



U.S. Department of Justice

Federal Bureau of Prisons

Office of the Director

Washington, DC 20534

January 30, 2009

The Honorable William Reukauf
Acting Special Counsel
Office of the Special Counsel
1730 M Street, N.W., Suite 300
Washington, D.C. 20036-4505

Re: OSC File No. DI-08-0523

Dear Mr. Reukauf:

I am in receipt of your correspondence wherein you conclude that allegations raised by Leroy A. Smith, Jr., an employee of the United States Department of Justice, Federal Bureau of Prisons, constitute a substantial likelihood that a violation of law, rule, or regulation and a substantial and specific danger to public health or safety has occurred. Mr. Smith has made allegations related to health and occupational safety violations in a Federal Prisons Industries (UNICOR) factory and within the Federal Correctional Institution (FCI) at the Federal Correctional Complex (FCC) Tucson.

The Office of Special Counsel requested an investigation and report on the allegations made by Mr. Smith. Please accept this correspondence as a summary of our investigation and findings. It should be noted that the Attorney General has delegated to me authority to review and sign the report, in accordance with 5 U.S.C. § 1213 (d).

Sincerely,

A handwritten signature in black ink that reads "Harley G. Lappin".

Harley G. Lappin
Director

Federal Bureau of Prisons - Office of Internal Affairs

Report of Investigation

OIA Case Number 2008-03216

OSC Case Number DI-08-0523

Subject: ALLEGED VIOLATION OF LAW, RULE, OR REGULATION AND SPECIFIC DANGER TO PUBLIC HEALTH OR SAFETY AT THE FEDERAL CORRECTIONAL INSTITUTION AND FEDERAL PRISON INDUSTRY FACTORY, TUCSON, ARIZONA

(1) Summary of the Information with Respect to Which the Investigation was Initiated

This investigation was initiated based upon a whistleblower disclosure alleging that employees at the United States Department of Justice (DOJ), Federal Bureau of Prisons (BOP), and Federal Prison Industries, Inc. (UNICOR), Tucson, Arizona, are responsible for violations of law, rule or regulation, gross mismanagement, abuse of authority, and substantial and specific danger to public health and safety. The Office of Special Counsel (OSC) received these allegations from Leroy A. Smith, Jr., Complex Safety Manager at the Federal Correctional Complex (FCC) in Tucson, Arizona, who consented to the release of his name.

Specifically, Mr. Smith's allegations pertained to the conduct of BOP and UNICOR officials related to: (1) untimely responses to environmental (air and wipe sampling) tests due to Black Carbon Dust and black mold; (2) the failure to train and properly equip employees and inmates who work with hazardous or toxic materials; and (3) the failure to act on air ventilation issues created as a result of inmate overcrowding when the BOP changed (inmate) cell configurations. Mr. Smith also alleged that the agency has failed to inform employees and inmates about the results of any environmental health and safety testing conducted by the agency or Occupational and Safety and Health Administration (OSHA). In addition, Mr. Smith alleged that the BOP and UNICOR have not given him sufficient authority to protect employees and inmates in violation of Executive Order 12196 and 29 CFR 1960, which states that safety officials shall have sufficient authority to correct unsafe and unhealthy working conditions. Finally, Mr. Smith alleged that even though investigations and environmental testing were conducted regarding his complaints, the investigations and tests were deliberately delayed or incomplete, and that officials continued to interfere

and coerce staff from ensuring adequate health and safety measures were taken.

(2) Conduct of the Investigation

This investigation commenced in July 2008, upon receipt of an Office of Special Counsel (OSC) letter tasking the Attorney General to conduct an investigation pursuant to 5 USC 1213.

The DOJ, BOP, Office of Internal Affairs (OIA), conducted an investigation at FCC Tucson, Arizona, during the weeks of July 28, 2008, August 12, 2008, and September 3, 2008. OIA investigators also conducted interviews at the Federal Correctional Institution (FCI) Phoenix, Arizona, FCI Texarkana, Texas, FCC Coleman, Florida, and at the BOP Central Office, Washington, D.C. The OIA interviewed thirty-three of its employees, one Inspector from the Department of Labor's Occupational Safety and Health Administration (OSHA), and consulted with the Department of Health and Human Services' National Institution for Occupational Safety and Health (NIOSH).

In an attachment to the OSC's letter tasking the Attorney General to conduct an investigation pursuant to 5 USC 1213, Mr. Smith raised allegations that inmates and staff who work in the UNICOR recycling factory at FCC Tucson may be exposed to hazardous metals (e.g., lead, cadmium, and barium). Initially, this was included within the scope of the investigation in an effort to be complete and thorough. However, upon learning that this allegation was under investigation by the BOP, the DOJ Office of the Inspector General (OIG) requested that the BOP refrain from investigating this allegation as they believed doing so would interfere with their ongoing investigation of exposure to hazardous metals in BOP UNICOR recycling factories. Thus, that allegation is not addressed in the current investigation.

(3) Summary of Evidence Obtained from the Investigation

The FCC Tucson is located in Tucson, Arizona. The facility encompasses a high security United States Penitentiary (USP), a medium security FCI, a minimum security Satellite Prison Camp (SPC) and a UNICOR factory within the FCI. The FCI maintains a complement of 187 federal employees and houses approximately 670 federally convicted inmates. The UNICOR factory employs approximately 56 federally convicted inmates supervised by six federal employees. The factory recycles electronic components such as desktop computers, notebook computers, motherboards, hard

drives, circuit boards, various printers, and communications devices.

Allegation 1:

Mr. Smith alleged that staff and inmates working in the UNICOR factory at FCI Tucson, Arizona, were exposed to hazardous air contaminants emitted as a result of dismantling computer components and carbon toner cartridges. Specifically, Mr. Smith alleged that he notified BOP Wardens at the FCI and USP, the Associate Warden Operations, the UNICOR Production Supervisor, the UNICOR Associate Warden, and the UNICOR Assistant Director that workers in the factory and warehouse were potentially exposed to harmful Black Carbon Dust on a daily basis. The applicable OSHA regulations are 29 CFR 1910.1000 (air contaminants). The applicable BOP policy was Program Statement 1600.08, Occupational Health and Environmental Safety. The Program Statement was amended in October 2007 and is now identified as 1600.09.

Mr. Smith also alleged that the FCI Warden and the UNICOR Associate Warden failed to provide adequate notification to employees regarding the results of air and wipe sampling conducted on April 26, 2006, and June 20, 2006. The regulations applicable to Mr. Smith's concerns are contained in 29 CFR 1910.1027 (d)(5)(I), Toxic and Hazardous Substances. The applicable BOP policy is Program Statement 1600.08, Occupational Health and Environmental Safety.

Finally Mr. Smith alleged that the FCI Warden, the Associate Warden Operations and others engaged in overt acts intended to obstruct him in his efforts to ensure the safety and welfare of inmates and employees in the UNICOR factory. The regulations applicable to Mr. Smith's concerns are Executive Order 12196 and 29 CFR 1960. The applicable BOP policy is Program Statement 1600.08, Occupational Health and Environmental Safety.

OSHA regulations establish Permissible Exposure Limits (PELs) for various materials including air contaminants such as Black Carbon Dust. Black Carbon Dust can be found in computer toner cartridges and other items. OSHA's PELs are based on eight-hour time weighted average exposure to these materials and are set to protect workers against deleterious health effects caused by such exposure. Exposure at or above the Acceptable Level (AL) triggers biological monitoring requirements for each exposed worker.

Our investigation revealed that within a week of arriving at FCC Tucson in March 2006, Mr. Smith complained about conditions in the UNICOR factory and requested air and wipe sampling of the factory and warehouse. On April 13, 2006, Mr. Smith submitted a written request to management requesting personal air quality sampling of the staff and inmate workers in the UNICOR factory and warehouse. Subsequently, management requested assistance from OSHA. On April 26, 2006, an OSHA representative performed air and wipe sampling in the UNICOR factory.

Mr. Smith stated that on April 26, 2006, he attended a meeting at the FCI in the Warden's Office regarding the OSHA testing. Mr. Smith alleged that the FCI Warden told him to leave the meeting without explanation and that her actions were hostile, discriminatory, and an overt act of retaliation against him for his previous whistleblower activity. We found that on April 26, 2006, Mr. Smith was told to leave the meeting regarding the OSHA testing. Although Mr. Smith had brought the issue to the attention of management, he was not responsible for safety related matters at FCI Tucson. The FCI Safety Manager was responsible for safety matters at FCI Tucson and Mr. Smith was responsible for oversight of the United States Penitentiary (USP) at Tucson. Furthermore, Mr. Smith did not seek the permission of the USP Warden or the FCI Warden before attending the meeting. The FCI Safety Manager attended the April 26, 2006, meeting and Mr. Smith was told to leave in order to avoid any conflict with the USP Warden. We found insufficient evidence that the FCI Warden was attempting to obstruct Mr. Smith from ensuring the safety and welfare of staff and inmates who work in UNICOR or that her actions were retaliatory in nature when she told Mr. Smith to leave the meeting.

On May 15, 2006, OSHA informed the FCI Warden that their inspection discovered no detectable hazards or other problems in the UNICOR factory and warehouse. The OSHA inspector verified that she told the FCI Warden that the results of her testing at FCI Tucson revealed no issues and that a written report would not be issued by OSHA. That same day the FCI Warden notified senior managers and Safety staff by E-mail that, "the air and wipe samples came back with no detectable levels of problems in our UNICOR factory and warehouse."

After the results of the OSHA assessment were received, Mr. Smith continued to complain about conditions in the UNICOR factory. In response to Mr. Smith's concerns management ordered further testing in the UNICOR Factory. On June 20, 2006, ACT Environmental Incorporated (ACT) performed an Industrial Hygiene Monitoring of the UNICOR recycling operation. The results of the

monitoring were received on July 10, 2006. The ACT testing revealed that Carbon Black Dust levels in the UNICOR factory were within OSHA standards.

Subsequent to the OSHA and ACT assessments of the UNICOR factory, Mr. Smith discussed notification of staff with the Wardens of the FCI and the USP. As mentioned previously, the FCI Warden notified management officials, including the FCI Safety Manager, about the OSHA testing on May 15, 2006. We found that staff and inmates were notified by management of the results of the OSHA testing in separate meetings, and Mr. Smith was informed of these meetings. However, the UNICOR Associate Warden did not maintain adequate records of these meetings. We found that staff remembered being informed of the results, but they could not recall the date that they were notified. Moreover, we found that management documented the meeting with inmates by requiring the attendees to sign a copy of the FCI Warden's May 15, 2006, notification E-mail. This document contained the name and register number of each inmate, but there was no evidence to show on what date the notification actually took place. On July 26, 2007, Mr. Smith again complained to the USP Warden and the FCI Warden that inmates and employees had not received proper notification of testing results. On July 31, 2007, the UNICOR Associate Warden told Mr. Smith that although a member of his staff had notified inmates and staff of the results in July 2006, he could not locate the documentary evidence to show when the notification took place. Subsequently, the UNICOR Associate Warden held a second series of notification meetings with staff and inmates on August 6, 2007. OSHA Regulations contained in 29 CFR 1910.1027 (d) (5) (I), Toxic and Hazardous Substances, states:

The employer must, within 15 working days after the receipt of the results of any monitoring performed under this section, notify each affected employee of these results either individually in writing or by posting the results in an appropriate location that is accessible to employees.

Bureau of Prisons Program Statement 1600.08, Occupational Health and Environmental Safety, also addresses notification:

An employee or inmate submitting a report of unsafe or unhealthful condition shall be notified in writing within 15 days if the official receiving the report determines there are not reasonable grounds to believe such a hazard exists and does not plan to make an inspection based on such a report. A written summary, if any, shall be made available to the employee or inmate making the report within 15 days

after completion of the inspection for safety violations or within 30 days if for health violations.

The FCI Safety Manager attended all meetings regarding the results of testing in the UNICOR Factory. The FCI Safety Manager provided limited guidance to the UNICOR Associate Warden indicating that no hazards had been identified, and that only personal protective equipment for normal working conditions were required in the factory and warehouse. Program Statement 1600.08, Occupational Health and Environmental Safety, states:

Safety Managers serve as staff advisors to the Chief Executive Officers of their institutions on matters relating to safety and environmental health programs.

In November 2007, the UNICOR Associate Warden prepared a training plan for those employees assigned to the rear gate whose work involved contact with materials going to and from the UNICOR factory. This training plan was not required, or specifically recommended, by either OSHA or the ACT assessments and was undertaken voluntarily by management. The training plan was under review at the time of our investigation and has not been implemented.

In January 2009, NIOSH reviewed ACT's industrial hygiene survey but did not review the results of OSHA's air and wipe sampling. NIOSH concluded that ACT's results suggest extremely low worker exposure to Black Carbon Dust, but noted that additional testing would be required to increase confidence in ACT's results. As discussed above, both ACT and OSHA sampling events demonstrated no hazardous air contamination by Black Carbon Dust. NIOSH also provided very useful information regarding the acquisition of consultants and methods for obtaining more robust reports.

Allegation 2:

On September 21, 2006, Mr. Smith and the Facility Manager found black mold within trailers belonging to the Recreation Department at FCI Tucson, Arizona. Environmental testing later confirmed the presence of mold spores. Before Mr. Smith could take steps to correct the mold contamination, the FCI Warden and an Associate Warden ordered employees from the Recreation and Correctional Services Departments to remove potentially contaminated equipment from the trailers. According to Mr. Smith, the actions of the FCI Warden and the Associate Warden may have contaminated other areas of the facilities with mold and mold spores. Mr. Smith alleged mold was also discovered in the

Administration building and no action has been taken to eliminate the mold or repair the leaking roof to this building. Mr. Smith alleged that the presence of this mold and the agency's failure to properly test or remediate the site fully constitutes a substantial and specific danger to public safety. There are no OSHA regulations dealing with mold specifically. The applicable BOP policy is Program Statement 1600.08, Occupational Health and Environmental Safety.

Our investigation revealed that employee complaints regarding mold in the Recreation trailers, Health Services, and the Administration building at FCI Tucson predated Mr. Smith's arrival in March 2006. We discovered that the FCI Safety Manager received verbal complaints about mold in the Recreation trailers and Medical Records Office beginning in 2001. We found that the FCI Safety Manager and the Facilities Department performed inspections in Recreation and Medical Records Office in response to those complaints and did not identify the presence of mold. On September 21, 2006, Mr. Smith notified the FCI Warden that he and the Facilities Manager had identified mold in a trailer used by the Recreation Department at FCI Tucson, Arizona.

The Centers for Disease Control and Prevention (CDC) informational webpage entitled, Environmental Hazards and Health Effects Molds, (<http://www.cdc.gov>), states in part:

Molds are fungi that can be found both indoors and outdoors. No one knows how many species of fungi exist but estimates range from tens of thousands to perhaps three hundred thousand or more. Molds grow best in warm, damp, and humid conditions, and spread and reproduce by making spores. . . . Some people are sensitive to molds. For these people, exposure to molds can cause symptoms such as nasal stuffiness, eye irritation, wheezing, or skin irritation. Some people, such as those with serious allergies to molds, may have more severe reactions.

Pursuant to OSHA's Safety and Health Information Bulletin (03-10-10), "Currently, there are no federal standards or recommendations (e.g., OSHA, NIOSH, EPA) for airborne concentrations of mold or mold spores." The OSHA website (<http://www.osha.gov>) states that in the absence of a specific standard, 29 USC 654(a)(1), the General Duty Clause, requires federal agencies to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."

Since there is no federal standard, the General Duty Clause of OSHA applies to this situation. In order to warrant closing a facility due to the presence of mold, a safety official must first reasonably determine there is an imminent hazard/danger. According to the OSHA (<http://www.osha.gov>), the following conditions "must be met before a hazard becomes an imminent danger:

- There must be a threat of death or serious physical harm. "Serious physical harm" means that a part of the body is damaged so severely that it cannot be used or cannot be used very well.
- For a health hazard there must be a reasonable expectation that toxic substances or other health hazards are present and exposure to them will shorten life or cause substantial reduction in physical or mental efficiency. The harm caused by the health hazard does not have to happen immediately.
- The threat must be immediate or imminent. This means that you must believe that death or serious physical harm could occur within a short time, for example before OSHA could investigate the problem.
- If an OSHA inspector believes that an imminent danger exists, the inspector must inform affected employees and the employer that he is recommending that OSHA take steps to stop the imminent danger."

At the time of Mr. Smith's discovery, BOP officials were aware that many roofs in the Medical Records, Administration building and Recreation trailers leaked and allowed moisture to collect inside the affected areas. Between March 2000 and May 2007, BOP officials submitted annual requests for additional funding from the Western Regional Office of the BOP for the repair of the leaking roofs. Each of the requests for additional funding had been denied until mold was positively identified in the Recreation trailers in September 2006. In the meantime, the Facilities Department made repairs to roofs, ceilings and window frames within their budget constraints and abilities.

In a memorandum dated September 21, 2006, Mr. Smith notified the FCI Warden that he ordered the closure of the Recreation trailer as a precautionary measure. Prior to writing this memorandum Mr. Smith discussed his plans with the FCI Warden and indicated to her that he did not close the Recreation trailers immediately after discovering the mold. Mr. Smith told us that

he did not close the trailers immediately because "it didn't seem to be an imminent danger, plus I wanted to speak with her and the USP Warden first." The FCI Warden agreed to close the trailers per Mr. Smith's recommendation.

Subsequent to the decision to close the trailers, the Supervisor of Recreation, the FCI Warden, USP Warden, Mr. Smith and others met to discuss relocating personnel and equipment from the trailers. During this meeting, Mr. Smith was adamant that the trailers could no longer be accessed. However, on September 25, 2006, Correctional Services and Recreation staff removed computers, office equipment and other supplies from the trailers. The removal of office equipment and supplies was contrary to the recommendations of Mr. Smith. However, management deemed it necessary for the continued operation of the facility. In addition, we found that on September 21, 2006, the BOP Industrial Hygienist from the Central Office Health Services Division, whom Mr. Smith had contacted, advised Mr. Smith that it was permissible for staff to re-enter the trailers to remove equipment as needed.

