

## **An Evaluation of Exposure to Mercury Vapor while using Air Cycle's "Bulb Eater" Model 55 VRS**

### **Introduction:**

In accordance with North Carolina Universal Waste Regulations, commercial establishments are prohibited from discarding mercury-containing fluorescent light bulbs along with normal solid waste. Mercury-containing fluorescent light bulbs must be recycled. Collecting and storing bulbs for recycling presents a storage issue for many establishments; therefore, some establishments crush bulbs to conserve space. Crushed bulbs are then stored in 55-gallon containers for recycling. Establishments choosing to crush bulbs may use a device such as Air Cycle Corporation's "Bulb Eater 55 VRS."

### **Background:**

A facility in North Carolina purchased Air Cycle's "Bulb Eater 55 VRS" to help manage their numerous fluorescent light bulbs. The facility typically crushes bulbs for 10 to 30 minutes every Friday depending on the quantity of bulbs received that week. Through company brochures, Air Cycle Corporation assured the facility operating the Bulb Eater would not result in high levels of mercury vapor. However, the treatment/crushing operation was evaluated to determine if mercury vapor concentrations increased to an unhealthy level during and after the Bulb Eater was operated.

### **Evaluation Strategy:**

The Bulb Eater is operated in a combination warehouse/office structure (see diagram 1). Three areas within the structure are believed to be affected by operating the Bulb Eater. These areas were evaluated using a Lumex RA-915+ Mercury Vapor Analyzer. The Lumex unit was calibrated in February, 2006. The three areas are in close proximity to where the Bulb Eater is operated and mercury-containing fluorescent light bulbs are stored. The three areas include:

- *Warehouse Crusher Area:* This is where the Bulb Eater is operated. Temperature and humidity are similar to outdoor conditions.
- *Office:* The office has a small window that opens to allow communication with warehouse employees. This office is a temperature-controlled environment.
- *Break area:* The door to enter the break area is adjacent to the Warehouse Crusher Area. The door is frequently opened and closed while the Bulb Eater is operating. This break area is a temperature-controlled environment.

In addition, the breathing zone of the employee operating the "Bulb Eater" was evaluated.

Each area was evaluated for 5 to 6 minutes. Samples were collected before, during and after the Bulb Eater operated. The Lumex was operated in the "On Stream-Protocol Mode", which provided three 30 second averages and a standard deviation.

The breathing zone was evaluated by hanging the Lumex sample probe approximately 5 inches below the employee's face for the entire time the employee operated the Bulb Eater. The employee wore a complete face shield while operating the Bulb Eater. All results from the three areas and breathing zone are presented in Appendix One.

### **Discussion of Results:**

The purpose of this evaluation was to determine if operating the Bulb Eater elevated mercury vapor concentrations to a level considered unhealthy by recognized risk based values. Results were compared to North Carolina Occupational Safety and Health PEL (50,000 ng/m<sup>3</sup>), American Governmental Industrial Hygienist TLV (25,000 ng/m<sup>3</sup>), US EPA Region 3, 6, and 9 (310 ng/m<sup>3</sup>) Health based standards, and the ATSDR MRL for Elemental Mercury Vapor (200 ng/m<sup>3</sup>). For comparison purposes, the most conservative value was used.

Results indicate an increase of mercury vapor in all three areas of the structure after the Bulb Eater was operated.

- *Office Area:* The mercury vapor level in the office increased from a "before" level of 14 ng/m<sup>3</sup> to 33 ng/m<sup>3</sup> after the Bulb Eater was operated.
- *Break Area:* The mercury vapor level increased from 12 ng/m<sup>3</sup> to 76 ng/m<sup>3</sup>.

*NOTE:* While an increase in both areas was observed, it is not believed these concentrations present any health problems related to mercury, because the ASTR MRL of 200 ng/m<sup>3</sup> for continuous exposure is not exceeded.

- *Warehouse Crusher Area and Breathing Zone:* Mercury vapor levels in the warehouse crusher area rose from 22 ng/m<sup>3</sup> to an average of 348 ng/m<sup>3</sup> after the Bulb Eater was operated. The breathing zone had an average of 831 ng/m<sup>3</sup>. Because the "after" level for the warehouse and the average level for the breathing zone exceeded the ASTR MRL, a time weighted average (TWA) was calculated. To calculate a TWA a "background" average of 22 ng/m<sup>3</sup> was assumed. The calculated TWA was based on the following information: 22 ng/m<sup>3</sup> for 32 hours (Monday through Thursday) and 831 ng/m<sup>3</sup> for 8 hours on Friday. This results in a TWA of 184 ng/m<sup>3</sup> and is still below the MRL for continuous exposure.

