

CHAPTER 7

Occupational Health and Safety Aspects of Oil and Gas Extraction

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WORKPLACE FATALITIES AMONG OIL AND GAS EXTRACTION WORKERS

Overview

The oil and gas (O&G) extraction workforce has an annual fatality rate seven times higher than all United States (US) workers (Mason et al., 2015). Manual labor, long work hours around heavy machinery, multiple contractors working on well sites simultaneously, and the constant movement of people and equipment (mainly on rural roads) contribute to elevated occupational fatality rates in this industry. Historically, the fatality rate for O&G extraction workers correlated with level of activity (e.g., number of active drilling rigs) (CDC, 2008). However, recent research published by the Centers for Disease Control and Prevention's National Institute for Occupational Safety and Health (CDC NIOSH) showed

that, despite a twofold increase in the number of workers and a 71% increase in active rigs during 2003–2013, there was a 36% decrease in the fatality rate (Mason et al., 2015).

Fatalities by Company Type and Establishment Size

O&G extraction fatality rates vary by type and size of company (Mason et al., 2015; Retzer et al., 2011). Using the North American Industrial Classification System (NAICS), worker deaths are classified by: (1) operators, who own or lease and operate the well, (2) well drilling contractors, and (3) servicing companies, who provide a variety of services completing and repairing the well. Drilling contractors have the highest fatality rate (44.6 per 100,000 workers), followed by servicing companies (27.9 per 100,000 workers). Operators have the lowest rate (11.6 per 100,000 workers) (Mason et al., 2015). Differences in fatality rates are likely explained by varying exposures to hazardous operations involved in drilling, completions, and servicing activities.

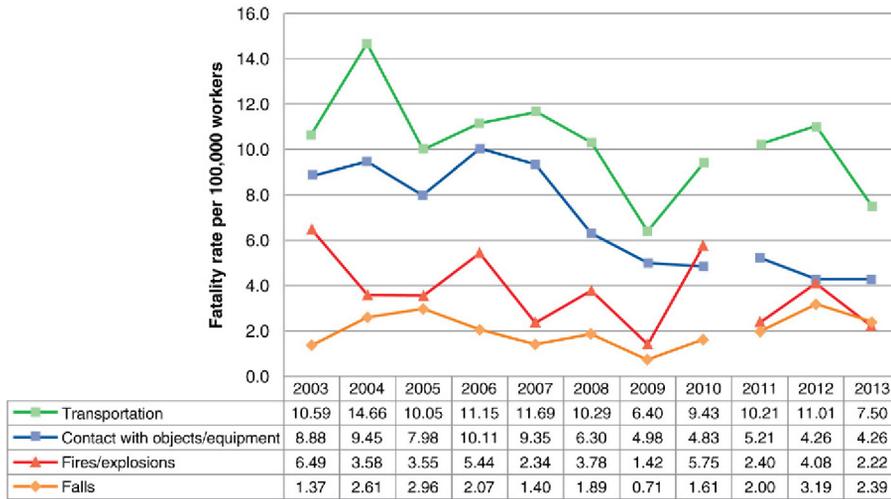
Consistent with findings in other industries, the smallest establishments (20 or fewer workers) have the highest fatality rates (Retzer et al., 2011). Small drilling contractors have fatality rates seven times greater than the industry as a whole. Small drilling contractors may employ older style rigs that have fewer engineered safety controls. Companies with 10 or fewer workers are also exempt from many federal occupational safety and health (OSH) regulations and may lack the resources to employ full-time safety and health professionals to provide safety and health training, implement policies and procedures, or cultivate a safety and health culture that is typically incorporated into larger companies.

The O&G extraction industry as a whole is exempt from several occupational safety and health regulations, including portions of the following Occupational Safety and Health Administration (OSHA) standards: process safety management of highly hazardous chemicals, benzene, hearing conservation, and lock-out/tagout. The regulatory environment for this industry will be discussed in more detail in Chapter 12.

Transportation – The Leading Cause of Death to Workers

Transportation incidents are the leading cause of death among O&G extraction workers, accounting for nearly 40% of all work-related fatalities (Mason et al., 2015; Retzer et al., 2013). During 2003–2013, 479 workers died on the job in transportation incidents. The largest proportion of transportation incidents involved motor vehicle crashes, though some of the deaths are associated with aircraft and boats. During 2003–2013, there was a downward trend in the transportation fatality rate (Mason et al., 2015) (See Figure 7.1). However, it still remains the leading cause of death among O&G extraction workers.

