DEPARTMENT OF HEALTH & HUMAN SERVICES
Program Support Center
U.S. Public Health Service
Federal Occupational Health Service

--Summary--
Findings and Recommendations Pertaining to Air/Wipe/Bulk/TCLP Sampling Data from Electronics Recycling Facilities, FCI Elkton (Lead and Cadmium Data Only)

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Submitted to:
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I. BACKGROUND

An investigative team comprised of safety and health professionals from the Federal Occupational Health Service (FOH) and the National Institute of Occupational Safety and Health (NIOSH) has completed initial characterizations of airborne exposures and facilities contamination stemming from various electronics recycling operations conducted at Federal Correctional Institution (FCI) Elkton. Characterizations were performed in early 2007 and involved the collection and analysis of air, wipe, bulk dusts and waste samples from the FCI Elkton's Recycling Factory, Warehouse, and Federal Satellite Low (FSL). Samples were collected from locations where various electronics recycling operations were currently taking place or had taken place in the past. The overall purpose of the characterizations was to evaluate whether inmates or staff had been or currently are at risk from elevated exposures to toxic substances.

Information provided in this Summary is based on the analytical data compiled in the spreadsheets entitled: "Elkton Wipe/Bulk/TCLP Data Table-Lead and Cadmium Only (Samples Collected 2/27-28/07)" and "Elkton Filter Data" (Appendices 1 & 2).[1] Also, the criteria referenced by the FOH and NIOSH Investigative Team to evaluate the risk posed by the various levels of contamination found on building surfaces is found at the end of Appendix 1.

II. FINDINGS

A. UNICOR Recycling Factory

1. The results of bulk and wipe samples taken from various surfaces in the Recycling Factory reflect that significant particulate lead and cadmium contamination currently exists inside the Factory's ventilation system near 20' high ceilings as well as on various elevated and non-elevated building surfaces (steel structural supports, on top of light fixtures, on upper surfaces of ceiling-mounted ducts, etc.).
2. It is likely that this contamination originally emanated from the cathode ray tube (CRT) glass breaking operations which were reported to have occurred for some period of time in one or more unenclosed locations on the factory floor.
3. The lead and cadmium contamination appears to be present on various elevated building surfaces located throughout the factory floor, even at distances well away from the current and former glass breaking areas. Contamination was found to be present at levels significantly exceeding quantitative surface contamination criteria established for lead.
4. The ability of the dust to accumulate on surfaces near the ceiling is consistent with the hypotheses that significant airborne dust containing lead and cadmium was released into the general factory environment.
    a. This supports the conclusion that dust particles were not effectively captured by local filters or effectively addressed via other engineering controls. Hence, especially in the absence of a stringently applied respiratory protection program and other exposure reduction controls, personal exposures of workers to lead and

[1] Personal and area air samples, as well as wipe, bulk dusts, and waste samples were analyzed for additional metals besides lead and cadmium. Since the data review for these other metals has not yet been completed, it is beyond the scope of this report to address these findings.

cadmium were likely to have occurred especially at elevations lower than where many of the surface samples were collected. That is, it is reasonable to assume that greater concentrations of contaminated dusts would have been present in the air and on surfaces nearer the floor (closer to the glass breaking operations) than 20' overhead. Also, it is likely that particles would tend to settle on the floor and lower surfaces and then become re-entrained in the air during dry sweeping, walking, etc.

b. Particle sizes would be expected to be small to allow them to accumulate at ~20' elevations and it is likely that a significant fraction of the lead and cadmium-laden dusts would have the increased toxicity associated with particles in the 'respirable size' range.

