E-11	1.19E-10	1.02E-10	1.90E-07	7.85E-16	Ru-106, Rh-106
Samarium-151	15715-94-3	M	5.55E-13	8.07E-13	1.59E-12	4.88E-12	3.57E-13	1.52E-21	Sm-151
Selenium-79	15758-45-9	F	7.29E-12	9.69E-12	1.60E-11	3.33E-12	6.37E-12	5.39E-20	Se-79
Strontium-90+D ^e	10098-97-2	M	7.40E-11	9.53E-11	1.44E-10	1.13E-10	4.81E-09	2.10E-17	Sr-90, Y-90
Yttrium-90	10098-91-6	Included in slope factor for Strontium-90							
Technetium-99	14133-76-7	M	2.73E-12	4.00E-12	7.66E-12	1.41E-11	3.54E-11	3.72E-19	Tc-99
Thorium-229+D ^e	15594-54-4	S	5.28E-10	7.16E-10	1.29E-09	2.25E-07	2.68E-07	1.08E-15	Th-229, Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213 (97.8%), Tl-209 (2.2%), Pb-209
Thorium-232	7440-29-1	S	1.01E-10	1.33E-10	2.31E-10	4.33E-08	1.42E-10	5.35E-19	Th-232
Tin-126+D ^e	15832-50-5	M	2.72E-11	3.92E-11	7.50E-11	1.01E-10	1.75E-06	7.19E-15	Sn-126, Sb-126m, Sb-126 (14%)
Tritium ^j	10028-17-8	V	5.07E-14	6.51E-14	9.25E-14	5.62E-14	0.00E+00	0.00E+00	H-3

Table B. Toxicity Values used in Human Health Risk Assessment: Radionuclide COPCs

ROPC	CAS no.	ICRP Lung Class ^a	Water Ingestion ^b (risk/pCi)	Food Ingestion ^b (risk/pCi)	Soil Ingestion ^b (risk/pCi)	Inhalation ^b (risk/pCi)	External Radiation to Soil ^b (risk/year per pCi/g soil)	External Radiation for Air Submersion ^c (m ² /Bq-sec)	Isotopes used to Calculate Slope Factor ^d
Tritium ^j	10028-17-8	M	1.12E-13	1.44E-13	2.20E-13	1.99E-13	NA	NA	H-3
Uranium-232	14158-29-3	M	2.92E-10	3.85E-10	5.74E-10	1.95E-08	2.33E-10	8.67E-19	U-232
Uranium-233	13968-55-3	M	7.18E-11	9.69E-11	1.60E-10	1.16E-08	2.84E-10	1.09E-18	U-233
Uranium-234	13966-29-5	M	7.07E-11	9.55E-11	1.58E-10	1.14E-08	1.18E-10	4.37E-19	U-234
Uranium-235+D ^e	15117-96-1	M	7.18E-11	9.76E-11	1.63E-10	1.01E-08	1.37E-07	5.43E-16	U-235, Th-231
Uranium-236	13982-70-2	M	6.70E-11	9.03E-11	1.49E-10	1.05E-08	7.10E-11	2.67E-19	U-236
Uranium-238+D ^e	7440-61-1	M	8.71E-11	1.21E-10	2.10E-10	9.35E-09	2.19E-08	9.03E-17	U-238, Th-234, Pa-234m (99.87%), Pa-234 (0.13%)
Zirconium-93	15751-77-6	M	1.11E-12	1.44E-12	2.12E-12	7.29E-12	0.00E+00	0.00E+00	Zr-93

NA = not available.

^a Lung absorption type recommended by the International Commission on Radiological Protection (ICRP): F = fast (particulate), M = medium (particulate), S = slow (particulate), V = vapor, and G = gas.

^b Cancer slope factors are from HEAST (EPA 2001). Slope factors for external exposure to soil have been adjusted for depth in soil (assumed to be 1 cm) by multiplying the infinite source external exposure slope factor by the ratio of the effective dose coefficients at 1 cm and at infinite depth; see Tables III.4 and III.7, respectively, in EPA Federal Guidance Report 12 (EPA 1993e).

^c External exposure slope factors for air submersion (for morbidity) are from Table 2.3 in EPA Federal Guidance Report 13 (EPA 1999b).

^d Isotopes used to calculate the slope factors are listed. See footnote e for information regarding "+D" slope factors.

^e +D slope factors from HEAST include contributions from short-lived daughter products (see far right column for the list of isotopes used to calculate the +D slope factors).

^f For this isotope, the first row of values listed corresponds to ICRP Lung Type of "M" (medium particulate), and the second row of values listed corresponds to ICRP Lung Type of "G" (gas).

^g m designates isotopes in a metastable state.

^h For radioisotopes of iodine, the values listed for food ingestion represent ingestion of milk; corresponding values for ingestion of nondairy foods would be lower by a factor of approximately 2. Inhalation values are provided both for inhalation of particulate aerosols (with default ICRP lung absorption type F; see first line of values) and inhalation of vapors (ICRP lung absorption type V; see second line of values). Corresponding values for inhalation of methyl iodide vapor are also provided in Federal Guidance Report 13, and are slightly lower than the vapor entries in each case.

ⁱ The first row of values listed corresponds to ICRP Lung Type of "M" (medium particulate), and the second row of values listed corresponds to ICRP Lung Type of "V" (vapor).

^j For tritium, two sets of values are provided for ingestion and inhalation pathways. The values in the first line represent ingestion of H-3 in the form of tritiated water and inhalation of tritiated water vapor, while values in the second line represent ingestion of organically bound tritium and inhalation of H-3 in particulate form (with default ICRP lung absorption type M). The corresponding value for inhalation of H-3 in organically bound gas would be greater than the value for tritiated water vapor by a factor of 2.3, while the value for inhalation of elemental hydrogen gas would be lower by a factor of 10,000.

DEPTH CORRECTION FOR HEAST SLOPE FACTORS - Meeting Minute No. 36; Comment No. 117

Comment:

None.

Original Response:

None.

Meeting Minute no. 36 (November 2000):

Discussion with John Mauro. ... For human health exposures; use ratio to convert the Health Effects Summary Table (HEAST) slope factor:

$$\text{Adjustment factor} = \left(\frac{\text{Dose conversion factor for 1 cm}}{\text{Dose conversion factor for infinite depth}} \right) \times (\text{HEAST value})$$

Revised Response:

None.

PROPOSED RESOLUTION (August 2001):

HEAST cancer slope factors for external gamma exposure are provided assuming a semi-infinite planar geometry (i.e., infinite surface area and depth). For the Hanford RPP-WTP, however, it is assumed that ROPCs are uniformly distributed over the top 1 cm of soil and not to an infinite depth. Because it is overly conservative to assume infinite depth conditions, an alternative approach will be utilized to eliminate significant overestimates of risk from external exposure.

Cancer slope factors in HEAST are derived from risk coefficients listed in Federal Guidance Report (FGR) No. 13 (EPA 1999), but this report does not provide coefficients for a 1-cm depth of contamination. However, FGR No. 12 (EPA 1993) does list dose coefficients for a range of depths including 1 cm, 5 cm, 15 cm, and infinite depth. HEAST factors will, therefore, be adjusted using dose coefficients provided in FGR No. 12 (EPA 1993) assuming that risk coefficients (and slope factors) scale proportional with dose coefficients and depth. Using this approach, adjustments to HEAST factors will be made using the following equation:

$$\text{CSF}_{\text{adj}} = \text{CSF}_{\text{HEAST}} \times (\text{DC}_1 \div \text{DC}_{\text{inf}})$$

where

CSF_{adj} = adjusted cancer slope factor for 1-cm depth,
 $\text{CSF}_{\text{HEAST}}$ = HEAST factor for an infinite depth,
 DC_1 = FGR No. 12 dose coefficient for 1-cm depth,
 DC_{inf} = FGR No. 12 dose coefficient for infinite depth.

The resulting slope factors are provided in column 8 of Table B. Table B will replace Table 4-3 from the RAWP.

References:

EPA 1993. *External Exposure to Radionuclides in Air, Water, and Soil*, Federal Guidance Report No. 12, EPA 402-R-93-081, Air and Radiation, September.

EPA 1999. *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*, Federal Guidance Report No. 13, EPA 402-R-99-001, Air and Radiation, September.

NEW GUIDANCE FOR EVALUATION OF EXTERNAL EXPOSURE FROM SOIL (Added By Bechtel, August 2001)

New Issue:

New Guidance (EPA 2000) is available for evaluation of external exposure to radionuclides in soil. Specifically, this guidance calls for the use of a shielding factor (Se) of 0.4 to account for shielding from building walls, floors, etc., while a receptor is indoors. The equation previously presented in the RAWP includes a shielding factor of 0.2 applied to all soil exposure.

PROPOSED RESOLUTION (August 2001):

A shielding factor of 0.4 will be used consistent with OSWER Directive 9355.4-14 (EPA 2000) to account for shielding while the receptor is indoors. No shielding will be assumed while the receptor is outdoors, as the gamma radiation originating in soil is not impeded by a solid obstacle prior to intercepting the receptor. External exposure to gamma radiation in soil from ROPCs will be quantified using the following equation. This equation will replace the equation shown in Section 7.1.5.8 of the RAWP.

$$I_{ee} = Cs \times EF \times (1/365) \times ED \times \{ET_o + [ET_i \times (1-Se)]\}$$

where

I_{ee}	= external exposure to gamma radiation from ROPCs in soil [(pCi-year/g)],
Cs	= average soil concentration of ROPC (pCi/g),
EF	= exposure frequency (day/year),
$1/365$	= conversion factor (year/day),
ED	= exposure duration (year),
ET_o	= exposure time fraction, outdoors (unitless),
ET_i	= exposure time fraction, indoors (unitless),
Se	= shielding factor (unitless).

The exposure time fraction outdoors (ET_o) represents the fraction of the day that the receptor is on-site outdoors while the fraction indoors (ET_i) represents the fraction of the day that the receptor is on-site indoors.

For the Resident Scenario, it is assumed that adults spend 94% of their time indoors and 6% outdoors (EPA 1997) while children spend 77% of their time indoors and 23% outdoors. The median percent of time spent outdoors at a farm (adults and children) is reported as 12%, and the 90th percentile is reported as 42% (EPA 1997). For the resident subsistence farmer and subsistence fisher scenarios, receptors (both adults and children) are assumed to spend 42% of their time outdoors and 58% indoors (approximately an additional 8 hours outdoors each day). For the Native American scenarios (Native American Subsistence Hunter/Gatherer and Native American Subsistence Fisher), the time spent outdoors is assumed to be comparable to the resident subsistence farmer and resident subsistence fisherman (i.e., 58% indoors, 42% outdoors for both adults and children). These exposure parameters will be added to Tables 7-2, 7-3, and 7-4 of the RAWP.

For the Hanford Worker Scenario, it is assumed that work is performed both outdoors and indoors; therefore, workers spend 50% of their time indoors and 50% outdoors.

References:

EPA 1997. *Exposure Factors Handbook*. Office of Research and Development, EPA/600/P-95/002F, Washington D.C. August.

EPA 2000. *Soil Screening Guidance for Radionuclides: Technical Background Document*, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.4-16, Washington, D.C., October.

NEW HEAST SLOPE FACTORS (Added By Bechtel, August 2001)

New Issue:

New radionuclide slope factors were published in HEAST 2001. Examples of differences between the 2001 values and the 1995 values include:

Values have changed slightly for some slope factors.

1995 Slope factors include values for ingestion; 2001 slope factors include separate values for water, food, and soil ingestion.

2001 Slope factors for radioisotopes of iodine, nickel, ruthenium, and carbon-14 include different values for various forms of these isotopes (e.g., particulate and vapor, in various types of food).

2001 Slope factors for tritium are presented separately for tritiated water and organically bound or particulate forms.

PROPOSED RESOLUTION (August 2001):

The new (2001) HEAST Slope Factors will be used to evaluate potential cancer risks from the ROPCs. These values are provided in Table B, which will replace Table 4-3 in the RAWP.

LATEST SLOPE FACTOR DATA FOR 2,3,7,8-TCDD - Meeting Minutes No. 3 And No. 23

Meeting Minute no. 3 (November 2000):

....The EPA is currently re-evaluating the slope factor for 2,3,7,8-TCDD. The new numbers that may be published may be ~ 6.5 times the current value.

Meeting Minute no. 23 (November 2000):

The EPA is currently re-evaluating the slope factor for 2,3,7,8-TCDD. The new numbers that may be published in the next two to three months may be ~ 6.5 times the current value.

PROPOSED RESOLUTION (August 2001):

The dioxin reassessment still has not been formally released. The Science Advisory Board (SAB) has completed their review of the reassessment, and U.S.EPA anticipates release of the final reassessment documents before the end of the year (U.S.EPA Information Sheet 3, May 25, 2001, update). If the reassessment is not formally released by September 30, 2001, the current oral and inhalation slope factors of $1.5 \times 10^{-5} \text{ (mg/kg-day)}^{-1}$ will be used for evaluating potential cancer risk from 2,3,7,8-TCDD for the Winter 2002 PRA. If the reassessment is approved prior to publication of the final RAWP, or later versions of the PRA or FRA, any changes to 2,3,7,8-TCDD will be included in these documents.

HIERARCHY OF ACUTE TOXICITY VALUES - Meeting Minute No. 7; Comment No. 86

Comment no. 86 (Summer 2000):

... When an AEGL-1 value is unavailable, but an AEGL-2 value is available, the AEGL-2 value should be used unless a more conservative value is available from one of the other sources in the hierarchy. This should be included in this discussion of toxicity values for acute effects.

Original Response (October 2000):

Clarification is needed. The hierarchy presented has been specified by Ecology and EPA during previous discussions.

Meeting Minute no. 7 (November 2000):

Propose the hierarchy of toxicity values in the RAWP. Ecology/EPA will identify any necessary changes to the toxicity values at the time of RAWP approval. If an AEGL-1 value is not available, an AEGL-2 value will be used unless there is a more conservative value elsewhere in the hierarchy. The latest AEGL value will be used in the work plan. If EPA has a newer value, it will be provided during their approval of the RAWP.

...

Revised Response (March 2001):

The hierarchy of toxicity values will be revised to read:

1. Values from NCEA (as provided by EPA Region X)
2. Acute Exposure Guideline Levels (AEGL-1). If an AEGL-1 value is not available but an AEGL-2 value is available, the AEGL-2 value will be used unless a more conservative value is available from one of the other sources in the hierarchy
3. Emergency Response Planning Guidelines (ERPG-1)
4. Acute Reference Exposure Levels (ARELs) from California EPA
5. Temporary Emergency Exposure Limits (TEEL-1)
6. Subcommittee on Consequence Assessment And Protective Actions (SCAPA) toxicity-based approach (DOE 1997).

