Occupational disease hazards in the oil and gas industry

Health and safety has been a priority for the oil and gas industry for many years. However, occupational hygiene exposures are often not properly assessed to determine the true risk to workers.

This document describes some of the occupational disease hazards (and other hazards) that workers in the oil and gas industry should be aware of. This industry produces and uses many chemical products on its worksites.

Workers exposed to chemicals produced and used in the oil and gas industry may develop occupational diseases of the lungs, skin, and other organs, depending on the amount and length of time of exposures. Workers exposed to hazardous noise levels may develop noise-induced hearing loss. Other dangers include confined spaces, in which untrained workers have been seriously injured or killed.

Exposure control plan (ECP)

Oil and gas industry employers must develop and implement a written exposure control plan (ECP) whenever workers may be overexposed to chemical hazards, including hydrogen sulfide (H_2S), drilling fluids, silica, diesel exhaust, and mercury.

An effective plan provides a detailed approach for protecting workers against chemical exposures, including health hazard information, engineering controls, safe work procedures, worker training, and record keeping.

ECPs must include the following elements:

- Statement of purpose
- Responsibilities of employers, supervisors, and workers
- Risk identification and assessment
- Risk controls
- Worker education and training
- Written safe work procedures
- Hygiene facilities and decontamination procedures
- Documentation
- Health monitoring (may also be required, depending on the nature of the chemicals being used)

Hydrogen sulfide

H_2S is often found in oil and natural gas deposits, and in some mineral rock. Oil and gas workers are likely to find H_2S at oil and natural gas wells, in refineries (where H_2S is removed from natural gas and oil), and in pipelines used to carry unrefined petroleum.

H_2S is a very toxic gas that has no colour and smells like rotten eggs. The gas can irritate the eyes, nose, throat, and lungs. With high levels of H_2S, poisoning can be swift and deadly – with little warning. A worker who is not wearing protective equipment may pass out quickly. The body may tremble, and death may follow within seconds or minutes as a result of breathing failure. It may be possible to revive the victim, but only if first aid is given right away.

If an H_2S leak occurs, the area must be evacuated; only workers wearing appropriate protective equipment may enter to correct the problem.

Employers must develop and implement effective evacuation/rescue and exposure control plans, which include training for workers and supervisors.

Drilling fluids

During drilling, a large volume of drilling fluids is circulated through the well and into open, partially enclosed, or completely enclosed systems at elevated temperatures. When these fluids are agitated, as they are during part of the recirculation process, there is a potential for significant worker exposure and subsequent health effects.

These health effects include dizziness, headaches, drowsiness, and nausea (typically associated with exposure to hydrocarbons), as well as dermatitis and sensitization from repeated skin contact with the drilling fluids. In addition, exposure to oil mists can cause irritation and inflammation of the respiratory system. Some of the mildly refined base oils have also been associated with cancer, as a result of the aromatic compounds in the oil mists.

Workers who spend a significant portion of their shifts in the following areas may be overexposed to hydrocarbons and oil mist:

- Drilling floor
- Chemical mixing station/room
- Mud pits/tanks (where treated drilling fluids are retained prior to pumping to the drill hole)
- Shale shakers (where drill cuttings are "shaken" from the drilling fluids that return from the drill hole)

An ECP for drilling fluids should include engineering controls, as well as safe work procedures and the use of personal protective equipment.

Silica

Silica is the basic component of sand and rock. Some common silica-containing materials include:

- Concrete, concrete block, cement, and mortar
- Granite, sand, fill dirt, and top soil
- Asphalt (containing rock or stone)
- Abrasive used for blasting
- Hydraulic fracturing sand (contains up to 99% silica)

Silicosis is a disease caused by the prolonged breathing of fine crystalline silica dust. The particles are deposited in the lungs, causing thickening and scarring of the lung tissue. Initially workers with silicosis may have no symptoms; however, as the disease progresses they may experience shortness of breath, severe cough, and weakness. These symptoms can worsen over time and lead to death. Crystalline silica exposure has also been linked to lung cancer.

Workers performing the following activities are at risk of breathing silica dust:

- Abrasive blasting using silica-containing products
- Cementing operations
- Drilling using dry product additives that contain quartz
- Maintenance of shale dryers (dry particulate may contain quartz)
- Hydraulic fracturing (loading, unloading, moving, or storing sand)
- Sweeping or moving sand or gravel containing silica

Because of the low occupational exposure limit for airborne silica dust, an ECP would likely include an appropriate respirator for all work activities that involve silica.

Mercury

Mercury, in a number of chemical forms, is a natural component of oil and gas and may be present at high concentrations in some formations. The mercury was likely liberated from geological deposits by heat and pressure and then migrated, as a vapour, to the oil and gas "traps."

When these gas reservoirs are produced and the processed fluids are cooled, liquid mercury can condense within heat exchangers, separators, coolers, valves, and piping. When this equipment (particularly components made from magnesium or aluminum alloys) is taken apart for maintenance or repair, workers can be exposed to mercury vapour.