Using the average for the breathing zone to calculate the TWA is extremely conservative because the data suggest the concentration will drop rapidly after the crushing stops. Therefore, it is not believed that the MRL of 200 ng/m<sup>3</sup> will be exceeded under the observed conditions.

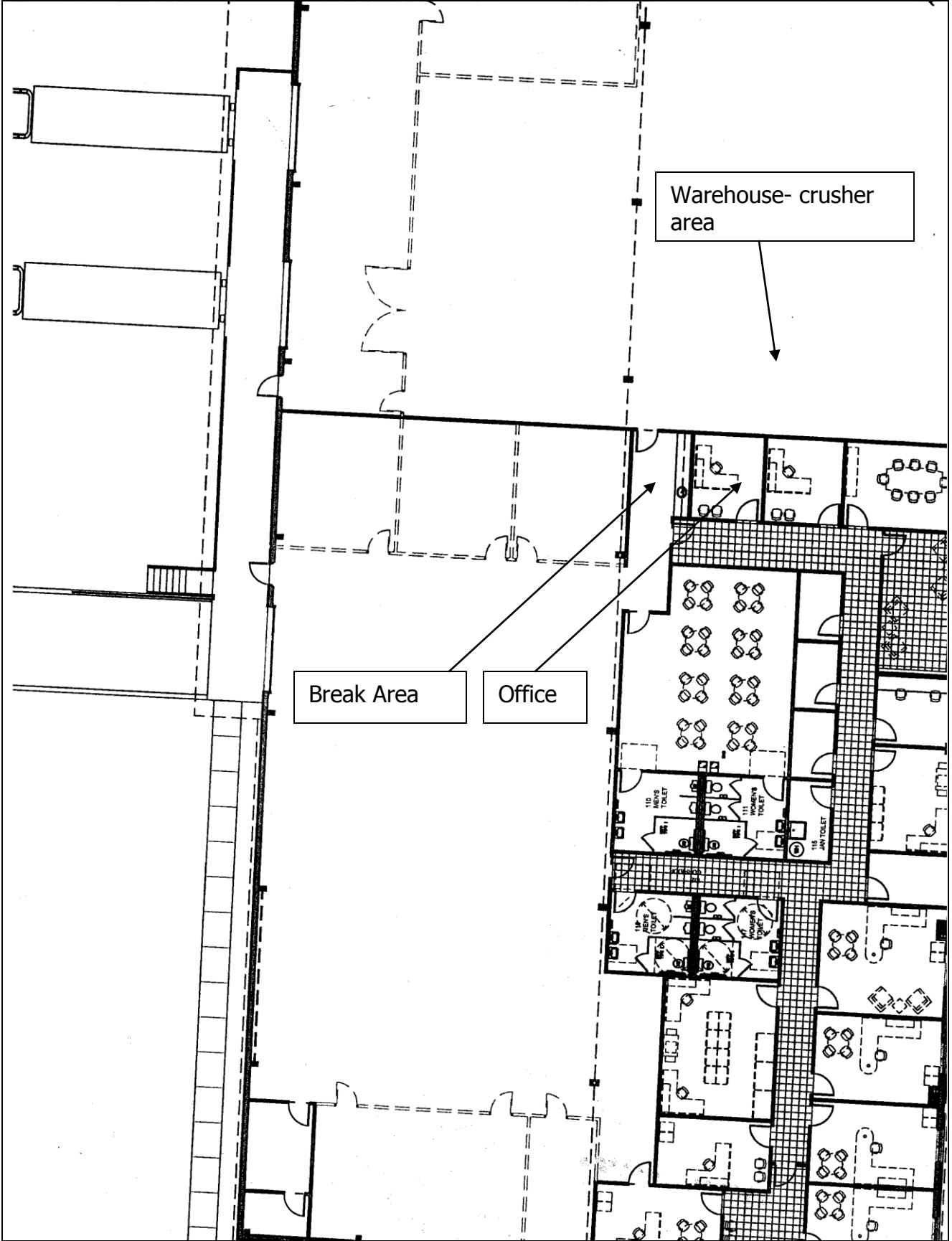
Results from the breathing zone indicate a peak exposure of 1700 ng/m<sup>3</sup>. This occurred when a bulb was broken before it was inserted into the Bulb Crusher. Such peak levels can be minimized by utilizing caution when operating the Bulb Crusher.

**Conclusion:**

Based on results obtained this day under the conditions noted, it is not believed that employees in affected areas are exposed to unhealthy concentrations of mercury vapor. The Bulb Crusher must be used in a manner recommended by the manufacture. Caution must be exercised to avoid accidentally breaking bulbs when operating the Bulb Crusher. Broken bulbs do affect mercury vapor concentrations.

