Office of Environment, Health, Safety and Security
Operating Experience Level 3

OE-3: 2014-02 May 2014

Dangers of Respirable Silica

Purpose

This Operating Experience Level 3 (OE-3) document provides information on a safety concern related to recurring worker exposure to dust containing crystalline silica at Department of Energy (DOE) sites. Common construction materials that contain silica include asphalt, brick, cement, concrete, drywall, grout, mortar, stone, sand, and tile. Materials that contain crystalline silica may become hazardous when they are disturbed and generate small-sized particles that enter the lungs ("respirable crystalline silica"). Activities such as grinding, cutting, jack hammering, abrasive blasting, and using mobile excavation equipment such as drills, loaders, and graders are activities that generate dust, potentially exposing workers to respirable silica. Breathing dust that contains silica can lead to silicosis, a nonreversible and sometimes fatal lung disease for which there is no effective treatment. Microscopic particles of silica cause scar tissue to form in the lungs, reducing the lungs' ability to extract oxygen from the air, making them more susceptible to infections. Quartz, a component of crystalline silica, has been classified as a possible human carcinogen.

Background

More than one million American workers are exposed to crystalline silica through their work, and an estimated 250 American workers die annually from silicosis. Although there is no cure for silicosis, it is preventable through good work planning and the use of appropriate controls.

Respirable silica is a recognized hazard requiring an effective work control plan to mitigate it.

Several recent DOE events demonstrate the importance of good work planning and control, along with Industrial Hygiene (IH) support of tasks where generation of silica dust may jeopardize workers' health.

In June 2013, two workers at Thomas Jefferson National Accelerator Facility (TJNAF) were exposed to silica above the ACGIH[1] threshold limit value (TLV) of 0.05 mg/m^3 during one full day's shift and two half-day shifts.

In July 2012, a management concern was identified at Pantex after laboratory results indicated possible silica contaminants on a breathing zone filter after grinding operations were performed in June 2012. Although there were no over-exposures, this event highlighted weaknesses in sampling strategies and work planning and controls.

In May 2012, sample results indicated that two Los Alamos National Laboratory (LANL) subcontractors had been exposed to silica dust above the ACGIH-TLV during March 2012 concrete cutting and jack-hammering activities.

In March 2012, TJNAF reported a recurring subcontractor failure to recognize silica as a

[1] ACGIH is a member-based organization that advances occupational and environmental health.

hazard. Two incidents occurred in the past year in which workers were exposed to respirable silica above the TLV. Two additional silica-related events warranted further review. In all, three of the events occurred on the same construction project, despite communication of lessons learned from the first event.

Discussion

The exposure or potential exposure events discussed below could have been prevented or mitigated with proper work planning and control and involvement of Industrial Hygiene support. 10 Code of Federal Regulations (CFR) 851, *Worker Safety and Health Program*, requires contractors to follow exposure levels established by Occupational Safety and Health Administration (OSHA) or the ACGIH, whichever is more protective. The rule also requires hazard communication training for workers who might be exposed to hazards, including silica, and requires the use of the hierarchy of controls starting with engineering controls and including use of respiratory protection after other controls have been applied.

Thomas Jefferson National Accelerator Facility

During surfacing of an existing concrete floor in the Test Lab High Bay area, two subcontractors were found to have exceeded the limits for exposure to crystalline silica, despite specified controls being in place: engineering controls, including the use of a fully shrouded floor surfacing unit and local exhaust; administrative controls, including silica hazard awareness training for subcontractors; and personal protective equipment (PPE), including half-face respirators with P100 cartridges. Air samples indicated that silica was within limits. Workers were issued full-face respirators for the remaining work. (SC--TJSO-JSA-TJNAF-2013-0003)

Pantex

Two of three subcontractor workers operating a concrete floor grinder wore breathing zone pumps as they worked. An area sampling pump was placed near the work location. The dust collector had been used previously and monitoring results had always been less than detectable for silica, so the work package did not require respiratory protection. As they "broke down" the equipment and were removing the High-Efficiency Particulate Air vacuum from the dust collector outside, the workers saw a swirl of dust but continued loading their equipment. Although there was no overexposure, the subsequent critique identified several areas for management attention including the following:

- Samples were sent offsite and took up to 10 days for analysis, even though the analytical lab could analyze samples within 24 hours if requested to do so. Pantex procedures were changed to require a 24-hour analysis turnaround.
- Respiratory protection had been removed from the work package because the dust collector had been effective in removing airborne dust, but no rationale for removing PPE was given.
- The Job Hazard Analysis needed revision to address post-work operations and hazards associated with floor grinding operations. (NA--PS-BWP-PANTEX-2012-0056)

Los Alamos National Laboratory

Two subcontractors cut and jack-hammered concrete to regain access to a leaking fire line. Controls included wetting down during cutting, ventilating the room, using N95 dust masks, and hiring another contractor to provide two dust monitors. Although no visible dust was observed during the work, initial monitoring results were split: one showed overexposure to silica and the other did not. Reanalysis confirmed the overexposure to both subcontractors. As a result, the subcontractor decided to require respirators for all future concrete cutting or grinding operations, and did so, on subsequent work at LANL's Nuclear Materials Safeguards and Security Upgrades Project (NMSSUP). NMSSUP notified all other subcontractors about the issue and requested them to assess the need for respirators to meet allowable silica limits in their

subcontracts for future operations, analyzing the potential need on a case-by-case basis. (NA--LASO-LANL-TA55-2012-0021)

TJNAF

In the first TJNAF 2012 event, workers were exposed over a 72-hour period while jack hammering concrete in a tunnel. Two workers were assigned to each shift, one spraying water on the working surface and the other operating the jackhammer. A single industrial fan was used to evacuate dust from the enclosed space. TJNAF and DOE Site Office personnel, on a routine walkthrough, recognized the suspended dust hazard and the insufficient use of controls. In addition, there had been no specific activity hazard analysis for the work. Workers were instructed to use half-face respirators, a second fan was added, and air sampling monitors were placed in various locations. A personal respirable dust sampling monitor was placed on one worker. Personal and area air monitoring results were similar: both exceeded the allowable standard for respirable silica. The respirators used by the finishers were inadequate.

