Appendix A4

Parameterization of Risk Assessment Model

PARAMETERIZATION OF RISK ASSESSMENT MODEL

The following bullets detail how each of the variables in the risk assessment model were selected. Values reflect either site specific input from meeting with Laotian team members or Health Canada default values (Health Canada 2004).

- C_S (Soil Concentration used by the accidental soil ingestion, inhalation of contaminated particles and dermal contact with contaminated soil pathways, units = mg/kg dry). The maximum soil/dust concentrations of dioxins/furans + DL-PCB TEQs measured in soil were used for modeling. It was anticipated that employees may be exposed to indoor dust and outdoor on-site soils during a shift. Residents of the dormitory may be exposed to on-site soils, while local residents would only be exposed to the highest off-site soil concentration.

- C_{Food} (Concentration measured in food, units = mg/kg wet). The maximum tissue concentration of dioxins/furans + DL-PCB TEQs measured was used in the model. Crabs had the highest concentrations of all other animals sampled (i.e., fish and snails).

- P_{Air} (Concentration of particulates suspended in the air, units = µg/m³). The Health Canada default value (0.76 µg/m³, as per USEPA 1992), was considered too low for Cambodia. Instead, a value of 100 µg/m³ was adopted during meetings with Cambodian team members.

- IR_S (mass of soil per day accidentally ingested, units = mg/day). The rate value used was taken directly from the Health Canada default table (0.00002 kg/day). The same rate was used for both children and adults. This means that on a per body weight basis, children accidentally consume about double the amount of soil than an adult (children are 32.9 kg, compared to an adult weight of 60 kg; see Bw below).

- IR_{Food} (mass of contaminated food per day ingested, units = kg/day). The default Canadian values were adopted for the model (0.11 kg/day for adults and 0.09 kg/day for children).

- IR_A (volume of air inhaled each hour, units = m³/hr). This variable is used for the inhalation pathway only. The rate value for adults and children were taken directly from the Health Canada default values. Note that Health Canada default values are presented in units of m³/day and therefore were divided by 24 hrs/day to get units of m³/hr.

- SA_H (surface area of skin exposed to contaminated soils, units = cm²). This variable was derived roughly from the Health Canada default values. While working in the warehouse, it was assumed that both hands and arms could be exposed and therefore a value of 1800 cm² was adopted. For the other scenarios, it was assumed that only part of the hand may be exposed and therefore a value

of 200 cm^2 was adopted (100 cm^2 for children). Values were developed during meetings with Cambodian team members.

- **SL_H** (Soil loading to exposed skin, indicates the usual surface area coverage per volume of contaminated soil, units = g/cm^2 - event). The Health Canada default value (0.0001 g/cm^2 for hands) was adopted.

- **AF_{GIT}** (absorption factor across the gastro intestinal tract, units = unitless). This variable was used both for accidental soil ingestion and food ingestion pathways. There are no readily available AF_{GIT} values for total dioxins/furans + DL-PCB TEQs. In these cases, Health Canada guidance recommends adopting a conservative estimate of "1". This indicates that 100% of chemical is absorbed across the gastrointestinal tract into the body.

- **AF_{Inh}** (Absorption Factor for the lungs, units = unitless). There are no readily available AF_{GIT} values for total dioxins/furans + DL-PCB TEQs. In these cases, Health Canada guidance recommends adopting a conservative estimate of "1". This indicates that 100% of chemical is absorbed across the lungs into the body.

- **AF_{Skin}** (Absorption Factor for the skin, units = unitless). For dioxins/furans + DL-PCB, an AF_{Skin} of 14% was adopted this is the absorption factor for PCB Aroclor mixtures commonly applied by the USEPA (cited in Mayes et al., 2002). The same factor was used for dioxins/furans + DL-PCB TEQs.

- **EF** (number of dermal exposures per day, units = events/day). It was assumed that there could be up to five exposure events per day in the warehouse, while adults outside the warehouse, living at the dormitory and local residents may have two exposure events per day. Children were assumed to have only one dermal exposure per day. These values were developed during discussions with Cambodian team members.

- **D_{hours}** (number of hours a day that an individual is potentially exposed, units = hrs/day). D_{hours} is used by the accidental ingestion and inhalation of contaminated particle pathways, but the value is slightly different for each exposure pathway. For accidental soil ingestion, it is assumed that individuals may only be exposed while they are near contaminated soils and also awake (i.e., 16 hours a day). The model assumed eight hours inside the warehouse and one hour outside the warehouse for SEDCW employees, and 16 possible hours of exposure for residents of the dormitory and local residents. For inhalation of contaminated particles it was assumed that individual may be exposed at any time that they are near to contaminated soils, therefore the model assumed eight hours for an employee working in the warehouse, one hour while working outside, and for residents of the dormitory or local residents, 24 hours.

- **D_{days}** (number of days per week, or days per year, that an individual is potentially exposed, units = days/week or days/year). D_{days} is used by all the exposure pathways, but the value is slightly different for each. For accidental soil ingestion, inhalation of contaminated particles and dermal contact, it was

assumed that warehouse employees would be potentially exposed five days a week, while dormitory resident tor local residents would be exposed seven days a week. The numbers were based on interviews with warehouse employees, and were selected during meetings with Cambodian team members. The food ingestion pathway uses days per year, which indicates the number of days each year that contaminated food items may be ingested. In this risk assessment it was assumed that only fish or other meat sources collected from the site were potentially contaminated.

- **D_{weeks}** (number of weeks per year that an individual is potentially exposed, units = weeks/year). D_{weeks} is used by the accidental soil ingestion, inhalation of contaminated particles and dermal contact pathways. It was assumed that the person (either an employee, dormitory resident or local resident) would be potentially exposed most weeks of the year, but would not be at the site during short periods of holiday or vacation. The numbers were based on interviews with employees, and were selected during meetings with Cambodian team members. For the inhalation of contaminated particulates pathway, D_{weeks}, should be multiplied by the proportion of weeks per year without rainfall. As it is likely that air-borne particulates will only be available for inhalation when soils are dry. In this risk assessment, application of the proportion of dry weeks was not necessary, as the inhalation pathway was not a significant contributor to total daily dose.

- **D_{years}** (number of years that an individual is potentially exposed, units = years). D_{years} is used by all exposure pathways, but only in the non-threshold model (i.e., the carcinogen model). SEDCW employees were assumed to be working at the site for approximately 30 years, while local residents were assumed to be living in the community for 30 years. The numbers were based on interviews with employees, and were selected during meetings with Cambodian team members.

- **BW** (Body weight, units = kg). Adults were assumed to weight 60 kg. The adult BW was developed during discussions with Cambodian team members. The child body weight was estimated to be 32.9 kg.

- **LE** (Life expectancy, the number of year that the person is likely to live. Not used for non-carcinogens, units = years). It was assumed that the average life expectancy was 55 years. The live expectancy value was developed during discussions with Cambodian team members.

References:

Health Canada. 2004. Federal Contaminated Site Risk Assessment in Canada Part I: Guidance on human health Preliminary Quantitative Risk Assessment (PQRA), Cat. H46-2/04-367E, ISBN 0-662-38244-7. Accessed on line at http://www.hc-sc.gc.ca/ewh-semt/contamsite/risk-risque-eng.php in July 2008.

Mayes BA, Brown GL, Mondello FJ, Holtzclaw KW, Hamilton SB, Ramsey AA.. 2002. Dermal absorption in rhesus monkeys of polychlorinated biphenyls from soil contaminated with Aroclor 1260,.Regul Toxicol Pharmacol., 35:289-95.