A previous comparison of the motor vehicle fatality rates across industries found that O&G extraction had a rate only slightly lower than that for workers in the transportation and warehousing industry (7.6 vs. 9.3 deaths per 100,000 workers) (Retzer et al., 2013). Possible explanations for this elevated rate include frequent travel between well sites, driving on rural roads that lack

**FIGURE 7.1****US O&G extraction worker fatality rates, leading causes of death, 2003–2013.**

The break in 2011 represents revisions in the coding system. Sources: National Institute for Occupational Safety and Health (NIOSH), using data from Bureau of Labor Statistics Census of Fatal Occupational Injuries and Quarterly Census of Employment and Wages.

standard safety features, lack of safety belt use, extended and irregular work hours that contribute to driver fatigue, and truck traffic associated with the high volume of sand and water needed for hydraulic fracturing (Retzer et al., 2013; CDC, 2008; Mode and Conway, 2007). A majority of drivers who died in motor vehicle crashes were driving light duty vehicles (<10,000 lbs), mostly pick-up trucks, which are typically not regulated requiring the operator to have a commercial driver license (Retzer et al., 2013).

Besides work-related vehicle crashes, commuting to-and-from remote job sites has been identified by industry as a particular concern. There is no national surveillance system that tracks commuting related motor vehicle crashes. However, O&G extraction companies are beginning to incorporate off-duty motor vehicle safety as a part of their health, safety, and environment (HSE) programs because it is recognized that many motor vehicle fatalities occur off duty. As the geographical areas where large numbers of wells are being drilled shifts over time, often to more rural or remote areas, workers need to commute longer distances. Once their rotation (typically 2 weeks) is complete, workers often begin their commute home immediately, but are often fatigued from long shifts for multiple consecutive days (Rothe, 2008).

Research of Canadian oil field workers reported that fatigue and falling asleep at the wheel are common during long commutes to and from rural well sites (Rothe, 2008). Crash studies in the general population involving noncommercial and commercial vehicles have shown an increase in crash risks associated with decreased sleep duration (Hanowski et al., 2007; Connor et al., 2002; Cummings et al., 2001). In the US, a number of motor vehicle fatality reports

for O&G extraction workers indicate drivers fell asleep while driving (Retzer et al., 2013). More research is needed on fatigue and its effect on worker safety and health. Factors likely affecting O&G extraction workers include inadequate sleep duration and poor sleep quality, long work days and commutes, and temporary lodging facilities with suboptimal sleeping environments.

One of the strategies being employed by O&G extraction companies to reduce risk to workers who drive are in-vehicle monitoring systems (IVMS). While the features of IVMS products vary widely, most systems monitor basic driving behavior, including speeding events, harsh braking events (an indicator of distraction), and harsh accelerations (an indicator of aggressive driving). Some monitors incorporate use of cameras, seatbelt monitors, and electronic logging of hours. Driver behavior reports are typically transmitted from an IVMS to designated persons for review on a regular basis. Companies report that use of IVMS helped them to reduce motor vehicle incident rates when combined with coaching of drivers who exhibit risky driving behavior. A review of O&G industry papers published on IVMS showed 50–90% reductions in crash rates after implementing IVMS (Retzer et al., 2013). Health and safety professionals who have used IVMS also report the ability to target their resources on drivers who need assistance to improve driving behavior, rather than costly company-wide initiatives. They also report that IVMS can help companies foster the concept of “driver social responsibility” on public roadways by endeavoring to avoid any negative impacts of O&G extraction in communities near well sites (International Association of Oil and Gas Producers, 2014a,b). However, an evaluation of the attitudes and opinions of truck drivers on the use of IVMS revealed that some drivers have concerns regarding privacy issues as well as the complexity, reliance, and reliability of the technology (Huang et al., 2005). The ultimate intent of IVMS is to safeguard employees when driving and not endanger other drivers on the road.

A second intervention proving useful for companies involves journey management (JM), a planned and systematic process of reducing transportation-related risks for a company's operations (Retzer et al., 2014). JM programs question the necessity of all trips and minimize the risks associated with necessary trips. Sophisticated JM software uses technology to anticipate, identify, and avoid hazardous road conditions. JM programs are widely implemented among operators but are just becoming incorporated into smaller US-based companies.