PROPOSED RESOLUTION (August 2001):

Table C, showing the Acute Inhalation Exposure Criteria (AIEC) developed using the hierarchy presented above with the AEGL-2 added, will replace Table 4-4 in the RAWP. After adding the AEGL-2 values and applying the new hierarchy, one AIEC changed: the AIEC for propionitrile changed from 33.8 mg/m³ to 16.7 mg/m³ (the AEGL-2 value). There were 8 other COPCs that had AEGL-2 values but no AEGL-1 value; however, all 8 had other criteria more conservative than the AEGL-2 value. The AIEC values provided in Table C will be used in the Winter 2002 PRA and RAWP.

**Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values)**

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value	AEGL-1 ¹	AEGL-2 ²	ERPG-1 ³	AREL ⁴	TEEL-1 ⁵	Conv. Factor ⁶	AIRC ⁷ (mg/m ³)
Organic Compounds									
Aromatic Halogenated Hydrocarbons									
2,3,4,6-Tetrachlorophenol	58-90-2								
4-Chloro-3-methylphenol	59-50-7						2.00E+01 mg/m ³	5.83E+00	2.00E+01
Aromatic Nonhalogenated Hydrocarbons									
2-Nitrotoluene	88-72-2								
4-Nitrobiphenyl	92-93-3						7.50E-01 mg/m ³	8.14E+00	7.50E-01
Benzaldehyde	100-52-7						1.50E+01 mg/m ³	4.34E+00	1.50E+01
Benzene	71-43-2				5.00E+01 ppm	1.30E+00 mg/m ³	1.60E+02 mg/m ³	3.19E+00	1.60E+02
Benzyl alcohol	100-51-6						5.53E+01 mg/m ³	4.42E+00	5.53E+01
Ethyl benzene	100-41-4						5.42E+02 mg/m ³	4.34E+00	5.42E+02
Styrene	100-42-5				5.00E+01 ppm	2.10E+01 mg/m ³	2.13E+02 mg/m ³	4.26E+00	2.13E+02
Toluene	108-88-3				5.00E+01 ppm	3.70E+01 mg/m ³	1.88E+02 mg/m ³	3.77E+00	1.88E+02
m-Xylene	108-38-3					2.20E+01 mg/m ³	6.51E+02 mg/m ³	4.34E+00	2.20E+01
o-Xylene	95-47-6					2.20E+01 mg/m ³	6.51E+02 mg/m ³	4.34E+00	2.20E+01
p-Xylene	106-42-3					2.20E+01 mg/m ³	6.51E+02 mg/m ³	4.34E+00	2.20E+01
Non-aromatic Nonhalogenated Hydrocarbons									
1,2-Epoxybutane	106-88-7							2.95E+02 mg/m ³	2.95E+02
1,3-Butadiene	106-99-0				1.00E+01 ppm			2.21E+01 mg/m ³	2.21E+01
1,4-Dioxane	123-91-1					3.00E+00 mg/m ³		2.70E+02 mg/m ³	3.60E+00
1-Methylpropyl alcohol	78-92-2							4.55E+02 mg/m ³	4.55E+02
1-Nitropropane	108-03-2							2.73E+02 mg/m ³	3.64E+00
2,2,4-Trimethylpentane	540-84-1							3.50E+02 mg/m ³	4.67E+00
2-Butanone	78-93-3					1.30E+01 mg/m ³		8.84E+02 mg/m ³	2.95E+00
2-Butenaldehyde (2-Butenal)	4170-30-3		1.90E-01 ppm	4.40E+00 ppm	2.00E+00 ppm			5.73E+00 mg/m ³	2.86E+00
2-Ethoxyethanol	110-80-5					3.70E-01 mg/m ³		5.53E+01 mg/m ³	3.68E+00
2-Heptanone	110-43-0							7.00E+02 mg/m ³	4.67E+00
2-Hexanone	591-78-6							4.09E+01 mg/m ³	4.09E+01
2-Methoxyethanol	109-86-4							7.00E+02 mg/m ³	4.67E+00
2-Methyl-2-propanol	75-65-0					9.30E-02 mg/m ³		4.67E+01 mg/m ³	3.11E+00
2-Methyl-2-propenenitrile	126-98-7		1.10E+00 ppm					4.55E+02 mg/m ³	4.55E+02
2-Methylaziridine	75-55-8		1.10E+01 ppm					2.74E+00 mg/m ³	2.74E+00
2-Methylpropyl alcohol	78-83-1							1.40E+01 mg/m ³	2.33E+00
2-Pentanone	107-87-9							4.55E+02 mg/m ³	3.03E+00
2-Propanone (Acetone)	67-64-1							8.80E+02 mg/m ³	3.52E+00
								2.37E+03 mg/m ³	2.37E+00

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor	AIEC ³ (mg/m ³)
<i>Organic Compounds</i>									
2-Propene-1-ol	107-18-6								
2-Propyl alcohol	67-63-0		1.80E+00 ppm	1.10E+01 ppm				2.37E+00	4.27E+00
3-Heptanone	106-35-4					3.20E+00 mg/m ³		2.46E+00	3.20E+00
3-Methyl-1-butanol	123-51-3								
3-Methyl-2-butanone	563-80-4							3.60E+00	4.50E+02
3-Pentanone	96-22-0								
4-Heptanone	123-19-3								
4-Methyl-2-pentanone	108-10-1							4.09E+00	3.07E+02
4-Methyl-3-penten-2-one	141-79-7							4.01E+00	1.00E+02
5-Methyl-2-hexanone	110-12-3							4.67E+00	2.80E+03
Acetaldehyde	75-07-0				1.00E+01 ppm			1.80E+00	1.80E+01
Acetamide	60-35-5							2.41E+00	7.50E+01
Acetic acid	64-19-7							2.45E+00	3.68E+01
Acetic acid ethyl ester	141-78-6							3.60E+00	4.32E+03
Acetic acid n-butyl ester	123-86-4								
Acetonitrile	75-05-8							1.68E+00	1.01E+02
Acrolein	107-02-8		3.00E-02 ppm	1.00E-01 ppm	1.00E-01 ppm	1.90E-04 mg/m ³		2.29E+00	6.87E-02
Acrylonitrile	107-13-1				1.00E+01 ppm			2.17E+00	2.17E+01
Bis(isopropyl)ether	108-20-3								
Butane	106-97-8								
Carbon disulfide	75-15-0							2.38E+00	5.70E+03
Cyanogen	460-19-5				1.00E+00 ppm	6.20E+00 mg/m ³		3.11E+00	3.11E+00
Cyclohexane	110-82-7							2.13E+00	6.38E+01
Cyclohexanone	108-94-1							3.44E+00	3.10E+03
Cyclohexene	110-83-8							4.01E+00	3.01E+02
Cyclopentane	287-92-3							3.36E+00	1.01E+03
Ethyl alcohol	64-17-5							1.88E+00	5.65E+03
Ethyl ether	60-29-7							3.03E+00	1.52E+03
Ethyl methacrylate	97-63-2								
Formaldehyde	50-00-0				1.00E+00 ppm	9.40E-02 mg/m ³		1.23E+00	1.23E+00
Formamide	75-12-7							1.84E+00	2.76E+01
Formic acid	64-18-6							1.88E+01	1.88E+01
Formic acid, methyl ester	107-31-3								

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^e	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Organic Compounds</i>									
Glycidialdehyde	765-34-4								
Methyl acetate	79-20-9						2.21E-01 mg/m ³	2.95E+00	2.21E-01
Methyl alcohol	67-56-1								
Methyl isocyanate	624-83-9				2.00E+02 ppm	2.80E+01 mg/m ³	2.62E+02 mg/m ³	1.31E+00	2.62E+02
Methyl methacrylate	80-62-6				2.50E-02 ppm		5.83E-02 mg/m ³	2.33E+00	5.83E-02
Methyl tert-butyl ether	1634-04-4						1.23E+03 mg/m ³	4.09E+00	1.23E+03
Methylacetylene	74-99-7						4.32E+02 mg/m ³	3.60E+00	4.32E+02
Methylcyclohexane	108-87-2						2.78E+03 mg/m ³	1.64E+00	2.78E+03
N,N-Dimethylacetamide	127-19-5						4.82E+03 mg/m ³	4.01E+00	4.82E+03
Nitromethane	75-52-5								
Oxirane	75-21-8			1.98E+02 mg/m ³ ^h			1.50E+02 mg/m ³	2.50E+00	1.50E+02
Phosgene	75-44-5			3.00E-01 ppm		4.00E-03 mg/m ³	1.35E+01 mg/m ³	1.80E+00	1.35E+01
Propargyl alcohol	107-19-7						4.04E-01 mg/m ³	4.04E+00	4.00E-03
Propionic acid	79-09-4						6.87E+00 mg/m ³	2.29E+00	6.87E+00
Propionitrile	107-12-0						3.03E+01 mg/m ³	3.03E+00	3.03E+01
Propylene glycol monomethyl ether	107-98-2			7.40E+00 ppm			3.38E+01 mg/m ³	2.25E+00	1.67E+01
Triethylamine	121-44-8						5.52E+02 mg/m ³	3.68E+00	5.52E+02
Trimethylamine	75-50-3					2.80E+00 mg/m ³	1.24E+01 mg/m ³	4.14E+00	2.80E+00
Vinyl acetate	108-05-4				1.00E-01 ppm		3.63E+01 mg/m ³	2.42E+00	2.42E-01
n-Butyl alcohol	71-36-3				5.00E+00 ppm		1.76E+01 mg/m ³	3.52E+00	1.76E+01
n-Heptane	142-82-5						1.52E+02 mg/m ³	3.03E+00	1.52E+02
n-Hexane	110-54-3						1.80E+03 mg/m ³	4.10E+00	1.80E+03
n-Nonane	111-84-2						5.28E+02 mg/m ³	3.52E+00	5.28E+02
n-Octane	111-65-9						1.05E+03 mg/m ³	5.24E+00	1.05E+03
n-Pentane	109-66-0						1.80E+03 mg/m ³	2.95E+00	1.80E+03
n-Propionaldehyde	123-38-6						7.50E+01 mg/m ³	2.37E+00	7.50E+01
n-Propyl alcohol	71-23-8						6.14E+02 mg/m ³	2.46E+00	6.14E+02
n-Valeraldehyde	110-62-3								
p-Cymene	99-87-6								
p-tert-Butyltoluene	98-51-1								
<i>Non-aromatic Halogenated Hydrocarbons</i>									
1,1,1,2-Tetrachloro-2,2-difluoroethane	76-11-9								
1,1,1,2-Tetrachloroethane	630-20-6						5.14E+01 mg/m ³	6.86E+00	5.14E+01

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Organic Compounds</i>									
1,1,1-Trichloroethane	71-55-6				3.50E+02 ppm	6.80E+01 mg/m ³	1.91E+03 mg/m ³	5.45E+00	1.91E+03
1,1,2,2-Tetrachloro-1,2-difluoroethane	76-12-0								
1,1,2,2-Tetrachloroethane	79-34-5						2.06E+01 mg/m ³	6.86E+00	2.06E+01
1,1,2,2-Tetrachloroethene	127-18-4				1.00E+02 ppm	2.00E+01 mg/m ³	6.78E+02 mg/m ³	6.78E+00	6.78E+02
1,1,2-Trichloroethane	79-00-5						1.64E+02 mg/m ³	5.45E+00	1.64E+02
1,1,2-Trichloroethylene	79-01-6				1.00E+02 ppm		5.37E+02 mg/m ³	5.37E+00	5.37E+02
1,1-Dichloroethane	75-34-3						1.21E+03 mg/m ³	4.04E+00	1.21E+03
1,1-Dichloroethene	75-35-4						7.92E+01 mg/m ³	3.96E+00	7.92E+01
1,2,2-Trichloro-1,1,2-trifluoroethane	76-13-1						9.57E+03 mg/m ³	7.66E+00	9.57E+03
1,2,3-Trichloropropane	96-18-4						1.81E+02 mg/m ³	6.03E+00	1.81E+02
1,2-Dibromo-3-chloropropane	96-12-8						7.24E-01 mg/m ³	9.66E+00	7.24E-01
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2						2.10E+04 mg/m ³	6.99E+00	2.10E+04
1,2-Dichloroethane	107-06-2						8.09E+00 mg/m ³	4.04E+00	8.09E+00
1,2-Dichloroethylene	540-59-0		5.30E+01 mg/m ³ ^b	1.60E+02 mg/m ³ ^b			2.38E+03 mg/m ³	3.96E+00	5.15E+01
1,2-Dichloropropane	78-87-5						5.08E+02 mg/m ³	4.62E+00	5.08E+02
1,3-Dichloropropene	542-75-6						1.36E+01 mg/m ³	4.54E+00	1.36E+01
1,4-Dichloro-2-butene	764-41-0						7.66E-02 mg/m ³	5.11E+00	7.66E-02
1-Chloroethene	75-01-4					1.80E+02 mg/m ³	1.28E+01 mg/m ³	2.55E+00	1.80E+02
2,2-Dichloropropionic acid	75-99-0								
2-Chloropropane	75-29-6								
3-Chloropropene (Allyl chloride)	107-05-1								
Bromochloromethane	74-97-5				3.00E+00 ppm		9.38E+00 mg/m ³	3.13E+00	9.38E+00
Bromodichloromethane	75-27-4						1.06E+03 mg/m ³	5.29E+00	1.06E+03
Bromoethene	593-60-2						4.00E+00 mg/m ³	6.70E+00	4.00E+00
Bromoform	75-25-2						6.56E+01 mg/m ³	4.37E+00	6.56E+01
Bromomethane	74-83-9						1.55E+01 mg/m ³	1.03E+01	1.55E+01
Carbon tetrachloride	56-23-5					3.90E+00 mg/m ³	5.82E+01 mg/m ³	3.88E+00	3.90E+00
Chlorodibromomethane	124-48-1		1.20E+01 ppm	6.80E+01 ppm	2.00E+01 ppm		1.26E+02 mg/m ³	6.29E+00	7.54E+01
Chlorodifluoromethane	75-45-6						6.00E+00 mg/m ³	8.51E+00	6.00E+00
Chloroethane	75-00-3						4.42E+03 mg/m ³	3.53E+00	4.42E+03
Chloroform	67-66-3						7.91E+03 mg/m ³	2.64E+00	7.91E+03
Chloromethane	74-87-3					1.50E-01 mg/m ³	9.76E+00 mg/m ³	4.88E+00	1.50E-01
Chloropentafluoroethane	76-15-3						2.06E+02 mg/m ³	2.06E+00	2.06E+02

