The National Institute for Occupational Safety and Health (NIOSH)

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Two Rescuers Die in Fracturing Tank in West Virginia Gas Field

FACE 8502

Introduction

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily upon selected electrically-related fatal injuries and confined space fatalities. By scientifically collecting data from a sample of fatal accidents, the FACE will identify and rank factors which increase the risk of fatal injuries for selected employees.

On October 4 1984, two workers died while attempting to rescue a third worker who had entered a fracturing tank at a natural gas well. A total of four men entered the. tank and were overcome by natural gas. The two workers who died drowned in 30 inches of liquid (water, gas, acid, and possibly oil) which had been released into the tank during “blow down” procedures. The other two workers, both rig hands, required medical treatment at local hospitals.

Contacts/Activities

Subsequent to a request for technical assistance from the Chief Medical Examiner, a DSR research team, consisting of a safety specialist, an occupational health nurse, and a visiting intern, met with the employer, surveyed the accident site, and visited the location where the fracturing tanks (including the one involved in the fatal accident) were currently being used. Since the incident (almost two months), the tanks had been moved, and were full of water such that the inside could not be inspected. During the survey, the location of the tanks at the time of the accident was established, and the site was recorded with video and 35m cameras. Interviews were held with the field and administrative supervisors, the rig supervisor, a paralegal assistant employed by the law firm representing the company, and the two injured workers. Information was obtained from these interviews regarding the employer’s history and activities, safety and training programs, and injury record. Further information obtained allowed DSR researchers to reconstruct the events leading to the worker deaths.

Synopsis of Events

On the day of the accident, at approximately 7:30 a.m., a five-man crew assembled in the office of the field supervisor to receive their instructions for the day. The crew consisted of two service rig hands (hereafter designated “rig hands”) and their supervisor, the service rig operator (hereafter designated “operator”). In addition, the rig supervisor (hereafter designated “supervisor”) and the service rig tool pusher (hereafter designated “tool pusher”) were assigned to the crew so that the supervisor could instruct the tool pusher in the assembly and usage of the packing and down hole tools necessary

to complete the job. The crew was informed that they were to “blow the well down” (relieve the internal pressure). If they could get the pressure down to acceptable levels, they were to start putting the tubing down. All members of the crew were familiar with the procedures necessary to blow down the well and insert the tubing. The crew began to work by about 8:30 a.m.

When the well Is “blown down,” gas, water, acid, and occasionally oil are released. These substances are directed into the fracturing tanks through two-inch steel “flow back” lines. Because of the pressure exerted on these lines, they are secured to the tanks with safety chains. When sufficient steel lines are not available to plumb in all of the tanks, a high pressure, double walled, two-inch rubber hose, called a Kelly hose, is used as a f low back line. When the Kelly hose is used, it must be tied down, both to the inside and outside of the tank, to prevent it from whipping around when the well is flowing during blow down.

By approximately 9:30 a.m., the well had blown down sufficiently to begin inserting the tubing, so the operator and one of the rig hands began to disconnect the well from the fracturing tanks. The remaining members of the crew (the supervisor, tool pusher, and one rig hand) were near the service rig,, assembling the down hole equipment when they heard the operator yell that the rig hand was in the tank. The operator then entered the tank himself. Despite warnings by the rig supervisor to stay out of the tank, the other rig hand entered the tank, followed by the tool pusher. When the supervisor got to the top of the tank and looked in, he could only see two of the men and they were unresponsive and “dazed looking.” He immediately got off of the tank and opened the valves to release the water in the tank. He then called f or help on the truck radio.

When the call’ was received at the office, the rescue squad was notified, and arrangements were made to have the supervisor of a second crew meet the ambulance and give them directions. In the meantime, the rig hands from the second crew proceeded to the site to provide additional assistance, and other supervisors and employees proceeded to the site as well.

When the two rig hands from the second crew arrived, they helped the supervisor remove two clean-out panels at the bottom of the tank. By this time, most of the liquids had been drained from the bottom of the tank. When the panels were removed, the bodies of the operator and tool pusher were found lying on the bottom, of the tank. one of the rig hands was found standing in the tank, but was unresponsive; the other rig hand, also unresponsive, was found attempting to climb up the internal support bars of the tank, but appeared ready to fall. The two rig hands who had entered the tank and survived the incident reported that within 10 – 15 seconds of entering, they were overcome by the gas. They could not remember anything past that point.

The autopsy reports indicated that the rig operator and the tool pusher died by drowning due to asphyxiation.

General Conclusions and Recommendations

The following factors-contributed to this fatal incident:

1. “Blowing the well” releases water, acid, oil, and natural gas into the fracturing tanks. In this area of the country, the primary component of natural gas is methane (75-85%). Although methane is not considered a toxic gas, it is a simple asphyxiant. In high concentrations, it displaces the oxygen required to sustain life. When methane is present in concentrations exceeding 20 to 30 percent (by volume), the inspired air is usually oxygen deficient, and signs and symptoms of oxygen deficiency may be noted. In addition, methane is an anesthetic at high concentrations. Either oxygen deficiency or the anesthetic qualities of methane could account for the workers being overcome so quickly.

2. The use of a Kelly hose as a flow back line necessitates entry into a confined space to secure the line to prevent it from whipping around when it’s under pressure. Had a sufficient number of metal flow back lines been available, the need to enter the tank would have been precluded.

3. There were no written or verbal safety policies or procedures for safe entry into a confined space. Appropriate procedures would have required testing for oxygen and/or methane levels prior to entry.

4. There were neither policies nor procedures for emergency rescue from a confined space.

5. The workers had not received specialized training for entering confined spaces. The employees stated that they knew what a confined space was. However, they had never received any training classes to inform them about the potential hazards associated with confined spaces, let alone training in confined space entry or emergency procedures.

Recommendation: A confined space policy and appropriate procedures should be established by the company. The policy and procedures should indicate: the areas designated to be confined spaces, conditions where entry to confined spaces is authorized (for example, when the tanks need to be fiberglassed), procedures to be followed before entry is permitted (testing, entry permit, training, lockout/tagout procedures, etc.), and rescue procedures. Emergency response by office personnel appeared to be good during this incident; however, an emergency procedure should be established, documented, and practiced.

Recommendation: A training program should be developed by the company to ensure that workers who are expected, in the course of their work, to enter and work in confined spaces, have knowledge of the hazards they may encounter, are fully cognizant of the requirements of the confined space evaluation and entry procedures, and are versed in emergency rescue procedures.

Recommendation: A procedure which makes metal flow back lines mandatory is needed. This would eliminate the need for entry into the fracturing tanks to either secure or disconnect Kelly hoses. Bars welded across the top opening to the tank would eliminate unauthorized entry into the field. When entry to the tank is authorized, both clean-out panels on the bottom of the tank should be opened. This gives two emergency entry/exits. If safe entry dictates the need for a top opening, the welded bars could be removed.

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