To reduce motor vehicle incidents in the O&G extraction industry worldwide, the IOGP released a Land Transport Safety Recommended Practice, #365. This guidance provides companies with the essential components of an effective land transport safety program. It is based on the best practices within industry and includes multiple tools for program implementation.

Other Leading Causes of Death

Contact/struck by/caught-in machinery injuries are the second leading cause of death to O&G extraction workers. Despite a lack of systematic, published epidemiological, or system safety analysis research attributing reasons for a

recent reduction in the rate of contact injury deaths in drilling operations (Mason et al., 2015), engineering controls (e.g., new drilling rigs with automated pipe handling features) that remove workers from hazardous tasks are likely a factor. A 2014 NIOSH study compared injury rates on contemporary drilling rigs (e.g., automated pipe handling, alternating current motor drives) to older, manual rigs, and found a significant reduction in incidence of severe injuries for floormen and other workers whose tasks require their presence on the rig floor (Blackley et al., 2014). One of the most common types of fatal contact injury on drilling rigs is being struck by falling objects, primarily drill pipes or “tubulars” that weigh many hundreds of pounds each and are hoisted above the drilling floor and assembled together to form a drill string thousands of feet long.

Another leading cause of death is falling from height. Workers commonly work at height above the rig floor and also in the derrick. Adequate fall protection is required to ensure safety, but failures of anchors or guarding, or worker failure to anchor properly, can result in falls leading to fatalities.

NIOSH Fatalities in O&G Database

NIOSH and its partners (the National Occupational Research Agenda [NORA] Oil and Gas Sector Council) maintain a surveillance system called the “Fatalities in Oil and Gas Extraction (FOG) Database” to better understand factors involved in O&G extraction worker deaths (<http://www.cdc.gov/niosh/topics/fog/>). FOG helped identify nine deaths associated with tank gauging (discussed in next section) that could have been overlooked in traditional data sources. Topics of concern identified through FOG also include deaths from hydrogen sulfide exposure (also discussed in next section) and deaths due to dropped objects. Another trend identified through FOG is the increased number of fires or explosions associated with hot work or welding on produced water tanks. Produced water (i.e., brine or salt water) is not classified as hazardous material by the Department of Transportation and may not be placarded on tanks as hazardous, a fact which can leave workers unaware of the flammable/explosive and possibly toxic contents (hydrocarbons) that may be in these tanks (see discussion on transportation of O&G in Chapter 9). Lastly, FOG is able to track fatalities by specific operations and recently found that rig-up and rig-down tasks on drilling and workover rigs resulted in more deaths than any other operation in 2014.

Because accurate and comprehensive information is not available, FOG does not include injury or illness data. More work in the area of health surveillance is needed for this worker population.

RISKS FOR CHEMICAL EXPOSURES IN OIL AND GAS EXTRACTION WORKERS

Overview

There is a lack of systematic, peer-reviewed, industrial hygiene studies for land-based O&G extraction workers (NIOSH, 2010). This section describes the most

common hazards and risks. It is also a call-to-action for industrial hygienists and safety professionals to understand that significant knowledge gaps exist. Workplace exposure assessment research is needed to understand the scope and magnitude of exposure risks and to prioritize controls to protect workers. This review addresses land-based O&G extraction. Offshore work typically involves stationary, fixed work areas unlike the dynamic and highly mobile nature of land-based operations. Risks for land-based operations differ because controls are typically designed and engineered into offshore platforms. Some exposure assessment studies exist for offshore worker; and implementation of administrative controls are easier for the “captive cohort” nature of offshore workers.

