California Department of Public Health

Occupational Health Branch

FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM (CA/FACE)

A Hydroblasting Laborer Dies When He Falls Into an Underground Vertical Pipe and Suffocates

Case Report: 16CA001

SUMMARY

A hydroblasting laborer working at a geothermal facility died when he fell into an open 24-foot deep vertical pipe. A pump had recently been removed by a facility crew, exposing the top end of the pipe which was at ground level. The opening was covered with a sheet of insulation jacketing which hid the underlying hole. When the victim stepped on the jacketing, he fell through the hole into liquid isopentane at the bottom of the pipe and suffocated. The California Fatality Assessment Control Evaluation (CA/FACE) program concluded that geothermal facility operators and onsite contractors should take the following steps to prevent similar incidents:

- Hazardous openings should be enclosed with guardrailing and affixed with a warning sign. Alternatively, the openings should be covered with a tool-secured cover strong enough to support foreseeable loads; the cover should be affixed with an appropriate warning placard.
- Employers sharing a worksite should notify others of activities which may create new hazards. This is part of their Injury and Illness Prevention Program (IIPP) responsibility on a multi-employer worksite.
- Supervisors and foremen, as part of their employer's IIPP responsibility, should assess worksites for newly-created hazards. This should be done at the beginning of the shift and periodically as needed.

INTRODUCTION

On Tuesday, March 29, 2016, at approximately 6 pm, a 27-year-old Hispanic male laborer suffocated in liquid isopentane when he fell into an uncovered vertical pipe at a geothermal facility. On April 5, 2016, CA/FACE learned of the fatality from the Cal/OSHA Headquarters' Weekly Bulletin. The CA/FACE investigator conducted an onsite investigation on May 13, 2016. During the site visit the investigator met with representatives of the geothermal facility, visited the location of the fatality, and took photographs. In addition, the investigator conducted

several phone interviews with the hydroblasting contractor management and employees. The county sheriff's and coroner's reports were also obtained.

EMPLOYER

The victim's employer was a hydroblasting contractor that served industrial clients. The company was established in 1988 and, at the time of the incident, employed 24 workers. The geothermal facility, where the incident occurred, was a major customer of the contractor's services. Hydroblasting uses a stream of high-pressure water to remove coatings and contaminants from various surfaces.

WRITTEN SAFETY PROGRAMS AND TRAINING

The employer had a written Injury and Illness Prevention Program (IIPP) and conducted regular tailgate safety meetings. However, the foremen who were interviewed did not consider it part of their assigned duties to conduct initial or regular site hazard assessments. The geothermal facility had a written IIPP and a written procedure covering 'Pump Maintenance.' This document mentioned covering any uncovered pipe opening, but did not specify how this was to be done so as to eliminate the hazard of falling into the pipe.

WORKER INFORMATION

The victim was a bilingual 27-year-old Hispanic male hydroblasting laborer who had been working for the company for 3 years. He was married and had three children.

INCIDENT SCENE

The incident scene was an outdoor geothermal well pad which was undergoing turn-around maintenance and repair. The well pad was comprised of heat exchangers, a turbine, condensers, and cooling towers. The well pad used a 'binary cycle' process employing isopentane as a low-boiling secondary fluid which, as part of a closed system, absorbed the heat from the geothermal steam in the heat exchangers, drove the turbine, and then was fed back to the condensers. A pump (the 'vertical motive feed pump') was used to transport the cooled isopentane from the condenser back to the heat exchanger. This pump motor and housing were at ground level and set on top of a 2 ft. diameter vertical pipe (ID 23.5 inches) which descended 24 ft. into the ground. The pipe was capped at its bottom end. This is commonly called a 'can.' At the time of this incident this 'can' contained a reservoir of approximately 150 gallons of liquid isopentane.

The employer was hired to use hydroblasting to clean the many horizontal tubes that ran the length of the condensers. The job was scheduled for four to five days in length; the employer had two twelve-hour crews onsite – one crew working 6 am to 6 pm, the other working from 6 pm to 6 am. Each crew consisted of three laborers and a foreman. The employer had set up small scaffolds on both ends (north and south) of the three condensers.

