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What Employees Need (and Want) to Hear When Justifying the Suspension of a Regulated Metals Plan for the Processing of Drums Containing Metal Turnings

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ABSTRACT

A Regulated Metals Plan (RMP) was implemented for outdoor work activities involving the removal and disposition of approximately 4,000 deteriorated waste drums containing 236 metric tonnes (260 tons) of lead turnings from various, unspecified machine shop facilities at the Paducah Gaseous Diffusion Plant. Until exposure monitoring could prove otherwise, the work area established for processing the drums was conservatively defined as a Lead Regulated Area (LRA) subject to the Occupational Safety and Health Administration's Lead Standard found in Title 29 of the Code of Federal Regulations, Part 1910.1025. The vast majority of the analytical results for the industrial hygiene breathing zone samples collected and tested for arsenic, beryllium, cadmium, chromium, lead, nickel, selenium, silver, and thallium using the National Institute for Occupational Safety and Health's analytical method 7300 were equivalent to the laboratory detection limits for each analyte. All results were less than 6% of their respective Permissible Exposure Limits (PEL), except for one nickel result that was approximately 17% of its PEL. The results provided justification to eventually downpost the LRA to existing employee protection requirements. In addition to removing the deteriorated drums and accompanying debris, the success of this project was quantified in terms of zero recordable injuries. The primary contributor in achieving this success was the sharing and communication of information between management, safety, and the field teams. Specifically, this was what the employees needed (and wanted) to hear when justifying the suspension of the RMP for the processing of drums containing metal turnings. Daily briefings on the status of the project and field monitoring results were just as important as maintaining budget and schedule milestones. Also, the Environmental, Safety & Health organization maintained its presence by continuing to monitor evolving field conditions to ensure the effectiveness of its plans and procedures.

INTRODUCTION

The Paducah Scrap Metal Removal Project (SMRP) was initiated as a Comprehensive Environmental Restoration, Compliance, and Liability Act (CERCLA) activity to remove existing contamination and, thus, eliminate the potential for release of hazardous substances to the environment. The objective of this project was to safely remove and disposition approximately 27,700 metric tonnes (30,500 tons) of contaminated scrap metal and miscellaneous materials contained in existing scrap yards (1). One specific segment of miscellaneous materials requiring removal and disposition contained approximately 4,000 deteriorated waste drums that had been sitting dormant and exposed to the weather for many years. The debris present in the drums was comprised of 236 metric tonnes (260 tons) of lead turnings that originated at various, unspecified machine shop facilities at the Paducah Gaseous Diffusion Plant (PGDP) (Figure 1).

Figure 1. Drums and metal turnings.

Analytical sampling results had previously suggested that the turnings could contain inorganic lead at concentrations that, if airborne, could exceed regulated limits for worker exposure. Because of lead's importance as a public health concern, a number of federal agencies had issued advisory standards or enforceable regulations that set regulatory action limits in different media. Therefore, a Regulated Metals Plan (RMP) was implemented specifically for outdoor work activities involving the removal and disposition of the drums and metal turnings.

This paper discusses the RMP and the Lead Regulated Area (LRA) that was initially developed for this segment of the SMRP cleanup activities. Existing employee communication mechanisms (e.g., prejob briefings, safety meetings) were used to publicize quantitative and qualitative sampling results between management, safety, and the field teams. The results provided justification to eventually downpost the LRA to existing Hazardous Waste Operations and Emergency Response (HAZWOPER) employee protection requirements, while eliminating any employee safety concerns associated with the downposting of the LRA.

LEAD TOXICITY AND ITS EFFECT ON ADULTS

Lead serves no useful purpose in the human body, but its presence in the body, through inhalation, ingestion, and dermal contact, can lead to toxic effects. The absorption and biologic fate of lead, once it enters the human body, depends on a variety of factors including nutritional status, health, and age. Adults typically absorb up to 20% of ingested lead. Most inhaled lead in the lower respiratory tract is absorbed, and most of the lead entering the body is excreted in urine or through biliary clearance.