On September 27, 2006, air and bulk sampling was conducted in the Recreation trailer, Administration building, Psychology Department, Lieutenants' Office, and Medical Records Office by Applied Environmental Services (AES). AES identified *Stachybotrys*, *Cladosporium*, and *Bipolaris/Drechslera* mold spores in the areas tested. The AES report also discussed the effects of the various molds detected during the testing and stated that with the exception *Bipolaris/Drechslera*, the molds encountered are common outdoor molds which do not affect most people. AES explained that *Bipolaris/Drechslera* exposure may cause a variety of health effects in people susceptible to allergies. AES recommended the following actions:

- Demolishing the East Trailer and professional cleaning of all items stored in the trailer before they were relocated.
- Professionally clean and repair leaks in the Lieutenant's Office, Psychology, Medical Records and Administration building area.
- Additional bulk sampling, and air sampling once repairs were made in the Lieutenant's Office, Medical Records and Administration building.
- Post abatement sampling to provide status of mold abatement effectiveness.

Upon receiving these results the Executive staff immediately closed the Recreation trailer, Lieutenants' Office and Psychology area.

The FCI Warden forwarded an emergency funding request to the Western Regional Office of the BOP for the removal of the trailers once she received AES' recommendations. The FCI Warden's successor also took immediate steps to eliminate the mold contamination in the institution and also requested funding from the Western Regional Office. During the course of this investigation we noted that construction of a building to replace the Recreation trailer was underway. We also found that mold in the Medical Records Office had been removed and leaks had been repaired as well.

Our investigation revealed that leaking roofs and mold contamination have been an ongoing issue at FCI Tucson. Based on a complaint of mold in the Administration building from the Warden's Secretary in May 2008, testing was conducted by Applied Enviro Solutions Inc. (AES) in June 2008. The AES reports identified elevated levels of mold in the Business Office, Warden's Office, Commissary and Safety Office. Although the test results did not indicate employees should be moved from the Administration building, the FCI Warden decided to move employees out of the affected areas in July 2008. Management began repairs in the effected areas in September 2008 and completed most work in December 2008. In addition to the repairs, management contracted with an Industrial Hygienist from AES who spoke to employees in June 2008 about the testing results and health issues related to mold exposure.

In January 2009, NIOSH reviewed 30 affidavits and four mold-related consultant reports. NIOSH recommended against further air sampling, stating such testing is not necessary when mold spores are detected. Rather, they recommended continued repairs of water intrusions as they occur and replacing or cleaning damaged materials.

Allegation 3:

Mr. Smith alleged that in August 2007, the agency exposed employees and inmates to a substantial and specific danger to public health and safety when it decided to increase the inmate cell occupancy from two to three inmates per cell at FCI Tucson, Arizona. Specifically, Mr. Smith was concerned that if the appropriate air recirculation levels were not consistent or compliant with American Correctional Association Standards (ACA Standards), inmates might not receive adequate fresh or filtered

recirculated air which could result in inmate or employee illness or aggravation of existing medical condition(s). According to Mr. Smith, the agency refused to allow him to authorize air recirculation tests in the newly configured inmate cells. The standard applicable to Mr. Smith's concerns is contained in The American Correctional Association Standards for Adult Correctional Institutions, 4th Edition. The applicable BOP policy is Program Statement 1600.08, Occupational Health and Environmental Safety.

The American Correctional Association Standards for Adult Correctional Institutions, 4th Edition, sets standards for airflow in existing inmate cells and other areas. Standard 4-4152 states:

Circulation is at least ten cubic feet of fresh or recirculated filtered air per minute per occupant for inmate rooms/cells, officer stations, and dining areas, as documented by an independent, qualified source.

Bureau of Prisons Program Statement 1600.08, Occupational Health and Environmental Safety, (referenced at the time the issue arose) set the following standard for ventilation:

At least 10 cubic feet of outside or recirculated filtered air per minute shall be provided for each occupant of each area except for dining rooms, which shall be provided with at least 20 CFM per occupant.

Our investigation revealed that the decision to house three inmates in certain cells within FCI Tucson predated Mr. Smith's arrival in March 2006. We found evidence that, in some housing units, inmates had been housed in three-man cells since 2004. We also found that documentation of previous air testing did exist and was available to Mr. Smith and others at the time of his complaint. The Facilities Department maintained records that showed ventilation testing had been conducted March 14, 2000, and at the time the results were within applicable standards. Although those testing results were within applicable standards, the USP Warden opted to order a new series of tests based on the recommendation of Mr. Smith and the FCI General Foreman.

On March 8, 2007, the Science Applications International Corporation (SAIC) conducted a survey of light, noise and ventilation in inmate housing units, food service dining areas and officer's stations at FCC Tucson. In a report dated April 4, 2007, test results were compared with ACA Standards. The SAIC's tests revealed that measured airflow in inmate occupied areas

ranged from 130.0 cfm to 290.0 cfm. Specifically, ventilation rates exceeded the ACA minimum in all assessed areas. The SAIC recommended that the Facilities Department make adjustments to balance the airflow among the inmate housing units. We also found that on March 8, 2007, Mr. Smith and an FCC Tucson Safety Specialist conducted their own air flow testing using locally available equipment. The readings were remarkably similar to those taken in the SAIC assessment. We also noted that many of the cells tested by Mr. Smith housed three inmates.

Following SAIC's testing, Mr. Smith opined that the assessment was flawed because it did not include the three-man cells and it did not assess air flow in all areas of the institution. Management disagreed with Mr. Smith's opinion and referred the matter to the Western Regional Office for evaluation. The Regional Facilities Administrator advised the USP Warden there was no need for concern and that the facility was in compliance with policy. Mr. Smith also consulted with employees of the Central Office Health Services Division and he believed their responses were supportive of additional testing. However, the responses Mr. Smith received were general statements in response to questions he had posed rather than an evaluation of the SAIC test.

Mr. Smith himself reported that ventilation in the inmate housing units was adequate later that same year. In a memorandum entitled Operational Review Report - Safety Department - July 23-27, 2007, dated August 21, 2007, prepared by Mr. Smith, review step 2.1.6 states:

Review Documentation to determine that circulation is at least 15 cubic feet for renovations, additions, and new construction (after January 1990) or 10 cubic feet per minute for existing construction of outside and/or recirculated air per minute per occupant for cells/rooms, officers' stations, and dining areas, as documented by an independent, qualified source. The air circulation must be checked one time per accreditation cycle.

Mr. Smith's response for this review step reads, "Circulation meets all standards."

In January 2009, NIOSH reviewed three consultant reports and the ACA Standards. NIOSH concluded that the information in the reports was insufficient for a determination of ACA compliance. According to NIOSH, the reports lacked specificity in terms of measurement methods, details of HVAC systems and the areas ventilated. Furthermore, NIOSH reported that one of the tests

included results that were based on an unverified assumption regarding outdoor air supplied to the HVAC system. The NIOSH report found that ventilation assessments reviewed were insufficient to conclude whether or not sufficient outdoor air was being provided to individual cells in accordance with ACA requirements.

(4) Violation or Apparent Violation of Law, Rule or Regulation

Allegation 1:

On April 26, 2006, air and wipe sampling was conducted by OSHA in the UNICOR factory at FCI Tucson, thirteen calendar days after Mr. Smith's first written notice to management. Further testing, based on Mr. Smith's requests, was performed by ACT Environmental on June 20, 2006. The results of both tests indicated levels of contamination that were below actionable levels and that workers were not exposed to hazardous levels of Black Carbon Dust. In both instances there was no evidence that management hindered or refused Mr. Smith's requests for testing. Furthermore, there was insufficient evidence that the FCI Warden was attempting to obstruct Mr. Smith from ensuring the safety and welfare of staff and inmates who work in UNICOR or that her actions were retaliatory in nature when she told Mr. Smith to leave the meeting on April 26, 2006.

A review of testing results conducted by NIOSH on January 22, 2009, supported the conclusion that carbon dust levels were "extremely low." NIOSH also indicated that ongoing testing should be considered to ensure that the exposure of workers to Black Carbon Dust remains minimized. We found that managers cooperated with Mr. Smith's requests for testing and training. There was no evidence that management officials engaged in overt acts intended to obstruct Mr. Smith in his efforts to ensure the safety and welfare of inmates and employees in the UNICOR factory.

Management did not notify inmates and staff of the results of OSHA or ACT assessments in a timely manner. This is an apparent violation of OSHA Regulations contained in 29 CFR 1910.1027 (d)(5)(I), Toxic and Hazardous Substances. The only documentary evidence establishing notification from management occurred on August 6, 2007, more than a year after the last air and wipe sampling conducted in the UNICOR factory and warehouse. Clearly, it was the responsibility of management to notify employees and others of the findings of the air and wipe testing conducted in the UNICOR factory and warehouse within 15 working

days of their receipt. Although the testing revealed no hazardous condition related to Black Carbon Dust, management had an obligation to inform workers. The FCI Warden notified the Executive staff and FCI Safety Manager and did not give further instructions. Although BOP policy does not state who among management is responsible for notifying staff of the results of testing, it is clear as to who advises management regarding health and safety matters. That responsibility lies with the Safety Manager. The former (retired) FCI Safety Manager, as the advisor to the FCI Warden, did not take deliberate action to guide the notification process on behalf of the Warden or to ensure that managers were properly informed of their roles in this process.

Allegation 2:

Insufficient evidence exists to substantiate any violations of law, rule or regulation occurred. FCC Tucson management officials did not expose employees and inmates to unsafe or unhealthy conditions. There was not a reasonable basis for determining there was an imminent danger presented by the mold. The fact that mold and mold spores are commonly found throughout the environment, Mr. Smith's own statement that the mold "didn't seem to be an imminent danger," and the absence of an immediate/imminent threat of death or serious physical harm from exposure to the mold or mold spores support that conclusion. Independent testing conducted at FCI Tucson revealed common mold had developed in several areas of the facility due to roof and other leaks. There is ample evidence that management took immediate corrective action when they became aware of the mold contamination. The evidence confirmed that roof leaks were the root cause of the mold. Evidence was revealed that demonstrates management was aware of the leaking roofs in advance of the discovery of mold in September 2006, and had been requesting funding to repair the roofs as far back as March 2000. There is also evidence that repairs were made within the limited means of the institution's budget. However, it was not until mold contamination was discovered in the Recreation trailers that steps were taken to find a solution to repair the leaks.

Mr. Smith made clear his belief that the trailers should be closed to staff and inmates in a memorandum to the Wardens of the FCI and USP on September 21, 2006. There was no evidence that the FCI Warden took action to obstruct Mr. Smith in his efforts to ensure the welfare of staff and inmates. Although the FCI Warden said she supported Mr. Smith's efforts, she did make some decisions that were contrary to his recommendations. Specifically, the removal of office equipment and supplies from

the trailers was deemed to be necessary for the continued operation of the facility.

The FCI Warden did not violate law or regulation when she permitted staff to re-enter the Recreation trailer to retrieve office equipment. Her actions were based on the needs of the institution and the absence of a serious threat to the health and safety of staff. Mr. Smith's assertion that Executive Order 12196, 29 CFR 1960, and BOP Program Statement 1600.08 allowed him to act independently of the Warden in situations involving the health and safety of employees and inmates is not accurate. Program Statement 1600.08, Occupational Health and Environmental Safety, permits independent action when a Safety Manager encounters an imminent hazard, which can "reasonably be expected to cause death or serious physical harm." Likewise, 29 CFR 1960.26 (b) (5), Conduct of inspections, states in part:

As soon as it is concluded on the basis of an inspection that a danger exists which could reasonably be expected to cause death or serious physical harm immediately, the inspector shall inform the affected employees and official in charge of the workplace of the danger. The official in charge of the workplace, or a person empowered to act for that official, shall undertake immediate abatement and the withdrawal of employees who are not necessary for abatement of the dangerous conditions.

On September 20, 2006, Mr. Smith was clear when he told the FCI Warden, "it didn't seem to be an imminent danger" when discussing the danger of mold contamination in the Recreation trailer. Thus, the FCI Warden acted reasonably in viewing Mr. Smith's memorandum of September 21, 2006, as no more than a recommendation, as she had full and final authority to determine whether conditions warranted permitting access to retrieve those items deemed necessary to continue operations.

We also found that the danger of contamination and cross contamination from removing office equipment from an area that has mold was likely minimal. Based on Mr. Smith's description of the contamination in the trailers and the amount of time that staff had worked in the trailers, the Central Office Industrial Hygienist did not believe there was a great risk to staff in re-entering the trailers to retrieve equipment.

Management has taken clear and decisive steps to inform employees of the results of mold testing. Management also evacuated employees from potentially hazardous areas under the recommendation of Mr. Smith, although such actions exceeded the

advice of other safety professionals. In June 2006 the CDC published a pamphlet entitled, Mold Prevention Strategies and Possible Health Effects in the aftermath of Hurricanes and Major Floods in which they state:

Sampling for mold is not part of a routine building assessment. In most cases, appropriate decisions about remediation and the need for PPE (Personal Protective Equipment) can be made solely on the basis of visual inspection.¹

In their January 22, 2009, review NIOSH representatives stated that they did not recommend further air sampling for mold to address ongoing indoor environmental quality complaints. NIOSH added that results of such testing was unlikely to alter the basic recommendation to fix water incursion problems and water damaged materials. Thus, the efforts of Mr. Smith and managers at FCI Tucson were beyond those recommended by CDC and NIOSH.

Allegation 3:

Three consultant reports (dated March 2000, February 2002, and April 2007) satisfied BOP managers that inmate housing unit ventilation rates were in compliance with ACA standards. In January 2009, NIOSH reviewed the same consultant reports and found that the ventilation assessments were insufficient to conclude whether sufficient outdoor air was being provided to individual cells in accordance with ACA requirements. According to NIOSH, the reports lacked specificity in terms of measurement methods, details of HVAC systems and the areas ventilated. Furthermore, NIOSH reported that one of the tests included results that were based on an unverified assumption regarding outdoor air supplied to the HVAC system.

(5) Action Taken or Planned as a Result of the Investigation

Allegation 1:

UNICOR and Safety staff will continue to monitor the factory for potential hazards and act to abate such contamination as appropriate. Based on the recommendations made by NIOSH, additional samples for Carbon Black Dust will be collected to ensure that occupational exposure limits are still not exceeded.

¹ Mold Prevention Strategies and Possible Health Effects in the aftermath of Hurricanes and Major Floods, Centers for Disease Control and Prevention, June 9, 2006.

Allegation 2:

Management continues to work toward repairing the leaking roof over the Administration building. In addition, mold has recently been identified in the Safety Office and action is being taken to correct structural problems and remediate contamination in that area as well.

Allegation 3:

HVAC systems will be evaluated to determine conformity with ACA standards, and the American Society of Heating and Air Conditioning Engineers Handbook on HVAC applications for Justice facilities as indicated by the NIOSH review. All areas of the institution will be sampled to include those cells housing one, two or three inmates.



U.S. Department of Justice

Federal Bureau of Prisons

Office of the Director

Washington, DC 20534

October 10, 2008

MEMORANDUM FOR THE ATTORNEY GENERAL

THROUGH: THE DEPUTY ATTORNEY GENERAL *Mark*

FROM: *Harley G. Lappin*
Harley G. Lappin
Director

SUBJECT: Delegation of Authority

PURPOSE: To obtain delegation of authority pursuant to 5 U.S.C. § 1213 (d) in order to provide response to request for investigation by the Office of Special Counsel

TIMETABLE: Immediately

SYNOPSIS: The Office of Special Counsel (OSC) has requested the Attorney General to investigate allegations which constitute a substantial likelihood that a substantial and specific danger to public health or safety has occurred at the Federal Correctional Complex in Tucson, Arizona.

DISCUSSION: In order to respond to the OSC request for investigation, the Director of the Bureau of Prisons must receive delegation of authority from the Attorney General.

RECOMMENDATION: Written approval of delegation of authority.

APPROVE: *Harley G. Lappin*

DISAPPROVE: _____

OTHER: _____

Attachment

Approved for acting attorney general
Mark
F.L.P.
1/27/09



National Institute for Occupational
Safety and Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati OH 45226-1998

January 22, 2009
HETA 2008-0305

Mr. Robert Westbrook
Special Agent
Office of Internal Affairs
Federal Bureau of Prisons
320 First Street, NW, Room 600
Washington, DC 20534-0001

Dear Mr. Westbrook:

On September 30, 2008, the National Institute for Occupational Safety and Health (NIOSH) received your request for technical assistance in your investigation of health and safety concerns at the Federal Correctional Institute (FCI) in Tucson, Arizona. Your initial request asked us to review available information about mold contamination in offices used by employees; air flow and ventilation rates in inmate housing areas; and possible lead, cadmium, beryllium, and barium contamination in the UNICOR computer recycling operation. On November 21, 2008, we received clarification on your request to exclude a review of the potential metal contamination and to add a review of potential carbon black exposures associated with the recycling operation.

You provided industrial hygiene consultants' reports including sampling results, internal memos and e-mails (primarily between the FCI Safety Manager, Warden, and Associate Warden of UNICOR), and affidavits from numerous employees at FCI Tucson. This letter summarizes our review of those documents and provides recommendations to improve the safety and health of the staff and inmates.

Records Review and Discussion

Carbon Black

We reviewed one consultant's report of industrial hygiene monitoring at the UNICOR computer recycling operations at FCI Tucson, dated July 10, 2006. On June 20, 2006, one personal breathing zone and one general area air sample for carbon black were collected by the consultant in the disassembly area (measured as total dust). The consultant's report does not indicate the duration of the air sampling or include information on the computer recycling activities that occurred while these samples were collected. Total dust was not detected on either air sample (concentrations were less than 0.03 mg/m³). No other documentation was provided for carbon black exposure in the documents you provided.

Ventilation

The Standards for Adult Correctional Institutions, issued by the American Correctional Association (ACA), require at least 15 cubic feet per minute (CFM) of outdoor or recirculated filtered air per occupant for cells/rooms, officer stations, and dining areas for renovation,

additions, and new construction. The standard allows for reducing the amount of outdoor air supplied to these areas to 33% of the amount specified above if adequate temperature control is provided in addition to air filtering. For existing facilities, the standard requires circulation of at least 10 CFM of fresh or recirculated filtered air per occupant for cells/rooms, officer stations, and dining areas. You informed us that the cells at FCI Tucson were originally designed to house two inmates; however, many of the cells have been reconfigured to house three inmates. Under the new configuration of three inmates per cell, a minimum air flow of 45 CFM per cell with 15 CFM of outdoor air is required, assuming the balance of the supplied air is filtered and temperature controlled [ACA 2003].

We reviewed three consultant reports (dated March 2000, February 2002, and April 2007) for evaluations conducted at FCI Tucson. In the reports dated March 14, 2000, and February 6, 2002, the consultant collected air flow measurements and calculated the rate of outdoor air entering select heating, ventilation, and air conditioning (HVAC) systems. Neither report describes the ventilation measurement methods, nor provides details regarding the HVAC systems and the areas ventilated. The percentage of outdoor air to recirculated air cannot be determined from the information provided in these consultant reports.

