Cambridge Environmental Inc

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Dear @@,

I write to discuss the detection of polychlorinated biphenyls (PCBs) in samples of air taken at the @@ Child Care and @@ in @@. As you know, indoor concentrations on the order of 300 nanograms of PCBs per cubic meter of air (ng/m^3)[1] were detected in January of this year, and are currently approximately 200 ng/m^3.[2]

Notably, these concentrations are similar to, or smaller than, those measured in numerous schools, homes, and other concrete buildings that were constructed during the 1960's and that contained PCBs-based building sealants. For example, in schools in Germany built then, PCB-concentrations in air "typically" range from 500 to 10,000 ng/m^3 (Gabrio *et al.*, 2000). In Switzerland, concentrations in similar buildings exceeded 1,000 ng/m^3 in one-quarter of samples, and exceeded 3,000 ng/m^3 in 5% of samples (Kohler *et al*., 2005). In concrete apartment-buildings in Sweden and Denmark, indoor air concentrations have also been found to contain on the order of 1,000 ng PCBs/m^3 (Sundahl *et al.* 1999; Frederiksen *et al.*, 2012).

As you know, the concentrations detected in and near the Child Care Center exceed (by up to a factor of 5) U.S. EPA's current guidelines for allowable concentrations of PCBs in air in schools. However, EPA's guidelines are likely more restrictive than needed, and the PCB-exposures at issue here are neither known nor reasonably expected to harm health. Accordingly, the Child Care Center should be considered to be safe, including for infants, other children, and adults, including pregnant women.

A brief review of the issues is as follows.

Because high doses of PCBs can indeed harm the health of people and other animals, and because they tend to accumulate in the environment and up food-chains, PCBs were essentially banned from production and sale in the U.S. (and elsewhere) in the late 1970's. However, thousands of types of products had by then been formulated using PCBs, and many of these

[1] A nanogram is a very small unit of mass. There are one billion nanograms in a gram and 454 billion nanograms in a pound.

[2] Various actions taken between January and May — thoroughly cleaning the day care center, replacing the carpet, replacing some duct-work, and purging the area with outside air — reduced PCB-concentrations to about 100 ng/m^3, but only temporarily. Within the Child Care Center, the highest concentration detected to date has been 350 ng/m^3. A single sample taken in the cafeteria dining area was found to contain 450 ng/m^3. This may or may not indicate a source in the cafeteria.

products continue to be sources of PCBs in ambient air, both indoors and outdoors, and in our food supply, including mother's milk (about which more below).

The specific sources of PCBs in indoor air in the @@ Building are not known. Possible sources include window caulking and other building sealants, fluorescent light ballasts, other electrical capacitors, wire insulation, machine oils, ceiling tiles, paints, varnishes, carbonless copy paper, and various inks (ATSDR, 2000). Whatever the sources, they have likely been emitting tiny quantities of PCBs-containing particles and vapors for some 40 years, so that essentially all surfaces throughout the building may well contain PCBs at miniscule concentrations.

As noted above, U.S. EPA (2012a) has developed guideline concentrations for PCBs in indoor air in schools (and, by extension, in child care centers). EPA does not regulate indoor air, and these guidelines are not standards or otherwise legally enforceable. The EPA guideline concentrations are as shown below.

U.S. EPA's guidelines for limits of PCB-concentrations in air in schools

Age of students (years)					
1 - 2	2 - 3	3 – 6	6 - 12	12-15	15 - 19
70 ng/m^3	70 ng/m^3	100 ng/m^3	300 ng/m^3	450 ng/m^3	600 ng/m^3

Note that no guideline is provided for children less than one year old. I would note also that the analogous "tentative" guideline set by the Swiss EPA is 6,000 ng PCBs /m^3, irrespective of occupants' ages (Kohler *et al.*, 2005). In Germany, the concentration-threshold for intervention is 9,000 ng PCBs/m^3 (Gabrio *et al.*, 2000).

EPA's stringent guideline concentrations are based on data from a study of PCBs in laboratory monkeys (Tryphonas *et al.*, 1989 and related studies, as cited in EPA, 2012b). In that study, adult monkeys ingesting PCBs at the rate of 5,000 ng per kilogram body weight per day (5,000 ng PCBs/kg-day) for two years showed reduced immune responses when injected with a standard antigen (red blood cells from sheep). It is not known whether the effects induced would be of clinical significance. Other studies of PCBs in other laboratory animals do reveal clear indications of harm to the animals' immune system, nervous system, and other systems and organs, but only at higher doses. Thus, for purposes of quantitative health risk assessment, the

"lowest observed effect level" of 5,000 ng PCBs/kg-day is U.S. EPA's chosen point of departure, and the question is what size doses, day in and day out, should be considered to be safe.

In 1996, U.S. EPA's answer was that daily exposure to levels that are 250 times smaller than this are safe, and that higher levels may or may not be. In other words, EPA's estimated, acceptable, daily intake over the long term — the Agency's "reference dose" — was 20 ng PCBs/kg-day (U.S. EPA, 2012b).

As it happens, this safety factor of 250, although prudent, is also arbitrary, and there is no evidence-based reason to believe that it need be this large in order to protect health. For example, EPA's health risk-assessors assume that humans could be up to 30 times more sensitive to the potentially toxic effects of PCBs than are monkeys, but other scientists (Kimbrough, 1995; Tilson *et al*., 1990) find evidence that humans are *less* sensitive than monkeys to these effects. Moreover, a study published in 1999 (and thus after EPA had established its reference dose) of the effects of PCBs in infant monkeys found that a dose of 7,500 ng PCBs/kg-day caused immune system effects that were only, *per* the authors, "either transient or biologically insignificant." For these and other reasons, doses larger than 20 ng/kg-day are likely to be safe.

This is fortunate, because, as it happens, infants' doses of PCBs received via breast milk are routinely much larger than 20 ng/kg-day. At current concentrations, mother's milk in the U.S. supplies an infant with some 400 ng PCBs/kg-day (based on data reported by LaKind *et al.*, 2009 and Park *et al.*, 2011). Moreover, in the 1970's, breast-fed infants were ingesting about ten times more — that is, on the order of 4,000 ng PCBs/kg-day (based on data in Konishi *et al.*, 2001, and Noren and Merifonyte, 2000).[3] It is theoretically possible that such doses from breast milk were harmful, but there is no evidence that they were, nor is there evidence that formula-fed infants — who ingest on the order of only 1- 2 ng PCBs/kg-day (Loran *et al.*, 2009) — have benefited from their much smaller exposures to PCBs.

An infant breathing air at the Child Care Center for 8 hours per day (at a PCB concentration of 350 ng/m^3) would inhale approximately 70 ng PCBs/kg-day. This dose exceeds EPA's reference dose (by a factor of about 3) but, as indicated above, this exceedance is not sufficiently large as to be worrisome.

Nonetheless, I recommend that an expert in PCB-source-identification be tasked with systematically examining this and other portions of the @@ Building, in hopes of finding important sources, and then of determining what remediation, if any, would be beneficial.

[3] This is why EPA has provided no guideline for acceptable concentrations of PCBs in air for infants: since PCB-doses from breast milk substantially exceed the reference dose, there would be little point in relying on air quality to limit infants' PCB exposures (except in the extreme). Put another way, EPA cannot put itself in the position of labeling mother's milk as hazardous and thus in need of "remediation."

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Thank you for the opportunity to have assisted you in this matter. I hope that this information has been helpful. Of course, I would be happy to discuss these and related issues with you and others, at your and their convenience.

with very best regards,

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Senior Scientist and President

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