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Organic Compounds</i>									
Cyanogen bromide	506-68-3								
Cyanogen chloride	506-77-4								
Dichlorodifluoromethane	75-71-8						1.51E-01 mg/m ³	2.51E+00	1.51E-01
Dichlorofluoromethane	75-43-4						1.48E+04 mg/m ³	4.94E+00	1.48E+04
Dichloromethane	75-09-2				2.00E+02 ppm		1.26E+02 mg/m ³	4.21E+00	1.26E+02
Difluorodibromomethane	75-61-6						6.94E+02 mg/m ³	3.47E+00	6.94E+02
Hexafluoroacetone	684-16-2						2.04E+00 mg/m ³	6.79E+00	2.04E+00
Iodomethane	74-88-4						1.45E+02 mg/m ³	5.80E+00	1.45E+02
Methylene bromide	74-95-3				2.50E+01 ppm		2.50E+02 mg/m ³	7.11E+00	2.50E+02
Pentachloroethane	76-01-7						3.00E+01 mg/m ³	8.27E+00	3.00E+01
Trichloroacetic acid	76-03-9						6.68E+00 mg/m ³	6.68E+00	6.68E+00
Trichlorofluoroethane	27154-33-2								
Trichlorofluoromethane	75-69-4						2.81E+03 mg/m ³	5.61E+00	2.81E+03
Trifluorobromomethane	75-63-8						1.83E+04 mg/m ³	6.09E+00	1.83E+04
cis-1,2-Dichloroethene	156-59-2						7.92E+02 mg/m ³	3.96E+00	7.92E+02
cis-1,3-Dichloropropene	10061-01-5						1.13E+01 mg/m ³	4.54E+00	1.13E+01
trans-1,2-Dichloroethylene	156-60-5						4.95E+01 mg/m ³	3.96E+00	4.95E+01
trans-1,3-Dichloropropene	10061-02-6								
<i>Dioxin and Furan Compounds (PCDDs/PCDFs)</i>									
1,2,3,4,6,7,8-Heptachlorodibenzo(p)dioxin	35822-46-9								
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4								
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7								
1,2,3,4,7,8-Hexachlorodibenzo(p)dioxin	39227-28-6								
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9								
1,2,3,6,7,8-Hexachlorodibenzo(p)dioxin	57653-85-7								
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9								
1,2,3,7,8,9-Hexachlorodibenzo(p)dioxin	19408-74-3								
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9								
1,2,3,7,8-Pentachlorodibenzo(p)dioxin	40321-76-4								
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6								
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5								
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4								
2,3,7,8-Tetrachlorodibenzo(p)dioxin	1746-01-6								
							2.50E-03 mg/m ³	1.46E+01	2.50E-03
							1.50E-03 mg/m ³	1.53E+01	1.50E-03
							7.50E-05 mg/m ³	1.39E+01	7.50E-05
							3.50E-03 mg/m ³	1.32E+01	3.50E-03

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	ABC ^g (mg/m ³)
<i>Organic Compounds</i>									
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9						2.00E-03 mg/m ³	1.25E+01	2.00E-03
Dibenzofuran	132-64-9								
Octachlorodibenzo(p)dioxin	3268-87-9								
Octachlorodibenzofuran	39001-02-0								
<i>Polychlorinated Biphenyls (PCBs)</i>									
2,2',3,3',4,4',5'-Heptachlorobiphenyl	35065-30-6								
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3								
2,3,3',4,4',5'-Hexachlorobiphenyl	38380-08-4								
2,3,3',4,4',5'-Hexachlorobiphenyl	69782-90-7								
2,3,3',4,4',5,5'-Heptachlorobiphenyl	39635-31-9								
2,3,3',4,4'-Pentachlorobiphenyl	32598-14-4								
2,3,4,4',5'-Pentachlorobiphenyl	74472-37-0								
2,3,4,4',5'-Pentachlorobiphenyl	31508-00-6								
2,3',4,4',5,5'-Hexachlorobiphenyl	52663-72-6								
2,3,4,4',5'-Pentachlorobiphenyl	65510-44-3								
3,3',4,4',5'-Pentachlorobiphenyl	57465-28-8								
3,3',4,4',5,5'-Hexachlorobiphenyl	32774-16-6								
3,3',4,4'-Tetrachlorobiphenyl	32598-13-3								
3,4,4',5'-Tetrachlorobiphenyl	70362-50-4								
Polychlorinated biphenyls (PCBs)	1336-36-3	4.00E-02 mg/m ³					3.00E+00 mg/m ³		4.00E-02
<i>Phthalates</i>									
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7						1.00E+01 mg/m ³	1.60E+01	1.00E+01
Butylbenzyl phthalate	85-68-7						5.00E+02 mg/m ³	1.28E+01	5.00E+02
Dibutyl phthalate	84-74-2						1.50E+01 mg/m ³	1.14E+01	1.50E+01
Diethyl phthalate	84-66-2						1.50E+01 mg/m ³	9.08E+00	1.50E+01
Dimethylphthalate	131-11-3						1.50E+01 mg/m ³	7.94E+00	1.50E+01
n-Dioctyl phthalate	117-84-0						1.50E+02 mg/m ³	1.60E+01	1.50E+02
<i>Light Polycyclic Aromatic Hydrocarbons (molecular weight <200 g/mole)</i>									
2-Chloronaphthalene	91-58-7						6.00E-01 mg/m ³	6.65E+00	6.00E-01
2-Methyl naphthalene	91-57-6						2.00E+01 mg/m ³	5.81E+00	2.00E+01
5-Nitroacenaphthene	602-87-9								
Acenaphthene	83-32-9						1.25E+00 mg/m ³	6.30E+00	1.25E+00
Acenaphthylene	208-96-8						2.00E-01 mg/m ³	6.22E+00	2.00E-01
Anthracene	120-12-7						6.00E+00 mg/m ³	7.28E+00	6.00E+00

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Organic Compounds</i>									
Fluorene	86-73-7						7.50E+01 mg/m ³	6.79E+00	7.50E+01
Indene	95-13-6						1.42E+02 mg/m ³	4.75E+00	1.42E+02
Naphthalene	91-20-3						7.86E+01 mg/m ³	5.24E+00	7.86E+01
Phenanthrene	85-01-8						2.00E+00 mg/m ³	7.28E+00	2.00E+00
Pyrene	129-00-0						1.50E+01 mg/m ³	8.27E+00	1.50E+01
Heavy Polycyclic Aromatic Hydrocarbons (molecular weight >200 g/mole)									
3-Methylcholanthrene	56-49-5						1.50E+00 mg/m ³	1.10E+01	1.50E+00
5-Methylchrysene	3697-24-3								
Benzo(a)anthracene	56-55-3						6.00E-01 mg/m ³	9.33E+00	6.00E-01
Benzo(a)pyrene	50-32-8						7.50E+00 mg/m ³	1.03E+01	7.50E+00
Benzo(b)fluoranthene	205-99-2								
Benzo(e)pyrene	192-97-2								
Benzo(g,h,i)perylene	191-24-2						3.00E+01 mg/m ³	1.13E+01	3.00E+01
Benzo(j)fluoranthene	205-82-3								
Benzo(k)fluoranthene	207-08-9								
Benzo(a,i)pyrene	191-30-0								
Chrysene	218-01-9								
Dibenz(a,h)anthracene	53-70-3						2.00E-01 mg/m ³	9.33E+00	2.00E-01
Dibenz(a,h)acridine	226-36-8						3.00E+01 mg/m ³	1.14E+01	3.00E+01
Dibenz(a,j)acridine	224-42-0								
Dibenz(a,e)fluoranthene	5385-75-1								
Dibenz(a,h)fluoranthene	No CAS no.								
Dibenzof(a,e)pyrene	192-65-4								
Dibenzof(a,h)pyrene	189-64-0								
Dibenzof(a,i)pyrene	189-55-9								
Fluoranthene	206-44-0								
Hexachloronaphthalene	1335-87-1						3.00E-02 mg/m ³	8.27E+00	3.00E-02
Indeno(1,2,3-cd)pyrene	193-39-5						2.00E-01 mg/m ³	1.37E+01	2.00E-01
Octachloronaphthalene	2234-13-1								
Pentachloronaphthalene	1321-64-8						3.00E-01 mg/m ³	1.65E+01	3.00E-01
Tetrachloronaphthalene	1335-88-2								
Trichloronaphthalene	1321-65-9								

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
Organic Compounds									
Light Substituted Benzene Compounds (molecular weight <200 g/mole)									
1,2,3-Trichlorobenzene	87-61-6								
1,2,4-Trichlorobenzene	120-82-1						5.00E+01 mg/m ³	7.42E+00	5.00E+01
1,2,4-Trimethyl benzene	95-63-6						3.71E+01 mg/m ³	7.42E+00	3.71E+01
1,2-Dichlorobenzene	95-50-1						1.80E+02 mg/m ³	4.91E+00	1.80E+02
1,3,5-Trimethyl benzene	108-67-8						3.00E+02 mg/m ³	6.01E+00	3.00E+02
1,3-Dichlorobenzene	541-73-1						3.68E+02 mg/m ³	4.91E+00	3.68E+02
1,3-Dinitrobenzene	99-65-0						3.60E+01 mg/m ³	6.01E+00	3.60E+01
1,4-Dichlorobenzene	106-46-7						3.00E+00 mg/m ³	6.87E+00	3.00E+00
1,4-Dinitrobenzene	100-25-4						6.61E+02 mg/m ³	6.01E+00	6.61E+02
2,4,5-Trichlorophenol	95-95-4								
2,4,6-Trichlorophenol	88-06-2						3.00E+01 mg/m ³	8.07E+00	3.00E+01
2,4-Dichlorophenol	120-83-2						3.00E+01 mg/m ³	8.07E+00	3.00E+01
2,4-Dimethylphenol	105-67-9						3.00E+01 mg/m ³	6.66E+00	3.00E+01
2,4-Dinitrophenol	51-28-5								
2,4-Dinitrotoluene	121-14-2						7.50E+00 mg/m ³	7.53E+00	7.50E+00
2,6-Dinitrotoluene	606-20-2						6.00E-01 mg/m ³	7.44E+00	6.00E-01
2-Chlorophenol	95-57-8						6.00E-01 mg/m ³	7.44E+00	6.00E-01
2-Chlorotoluene	95-49-8						5.25E+00 mg/m ³	5.25E+00	5.25E+00
2-Nitrophenol	88-75-5						3.88E+02 mg/m ³	5.17E+00	3.88E+02
4,6-Dinitro-o-cresol	534-52-1								
4-Chlorotoluene	106-43-4						5.00E-01 mg/m ³	8.10E+00	5.00E-01
4-Nitrophenol	100-02-7						3.88E+02 mg/m ³	5.17E+00	3.88E+02
Aniline	62-53-3		3.00E+01 mg/m ³ ^b				3.00E+01 mg/m ³	5.69E+00	3.00E+01
Benzotrithloride	98-07-7						2.28E+01 mg/m ³	3.81E+00	3.00E+01
Benzyl chloride	100-44-7				1.00E+00 ppm	2.40E-01 mg/m ³	1.00E-01 mg/m ³	7.99E+00	1.00E-01
Bromobenzene	108-86-1						5.17E+00 mg/m ³	5.17E+00	5.17E+00
Chlorobenzene	108-90-7						4.81E+01 mg/m ³	6.42E+00	4.81E+01
Cumene	98-82-8						1.38E+02 mg/m ³	4.60E+00	1.38E+02
Nitrobenzene	98-95-3						7.37E+02 mg/m ³	4.91E+00	7.37E+02
Phenol	108-95-2						1.51E+01 mg/m ³	5.03E+00	1.51E+01
Toluene-2,6-diamine	823-40-5				1.00E+01 ppm	5.80E+00 mg/m ³		3.85E+00	3.85E+01
Trimethyl benzene	25551-13-7								

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Organic Compounds</i>									
alpha-Methylstyrene	98-83-9								
m-Cresol	108-39-4								
n-Butyl benzene	104-51-8						1.10E+02 mg/m ³	5.49E+00	1.10E+02
n-Propyl benzene	103-65-1						3.68E+02 mg/m ³	4.91E+00	3.68E+02
o-Cresol	95-48-7								
o-Dinitrobenzene	528-29-0								
o-Nitroaniline	88-74-4								
o-Toluidine	95-53-4						2.63E+01 mg/m ³	4.38E+00	2.63E+01
p-Chloroaniline	106-47-8						3.00E+01 mg/m ³	5.21E+00	3.00E+01
p-Cresol	106-44-5								
p-Nitrochlorobenzene	100-00-5						2.00E+00 mg/m ³	6.44E+00	2.00E+00
p-Toluidine	106-49-0								
sec-Butyl benzene	135-98-8						2.74E+01 mg/m ³	5.49E+00	2.74E+01
tert-Butyl benzene	98-06-6						1.10E+02 mg/m ³	5.49E+00	1.10E+02
<i>Other Light Semivolatile Compounds (molecular weight <200 g/mole)</i>									
1,1-Dimethylhydrazine	57-14-7			7.40E+00 mg/m ³ ^b					1.84E+00 mg/m ³
1,1'-Biphenyl	92-52-4								4.00E+00 mg/m ³
1,2-Dimethylhydrazine	540-73-8			7.40E+00 mg/m ³ ^b					3.69E+00 mg/m ³
1,2-Diphenylhydrazine	122-66-7								3.00E+01 mg/m ³
1,3-Propane sulfone	1120-71-4								2.50E+00 mg/m ³
2,4-Toluene diisocyanate	584-84-9		2.00E-02 ppm	1.20E-01 ppm			1.42E-01 mg/m ³	7.12E+00	1.42E-01
2-Chloroacetophenone	532-27-4								
2-Propenoic acid	79-10-7				2.00E+00 ppm	6.00E+00 mg/m ³	5.89E+00 mg/m ³	2.95E+00	5.89E+00
4,4-Methylenedianiline	101-77-9						8.10E-01 mg/m ³	8.10E+00	8.10E-01
Acetophenone	98-86-2						3.00E+01 mg/m ³	4.91E+00	3.00E+01
Benzoic acid	65-85-0						1.25E+01 mg/m ³	4.99E+00	1.25E+01
Bis(2-chloroethoxy)methane	111-91-1								
Bis(2-chloroethyl) ether	111-44-4								
Chlorocyclopentadiene	41851-50-7						5.85E+01 mg/m ³	5.85E+00	5.85E+01
Cyclohexanol	108-93-0								
Dichloroisopropyl ether	108-60-1						6.99E+01 mg/m ³	6.99E+00	6.99E+01