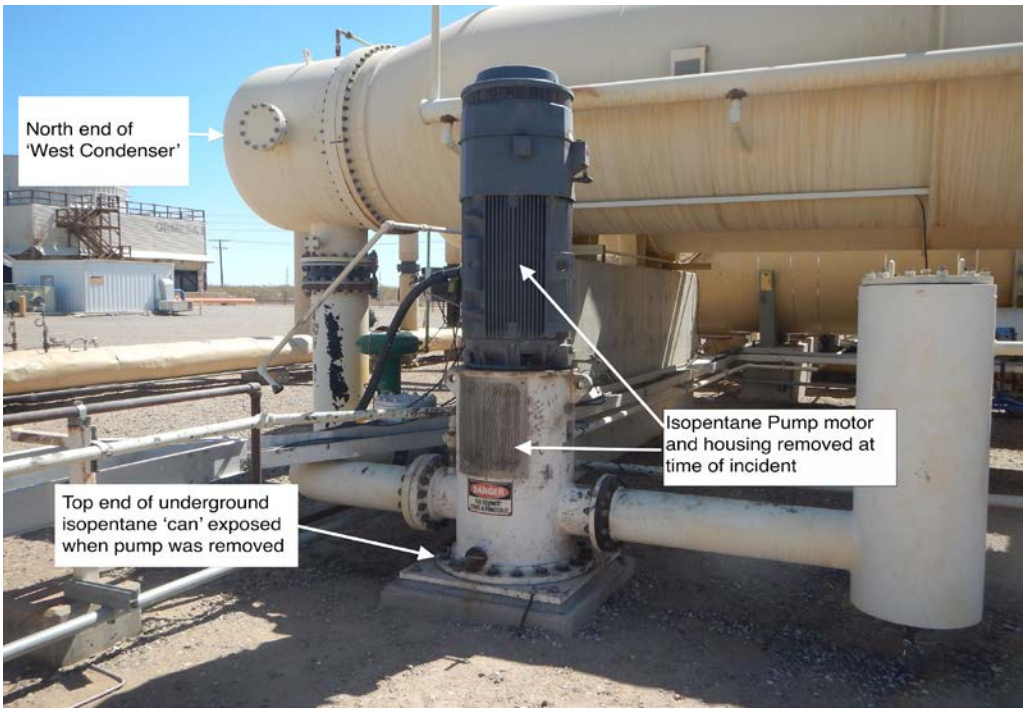
WEATHER

On March 29th, the weather was clear and windy with a high temperature of 72 degrees. The sunset was at 7 pm.

INVESTIGATION

On the day of the incident, the employer's morning crew began its shift at 6 am. At approximately 9:30 am a geothermal facility crew pulled the isopentane pump motor and housing from their base, and pulled the pump mechanism out of the 24-ft.-deep 'can'. The pump was located just south (approximately 12 ft.) from the north end of the 'west condenser' (see Exhibit A, below), where the employer had set up a scaffold.

Exhibit A



When the geothermal crew removed the pump, they exposed the vertical 'can' opening which was beneath the pump. The 'can' consisted of a 2 ft. diameter circular pipe which descended vertically 24 ft. from ground level. The bottom of the 'can' was capped and, at the time, contained an estimated 150 gallons of liquid isopentane. A geothermal plant employee found a nearby sheet (4 ft. x 4 ft., 1-2 inches thick) of insulation jacketing that had been temporarily removed from the turbine, and used it to cover the exposed 'can' hole in order to minimize contamination of the isopentane. On top of this sheet of insulation jacketing, two 6 ft. scaffold boards were placed across the top of the 'can'. These boards were likely taken from the scaffold set up by the contractor on the south end of the 'west condenser'. The geothermal facility did not notify the employer that the pump had been removed, and that the underlying isopentane 'can' had only an improvised cover. Later that day, the two scaffold boards were removed, leaving only the insulation jacketing covering the top of the 'can'. It is not known who removed these boards and for what purpose.

At approximately 6 pm the employer's night crew, including the victim, arrived to start their shift. The night crew foreman later reported that he did not know that the pump had been removed and the underlying 'can' exposed. The victim volunteered to be the first employee to take on blasting duties at the north end of the 'west condenser'. He was last seen leaving the job trailer, walking towards the bank of condensers. He was wearing a jumpsuit with both a Tyvek suit and a rain slicker over it, steel-toed rubber boots, and fall-arrest harness and lanyard. He also was wearing a hard hat and carrying a full-face air-purifying respirator.