Absorbed lead that is not excreted is exchanged primarily among three compartments:

- Blood
- Mineralizing tissues (bones and teeth), which typically contain the vast majority of the lead body burden
- Soft tissue (e.g., liver, kidneys, lungs, brain, spleen, muscles, and heart)

Although the blood generally carries only a small fraction of total lead body burden, it does serve as the initial receptacle of absorbed lead and distributes lead throughout the body, making it available either to other tissues or for excretion. Blood lead is also important because the blood lead level is the most widely used measure of lead exposure (2).

LEAD REGULATED AREA

Until exposure monitoring could prove otherwise, the work area established for processing the drums was conservatively defined as an LRA subject to the Occupational Safety and Health Administration's (OSHA's) Lead Standard found in 29 CFR 1910.1025 (3). The field teams assigned to the LRA consisted of employees from eight labor categories:

- Operator As
- Operator Bs
- Heavy Equipment Operators
- Field Coordinators
- Front Line Managers
- Security Liaisons
- Samplers
- Radiological Control Technicians

Since a significant number of drums were deteriorated, as well as stacked on top of each other, they were handled primarily by mechanical methods (e.g., using heavy equipment with a grappler attachment). This engineering control, used to initially handle and stage the drums for removal and disposition, reduced the potential of the lower-tiered drums from shifting or collapsing, thus preventing employee injuries. Furthermore, as the industrial hygiene air sample results would later confirm, this approach was believed to significantly reduce the potential for employee exposure from suspect airborne heavy metals.

The heavy equipment would then deposit the drum's contents onto a sorting table for screening. The sorting table had a basin for collection of accumulated rainwater that was containerized for further sampling and processing. Also, staging and containment areas were established allowing security inspectors and radiological control personnel to visually and radiologically survey the materials, respectively, prior to repackaging and disposal.

Since the drums were located in an open field, additional gravel was placed in and around the work area to eliminate muddy conditions following inclement weather. Industrial ventilation had been considered as another possible engineering control to reduce the dispersal of dust and airborne particulates. However, the concept was abandoned based upon the unpredictable nature of wind and weather patterns experienced at the work location and because the construction of an enclosed structure to conduct these activities was deemed impractical.

Because of these considerations, employee exposure was minimized by the following administrative controls:

- Using employees already trained in 40-hour HAZWOPER (29 CFR 1910.120)
- Completing a lead worker protection training module
- Participating in a biological monitoring program (e.g., blood, urine) for heavy metals
- Using signs and barricades (e.g., fencing, stanchions) delineating the LRA
- Restricting access to the LRA
- Using a vacuum equipped with a high efficiency particulate air (HEPA) filter for cleaning personal protective equipment (PPE) prior to doffing and leaving the LRA
- Segregating waste containers for lead-contaminated waste
- Requiring affected employees to wash their hands prior to taking anything by mouth and to shower prior to departing the project site at the end of the day

A PPE ensemble, described below and shown in Figure 2, was required when employees were expected to come in contact with the drums and their contents directly:

- Powered air-purifying respirator (PAPR) with HEPA filter cartridges
- Hard hat
- Outer layer of Tyvek® or Saranex® coveralls, apron, sleeves, and surgeon's gloves
- Leather gloves when manually handling drums, debris, and/or hand tools
- High-visibility safety vest
- American National Standards Institute (ANSI) Z41 safety boots
- Industrial hygiene monitoring pumps for monitoring heavy metals using the National Institute for Occupational Safety and Health (NIOSH) analytical method 7300 (4)
- Radiological PPE specified on the applicable Radiation Work Permit (RWP) (e.g., Tyvek® or Saranex® coveralls, 2 layers of surgeon's gloves, tear-away booties, and shoe covers)

Figure 2. Employees wearing the assigned PPE ensemble working at a sorting table.