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^e	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIRC ^g (mg/m ³)
<i>Organic Compounds</i>									
Dichloromethyl ether	542-88-1						1.41E-02 mg/m ³	4.70E+00	1.41E-02
Dichloropentadiene	No CAS no.								
Dimethyl sulfate	77-78-1						1.55E+00 mg/m ³	5.16E+00	1.55E+00
Dimethylamine	121-69-7								
Diphenyl ether	101-84-8								
Epichlorohydrin	106-89-8	5.00E+00 ppm	2.40E+01 ppm		2.00E+00 ppm	1.30E+00 mg/m ³	7.56E+00 mg/m ³	3.78E+00	1.89E+01
Ethyl Carbamate (Urethane)	51-79-6								
Ethyl methanesulfonate	62-50-0								
Ethylene dibromide	106-93-4						1.54E+02 mg/m ³	7.68E+00	1.54E+02
Ethylene glycol	107-21-1						5.07E+01 mg/m ³	2.54E+00	5.07E+01
Ethylene glycol monobutyl ether	111-76-2					1.40E+01 mg/m ³	3.62E+02 mg/m ³	4.83E+00	1.40E+01
Ethylene glycol monoethyl ether acetate	111-15-9					1.40E-01 mg/m ³	8.10E+01 mg/m ³	5.40E+00	1.40E-01
Ethylene thiourea	96-45-7						1.00E+01 mg/m ³	4.18E+00	1.00E+01
Furfural	98-01-1						7.85E+00 mg/m ³	3.93E+00	7.85E+00
Maleic hydrazide	123-33-1								
Malononitrile	109-77-3								
Methyl styrene (mixed isomers)	25013-15-4								
Methylhydrazine	60-34-4			1.90E+00 mg/m ³ ^b			3.77E-01 mg/m ³	1.88E+00	3.77E-01
N,N-Diphenylamine	122-39-4						3.00E+01 mg/m ³	6.92E+00	3.00E+01
N-Nitroso-N,N-dimethylamine	62-75-9						2.50E+00 mg/m ³	3.03E+00	2.50E+00
N-Nitrosodi-n-butylamine	924-16-3								
N-Nitrosomorpholine	59-89-2						3.00E+01 mg/m ³	4.75E+00	3.00E+01
Nitric acid, propyl ester	627-13-4								
Oxalic acid	144-62-7						2.00E+00 mg/m ³	3.68E+00	2.00E+00
Phthalic anhydride	85-44-9						1.80E+01 mg/m ³	6.05E+00	1.80E+01
Pyridine	110-86-1						4.85E+01 mg/m ³	3.23E+00	4.85E+01
Quinoline	91-22-5						3.17E+00 mg/m ³	5.28E+00	3.17E+00
Quinone	106-51-4						1.33E+00 mg/m ³	4.42E+00	1.33E+00
Safrole	94-59-7								
Tetrahydrofuran	109-99-9						7.37E+02 mg/m ³	2.95E+00	7.37E+02
di-n-Propylnitrosamine	621-64-7						2.00E-01 mg/m ³	5.32E+00	2.00E-01

**Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)**

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^e	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^c	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Organic Compounds</i>									
o-Anisidine	90-04-0						1.50E+00 mg/m ³	5.03E+00	1.50E+00
p-Phthalic acid	100-21-0								
Other Heavy Semivolatile Compounds (molecular weight >200 g/mole)									
1,2,4,5-Tetrachlorobenzene	95-94-3								
1,3,5-Trinitrobenzene	99-35-4								
2,6-Bis(tert-butyl)-4-methylphenol	128-37-0						3.00E+01 mg/m ³	8.82E+00	3.00E+01
2-Cyclohexyl-4,6-dinitrophenol	131-89-5						3.00E+01 mg/m ³	8.71E+00	3.00E+01
2-sec-Butyl-4,6-dinitrophenol	88-85-7						4.50E+00 mg/m ³	9.82E+00	4.50E+00
3,3'-Dimethoxybenzidine	119-90-4						5.00E+00 mg/m ³	9.99E+00	5.00E+00
3,3'-Dichlorobenzidine	91-94-1						6.21E+00 mg/m ³	1.03E+01	6.21E+00
4-Bromophenylphenyl ether	101-55-3								
Ammonium perfluorooctanoate	3825-26-1								
Azobenzene	103-33-3								
Bis(3-tert-butyl-4-hydroxy-6-methyl-phenyl)sulfide	96-69-5								
Captan	133-06-2						1.50E+01 mg/m ³	1.23E+01	1.50E+01
Chlorobenzilate	510-15-6						2.50E-01 mg/m ³	1.33E+01	2.50E-01
Dibutylphosphate	107-66-4						1.72E+01 mg/m ³	8.59E+00	1.72E+01
Dimethyl aminoazobenzene	60-11-7						7.50E+01 mg/m ³	9.21E+00	7.50E+01
Hexachlorobenzene	118-74-1						7.50E-02 mg/m ³	1.16E+01	7.50E-02
Hexachlorobutadiene	87-68-3				3.00E+00 ppm		3.20E+01 mg/m ³	1.07E+01	3.20E+01
Hexachlorocyclopentadiene	77-47-4						2.23E-01 mg/m ³	1.11E+01	2.23E-01
Hexachloroethane	67-72-1						2.90E+01 mg/m ³	9.68E+00	2.90E+01
Hexachlorophene	70-30-4						3.00E+01 mg/m ³	1.66E+01	3.00E+01
Hexamethylene-1,5-diisocyanate	822-06-0						1.03E-01 mg/m ³	6.88E+00	1.03E-01
Mirex	2385-85-5						7.50E-02 mg/m ³	2.23E+01	7.50E-02
Nitrofen	1836-75-5								
Pentachlorobenzene	608-93-5						3.00E+01 mg/m ³	1.02E+01	3.00E+01
Pentachloronitrobenzene	82-68-8						1.50E+00 mg/m ³	1.21E+01	1.50E+00
Pentachlorophenol	87-86-5						1.50E+00 mg/m ³	1.09E+01	1.50E+00
Picric acid	88-89-1						3.00E-01 mg/m ³	9.36E+00	3.00E-01
Pronamide	23950-58-5								
Strychnine	57-24-9						3.00E-01 mg/m ³	1.37E+01	3.00E-01

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Organic Compounds</i>									
Terphenyls	26140-60-3								
Tributyl phosphate	126-73-8						1.25E+00 mg/m ³	9.41E+00	1.25E+00
Trifluralin	1582-09-8						6.53E+00 mg/m ³	1.09E+01	6.53E+00
Triphenylamine	603-34-9						7.50E-02 mg/m ³	1.37E+01	7.50E-02
<i>Herbicides and Organochlorinated Pesticides</i>									
2,4,5-T	93-76-5						3.00E+01 mg/m ³	1.04E+01	3.00E+01
2,4-D and esters	94-75-7						3.00E+01 mg/m ³	9.03E+00	3.00E+01
4,4-DDD	72-54-8						3.00E+01 mg/m ³	1.31E+01	3.00E+01
4,4-DDDE	72-55-9						3.00E+01 mg/m ³	1.30E+01	3.00E+01
4,4-DDT	50-29-3						3.00E+00 mg/m ³	1.45E+01	3.00E+00
Aldrin	309-00-2						7.50E-01 mg/m ³	1.49E+01	7.50E-01
Chlordane	57-74-9						1.50E+00 mg/m ³	1.67E+01	1.50E+00
Delta-BHC	319-86-8								
Dieldrin	60-57-1						7.50E-01 mg/m ³	1.56E+01	7.50E-01
Endothall	145-73-3								
Endrin	72-20-8						3.00E-01 mg/m ³	1.56E+01	3.00E-01
Heptachlor	76-44-8						1.50E-01 mg/m ³	1.53E+01	1.50E-01
Isodrin	465-73-6								
Methoxychlor	72-43-5						3.00E+01 mg/m ³	1.41E+01	3.00E+01
Silvex (2,4,5-TP)	93-72-1						3.00E+01 mg/m ³	1.10E+01	3.00E+01
Toxaphene	8001-35-2						1.00E+00 mg/m ³	1.69E+01	1.00E+00
alpha-BHC	319-84-6						7.50E+00 mg/m ³	1.19E+01	7.50E+00
beta-BHC	319-85-7						2.00E+00 mg/m ³	1.19E+01	2.00E+00
gamma-BHC (Lindane)	58-89-9						1.50E+00 mg/m ³	1.19E+01	1.50E+00
<i>Inorganic Chemicals and Compounds</i>									
<i>Metals</i>									
Aluminum	7429-90-5						3.00E+01 mg/m ³	1.10E+00	3.00E+01
Antimony	7440-36-0						1.50E+00 mg/m ³	4.98E+00	1.50E+00
Arsenic	7440-38-2					1.90E-04 mg/m ³	3.00E-02 mg/m ³	3.06E+00	1.90E-04
Barium	7440-39-3						1.50E+00 mg/m ³	5.61E+00	1.50E+00
Beryllium	7440-41-7						5.00E-03 mg/m ³	3.68E-01	5.00E-03
Bismuth	7440-69-9						5.00E+00 mg/m ³	8.54E+00	5.00E+00

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Inorganic Chemicals and Compounds</i>									
Boron	7440-42-8						7.50E+00 mg/m ³	4.42E-01	7.50E+00
Cadmium	7440-43-9						3.00E-02 mg/m ³	4.59E+00	3.00E-02
Calcium	7440-70-2						3.00E+01 mg/m ³	1.64E+00	3.00E+01
Chromium (and VI)	18540-29-9						1.50E+00 mg/m ³	2.13E+00	1.50E+00
Cobalt	7440-48-4						6.00E-02 mg/m ³	2.41E+00	6.00E-02
Copper	7440-50-8					1.00E-01 mg/m ³	3.00E+00 mg/m ³	2.60E+00	1.00E-01
Iron	7439-89-6						3.00E+01 mg/m ³	2.28E+00	3.00E+01
Lead	7439-92-1						1.50E-01 mg/m ³	8.47E+00	1.50E-01
Lithium	7439-93-2						3.00E+01 mg/m ³	2.84E-01	3.00E+01
Magnesium	7439-95-4						3.00E+01 mg/m ³	9.94E-01	3.00E+01
Manganese	7439-96-5						3.00E+00 mg/m ³	2.25E+00	3.00E+00
Mercury	7439-97-6					1.80E-03 mg/m ³	1.00E-01 mg/m ³	8.20E+00	1.80E-03
Molybdenum	7439-98-7						1.50E+01 mg/m ³	3.92E+00	1.50E+01
Nickel	7440-02-0					6.00E-03 mg/m ³	3.00E+00 mg/m ³	2.40E+00	6.00E-03
Phosphorus	7723-14-0						3.00E-01 mg/m ³	5.06E+00	3.00E-01
Potassium	7440-09-7						2.00E+00 mg/m ³	1.60E+00	2.00E+00
Rhodium	7440-16-6						3.00E+00 mg/m ³	4.21E+00	3.00E+00
Selenium	7782-49-2						6.00E-01 mg/m ³	3.23E+00	6.00E-01
Silicon	7440-21-3						3.00E+01 mg/m ³	1.15E+00	3.00E+01
Silver	7440-22-4						3.00E-01 mg/m ³	4.41E+00	3.00E-01
Sodium	7440-23-5						1.50E+02 mg/m ³	9.40E-01	1.50E+02
Strontium	7440-24-6						3.00E+01 mg/m ³	3.58E+00	3.00E+01
Tantalum	7440-25-7								
Thallium	7440-28-0						3.00E-01 mg/m ³	8.35E+00	3.00E-01
Tin	7440-31-5						6.00E+00 mg/m ³	4.85E+00	6.00E+00
Total Sulfur	63705-05-5						7.50E-01 mg/m ³	1.31E+00	7.50E-01
Tungsten	7440-33-7						1.00E+01 mg/m ³	7.51E+00	1.00E+01
Uranium	7440-61-1						6.00E-01 mg/m ³	9.73E+00	6.00E-01
Vanadium	7440-62-2						7.50E-02 mg/m ³	2.08E+00	7.50E-02
Yttrium	7440-65-5						3.00E+00 mg/m ³	3.63E+00	3.00E+00
Zinc	7440-66-6						3.00E+01 mg/m ³	2.67E+00	3.00E+01
Zirconium	7440-67-7						1.00E+01 mg/m ³	3.73E+00	1.00E+01

Table C. Acute Inhalation Exposure Criteria for COPCs
(including a new column for AEGL-2 values) (continued)

Constituent of Potential Concern	CAS Registry Number	NCEA Provisional Value ^a	AEGL-1 ^b	AEGL-2 ^b	ERPG-1 ^c	AREL ^d	TEEL-1 ^e	Conv. Factor ^f	AIEC ^g (mg/m ³)
<i>Inorganic Chemicals and Compounds</i>									
Non-metals and Anions									
Ammonia/Ammonium Bromide	7664-41-7		2.50E+01 ppm	1.10E+02 ppm	2.50E+01 ppm	3.20E+00 mg/m ³	1.74E+01 mg/m ³	6.96E-01	1.74E+01
Chloride	16887-00-5								
Cyanide	57-12-5						5.00E+00 mg/m ³	1.06E+00	5.00E+00
Fluoride	16984-48-8						7.50E+00 mg/m ³	7.76E-01	7.50E+00
Hydroxide	14280-30-9								
Iodine	7553-56-2						1.04E+00 mg/m ³	1.04E+01	1.04E+00
Nitrate	14797-55-8				1.00E-01 ppm		3.00E+01 mg/m ³		3.00E+01
Nitrite	14797-65-0								
Phosphate	14265-44-2								
Sulfate	14808-79-8					1.20E-01 mg/m ³			1.20E-01
Criteria Pollutants									
Carbon dioxide	124-38-9								
Nitrogen dioxide	10102-44-0		5.00E-01 ppm	1.20E+01 ppm			5.40E+04 mg/m ³	1.80E+00	5.40E+04
Ozone	10028-15-6						3.76E+00 mg/m ³	1.88E+00	9.40E-01
Particulate matter	No CAS no.						1.96E-01 mg/m ³	1.96E+00	1.80E-01
Sulfur dioxide	7446-09-5				3.00E-01 ppm	6.60E-01 mg/m ³	7.85E-01 mg/m ³	2.62E+00	7.85E-01

^a Provisional acute 1-hour inhalation value, obtained from National Center for Environmental Assessment (NCEA).

^b Acute exposure guideline level (AEGL-1 and AEGL-2) values (1-hour averaging time), obtained from EPA Region X, unless otherwise noted.

^c Emergency Response Planning Guidelines (ERPG-1) values, obtained from <http://www.scapa.bnl.gov/scapaw1.htm>.

^d Acute reference exposure level (AREL) values, obtained from California EPA (see <http://oelha.ca.gov/scientific/relnums.htm>).

