OIL AND GAS WORKER SAFETY GUIDE

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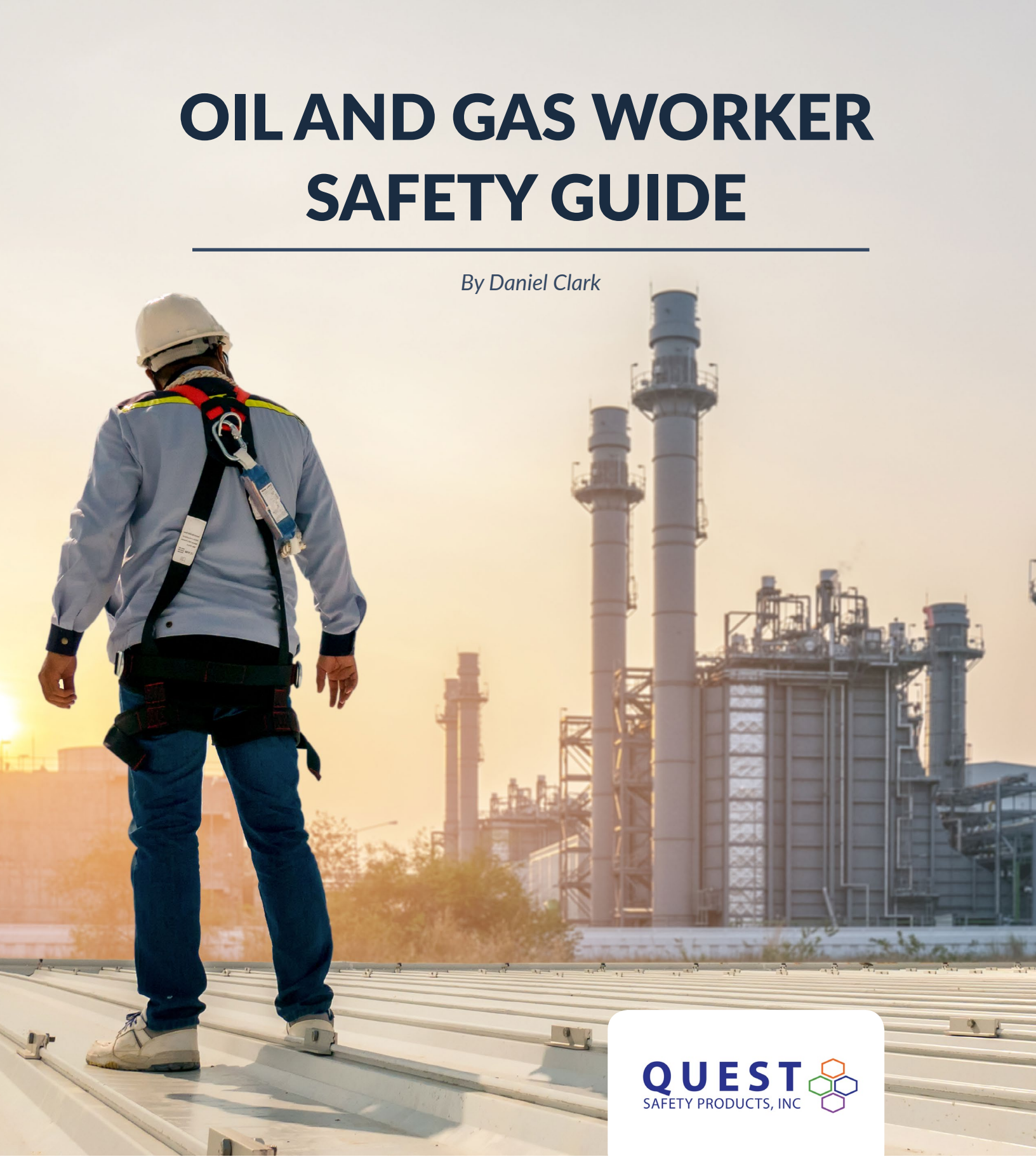