In the April 4, 2007 report, ventilation measurements were collected in what the consultant called “a representative number of housing unit locations.” Air flow rates measured in selected cells ranged from 130 to 290 CFM. The two officer stations monitored had air flow rates of 180 and 318 CFM. The two food service dining areas monitored had air flow rates of 76 and 234 CFM. Except for the food service dining area, the consultant’s report does not document the maximum number of occupants for the spaces evaluated, and the amount of outdoor air supplied to the HVAC systems or individual cells was not provided. An assumption was used by the consultant that the HVAC systems provided 20% outdoor air, based on information provided by FCI Tucson representatives; however, no ventilation measurements were made to confirm this assumption.

Mold

A review of 30 affidavits provided by FCI Tucson employees working in the trailers, administration building, and health services building revealed five who reported sinus infections they thought were related to mold exposure. In their affidavits, employees working in the affected areas also reported symptoms of runny nose, asthma exacerbations, bronchitis, and skin irritation that they believed were due to their mold exposure. There were no medical records of physician evaluations, assessments, or treatment plans in the materials we received. We did review an affidavit from an employee regarding the exacerbation of their allergies while working in one of the buildings. As noted by this employee, worsening of allergies is the most common health problem associated with mold exposure. The Institute of Medicine (IOM), in their review of damp indoor environments and related health problems, found that there is sufficient evidence of an association with damp indoor environments and upper respiratory symptoms and asthma symptoms in sensitized asthmatic persons. They also found there was inadequate or insufficient evidence to determine whether an association exists with skin symptoms. Regarding sinusitis, the IOM noted that that “available information does not indicate that exposure to a damp indoor environment or the presence of agents associated with them places other-wise-healthy people at risk for the various forms of sinusitis [IOM 2004].”

The symptoms reported are also common in the general population as well. For example, sinusitis is the most frequently reported chronic disease in the United States, topping arthritis, allergies, and hypertension [Benson and Marano 1993]. Fourteen percent of U.S. adults reported physician diagnosed sinusitis in 2003, according to the National Health Interview Survey [CDC 2005]. The average adult has two to three upper respiratory infections per year, while children have between six and eight [Benninger et al. 2003]. Lipscomb reported 1-year symptom prevalence rates from three populations in California [Lipscomb et al. 1992]. The top four health complaints in these populations were stuffy nose or congestion, irritated eyes, allergies or asthma, and headaches.

Consultant reports were provided for four mold-related evaluations conducted between 2006 and 2008. In affidavits provided, leaks were reported in the roof of the administrative building as early as 1995 or 1996 and in the health services building as early as 2000 or 2001. One affidavit states that “facilities” would repair the leaks; however, every time it rained the roof leaked again. Between 2000 or 2001 and 2005, other leaks were reported in various locations throughout the building, including the dental clinic. In the spring of 2004 or 2005, employees became concerned with mold and voiced their concern to management. In September 2006, a consultant conducted air and bulk sampling for mold contamination in the annex, a building consisting of east and west trailers. Mold contamination was identified and recommendations were provided by the consultant to repair the leaks in the roof and remediate the contaminated areas and items.

The affidavit from the Regional Facilities Administrator states that because of the cost required to remediate the mold in the east and west trailers, they chose to dispose of the trailers at a landfill. He also states that the roofs on the health services building (medical records offices) and administration building (business offices) were replaced. Other employee affidavits state that surfaces were cleaned and contaminated items were removed by an outside firm from what appears to be the health services building and administration building. Other than the employee affidavits, no other records documented this remediation.

The July 3, 2008, consultant’s report described the results of air sampling conducted in June 2008. In that sampling, mold spores were identified in the administration building. The report explains that mold remediation in the administration building was previously completed, but continued or new roof leaks subsequently damaged the ceiling tiles. The earlier June 26, 2008, consultant’s report was not provided to us. In two consultant’s reports (dated July 3 and July 20, 2008), mold was found in the administration building and its HVAC system. Recommendations were made in subsequent reports (July 18 and July 20, 2008) to repair the roof and remediate the mold in the building.

Conclusions and Recommendations

Carbon Black

Although the sampling results suggest that worker exposure to carbon black was extremely low, it is difficult to draw a conclusion from one sample. You may consider collecting additional samples for carbon black (as total dust as done by the previous consultant) to increase your confidence that occupational exposure limits are not exceeded.

Ventilation

The ventilation assessments that we reviewed are insufficient for us to conclude whether sufficient outdoor air is being provided to individual cells to meet the ACA requirements. We do recommend evaluating the HVAC systems to determine conformity with the ACA standard, the American Society of Heating, Refrigerating and Air-Conditioning Engineers Handbook on HVAC Applications for justice facilities, or “Prevention and Control of Tuberculosis in Correctional and Detention Facilities: Recommendations from CDC” [CDC 2006; ASHRAE 2007]. At a minimum, the following three parameters must be evaluated to determine conformity with these ventilation standards: (1) the amount of outdoor air supplied; (2) the total air flow rate to the cells or other occupied areas; and (3) the air filtration and temperature controls of the HVAC systems. In addition, details on the ventilation test methods, the HVAC systems being evaluated, and the maximum number of occupants must be described.

Mold

Mold exposure or exposure to damp indoor environments in otherwise healthy people does not put them at risk for sinusitis, new-onset asthma, or allergies. In those with existing allergies or asthma, these conditions may worsen their symptoms. It is likely these symptoms will continue until all water intrusions are repaired.

Recommendations provided by the consultants to repair the roof and other sources of water intrusion, and to remediate the mold were appropriate and follow those recommendations made by the U.S. Environmental Protection Agency and Centers for Disease Control and Prevention in the enclosed documents “Mold Remediation in Schools and Commercial Buildings” and “Mold Preventions Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods.” It is unclear why initial repairs and replacement of the roof were ineffective in preventing additional water incursions. As noted in the affidavit given by the Regional Facilities Administrator, all water intrusions must be repaired before cleaning mold-contaminated surfaces and removing mold contaminated materials to avoid a reoccurrence of the mold. However, this does not appear to have happened at FCI Tucson.

We do not recommend continued air sampling for mold to address ongoing indoor environmental quality complaints from FCI Tucson employees. These results are unlikely to alter basic recommendations, such as fixing water incursion problems, replacing water-damaged materials, and cleaning mold contaminated items. In addition, no standardized evaluation criteria exist to assist in the interpretation of the mold sample results. Finally, the cost of these tests (both in sample collection and analysis) can be high.

We recommend maintaining good communication between FCI Tucson employees and management. If there is not one presently, a team consisting of employees and management should be formed to address occupational health and safety concerns. In addition to maintaining good communication, developing a written indoor environmental quality management program is beneficial. The information contained in the enclosed “Building Air Quality – A Guide for Building Owners and Facility Managers” and “Building Air Quality – Action Guide” contains practical advice regarding the prevention, evaluation, and correction of indoor environmental quality problems and is particularly useful for the implementation of an effective indoor environmental quality management program.

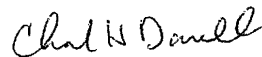
General

Many of the consultants' reports reviewed, specifically the ventilation and carbon black reports, were missing key information. Examples of missing information include the selection rationale and description of testing methods used and details of the workplace conditions at the time of sampling (i.e., what work was taking place, specifics of HVAC systems servicing the affected areas, and the maximum occupancy of affected areas). This information is necessary to determine the significance of the findings. When selecting consultants, FCI Tucson should carefully evaluate the qualifications and expertise of consultants who are hired to assess occupational or environmental health and safety issues. One useful benchmark for vetting individuals who provide industrial hygiene services is the designation of Certified Industrial Hygienist (CIH). Certification by the American Board of Industrial Hygiene (ABIH) ensures that prospective consultants have met ABIH standards for education, ongoing training, and experience; and have passed a rigorous ABIH certification examination.


No mention was made of an occupational health clinic at the facility. Employees should be encouraged to report symptoms they feel are work related to the occupational health clinic (if one is available) or to their supervisor. Employees who report work related symptoms should be evaluated by a physician experienced in occupational medicine, so that an appropriate evaluation can be done. The occupational health clinic can serve a vital role in documenting, communicating (to management and employees), and preventing occupational illness.

This letter closes our file on this technical assistance request. If you have any questions, please do not hesitate to contact Chad Dowell at (513) 841-4202 or Judith Eisenberg at (513) 841-4468.

Sincerely yours,



Chad H. Dowell, MS, CIH
Industrial Hygienist



Judith Eisenberg, MD, MS
Medical Officer
Hazard Evaluations and Technical
Assistance Branch
Division of Surveillance, Hazard
Evaluations and Field Studies

Enclosures:

Mold Remediation in Schools and Commercial Buildings

Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods

Building Air Quality – A Guide for Building Owners and Facility Managers

Building Air Quality – Action Plan

References

ACA [2003]. Standards for adult correctional institutions. 4th ed. Alexandria, VA: American Correctional Association.

ASHRAE [2007]. American Society of Heating, Refrigerating, and Air-Conditioning Engineers Handbook – HVAC Applications. Atlanta, GA: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.

Benninger MS, Ferguson BJ, Hadley JA, Hamilos DL, Jacobs M, Kennedy DW, Lanza DC, Marple BF, Osguthorpe JD, Stankiewicz JA, Anon J, Denneny J, Emanuel I, Levine H [2003]. Adult chronic rhinosinusitis: definitions, diagnosis, epidemiology, and pathophysiology. *Otolaryngol Head Neck Surg.* 129(3 Suppl):S1-S32.

Benson V, Marano MA [1993]. Current estimates from the National Health Interview Survey, 1993, National Center for Health Statistics. *Vital Health Stat* 10(182).

CDC [2005]. Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2003 [www.cdc.gov/nchs/nhis.htm]. Date accessed: January 2009.

CDC (Centers for Disease Control and Prevention) [2006]. Prevention and control of tuberculosis in correctional and detention facilities: recommendations from CDC. *MMWR* 55(RR09):1-44.

IOM [2004]. Human health effects associated with damp indoor environments. In: *Damp indoor spaces and health*. National Academy Press, Washington, DC. pp. 211.

Lipscomb JA, Satin KP, Neutra RR [1992]. Reported symptom prevalence rates from comparison populations in community-based environmental studies. *Arch Environ Health* 47(4):263-269.



U.S. Department of Justice

Office of the Inspector General

March 20, 2009

MEMORANDUM FOR PAUL M. LAIRD
ASSISTANT DIRECTOR
INDUSTRIES, EDUCATION AND VOCATIONAL TRAINING
DIVISION
FEDERAL BUREAU OF PRISONS

FROM: S. RANDALL HUMM *SRH*
INVESTIGATIVE COUNSEL
OVERSIGHT AND REVIEW DIVISION

SUBJECT: FOH Comprehensive Report on UNICOR's Recent
E-Waste Recycling Operations at FCC Tucson

As part of the Office of the Inspector General's (OIG) ongoing investigation of Federal Prison Industries' (UNICOR) electronics (e-waste) recycling operations, the Federal Occupational Health Service (FOH) has provided the OIG with the attached report detailing its findings from field work at the Federal Correctional Complex (FCC) in Tucson, Arizona. FOH's report is the third of eight reports that FOH is preparing that consolidate and present information on health, safety, and environmental compliance issues at the UNICOR factories that recycle e-waste.

In its report, FOH describes the testing it conducted at FCC Tucson in 2007 with the National Institute for Occupational Safety and Health (NIOSH) and summarizes the results obtained from an earlier industrial hygiene evaluation performed by a UNICOR contractor. The report also discusses the activities of the Occupational Safety and Health Administration (OSHA) at UNICOR's Tucson recycling factory.

From this work FOH concluded, among other things:

Heavy Metals Exposures

- OSHA and UNICOR consultant monitoring results from April and June 2006 showed that inhalation exposure to lead, cadmium, and

other toxic metals during recycling operations are maintained below OSHA permissible exposure limits.

- One cadmium area result obtained by the UNICOR consultant showed cadmium exposure above the action level. However, the consultant did not bring this exposure to the attention of UNICOR or the Federal Bureau of Prisons (BOP). In addition, NIOSH found from its own sampling that surface contamination for lead was significantly higher than levels found by the consultant. Similar surface contamination differences were found for cadmium. The reason for these differences is unknown.
- Lead and cadmium surface contamination in the UNICOR factory can be controlled by implementing improved housekeeping and cleaning practices and by implementing an operations and maintenance plan.

Noise and Heat Exposure

- Noise measurements conducted by NIOSH found noise exposure at levels that suggests the need for a more comprehensive noise study.
- NIOSH found that temperature measurements indicated the need to periodically evaluate heat stress.

Safety and Health Programs, Plans, and Practices

- UNICOR does not have a site-specific safety and health program for UNICOR's recycling operations at FCC Tucson.

The FOH report also includes several recommendations to improve recycling operations at UNICOR's Tucson site. According to FOH, UNICOR should:

- Conduct follow-up analysis including additional personal exposure (breathing zone) monitoring during demanufacturing and associated activities to determine the significance of the one cadmium area exposure result that was above the action level;
- Implement an annual surface monitoring program to ensure that surface concentrations of lead and cadmium are not building up over time;

- Develop and implement an operations and maintenance plan to ensure that surface contamination is minimized and that existing contamination is not released that could result in inhalation or ingestion exposures; and
- Conduct a noise survey and evaluate the heat exposure hazard to determine any precautions necessary to prevent heat strain and heat stress.

We request that complete copies of FOH's report be shared with UNICOR's Industrial Hygienist, the BOP's Health Services Division, and factory managers in the UNICOR Recycling Business Group. The report should also be made available to all concerned staff and inmates.

If you have any questions, please feel free to contact me at (202) 353-0332.

Thank you for your cooperation.

Attachment



EVALUATION OF ENVIRONMENTAL, SAFETY, AND
HEALTH INFORMATION RELATED TO UNICOR
E-WASTE RECYCLING OPERATIONS AT
FCC TUCSON

PREPARED FOR THE UNITED STATES DEPARTMENT OF JUSTICE
OFFICE OF THE INSPECTOR GENERAL

Submitted to: Mr. S. Randall Humm
Investigative Counsel
Oversight and Review Division
Office of the Inspector General
U.S. Department of Justice

Submitted by: Captain Joseph Terra, CIH
FOH Safety and Health Investigation Team
Program Support Center
U.S. Public Health Service
Federal Occupational Health Service

March 20, 2009

Table of Contents

1.0	INTRODUCTION	4
2.0	UNICOR E-WASTE RECYCLING FACILITIES AND OPERATIONS AT FCI TUCSON.....	5
3.0	BOP/UNICOR SAFETY AND HEALTH PROCEDURES AND PRACTICES AT FCI TUCSON	9
3.1	UNICOR Safety and Health Practices and Procedures to Control Toxic Metals Exposure	10
3.2	Other UNICOR and FCI Tucson Safety and Health Procedures	12
3.3	FCI Tucson Safety Department Concerns	12
3.4	Environmental Procedures	13
4.0	FIELD INVESTIGATIONS AND MONITORING RESULTS	14
4.1	Investigations for Exposure to Toxic Metals	15
4.1.1	OSHA Exposure Monitoring for Toxic Metals and Other Findings ..	16
4.1.2	UNICOR Consultant Monitoring Report for Toxic Metals	16
4.1.3	NIOSH/DART Surface Wipe and Bulk Dust Sample Results.....	18
4.2	Investigations for Noise Exposure	22
4.3	Heat Exposure and Repetitive Stress	22
4.4	Environmental Issues	23
5.0	CONCLUSIONS.....	23
5.1	Heavy Metals Exposures.....	24
5.2	Noise, Heat, and Repetitive Stress Exposure.....	25
5.3	Safety and Health Programs, Plans, and Practices.....	25
5.4	Health and Safety Regulatory Compliance.....	26
5.5	Environmental Compliance	27
6.0	RECOMMENDATIONS	27
6.1	Heavy Metals Exposures.....	27
6.2	Noise, Heat, and Repetitive Stress Exposure.....	30
6.3	Safety and Health Programs, Practices, and Plans.....	30
6.4	Health and Safety Regulatory Compliance.....	31
6.5	Environmental Compliance	31
7.0	REFERENCES	31

Figures

Figure 1: UNICOR E-Waste Recycling Facility, FCI Tucson

Tables

Table 1: Occupational Exposure Limits

Images

Image 1: UNICOR e-waste disassembly area at FCI Tucson

Image 2: 'Inside' warehouse adjacent to disassembly area at FCI Tucson where baling of e-wastes is performed.

Attachments

Attachment 1 NIOSH [2008]. Control technology and exposure assessment for electronic recycling operations, UNICOR, Tucson Federal Correctional Institution EPHB 326-18a.

Attachment 2 OSHA [2006]. Department of Labor OSHA Inspection Number 309845071 -- Federal Correction Institution Tucson (FCI Tucson) -- 04/27/06

duct tape, to prevent collection and exposure to cadmium and other heavy metals that are present.

2. When wearing the hooded respirator, ensure that the hood completely covers the neck and shoulders to prevent inward migration of air that is contaminated with cadmium and other heavy metals.
3. When handling the hooded respirators, contaminated gloves or hands or other objects should be kept outside of the respirators to ensure their cleanliness. Mandatory cleaning should be monitored by the foreman, and quality assurance checks should be completed to ensure that the respirators were cleaned and free of heavy metals.
4. A complete noise survey should be performed for the facility to have a baseline. Identify noise producing processes and objects, and if needed, lower the noises levels with engineering controls, such as adding sliders or wheels to the stair platforms.
5. The facility should evaluate and document the proper HEPA filter that is to be used for Vacuum #3. With that, establish a change schedule based on technical and analytical data to prevent recirculation of collected heavy metals from the vacuum to the work environment.
6. Perform quality assurance checks on boxes that are leaving the glass breaking building to ensure they are cleaned, and the outside inmate population is not exposed.
7. Perform quality assurance checks on other noted items of possible environmental contamination from the process which are exposing employees to possible ingestion hazards (see NOTE below).