5. As would be expected, surface contamination inside the current area where CRT glass breaking occurs was found to be high. Engineering controls (air filtration, enclosures, etc.) and personal protective equipment (respirators, coveralls, etc.) are currently used to mitigate contamination release and exposure concerns. Wipe sample results indicate that lead and cadmium-laden dusts are distributed throughout the glass breaking area, although some surfaces appear to be effectively decontaminated during periodic (daily and weekly) housekeeping operations.
6. Outside the enclosed glass breaking room, wipe samples taken from work benches, in the change room, and other 'non-control' areas associated with the current glass breaking operation generally reflect that these working surfaces become contaminated to some extent over the course of normal work activities. These data suggest that some contamination migration outside the enclosed 'control' area (i.e., where respirators and other personal protection equipment are used) does occur, although the routine cleaning of these surfaces appears to keep these contamination levels in check.
7. Bulk samples of settled dust collected from various locations outside the current glass breaking room (e.g., from ductwork by the ceiling, from ballast on the roof beneath a rooftop air handler, etc.) were found to contain significant lead and cadmium concentrations. Testing performed on a limited number of samples showed that this accumulated dust contained extractible lead at levels which suggest that any clean-up of accumulated dusts from the factory may require these sediments to be treated as hazardous waste.
8. It is unknown to what extent the recent (i.e., February 2007) inadvertent release of dusts from the ventilation ducts (reportedly due to a wiring error made during maintenance of an air handler) has contributed to the surface contamination found, but it is likely from the filter/bulk/wipe samples that at least some lead and cadmium-containing dusts remain in/on the ducts and that these dusts may require any ducts that are discarded to be treated as hazardous waste.
9. Testing via the EPA RCRA Toxic Characteristic Leaching Procedure (TCLP) showed that mop wash water from floor cleaning operations performed inside the current CRT glass breaking operations does not need to be handled as hazardous waste with respect to lead and cadmium. Further testing of this waste water may be necessary to determine if it can be discharged to the drain(s) inside the recycling factory.
10. TCLP testing of samples collected from gaylord boxes labeled "Broken Funnel Glass" and "Mixed Waste" showed that these waste streams would be considered "hazardous waste" per the EPA RCRA TCLP criteria for lead if the waste was <u>not</u> recycled or

otherwise did not meet new (effective Jan 29, 2007) requirements pertinent to "used and broken CRTs." Samples identified as "Broken Glass from Panel Box" and "Dust from Gaylord box labeled monochrome waste" reflect that these wastes would not be considered hazardous waste.

11. Results of air sampling in all but the glass breaking area of the Recycling Factory indicated that during the two days of operations when tests were conducted, exposures to lead and cadmium were well within recommended levels (generally 10 to 100 times below the permissible limits).
12. Measurements of airborne lead and cadmium during two days of glass breaking operations showed that exposures were less than half of the permissible levels. This reflects that the local exhaust ventilation in the back of the glass breaking booth is successfully keeping exposures low. For additional protection, it should be noted that workers in this area also wear respirators, gloves and coveralls.
13. Air monitoring performed in the glass breaking area during the filter change-out operations, however, showed concentrations that exceeded the OSHA Permissible Exposure Limit (PEL) by a factor of over 450 times for cadmium and over 50 times the PEL for lead. This operation was characterized by excessive visible dust caused by activities such as removing dust-laden filters and banging them together to knock the particulates off.

B. Warehouse

1. The results of the bulk and wipe sampling performed in the Warehouse show that particulate lead and cadmium contamination currently exists on the various surfaces tested (on elevated horizontal surfaces of light fixtures, pipes, etc.). Significant deposits of visible black dust were observed on all these surfaces. Based on the limited sampling regimen, it appears that the contamination is focused primarily on surfaces in proximity to an area currently designated as the "Warehouse Sorting Area." This open area reportedly had been where some CRT glass breaking originally occurred in 1998.
2. Surface contamination appears to be much less in Warehouse areas that are located away from the 'Sorting Area' (i.e., the former glass breaking area) and, overall, much less concentrated as compared to that found on surfaces in the Recycling Factory. These results are consistent with the premise that the contamination originally emanated from the reported CRT glass breaking operations but that the operation was smaller in scope and/or duration (or had better engineering controls) than that which took place in the Recycling Factory.
3. The presence of the surface contamination in the Warehouse suggests that some degree of personal lead/cadmium exposure occurred in the past through inhalation and/or ingestion and may still be occurring today to a much lesser degree (i.e., through workers breathing/ingestion of re-entrained dust, touching dust-contaminated surfaces, etc.).
4. Three personal air samples and one area air sample were collected in the Elkton Warehouse during one day of electronics recycling operations in this facility. Only one lead sample was above the limit of detection for the analytical method, that one being approximately 1% of the permissible limit for lead. Cadmium was measured in all four samples, but never in concentrations above 10% of the limit.