Based on interviews and physical evidence, the victim may have decided to take a shorter route to the south end of the 'west condenser', where his support crew had been instructed to set up plastic sheeting to collect the runoff water. Rather than walk around the entire bank of condensers, he may have taken the shortcut that was frequently used by the crew. This involved climbing over the low-lying horizontal pipes and electrical conduit at the north end of the condenser. Standing on top of the flanged pipe end (that had recently been disconnected from the removed pump housing), approximately 1 to 2 ft. off the ground, he may have jumped onto the sheet of insulation jacketing covering the open end of the 'can'. The victim likely landed on the blanketing with both feet within the circumference of the underlying opening. The insulation jacketing covering the top of the 'can' did not support his weight and the victim slid down into the liquid isopentane.

When the victim was found to be missing shortly after the beginning of the work shift, the employer's foreman conducted a brief search of the area. He did not notice the exposed 'can.' After consulting other crew members, the foreman thought that the victim had walked off the job for a personal reason, and the crew completed the shift without him. When the victim failed to appear the following evening, his wife called the sheriff's department to report he was

missing, and the employer notified the geothermal facility. A search of the facility and the surrounding area was unsuccessful. The following day the facility crew attempted to reinstall the repaired pump mechanism. They noticed a hard hat floating on the surface of the liquid isopentane. A crane was used to pull the 'can' out of the ground. When it was tilted upside down the victim's body slid out, feet entangled in the sheet of insulation jacketing.

CONTRIBUTING FACTORS

Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in an injury or fatality. The CA/FACE team identified the following contributing factors in this incident that ultimately led to the fatality:

- Lack of established geothermal plant procedures for safely enclosing or covering 'can' openings created when pumps are removed.
- The geothermal facility did not notify the employer that by removing the pump they had created a new hazard in the employer's jobsite.
- The employer's foremen did not conduct inspections of their jobsite for newly-created hazards.

CAUSE OF DEATH

The cause of death according to the death certificate was suffocation due to exposure to isopentane.

RECOMMENDATIONS

Geothermal facility operators and onsite contractors should take the following steps to prevent similar incidents:

Recommendation #1: Hazardous openings should be enclosed with guardrailing and affixed with a warning sign. Alternatively, the openings should be covered with a tool-secured cover strong enough to support foreseeable loads; the cover should be affixed with an appropriate warning placard.

Discussion: The geothermal plant had no procedure to safely enclose or cover 'can' openings created when pumps were removed. There were no guardrail or fabricated covers designed for this use available to the crew. In the past, the crew had used a range of materials to improvise covering or enclosing 'can' openings. In this incident, if there had been an established procedure on which the crew had been trained, together with either a railing or a fabricated cover for the crew to use, the exposed 'can' opening would have been eliminated.

Recommendation #2: Employers sharing a worksite should notify others of activities which may create new hazards. This is part of their IIPP responsibility on a multi-employer worksite.

Discussion: Geothermal plant management reported that there was no communication between the facility crew and the hydroblasting crew regarding the removal of the nearby pump and the hazardous 'can' opening that it uncovered. Had the employer been notified, the employer would have been able to take steps to ensure the safety of its employees. It is likely that the victim would have known of the hazard and stayed clear of the area. The plant management should have trained employees to notify affected outside contractors of newly-created hazards.

Recommendation #3: Supervisors and foremen, as part of their IIPP responsibility, should assess worksites for newly-created hazards. This should be done at the beginning of the shift and periodically as needed.

Discussion: The hydroblasting contractor day shift foreman reported that he was not aware of the hazard created by the removal of the pump. Had he conducted periodic inspections of the worksite, he might have noticed the hazard of the open 'can'. The nightshift foreman similarly reported that he was unaware of the hazard created during the prior shift. An initial inspection of the worksite at the beginning of the shift may have led to the discovery and elimination of the hazard. The employer should train supervisors and foremen to assess worksites for newly-created hazards.

REFERENCES

California Code of Regulations, Title 8, §3480 Vats, Pans and Tanks. (www.dir.ca.gov/title8/3480.html)

California Code of Regulations, Title 8, §3203 and §1509, Injury and Illness Prevention. (www.dir.ca.gov/title8/3203.html)

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FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The California Department of Public Health, in cooperation with the Public Health Institute and the National Institute for Occupational Safety and Health (NIOSH), conducts investigations of work-related fatalities. The goal of the CA/FACE program is to prevent fatal work injuries. CA/FACE aims to achieve this goal by studying the work environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact. NIOSH-funded, state-based FACE programs include: California, Iowa, Kentucky, Massachusetts, Michigan, New Jersey, New York, Oregon, and Washington.

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Additional information regarding the CA/FACE program is available from:

California FACE Program
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