This report describes conditions on June 30, 2006. The survey was conducted and recommendations made in accordance with good industrial hygiene practice. Nothing should be assumed concerning other conditions or areas. The employer has a responsibility to provide the employee with a workplace free from recognized hazards causing, or likely to cause, serious physical harm. It is also the employer's responsibility to inform, educate, and instruct employees as to the nature and effects of these hazards and what to do to minimize their exposure. In all cases, final responsibility for use of information contained in this report and protection of employees from health hazards rests with the employer.

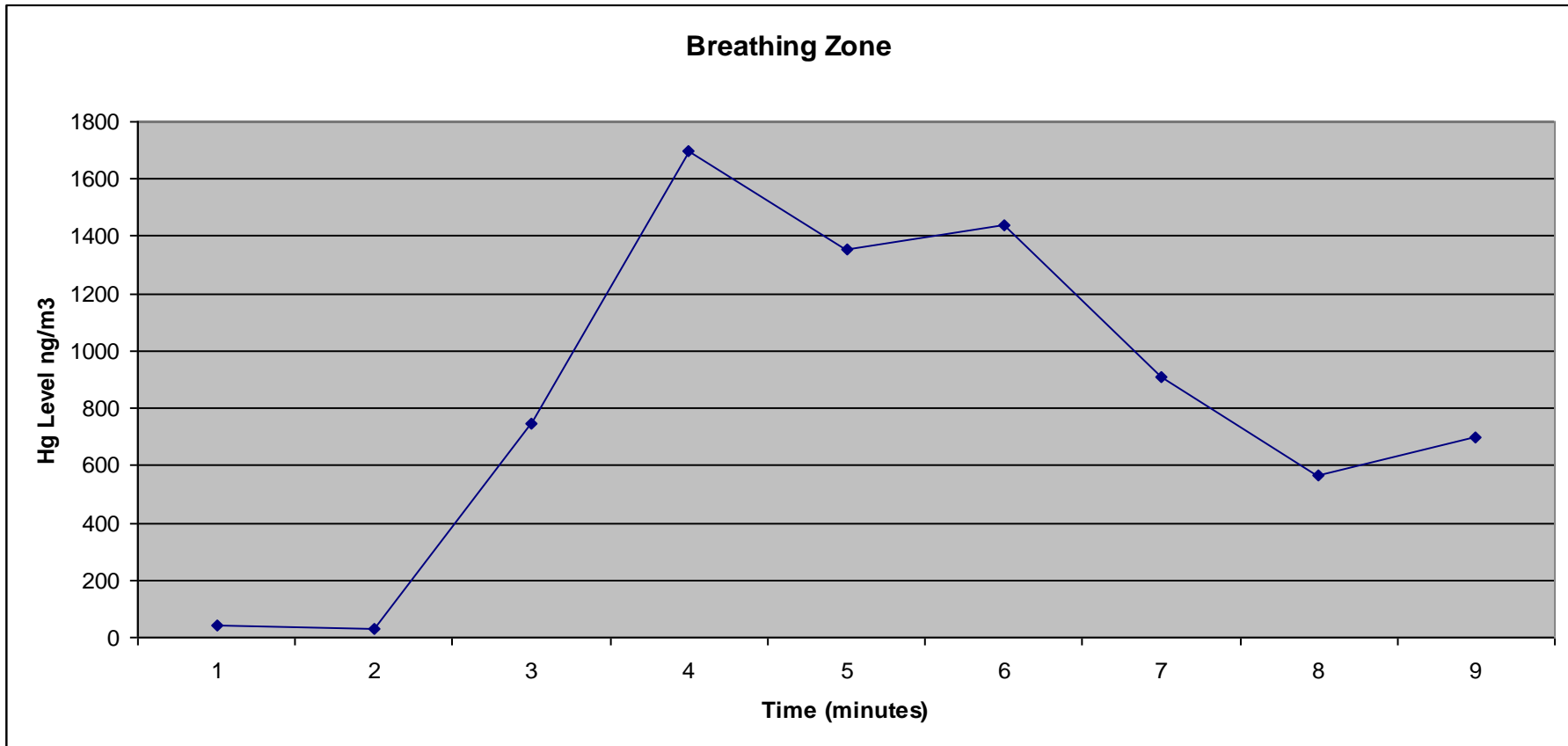
Diagram One



## Appendix One

## BEFORE AND AFTER COMPARISON

Time	Location, Activity	Mercury Concentration (ng/m <sup>3</sup> )	Relative Standard Deviation	Average (ng/m <sup>3</sup> )	Time	Location, Activity	Mercury Concentration (ng/m <sup>3</sup> )	Relative Standard Deviation	Average (ng/m <sup>3</sup> )
<b>9:03</b>	<b>Inside office</b>				<b>9:51</b>	<b>Inside Office</b>			
9:05	inside office	14	4%		9:52	Inside Office	23	8%	
9:07	inside office	14	4%		9:53	Inside Office	25	13%	
9:08	inside office	14	4%		9:54	Inside Office	41	4%	
9:09	inside office	14	4%		9:55	Inside Office	35	13%	
9:10	inside office	14	4%	<b>14</b>	9:56	Inside Office	43	4%	<b>33</b>
<b>9:14</b>	<b>Break Area Hallway</b>				<b>9:46</b>	<b>Break Area Hallway</b>			
9:16	Break area hallway	15	1%		9:47	Break Area Hall way	73	1%	
9:17	Break area hallway	11	1%		9:48	Break Area Hall way	90	24%	
9:18	Break area hallway	11	2%		9:49	Break Area Hall way	80	9%	
9:19	Break area hallway	12	10%		9:50	Break Area Hall way	68	4%	
9:20	Break area hallway	10	3%	<b>12</b>	9:51	Break Area Hall way	71	19%	<b>76</b>
<b>9:21</b>	<b>Crusher Area</b>				<b>9:41</b>	<b>Crusher Area</b>			
9:22	Crusher Area	25	33%		9:42	Crusher Area	290	71%	
9:23	Crusher Area	17	84%		9:43	Crusher Area	680	71%	