Additional equipment was made available to support field operations and consisted of the following items:

- HEPA vacuum with spare filters
- Generator with ground fault circuit interrupter (GFCI) protection and grounding rod
- Wet wipes
- Class ABC and Class D fire extinguishers dedicated to the LRA
- Lead Check® swabs and/or wipes for spot checking personnel and/or equipment leaving the LRA

LEAD EXPOSURE MONITORING

Industrial hygiene air monitoring began at the start of drum processing activities to determine the level of airborne metals exposure that an unprotected worker might receive in the LRA during normal work operations. The samples would also be used to confirm if working conditions in the drum processing zone required designation as an LRA.

The industrial hygiene air monitoring pumps were placed on employees from various labor classifications during each work day to determine whether or not an employee performing a particular job function would be more likely exposed to airborne metals than other employees working in the LRA. All of the employees present in the work zone, with the exception of Heavy Equipment Operators, performed their daily work functions at ground level and in close proximity to the drum processing operation.

ANALYTICAL METHODS – AIR SAMPLING

Airchek 2000 sampling pumps, manufactured by SKC, Inc., (5) were used to obtain breathing zone air samples using 0.8-micron, mixed-cellulose ester filters, which were then shipped to Galson Laboratories for analysis (6). The samples were tested for arsenic, beryllium, cadmium, chromium, lead, nickel, selenium, silver, and thallium using the NIOSH analytical method 7300

(4). The results of the analyses were then adjusted to represent 10-hour time weighted average concentrations, which were then compared to the Permissible Exposure Level (PEL) established by OSHA for each analyte.

AIR SAMPLING RESULTS

A total of 88 air samples were obtained during 10 consecutive working days in the LRA. The percentage of industrial hygiene air samples collected by labor category was compiled for communication and reference purposes.

- Operator As – 4.5%
- Operator Bs – 22.7%
- Heavy Equipment Operators – 23.9%
- Field Coordinators – 9.1%
- Front Line Managers – 13.6%
- Security Liaisons – 5.7%
- Samplers – 11.4%
- Radiological Control Technicians – 9.1%

Even with Operator Bs and Heavy Equipment Operators accounting for almost 47% of the total industrial hygiene air samples collected, the vast majority of the results were equivalent to the laboratory detection limits for each analyte. All results were less than 6% of their respective PELs, except for one nickel result that was approximately 17% of its PEL.

The plant Radiological Control organization conducted independent industrial hygiene air monitoring using techniques similar to those employed by the SMRP. Their results, consisting of 5 samples, were consistent with the results obtained by the Environmental, Safety & Health (ES&H) organization.

BIOLOGICAL MONITORING

Scrap Metal Removal Project employees participated in a biological monitoring program by submitting biological samples (e.g., blood, urine) for analysis of metal constituents according to medical monitoring protocols and/or as stipulated in applicable OSHA regulations (3).

BIOLOGICAL MONITORING RESULTS

Biological monitoring results for all employees working inside of the LRA were negative.

ANALYTICAL METHODS - QUALITATIVE TESTING

Qualitative lead testing was performed on various surfaces inside of the LRA using Lead Check® swabs manufactured by Hybrivet Systems, Inc. (7). Specific applications for the swabs described in the vendor literature included clearance screening for lead abatement projects, such as lead detection in paint, solder, plumbing fixtures, and assorted waste materials. Performance specifications, as represented by the manufacturer, indicated that Lead Check® swabs

reproducibly detected as little as 1 microgram of lead on tested surfaces in defined laboratory studies.

Approximately 24 swabs were used to determine the presence of lead-containing materials at multiple locations within the LRA. Each swab was touched to a surface to be tested, and a chemical inside of the swab reacted with lead-containing materials, if present, at the tested point. The presence of lead was determined by a distinct display of red coloration on the tested surface and/or the tip of the swab. Tested surfaces included sorting pans in which the metal turnings/sweepings were inspected, heavy equipment attachments used to handle the drums and their contents, equipment cabs, PPE (e.g., respirators), large pieces of gravel surrounding the drum piles, vacuum stations, and HEPA vacuum intake hoses.