^e Temporary Emergency Response Limits (TEEL-1) values, obtained from http://tis.eh.doe.gov/web/chem_safety/teel.html.

^f Conversion Factor, for converting from ppm to mg/m³, from http://tis.eh.doe.gov/web/chem_safety/teel.html.

^g Acute Inhalation Exposure Criteria (AIEC) in mg/m³, used to quantify hazard quotients for short-term inhalation exposures to COPCs.

The following hierarchy was used in selecting the AIEC:

1. Values from NCEA (as provided by EPA Region X).
2. AEGL-1.
3. ERPG-1.
4. AREL.
5. TEEL-1.

6. SCAPA-approach.

7. AEGL-2 if AEGL-1 missing and AEGL-2 value is smaller than all other available values.

^h Acute exposure guideline level (AEGL-1 and AEGL-2) values (1-hour averaging time), obtained from EPA Federal Register, October 30, 1997 (Volume 62, Number 210).

MAP OF DAY CARE CENTERS (Meeting Minute No. 1; Comment No. 67)

Comment no. 67 (Summer 2000):

Section 7.1.2, Identification of Exposure Scenarios, Page 7-4. The RAWP states that the risk assessment approach used is designed to protect human health, including special subpopulations. However, special subpopulations (i.e. daycares, hospitals, nursing homes) in the area surrounding the Hanford site are not defined. EPA's HHRAP recommends that the risk assessment include the identification and/or mapping of the locations of special subpopulations at potentially higher risk, focusing on the characteristics of the exposure setting to ensure that selected exposure scenario locations are protective of the special populations.

Recommendation: Identify the type and location of special subpopulations in the assessment area. We recommend mapping the locations.

Original Response (October 2000):

Special subpopulations at potentially higher risk due to characteristics of the exposure setting are identified in the RAWP as:

- A) Hanford Site Industrial Worker due to their close proximity to the emission source.
- B) Native American Subsistence Resident due to (1) their potential presence at locations with high emissions concentrations resulting from proximity to the facility or elevation (e.g., Gable Mtn), (2) their potential for above-average consumption of exposed biota (e.g., wild-grown plants, subsistence fishing) and (3) their potential exposure via exposure pathways not included in "standard" scenarios (e.g., sweat lodge exposures).

As noted in the comment, the purpose of identifying potentially sensitive subpopulations is to ensure that selected exposure scenario locations are protective of special populations. The HHRAP recommends the evaluation of a residential scenario at the location of sensitive subpopulations such as daycare centers because the residential scenario will be overly conservative due to ingestion of homegrown produce. The RAWP includes the evaluation of residential subsistence scenarios (i.e., resident adult and child, nursing infant, subsistence farmer and hunter/gatherer) at the locations of maximum emission concentrations. These residential scenarios will result in overestimates of exposure by potential receptors at daycare centers, hospitals or nursing homes. These overestimates of exposure, combined with RfD and CSF values designed to protect sensitive subpopulations will ensure the protection of these subpopulations.

Meeting Minute no. 1 (November 2000):

Comment 67 – Sensitive receptors. It was agreed to add locations of sensitive receptors such as day care organizations, hospitals, etc. on a map and explain in the Risk Assessment Work Plan (RAWP) the margin of safety for those receptors not modeled in the Screening Level Risk Assessment (SLRA). These locations will be plotted on a RAWP map following the initial run of the Preliminary Risk Assessment (PRA). It was agreed that DOE would not have to anticipate what additional receptors, if any, the public may want modeled. The public may request that risk estimates be provided for representative sensitive receptors during the public comment period, and the project should be prepared to make these estimates if requested.

Revised Response (March 2001):

Clarification. Special subpopulations at potentially higher risk due to characteristics of the exposure setting are identified in the RAWP as:

- Hanford Site Industrial Worker due to their close proximity to the emission source.
- Native American Subsistence Resident due to (1) their presence at locations with high emissions concentrations resulting from proximity to the facility or elevation (e.g., Gable Mountain), (2) their potential for above-average consumption of exposed biota (e.g., wild-grown plants, subsistence fishing) and (3) their potential exposure via exposure pathways not included in "standard" scenarios (e.g., sweat lodge exposures).

A map will be added to the RAWP identifying the locations of daycare centers, schools, hospitals, and nursing homes near the modeled receptor areas. Calculation of risks to such other special populations will be considered as appropriate, following the public comment period.

The following text will be added to Sect. 7.1.2 of the RAWP to clarify that all potential receptors are protected: "The exposure scenarios included in the quantitative risk assessment are designed to cover a wide range of possible receptor activities, age groups, and lifestyles. The exposure assessment and risk characterization results for these receptors can be extrapolated to other special subpopulations of interest. For example, if a school or daycare center is located near the facility, potential exposure to children is being evaluated in the residential scenarios for concentrations at various locations, including ground maximum, site boundary maximum, Gable Mountain, and Columbia River maximum. Evaluation of a child resident at the location of ground maximum COPC/ROPC concentrations will overestimate risks at a school or daycare center because the residential scenario includes ingestion of homegrown produce and assumes the child is at home all day and all night."

PROPOSED RESOLUTION (August 2001):

Issue identified to confirm revised response as stated above.

AGENCY INPUT ON HAZARD INDICES (Meeting Minute No. 9; Comment No. 91)

Comment no. 91 (Summer 2000):

Section 7.3.1, Page 7-29, lines 15-16. The process for segregation of HI by toxicological endpoint is not proposed.

Recommendation: This discussion should be clarified to indicate that any segregation of the HI by toxicological endpoint must be proposed on a chemical-specific basis to the regulatory Agencies before being incorporated into the risk assessment.

Original Response (October 2000):

Agree. The text will be revised to read: "If the target HI is exceeded, a segregation of the HI by toxicological endpoint will be considered. If segregation by toxicological endpoint is used, chemical groupings by endpoint will be assigned by the WTP with input from Ecology and USEPA."

Meeting Minute no. 9 (November 2000)

Comment 91 – Any segregation of Hazard Indices (HIs) by endpoint will require Ecology/EPA approval. EPA/Ecology will help in resolving issues as necessary.

Revised Response (March 2001):

Agree. The text will be revised to read: "If the target HI is exceeded, a segregation of the HI by toxicological endpoint will be considered. If segregation by toxicological endpoint is used, chemical groupings by endpoint will be assigned with approval by Ecology and USEPA."

PROPOSED RESOLUTION (August 2001):

Issue identified to confirm revised response with the clarification that the segregation by toxicological endpoint will be determined after delivery of the draft PRA and during the normal technical review process.

EXCLUSIVE DIET FOR MAMMAL AND BIRD RECEPTORS (Added by Bechtel)

New Issue:

The RAWP (Section 8.2, pages 8-23 and 8-24) states that dietary exposure will be evaluated for both an "equal" diet and an "exclusive" diet. The equal diet consists of equal portions of each of the receptor's major dietary items, whereas the exclusive diet consists solely of the dietary item with the highest concentration of COPC or ROPC. Thus the exclusive diet is more conservative than the equal diet.

As stated in the SLERAP (Section 5.3.2.4), the dietary exposure equation for herbivores (Trophic Level 2) includes ingestion of soil, water, and plants. The exposure equation for omnivores (Trophic Level 3) includes ingestion of soil, water, plants, and Trophic Level 2 and 3 receptors, according to diet. The exposure equation for carnivores includes ingestion of soil, water, and Trophic Level 2, 3, and 4 receptors, according to diet. An exclusive diet of Level 3 receptors for omnivores and Level 4 receptors for carnivores would be conservative.

Implementation of the equal diet is difficult because wild mammals and birds are usually opportunistic feeders. Therefore, their diets change depending on the available food, and determining the number of dietary items over which to apportion their exposure is problematic. In addition, evaluating both diets would increase the number of table pages from the currently proposed 249 pages of printed tables and over 2600 pages overall, including non-printed tables, to over 400 pages of printed tables and nearly 5000 pages overall.

PROPOSED RESOLUTION (August 2001):

The (August 2001) exclusive diet provides an exposure that is both conservative and economical, and it will identify areas that need to be evaluated with more precision. Therefore, we propose to evaluate only the exclusive diet. For example, if the COPC has a higher bioconcentration factor (BCF) in terrestrial invertebrates than plants (e.g., for pentachlorophenol, the soil-to-invertebrate transfer factor is 1.03, whereas the soil-to-plant transfer factor is 0.045), omnivores that eat predominantly invertebrates will have higher body burdens than omnivores that eat predominantly plants. Therefore, to maximize the calculated exposure, in this case, the omnivore will be assumed to eat terrestrial invertebrates exclusively. Equal or representative diets may be evaluated in the Final Risk Assessment if the more conservative diet reveals any reasonable likelihood of risk to receptors.

HIERARCHY FOR ECOLOGICAL EFFECTS VALUES - Meeting Minutes no. 38 and 39; Comments no. 13 and 15

Comment no. 13 (Summer 2000):

The work plan should include an ecological effects evaluation for COPCs/ROPCs evaluated in the ERA that are not listed in EPA's combustion guidance (cited as EPA 1999b in reference section).

Comment no. 15 (Summer 2000):

Documentation on the basis of selecting specific parameter values is inadequate. The text should describe the hierarchy used to select parameter values when they are available from two or more sources. The tables should include a column for briefly describing the basis of each value. This deficiency is most pronounced for the values proposed for evaluating the ecological risk of the chemicals.

Original Response to Comment no. 13 (October 2000):

Agree. Summary ecological effects evaluations for COPCs/ROPCs that are not in the SLERAP will be added, and sources will be cited. We propose that we have a discussion to reach an agreement regarding the appropriate level of detail, i.e., where it is appropriate to decrease the level of detail and where it is appropriate to increase the level of detail.

Original Response to Comment no. 15 (October 2000):

Clarification. The method for choosing among alternative TRVs will be clarified as follows:

- For freshwater TRVs, the hierarchy will be values from the SLERAP, National Ambient Water Quality Criteria, the Final Chronic Values, then Great Lakes Tier II Secondary Chronic Values, then toxicity values from published literature. If there is no toxicity value for a COPC, a surrogate with a similar structure will be sought from Ecology and EPA. If there is no surrogate, no TRV will be listed, and this lack of data will be handled as an uncertainty.
- For sediment TRVs, the hierarchy will be values from the SLERAP, then No Effect Levels and Lowest Effect Levels from Persaud et al. (Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. Ontario Ministry of the Environment and Energy.), then Apparent Effects Thresholds from Washington State Department of Ecology (Washington State Department of Ecology. 1994. *Creation of Freshwater Sediment Quality Database and Preliminary Analysis of Freshwater Apparent Effects Thresholds*. June.), then values published by Ingersoll et al. (Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, and N.E. Kemble. 1996. Calculation and evaluation of sediment effect concentrations. *J. Great Lakes Res.*: 22:602-623). For COPCs whose values are not available from those sources, values and methods found in Jones et al. (1997) will be used. If there is no TRV in these sources, no TRV will be listed, and this lack of data will be handled as an uncertainty.
- For terrestrial plant TRVs, the hierarchy will be values from Efroymson et al. (1997), then values in the Phytotox database, then values from the Ecological Data Quality Levels Database (PRC). 1995. *Region 5 Ecological Data Quality Levels (EDQL), Final Technical Approach for Developing EDQL for RCRA Appendix IX Constituents and Other Significant Contaminants of Ecological Concern.*), then surrogate values from structurally similar chemicals obtained from Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.
- For terrestrial invertebrate TRVs, the hierarchy will be values from Efroymson et al. (1997), then values in published literature, then surrogate values from structurally similar chemicals obtained from Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.
- For terrestrial mammal and bird TRVs, the hierarchy will be values from Sample et al. (1996), then values from the ECOTOXicology Database System (EPA 1996, URL <http://www.epa.gov/ecotox>), then

surrogate values for structurally similar chemicals provided by Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.

The rationale for choosing bioconcentration factors is presented in the response to Comment RAWP-128.

Meeting Minutes no. 38 (November 2000):

Comment 13 - For chemicals with multiple values, use the most conservative. Follow the explicit guidance for selecting the No Observed Adverse Effects Levels (NOAELs) over Lowest Adverse Observed Effects Levels (LOAELs), etc. Continue to use the table format to present the information. Be specific as to source of the data. Look in SLERAP, Appendix E for guidance.

Meeting Minutes no. 39 (November 2000):

Comment 15 - Take out Region 5 EDQL. Look at the 1999 version of the SLERAP; go to literature if values not available there. Bill Desmond will confirm the hierarchy published in the response is okay.

Revised Response to Comment no. 13 (March 2001):

Agree. Summary tables of ecological effects for COPCs/ROPCs that are not in the SLERAP will be added to the RAWP, and sources of data will be cited by use of references to the reference list. Complete toxicity profiles will not be provided. SLERAP guidance for selecting values will be used, as outlined in Sect. 5.4.1 of the SLERAP. Specifically, the hierarchy of sources will be:

standards, criteria, guidance, or benchmarks established by a government agency, toxicity values published in scientific literature and evaluated for inclusion in the RAWP (chronic reproductive endpoints will be preferred, and studies with both a NOAEL and a LOAEL will be preferred over those with only a NOAEL or a LOAEL), for nonpolar organic COPCs in sediment, toxicity values calculated by using equilibrium partitioning, or toxicity values for surrogate chemicals that have been identified by EPA.

Methods for choosing among alternative TRVs are presented in more detail in RAWP-015. If multiple values with the same standing in the hierarchy are found.

Revised Response to Comment no. 15 (March 2001):

Clarification. The method for choosing among alternative TRVs will be clarified as follows:

- For freshwater TRVs, the hierarchy will be values from the SLERAP, National Ambient Water Quality Criteria, then Final Chronic Values, then Great Lakes Tier II Secondary Chronic Values, then toxicity values from published literature. If there is no toxicity value for a COPC, a surrogate with a similar structure will be sought from Ecology and EPA. If there is no surrogate, no TRV will be listed, and this lack of data will be handled as an uncertainty.
- For sediment TRVs, the hierarchy will be values from the SLERAP, then No Effect Levels and Lowest Effect Levels from Persaud et al. (Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. Ontario Ministry of the Environment and Energy.), then Apparent Effects Thresholds from Washington State Department of Ecology (Washington State Department of Ecology. 1994. Creation of Freshwater Sediment Quality Database and Preliminary Analysis of Freshwater the lowest (i.e., most conservative) will be used. Sources of data will be explicitly identified in the data tables, and full citations will be provided. Apparent Effects Thresholds. June.), then values published by Ingersoll et al. (Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, and N.E. Kemble. 1996. Calculation and evaluation of sediment effect concentrations. *J. Great Lakes Res.*: 22:602-623). For COPCs whose values are not available from those sources, values and methods found in Jones et al. (1997) will be used. If there is no TRV in these sources, no TRV will be listed, and this lack of data will be handled as an uncertainty.

