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# LLNL Lessons Learned LLNL

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## Equipment Work Results in CO Overexposure

In April, 2003, workers were assigned to replace equipment on the ceiling of a high bay in an LLNL facility. A Bridging Document for the Integration Work Sheet (IWS) covered the work, and was reviewed by the Task Lead and the Facility Point of Contact (FPOC).

The Task Lead and FPOC determined a manlift would be the most feasible means of reaching the equipment, located 33 feet above the floor. A propane gas-powered manlift was moved into the bay (see photo below). Facility personnel allowed the facility's large bay doors to remain closed during the work, believing the building ventilation system would adequately remove the manlift's exhaust emissions. Personnel also assumed that building security required the doors to be kept closed.

It was expected that the manlift's engine would operate intermittently; however, in one area the manlift's basket had to be relocated frequently, resulting in the engine running continuously for approximately 30 minutes. After an hour, the Technician on the manlift began to experience fatigue and nausea and was assisted down from the elevated manlift platform. The Technician was placed in a chair and the Task Lead notified a Protective Service Officer (PSO). The PSO alerted the Fire Department, and then crashed the emergency exit door adjacent to the CAIN booth to evacuate the affected Technician.

The building was evacuated and firefighters, wearing self-contained breathing apparatus, performed a sweep of the building. Carbon monoxide (CO) measurements of approximately 850 parts per million (ppm) were detected approximately 30 minutes after the manlift operations had ceased.

**Note:** The American Council of Governmental Industrial Hygienists' Threshold Limit Value for CO is 25 ppm averaged over an 8-hour work period; 1200 ppm is considered immediately dangerous to life and health.

Paramedics administered oxygen to the affected Technician, who was then transferred to Valley Care Hospital for observation. The Technician demonstrated symptoms consistent with CO poisoning. (See "CO Facts" next page.) Although the Technician fully recovered, there was the potential for serious injury in this near-asphyxiation incident.



Manlift

### Carbon Monoxide Facts

- CO is a colorless, odorless, and tasteless gas that has a toxic effect on the central nervous and cardiovascular systems.
- Exposure to CO can cause symptoms such as headache, fatigue, vertigo, nausea, confusion, and loss of muscle control, and can be fatal in high concentrations.
- CO in hot exhaust tends to accumulate near ceilings but unsafe concentrations may accumulate at lower elevations with continued operation of internal combustion engines. Unsafe exposure concentrations may also occur near the equipment.

### Analysis

Many components of Integrated Safety Management were not considered during the planning and performance of this operation.

#### Define the Scope of Work

- A generic IWS, which did not fully describe the operation, and a Bridging Document were used to describe the equipment replacement work.
- The Bridging Document was not revised to indicate the use of an internal combustion-engine powered manlift.

#### Analyze the Hazards

- A hazards analysis would have identified the indoor use of an internal combustion engine-powered manlift, and would have required a formal prestart review.
- The ES&H Team, facility personnel, and the work crew were not consulted when the scope of work was defined, the hazards identified, or the Bridging Document reviewed.
- Building personnel were not familiar with the ventilation system's low level of make-up air.
- Building personnel assumed the facility ventilation system was adequate to handle engine emissions for short periods, but were not aware that the manlift's engine would run for extended periods (30 minutes).
- The *ES&H Manual* does not address the general use of internal combustion-powered equipment indoors.
- An unsuccessful attempt to evacuate the affected Technician through a CAIN booth, rather than the immediate use of emergency crash-out doors, unnecessarily delayed the Technician's evacuation from the work area. This delay in evacuating the Technician could have been fatal.

#### Develop and Implement Controls

- No CO monitors were utilized to monitor the room air or breathing zone of the workers.
- Oxygen monitors installed near the floor did not activate and sound an alarm because oxygen levels in the room were not depleted.

## Recommended Action

Approximately 200 persons per year die of CO poisoning in the United States. Be cautious at work and in your personal life.

1. Identify the *complete* scope of work and associated hazards in IWSs, Bridging Documents, and Work Orders.
2. Use your ES&H Team as a resource to assist in defining the hazards. Changes to the scope of work should be reviewed and approved by supervisors and ES&H Team personnel as warranted.
3. Supervisors should assure that workers have reviewed the scope of work documents, are aware of the hazards, and have the necessary knowledge and equipment to implement the controls.
4. If feasible, DO NOT operate gasoline or other fuel-powered tools or engines (e.g., mowers, weed trimmers, snow blowers, chain saws, small engines, heaters, or generators) in enclosed spaces or near building air intakes or openings (doors and windows). When no alternative equipment is available, operations shall be reviewed and approved by the area ES&H Team, Authorizing Individual, FPOC, and the Responsible Individual and documented in an appropriate IWS or other controlling document (e.g., confined space entry permit).
5. The ES&H Team will perform an analysis of the facility ventilation before the indoor operation of gasoline- or other fuel powered tools and engines, and establish controls and parameters to ensure the operation can be conducted safely.
6. Maintain gasoline or other fuel powered tools or engines in good working order to keep CO emissions down.
7. When a co-worker is exhibiting symptoms of serious sickness such as CO poisoning, call 911.
8. Review the interaction of safety and security at all worksites during work planning, whether indoors or outside a facility. Do not compromise safety for security concerns.
9. Use emergency procedures e.g., crash out doors, rather than CAIN booths, to exit buildings when there is an emergency situation. The emergency alarms will also summon assistance.

## Where to Get Help or More Information

- Your ES&H Team.
- Document 11.2, "Hazards—General and Miscellaneous," in the *ES&H Manual* (to be revised).
- OSHA Fact Sheet on Carbon Monoxide:  
[http://www.osha.gov/OshDoc/data\\_General\\_Facts/carbonmonoxide-factsheet.pdf](http://www.osha.gov/OshDoc/data_General_Facts/carbonmonoxide-factsheet.pdf)

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