NOTE: An Industrial Survey that was conducted by KAM Environmental, Inc. ("KAM") was collected by the CSHO during his inspection (see FCI0014). The KAM survey was performed at the facility shortly after the glass breaking began. The KAM survey noted some deficiencies, and recommended actions that were based on their wipe samples. The CSHO wiped some of the same areas that were done during the KAM survey. The CSHO compared his wipe samples to five comparable wipe samples that were done during the KAM survey. Only one comparison caused concern. One of the KAM samples (W2) was a wipe taken from a Glass Breaker's ungloved hand. Since it is against OSHA practice to do this, a wipe sample was taken by the CSHO from the inside of the PPE inner glove and PPE inner sleeve that was against the skin, and then compared to sample W2. Cadmium was detected by the OSHA wipe (as it was during the KAM survey), and improvements that were mentioned in the KAM survey and other industry practices should be taken to eliminate this exposure. This concept

should be implemented for all possible contaminated exposure areas.

- 8 Heat stress should be evaluated for the inmates and future monitoring performed and documented.

If you have any questions regarding this letter or the results, please contact me or Mark Davis at (904) 232-2895. Thank you for your cooperation during our inspection of your facility, and for your personal support of the safety and health of your employees and the inmates.

Sincerely,


JAMES D. BORDERS
Area Director

1.0 INTRODUCTION

At the request of the U.S. Department of Justice (DOJ) Office of the Inspector General (OIG), the Federal Occupational Health Service (FOH) coordinated environmental, safety and health (ES&H) assessments of electronics equipment recycling operations at a number of Federal Bureau of Prisons (BOP) facilities around the country. The assessments were conducted as a result of whistleblower allegations that inmate workers and civilian staff members were being exposed to toxic materials, including lead, cadmium, barium, and beryllium at electronics recycling operations overseen by Federal Prison Industries (UNICOR).¹ The allegations stated that these exposures were occurring from the breaking of cathode ray tubes (CRTs) and other activities associated with the handling, disassembly, recovery, and recycling of electronic components found in equipment such as computers and televisions (i.e. e-waste).² It was further alleged that appropriate corrective actions had not yet been taken by BOP and UNICOR officials and that significant risks to human health and the environment remained.

This FOH report consolidates and presents the findings of technical assessments performed at UNICOR's e-waste recycling operations at the Federal Correctional Complex³ in Tucson, Arizona by industrial hygienists and other safety and health specialists representing federal agencies including FOH, the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (CDC/NIOSH), and the Occupational Safety and Health Administration (OSHA). Reports from these agencies are presented in Attachments 1 and 2 (also see references for these reports in Section 7.0). The primary objectives of these assessments were to characterize current UNICOR operations and working conditions at the Tucson Federal Correctional Institution (FCI Tucson) in light of the whistleblower allegations and to identify where worker exposures, environmental contamination/degradation, and violations of governmental regulations and BOP policies may still exist so that prompt corrective actions may be taken where appropriate. In addition, this FOH report also relies upon information from documents assembled by the OIG which were developed by various consultants, regulatory agencies, BOP staff, and others.

The overall purpose of this report is to characterize current operations and working conditions at FCI Tucson especially with respect to the potential for inmate and staff exposures⁴ that may result from present day e-waste recycling activities as well as from

¹ FPI, (commonly referred to by its trade name UNICOR) is a wholly-owned, government corporation that operates factories and employs inmates at federal correctional institutions.

² E-waste is defined as a waste type consisting of any broken or unwanted electrical or electronic device or component.

³ FCC Tucson is comprised of two main facilities: a Federal Correctional Institution (FCI) and a United States Penitentiary (USP). Since e-waste demanufacturing operations are performed exclusively at the FCI, henceforth in this report the e-waste facilities will be referred to as being at FCI Tucson.

⁴ In this report, the term "exposure" refers to the airborne concentration of a contaminant (e.g., lead or cadmium) that is measured in the breathing zone of a worker but outside of any respiratory protection devices used. Unless otherwise noted, "exposure" should not be confused with the ingestion, inhalation, absorption, or other bodily uptake of a contaminant. Concentrations reported and discussed in this report are not adjusted based on respirator protection factors. However, when reported, it is indicated whether the exposure was within the protective capacity of the respirator.

legacy contamination on building components from electronics recycling operations which took place in the past. Recommendations are provided to address deficiencies identified in the report and to improve workplace health and safety.

FCI Tucson is one of eight BOP institutions that have ongoing e-waste recycling operations for which, to date, an assessment report has been prepared by FOH. On October 10, 2008, FOH issued a separate report entitled "*Evaluation of Environmental, Safety, and Health Information Related to Current UNICOR E-Waste Recycling Operations at FCI Elkton*" detailing current exposure conditions at FCI Elkton. The FOH report for FCI Elkton should be reviewed for a more comprehensive discussion of the hazardous components found in waste electronics, pertinent regulatory requirements, and other information that provides additional context to this report on FCI Tucson. FOH will be preparing assessment reports for the remaining BOP institutions that perform recycling upon completion of their respective environmental, safety, and health (ES&H) assessments.

Currently, e-waste recycling operations at FCI Tucson involve the receipt of waste electronics from various locations around the country, disassembly and sorting activities (otherwise referred to as 'breakdown' or 'demanufacturing'), and the associated material handling and facilities maintenance required to support these operations. Facilities and preparations for conducting glass breaking operations were established at FCI Tucson, but glass breaking operations were never implemented. FCI Tucson recycling facilities and operations are described below in Section 2.0 in greater detail.

2.0 UNICOR E-WASTE RECYCLING FACILITIES AND OPERATIONS AT FCI TUCSON

UNICOR e-waste recycling operations commenced at FCI Tucson in February 2005. These operations included receiving and sorting, disassembly, and packaging and shipping. Preparations were made to perform glass breaking, but this operation was never implemented. These operations are conducted at the warehouses, one of which is adjacent to the institution, and the recycling factory located within the institution.

As part of the OIG investigation, NIOSH's Division of Applied Research and Technology (DART), accompanied by FOH, performed an on-site survey of the recycling workplace in June 2007 to evaluate hazards and hazard controls. In its report (Attachment 1), NIOSH/DART described FCI Tucson's e-waste recycling processes. This section summarizes information provided about FCI Tucson's recycling facilities and operations.

The recycling of electronic components is performed in a facility located within the FCI. A diagram of the general layout of the recycling factory is provided in Figure 1, below. The inmate population of the UNICOR factory was approximately 86 in 2007.

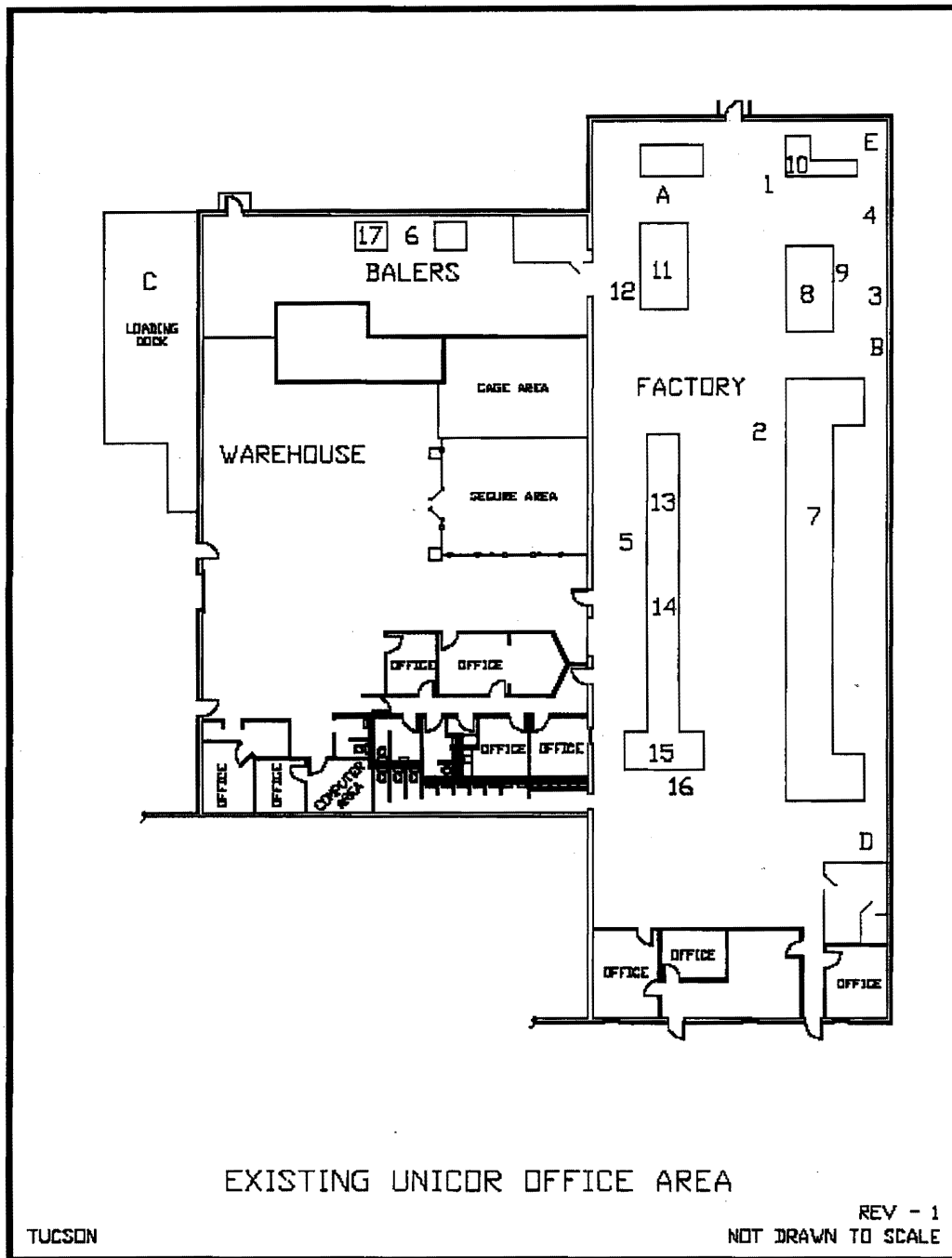


Figure 1. UNICOR E-Waste Recycling Facility, FCI Tucson

The recycling of electronic components at the FCI factory currently consists of three production processes: 1) receiving and sorting, 2) disassembly, and 3) packaging and shipping. Each is discussed below.

Incoming materials are received at a warehouse at a minimum security camp adjacent to the USP where they are examined and sorted. This camp warehouse is located in a separate building several hundred yards from the current e-waste disassembly area. Approximately 25 inmates were assigned to this warehouse in 2007. At the camp warehouse, interstate trucks drop off all e-waste materials for contraband checks, initial sorting, and hard drive destruction. Other activities performed here include computer testing and repairs, toner removal from printers, and some (limited) component removal from computers for use in the repair of others. A second warehouse is also associated with e-waste operations at FCI Tucson. It is referred to as the 'inside warehouse' and is immediately adjacent to the FCI Tucson e-waste disassembly area. This area is no longer used as a warehouse but is so-designated on building drawings (as shown in Figure 1). In this area e-waste materials are received from the camp warehouse, unloaded, and staged for processing in the disassembly area. Also, baling operations of processed materials take place in the 'inside warehouse'.

The bulk of the materials received are computers, either desktop or notebooks, or related devices such as printers. Items such as notebook computers that can be upgraded and resold are sorted for that task.

After electronic memory devices (e.g., hard drives, disks, etc.) are removed and degaussed or destroyed, central processing units (CPUs), servers, and similar devices are sent for disassembly. Monitors and other devices (e.g., televisions) that contain cathode ray tubes (CRTs) are separated and sent for disassembly and removal of the CRT. Printers, copy machines, and any device that could potentially contain toner, ink, or other expendables are segregated and these expendables are removed prior to the device being sent to the disassembly area.

In the disassembly process, external cabinets, usually plastic, are removed from all devices and segregated. Valuable materials such as copper wiring and aluminum framing are removed and sorted by grade for further treatment if necessary. Components such as circuit boards or chips that may have value or may contain precious metals such as gold or silver are removed and sorted. With few exceptions each of the workers in the main factory performs all tasks associated with the disassembly of a piece of equipment and uses the provided powered and un-powered hand tools (primarily screwdrivers and wrenches). A few workers collect the various parts and place them into the proper collection bin. Work tasks include removing screws and other fasteners from cabinets, unplugging or clipping electrical cables, removing circuit boards, and using whatever other methods are necessary to break these devices into their component parts. Currently, virtually all components are sold for some type of recycling.

Images of the disassembly area are shown in Images 1 and 2 which follow.



Image 1. UNICOR e-waste disassembly area at FCI Tucson



Image 2. 'Inside' warehouse adjacent to disassembly area at FCI Tucson where baling of e-wastes is performed.

The final process, packaging and shipping, returns the various materials segregated during the disassembly steps to the warehouse where they are sent to contracted purchasers of the various materials. To facilitate shipment, some bulky components such as plastic cabinets or metal frames are placed in a hydraulic baler to be compacted for easier shipping. Other materials are boxed or containerized and removed for subsequent sale.

Glass breaking has not been performed at FCI Tucson, though a glass breaking booth was previously set-up but disassembled prior to any use. CRTs are shipped, unbroken, from FCI Tucson to other locations for breaking and recycling.

The NIOSH/DART report presents information on personal protective measures and work practices used during e-waste recycling activities. These controls are summarized in Sections 3.0 and 4.0 of this report. The NIOSH/DART report, Attachment 1, should be consulted for additional details.

3.0 BOP/UNICOR SAFETY AND HEALTH PROCEDURES AND PRACTICES AT FCI TUCSON

Under 29 CFR 1960 each federal agency is obligated to develop a comprehensive and effective safety and health program. Such programs establish requirements and processes for controlling occupational hazards and meeting federal occupational safety and health regulations. The BOP has established an ES&H program entitled Occupational Safety, Environmental Compliance, and Fire Protection (BOP Program Statement 1600.09). UNICOR's compliance with this policy will be evaluated in the OIG's final report.

Various OSHA standards require written programs or plans to address occupational hazards or implement hazard control measures. Examples that could be applicable to various UNICOR e-waste recycling factories, particularly for glass breaking include:

- 29 CFR 1910.1025, Lead requires a written lead compliance plan;
- 29 CFR 1910.1027, Cadmium requires a written cadmium compliance plan;
- 29 CFR 1910.134, Respiratory Protection requires a written respiratory protection program; and
- 29 CFR 1910.95, Occupational Noise Exposure requires a written hearing conservation program.

At FCI Tucson, glass breaking, which is associated with higher lead and cadmium exposures, has never been performed, and current disassembly processes have not been shown to result in lead and cadmium exposures at levels that would require a written compliance plan. However, even when specific hazards do not meet the exposure threshold for a written standard-specific plan/program, a good practice approach warrants that a general safety and health plan be put in place to identify workplace hazards and specify appropriate hazard controls and safe work practices. Safety and health practices for both routine and non-routine work activities should be addressed. Other hazards such

as heat exposure and repetitive stress (e.g., repeated lifting of heavy loads) could also warrant written programs to ensure appropriate evaluation and control of the hazards. UNICOR's safety and health practices and programs conducted at FCI Tucson are discussed below for e-waste recycling activities. Environmental compliance programs to ensure compliance with state and federal regulations are also discussed.

3.1 UNICOR Safety and Health Practices and Procedures to Control Toxic Metals Exposure

At FCI Tucson, UNICOR has various documents in place that address safety and health rules, practices, and procedures to control exposures to toxic metals. One of these documents is UNICOR's Quality Management System, section 6.2.2 "Competence, Awareness, and Training (Procedure)." Elements include the following:

- A basic 32-hour core curriculum course for staff;
- A basic job orientation for inmate workers that includes safety instructions, hazard communication training, and instruction for the work assignment. Toxic metals hazards and controls are addressed in the course outline, including a concise procedure for handling the accidental breakage of CRT glass. [Note: The document does not specify the duration of this orientation];
- Safety rules that include mandatory safety shoes and safety glasses, restrictions on eating, drinking, chewing, and smoking in the disassembly area, brief hand washing requirements, brief lifting precautions, glove requirements, and other non-specific PPE instructions; and
- A training outline for hazardous material recognition and handling, including information on toxic metals potentially encountered during e-waste recycling activities.

Also as part of the Quality Management System, UNICOR has document "7.5.3(a) Identification-Step by Step Work Instructions (Procedure)." This document provides work instructions for the various recycling operations and activities. The instructions do not specifically address toxic metals exposures or procedures to address these hazards but do contain general PPE requirements in the "tools" section, such as for use of safety glasses, gloves, and hearing protection.

NIOSH/DART reported on the type of PPE and respiratory protection that was either worn by or available to inmate workers performing recycling operations at FCI Tucson, such as for the disassembly processes (see NIOSH/DART report, Attachment 1). NIOSH/DART stated that safety glasses were used in most locations, and that hearing protection was available where needed, primarily near the baler. [Note: UNICOR's baler procedure requires hearing protection, as does the crusher procedure.] Disposable respirators were also available to workers on a voluntary use basis.

UNICOR does not have a written respiratory protection program specific to its recycling operations at FCI Tucson, although FCI Tucson has a generic respirator program for its general activities. This document was recently replaced with an updated respiratory protection plan. The original document, Respiratory Protection TCN 1600.8F5, dated October 20, 2004, states that "the only nuisance dust mask approved for use is the single strap which will not require medical approval or fit testing as this is not a tight face to mask fitting unit." This device is currently in use by UNICOR for its recycling operations at FCI Tucson. This mask is not tight fitting to the face. As requested by FOH, the Lead Safety Specialist provided FOH with the current respiratory protection plan that was updated in January 2009. This most recent plan supersedes the program of 2004. The recent plan calls for the use of a more effective disposable respirator. The Assistant Warden expressed willingness to make this upgrade, but also expressed uncertainty regarding requirements for its use; specifically would fit testing be required. The document initially states that fit testing is required, but later Section 5, Fit Testing states that fit testing is to be performed when respirator use is "required." UNICOR at FCI Tucson provides disposable respirators for voluntary use, but does not require their use.

FOH offers the following information for UNICOR's and FCI Tucson's consideration regarding the disposable respirator issue. The employer is not required to do medical qualification or fit testing or have a written respiratory protection program for voluntary use of dust masks (or for respirators whose only use would be for emergency escape). Per an OSHA Instruction /Inspection Procedure dated 9/25/1998: "For voluntary use of filtering facepiece dust masks, the employer needs only ensure that dust masks are not dirty or contaminated, that their use does not interfere with employee's ability to work safely, and that a copy of Appendix D is provided to each voluntary wearer. Merely posting Appendix D is not considered adequate". According to OSHA's enforcement guidelines, Appendix D (or employer's equivalent) is only required to be issued initially.

