

2. Please run the Johnson and Ettinger model using a risk of 10-6 and 10-7.

Versar is temporarily holding off on performing the modeling, per e-mail from Kim Tisa, Region 1, on May 12, 2005.

Technical Directive, May 5, 2005: Please review the responses and determine if Versar's comments from April 14, 2005 have been adequately addressed.

May 2, 2005, Memorandum (Alan D. Hanscom, BETA Group, Inc. to Kimberly Tisa, EPA, Region 1)

General Comment - Calculation of PCB Concentrations

Please provide additional information regarding the PCB soil exposure point concentration (EPC) of 94.5 mg/kg used to calculate the indoor air concentrations. Attachment C of the *Risk-Based Cleanup Request* (March 21, 2005) identifies different sampling areas, but it is not clear which areas and samples were considered when choosing the 94.5 mg/kg value. The May 2nd memorandum indicates that 94.5 mg/kg PCB concentration is the maximum detected soil concentration remaining at the site. However, Page 8 of 18 of the *Cleanup Request* indicates that the maximum measured total PCB concentration was 46,500 mg/kg, but when looking at results in Attachment C, there appear to be numerous samples that are higher than the EPC. The risk assessment information should clearly indicate what data are used for the indoor air calculation.

Comments #3(a) - Related to Formulas and Accuracy of RBAC Calculation (Current Worker Exposure)

Table 2, Calculation of Alternate Air Dust Concentration (May 2, 2005, memorandum)

In Table 2, the soil screening level (SSL) equation is rearranged and a particulate emission factor (PEF) is calculated for a target risk. This target PEF is then used to calculate a target respirable particulate concentration (i.e., PM₁₀ - particulate matter with an aerodynamic diameter #10 :m) and the measured total suspended particulate air concentration is compared to the target value. The PEF calculation for a target cancer risk of 1×10^{-6} , shown in Table 2, incorrectly uses an averaging time, AT, of 1 year; for carcinogenic risk, AT should be equal to 70 years. The air concentration based on a target non-carcinogenic risk should also be calculated.

Since the PCB soil concentrations and the particulate air concentration related to the construction work is known, it would be preferable to compare a target PCB air concentration to the actual PCB air concentration. Table 1 shows the measured air dust concentrations taken during the clean corridor work. This data (which was not included in previous submissions) should be used with the measured PCB soil concentrations from the corridor area to calculate the PCB air concentration during the clean corridor work. The value can then be compared to the target PCB air concentration associated with the target cancer and non-cancer risks. The PCB air

concentration would be based on total suspended particulate instead of the PM₁₀ or respirable particulate air concentration, but, if the PCB air concentration is below the target concentration, then the respirable amount of PCBs in the air would be well within the limit.

The PCB air concentration may be derived by the following equation:

$$EPC_{\text{air}} = PM_{10} \times (C_{\text{soil}} \times CF)$$

where:

- EPC_{air} = Exposure point concentration (mg_{PCBs}/m³_{air});
- PM₁₀ = Particulate matter with an aerodynamic diameter #10 :m (:g/m³_{air})
- C_{soil} = PCB soil concentration (mg_{PCBs}/kg_{soil});
- CF = Conversion factor (10⁻⁹ kg/:g).

Thus, for the clean corridor PCB soil concentration, C_{soil}, of 46.6 mg/kg, and the particulate air concentration of 460 :g/m³_{air}, the PCB air concentration during construction would be 2.1x10⁻⁶ mg/m³.

Solving for a target PCB concentration, based on a target cancer risk of 1x10⁻⁶:

$$EPC_{\text{air}} (\text{PCBs}) = \frac{TR \times AT \times CF}{UR \times ET \times EF \times ED} = \frac{(1 \times 10^{-6}) \times (70 \text{ yr}) \times \left(8760 \frac{\text{hr}}{\text{yr}}\right)}{0.57 \left(\frac{\text{mg}}{\text{m}^3}\right)^{-1} \times \left(8 \frac{\text{hr}}{\text{d}}\right) \times \left(250 \frac{\text{d}}{\text{yr}}\right) \times (1 \text{ yr})}$$

$$EPC_{\text{air}} (\text{PCBs}) = 5.4 \times 10^{-4} \frac{\text{mg}}{\text{m}^3} \text{ or } 0.54 \frac{\mu\text{g}}{\text{m}^3}$$

The same calculation should be performed for a target non-cancer risk (i.e., hazard quotient), 0.1 is assumed for this example:

$$EPC_{\text{air}} (\text{PCBs}) = \frac{TR \times AT \times CF \times RfC}{ET \times EF \times ED} = \frac{(0.1) \times (1 \text{ yr}) \times \left(8760 \frac{\text{hr}}{\text{yr}}\right) \times \left(7 \times 10^{-5} \frac{\text{mg}}{\text{m}^3}\right)}{\left(8 \frac{\text{hr}}{\text{d}}\right) \times \left(250 \frac{\text{d}}{\text{yr}}\right) \times (1 \text{ yr})}$$

$$EPC_{\text{air}} (\text{PCBs}) = 3.1 \times 10^{-5} \frac{\text{mg}}{\text{m}^3} \text{ or } 0.031 \frac{\mu\text{g}}{\text{m}^3}$$

Thus, the calculations demonstrate that the PCB air concentrations associated with total suspended particulates were below the target PCB concentrations associated with respirable particulates or PM₁₀ (i.e., the amount of respirable particulates would be less than the total suspended particulates, so, the target concentration is easily met).