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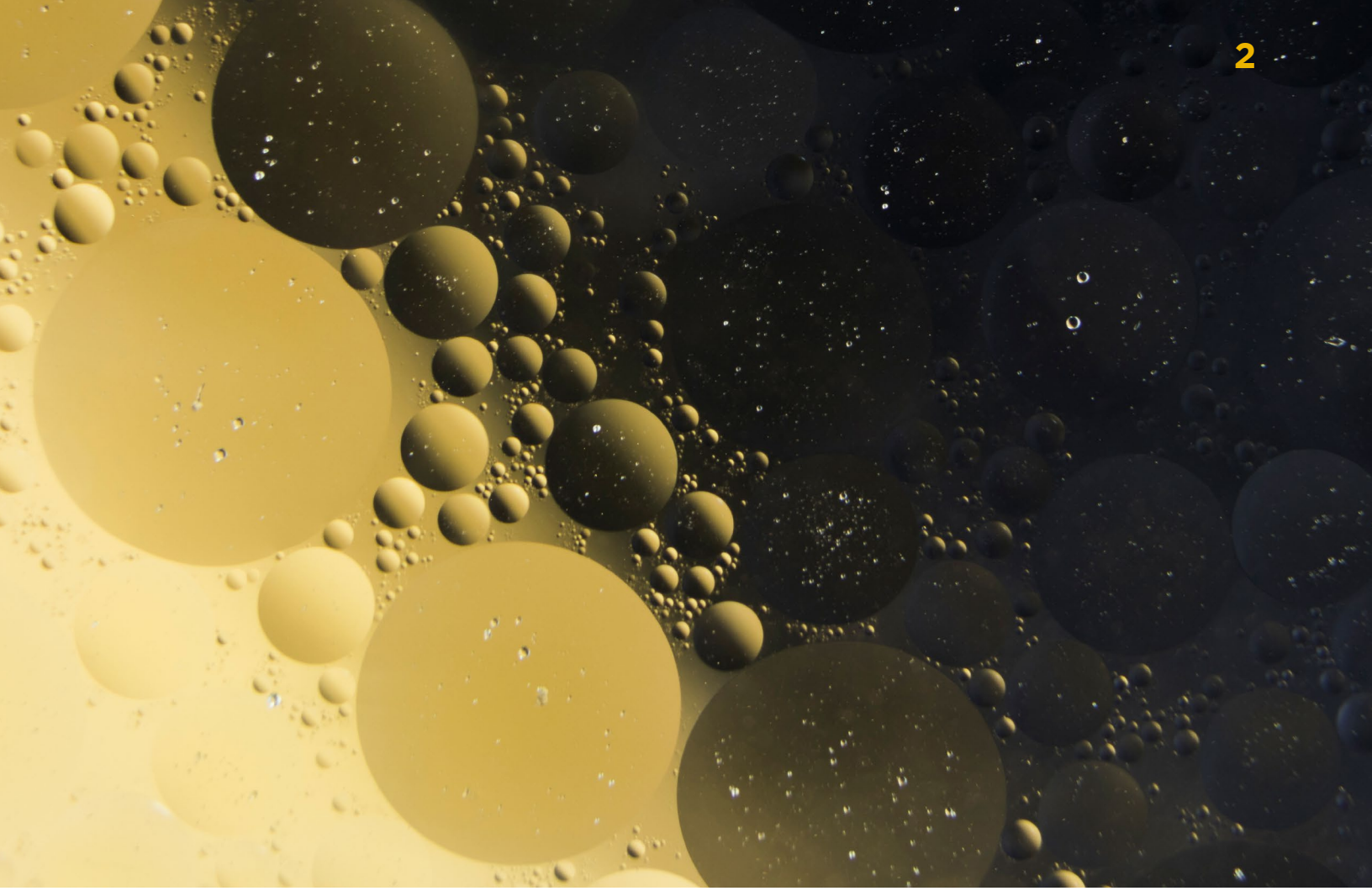

Working in the oil and gas industry is appealing and lucrative. It's a competitive mix of regional pride, fluctuating economic highs and lows, and technical challenges – replete with major hazards in every step of the process. From upstream to downstream, the total distributed process involves a chain of regionally and procedurally distinct industries working in concert to bring oil and gas to market. Workers in all corners of the petrochemical sector have to be diligent about the array of hazards they face, including high pressure, flammable, and toxic chemicals.

The earth doesn't give up her hydrocarbons easily, nor do they come in discrete packages. Heavy or light, sweet or sour, bitumen, crude, mixed with water or sand, occasionally containing trace radiation or a combination of the above – you have to earn every ounce. Depending on the composition, produced oil and gas has to be channeled through a series of refinement steps which must be carefully controlled by knowledgeable professionals. Any misstep, spill, or leak is an issue, and the public is always watching.