Because UNICOR at FCI Tucson does not require use of respirators, a written respiratory protection program is not required by OSHA. Regardless of the disposable mask selected, UNICOR should ensure that the limitations of the dust mask selected are addressed with the wearers and that they understand the types of hazards that the respirator is designed to control. For documentation purposes UNICOR should have users read and sign Appendix D of 29 CFR 1910.134, and UNICOR and FCI Tucson should maintain the Appendix D signed records. If UNICOR implements elements of an operations and maintenance (O&M) plan that would require respiratory protection for new or non-routine activities, then UNICOR would need to implement a written respiratory protection program consistent with the types of respirators used (see Section 6.0 for additional information and recommendations).

Although various safety practices and procedures are applied at the FCI Tucson recycling factory, a written safety and health document to define existing workplace hazards and control measures is not in place for UNICOR recycling activities conducted specifically at FCI Tucson. As a "good practice" approach, such a document should be developed and implemented and would serve to concisely define the safety and health practices and

requirements specific to FCI Tucson recycling, such as PPE requirements or voluntary use, hygiene (e.g., hand washing) practices, daily and periodic housekeeping practices, special training requirements for any hazardous equipment use or other hazard controls, and other practices essential to conduct work safely. Non-routine or periodic work activities should also be addressed in the document, particularly those that potentially disturb dusts such as cleaning and handling/disposing of wastes from HEPA vacuums or containers. The document could specify the safety rules covered in the job orientation training and could also specify requirements for periodic site assessments, hazard analyses, and regulatory compliance reviews.

3.2 Other UNICOR and FCI Tucson Safety and Health Procedures

Other than the documents described in Section 3.1, above, UNICOR does not have safety and health procedures specific to its recycling operations at FCI Tucson. However, FCI Tucson has many written safety procedures that apply to operations for the institution as a whole. FOH reviewed 15 of these procedures that were issued by the Safety Department. These procedures are not specific to the recycling operations, but as an operation conducted at FCI Tucson, recycling would be under their umbrella.

These Safety Department procedures address such topics as hearing conservation, flammable and combustible materials, electrical safety, respiratory protection, safety shoes, hot work, fire prevention and control, hazard communication, confined space entry, disposal of infectious waste, pest control, personal protective equipment, hearing conservation, and housekeeping. These procedures are fairly general in content, and do not specifically address recycling practices. In addition, the FCI Tucson Lead Safety Specialist stated that these procedures are to some extent obsolete. For example, annual noise monitoring is not currently performed as specified in the hearing conservation procedure.

The FCI Tucson hearing conservation program, dated October 7, 2002, states that the Occupational Safety and Health Environmental Department is to perform annual noise evaluations throughout the institution to determine which areas have noise levels above 85 dBA. The Lead Safety Specialist stated that this program has not been supported by BOP or UNICOR management for years and that no noise monitoring evaluations have been conducted by UNICOR or FCI Tucson for the recycling activities. The Assistant Warden confirmed that noise monitoring has not been conducted.

UNICOR is in the process of developing a heat stress program. This program will be evaluated and discussed in the final OIG report. See Section 4.3 for NIOSH/DART and FOH heat measurements and observations at FCI Tucson.

3.3 FCI Tucson Safety Department Concerns

In reviewing correspondence from the FCI Tucson Safety Department, FOH noted several recommendations or deficiencies involving safety and health practices at

UNICOR's FCI Tucson e-waste recycling operations that were raised by Safety Specialists. Examples include the following.

- On April 11, 2006, the Lead Safety Specialist identified a need to conduct air and surface sampling such that proper PPE could be established to protect workers against "harmful dust."
- On April 13, 2006, the Lead Safety Specialist recommended to the Associate Warden of Operations that personal toxic metals monitoring for staff and inmate workers should be conducted at the UNICOR recycling operations at FCI Tucson. Monitoring was later conducted as reported in Section 4.1.
- On May 17, 2006, the Lead Safety Specialist notified the Acting Associate Warden that staff and inmate workers have not been informed of exposure monitoring results as required by OSHA and Bureau policy, and recommended that they be informed.
- On May 17, 2006, the Lead Safety Specialist informed the Acting Associate Warden that the staff who work at the rear gate have not received formal training on the hazards associated with computer recycling products. He mentioned that UNICOR has not determined PPE needs for these personnel. In a recent discussion with FOH, the Lead Safety Specialist stated that these personnel enter trucks and move and search boxes containing e-waste materials. Additional correspondence and a proposed procedure for "rear gate" activities have since been submitted, but not acted upon.

These communications indicate that the FCI Tucson Safety Department is actively engaged to ensure hazard evaluation, communication, and control. Regarding the toxic metals exposure monitoring issue, management responded by arranging for a UNICOR consultant to conduct monitoring in June 2006. See Section 4.1 for monitoring results and information on the effectiveness in responding to the results. Regarding the staff working at the rear gate, the FCI Tucson Lead Safety Specialist recently stated that this issue has still not been addressed to date. The UNICOR Industrial Hygienist was of the opinion that this issue should be a BOP action rather than a UNICOR action.

This open "rear gate" safety item points to the need for BOP and UNICOR to list, track, address, accept or not accept, and close out recommendations from its safety and health staff, consultants, and others, including from the OIG investigation. Such a system will be further discussed in the final OIG report. This item is also an example of the need to clearly delineate responsibilities between BOP and UNICOR for safety and health ownership and actions.

3.4 Environmental Procedures

FCI Tucson has an Environmental Awareness/Pollution Prevention Program, dated March 1, 2006. This procedure primarily addresses the recycling of general use materials

associated with general institutional operations and activities, but does not specifically address UNICOR's e-waste recycling operations.

Debris from cleaning operations and equipment such as HEPA vacuums contain dusts and debris contaminated with toxic metals. UNICOR and FCI Tucson should define testing and disposal practices to ensure proper disposal in accordance with U.S. EPA regulations. See Section 4.5 for a discussion of this and other environmental issues.

4.0 FIELD INVESTIGATIONS AND MONITORING RESULTS

Several field investigations of FCI Tucson's e-waste recycling operations have been conducted since 2005. These investigations are listed below:

- OSHA conducted a lighting survey and limited noise monitoring in May 2005.
- OSHA conducted toxic metals exposure monitoring at FCI Tucson in April 2006 as part of a facility inspection (see OSHA Narrative Report as Attachment 2).
- In June 2006, a consulting firm retained by UNICOR and FCI Tucson conducted a field investigation to evaluate exposure to toxic metals in the recycling areas.
- As part of the DOJ OIG investigation, NIOSH/DART and FOH conducted a survey in June 2007 to determine existing toxic metal surface contamination on various building components and to generally evaluate the e-waste recycling operation, associated hazards, and hazard controls (see NIOSH/DART report as Attachment 1).

Results of the OSHA inspections, the consultant's evaluation, and the FOH and NIOSH/DART survey are summarized and discussed in this section⁵.

Toxic metals of greatest interest for e-waste recycling include lead, cadmium, and barium. Beryllium can also be associated with e-waste materials and is also of interest because of its high toxicity, adverse health effects, and low exposure limit. These metals were the focus of the field investigations, although 27 other metals were also evaluated. See the FCI Elkton report referenced in Section 1.0 for details regarding e-waste hazards.

Exposure monitoring results are compared to permissible exposure limits (PELs) established by OSHA. In addition, non-mandatory American Conference of Governmental Industrial Hygienist (ACGIH) threshold limit values (TLVs) and NIOSH recommended exposure limits (RELs) are also available for reference. Personal exposure limits are often based on 8-hour time weighted average (TWA) exposures and the TWAs

⁵ Given the many variables that may impact air sampling and exposure monitoring, testing data and findings can vary from one period to the next. Also, the findings, interpretations, conclusions and recommendations in this report may in part be based on representations by others which have not been independently verified by FOH.

are applicable to the exposures discussed in this report. Table 1 provides exposure limits for lead, cadmium, barium, and beryllium. PELs and TLVs for other hazards can be found in OSHA standards (29 CFR 1910) and the most recent ACGIH TLV Booklet.

Table 1
Occupational Exposure Limits¹

	LEAD ($\mu\text{g}/\text{m}^3$)	CADMIUM ($\mu\text{g}/\text{m}^3$)	BARIUM ($\mu\text{g}/\text{m}^3$)	BERYLLIUM ($\mu\text{g}/\text{m}^3$)
OSHA PEL	50	5.0	500	2
OSHA ACTION LIMIT	30	2.5		
ACGIH TLV (Total Exposure)	50	10.0	500	2
ACGIH TLV (Respirable Fraction)	N/A	2.0		
NIOSH REL	50	Ca^2	500	0.5

NOTES:

1. All limits are based on an 8-hour time weighted average (TWA) exposure. NIOSH RELs are based on TWA concentrations of up to a 10-hour workday during a 40-hour workweek.
2. Ca (Potential Occupational Carcinogen). NIOSH RELs for carcinogens are based on lowest levels that can be feasibly achieved through the use of engineering controls and measured by analytical techniques. [NIOSH 2005]

Exposure standards for any other hazards evaluated are discussed in the sections below where results of the investigations are presented.

4.1 Investigations for Exposure to Toxic Metals

Given the various materials and components in e-waste, recycling activities have the potential to result in worker exposure to toxic metals including, in particular, lead and cadmium. The magnitude and potential health consequences of exposures are dependant on a number of factors such as workplace engineering controls including ventilation, work practices, protective equipment utilized (e.g., respirators, protective clothing, gloves, etc.), duration of exposures, and others. The FOH report for FCI Elkton should be reviewed for a more comprehensive discussion of the hazardous components found in waste electronics, their relative toxicities, pertinent regulatory requirements, and other information.

Three investigations that included evaluation of toxic metals exposure during FCI Tucson's e-waste recycling operations are discussed below in chronological order of the studies. These investigations were conducted by OSHA, a UNICOR consultant, and NIOSH/DART and FOH.

4.1.1 OSHA Exposure Monitoring for Toxic Metals and Other Findings

OSHA conducted an inspection of e-waste recycling operations at FCI Tucson in April 2006, during which it characterized recycling operations through personal air monitoring, area air monitoring, and hand wipe sampling (see Attachment 2 for the OSHA report). Samples were analyzed for lead, cadmium, barium, and beryllium. Results and recommendations of this inspection were provided in a narrative report and are summarized below.

- OSHA reported that all exposure results were below the OSHA PELs.
- OSHA noted that hand wipe sample results indicated the need for continued vigilance in keeping hands clean in order to prevent transmission of contaminants (i.e., hand-to-mouth ingestion or take home contamination).
- OSHA noted that UNICOR did not have an industrial hygiene baseline study, but stated that UNICOR was in the process of scheduling one. OSHA emphasized that this survey should be performed and requested a copy of the results.
- OSHA also reported that "...some medical tests were completed..." in preparation for glass breaking, but since glass breaking was never implemented these tests are not required.
- OSHA stated that "...overall the facility looked very good and no apparent violations of OSHA standards were observed." The report praised the MSDS program and training documentation. OSHA stated that no citations were to be issued.

Regarding the industrial hygiene (IH) baseline survey, such a survey has not been conducted by UNICOR in response to the OSHA recommendation, even though OSHA was informed that scheduling for an IH baseline survey was in progress. The FCI Tucson Lead Safety Specialist confirmed this information. The Assistant Warden cited a consultant monitoring episode conducted in 2006; however, this monitoring episode, although useful, can not be considered an IH baseline survey. For instance, it did not evaluate the breadth of hazards associated with the recycling operations and did not appropriately discuss the toxic metals exposure results (see Section 4.1.2, below).

4.1.2 UNICOR Consultant Monitoring Report for Toxic Metals

In written correspondence dated April 13, 2006, from the FCI Tucson Lead Safety Specialist to the Assistant Warden of Operations, the Safety Specialist requested that UNICOR conduct personal air quality sampling of the staff and inmate workers in the UNICOR factory and warehouse at FCI Tucson. The Safety Specialist noted that inspections and walkthroughs of the factory and warehouse found occasions where dust levels were visible to the eye and where dust masks worn by workers had turned black. [Note: In a recent discussion with FOH, the Safety Specialist stated that visible dust

emissions have since been remedied.] The Lead Safety Specialist further noted that such dust masks do not protect workers from harmful dusts generated from CRTs and cited BOP's document 1600.08, Chapter 1, Page 25 requiring a hazard assessment of PPE use. Later in April, OSHA conducted exposure monitoring at FCI Tucson (see Section 4.1.1). UNICOR then retained a consulting firm to conduct its own evaluation which included exposure monitoring. The consultant's findings are discussed below.

The consultant's evaluation, conducted in June 2006, included monitoring for both personal exposures and area air levels. Two personal exposure samples were collected for inmate workers performing disassembly. Three area air samples were also collected in the recycling areas. In addition, surface wipe samples were collected from surfaces in various recycling areas. Samples were analyzed for 28 metals including lead, cadmium, barium, and beryllium. Sampling results and overall findings are summarized below.

- The five personal and area exposure samples were collected in the disassembly and crushing/baling areas. The consultant reported that all personal and area monitoring results were below the OSHA PELs. In reviewing the data tables, FOH notes, however, that one area sample showed the cadmium level to be above the OSHA action level. Cadmium was found in the "east area" at $3.5 \mu\text{g}/\text{m}^3$ versus the action level of $2.5 \mu\text{g}/\text{m}^3$ and PEL of $5.0 \mu\text{g}/\text{m}^3$. This level is 70% of the PEL; however, the consultant's report did not clearly show whether the result as reported was an 8-hour TWA. The consultant made no mention of the significance of this result in its report. FOH provides a further discussion of the implications of this result later in this section and also discusses follow-up information concerning this result that was obtained by UNICOR in 2008 from the consultant.
- Seven surface samples were collected from work surfaces, equipment, floors, or other accessible work areas. The consultant reported that all metal concentrations were "low." In reviewing the data tables, FOH notes that all lead results were "none detected" (ND), and based on the detection limit reported, this would equate to less than $2 \mu\text{g}/100\text{cm}^2$ or less than about $20 \mu\text{g}/\text{ft}^2$. These results are significantly less than the levels found by the NIOSH/DART and FOH survey conducted in June 2007 which ranged from a low of $23 \mu\text{g}/\text{ft}^2$ to a high of $1,300 \mu\text{g}/\text{ft}^2$. Similarly, the consultant found that cadmium results were ND or very near the detection limit, which were also less than results found by NIOSH/DART. See Section 4.2 for a discussion of the NIOSH/DART and FOH survey results.
- Using total particulates as a surrogate for carbon black analyses, the consultant reported that the carbon black exposures were less than the PEL ($<0.03 \text{ mg}/\text{m}^3$ total dust versus a carbon black PEL of $3.5 \text{ mg}/\text{m}^3$).
- The consultant found that all work practices and procedures were performed in a safe manner and recommended no changes in practices and procedures. The consultant found that the facility appeared cleaner than other e-waste recycling operations that he had observed.

As noted above, one cadmium area air sample was above the OSHA action level, as presented in the consultant's report. The consultant did not mention this finding in its report, even though an exposure above the action level has regulatory implications defined by the OSHA cadmium standard, assuming the sample is representative of the workers' breathing zone. For instance, initial monitoring above the cadmium action level requires additional monitoring to be conducted at least every six months and sometimes more frequently depending on conditions, until levels are consistently found to be below the action level. Also, medical surveillance and biological monitoring is required if exposures above the action level can occur for more than 30 days per year. It is incumbent on the employer to demonstrate that such exposures do not occur for more than 30 days per year, if medical surveillance is not implemented.

A UNICOR Industrial Hygienist made an inquiry of the consultant regarding this sample result and the consultant responded by email in January 2008. The consultant reported that the sample was taken in the middle of a work bench approximately six inches above the surface where disassembly was being performed, and workers were located on both sides of the bench. The consultant also confirmed that the sample was an area sample and not a personal sample. The consultant reported that the sample duration was 383 minutes from which the consultant apparently calculated the 8-hour TWA for this sample as 0.00199 mg/m^3 ($1.99 \text{ }\mu\text{g/m}^3$) and reported that this level does not exceed the cadmium action level. However, based on a 383 minute sample with an exposure of $3.4 \text{ }\mu\text{g/m}^3$ for that duration and assuming zero exposure for the rest of the 8-hour period, the 8-hour TWA actually calculates to $2.7 \text{ }\mu\text{g/m}^3$ which is above the cadmium action level of $2.5 \text{ }\mu\text{g/m}^3$.

According to the OSHA cadmium standard, monitoring to determine exposures relative to the action level are to be "breathing zone" samples. It is not known whether this area sample is representative of the workers' breathing zone; however, the sample was taken above the work bench where workers are stationed. UNICOR should consider that the result is representative of the breathing zone, unless it demonstrates otherwise by conducting sufficient additional monitoring over time or other means.

Based on this cadmium result, UNICOR should have conducted follow-up breathing zone monitoring to determine whether this area exposure is a rare or frequent occurrence, to determine if this area result is representative of the worker's breathing zone, to determine if it represents a worst case exposure, and to determine and correct contributing factors for the exposure. FOH also notes, however, that based on the consultant's narrative report, the consultant did not provide UNICOR with any indication that a cadmium area exposure result was above the action level, warranting follow-up analysis. The consultant also did not provide this information in its follow up email correspondence.

4.1.3 NIOSH/DART Surface Wipe and Bulk Dust Sample Results

As part of the OIG investigation, in June 2007 FOH and NIOSH/DART conducted bulk dust and surface wipe sampling in current areas where e-waste recycling is performed at

FCI Tucson. Samples were analyzed for total lead, cadmium, barium, nickel, and other toxic metals.