Hydrogen Sulfide

Hydrogen sulfide (H_2S or “sour gas”), is well known as a serious workplace exposure hazard in O&G extraction. Health effects associated with H_2S exposure range from acute and chronic respiratory and eye irritation to neurological effects and death from pulmonary edema or oxygen deficiency. Virtually all O&G extraction workers receive awareness-level training in recognition of H_2S hazards and the presence of olfactory warning properties (i.e., smell) can help with hazard identification at very low concentrations. Hydrogen sulfide occurs in crude oil and natural gas from the decay of organic matter (e.g., kerogen) in sedimentary formations. O&G wells vary greatly in H_2S content across basins and formations; consequently, exposure risks vary widely. Exposures to H_2S can occur during drilling, completions, and servicing operations. H_2S emission can also occur from water stored or brought on site contaminated with sulfite-reducing bacteria. Sulfur dioxide, produced from the combustion of H_2S , can also be an exposure hazard for workers in proximity to incomplete H_2S combustion. Precautions, such as flaring or use of H_2S scavenging equipment (“gas busters”), personal protective equipment, and H_2S personal monitors are used at wells with known H_2S contamination. Twenty-two fatalities in the O&G industry were identified from acute exposures to H_2S from 1984–1994 (Fuller and Suruda, 2000). During 2005–2014, there were nine H_2S fatalities identified from the NIOSH FOG database. A Canadian questionnaire study of 175 O&G extraction workers reported acute and chronic respiratory irritant symptoms. Some workers reported loss of consciousness from exposure to H_2S (Hessel et al., 1997).

Hydrocarbon Gases and Vapors

O&G extraction involves risks for inhalation and dermal exposures to hydrocarbons, including, but not limited to naphthalene, benzene, toluene, ethylbenzene, and xylenes (collectively known as N-BTEX), propane, pentane, butane, cyclohexane, methyl-cyclohexane, and n-heptane. Exposures to hydrocarbons can affect the eyes, lungs, and central nervous system. Hydrocarbon emissions from production tanks, if significant enough, can also lead to oxygen deficiency through simple displacement and generation of flammable atmospheres. A recently identified risk for fatalities in O&G extraction workers is from the combined acute effects of hydrocarbon exposures and oxygen deficient atmo-

spheres during manual gauging and fluid collection at crude oil production tanks (NIOSH/OSHA, 2015). Nine worker deaths were identified from 2010–2014 involving manually gauging tanks ($n = 4$) or collecting fluid samples ($n = 5$) from open production tank hatches. Low molecular weight hydrocarbons and benzene (an occupational carcinogen) were identified in the blood of several decedents; exposure to H_2S was ruled out in these nine cases. One worker wore a multigas monitor that reached a nadir of 6.9% oxygen around the approximate time of death (normal concentration is 20.5%). This is consistent with the finding that very high concentrations of hydrocarbon gases and vapors can displace ambient oxygen and create a toxic environment in which one to two breaths leads to a limited duration of useful consciousness (Miller and Mazur, 1984). NIOSH issued science blogs about the hydrocarbon-related deaths and associated hazards (King et al., 2015; Snawder et al., 2014) and Hazard Alerts were developed by NIOSH and OSHA and the National Service, Transmission, Exploration & Production Safety (STEPS) Network (2015) in conjunction with its partners.

A Canadian study evaluated 1,547 full-shift and short-term area and personal breathing zone (PBZ) samples that were voluntarily submitted by five companies involved in O&G extraction, oil processing, and pipeline work in the province of Alberta (Verma et al., 2000). The highest risks for benzene exposures involved conventional gas extraction. Less than 1% of the exposures exceeded the province of Alberta occupational health criterion at the time of the study (1 part per million [ppm]) and 5% of samples were greater than the province of Alberta short-term exposure limit (STEL) of 5 ppm for benzene. A retrospective assessment (including interviews and modeling of monitoring and exposure assessment data) of benzene exposures in the Australian Petroleum Industry focused mainly on workers in midstream and downstream activities (transport and refinery), but did provide an estimate of exposure risk in upstream operations using 34 reference points. A mean benzene exposure of 0.05 ppm (range 0.001–0.06) was reported; risks for skin exposures were not evaluated (Glass et al., 2000).

Worker exposures to xylenes and other hydrocarbons can occur during O&G extraction, including work around mud pumps, shale shakers, and drill cuttings. Flowback operations can also present exposure risks when working around ponds, pits, and flowback tanks. Malaysian researchers reported that xylene is used as a solvent in well stimulation to dissolve accumulated organic plugs of paraffins from wellbores (Zoveidavianpoor et al., 2012). The researchers hypothesize that task-based activities may result in “higher exposures” but provide scant details relating to specific occupational exposure levels. A literature review of potential risks for exposures to hydrocarbons in drilling fluids reported that derrickmen, mud engineers, roughnecks, motormen, and laboratory supervisors are at risk from hydrocarbon exposure and, depending on exposure levels, potential health effects (Broni-Bediako and Amorin, 2010). Areas of exposure included the drilling floor, shale shakers, mud pits, sack room (mud mixing house), laundry facilities, and deck operational areas. In addition to inhalation, risks for dermal exposures, dermatitis, and skin irritation were also described. The presence of sensitizers (e.g., polyamine emulsifiers) and corrosive chemicals

(e.g., zinc bromide) in drilling fluids is mentioned. No quantitative exposure assessment data were provided.