C. **FSL**

1. The results of the bulk and wipe sampling performed at the FSL show that particulate lead contamination currently exists on the various surfaces tested. Some cadmium contamination was also present on the surfaces tested, but to a much lesser extent.
2. Surfaces located in or near where the former chip recovery/de-soldering area was previously located showed the presence of extremely high concentrations of lead while other surfaces such as those within walled offices and on the opposite end of the building were low.
3. Inner surfaces of local exhaust ventilation ducts and dampers (either currently in-place or removed and discarded) showed extremely high concentrations. This reflects that this ventilation system once removed FSL air containing significant quantities of lead produced by the de-soldering operations. The data also suggests that, should these de-soldering operations have been conducted without the benefit (i.e., prior to) the installation of the local exhaust system, significant airborne concentrations, and personal exposures, would have resulted.
4. Surfaces on in-place exhaust dampers of the FSL's exterior wall by where the former chip recovery/de-soldering operations were located had high concentrations of lead. This indicates that airborne lead contamination was exhausted into the outdoor environment.
5. Surfaces on floors, work tables, and routinely used machines showed the presence of some contamination. Therefore, these surfaces (with which current workers routinely come into contact) have potential to contribute to lead exposure (e.g., via hand-to-mouth, ingestion). However, concentrations on these surfaces were found to be generally low suggesting that existing cleaning and end-of-shift housekeeping are currently successful in keeping levels in check.
6. Two days of air sampling during electronics recycling operations at the FSL showed no airborne lead or cadmium concentrations exceeding permissible limits. More specifically, no airborne lead levels were measured above 2% of the most stringent criteria (excluding one sample with which tampering was suspected). No cadmium measurements were found above 10% of the adopted criteria for that metal.

III. RECOMMENDATIONS

1. Air monitoring in the general factory work areas of each of the three buildings indicates that the presence of surface contamination containing lead and cadmium is not posing an imminent inhalation threat that requires immediate evacuation and remediation but rather one that can be responded to in a prompt but well-coordinated manner. Assuming that the industrial hygiene assessment and the ongoing monitoring of conditions (see Recommendation #8, below) are favorable and do not show that degradation or other factors are resulting in increased exposure potential, some flexibility in scheduling the clean-up activities is deemed acceptable. However, it is recommended that cleanup activities should be completed in accordance with approved project specifications within three years. As such, abatement activities may be coordinated with and integrated into

other building upgrade plans (e.g., ventilation retrofits, rooftop filter cleaning and/or replacement, expansion operations, etc.).