Federal standards or other definitive criteria or guidelines have not been developed for acceptable levels of lead or cadmium surface contamination or dust concentrations in industrial areas where activities are performed involving lead and/or cadmium bearing materials. However, several recommendations or guidelines, primarily for lead, provide points of reference to subjectively evaluate the significance of surface contamination. Some guidelines that are available are noted below (see the NIOSH/DART FCI Elkton report for a more detailed discussion of guidelines):

- OSHA's Directorate of Compliance Programs indicated that the requirements of OSHA's standard for lead in the construction workplace (i.e., 29 CFR 1926.62) can be summarized and/or interpreted as follows: all surfaces shall be maintained as 'free as practicable' of accumulations of lead; the employer shall provide clean change areas for employees whose airborne exposure to lead is above the PEL; and the employer shall assure that lunchroom facilities or eating areas are as free as practicable from lead contamination. The OSHA Compliance Directive for the Interim Standard for Lead in Construction, CPL 2-2.58 recommends the use of the Department of Housing and Urban Development's (HUD) initially proposed decontamination criteria of 200 $\mu\text{g}/\text{ft}^2$ for floors in evaluating the cleanliness of change areas, storage facilities, and lunchrooms/eating areas. In situations where employees are in direct contact with lead-contaminated surfaces, such as, working surfaces or floors in change rooms, storage facilities, lunchroom and eating facilities, OSHA has stated that the Agency would not expect surfaces to be any cleaner than the 200 $\mu\text{g}/\text{ft}^2$ level.
- For other surfaces (e.g., work surfaces in areas where lead-containing materials are actively processed), OSHA has indicated that no specific level can be set to define how "clean is clean" nor what level of lead contamination meets the definition of "practicable." Specifically addressing contaminated surfaces on rafters, OSHA has indicated that they must be cleaned (or alternative methods used such as sealing the lead in place), as necessary to mitigate lead exposures. OSHA has indicated that the intent of this provision is to ensure that employers regularly clean and conduct housekeeping activities to prevent avoidable lead exposure, such as would potentially be caused by re-entrained lead dust. Overall, the intent of the "as-free-as-practicable" requirement is to ensure that accumulation of lead dust does not become a source of employee lead exposures. OSHA has stated that any method that achieves this end is acceptable.
- Lange [Lange, JH 2001] proposed a clearance level of 1,000 $\mu\text{g}/\text{ft}^2$ for floors of non-lead free commercial buildings and 1,100 $\mu\text{g}/\text{ft}^2$ for lead-free buildings. These proposed clearance levels are based on calculations that make a number of intentionally conservative assumptions.

- HUD has established clearance levels for lead on surfaces after lead abatement. These levels range from 40 to 800 $\mu\text{g}/\text{ft}^2$, depending on the type of surface. The level of 200 $\mu\text{g}/\text{ft}^2$ is most commonly used. These levels, however, apply to occupied living areas where children reside, and are not intended for industrial operations.
- Regarding lead in bulk dust or soil samples, the U.S. EPA has proposed standards for residential soil-lead levels. The level of concern requiring some degree of risk reduction is 400 ppm (mg/kg), and the level requiring permanent abatement is 2,000 ppm (mg/kg). Again these levels are residential criteria, rather than for industrial settings.
- There is no quantitative guidance for surface cadmium concentrations. OSHA states that surfaces shall be as free as practicable of accumulations of cadmium, all spills and sudden releases of cadmium material shall be cleaned as soon as possible, and that surfaces contaminated with cadmium shall be cleaned by vacuuming or other methods that minimize the likelihood of cadmium becoming airborne.

During its June 2007 survey, NIOSH/DART collected surface wipe and bulk dust samples from various locations in the FCI Tucson recycling facilities both inside the glass breaking room and in the general factory and associated areas. Samples were analyzed for lead and cadmium and other toxic metals. Summary results for lead and cadmium levels in these samples are presented below (see Attachment 1 for complete results for all metals evaluated).

- Five bulk dust samples were collected in the recycling factory. Lead ranged from 34 mg/kg to 1,000 mg/kg. All levels were below the U.S. EPA soil-lead criterion for permanent abatement, although this criterion is not directly applicable to surface dust in an industrial workplace. Three of the five were above the U.S. EPA criterion that suggests some degree of risk reduction. Risk reduction involves a program of cleaning and housekeeping, as well as an operations and maintenance (O&M) plan to prevent build-up of contamination. Wastes collected from cleaning and O&M activities should be tested via the TCLP methodology to ensure disposal in accordance with U.S. EPA regulations.
- Surface wipe samples were collected in the FCI Tucson recycling factory and analyzed for lead and cadmium along with other metals. Six of 17 surfaces had lead concentrations above the OSHA-referenced criteria of 200 $\mu\text{g}/\text{ft}^2$, with the highest measurements at 900 $\mu\text{g}/\text{ft}^2$ and 1,300 $\mu\text{g}/\text{ft}^2$. The two highest results were from elevated surfaces (light fixtures) only accessible by ladder. Three other samples above 200 $\mu\text{g}/\text{ft}^2$ were also from light fixtures. Only one sample above 200 $\mu\text{g}/\text{ft}^2$ was from a work surface to which workers could be routinely exposed during daily activities. As stated above, the OSHA criterion does not apply to work areas involving lead materials and is not directly applicable to recycling work areas. It would apply to clean rooms, lunch areas and similar non-

work areas that are associated with lead work activities. The level proposed by Lange, also for occupied work environments is 1,000 or 1,100 $\mu\text{g}/\text{ft}^2$, which approximates the level of the two highest surface wipe samples.

- The highest cadmium surface concentration in the FCI Tucson recycling factory was 100 $\mu\text{g}/\text{ft}^2$ with all others below 80 $\mu\text{g}/\text{ft}^2$.

In evaluating these results, FOH notes that the levels of lead surface contamination, although generally within the range of available criteria, are significantly higher than those found by the UNICOR consultant that conducted sampling only 12 months prior to NIOSH/DART. All consultant samples were less than the lead detection limit which was about 20 $\mu\text{g}/\text{ft}^2$, while NIOSH/DART samples were up to 65 times this level and averaged more than 10 times this level. NIOSH/DART collected samples from both elevated surfaces and work surfaces. When eliminating elevated surfaces from this equation, NIOSH/DART results are still up to 10 times higher for work surfaces and about five times higher on average. Similar differences were noted for cadmium surface results. [Note: Although direct comparison of results is problematic because of variability in sample locations and other factors, the levels are different enough to warrant follow-up evaluation.]

The reason for the differences in surface contamination between 2006 and 2007 is not known with certainty, but possibilities could include differences in sampling methods, differences in sampling times relative to surface cleaning, and differences in sampling locations that do not allow for a direct comparison of results. Consultant monitoring was conducted approximately 16 months after the start of recycling operations, therefore, sufficient time should have passed to allow for surfaces to exhibit contamination representative of the recycling operations. Regardless of the reason(s) for the differences in results, UNICOR should conduct periodic surface testing to determine if surface contamination is building up over time and to take action to prevent and correct this condition if it is occurring.

The levels of lead and cadmium contamination found in June 2007 at the FCI Tucson recycling factory are not widespread throughout the facility. However, based on some levels near the suggested Lange guidance, UNICOR and FCI Tucson should implement procedures to reduce the risk of exposure to surface dusts and dust accumulations. UNICOR and FCI Tucson should implement an operations and maintenance (O&M) plan to limit contact with existing lead and cadmium contamination, limit its accumulation, prevent and/or control any releases of the contamination to the air, and generally prevent potential for inhalation and ingestion (i.e., hand-to-mouth contact) exposure. With proper controls established, this plan could include periodic clean-up of surfaces by inmate or other workers using appropriate wet methods and HEPA vacuuming, such as the light fixtures and other surfaces above the work area where regular cleaning is not conducted and where dusts can accumulate over time. UNICOR should also conduct periodic surface sampling (perhaps annually) to ensure that surface contamination levels are kept in check and are not significantly building up over time, as contrasting data from 2006

and 2007 could suggest. Elements of an O&M plan and suggestions for surface sampling are discussed in Section 6.0, Recommendations.

In addition, NIOSH/DART observed that cleaning is conducted primarily using brooms and brushes. This can generate airborne dusts that increase personal exposures and become re-deposited on other surfaces at various elevations. Brush and similar cleaning methods are also explicitly prohibited in the OSHA cadmium standard. NIOSH/DART recommends use of HEPA vacuums and wet methods to clean surfaces of dusts containing lead, cadmium, and other toxic metals. When using wet methods, care should be taken to ensure that other safety hazards (such as slips or electrical hazards) are not introduced into the work area.

4.2 Investigations for Noise Exposure

Noise measurements were taken at various UNICOR recycling locations at FCI Tucson by OSHA and NIOSH/DART. These results are discussed below.

OSHA conducted noise monitoring on May 4, 2005. Operations at a metal baler, cardboard baler, and station 14 during air gun use were monitored. The report states that a sound level meter and noise dosimeter were used. Some sound levels above 85 dB were reported for short periods, but as TWAs, the results were less than 85 dB, which is the level that triggers the requirement for a hearing conservation program. This monitoring, although useful for these activities, is limited in its scope and does not represent a complete noise survey for all recycling operations that could contribute to noise exposures.

NIOSH/DART also conducted a limited amount of noise testing using a hand-held sound level meter (SLM). No noise dosimetry was performed. NIOSH/DART found peak levels up to 103 dBA near the plastic baler and 86 dBA near the metal baler. Where hard disks were being destroyed, peak levels over 100 dBA were common and levels were up to 112 dBA. The background noise in this area was in the range of 80 to 85 dBA. NIOSH/DART concluded that the SLM measurements indicated the need for a more comprehensive noise study.

UNICOR has not conducted a noise evaluation at FCI Tucson. This is a deficiency in hazard analysis and control.

4.3 Heat Exposure and Repetitive Stress

In June 2007, NIOSH/DART found that indoor temperatures ranged from 71 to 81 degrees F in the factory and up to 91 degrees F in the camp warehouse located across the street from the FCI recycling factory. Relative humidity ranged from 30% to 60%. Outdoor temperatures were measured in excess of 100 degrees F. NIOSH/DART concluded that heat stress (i.e., heat exposure) should be periodically evaluated to ensure proper precautions are in place to prevent excessive heat exposure. Heat exposure evaluations should be focused on the camp warehouse and outside or other areas without

air conditioning. Heat exposure in the general factory area and its associated warehouse during the NIOSH/DART and FOH site visits was not a factor.

As with other UNICOR recycling facilities, NIOSH/DART also observed tasks such as lifting that could produce repetitive stress. NIOSH/DART recommended that UNICOR evaluate tasks to determine if they are biomechanically taxing and implement modifications, procedures, training, or equipment to mitigate any identified hazard.

4.4 Environmental Issues

FOH conducted a limited review of available information pertaining to environmental issues associated with e-waste recycling operations at FCI Tucson. E-mail correspondence in March 2005 between the Arizona Department of Environmental Quality (ADEQ) Hazardous Waste Inspections and Compliance Unit and UNICOR at FCI Tucson reflected that UNICOR had made appropriate up-front inquiries prior to the initiation of CRT recycling operations and that ADEQ conveyed the position that intact electronic scrap was not considered a hazardous waste (consistent with the U.S. EPA proposed rule on CRT management published June 12, 2002 that allowed for an exclusion from the EPA definition of solid waste for used CRTs and glass, including broken and crushed, provided it was recycled and not disposed). ADEQ and UNICOR therefore concluded that the e-waste recycling activities at FCI Tucson did not fall under ADEQ's regulatory oversight so long as e-waste materials (particularly CRTs) were managed in accordance with the practices outlined in the EPA's proposed rule. The correspondence outlined a number of requirements should CRT glass breaking commence, but since this operation never occurred these requirements did not need to be followed.

According to UNICOR officials at FCI Tucson, e-waste activities at this facility are not currently subject to any environmental permits associated with hazardous waste, air, or water/wastewater and none are in place. Cleaning activities such as HEPA vacuuming or wet mopping/wiping accumulate dusts that potentially contain toxic metals. These dusts and associated wastes should be tested via the TCLP methodology to determine proper disposal methods in accordance with U.S. EPA regulations. The Lead Safety Specialist said that evaluations of HEPA vacuum wastes and mop rinse water were underway or being planned to determine acceptable disposal methods per U.S. EPA regulations.

5.0 CONCLUSIONS

Conclusions concerning safety, health, and environmental aspects of UNICOR's e-waste recycling operations at FCI Tucson are provided below under the following subsections:

- Heavy Metals Exposures;
- Noise, Heat, and Repetitive Stress Exposure;
- Safety and Health Programs, Practices, and Plans;
- Health and Safety Regulatory Compliance; and

- Environmental Compliance.

These conclusions are supported by the results, findings, and analyses presented and discussed in Sections 3.0 and 4.0 of this report, as well as the documents assembled by the OIG and reviewed by FOH. These conclusions, in part, are consolidated from the various federal agency reports, and are also supplemented by FOH based on the entire body of information assembled and reviewed. See Attachments 1 and 2 for additional conclusions from the individual contributing federal agencies, including NIOSH/DART and OSHA.

5.1 Heavy Metals Exposures

1. OSHA's and the UNICOR consultant's monitoring results from April and June 2006 showed that inhalation exposure to lead, cadmium, and other toxic metals during FCI Tucson recycling operations are maintained below the OSHA PELs. However, one cadmium area result determined by the UNICOR consultant showed cadmium exposure above the action level, but below the PEL. [Note: FCI Tucson's recycling operations include disassembly and associated activities, but do not include CRT glass breaking.]
2. UNICOR and FCI Tucson did not follow-up with additional monitoring or further evaluation to determine the source, cause, or frequency of the cadmium result that was above the action level. Workers were stationed near this area sample and UNICOR should presume that this sample is representative of the workers' breathing zone, unless it demonstrates otherwise. Follow-up monitoring is required by OSHA when cadmium breathing zone exposure is above the action level. Medical surveillance is required by OSHA when the cadmium action level is exceeded for 30 days or more per year. In the narrative of its report and later follow up email correspondence, the UNICOR consultant did not bring the cadmium exposure that was above the action level to the attention of UNICOR.
3. Based on surface wipe samples collected by NIOSH/DART in June 2007, lead and cadmium surface contamination in the factory can be controlled by implementing improved housekeeping and cleaning practices and by implementing an operations and maintenance (O&M) plan. An element of the O&M plan could include periodic clean-up of surfaces by inmate or other workers; however, this would have to be performed using proper hazard controls. This conclusion, however, is based on the 2007 levels remaining constant and not being allowed to increase (see Conclusion 4 for additional information on this issue).
4. In June 2007, NIOSH/DART found that lead surface contamination was significantly higher than levels found by a UNICOR consultant in June 2006. Similar surface contamination differences were found for cadmium. UNICOR should conduct further sampling and analysis to determine if surface levels are significantly increasing over time and should take any necessary preventive or

corrective action based on the results (see Recommendations, Section 6.0 for more detailed information on further analyses recommended).

5. Given that glass breaking has never been performed at FCI Tucson, the source of surface dust contamination is not from glass breaking, but is from contamination which has been released to the air and re-deposited on surfaces during routine e-waste disassembly and handling. Effective cleaning and housekeeping practices, proper handling of dusts and debris resulting from cleaning and housekeeping, and possibly ongoing cleaning during disassembly are important to keep surface contamination in check and limit potential worker exposure during recycling operations.
6. NIOSH/DART observed that cleaning was primarily performed using brooms and brushes which can generate airborne dusts that contribute to inhalation exposures to toxic dust. Also, dry sweeping can cause dusts to become re-deposited on building surfaces, including elevated surfaces (see Attachment 1).

5.2 Noise, Heat, and Repetitive Stress Exposure

7. Spot noise measurements conducted by NIOSH/DART found noise exposure at levels that suggest the need for a more comprehensive noise study (see Attachment 1), beyond the limited monitoring conducted by NIOSH/DART. A previous noise evaluation conducted by OSHA did not reveal exposures above the level that requires implementation of a hearing conservation program, but the OSHA study was also of limited scope. UNICOR has not conducted a noise evaluation at FCI Tucson.
8. NIOSH/DART found that ambient outside temperature measurements and camp warehouse temperature measurements indicated the need to periodically evaluate heat stress potential in these areas and ensure implementation of proper precautions, as indicated from the evaluation (see Attachment 1). Heat exposure was not a factor in the general recycling factory and associated FCI warehouse on the days of the FOH and NIOSH/DART study.
9. NIOSH/DART observed tasks (such as lifting and using screwdrivers) being conducted in an awkward manner which could produce repetitive stress injuries (see Attachment 1).

5.3 Safety and Health Programs, Plans, and Practices

10. UNICOR's Quality Management System, "6.2.2 Competence, Awareness, and Training (Procedure)" calls for a basic 32-hour core curriculum course for staff. The same document outlines a basic job orientation for inmate workers. It includes safety instructions, hazard communications training, and instruction for the work assignment. Toxic metals hazards and controls are addressed in the course outline, including a concise procedure for handling of accidental breaking

of CRT glass. The document contains safety rules that include mandatory safety shoes and safety glasses, restrictions on eating, drinking, chewing, and smoking in the demanufacturing area, brief hand washing requirements, brief lifting precautions, glove requirements, and other non-specific PPE instructions.

11. UNICOR is in the process of providing a different disposable respirator for voluntary use to replace the existing single strap unit which is not tight fitting to the face. UNICOR and FCI Tucson personnel expressed some concern and/or uncertainty regarding requirements for its implementation, such as any requirement for fit testing. OSHA's position is that fit testing is not required for voluntary use, but information from Appendix D of 29 CFR 1910.134 must be provided to workers. See Section 3.1 of this report for information on this topic that will serve to assist UNICOR in implementation of this disposable respirator.
12. UNICOR does not have a site-specific safety and health program for FCI Tucson recycling operations. Such a program that addresses both routine and non-routine activities would be a good practice for all UNICOR recycling facilities that do not have this type of program.

5.4 Health and Safety Regulatory Compliance

13. Based on OSHA's and UNICOR's consultant monitoring performed in 2006, current routine FCI Tucson operations conducted in the factory and other associated areas (e.g., disassembly) are in compliance with the OSHA lead and cadmium standards regarding control of employee exposure at levels below the OSHA PEL. However, the one cadmium area sample that was above the action level raises concerns over compliance with the OSHA monitoring requirements for cadmium and possibly medical surveillance requirements if exposures above the action level occur for 30 days or more per year.
14. The OSHA cadmium standard states that surfaces contaminated with cadmium shall be cleaned by vacuuming or other methods that minimize the likelihood of cadmium becoming airborne. NIOSH/DART observed that cleaning is primarily performed using brooms and brushes which can increase airborne exposures. OSHA explicitly restricts use of brushing as employed by UNICOR at FCI Tucson (see Attachment 1).
15. At the time of the June 2007 NIOSH/DART and FOH investigation, UNICOR did not provide for heat exposure controls at FCI Tucson. Although OSHA does not have a heat exposure standard, it can enforce heat exposure controls under the General Duty Clause.
16. UNICOR has not conducted a complete noise monitoring survey to ensure compliance with 29 CFR 1910.95, Noise.

5.5 Environmental Compliance

17. No information was obtained that indicated that e-waste activities at FCI Tucson are currently subject to any environmental permits dealing with hazardous waste, air, or water/wastewater. Based on recent discussions with UNICOR representatives at FCI Tucson no such permits are currently in place.

