MEMO

To: Stephen Lee, Supervisor
Emergency Response Team
Minnesota Pollution Control Agency

Via: Rita Messing, PhD, Supervisor
Site Assessment and Consultation Unit

From: Carl Herbrandson, PhD, Toxicologist
Site Assessment and Consultation Unit

Date: January 30, 2007

Re: **Mercury cleanup concentrations**

This memo explains mercury vapor concentrations that have been used by MDH to give advice at various mercury spill sites, and is a synopsis of Minnesota Department of Health rationale for mercury vapor guidance concentrations.

MDH advice is based on two health-based criteria:

1) **300 ng/m^3: This is an EPA Reference concentration (RfC) and is a safe chronic exposure concentration for a lifetime.** This RfC is protective of the general public, including sensitive individuals.
2) **1800 ng/m^3: This is a California Reference exposure level (REL) and is a safe acute exposure concentration for 1 - 1 hour exposure per day.** The acute REL was derived specifically to protect sensitive individuals – e.g. fetuses carried by pregnant women. Use of this acute number is also appropriate for other sensitive individuals such as children and women who may become pregnant.

MDH recommends that MPCA consult appropriate MDH staff if you are in doubt about application of mercury guidance.

There is no single way to clean and clear all houses or buildings where there are spills.

It is important to remember that the concentrations you measure in a room are not only a function of the amount of mercury spilled, but also a measure of:

1. ventilation
2. how recently and the degree to which a mercury source is disturbed prior to measurement
3. room temperature
4. the surface area of a mercury source
5. the age of the source

Therefore, higher concentrations will be measured in a room when there is:

1. minimum ventilation;
2. a lot of movement (especially disturbance of the source – for instance, walking on a contaminated carpet or sitting on a contaminated couch);
3. a spill with a large surface area (vacuuming or sweeping will increase surface area);
4. high temperature in the room, and;
5. a recent source.

While the concentration of mercury vapor in the "breathing zone" is important, our biggest concern (besides a spill in an oven or a heating vent!) is a source that is in a carpet, a bed, or a piece of furniture, where someone may have an extended, direct exposure. It is important to think about the behavior of people in the room. Could there be a large mercury vapor emission where they lie down and read, watch TV, or sleep? We are especially concerned about spills in locations where a child may lie down or play. Spots in a carpet may be > 10,000 ng/m^3 even when the "breathing zone" concentration throughout most of a home is 500 ng/m^3 or less. We have seen limited exposures to concentrations near 50,000 ng/m^3, over time, lead to serious health impacts. Our concern about the potential for extended exposures to high concentrations is why we are, at times, more concerned about the tracking of a spill, than we are with exposures to the initial spill.

Does measuring the mercury vapor concentration in 5 locations in a single room assure that all hot spots will be found? No, but it probably has a better chance of finding all of the "hot spots" than traditional, static methods. If the Lumex operator is astute, understands how mercury behaves in indoor air, and considers human behaviors and how they may impact exposures, he or she can increase the chances that an appropriate cleanup will occur.

Application of MDH Guidance numbers

Mercury toxicity depends on cumulative exposure (concentration x time = exposure). Therefore, MDH suggests the following for site-specific guidance.

300 ng/m^3 is a long term (residential) exposure limit.

At sites, this often translates to:

500 ng/m^3 - clearance of a residence. This is a maximum concentration at multiple locations in the breathing zone in every room (not an average concentration). This is higher than the exposure limit because it is a spot measurement, not an average; and mercury emissions from the source will decrease as an oxide skin forms (up to 50% decrease over a few months or year) – or as micro-droplets evaporate.

800 ng/m^3 - clearance of a workplace or school. This is higher than the residential number because time of exposure is typically limited to about 40 hours per week. It should be applied to measurements taken in the breathing zone. While this number should be applied as an average, it has typically been looked at as a maximum.

For example, when applying this number: When breathing zone samples are taken in many places in a room, 1200 ng/m^3 may be an OK one spot maximum for a room in a school or a workplace (similar to the residential 500

ng/m^3, above). This higher number could be applied and be protective depending on an evaluation of:

- location of spill (classroom vs hallway or closet); and
- type of contamination (big vs small spill, or large vs small area);
- ventilation during testing (off but typically on).

300 ng/m^3 has been applied as a clearance concentration at some schools (based on the 2005 joint MDH, MPCA information sheet) because of the trepidation about parental concerns and having residential numbers below school numbers.

1800 ng/m^3 is a short term exposure limit (1 hr average exposure) for pregnant women and children.

At sites, this may translate to:

for most adults (adult males and women who will not get pregnant):

50,000 ng/m^3 – for "walking through"

5-20,000 ng/m^3 – for a short time (15 minutes, or so)

5,000 ng/m3 – for up to an hour, or so

for women who may get pregnant and all children:

1800 – 5000 ng/m^3 – for a short time (<15 min)

OSHA numbers are appropriate when exposure to mercury is an expectation of someone's job (for example a recycling facility or, possibly, a dentist office). Consult the Attorney General's office if this needs clarification. MDH does not review OSHA numbers, and exposure of the general public to chemicals near the OSHA limits may result in adverse health effects.

Personal Property

Application of guidance to contaminated clothing, washing machines, jewelry, motor vehicles or other personal property can be problematic. Guidance for any cleanup should reflect the potential exposures and the likelihood that an exposed individual is sensitive to mercury toxicity. In addition, the possibility that the mercury can be cleaned (as may be the case with mercury contamination on the soles of shoes) should be considered. MDH does not have enough information about the extent of exposure that may occur, from these contaminated items, to develop consistent cleanup numbers. But caution is advised.

Workplace exposures for State employees:

OSHA standards allow 40 hr/week exposures to mercury vapor at up to 50,000 ng/m^3, without PPE (MN OSHA Standard). However, OSHA standards do not apply to MDH (and MPCA) employee exposures to mercury. Exposure guidelines for MDH (and MPCA) employees are the same as exposure guidelines for the general public. This is because mercury exposure is not an expectation for state agency jobs.

Personal on-the-job exposure:

While longterm exposure limits are typically yearly exposure averages, it is usually easier to break exposures down into weekly or monthly time blocks. Therefore, think about your own personal exposure in terms of your weekly average work exposure (40 hour). To keep your average exposure below the recommended 300 ng/m^3 (24/7) exposure, workplace exposures (adjusted for differences in breathing rates and ambient air mercury at and away from work) should be limited to about 800 ng/m^3 for a 40 hour work week. This is approximately equivalent to 30,000 ng/m^3 for 1 hour; 10,000 ng/m^3 for 3 hours; 1000 ng/m^3 for 30 hours. This conversion to higher exposures over shorter time periods may not be protective for a sensitive individual (see section below).

If you are pregnant – or plan to be pregnant:

Your weekly work exposure should not exceed the longterm 800 ng/m^3 average for a 40 hour week, and, in addition, you should limit your 1 hour maximum exposures to 1800 ng/m^3. Also, limit the number of 1 hour exposures near 1800 ng/m^3 to 1 per 24 hours. Another way to estimate an acceptable exposure is to calculate your exposure in 2 hour averages and to keep the average below 800 ng/m^3. This would assure that an hourly exposure is below 1800 ng/m^3 and that your longterm exposure average is below 800 ng/m^3.

If you have additional questions please contact me at:

651-201-4906 or carl.herbrandson@state.mn.us