- For terrestrial plant TRVs, the hierarchy will be values from the SLERAP, then values from Efroymson et al. (1997a), then values in the Phytotox database, then surrogate values from structurally similar chemicals obtained from Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.
- For terrestrial invertebrate TRVs, the hierarchy will be values from Efroymson et al. (1997b), then values in published literature, then surrogate values from structurally similar chemicals obtained from Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.
- For terrestrial mammal and bird TRVs, the hierarchy will be values from Sample et al. (1996), then values from the ECOTOXicology Database System (EPA 1996, URL <http://www.epa.gov/ecotox>), then surrogate values for structurally similar chemicals provided by Ecology and EPA. COPCs with no surrogates will not be evaluated for toxicity, and this lack of data will be handled as an uncertainty.

The rationale for choosing bioconcentration factors is presented in the response to Comment RAWP-128.

PROPOSED RESOLUTION (August 2001):

Region 5 Ecological Data Quality Levels (EDQLs) will not be used as was recorded in meeting minute no. 39. For all TRVs the first choice will be data published in the SLERAP, followed by the hierarchy given in the response to Comment no.15, except sediment, which is clarified below.

Tetra Tech has approved most data hierarchies and has worked with Ecology and Bechtel to re-determine the hierarchy for sediment as follows:

- For sediment TRVs, the hierarchy will be values from the SLERAP, then Threshold Effect Levels and Probable Effect Levels from Smith et al. (Smith, S.L., D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and J. Field. 1996. "A Preliminary Evaluation of Sediment Quality Assessment Values for Freshwater Ecosystems." *J. Great Lakes Res.* 22:624-638), then No Effect Levels and Lowest Effect Levels from Persaud et al. (Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. Ontario Ministry of the Environment and Energy.), then Apparent Effects Thresholds from Washington State Department of Ecology (Washington State Department of Ecology. 1994. *Creation of Freshwater Sediment Quality Database and Preliminary Analysis of Freshwater Apparent Effects Thresholds*. June.), then consensus-based sediment quality guidelines published by MacDonald et al. (MacDonald, D.D, C.G. Ingersoll, and T.A. Berger. 2000 "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." *Arch. Environ. Contam. Toxicol.* 39: 20-31). For COPCs whose values are not available from those sources, values and methods found in Jones et al. (1997) will be used. If there is no TRV in these sources, no TRV will be listed, and this lack of data will be handled as an uncertainty.

DOCUMENTATION OF ORNL COMPILED VALUES - Meeting Minute No. 43; Comment No. 130

Comment no. 130 (Summer 2000):

Section 8.3.1.1 Toxicity Reference Values for Terrestrial Receptors, Single Chemical TRVs, Pages 8-48 and 8-49. The RAWP proposes to use benchmarks developed by DOE's Environmental Sciences Division at the Oak Ridge Reservation. We are very familiar with these benchmarks, however the basis of many of these benchmarks is often poorly documented.

Recommendation: Provide detailed rationale for TRVs adopted from Oak Ridge, and any other TRVs based on laboratory studies. Please review EPA's SLERAP for specific procedures for selecting toxicity values and for applying uncertainty factors.

Original Response (October 2000):

Clarification. Toxicity data for COPCs not found in the SLERAP will be fully referenced.

Meeting Minute no. 43 (November 2000):

Comment 130 - Use the Oak Ridge studies, but not necessarily adopt their benchmarks. Be able to document the number used.

Revised Response (March 2001):

Clarification. Toxicity data for COPCs not found in the SLERAP will be fully referenced. A discussion will be added to the text to describe the process for choosing toxicity benchmarks from the data that are available, as outlined in Sect. 5.4.1 of the SLERAP. Specifically, the hierarchy of sources will be:

- standards, criteria, guidance, or benchmarks established by a government agency,
- toxicity values published in scientific literature and evaluated for inclusion in the RAWP (chronic reproductive endpoints will be preferred, and studies with both a NOAEL and a LOAEL will be preferred over those with only a NOAEL or a LOAEL),
- for nonpolar organic COPCs in sediment, toxicity values calculated by using equilibrium partitioning, or
- toxicity values for surrogate chemicals that have been identified by EPA.

Methods for choosing among alternative TRVs are presented in more detail in the response to RAWP-015. If multiple values with the same standing in the hierarchy are found, the lower or lowest (i.e., more or most conservative) will be used. Sources of data will be explicitly identified in the data tables, and full citations will be provided.

PROPOSED RESOLUTION (August 2001):

As stated in the Revised Response no. 130, Bechtel/SAIC will select and use wildlife and other TRVs by applying the SLERAP hierarchy of sources. The ORNL compilations furnish data that will be used in the PRA. The data are of two types: a summarized or derived number on tables and a digest of toxicity studies used to derive the number. For example, Appendix A of Sample et al. (*Toxicological Benchmarks for Wildlife: 1996 Revision*, ES/ER/TM-86/R3, 1996) presents digests of the toxicity studies used to derive NOAELs and LOAELs. These digests will be reviewed to ascertain that they include an ecologically relevant endpoint (e.g., growth, reproduction, or mortality) and appropriate uncertainty factors (Ufs). The information in the digests will be prioritized according to the hierarchy presented in the guidance and as documented below:

- 1) chronic NOAEL,
- 2) subchronic NOAEL multiplied by an UF of 0.1 to convert to a chronic NOAEL,
- 3) chronic LOAEL multiplied by an UF of 0.1 to convert to a chronic NOAEL,
- 4) subchronic LOAEL multiplied by an UF of 0.01 to convert to a chronic NOAEL,
- 5) acute median lethality point estimate multiplied by an UF of 0.01 to convert to a chronic NOAEL, and
- 6) single dose toxicity value, whose UF will be chosen by best scientific judgment depending on the nature and duration of exposure, the endpoint observed, and the level of effect.

Data sources will be cited in full (e.g., original reference citation in Sample et al. 1996).

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Meeting Minute #45 - Sediment/Surface Water Transfer Models

Comment:

None

Original Response:

None

Meeting Minute #45 (November 2000):

...Put in descriptions of how we do surface water; how long we assume water is stagnant for the sake of conservatism.

Revised Response:

None

PROPOSED RESOLUTION (August 2001):

Surface water concentrations in the Columbia River will be calculated by using deposition rates only. As specified in the RAWP, erosion and runoff are not addressed because evapotranspiration exceeds precipitation in the Hanford Site area, resulting in insufficient water to cause significant erosion or runoff of COPCs (RAWP Sections 6.2 and 6.4). There is not assumed to be any stagnant water in the Columbia River.

Deposition of particles and vapors into the Columbia River is represented schematically in Figure 1. Deposited COPCs and ROPCs are distributed in the surface water as dissolved concentration or the particulate state, and they move from surface water into sediment. The distribution results in different concentrations that can be calculated; they are represented in Figure 2. Concentrations of COPCs and ROPCs in surface water will be calculated by using Equations B-2-9 through B-2-18 in Appendix B of the SLERAP, published data on discharge rates, estimates of the area of the river involved and other site-specific and chemical-specific parameters (equations and definitions of parameters are presented in Exhibit 1). Concentrations in sediment are calculated by using Equations B-2-9, B-2-10, and B-2-19 in Appendix B of the SLERAP, along with site-specific and chemical-specific parameters (equations and definitions of parameters are presented in Exhibit 1).

The concentration estimates will be very conservative because (1) the method assumes that deposition occurs over the entire Hanford Reach at the maximum modeled rate; (2) it calculates the concentration that would occur as a result of deposition through the entire reach (because the total loading is calculated as the deposition rate multiplied by the total surface area); the concentration at the beginning of the reach would actually be very low, and the concentration at mid-reach would be expected to be about half the calculated maximum concentration; and (3) sediment concentrations will be those that have accumulated at the end of 40 years.

Ingrowth of daughter radionuclides in sediment will be evaluated by calculating the formation and decay of daughter products after each year of deposition for the 40-year deposition period. Daughter radionuclides will not be evaluated in surface water because newly deposited ROPCs will remain in the Hanford Reach for only a few days.

Exhibit 1. Surface water/sediment concentration equations for Hanford RPPWTP, from SLERAP Appendix B.

Eq. B2-18 $C_{dlw} = \frac{C_{wctot}}{1 + Kd_{sw} * TSS * 1E-6}$

Eq. B2-17 $C_{wctot} = f_{wc} * C_{wctot} * (d_{wc} + d_{bs}) / d_{wc}$

Eq. B2-10 $f_{wc} = \frac{(1 + Kd_{sw} * TSS * 1E-6) * d_{wc} / d_z}{(1 + Kd_{sw} * TSS * 1E-6) * d_{wc} / d_z + (\theta_{bs} + Kd_{bs} * BS) * d_{bs} / d_z}$

Eq. B2-9 $C_{wctot} = \frac{L_T}{V f_x * f_{wc} + k_{wt} * A_w * (d_{wc} + d_{bs})}$

Eq. B2-1 $L_T = L_{DEP} + L_{DIF} + L_{RI} + L_R + L_E$

Eq. B2-2 $L_{DEP} = Q * [F_v * D_{ywwv} + (1 - F_v) * D_{ywp}] * A_w$

Eq. B2-3 $L_{DIF} = K_v * Q * F_v * C_{wv} * A_w * 1E-6 / (H / (R * T_{wk}))$

Eq. B2-11 $k_{wt} = f_{wc} * K_v + f_{bs} * K_b$

Eq. B2-12 $k_v = \frac{K_v}{d_z * (1 + Kd_{sw} * TSS * 1E-6)}$

Eq. B2-13 $K_v = [K_L^{-1} + (K_G * H / (R * T_{wk}))^{-1}]^{-1} * \theta^{T_{wk} - 29.3}$

Eq. B2-14 $K_L = (1E-4 * D_w * u / d_z)^{0.5} * 3.1536E7$

Eq. B2-19 $C_{sed} = f_{bs} * C_{wctot} * (Kd_{bs} / (\theta_{bs} + Kd_{bs} * BS)) * (d_{wc} + d_{bs}) / d_{bs}$

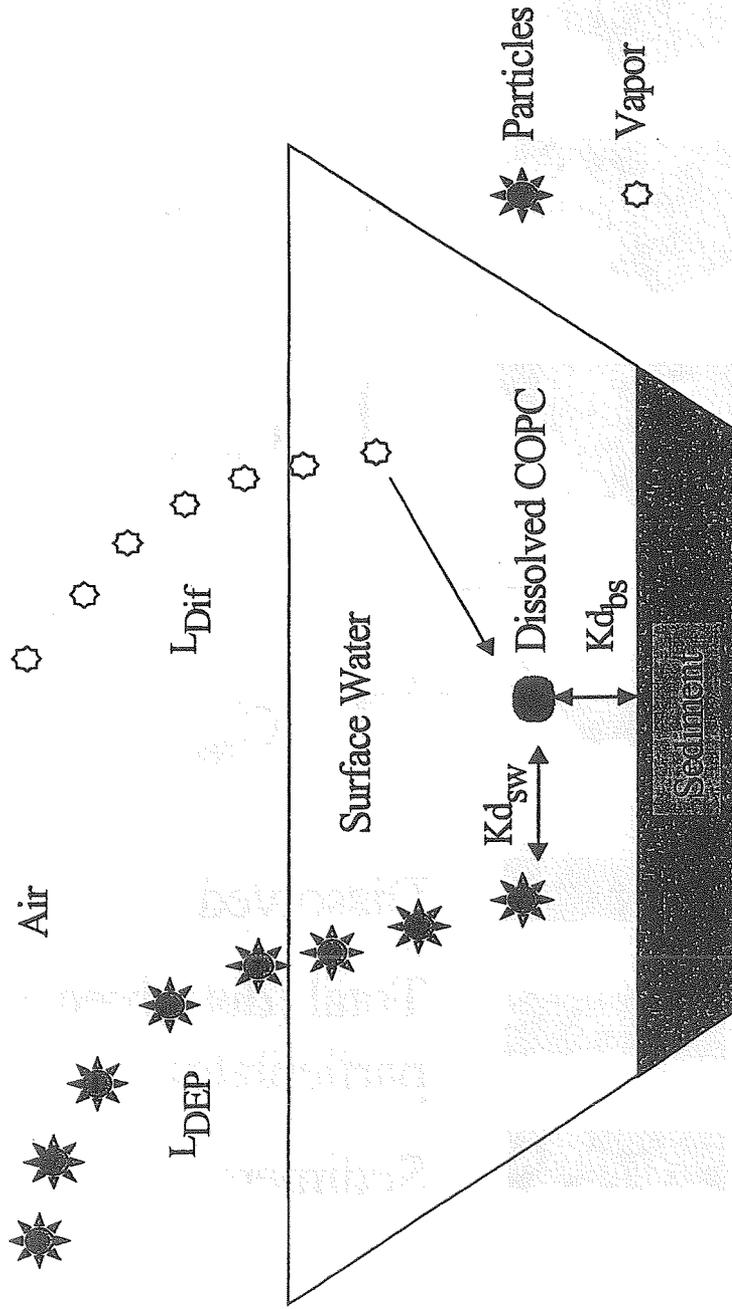
Exhibit 1. Parameter names, definitions, and values or sources
(9 COPC-specific, 10 site-specific, 12 calculated, and 3 constant)

Name	Depends on	Definition, units, value, etc.
C_{dw}	Calc.	Concentration of COPC or ROPC dissolved in the water (mg/L or pCi/L)
C_{wctot}	Calc.	Total concentration of COPC or ROPC in the water column (mg/L or pCi/L)
$K_{d_{sw}}$	COPC	Suspended sediment/surface water distribution coefficient: constituent-specific, found in RAWP Tables B-1-1 (organic) and B-1-2 (inorganic)
TSS	Site	Total suspended solids (Default = 10 mg/L)
f_{wc}	Calc.	Fraction of COPC or ROPC in the water column
C_{wctot}	Calc.	Total concentration of COPC or ROPC including the water column and bed sediment (mg/L or pCi/L)
d_{wc}	Site	Depth of the water column (estimated average 3 m)
d_{bs}	Site	Depth of bed sediment (Default = 0.03 m)
d_z	Site	Combined depth = $d_{wc} + d_{bs}$
θ_{bs}	Site	Porosity of bed sediment (Default = 0.6)
$K_{d_{bs}}$	COPC	Bed-sediment/surface water distribution coefficient: constituent-specific, found in RAWP Tables B-1-1 (organic) and B-1-2 (inorganic)
BS	Site	Benthic solids concentration (Default = 1 g/cc)
L_T	Calc.	Total load to the water body (g/yr)
V_{fx}	Site	Discharge rate
k_{wt}	Calc.	Overall total water body COPC dissipation rate constant (yr^{-1})
A_w	Site	Area of the receiving body (TBD)
L_{DEP}	Calc.	Total wet and dry particle and wet vapor direct deposition load (g/yr)
L_{Dir}	Calc.	Vapor phase diffusion (dry deposition) to water body (g/yr)
L_{RI}	NA	Runoff from impervious surfaces (g/yr) = 0
L_R	NA	Runoff from pervious surfaces (g/yr) = 0
L_E	NA	Soil erosion load (g/yr) = 0
Q	COPC	Emission rate (g/s) (used to calculate L_{DEP} and L_{Dir} in PRA Table 4-16)
F_v	COPC	Fraction of airborne COPC or ROPC in the vapor phase (0 or 1)
Dy_{www}	COPC	Air modeling result, total wet deposition from vapor ($s/m^2 \cdot yr$) (Dy_{ww} in PRA Table 4-9)
Dy_{twp}	COPC	Air modeling result, total wet and dry particulate deposition ($s/m^2 \cdot yr$) (sum of Dy_{dp} and Dy_{wp} in PRA Table 4-9)
K_v	Calc.	Overall COPC transfer rate coefficient (m/yr)