6.0 RECOMMENDATIONS

Recommendations concerning safety, health, and environmental aspects of UNICOR's e-waste recycling operations at FCI Tucson are provided below under the following subdivisions:

- Heavy Metals Exposures;
- Noise, Heat, and Repetitive Stress Exposure;
- Safety and Health Programs, Practices, and Plans;
- Health and Safety Regulatory Compliance; and
- Environmental Compliance.

These recommendations relate to the conclusions presented in Section 5.0, above. Some recommendations are taken from supporting documents such as the NIOSH/DART report (Attachment 1) and OSHA inspection report (Attachment 2). See these reports for additional recommendations, as well. Other recommendations are developed by FOH from the body of data and documents reviewed to prepare this report. Recommendations are provided for current factory operations (e.g., disassembly and associated activities).

6.1 Heavy Metals Exposures

1. UNICOR should conduct follow-up evaluation of lead and cadmium exposures including additional personal exposure (breathing zone) monitoring during disassembly and associated activities to determine the significance of the one cadmium area exposure result that was above the action level, but below the PEL. Guidance for further analysis and monitoring is recommended below
 - The minimum requirement specified in the OSHA cadmium standard is that breathing zone samples be taken at least every six months (and possibly more often) when any initial or periodic monitoring sample exceeds the action level. To justify discontinuation of monitoring for the personnel represented, two additional monitoring episodes at least seven days apart must indicate exposures to be below the action level. It is recommended that UNICOR conduct monitoring beyond the minimum requirement to ensure that variability in exposures be evaluated and to ensure that all activities that could result in exposure be captured.

- Additional monitoring should concentrate on the use of breathing zone samples, and represent the breadth of activities related to disassembly, including both routine and non-routine activities. UNICOR should ensure that additional exposure monitoring characterizes the activities and location represented by the area sample collected by its consultant in 2006 that exceeded the action level. Cleaning and any other activities that could disturb existing dust should also be monitored.
 - The follow-up monitoring and analysis should involve more than just collecting samples. It should involve an analysis and documentation of the operations and activities conducted, their duration, pertinent observations, locations, types and quantities of materials processed, and any other information that is important to evaluate exposure levels and take preventive or corrective action in the future should exposures be elevated.
2. Even if additional monitoring as recommended above shows that monitoring can be discontinued, it is recommended that UNICOR periodically conduct at least a limited amount of personal exposure monitoring that characterizes exposures resulting from current recycling and associated activities. This monitoring will serve to document continued control of the lead and cadmium hazards. An annual monitoring program would be appropriate. This recommendation goes beyond the requirements of the OSHA lead and cadmium standards, but would provide important documentation of consistently low exposures.
 3. If consistently low exposures are found over time, then monitoring could be limited to any new activities (e.g., non-routine or certain O&M activities) and future changes in work operations, work processes/practices, personal protection, and other practices. Exposure monitoring is an OSHA requirement when any change is made that could result in a new or additional lead or cadmium exposure.
 4. Given the increase in surface sampling results in 2007 over 2006, UNICOR should implement an annual surface monitoring program to ensure that surface concentrations of lead and cadmium are not building up over time. As NIOSH/DART did, UNICOR should conduct sampling for both work surfaces and elevated surfaces in the factory and associated areas. The method of monitoring should be identical to the NIOSH/DART method to allow proper comparisons of data. UNICOR should implement this annual surface monitoring program for all recycling facilities to ensure that contamination levels are kept in check. This monitoring in combination with an effective O&M plan could avoid future costly remediation requirements (also see the O&M recommendation below).
 5. In conducting hazard evaluations that include exposure monitoring and surface sampling, UNICOR should select well qualified contractors, consultants, or internal industrial hygiene personnel with appropriate background, training, education, and experience for the assigned tasks. Industrial hygienist(s) certified

by the American Board of Industrial Hygiene (ABIH) should provide leadership in hazard identification, evaluation, and control. Approved, standardized, and consistent methods should be applied. The industrial hygienists should provide a thorough evaluation of workplace conditions during monitoring episodes and provide a complete narrative discussion of the findings, along with conclusions and recommendations.

6. UNICOR should develop and implement an operations and maintenance (O&M) plan at FCI Tucson to ensure that surface contamination is minimized and that existing contamination is not released that could result in inhalation or ingestion exposures. Elements of this plan could include:
 - Identification of activities that could disturb contamination (e.g., HVAC maintenance, periodic or non-routine cleaning of elevated surfaces, and various building maintenance functions);
 - Processes to identify and control hazards for routine and non-routine activities (e.g., job hazard analysis process prior to conducting certain work with identification of mitigating actions);
 - Mitigating techniques and procedures during activities of concern (e.g., dust suppression and/or clean-up and capture, filter removal and bagging processes, hygiene and housekeeping practices, and use of PPE and respiratory protection);
 - Training and hazard communication;
 - Disposal of contaminated materials; and
 - Periodic inspection, monitoring and evaluation of existing conditions, as appropriate.

At UNICOR's discretion, the O&M plan could also include periodic clean-up of surfaces by inmate or other workers, such as the elevated surfaces that NIOSH/DART found to contain the higher contamination levels. If this element were adopted, however, UNICOR should ensure that practices to control exposures are included in the plan and implemented, such as appropriate PPE, respiratory protection, exposure monitoring, clean-up methods (e.g., HEPA vacuuming and wet methods), waste disposal, hygiene and housekeeping practices, and others deemed appropriate by UNICOR. Initial exposure and/or additional monitoring for clean-up under the O&M plan should be conducted to determine whether exposure during clean-up is above the action levels and PELs for lead and cadmium. Controls for future clean-up activities should then be based on exposure results.

6.2 Noise, Heat, and Repetitive Stress Exposure

7. NIOSH/DART recommends that UNICOR evaluate FCI Tucson work activities for hazards related to lifting and other repetitive stress, and implement any appropriate procedures, training, or equipment to address the hazards (see Attachment 1, Recommendation 2). UNICOR should conduct a noise survey as recommended by NIOSH/DART (see Attachment 1, Measurements and Observations section) to ensure compliance with 29 CFR 1910.95, Noise.
8. NIOSH/DART recommends that UNICOR evaluate the heat exposure hazard to determine any precautions necessary to prevent heat strain and heat stress (see Attachment 1, Recommendation 3.)

6.3 Safety and Health Programs, Practices, and Plans

9. As a “good practice” approach, UNICOR should prepare a concise written safety and health document specifically for its recycling operations at FCI Tucson, as well as for each of its other recycling factories that lack such a document. Such a document should be developed and implemented and would serve to concisely define the safety and health practices and requirements specific to FCI Tucson recycling, such as PPE requirements or voluntary use, hygiene (e.g., hand washing) practices, daily and periodic housekeeping practices, special training requirements for any hazardous equipment use or other hazard controls, and other practices essential to conduct work safely. Elements of the inmate worker job orientation content that addresses safe work rules should be part of this document.
10. Per OSHA requirements regarding voluntary respirator use, UNICOR should provide Appendix D of 29 CFR 1910.134 to workers and ensure that the workers read and understand the information. In addition, UNICOR should ensure that workers understand the proper use and limitations of the respirators that UNICOR provides. For good practice documentation purposes, UNICOR should have inmate workers read and sign Appendix D of 29 CFR 1910.134, and UNICOR and FCI Tucson should maintain the Appendix D signed records.
11. BOP and UNICOR should implement a system to list, track, address, accept or not accept, and close out recommendations or deficiencies identified by its health and safety staff, consultants, and others, including from the OIG investigation. This system will also assist in clearly defining responsibility for actions between UNICOR and BOP. This recommendation applies to all UNICOR recycling factories and will be further discussed in the OIG final report.

6.4 Health and Safety Regulatory Compliance

12. FCI Tucson should conduct an activity-based job hazard analysis (JHA) for any new, modified, or non-routine work activity prior to the work being conducted. The JHA process is intended to identify potential hazards and implement controls for the specific work activity prior to starting the work. For instance, the JHA process should be integral to an effective O&M plan, as described in Section 6.1.
13. Per OSHA's 2006 recommendation and FCI Tucson's statement that one is to be scheduled, UNICOR and FCI Tucson should conduct a baseline industrial hygiene survey (see Attachment 2).
14. As recommended by NIOSH/DART (see Attachment 1, Recommendations 5 and 6), UNICOR should discontinue broom and brush cleaning of dusts containing lead, cadmium, and other toxic metals. Instead, HEPA vacuuming and wet methods should be used. Hand washing should be strictly enforced before eating, drinking, smoking, and after work shifts are completed. OSHA also recommended vigilance in keeping hands clean to avoid transmission of contaminants (see Attachment 2).
15. Based on additional monitoring results recommended in Section 6.1, UNICOR should implement any actions that are required under the OSHA lead and cadmium standards or that are appropriate to reduce employee exposures, such as equipment cleaning prior to or during disassembly, PPE modifications, housekeeping practices, and others.

6.5 Environmental Compliance

16. In implementing clean-up methods, UNICOR should evaluate the wastes from HEPA vacuums, mop rinse water, and other potentially contaminated debris to determine acceptable disposal methods per U.S. EPA regulations. The FCI Tucson Lead Safety Specialist identified this need and indicated that these evaluations are planned or currently underway.

7.0 REFERENCES

CFR. [29 CFR 1910.1027]. Occupational Safety and Health Standards. Cadmium. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

CFR. [29 CFR, Part 1910.1025]. Occupational Safety and Health Standards. Lead. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

CFR. [29 CFR, Part 1926.62]. Safety and Health Regulations for Construction. Lead. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

CFR. [29 CFR 1910.134]. Occupational Safety and Health Standards. Respiratory Protection. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

CFR. [29 CFR 1910.95]. Occupational Safety and Health Standards. Occupational Noise Exposure. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

CFR. [29 CFR, Part 1960]. Basic Program Elements for Federal Employees. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

CFR [40 CFR, Part 745]. Lead-based Paint Poisoning Prevention in Certain Residential Structures. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

CFR [24 CFR 35, subparts B-R]. Lead Safe Housing Rule. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

EPA [2002, June 12]. Proposed Rule on Discarded Cathode Ray Tubes and Mercury-Containing Equipment. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

Lange JH [2001]. A suggested lead surface concentration standard for final clearance of floors in commercial and industrial buildings. *Indoor and Built Environment* 10:48-51.

NIOSH [2005]. NIOSH Pocket Guide to Chemical Hazards (Appendix A), Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2005-149.

NIOSH [2008]. Control technology and exposure assessment for electronic recycling operations, UNICOR, Elkton Federal Correctional Institution, Elkton, Ohio. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health DHHS (NIOSH) Publication No. EPHB 326-12a. *(Please refer to this document for additional citations to relevant reference documents.)*

NIOSH [2008]. Control technology and exposure assessment for electronic recycling operations, UNICOR, Tucson Federal Correctional Institution EPHB 326-18a.

OSHA [CPL 02-02-058]. OSHA Directive. Lead Exposure in Construction. 29 CFR 1926.62.

OSHA [2006]. Department of Labor OSHA Inspection Number 309845071 -- Federal Correction Institution Tucson (FCI Tucson) -- 04/27/06

Attachment 1

**WALK-THROUGH SURVEY REPORT:
ELECTRONIC RECYCLING OPERATION**

At

**FEDERAL CORRECTIONAL INSTITUTION
TUCSON, ARIZONA**

**PRINCIPAL AUTHOR:
G. Edward Burroughs, Ph.D., CIH, CSP**

**REPORT DATE:
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**FILE NO.:
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**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Division of Applied Research and Technology
4676 Columbia Parkway
Cincinnati, Ohio 45226**

SITES SURVEYED: UNICOR Recycling Operations
Federal Correctional Institution
Tucson, AZ

NAICS: 562920

SURVEY DATE: June 27 - 28, 2007

SURVEY CONDUCTED BY: Edward Burroughs, PhD, CIH, CSP (NIOSH)
Paul Pryor, MS, CIH (FOH)

"The findings and conclusions in this report have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy."

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Mention of company names or products does not constitute endorsement by the Centers for Disease Control and Prevention.

The findings and conclusions in this report do not necessarily reflect the views of the National Institute for Occupational Safety and Health.

INTRODUCTION

On June 27 - 28, 2007 a researcher from the National Institute for Occupational Safety and Health (NIOSH), accompanied by a representative from Federal Occupational Health (FOH), conducted a walk-through evaluation of exposures to metals and other occupational hazards associated with the recycling of electronic components at the Federal Prison Industries (aka, UNICOR) facility in the Federal Correctional Institution (FCI), Tucson, AZ. The principal objectives of this visit were:

- a. To observe potential exposures to metals including barium (Ba), beryllium (Be), cadmium (Cd), lead (Pb) and nickel (Ni).
- b. To evaluate contamination of surfaces in the work areas that could create dermal exposures or allow re-entrainment of metals into the air.
- c. To identify and describe the control technology and work practices used in operations associated with occupational exposures to toxic substances, and to determine additional controls, work practices, substitute materials, or technology that can further reduce these exposures.
- d. To evaluate the use of personal protective equipment in operations involved in the recycling of electronic components.

PROCESS DESCRIPTION

The recycling of electronic components at this prison is done in a facility located within the Federal Correctional Institution (FCI). A diagram of that facility is shown in Figure I. This figure provides a general layout of the work process, although workers often moved throughout their respective areas in the performance of their tasks. The population of the UNICOR facility was approximately 86 in the FCI factory with an additional 25 in the camp warehouse.

The recycling of electronic components at this facility can be organized into three production processes: a) receiving and sorting, b) disassembly, and c) packaging and shipping. Incoming materials to be recycled are received at a warehouse where they are examined and sorted. During this evaluation it appeared that the bulk of the materials received were computers, either desktop or notebooks, or related devices such as printers. Some items, notably notebook computers, could be upgraded and resold, and these items were sorted out for that task.

After electronic memory devices (e.g., hard drives, discs, etc.) were removed and degaussed or destroyed, computers' central processing units (CPUs), servers and similar devices were sent for disassembly; monitors and other devices (e.g., televisions) that contain cathode ray tubes (CRTs) were separated and sent for disassembly and removal of the CRT. Printers, copy machines and any device that could potentially contain toner, ink, or other expendables were segregated and those expendables were removed prior to the device being sent to the disassembly area.

In the disassembly process external cabinets, usually plastic, were removed from all devices and segregated. Valuable materials such as copper wiring and aluminum framing were

removed and sorted by grade for further treatment if necessary. Components such as circuit boards or chips that may have value or may contain precious metals such as gold or silver were removed and sorted. With few exceptions each of the workers in the main factory will perform all tasks associated with the disassembly of a piece of equipment into the mentioned components with the use of powered and un-powered hand tools (primarily screwdrivers and wrenches), with a few workers collecting the various parts and placing them into the proper collection bin. Work tasks included removing screws and other fasteners from cabinets, unplugging or clipping electrical cables, removing circuit boards, and using whatever other methods necessary to break these devices into their component parts. Essentially all components currently are sold for some type of recycling.

The final process, packing and shipping, returned the various materials segregated during the disassembly steps to the warehouse to be sent to contracted purchasers of those individual materials. To facilitate shipment some bulky components such as plastic cabinets or metal frames were placed in a hydraulic bailer to be compacted for easier shipping. Other materials were boxed or containerized and removed for subsequent sale.

A fourth production process, the glass breaking operation where CRTs from computer monitors and TVs were sent for processing, was not currently being done at Tucson. CRTs are shipped, unbroken, from Tucson to other locations for breaking and recycling. This process was observed and evaluated at other UNICOR facilities as part of this research and those reports are available.

POTENTIAL HAZARDS

Computers and their components contain a number of hazardous substances. Among these are “platinum in circuit boards, copper in transformers, nickel and cobalt in disk drives, Ba and Cd coatings on computer glass, and Pb solder on circuit boards and video screens” [Chepesiuk 1999]. The Environmental Protection Agency (EPA) notes that “In addition to lead, electronics can contain chromium, cadmium, mercury, beryllium, nickel, zinc, and brominated flame retardants” [EPA 2008]. Schmidt [2002] linked these and other substances to their use and location in the “typical” computer: Pb used to join metals (solder) and for radiation protection, is present in the CRT and printed wiring board (PWB). Aluminum, used in structural components and for its conductivity, is present in the housing, CRT, PWB, and connectors. Gallium is used in semiconductors; it is present in the PWB. Ni is used in structural components and for its magnetivity; it is found in steel housing, CRT and PWB. Vanadium functions as a red-phosphor emitter; it is used in the CRT. Beryllium, used for its thermal conductivity, is found in the PWB and in connectors. Chromium, which has decorative and hardening properties, may be a component of steel used in the housing. Cadmium, used in Ni-Cad batteries and as a blue-green phosphor emitter, may be found in the housing, PWB and CRT. Cui and Forssberg [2003] note that Cd is present in components like SMD chip resistors, semiconductors, and infrared detectors. Mercury may be present in batteries and switches, thermostats, sensors and relays [Schmidt 2002, Cui and Forssberg 2003], found in the housing and PWB. Arsenic, which is used in doping agents in transistors, may be found in the PWB [Schmidt 2002].

EVALUATION TECHNIQUES

Observations regarding work practices and use of personal protective equipment were recorded. Information was obtained from conversations with the workers and management to confirm this was a typical workday to help place conclusions in proper perspective.

Bulk material samples were collected by gathering a few grams of settled dust or material of interest and transferring this to a glass bottle for storage and shipment. These samples were analyzed for metals using NIOSH Method 7300 [NIOSH 1994] modified for bulk digestion.

Surface wipe samples were collected using Ghost™ Wipes for metals (Environmental Express, Mt. Pleasant, SC) to evaluate surface contamination. These wipe samples were collected in accordance with ASTM Method D 6966-03 [ASTM 2002], using a disposable paper template with a 12 inch by 12 inch square opening. The templates were held in place by hand or taped in place to prevent movement during sampling. Wipes were placed in sealable test tube containers for storage and then sent to the laboratory to be analyzed for metals according to NIOSH Method 7303 [NIOSH 1994].

An assessment of noise levels in various locations was made using a hand held sound level meter (Model 2400, Quest Technologies, Oconomowoc, WI) calibrated on-site prior to use with a 110 dB source. All noise measurements were weighted on an “A” scale, slow response.

Ambient dry bulb temperature and humidity measurements were made periodically with a Velocicalc Plus (TSI Inc., Shoreview, MN) air meter.