Comment #3(c) - Related to Henry's Law Constant for Aroclor 1254 and Evaluation of PCBs for Indoor Air Intrusion

Table 3-1, Calculation of indoor inhalation of PCBs volatilized from soil (May 2, 2005, memorandum)

As noted in the May 9, 2005, memorandum, a unit risk value of 0.1 (mg/m³)⁻¹ should have been used in the risk calculations instead of the unit risk of 2.0 (mg/m³)⁻¹. The revised cancer risk for indoor inhalation of volatilized PCBs (shown in Table 3-1), using the unit risk of 0.1 (mg/m³)⁻¹, would be 9.6x10⁻¹⁰ instead of 1.5x10⁻⁷:

$$\text{Cancer risk} = \frac{(\text{Cair}) \times (\text{EF}) \times (\text{ED}) \times (\text{EP}) \times (\text{CF})}{(\text{AP})} \times \text{UR}$$

$$\text{Cancer risk} = \frac{(9.44 \times 10^{-7} \frac{\text{mg}}{\text{m}^3}) \times (250 \frac{\text{d}}{\text{yr}}) \times (25 \text{ yr}) \times (1.14 \times 10^{-4} \frac{\text{yr}}{\text{hr}})}{(70 \text{ yr})} \times 0.1 (\frac{\text{mg}}{\text{m}^3})^{-1}$$

$$\text{Cancer risk} = 9.6 \times 10^{-10}$$

The calculated HQ of 0.003 is correct. The placement of an engineering barrier would result in even lower risks than the calculated risks (above).

Because children will be spending time in the building, risk calculations, similar to those performed for adults, should be performed for children. The May 9, 2005, memorandum indicates that risk estimates for children would be expected to be similar to those for adults, based on their similar inhalation rate to body weight ratios, 0.29 and 0.31, respectively. However, it is helpful to see the actual values, so the cancer risk and HQ for children inhaling PCBs evaporated from the soil were calculated as follows:

$$\text{Cancer risk} = \frac{(\text{C}_{\text{air}}) \times (\text{IR}) \times (\text{EF}) \times (\text{ED}) \times (\text{EP})}{(\text{BW}) \times (\text{AP})} \times \text{SF}$$

$$\text{Cancer risk} = \frac{(9.44 \times 10^{-7} \frac{\text{mg}}{\text{m}^3}) \times (13.5 \frac{\text{m}^3}{\text{d}}) \times (\frac{1 \text{ d}}{24 \text{ hr}}) \times (8 \frac{\text{hr}}{\text{d}}) \times (250 \frac{\text{d}}{\text{yr}}) \times (2 \text{ yr})}{(50.6 \text{ kg}) \times (70 \text{ yr}) \times (365 \frac{\text{d}}{\text{yr}})} \times 0.4 (\frac{\text{mg}}{\text{kg-d}})^{-1}$$

$$\text{Cancer risk} = 6.57 \times 10^{-10}$$

And non-cancer risk would be calculated as follows:

$$\text{Non-cancer risk} = \frac{(\text{C}_{\text{air}}) \times (\text{IR}) \times (\text{EF}) \times (\text{ED}) \times (\text{EP})}{(\text{BW}) \times (\text{AP})} \times \frac{1}{\text{RfD}}$$

$$\text{Non-cancer risk} = \frac{(9.44 \times 10^{-7} \frac{\text{mg}}{\text{m}^3}) \times (13.5 \frac{\text{m}^3}{\text{d}}) \times (\frac{1 \text{ d}}{24 \text{ hr}}) \times (8 \frac{\text{hr}}{\text{d}}) \times (250 \frac{\text{d}}{\text{yr}}) \times (2 \text{ yr})}{(50.6 \text{ kg}) \times (2 \text{ yr}) \times (365 \frac{\text{d}}{\text{yr}})} \times \frac{1}{7 \times 10^{-5} (\frac{\text{mg}}{\text{kg-d}})}$$

$$\text{Non-cancer risk} = 8.21 \times 10^{-4}$$

In this calculation, it was assumed that the children were 7th and 8th graders (middle school grades), from 12 to 14 years of age. The assumed inhalation rate of 13.5 m³/d is taken from Table 5-23 of the *Exposure Factors Handbook* (EPA, 1997). The value is the average inhalation rate for males (15 m³/d) and females (12 m³/d), 12-14 years of age. The body weight was based on the average body weight for 12 to 14 year olds from Table 7-3 of the *Exposure Factors Handbook*. The exposure frequency of 8 hours per day and the exposure duration of 250 days per year are conservative assumptions since students may only spend about 6 hours per day and less than 200 days per year at school.

Table 3-5, Summary of Site Input Variables (May 2, 2005, memorandum)

Generally, the assumed variables are consistent with or similar to EPA or ASTM default values. However, the areal fraction of cracks in foundation, 0, assumed to be 0.0002 cm²/cm², was taken from EPA's *Users Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (EPA, 2003)

and is the default for a basement house. From the information provided in the Risk-Based Cleanup Request (BETA Group, March 21, 2005), it is not apparent that a basement is planned for the building. If the building will be a slab-on-grade structure, then the default value of $0.0038 \text{ cm}^2/\text{cm}^2$ for 0 should be used from the EPA reference.

May 9, 2005, Memorandum

Please provide a basis for choosing a Hazard Index of 0.2 to determine a non-carcinogenic action level.