DEADLY AMBITION

High risk meets high reward in the oil patch. One can make a good living in the industry but it's no joke – these are some of the hardest working people out there! Production goes on around the clock, through blazing heat, bitter cold, political unrest, economic collapse, and emergency conditions. They face some of the toughest engineering challenges and the work is mentally and physically demanding. Worker are vigilant under the weight of stress and fatigue, but incidents do occur.

NIOSH captures Fatality in Oil and Gas (FOG) data and shares it on the CDC website to track ongoing safety performance in the industry. In 2016, there were 63 fatalities compared with 29 the previous year, but if you correct for the activity in the sector it is more or less consistent. Some trends emerge when the data is further broken down, revealing that fatal incidents skew heavily to workers in their first year, those working alone, well servicing activity and, to a huge degree, traveling in vehicles. New or inexperienced workers are more likely to get injured on the job, so incident numbers tend to rise and fall with the economy when new worker demand trends upward.

While some activities are far more perilous than others, working in oil and gas means facing a number of hazards that must always be kept in mind. We'll go over the most significant ones.

Fire and Explosion

Fire is one of the largest risks in oil and gas, mainly because the potential severity of fire-related incidents is so high.

HOT WORK

Any work that creates or has a potential to create sparks or has any other ignition potentials (such as starting engines) is considered "hot work." Welding, brazing, grinding, cutting, or otherwise machining metal all have potential to create sparks, and it just takes a single errant one meeting the right mixture of air can create flames on a worksite. Less obviously, any work that utilizes electrical equipment that is not "intrinsically safe" (meaning the electrical switching mechanism is isolated from atmosphere) is also considered hot work. That would include any energized power sources, DC battery powered hand tools, lighting – anything electrical that isn't specifically defined intrinsically safe.

SPARKS IN ODD PLACES

Grounding and bonding any equipment that, roughly speaking, moves material from one container to another also falls under the umbrella consideration of hot work. When different materials move against one another, as with gas traveling through a pipe or hose, they generate a static electrical charge. If materials become charged and have no path to discharge to the earth, they may build up a voltage potential between two surfaces. A static discharge has enough energy to ignite an atmosphere in the explosive range, which can easily happen when disconnecting lines. This might seem overly specific, but this exact scenario has led to numerous incidents when improper grounding and bonding is used.

PYROPHORICS

When hydrogen sulphide (sour gas) reacts with iron in a low oxygen environment, one of the chemical products is iron sulphide. When exposed to air, this chemical can produce enough heat in an exothermic reaction to ignite itself (this is known as pyrophoric scale). Awareness of where this process occurs is important when opening vessels because it will spontaneously ignite once it dries out enough.

This is worth a special mention since it is fairly unique to oil and gas settings and it has contributed to some major incidents. It is easy to overlook, so it is worth noting in orientations and during training.

SPARK WATCH

Wayward sparks can continue to pose a hazard long after hot work tasks are finished. Wherever sparks, slag, or flames are produced, procedures usually include watch duties following work for a specified period in case an explosive atmosphere develops or an incipient spark kindles into a flame. Spark watch might be a dull assignment, but it's an important one.

Hazardous Atmospheres

Hazardous atmospheres are another principal concern on any oil and gas site. Leaks anywhere in a system consisting of miles of pipe, vessels, tanks, and valves can silently produce explosive or toxic atmospheres, posing a serious hazard to workers. Proactive approaches are needed in order to monitor air composition before, during, and even after work is carried out.

SOMETHING IN THE AIR

In the upstream oil and gas industry in Western Canada, 17% of fatalities are related to toxic substance exposure. Many of these cases are latent cancers or conditions resulting from long-past exposures, and yet they remain relevant since asbestos is still present on many sites.

Lab data is used to establish levels of exposure to substances that may be present on a worksite. The American College of Governmental Industrial Hygienists (ACGIH) releases an extensive lists of Threshold Limit Values (TLV) which gives the concentration of a substance to which a worker can (in theory) be continuously exposed without harm during their working career. Even so, in basically every case, a 0 level is preferred if it can reasonably be achieved. ACGIH data is used to establish Occupational Exposure Limits (OEL), Short Term Exposure Limit (STEL) Ceilings, and a method for calculating Time Weighted Averages (TWA). Workers should be informed about the relevant levels for the substances they may encounter, and the specific controls they require.