2. While air samples taken on the general factory floor in the Recycling Factory, Warehouse, and FSL did not show airborne exposures of concern during typical, day-to-day operations, the data from the 'filter change-out' operation showed that airborne exposures can exceed by a factor of over 450 times the concentration adopted by OSHA as the Permissible Exposure Limit (PEL) for cadmium and over 50 times the PEL for lead. Even though the workers performing this operation wore respiratory protection (i.e., powered air purifying respirators-PAPRs), these excessive exposures well exceed the Protection Factor afforded by this type of respirator. Hence, this operation should be immediately discontinued until improved dust suppression and engineering controls can be identified, instituted, and confirmed as effective. Note: It should be noted that OSHA regulations mandate a number of specific requirements for whenever exposures to lead and/or cadmium exceed their respective action levels or PELs. Requirements may include provisions for instituting medical surveillance, enhanced engineering controls, air monitoring, special worker notifications, showers, laundering of contaminated work clothes, etc. Since it is apparent that action levels and PELs can be exceeded during the filter change-out operation, it is recommended that a comprehensive regulatory assessment be performed with respect to OSHA regulations found at 29 CFR 1910.1025 (Lead) and 29 CFR 1910.1027 (Cadmium).
3. Based on the elevated air monitoring results obtained during the filter change-out operations, it is strongly recommended that Elkton's Respiratory Protection Program be re-evaluated for this operation in order to comply with OSHA regulation 1910.134. Specifically, the use of PAPRs must comply with 1910.134 (d) (3) (i) (A) concerning Assigned Protection Factors as they relate to the exposure conditions found during this operation.
4. An operations and maintenance (O&M) plan should be immediately developed and implemented in order to protect staff, inmates, contractors, and the environment from lead and cadmium residues found on various surfaces throughout the Recycling Factory, Warehouse and FSL. The O&M plan should identify policies and procedures for minimizing personal exposures and the spread of contamination during any activities which might result in the disturbance of or contact with contaminated building surfaces and components. Given the very high concentrations of lead and cadmium found in many dust deposits, special emphasis should be on preventing re-entrainment and release to the workplace air or exposure via ingestion. Elements of the O&M plan should include:
    - Specific identification of activities and operations which may disturb the contamination (e.g., duct maintenance, work involving contact with structural supports, etc.);
    - Pre-job identification, delineation and assessment of areas/surfaces of concern;
    - When and how to use exposure mitigating techniques (e.g., techniques for dust suppression, local capture ventilation, etc.) and personal protection equipment (e.g., coveralls, respirators, gloves) during any activities/operations of concern;
    - Training and hazard communication;
    - Emergency scenario contingencies (e.g., should inadvertent release/exposures occur);

- Disposal of dust-contaminated materials/wastes (possibly classified as hazardous waste); and
- Ongoing monitoring and evaluation of conditions (via air, skin, surface sampling);

5. It is recommended that the FOH and NIOSH Investigative Team participate in the review of the O&M plans and abatement specifications, the ongoing monitoring and evaluation of conditions, and the oversight of any abatement actions.
6. It is recommended that comprehensive plans be developed and implemented to remediate the contamination (inside ducts, on surfaces, etc.) in accordance with sound hazardous material abatement specifications (such as, for example, adaptations of specifications currently used to remove lead paint from residences). These plans should address considerations such as the containment of the remediation areas, method of remediation (removal, isolation/enclosure, encapsulation, etc.), worker protection, clearance levels to be achieved, disposal of hazardous wastes, etc.
7. Especially in the Warehouse and FSL where some areas/surfaces were found to exist with little/no contamination, it may be prudent to more precisely delineate which building locations and components warrant clean-up and which do not.
8. Given the very high concentrations of lead and cadmium in some dust samples (one sample from the FSL was as high as16% lead), periodic industrial hygiene evaluations and facility inspections are recommended to confirm that conditions remain acceptable until corrective actions are completed. Such evaluations (air sampling, hand wipe sampling, assessments of dust disturbance potential, etc.) should be performed to better characterize current exposures during various routine and non-routine operations and activities.
9. Regarding the ongoing CRT glass breaking operations, although air monitoring did not show that workers were exposed at levels exceeding OSHA action levels or PELs, it was apparent that dust migrated from the control area to adjacent general work areas. Therefore, improvements in contamination containment (e.g., install a state-of-the-art three stage decontamination room(s) adjacent to the GBO) should be implemented in order to reduce the presence of lead and cadmium on surfaces outside the control area (i.e., work benches, changing room, etc.). Also, OSHA regulations (29 CFR 1910.1025 and 29 CFR 1910.1027) may call for additional, periodic full shift exposure monitoring to document negative exposures (i.e., below action levels) during this operation.
10. Based on the testing performed, bulk quantities of settled dusts originating from the glass breaking and de-soldering operations should be treated as hazardous waste, unless additional testing permits otherwise.
11. It is recommended that additional characterization be performed of possible environmental impacts from the release to the FSL building exterior of lead exhaust air from the de-soldering operation.

APPENDIX 1