MEASUREMENTS AND OBSERVATIONS

The measurements and observations described here were made in June, 2007 at the UNICOR recycling operation at FCI Tucson. During this visit, surface wipe and bulk dust samples were collected in locations where the electronics recycling operations were taking place or had taken place in the past. Results of surface wipe samples are presented in Table 1 and bulk material sample results are presented in Table 2 for the metals of primary interest. Observations are presented below.

The highest measurements for lead by wipe samples were those taken from the top of light fixtures in locations accessible only from a ladder. Six of the 17 wipe samples were taken from these locations, and 5 of these 6 samples were >300 µg Pb/sq ft. One of these samples (TFMWW-1) was in excess of the 1,000 µg Pb/sq ft concentration recommended by Lange for final clearance of floors in commercial and industrial buildings (the most applicable recommendation found). Of the 11 other surfaces tested, all but one were below 200 µg Pb/sq ft, the most stringent recommendation found and a level which OSHA “would not expect surfaces to be any cleaner than.” [Fairfax 2003]. Additionally, the 200 µg/sq ft recommendation applies to clean areas such as lunch areas, change areas, and storage areas, rather than work areas where lead containing materials are actively processed.

The highest Cd surface measurement (TFMWW-4) was 100 $\mu\text{g}/\text{sq ft.}$, with all others below 80 $\mu\text{g}/\text{sq ft.}$ Although there are no published criteria for use in evaluating wipe samples, the OSHA Cadmium standard [29 CFR 1910.1027] mandates that "All surfaces shall be maintained as free as practicable of accumulations of cadmium," that, "all spills and sudden releases of material containing cadmium shall be cleaned up as soon as possible," and that, "surfaces contaminated with cadmium shall, wherever possible, be cleaned by vacuuming or other methods that minimize the likelihood of cadmium becoming airborne."

Ni surface contamination was highest in samples TFMWW-1 and TFMWW-4 at 780 and 670 $\mu\text{g}/\text{sq ft.}$, respectively. All other measurements were at or below 460 $\mu\text{g}/\text{sq ft.}$, and the maximum work surface measurement was 210 $\mu\text{g}/\text{sq ft.}$ Like Cd, there are no published criteria for use in evaluating wipe samples for Ni and while the toxicity of this metal is somewhat dependent on species no compound identification was conducted.

Wipe samples did not indicate levels of Ba in any wipe samples at levels of concern, with the highest Ba concentrations (TFMWW-1 & 4) at 410 and 460 $\mu\text{g}/\text{sq ft.}$ All other Ba measurements were 200 $\mu\text{g}/\text{sq ft.}$ or below. There are no published criteria for use in evaluating wipe samples.

No Be was detected in any sample from the Tucson FCI above the limit of detection of 0.06 $\mu\text{g}/\text{sq ft.}$

The five bulk samples showed no discernable pattern of contamination in this facility. No Be was detected in any bulk sample above the limit of detection of 0.3 mg/kg. The highest metal concentrations were Pb at 1,000 mg/kg and Ni at 880 mg/kg in samples TFMWB-1 and 4, respectively. These two samples were collected from opposite corners of the factory area, as shown on Figure 1.

Operations at the Tucson FCI were similar to procedures observed at other UNICOR recycling facilities where personal exposures have been evaluated and at which there were few significant exposures in the receiving and sorting, disassembly, and packaging and shipping processes.

No local exhaust ventilation systems were in use at the time of this visit nor were any needed. Work areas were kept reasonably clean, primarily by the use of brooms and brushes which can be a source of airborne dust, so the use of HEPA vacuums and wet mopping is recommended in the next section. Care must be taken when using wet methods to assure no electrical or other safety hazard is introduced.

Safety glasses were used in most operations. Hearing protection was available where needed (primarily near the bailer) and disposable respirators were available to workers who chose to use them although respirators were not required at this facility.

Spot measurements of noise made with a hand-held sound pressure meter suggested the need for a more comprehensive noise study. Peak levels up to 103 dBA near the plastic bailer and 86 dBA near the metal bailer were measured with durations of 20 to 40 seconds. In the area

where hard discs were being destroyed by puncturing, shorter duration (<2 seconds) peaks over 100 dBA (up to 112) were common and the background noise level was in the range of 80 to 85 dBA.

Ambient indoor temperatures ranged from 71 to 81°F in the factory and to 91°F in the warehouse, with relative humidity's from 30 to 60%. Outdoor temperatures in excess of 100°F were measured.

CONCLUSIONS AND RECOMMENDATIONS

Based on measurements and observations presented, the following recommendations are made.

1. Training of workers should be scheduled and documented in the use of techniques for dust suppression, personal protection equipment (e.g., respirators, gloves, etc.) and hazard communication. Additional training, recordkeeping and other restrictions apply if a formal respiratory protection program is implemented.
2. Frequently while conducting the on-site work, NIOSH researchers observed tasks (such as lifting and using screwdrivers) being conducted in an awkward manner which could produce repetitive stress injuries. Tasks should be evaluated to determine if they are biomechanically taxing and if modifications in procedures or equipment would provide benefit to this workplace.
3. Ambient temperature measurements indicate that heat stress should be periodically evaluated to ensure proper precautions are in place to prevent problems associated with a hot environment.
4. A program should be established within the Bureau of Prisons to assure that all UNICOR operations, including but not limited to recycling, should be evaluated from the perspective of health, safety and the environment in the near future. This program should be overseen by competent, trained and certified individuals.
5. Due to the levels of surface contamination of Pb measured in the recycling facility, workers should wash their hands before eating, drinking, or smoking.
6. Daily and weekly cleaning of work areas by HEPA-vacuuuming and wet mopping should be conducted, taking care to assure no electrical or other safety hazard is introduced.
7. A comprehensive noise survey should be conducted focusing on the bailing and disk-destroying areas since spot measurements showed these are the most likely areas for potential noise problems.

REFERENCES

ASTM [2002]. Standard practice for collection of settled dust samples using wipe sampling methods for subsequent determination of metals. West Conshohocken, PA: ASTM International.

CFR. Code of Federal regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

Chepesiuk R [1999]. Where the chips fall: environmental health in the semiconductor industry. *Environ Health Perspect.* 107:A452–A457.

Cui J, Forssberg E [2003]. Mechanical recycling of waste electric and electronic equipment: a review. *J Hazard Mater.* 99:243–263.

EPA [2008]. eCycling. Available on-line at <http://www.epa.gov/ecycling/>. Accessed June 3, 2008.

Fairfax RE [2003]. Letter of January 13, 2003 from RE Fairfax, Director, Directorate of Compliance Programs, OSHA, to Frank White, Vice President, Organization Resource Counselors, Inc. Available at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=25617. Accessed May 12, 2008

Lange JH [2001]. A suggested lead surface concentration standard for final clearance of floors in commercial and industrial buildings. *Indoor and Built Environment* 10:48–51.

Schmidt CW [2002]. e-Junk explosion. *Environ Health Perspect.* 110:A188–A194.

NIOSH [1994]. NIOSH Manual of Analytical Methods (NMAM®), 4th ed. Schlecht, P.C. & O'Connor, P.F. eds. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 94-113 (August, 1994), 1st Supplement Publication 96-135, 2nd Supplement Publication 98-119, 3rd Supplement 2003-154.

Table 1.
TUCSON WIPE SAMPLES

Sample Location*	Sample I D	Sample Description**	Ba ug/sq ft	Be ug/sq ft	Cd ug/sq ft	Pb ug/sq ft	Ni ug/sq ft
1	TFMWW-1	Top of Light Fixture Near Work Stations 16 & 18	410	<0.06	76	1,300	780
2	TFMWW-2	Top of Light Fixture Center of Shop near WS 8 + 25	69	<0.06	20	83	53
3	TFMWW-3	Top of Light Fixture Behind W S 7	290	<0.06	74	290	300
4	TFMWW-4	Top of Light Fixture Beside W S 19	460	<0.06	100	900	670
5	TFMWW-5	Top of Light Fixture Behind W S 28	190	<0.06	47	460	170
6	TFMWW-6	Top of Light Fixture in Bailing Room Between Bailers	100	<0.06	74	310	460
7	TFMWW-7	Work Surface W S 4	48	<0.06	8	73	170
8	TFMWW-8	Work Surface W S 10	37	<0.06	14	58	91
9	TFMWW-9	Inside trough in front of W S 10	75	<0.06	37	99	210
10	TFMWW-10	Work Surface W S 15	49	<0.06	13	210	100
11	TFMWW-11	Work Surface W S 20	40	<0.06	6	51	120
12	TFMWW-12	Trough in Front of W S 20	15	<0.06	4	23	43
13	TFMWW-13	Top of Work Surface W S 26	10	<0.06	3	150	42
14	TFMWW-14	Work Surface W S 30	12	<0.06	4	24	32
15	TFMWW-15	Work Surface W S 33	29	<0.06	3	32	43
16	TFMWW-16	Trough in Front of W S 33	54	<0.06	6	110	110
17	TFMWW-17	Inside Metal (Blue) Bailer	81	<0.06	14	32	130

* Location identifiers correspond with Figure I

** "W S" indicates work station

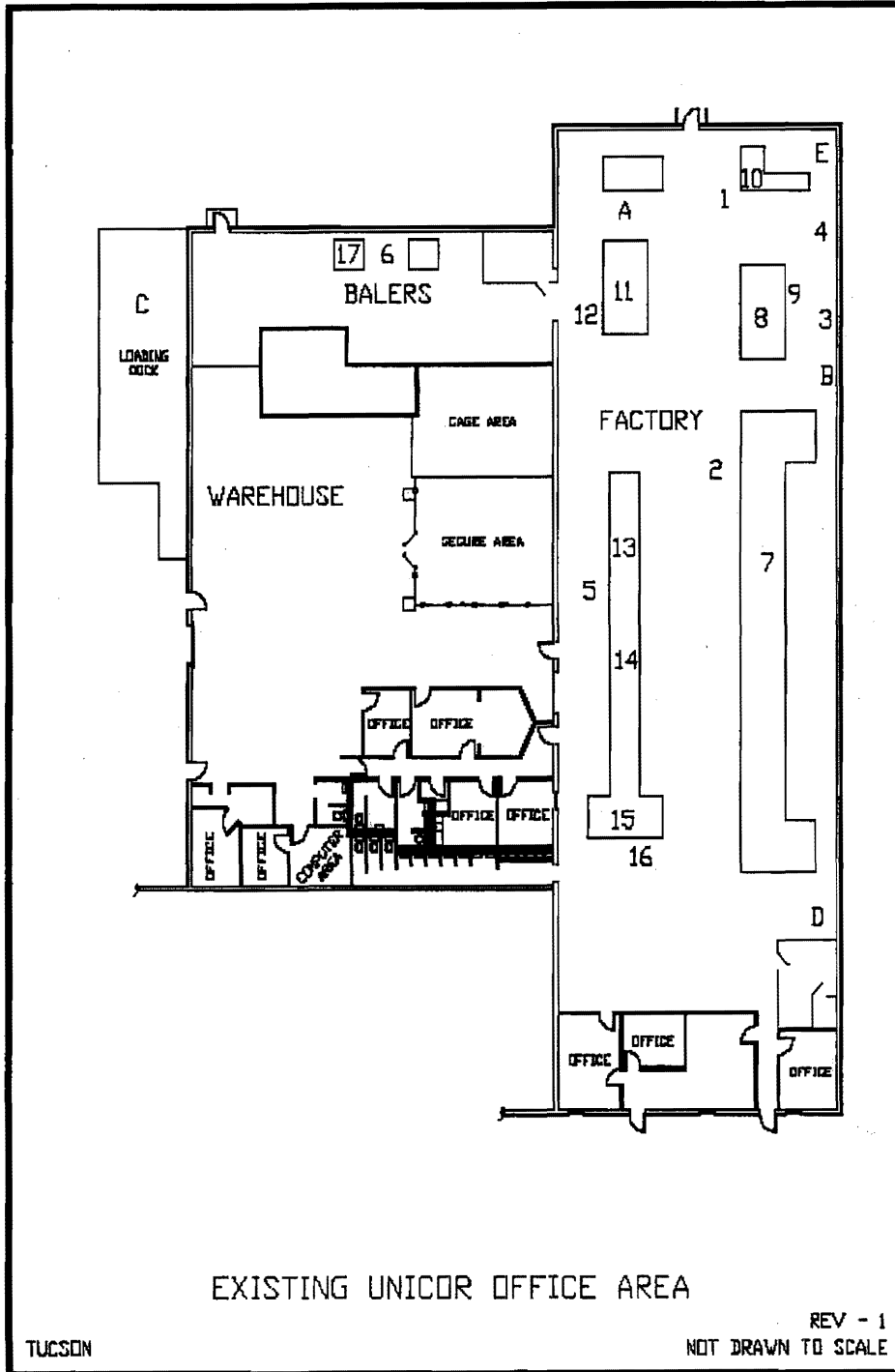
Table 2.
TUCSON BULK SAMPLES

Diagram location*	Sample I D	Description**	Ba mg/kg	Be mg/kg	Cd mg/kg	Pb mg/kg	Ni mg/kg
A	TFMWB-1	Bottom of Trash Can at W S 20	290	<0.3	52	1000	140
B	TFMWB-2	Top of Conduit Along Wall, near W S 14	440	<0.3	130	590	310
C	TFMWB-3	Dirt from Floor of Semi-Trailer used to haul product between warehouse & shop	240	<0.3	5	110	31
D	TFMWB-4	Dust from HEPA Vac Near W S 1	380	<0.3	42	790	880
E	TFMWB-5	Dust from HEPA Vac Near W S 14	20	<0.3	14	34	60

* Location identifiers correspond with Figure I

** "W S" indicates work station

Figure I Tucson UNICOR Floor Plan



Attachment 2

U.S. Department of Labor

Occupational Safety and Health Administration
 1851 Executive Center Drive, Suite 227
 Jacksonville, Florida 32207-2350
 Telephone: 904-232-2895
 Facsimile: 904-232-1294

Reply to the Attention of the Area Director

March 8, 2007

Bureau of Prisons
 Federal Correctional Institute Marianna, Florida
 Attn: Scott A. Middlebrooks - Warden
 625 FCI Road
 Marianna, FL 32446

RE: OSHA Inspection No. 310028832

Dear Mr. Middlebrooks:

The results of OSHA's personal air monitoring, area monitoring, and wipe sampling that was performed at your facility on November 8, 2006 for the Cathode Ray Tube glass breaking operation were as follows:

November 8, 2006 - Air Monitoring Results

INMATE	CONTAMINANT PHYSICAL AGENT	RESULTS	OSHA EXPOSURE LIMITS
	Lead	Non Detectable	50.0 µg/m ³
	Cadmium	Non Detectable	5.0 µg/m ³
	Beryllium	Non Detectable	2.0 µg/m ³
	Barium	Non Detectable	0.5 mg/m ³
	Lead	Non Detectable	50.0 µg/m ³
	Cadmium	Non Detectable	5.0 µg/m ³
	Beryllium	Non Detectable	2.0 µg/m ³
	Barium	Non Detectable	0.5 mg/m ³
	Lead	Non Detectable	50.0 µg/m ³
	Cadmium	Non Detectable	5.0 µg/m ³
	Beryllium	Non Detectable	2.0 µg/m ³
	Barium	Non Detectable	0.5 mg/m ³

INMATE	CONTAMINANT PHYSICAL AGENT	RESULTS	OSHA EXPOSURE LIMITS
	Lead	Non Detectable	50.0 µg/m ³
	Cadmium	0.000637 µg/m ³	5.0 µg/m ³
	Beryllium	Non Detectable	2.0 µg/m ³
	Barium	Non Detectable	0.5 mg/m ³
	Lead	Non Detectable	50.0 µg/m ³
	Cadmium	Non Detectable	5.0 µg/m ³
	Beryllium	Non Detectable	2.0 µg/m ³
	Barium	Non Detectable	0.5 mg/m ³

November 8, 2006 - Wipe Samples

INMATE & LOCATION	CONTAMINANT PHYSICAL AGENT	RESULTS	OSHA EXPOSURE LIMITS
	Lead	193.85 µg	Not Established
Inside workstation #1	Cadmium	49.46 µg	Not Established
	Beryllium	Non Detectable	Not Established
	Barium	Non Detectable	Not Established
	Copper	3.33 µg	Not Established
	Iron Oxide	540.8648 µg	Not Established
	Manganese	3.455 µg	Not Established
	Zinc Oxide	789.015 µg	Not Established
Wrist area underside of Coverall Sleeve	Cadmium	0.5150 µg	Not Established
inside outer glove, outside cotton inner glove	Zinc Oxide	37.5899 µg	Not Established
	Cadmium	1.5 µg	Not Established
Shipping Area Weigh scale	Iron Oxide	119.4598 µg	Not Established

INMATE & LOCATION	CONTAMINANT PHYSICAL AGENT	RESULTS	OSHA EXPOSURE LIMITS
Stair platform at glass breaking workstation	Iron Oxide	136.459 µg	Not Established
	Lead	29.20 µg	Not Established
	Zinc Oxide	86.5066 µg	Not Established
	Cadmium	2.39 µg	Not Established
inside respirator on face shield	Zinc Oxide	60.2435 µg	Not Established
	Cadmium	0.9650 µg	Not Established
Overhead bay door area floor	Iron Oxide	84.3582 µg	Not Established
	Lead	6.25 µg	Not Established

November 8, 2006 - Area air monitoring.

INMATE & LOCATION	CONTAMINANT PHYSICAL AGENT	RESULTS	OSHA EXPOSURE LIMITS
Glass breaking workstation #1	Zinc Oxide	0.0955 mg/m ³	5.0 mg/m ³

* mg/m³ is the abbreviation for milligrams per cubic meter of air.

* µg is the abbreviation for micrograms.

* µg /m³ is the abbreviation for micrograms per cubic meter of air.

Overall the facility had been reviewed thoroughly by FCI Marianna. All safety and health plans had been created and put into practice by the Bureau of Prisons generally, and locally, additions were made to the procedures to fit the facility. The air monitoring results were below OSHA's permissible exposure limits and action levels. Therefore, the use of the hooded respirators was not required; however, we STRONGLY ENCOURAGE their continued use.

When working with heavy metals, air concentrations are not the only hazard. Surface contamination and body contamination increases the chance for absorption and ingestion, and that was why wipe samples were collected. From review of the wipe samples the following recommendations were made in writing to the Warden when we shared the results of our sampling with him:

1. Open areas in the personal protective equipment (PPE), such as the wrist area where the coverall sleeve goes under the outer glove, and on top of the inner glove, should be closed by some means, such as with