Exhibit 1. Parameter names, definitions, and values or sources (continued)

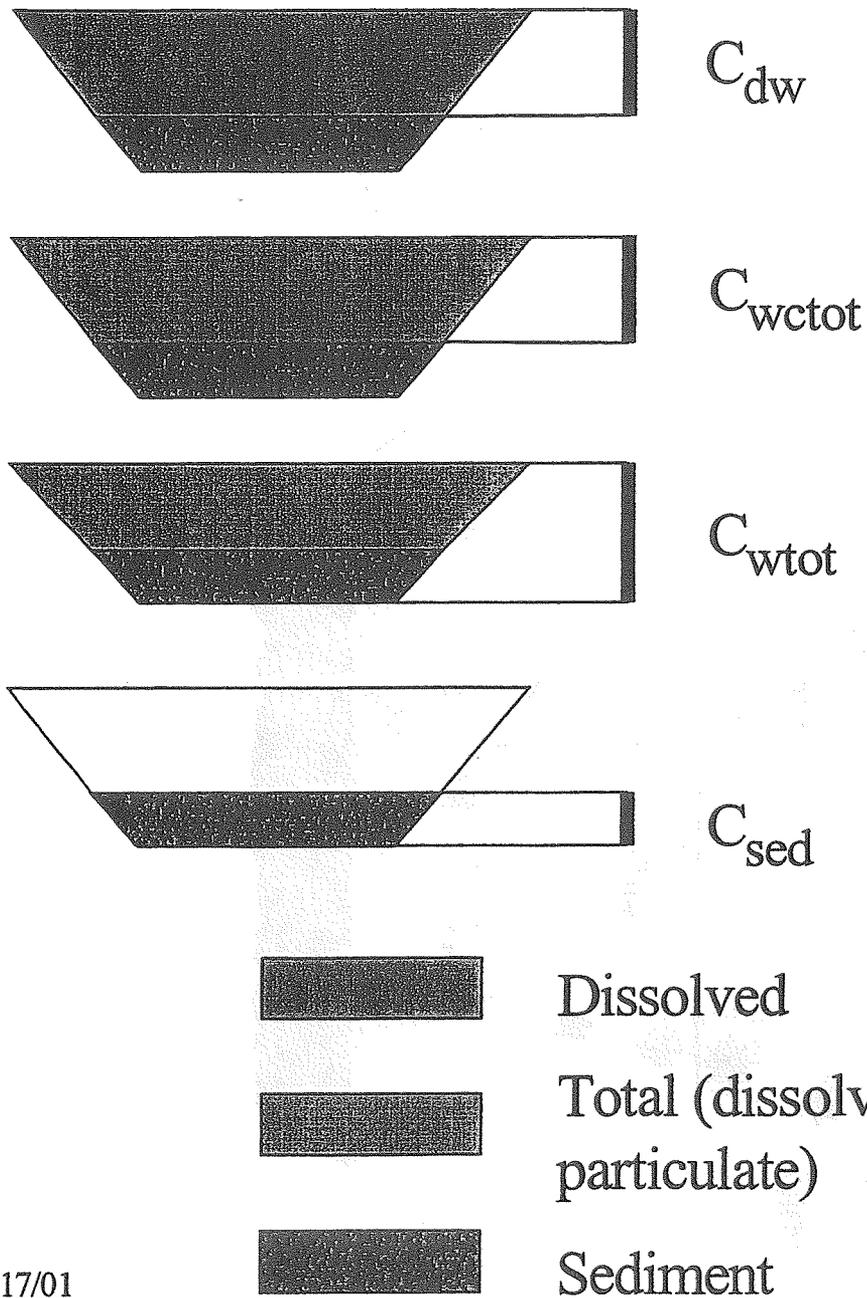
Name	Depends on	Definition, units, value, etc.
C _W	COPC	Unitized yearly average air concentration in vapor phase (µg-s/g-m ³) (from PRA Table 4-9)
H	COPC	Henry's Law constant, found in RAWP Tables B-1-1 (organic) and B-1-2 (inorganic)
R	Constant	Gas constant = 8.205E-5 atm-m ³ /mol-K
T _{wk}	Site	Water temp (K)
k _v	Calc.	Water column volatilization rate constant (yr ⁻¹)
K _L	Calc.	Liquid-phase transfer coefficient (m/yr)
K _G	Constant	Gas-phase transfer coefficient (Default = 3.65E4 m/yr)
θ	Constant	Temp. correction factor (1.026)
D _w	COPC	Diffusivity of COPC in water, found in Tables B-1-1 (organic) and B-1-2 (inorganic)
u	Site	Current velocity (estimated 3 m/s)
C _{sed}	Calc.	Concentration of COPC or ROPC in bed sediment (mg/kg)

Figure 1. Deposition of COPCs and ROPCs in Surface Water and Sediment



8/17/01

Figure 2. Different COPC and ROPC Concentrations Recognized by the Surface Water/Sediment Model



8/17/01

[PSC1]

SURROGATE VALUES FOR BCFS, FCMS, OTHERS – Meeting Minutes No. 32; Comment No. 108

Comment no. 108 (Summer 2000):

Section 8.2, Exposure Assessment, Pages 8-23 and 8-24. [A] The description of the procedures for modeling stressor concentrations in prey of measurement receptors are not consistent with the procedures recommended in EPA's SLERAP, which uses simplifying assumptions [(bioconcentration factor (BCF) multiplied by a trophic level-specific food chain multiplier (FCM)]. Please note that the appropriateness of all BAF and BSAF values proposed must be thoroughly documented.

[B] The exposure assessment does not discuss how COPCs and ROPCs without bioaccumulation data will be handled. Will surrogate information be used? Will these stressors not be quantitatively evaluated?

Recommendation. We recommend this ERA use methods in EPA's SLERAP. Also, provide an overview of how COPCs and ROPCs with insufficient exposure information will be handled in the assessment.

Original Response (October 2000):

Agree. The comment has been tentatively accepted. The FCM approach will be used to calculate surrogate BAF-T values. The equation presented in the SLERAP for BASFs ($BASF = 0.819 \times \log K_{ow} - 1.146$) will be used. The level of detail of documentation will be determined during discussions with the regulatory agencies.

Meeting Minute no. 32 (November 2000):

[1] Do food chain multiplier (FCM) for aquatic and terrestrial organisms. Compare aquatic FCMs with terrestrial FCMs. Discuss the comparisons in the uncertainty discussion. This method will work for any organic.

[2] For inorganics, except methyl mercury and selenium, set Bioconcentration Factor (BCF) at 1 – unless guidance recommended values are available.

[3] Do all you can with hierarchy, defaults, etc.

[4] In the absence of data, use a surrogate. Wait until emissions estimate is available; look at the higher numbers. Those are the candidates for using surrogates. If surrogates are needed, the Agencies will provide direction and data for surrogates in the RAWP review stage.

Revised Response (March 2001):

Agree. The FCM approach will be used to calculate BCF_{fish} values for aquatic receptors and BAF-T values for terrestrial receptors. The FCM method for aquatic receptors uses the published BCF as a point of departure and multiplies it by a factor that accounts for greater bioaccumulation with trophic distance from the primary receptors. In contrast, the FCM method for terrestrial receptors uses BCFs for ingested soil, ingested water, and ingested prey separately: for ingested soil and ingested water it applies the BCF multiplied by the receptor's FCM, and for prey it applies the ratio of the receptor's FCM to the prey's FCM multiplied by concentration in the prey. The FCM for inorganics is assumed to be 1.0. The FCM for organics varies with K_{ow} and is based on empirical observations of the relationship of BCF to K_{ow} .

Bioconcentration factors published in the SLERAP will be used whenever they are present. The COPCs listed in the SLERAP comprise about thirty of the 470 COPCs/ROPCs for the SLRA. Published BCF and BAF data for COPCs and ROPCs that are used but are not found in the SLERAP will be fully referenced. For inorganics with no published BAF values, except methyl mercury and selenium, the BCF will be 1.0 unless guidance recommended values are available. For organics with no published BCF and BAF values, empirical equations will be used as presented in the SLERAP, Appendix C. Equations are given for soil invertebrates, plants in soil and sediment, aquatic invertebrates, algae, fish, and benthic invertebrates in sediment. For

example, the equation presented in the SLERAP for sediment invertebrates ($\log \text{BASF} = 0.819 \times \log K_{ow} - 1.146$) will be used for organic COPCs in sediment. In the absence of data for the few organics with neither SLERAP published uptake factors nor K_{ow} s, surrogates will be needed. Surrogates will be provided by the Agencies during the RAWP review process. Uncertainties about the use of aquatic food chain multipliers for terrestrial biota will be discussed in the uncertainties section.

PROPOSED RESOLUTION (August 2001):

[1] FCMs will be used to calculate exposure of receptors. For each COPC, the aquatic and terrestrial FCMs will be the same and will depend on $\log K_{ow}$ and trophic level. Uncertainties will be discussed.

[2] BCFs for inorganics are typically greater than 1. BCFs for some inorganic COPCs (and by extension, ROPCs) are given in the SLERAP. Other BCFs were published by U.S. NRC (NUREG/CR-5512, 1992). FCMs for inorganic are set at 1 except for selenium and for newly published values for methyl mercury (EPA 2001). BCFs for methyl-mercury will be 5.9×10^4 for Trophic Level 1, 8.6×10^4 for Trophic Level 2, 1.3×10^6 for Trophic Level 3, and 6.8×10^6 for Trophic Level 4. BCFs for selenium will be used as published in the SLERAP, Appendices C and D.

[3] Bechtel/SAIC intend to follow selection criteria presented in the SLERAP for published or calculated uptake factors and to derive food chain multipliers. Uptake factors for COPCs with no data will be calculated by using methods described in response [4] below. Food chain multipliers will be calculated by using the data in Table 5-2 (5.3.2.3) of the SLERAP along with $\log K_{ow}$ values for COPCs.

[4] An evaluation of available uptake factors showed that it is not necessary to base a choice of surrogates on the calculated emission rates. In addition, it is not appropriate to do so because some COPCs emitted at low rates may be more toxic than some COPCs emitted at higher rates. As detailed in the following paragraphs, methods are available in the guidance (SLERAP) to calculate uptake factors for all COPCs and ROPCs for which they are needed.

Bioaccumulation factors (BAFs) are required to calculate concentrations of COPCs and ROPCs in the tissues of prey as part of the exposure evaluation of predators; BAFs are not needed to evaluate toxicity by direct exposure to soil, water, or sediment. If measured BAFs are not available, alternative methods are required. Methods to obtain BAFs for organic COPCs, inorganic COPCs, and ROPCs will predominantly be those presented in the SLERAP and described below.

Organic COPCs: Methods are presented in the SLERAP to calculate BAFs for plants, invertebrates, mammals, and birds for all organic COPCs that have $\log K_{ow}$ values, by using equations based on statistical analyses of bioaccumulation of compounds with known K_{ow} values. These equations will be used to derive BAFs for organic COPCs as needed. $\log K_{ow}$ values are not available for some organic COPCs. However, among the organic COPCs, in every case where there is no $\log K_{ow}$, there is also no toxicity reference value for either mammals or birds. Therefore, toxicity of those COPCs will not be evaluated, and BAFs are not needed.

Inorganic COPCs: The SLERAP states that for inorganic COPCs with no published bioaccumulation data or estimates for a given receptor, the arithmetic average of all the available BAFs for that receptor is to be used. The exception is for water-to-algae transfer, for which no guidance is presented. The logic for arithmetic averages seems to be as good for this transfer as for other medium-to-organism transfers. Therefore, the arithmetic average of available BAFs for inorganic constituents will be used for each BAF for which no published data are available.

ROPCs: Because ROPCs are inorganic constituents that, in general, do not differ in chemical properties from their stable isotopes that may be COPCs, ROPCs are included as inorganic constituents. Published BAFs of ROPCs will be included in the calculation of average values, and the average of values for inorganic COPCs and ROPCs will be used for ROPCs without published BAFs.

Two ROPCs that do not have published BAFs are an exception to the above rule: tritium and carbon-14. BAFs and/or methods to calculate tritium and C-14 concentrations in plants and animal tissues are presented in Regulatory Guide 1.109 (U.S. NRC 1977), and BCFs for fish are given in NUREG/CR-5512 (U.S. NRC 1992). For aquatic plants and invertebrates, it will be assumed that the concentration of tritium in tissue is the same as the concentration in the surrounding water. It will be assumed that the BAF for C-14 in aquatic plants and invertebrates is the same as for fish, because in both organisms the specific activity of carbon (pCi/g carbon) is expected to be the same as the specific activity of carbon in the surrounding water. For terrestrial and benthic invertebrates, the ratio of C-14 to tissue carbon will be assumed to be the same as the ratio of C-14 to Total Organic Carbon in the soil and sediment, respectively.

In summary, methods are available to derive uptake factors for all COPCs and ROPCs for which there are TRVs. Therefore, there is no need for EPA to supply any surrogate BCFs, FCMs, or others such transfer relationships.

SALMONID TOXICITY - Meeting Minute No. 28; Comments No. 12 And No. 101

Comment no. 12 (Summer 2000):

The risk to local populations of Chinook salmon and steelhead, protected fish species regulated by the National Marine Fisheries Service, should be evaluated separately from 'aquatic life'. These receptors are protected species, and the results from the risk assessment of aquatic life may not provide sufficient detail about the potential risk to these species. The problem formulation section of the ERA should discuss the need to evaluate these receptors separately, and also provide other required information, including exposure scenario locations, assessment endpoints, and measurement endpoints. The exposure assessment for these receptors is the same as the one for "aquatic life". Toxicity reference values in ATG, Inc.'s risk assessment for these receptors should be suitable for this analysis.