9:24	Crusher Area	19	80%		9:44	Crusher Area	453	68%	
9:25	Crusher Area	31	127%		9:45	Crusher Area	349	64%	
9:26	Crusher Area	17	71%	<b>22</b>	9:45	Crusher Area	349	64%	<b>348</b>



**NOTE:** Nine minutes were required for the operator to crush 60 bulbs. A peak of 1700ng/m<sup>3</sup> was recorded. The average was 831ng/m<sup>3</sup>.



<b>Time (am)</b>	<b>Location, Activity</b>	<b>Mercury Concentration (ng/m<sup>3</sup>)</b>	<b>Relative Standard Deviation</b>
<b>8:41</b>	<b>Lumex operating</b>		
<b>9:03</b>	<b>Inside office</b>		
9:05	inside office	14	4%
9:07	inside office	14	4%
9:08	inside office	14	4%
9:09	inside office	14	4%
9:10	inside office	14	4%
<b>9:14</b>	<b>Break area hallway</b>		
9:16	Break area hallway	15	1%
9:17	Break area hallway	11	1%
9:18	Break area hallway	11	2%
9:19	Break area hallway	12	10%
9:20	Break area hallway	10	3%
9:21	<b>Crusher Area</b>		
9:22	Crusher Area	25	33%
9:23	Crusher Area	17	84%
9:24	Crusher Area	19	80%
9:25	Crusher Area	31	127%
9:26	Crusher Area	17	71%
<b>9:28</b>	<b>Baseline test- Breathing zone Crusher was connected and operating</b>		
<b>9:30</b>			
<b>9:31</b>	<b>First of sixty bulbs feed into crusher</b>		
9:32	Breathing Zone	41	8%
9:33	Breathing Zone	30	68%
9:34	Breathing Zone	746	188%
9:35	Breathing Zone	1700	30%
9:36	Breathing Zone	1355	106%
9:37	Breathing Zone	1436	40%

9:38	Breathing Zone	908	24%
9:39	Breathing Zone	568	41%
9:40	Breathing Zone	699	21%
<b>9:41</b>	<b>Crusher turned off</b>		
<b>9:41</b>	<b>Crusher Area</b>		
9:41	Crusher Area	478	49%
9:42	Crusher Area	290	71%
9:43	Crusher Area	680	71%
9:44	Crusher Area	453	68%
9:45	Crusher Area	349	64%
<b>9:46</b>	<b>Break Area Hall way</b>		
9:47	Break Area Hall way	73	1%
9:48	Break Area Hall way	90	24%
9:49	Break Area Hall way	80	9%
9:50	Break Area Hall way	68	4%
9:51	Break Area Hall way	71	19%
<b>9:51</b>	<b>Inside Office</b>		
9:52	Inside Office	23	8%
9:53	Inside Office	25	13%
9:54	Inside Office	41	4%
9:55	Inside Office	35	13%
9:56	Inside Office	43	4%