Work activities that may carry a risk of exposure to mercury in gas processing facilities include:

- Vessel cleaning
- Welding, grinding, buffing, and polishing
- Machining
- Pipefitting
- Installation and removal of components or infrastructure
- Hydro excavating
- Electrical work

Chronic (long-term) exposure to high concentrations of mercury vapour affects the central nervous system and can cause stupor, tremors, nervousness, personality changes, and vision and hearing problems. Contact with mercury can also affect the kidneys and cause irritation and burns to the skin and eyes.

Owners must conduct a hazardous materials survey and a risk assessment for mercury at their facilities. This information must be kept on site and communicated to all contractors who will be performing work at these locations. Employers must also develop and implement an effective written ECP for mercury.

Diesel exhaust

Diesel engines provide power to many types of vehicles, heavy equipment, diesel generators, and other machinery used in the oil and gas industry.

The exhaust from these engines contains a mixture of gases (including carbon monoxide and oxides of nitrogen) and small particles that can affect worker health. Some of these particles have cancer-causing chemicals, known as aromatic hydrocarbons, attached to their surfaces.

Short-term exposure to diesel exhaust can cause eye and upper respiratory (nose and throat) irritation. Long-term health issues can include respiratory disease, cardiovascular problems, and lung cancer.

Engineering controls are the best strategy for controlling worker exposure to diesel exhaust. Possible controls include the following:

- Carry out routine maintenance on diesel engines and engine emission systems.
- Install oxidation catalysts and exhaust filters.
- Use low-sulphur fuels or special fuel additives.
- Extend stacks so the exhaust is directed away from workers.
- Restrict the amount of diesel-powered equipment in a given work area, and designate areas that are off limits for vehicle and engine operation.

Naturally occurring radioactive materials (NORM)

Naturally occurring radioactive materials (NORM) are radioactive elements that have always been present in the earth's crust and are found naturally in the environment. These include uranium, thorium, radium, and radon. The background concentration of NORM is typically low; however, higher levels may arise as the result of human activities.

In the oil and gas industry, NORM may be present in the liquids and gases from some geological formations. Scale from oil recovery brine, for example, may contain radium at much higher concentrations than the original water source. Sludge and drilling fluids may also contain elevated levels of NORM. Special precautions are needed for handling, transporting, and disposing of these materials.

Workers can be exposed to NORM through exposure to an external source (irradiation) or when radioactive material is taken into the body (for example, through inhalation, ingestion, or absorption). Health effects of exposure depend on the intensity of the radiation, the duration of the exposure, and the organs affected. Long-term exposure to NORM above exposure limits has been associated with certain forms of cancer. NORM exposures are generally quite low; however, all radiation exposures must be kept as low as reasonably achievable (ALARA).

NORM can be found in many components of operating oil and gas facilities, including:

- Piping runs, including down-hole piping
- Well heads
- Production manifolds
- Gas/oil separator flow lines
- Dehydrators and desalinators
- Valves
- Storage tanks

In order to protect workers who clean and maintain equipment that is potentially contaminated by NORM, or who may enter contaminated tanks or vessels, a written NORM management program should be developed and implemented.

Confined spaces

A confined space is an enclosed or partially enclosed area that is big enough for a worker to enter. It is not designed for someone to work in regularly, but workers may need to enter the confined space for tasks such as inspection, cleaning, maintenance, and repair. A small opening, a high opening, or a layout with obstructions can make entry and exit difficult and can complicate rescue procedures.

Entry into confined spaces can be very hazardous. Workers must not be allowed to enter such spaces unless proper training, equipment, and procedures are in place. Workers have died because they did not know they were entering a confined space with a hazardous atmosphere, and therefore did not take the necessary precautions.

Confined spaces are common in the oil and gas industry, particularly in processing operations. Confined spaces include:

- Storage tanks
- Process and reaction vessels
- Boilers
- Ventilation and exhaust ducts
- Tunnels and pits
- Pipelines

A hazard assessment must be conducted for every confined space on a worksite. Before workers can enter a confined space, the employer must prepare and implement a confined space program that includes written safe work procedures for entry into and work in each of the confined spaces.

Hazardous noise

Noise-induced hearing loss is permanent hearing loss caused by long-term exposure to hazardous noise. The severity of the hearing loss is affected by the intensity of the noise and the duration of exposure.

Sources of hazardous noise are common on oil and gas sites and include the following:

- Mud pumps and tanks
- Shale shaker/centrifuge
- Offloading, main oil, and cement pumps
- Gas compression and water injection
- Fracturing
- Derrick, dog house, and pipe decks
- Diesel/gas turbine power generators
- Air system and air tugger

Oil and gas industry employers must develop and implement a written noise control and hearing conservation program where workers are exposed to hazardous noise. The program must include the following elements:

- Noise measurements
- Noise controls methods
- Hearing protection devices
- Posting of noise hazard areas
- Annual hearing tests

Engineering controls, such as the addition of sound-attenuating curtains or walls, are the best strategy for reducing worker exposure to hazardous noise. Often, however, controls are not enough to eliminate the hazard, so appropriate hearing protection devices must be worn at all times around hazardous noise sources.

Because noise-induced hearing loss develops slowly over time, annual hearing test results are the best way to determine the success of hearing conservation efforts. It is important to review test results and to educate and train workers about the risk of exposure to hazardous noise.

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