Air monitoring is used in any work area where a concentration may exceed the exposure limits, and any detection above an ambient level is looked at carefully. If you get a sniff of gas where you are monitoring, there is a reasonable assumption that the concentration is higher somewhere nearby, so assessment is needed to make sure that the source is controlled.

Incidentally, “taking a sniff” is a term sometimes used to mean sampling air in an area, but with a calibrated monitor. Many chemicals that may be present, such as any alkanes (pentane, butane, hexane, propane, methane) actually have no detectable odor. In some cases, mercaptan odor is added to gas as it is processed in order to give it a familiar odor so that it can be smelled.

A CLEAN SHAVE

Where a potential exists for a worker to have to “mask up” or go “under air” (don a full mask, supplied air respirator, or a particle filter mask), they have to be ready to do so at a moment’s notice. For male workers, this means that most sites require a clean shaven face. At least, it has to be clean shaven anywhere that the mask contacts the skin in order to make an airtight seal. If a mask can’t seal to the face, it can’t function as designed. In practice, this means that any worker who may have to mask up can sport a mustache but the rest has got to go. In addition, masks should be “fit tested” to select a respirator that maintains an airtight seal to their specific face size and shape.

Driving

You often hear safety reps reiterate that driving is the most dangerous thing that we do in the oil patch. Over the past 17 years, 44% of occupation fatalities in western Canadian upstream oil industry were transportation incidents. The big picture statistics across all industries paints this picture vividly. The U.S. Bureau of Labor Statistics reported in 2017 that of the fatal workplace injuries for the year, 2,077 were related to transportation, with the second highest category being falls at 887. Of the transport fatalities, 1,299 were roadway incidents, which is more than air, water, rail, pedestrian, and non-roadway incidents combined.

Road conditions in the oil patch vary from paved roads to gravel, dirt, trunk roads, or no road at all. In Canada, a good deal of oil and gas activity also happens in the northern region, which is subject to extremely harsh weather, and times of year with poor light. Go far enough north in December and you might find the sun never really rises at all!

Each of these factors coalesce into extreme danger on the road, and that doesn't even include the biggest factor of all: the drivers themselves.

THE ROAD TO ZERO INCIDENTS

Fatigue, substance use, and speed are common factors in vehicle incidents. Current trends in industry technology reflect an effort to target those specific factors with in-car trip monitoring, dry camps, "fit for work" mobile games, defensive driving requirements, GPS tracking, vehicle inspection, and other creative behavior-based approaches. In Alberta, the legislation was recently revised to include vehicles of all types in the definition of "work site" in an effort to better capture those activities under regulation.

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Confined Space

A confined space is an area not designed for continuous occupancy, which has a limited means of entry and egress, and a potential for a hazardous atmosphere or other hazards to develop. Placards indicating identified confined spaces are ubiquitous on oil and gas worksites, and best practices for entry combine several major safety principles.

LITTLE ROOM FOR ERROR

Lockout procedures must be rigorously followed and double-checked to ensure that a confined space cannot be opened to sources of energy while occupied. Physical locks are put on control panels and valves to prevent chemicals entering, moving parts moving, electrical current flowing, or any other hazard being unexpectedly introduced into an occupied confined space. Air quality must be continuously monitored for LEL (lower explosive limit – the lowest concentration of a gas in air that is flammable), the presence of specific gases, and the level of oxygen any time someone is in the space.

The presence of gas poses obvious problems, but oxygen being either too high or too low can both be hazardous. Lowered oxygen (<19.5% by volume) is an alarm condition as workers in the atmosphere can develop confusion and other hypoxic symptoms. High oxygen (>23%), on the other hand, poses an increased fire risk.

Toxic or potentially explosive atmospheres are a concern if a vessel has been improperly isolated or incompletely purged. A variety of flammable vapors can be present on oil and gas sites, so continuous monitoring for LEL is done, particularly where “hot work” might be conducted.

DOCUMENTATION

Confined space entry is treated with the utmost seriousness on oil and gas sites. There is a permitting process to allow only specified workers into a space, all of whom must be adequately trained. The whole process is supervised by a separate, competent worker continuously monitoring and recording air quality within the space.

Each worker entering has to "lock out" the vessel, meaning they physically add a lock to an isolation valve or panel such that it can't be re-energized before all locks are removed. Employers need to implement a process by which workers entering a confined space are signed in or out as they enter and leave the space, as to ensure that all have exited at the completion of work and a rescue plan if any don't.