Comment no. 101 (Summer 2000):

Section 8.1.2.3, Aquatic Ecosystems, Pages 8-7 through 8-8. The Columbia River provides critical habitat for salmon and steelhead trout, special status species. For this reason, it is important to evaluate these receptors in addition to "aquatic life". This reach (the portion of the Columbia River closest to the site) should be evaluated as an exposure scenario location for the ERA, and therefore the air modeling should include an adequate number of grid nodes over the reach.

Recommendation: Discuss the basis for the Chinook salmon and steelhead trout being listed as protected species. Also, please review ATG's procedures for screening risk to these fish.

Original Response to Comment no. 12 (October 2000):

Disagree. This approach is inconsistent with the screening-level risk assessment process presented in Figure 1-1 of SLERAP, where collection of additional site-specific information is performed following the initial toxicity assessment, exposure assessment, and subsequent risk characterization. Aquatic life will be first evaluated. If unacceptable risk is identified, additional site-specific information will be obtained, such as analysis of specific forms of aquatic life, and analyzed. The exposure assessment of anadromous fish is very different from that of generalized aquatic life, because anadromous fish are present only as juveniles and during spawning, and during spawning they have no ingestion exposure. Toxicity values in ATG's risk assessment will be reviewed and used as appropriate. We request that Ecology provide the latest or approved copy of the ATG risk assessment.

Original Response to Comment no. 101 (October 2000):

Clarification. Analysis of additional aquatic receptors seems inconsistent with the SLRA approach of screening. As mentioned in the comment RAWP-001, reviewers mentioned methods and data that go beyond the normal screening level analysis. To add fine distinctions of fish species seems a continuation of that overly ambitiousness. In addition, the special status species noted are anadromous and are exposed as juveniles and then only briefly at the end of their lifetime, exposed after fertilized ova have been formed, and exposed not at all by ingestion. We request a discussion on this to resolve the balance of screening level work and much more complex work. See also the response to comment RAWP-012.

Meeting Minute no. 28 (November 2000):

Comment 101,12 - Addressing risk to salmonids is a risk communication issue and will help demonstrate the WTP is consistent with the Endangered Species Act. Include two tables in the risk assessment report, one addressing the risk to aquatic life and the other addressing risk to salmonids. The analysis will be performed on salmonids in general, not specific salmonid species. Include references for data used to calculate risk; these values should reside in the ECOTOX database. EPA observed that limited data would be available. Look at the ATG table addressing salmonids; provide a reference for the data (ATG did not).

Revised Response to Comment no. 12 (March 2001):

Agree. An additional analysis of risks to salmonids will be added, noting the protected status of some of the salmonids. Specific published toxicity data for salmonids, including those in the ECOTOX database, will be used whenever possible. Toxicity values in ATG's risk assessment will be reviewed and used as appropriate. We request that Ecology provide the latest or approved copy of the ATG risk assessment, including the data appendices.

Revised Response to Comment no. 101 (March 2001):

Agree. An analysis of risks specific to salmonids will be added, noting the protected status of some of the salmonids. Specific published toxicity data for salmonids will be used whenever possible. See also the response to comment RAWP-012.

PROPOSED RESOLUTION (August 2001):

Two fish species, the chinook salmon (*Oncorhynchus tshawytscha*) and the steelhead (*Oncorhynchus mykiss*) are regulated as Evolutionarily Significant Units by the National Marine Fisheries Service. Both species are salmonids found in the Columbia River. Therefore, it is appropriate to do a risk evaluation for these species that is separate from the evaluation of "aquatic biota". Most salmonid species of the Columbia River spend only a few days in the Hanford Reach, although the fall-run chinook, which hatch predominantly just upstream of the reservation, spend approximately two months in the section of the river in the northeast portion of the reservation. Although this is only a small fraction of the salmon's lifespan, it is a sensitive growth stage. Therefore, chronic and subchronic exposure data are assumed to apply for exposure of juvenile salmonids. In addition, a TUF of 1 will be used because the fish may be present in the Hanford Reach throughout the sensitive life stage. This information will be presented in the exposure scenario evaluation.

Toxicity data for salmonids will be presented in a separate column in the TRV table. We will use toxicity data for juvenile fish whenever possible. Separate columns for exposure of salmonids to ROPCs will appear in tables for radiation doses to aquatic biota. A separate table will be included for HQs.

A search for additional data has revealed information summarized as follows: Based on the proposed resolution to Comment no. 12 (August 2001), the preferred data are chronic toxicity data (water concentrations), for juvenile stages of Columbia River salmonids, including the Chinook, steelhead, and sockeye salmon, which are T&E species in the upper Columbia River Basin. Presently a variety of salmonid toxicity data have been located in addition to the data in ATG (1998). For 11 metals in soft water, there are LC₅₀s, incipient lethal levels, or MATCs (Nelson et al. 1991). Most of these data are for rainbow trout, including a MATC for eggs for lead, but there is a copper LC₅₀ for Coho salmon. There are acute LC₅₀s for 6 salmonids, including the sockeye and Chinook, for 2 pesticides, Troclopypyr acid and Tryclopypyr BEE (Wan et al. 1987). There are chronic LOAEL and acute LOAEL values for 20 and 13 chemicals, respectively, for salmonids, but only 2,4-D and zinc have chronic LOAELs for Coho salmon. Data are available for 11 metals and 22 organic compounds. Dose-response data from 10-week and 18-month experiments on rainbow trout (beginning as eggs) are available for silver (Davies et al. 1978). Multiple LC₅₀ and other toxicity values for Coho salmon (cadmium, chromium, mercury and selenium) and Chinook salmon (chromium and selenium) are available in the EPA ECOTOX database. The ages of test organisms are not available for many of these data.

References:

ATG, Inc. 1998. Mixed Waste Facility RCRA/TSCA Permit Application. Attachment 4 – Risk Assessment Work Plan. Rev. 4. Richland, WA. June 26, 1998.

Nelson, R. L., M. L. McHenry, and W. W. Platts. 1991. Mining. American Fisheries Society Special Publiion 19:425-457.

Wan, M. T., D. J. MOUL et R. G. WATTS. 1987. Acute toxicity to juvenile Pacific salmonids of Garlon[®] – 3A, Garlon[®] –4, triclopypyr, trichloropyridine. Bull. Environ. Contam. Toxicol. 39: 721-728.

REFERENCE FROM AGENCY ON ECOLOGICAL QF OF 5 - Meeting Minute No. 35; Comment No. 116

Comment no. 116 (Summer 2000):

Section 8.2.2.4, Internal Exposure (Terrestrial Receptors), Page 8-29, and Section 8.2.3.4, Page 8-35. This section presents the model for assessing internal exposures to organisms other than man. In the equation of the internal dose rate on page 8-29 and 8-35, it may be more appropriate to assign QF in the range of 5-10 for alpha radiation (e.g., Kocher and Trabalka, in press), rather than 20...

Original Response (October 2000):

None

Meeting Minute no. 35 (November 2000):

Comment 116 - Discussion with John Mauro. He felt CHG should use the QF of 5 rather than 20; it was agreed that the QF of 5 would be used. DOE and CHG requested the EPA/Ecology technical basis for this value.

Revised Response (March 2001):

A quality factor of 5 will be used for all alpha emitters.

PROPOSED RESOLUTION (August 2001):

A QF of 5 will be used in the risk assessment. We await the appropriate reference from Ecology or EPA. The reference appears to be Kocher, D. C., and J. R. Trabalka. 2000. "On the Application of a Radiation Weighting Factor for Alpha Particles in Protection of Non-Human Biota." Health Physics Society Journal 79 (October). Confirmation is needed.

Attachment 2 to CCN 023430

River protection Project -- Waste Treatment Plant Emissions Estimate

Lee Bostic

9/7/01



September 6, 2001

Objectives

- Background
- Status
- Emissions Estimate Basis and Results
- Future Development

Background

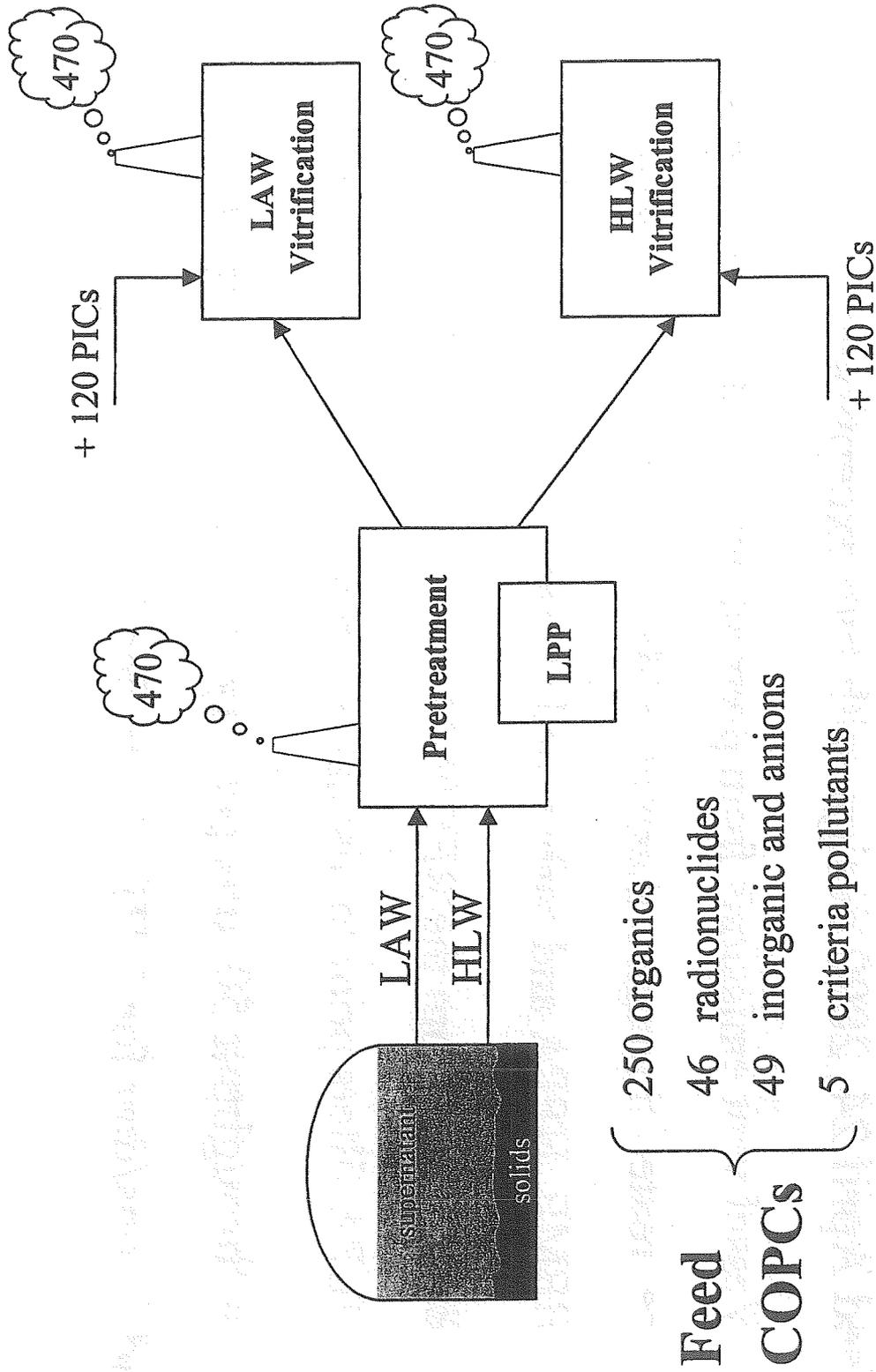
- November 1-2, 2000 discussion of objectives
 - Use Aspen OLI Custom Modeler (ACM) software to estimate emissions for 470 COPCs from three stacks
 - Use April 24, 2000 design configuration
 - Use equipment decontamination factors:
 - ♦ documented in approved engineering calculations
 - ♦ available R&T testing data
 - ♦ ACM calculations
 - Estimate PIC emissions based on VSL bench scale melter testing
 - Use a subset of representative compounds to address the complete list of COPCs

Status

- *Integrated Emissions Baseline Report* issued May 7, 2001
- 132 of the 470 COPCs were analyzed using ACM
- ACM results expanded to 470 COPCs from three stacks



Graphical Depiction of Emissions Estimate



Design Basis

- Used April 24, 2000 design with two exceptions:
 - Vessel vent emissions from pretreatment plant process vessels will be treated through a thermal oxidation unit, a caustic scrubber, HEME, HEPA and carbon bed absorber
 - Exhaust air from the RFD/PJM system will pass through separate HEPA filters prior to discharge through the HLW vitrification stack
- Plant throughput 50 tons per day for 3-LAW vitrification units and 3 tons/day for 1-HLW vitrification unit

Design Basis (continued)

- Organic waste feed concentrations derived from maximum contract limit for total organic carbon (TOC) of 4 wt.%
 - 3.5 wt% attributable to nonhazardous organics (e.g., complexants, low molecular weight acids)
 - 0.5 wt% attributed to hazardous organics

Basis for DFs and RFs

- Decontamination factors (DFs) for COPCs across evaporator system based on:
 - Predictive thermodynamic software (ESP/OLI)
 - Hanford Site 242-A Evaporator operating data
- Vessel vent emissions were based on vapor-liquid equilibrium (Henry's Law)
- Organic emissions from RFD/PJM determined to contribute less than 0.1 % volatile emissions and were neglected

Products of Incomplete Combustion

- PICs were estimated based upon potential to be formed within the melter and thermal oxidizing units
- Emission rates for PICs were set to estimated stack detection limits
- Results were compared to bench scale test results from Vitreous State Laboratory to verify conservative estimate

Results

- Tables 18, 29 and 20 summarize resulting organic, inorganic and radionuclide emission rates respectively
- The combined organic emissions from three stacks were estimated to be 0.285 ton TOC/yr
- Some non-PIC organics are predicted to be below their corresponding stack detection limits

Future Emissions Development

- Revise the Emissions Estimate to reflect updated design configuration
 - Pretreatment changes that route HLW feed streams through evaporative process
 - Addition of Silver Mortenite
- Use resulting emissions estimates to develop Screening Level Risk Assessment

Future Emissions Development

continued

- Evaluate effect of detection limits based on performance demonstration test
 - PODCs input into Final Risk Assessment at detection limits
 - Dioxins/furans and PICs input at detection limits
 - Other COPCs input at estimated feed concentration and applying the control equipment DFs