A Norwegian study at a drilling fluids test center investigated oil mist and vapor generation at shale shakers (Steinsvåg et al. 2011). Mist, vapour, and total volatile hydrocarbons were measured under different temperature parameters and base oils of differing viscosities (i.e., n-paraffin alkanes with boiling points of 210–260°C and petroleum distillate base oil with boiling points of 250–325°C). Results indicate statistically different mist and vapor concentrations between the two different drilling fluids. Oil mists generated using higher boiling point petroleum-based fluids were approximately two times higher than oil mists generated when using the lower boiling point alkane-paraffin fluid. Oil mists and vapor at shale shakers exceeded the Norwegian exposure limits of 1 mg/m³ of air for oil mist, and 50 mg/m³ for oil vapor, when fluid temperatures were greater than 50°C. The researchers report that oil mist and vapors from shale shakers are difficult to control, but suggest that exposures could be reduced by cooling drilling fluids to less than 50°C before they enter the shale shaker units, enclosing shale shakers and related equipment, and carefully considering which fluid system to use.

NIOSH researchers reported 17 workers gauging flowback and production tanks had higher risks for benzene exposures (full-shift TWA = 0.25 ± 0.16 ppm), compared with 18 workers at the same sites who did not gauge tanks (full-shift time-weighted average (TWA) = 0.04 ± 0.03 ppm [Figure 7.2]). The results showed that 2 of the 17 samples met or exceeded the American Conference of Governmental Industrial Hygienists (ACGIH) unadjusted benzene threshold limit value (TLV®) of 0.5 ppm and 6 of 17 samples exceeded an adjusted TLV of 0.25 ppm for the 12-h shift. Some task-based samples for benzene also exceeded the NIOSH short term exposure limit (STEL) for benzene (1 ppm as a 15-min

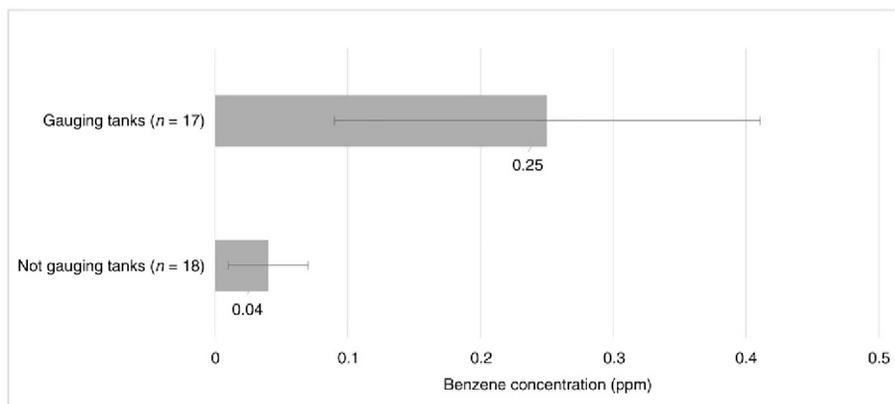


FIGURE 7.2
Time-weighted average, personal breathing zone benzene concentrations for workers gauging or not gauging tanks. Source: Esswein et al. (2014).

TWA). Direct-reading instruments detected peak benzene concentrations greater than 200 ppm at tank hatches. None of 35 full-shift PBZ samples exceeded the OSHA permissible exposure limit (PEL) for benzene of 1 ppm for general industry or 10 ppm for the O&G drilling, production, and servicing operations who are exempt from the OSHA benzene standard. Exposures to other measured hydrocarbons (e.g., toluene, ethyl benzene, and xylenes) did not exceed any established occupational exposure limits (Esswein et al., 2014).