All of the above comes into effect if the planned work will involve "breaking the plane" of a confined space – that is, any body part whatsoever passing through the entrance to the vessel. As I said, it's serious business.

TAKE MY BREATH AWAY

Oxygen deficient atmospheres can often occur in low-lying or underground areas with poor ventilation or in vessels with little air circulation. Carbon dioxide, which is heavier than air, can settle into underground areas and displace oxygen leaving a smothering atmosphere. When a vessel has been inerted with nitrogen, as is common practice, poor ventilation may mean that there is no breathable atmosphere inside, which can persist. Unlike with CO_2, someone entering a nitrogen environment may feel no physiological warning signs of suffocating, but they can succumb to it with merely a few breaths. Unfortunately, this has proved fatal in many cases.

Emergency Response Plan

There is a great deal to consider in organizing an emergency response plan for an oil and gas operation. Every worker on site is oriented to emergency procedures, alerts, evacuation plans, and their own responsibilities with respect to emergency situations. Specially trained responders are regularly scheduled workers on many sites, and spend their ample down-time practicing, drilling and examining scenarios.

Those tasked with compiling emergency action guidelines have to consider all categories of loss: people, environment, materials, and equipment. On top of worker safety, any threats to the public must be specially considered including the communication parameters, alarm conditions, and geography. For example, sour gas is heavier than air and will tend to "roll" downhill and collect in low-lying areas. Safety professionals have to consider this factor along with wind direction and neighboring populated areas to establish zones and define actions.

Fall Protection

Harnesses, fall restraint systems, and life lines are common implements on oil and gas sites, particularly in turnaround/shutdown conditions. Fall protection provisions have to be implemented for a broad array of tasks so that they protect the worker without unreasonably hindering the work or inadvertently posing additional hazards.

The standard requirement is to use fall protection for any work occurring at a height above 10 feet (3 meters). The relatively low height occasionally earns jeers from some workers but most in the oil patch are used to it and comply as a matter of course. Some sites even choose to exceed the minimum standard and require fall protection for any work above 6 feet, which is increasingly becoming standard in the industry.

It simply doesn't take much height to make a fall dangerous. As of this writing, OSHA has 10 fatalities from falls recorded so far in 2019, and most are from surprisingly modest heights.

PLANNING FOR THE FALL

Fall protection planning roughly consists of two categories: arrest and restraint. The former deals with providing equipment to safely stop a falling worker, and the latter attempts to restrict workers from approaching a ledge or opening where a fall could occur. The difference could alternately be thought of as fall protection versus fall prevention.

Depending on the work being done, restraint systems could be preferable safety-wise, representing an engineering control compared to fall arrest's PPE-based approach. However, practicability is a consideration. In many cases a fall arrest system gives more needed mobility to a worker and is thus preferred, but by design it aims to dampen the consequences of a fall incident, not prevent one.

Even with proper gear, trauma from falls can occur. In 2017, NIOSH fall statistics include one fatality from a fall that was curtailed by a fall arrest system – a reminder of why PPE is the least-desirable control method.

The nature of the fall hazards in oil and gas aren't particularly novel. They have much in common with construction and other industries, but since working at heights is so common it bears special consideration when viewing safety in the industry overall. In 2017, 713 US workers (across all industries) died when they fell to a lower level on a worksite. That year, falls were the second most populous fatality category after transportation.

HARNESSES, CARABINERS, HOOKS, AND ANCHORS

Most of the fall protection parameters are similar to those specified in other industries. Equipment needs inspection prior to use, noting any degradation that could be caused by friction, age, chemical solvents or heat. Anchor points have to be engineered to bear the mass of a body after a 6-foot fall, which is a significant tug!

Response and rescue plans need to consider time, even when fall protection works as designed, to prevent suspension syndrome in the fallen worker.

The physics and engineering is ideally considered long before work begins so that appropriate equipment and structures are in place and ready to use. The physics homework should be long since complete, figuring out swing arcs, fall energy in Newtons (N), fall distances and clearances so that the worker can safely select an anchor point, tie off, and go to work.

Oil and Gas Going Forward

Oil and gas can be a great industry to work in, but it has demands to meet. You have to be smart, vigilant, and focused to make sure you and your coworkers work and make it home safely. To your benefit, you get to work alongside some brilliant, innovative engineering and some of the hardest-working folks you'll probably ever meet.

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