The subcontractor immediately instituted corrective action, including sending workers to the medical unit and providing them with exposure monitoring results; evaluating and fitting the five workers for full-face respirators; and providing hazard communication training. TJNAF and the Site Office discussed silica hazards with appropriate staff and evaluated the site's Industrial Hygiene monitoring program. (SC--TJSO-JSA-TJNAF-2011-0013)

In December 2011, two subcontractors working in an open stairwell received respirable silica exposures above the allowable limits, despite lessons learned that were appropriately communicated after the first event. They were using a small jackhammer to remove concrete and applying a heavy mist of water at the point of contact. Area samples were collected. Although the workers were wearing N95 disposable dust masks, the assigned protection factor, initially applied in the TJNAF analysis, should not have been taken into account since it was not supported by a fully compliant or formalized respiratory protection program. When the area sample results indicated that workers were potentially overexposed, silica and dust-producing work was stopped, and a PPE awareness briefing was conducted. Corrective actions included providing silica program training and creating a matrix to identify differences between various regulations regarding silica. (SC--TJSO-JSA-TJNAF-2012-0001)

TJNAF filed a third report in March 2012 to acknowledge the recurring problem and discuss the failure to recognize respirable silica as a hazard, which was a common cause for the two previous exposure events. To help prevent recurrence, TJNAF took corrective actions that included assigning additional safety resources to the project; requiring the subcontractor to submit a corrective action plan; and revising contract documents to identify silica as a high hazard. (SC--TJSO-JSA-TJNAF-2012-0004)

CONTROLS

Managers of projects whose work includes construction, deactivation and decommissioning, drilling, abrasive blasting, and the use of mobile excavation equipment, should recognize the potential occupational exposure to respirable silica.

10 CFR 851 requires hazard communication training for workers exposed to hazardous substances, including silica, and requires appropriate controls be implemented following the hierarchy of controls. Controls may include:

- Engineering controls such as blasting cabinets and local exhaust ventilation, or water sprays and wet methods for cutting, drilling, and sawing;
- Work control procedures that address all dusts that may be generated;

- A respiratory protection program that addresses selection of respirators approved for protection against silica;
- Safety training that addresses all potential hazards, including likely sources of silica exposures and health consequences of potential exposures; and
- Good habits such as washing hands and face before eating, drinking, or smoking away from the exposure area.

Source: *A Guide to Working Safely with Silica: If It's Silica, It's Not Just Dust* at http://www.msha.gov/S&HINFO/SILICO/SILICAX.pdf

CONCLUSION

The potential for silica exposure exists at every DOE site. In the past five years, ten sites have reported potential or actual silica exposures in the Occurrence Reporting and Processing System (ORPS); on average, three or four exposure events are reported annually. Causes include failure to recognize respirable silica as a hazard, inadequate work planning and/or hazard analysis, lack of IH support and monitoring, and lack of hazard communication training. Simple changes, made consistently, can make a significant difference in protecting workers from silica exposure.

REFERENCES

10 CFR 851, Worker Safety and Health Program.

The OSHA website contains information about silica in a variety of occupations at http://www.osha.gov/:

- *A Guide to Working Safely with Silica: If It's Silica, It's Not Just Dust*, at http://www.cdc.gov/niosh/pdfs/silicax.pdf
- National Emphasis Program on Crystalline Silica at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=3790
- NIOSH, Engineering Controls for Silica in Construction at http://www.cdc.gov/niosh/topics/silica/constructionControlMain.html
- *Recommended Skills and Capabilities for Silica Competent Persons, AIHA, March 2013*

ORPS reports:

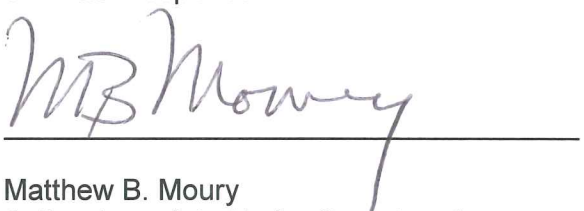
- SC--TJSO-JSA-TJNAF-2013-0003, FML-13-0702, Silica over 2005 ACGIH-TLV Exposure Limits in Test Lab
- NA--PS-BWP-PANTEX-2012-0056, *Exposure to Silica Dust*
- NA--LASO-LANL-TA55-2012-0021, *Two Subcontractor Employees Received Exposure to Silica Above ACGIH Threshold Values*
- SC--TJSO-JSA-TJNAF-2012-0004, *TEDF-12-0329 - Recurring Subcontractor Failure to Recognize Silica as a Hazard*
- SC--TJSO-JSA-TJNAF-2012-0001, *TEDF-11-1221-NEW Silica Exposure Above Allowable ACGIH TLV Limits*
- SC--TJSO-JSA-TJNAF-2011-0013, *12GeV-11-0928-NEW Respirable Crystalline Silica Overexposure During Hall D Stub Tie-in*

Definitions

TLV – Threshold limit value, a time-weighted average concentration under which most people can work consistently for 8 hours a day, day after day, with no harmful effects.

Questions regarding this OE-3 document can be directed to Ashley Ruocco at 301-903-7010 or ashley.ruocco@hq.doe.gov.

This OE-3 document requires no follow-up report or written response.



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