Diesel Particulate Matter

Diesel engines are common on drilling, completions, and well-servicing sites. Diesel particulate matter (DPM) is emitted from diesel engines as a complex aerosol containing vapor and solid phase hydrocarbons, sulfates, oxides of nitrogen, and elemental and organic carbon particles. DPM is respirable and, therefore, capable of entering the gas exchange region of the lungs. Depending on the duration and magnitude of exposure, DPM can irritate the eyes and upper respiratory system, causing cough and phlegm production, and can exacerbate pre-existing asthma (Pronk et al., 2009). Certain polyaromatic compounds in DPM have been determined by NIOSH to be occupational carcinogens (IARC, 2013). Neither OSHA, NIOSH, nor ACGIH have an occupational exposure limit for DPM, but the state of California, Department of Health Services, has an occupational exposure limit for DPM of 20 $\mu\text{g}/\text{m}^3$ of air as a TWA, referenced as elemental carbon, which is a surrogate for DPM exposures (CDHS, 2002). No published DPM exposure assessment research for O&G extraction workers was identified in the literature. NIOSH researchers conducted air sampling/exposure assessments for DPM from 2008–2012 at drilling, hydraulic-fracturing, well-servicing, and rig move operations. In this study, 104 air samples (48 PBZ and 56 area) were collected and analyzed for elemental carbon as a surrogate for DPM. Area air samples ranged from below the limit of detection (<LOD) to 68 $\mu\text{g}/\text{m}^3$ as a TWA; PBZ results were in a range of <LOD to 52 $\mu\text{g}/\text{m}^3$ as a TWA (authors' unpublished results). Exposure risk factors for DPM are believed to include: number, type, horsepower, and duration of operating diesel engines; controls, if any (e.g., low-sulfur fuels, engine filtration, the presence of diesel organic exhaust catalyst); temporal and spatial aspects of engine location relative to workers and workstations; wind direction and velocity; and weather conditions, such as inversions.

Respirable Crystalline Silica

Occupational exposures to respirable crystalline silica are associated with the development of silicosis, lung cancer, pulmonary tuberculosis, and airways diseases. Silicosis is a debilitating and often fatal lung disease that is preventable. Respirable crystalline silica exposures may also be related to the development of autoimmune disorders, chronic renal disease, and other adverse health effects (NIOSH, 2002). NIOSH researchers collected 111 full-shift PBZ samples for respirable crystalline silica at 11 hydraulic fracturing sites in 5 states over a 15-month period. Workers in 15 different job titles participated in the exposure assessment study (Esswein et al., 2013). Silica-containing dusts were visibly present at all sites

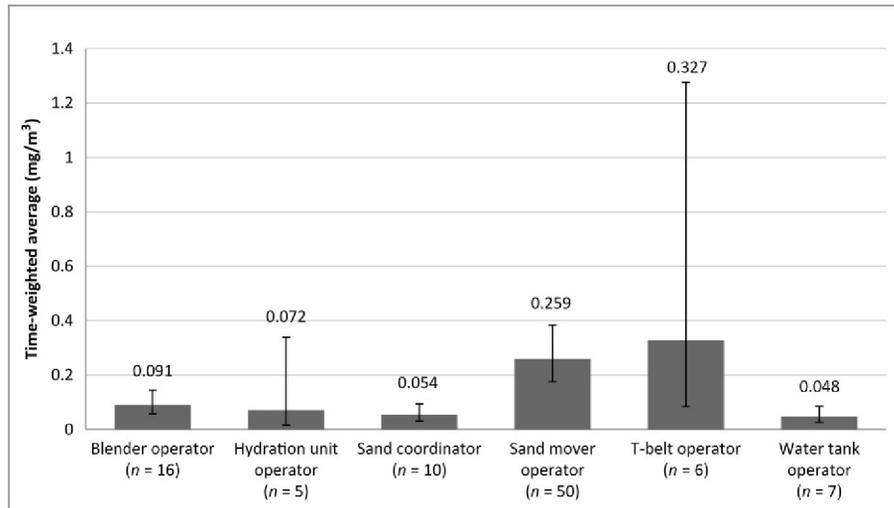


FIGURE 7.3
Respirable crystalline silica, time-weighted average geometric means (mg/m³) and 95% confidence intervals for 6 job titles of workers conducting hydraulic fracturing operations.
 Source: *Esswein et al. (2013)*.