QUALITATIVE TESTING RESULTS

Qualitative lead results for all tested surfaces inside of the LRA obtained from Lead Check® swabs were negative. These results suggested that the amount of lead present in the individual items was below the detection capability of swabs. However, the significance of these results in connection with processing 236 metric tonnes (260 tons) over the course of the project verified that the field teams were using proper field controls to prevent the generation of any transferable lead, thus eliminating any cross contamination issues.

SUSPENSION OF THE SCRAP METAL PROJECT REGULATED METALS PLAN

After processing approximately 200 out of an estimated 4,000 drums for disposal, all industrial hygiene air sampling results were less than 50% of the OSHA PEL and qualitative lead testing results were all negative. Furthermore, based upon interviews with field teams regarding the types of materials observed inside of the drums and historical process knowledge about the machine shop cuttings at the PGDP, the SMRP did not have sufficient evidence to suggest that the contents of the remaining drums were significantly different from the materials observed during initial processing activities.

The following recommendations were proposed, communicated, and accepted by the employees for future drum processing operations for this particular segment of activities at the SMRP:

- **The LRA area was downposted after collecting negative quantitative and qualitative results for lead.** Future drum processing operations would be conducted using standard PPE for ordinary metal processing and disposal activities. Employees would be permitted to wear additional PPE at their request or as the project ES&H organization deemed appropriate for changing field conditions.

- **Reduction in air monitoring frequency from daily to weekly sampling.** Industrial hygiene air monitoring was conducted on one working day each week and focused on a sampling group that represented the highest probability of potential exposure to airborne metal constituents. Analytical results that exceeded a recognized action level or suggested the potential for employee exposure to any regulated metal (e.g., arsenic, beryllium, cadmium, lead, etc.) would be investigated and appropriate measures taken,

including the possible reimplementation of the RMP to ensure that worker health was protected until the issue was resolved.

- **Employees would continue participating in a biological monitoring program.** Routine biological samples (e.g., blood, urine) would be submitted for metals analysis according to medical monitoring protocols.

CONCLUSIONS

The potential harmful effects of exposure to lead in occupational workers can be very significant. Therefore, an RMP was developed to monitor for the presence of airborne lead and other toxic heavy metals when removing deteriorated drums and debris from a specific scrap yard. Analytical results obtained from industrial hygiene air monitoring in the LRA were far below the action levels established by regulatory agencies and project-level procedures (i.e., less than 50% of the OSHA PEL). Therefore, the analytical data supported the downposting of the area since the exposure to airborne metals was no longer an occupational hazard associated with processing the deteriorated drums. Furthermore, as data was collected to justify reducing the level of PPE initially required for employees, other potentially serious health effects (e.g., limited peripheral vision, heat stress, decreased physical mobility, etc.) were subsequently reduced.

In addition to removing the deteriorated drums and accompanying debris, the success of this project was quantified in terms of zero recordable injuries. The primary contributor in achieving this success was the sharing and communication of information between management, safety, and the field teams. Specifically, this was what the employees needed (and wanted) to hear when justifying the suspension of the RMP for the processing of drums containing metal turnings. Essentially, daily briefings on the status of the project and field monitoring results were just as important as maintaining budget and schedule milestones. Also, the ES&H organization maintained its presence on the SMRP by continuing to monitor evolving field conditions to ensure the effectiveness of its ES&H plans and procedures.

Furthermore, all SMRP employees were aware of their stop/suspend work authority as it related to off-normal or unforeseen conditions in the drum processing area. Field teams were encouraged to report any drum contents that appeared to be different from materials previously handled and processed. Measures could then be implemented to continue drum processing activities along with segregating suspect materials for later handling under more stringent controls, reinstating the RMP with an increased level of PPE for site workers, and/or performing verification sampling for regulated constituents prior to conducting further processing activities.

Following removal of the 236 metric tonnes (260 tons) of deteriorated drums and lead turnings, including the entire 27,700 metric tonnes (30,500 tons) of scrap metal, the applicable yards were covered by either a layer of gravel or hydroseeding. Areas were sloped, to the extent practical, to manage storm water runoff and minimize erosion (Figure 3).

Figure 3. A view of the LRA after removing the deteriorated drums and lead turnings.

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