during pneumatic transfer of sand. Sand mover and transfer belt operators had the greatest risk of exposure, exceeding the calculated OSHA PEL and the NIOSH recommended exposure limit (REL). The study reported: (1) 57 of 111 samples (51.4%) exceeded a calculated OSHA PEL, which varies based on the percentage silica in the sample, (2) 76 of 111 (68.5%) samples exceeded the NIOSH REL of 50 $\mu\text{g}/\text{m}^3$ as a TWA, and (3) 93 of 111 (83.8%) exceeded the TLV of 25 $\mu\text{g}/\text{m}^3$ established by the ACGIH. Mean exposure severities (exposure divided by occupational exposure limit), as compared with the NIOSH REL, ranged from less than 1 for 7 job titles (e.g., data van, pump truck, roving and wireline operators, and quality assurance/quality control (QA/QC) techs), to 10.44 for sand mover operators and 14.55 for transfer belt operators. A severity of “1” is equal to the respective occupational exposure criterion. Mean severities of exposures, compared with OSHA calculated PELs, ranged from < 1 for the same 7 job titles and 5.66 and 7.62 for sand mover operators and transfer belt operators, respectively. Workers with these same two job titles were determined to have the highest exposure risks for silica exposures based on calculated geometric means (Figure 7.3). Seven point sources of silica dust generation at hydraulic fracturing sites were identified and a variety of controls were recommended to limit crystalline silica emissions from the sources identified.

Metals

Risks for exposures to metals can occur from welding, cutting, grinding, repair and fabrication of machines and parts, and hardbanding or “hard facing” of tubulars to deter abrasion from drill pipe handling machinery. Hazards from

fume and particulates can include parent or filler metals (e.g., chromium, cobalt, copper, iron, manganese, molybdenum, nickel, tungsten, vanadium, zirconium). No studies describing risks for workplace exposures to metals in O&G extraction during hardbanding, welding, fabrication, and repair operations were identified in the literature.

Six cases of elevated blood lead levels (BLLs) in workers and children from occupational and take-home exposures to lead-containing “pipe dope” were reported by the Oklahoma Childhood Lead Poisoning Prevention Program (Khan, 2011). The lead was reportedly from lead-containing pipe dope used as an assembly lubricant during well string makeup during drilling operations. Four children of three workers involved in drilling and well servicing were reported to have BLLs ranging from 18–22 $\mu\text{g}/\text{dL}$. Two of the workers associated with the children with elevated BLLs had BLLs of 29 and 39 $\mu\text{g}/\text{dL}$; the third worker did not get a BLL test. The CDC defines elevated BLLs as greater than 5 $\mu\text{g}/\text{dL}$ in children and ≥ 10 $\mu\text{g}/\text{dL}$ in adults (CDC, 2013). Environmental evaluations in the homes of the workers identified “elevated” lead surface concentrations in a laundry room, atop washing machines and furniture, and on work clothing and footwear.

Government and Industry Safety and Health Initiatives

Multiple government and industry efforts to address OSH in O&G extraction have been implemented in recent years. The National Service, Transmission, Exploration & Production Safety Network (STEPS) (www.nationalstepsnetwork.org) was established in South Texas in 2003 to focus on safety and health issues in the industry and to reduce injuries and fatalities in that region. STEPS has grown to 22 independent regional networks serving 20 states and has become the most effective tool for disseminating key safety and health information throughout the industry. The OSHA Oil and Gas Safety and Health Conference, the first national conference dedicated to the safety and health of workers in the oilfield, was created in 2008 and is held every two years. In addition, a standardized worker safety orientation called SafeLandUSA was developed. The SafeLandUSA orientation was incorporated into requirements for contract workers to access and work at well sites owned mostly by O&G operators. A new course in hazard recognition and regulatory health and safety standards for onshore O&G exploration and production operations called OSHA 5810 has been developed and is offered through OSHA Training Institutes and Education Centers throughout the US. There were also Federal Government efforts to address OSH concerns in this industry, including establishment of the CDC NIOSH National Occupational Research Agenda (NORA) Oil and Gas Sector Council (see Chapter 12). This program emphasizes collaborative efforts that led to partnerships with industry, government, and other stakeholders to conduct research in reducing the rate of injury and disease among workers in the O&G extraction industry by determining hazards and quantifying risks and ultimately implementing effective interventions. This program analyzes surveillance data and information gained from industry, workers, and safety organizations, conducts exposure assessment research on key safety and health issues,

and develops and implements practical workplace solutions. OSHA has also initiated local, regional, and national emphasis programs specifically targeting aspects of the O&G extraction industry.

Disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the views of NIOSH.

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