The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research NIOSH

Painter Dies from Burns Received from Explosion Inside Tank

FACE 8938

Introduction

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working 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.

On May 16, 1989, a 41-year-old male painter (the victim) suffered burn injuries from an explosion which occurred while he was painting the inside of a 1300-gallon tank. He died 5 days later. A 32-year-old male painter (co-worker) stationed outside the tank suffered burns and a broken arm.

Contacts/Activities

State officials of the occupational safety and health program notified DSR of the fatal incident and requested technical assistance. On June 22, 1989, a DSR team consisting of a research industrial hygienist and a medical officer met with state OSHA Compliance Officers and a company representative to gather information, and traveled to the site of the incident to conduct an investigation.

Overview of Employer's Safety Program

The employer is a sheet metal fabrication company with 30 employees. The company manufactures steel tanks and has been in business for 20 years. Most of the employees are sheet metal workers, welders and painters. The victim had been with the company as a painter for 3 ½ years. The co-worker had been a painter with the company for 4 years. The company has a management level employee who serves as the safety officer on a collateral-duty basis. The safety officer conducts safety meetings once a month. New employees receive a safety orientation which consists of a brief discussion of company requirements for workers to wear steel toe boots, hearing and eye protection. New employees are given handouts which they are expected to read covering safety requirements. The Company has no written safety program and does not have any written confined space entry procedures. Confined space entry procedures regarding ventilation of tanks during welding is discussed at monthly safety meetings.

Synopsis of Events

The victim and co-worker had been assigned to paint the inside of a recently fabricated 1300-gallon steel tank. The tank measured 68 inches high, 75 inches in diameter and stood vertically with a 22-inch diameter manway opening on the top.

The victim entered the tank by stepping on the mixing blades that had been built into the inside of the tank. He was wearing a supplied air respirator (without an auxiliary escape Self Contained Breathing Apparatus (SCBA)), welders cap, coveralls, rubber gloves, and steeltoe boots. To provide lighting for the victim, the co-worker positioned a 500-watt, non-explosion-proof halogen lamp over the manway opening. The co-worker then sat on top of the tank next to the manway to observe the victim. He (the co-worker) was wearing a dust/mist respirator. Using an airless spray gun, the victim began spray painting the inside of the tank with an epoxy base paint. The victim had completed painting the bottom and sides of the tank, and as he was painting the top when the spray gun nozzle hit the lamp, breaking the sealed beam. This ignited the epoxy vapor which caused a flash fire explosion. The victim was able to climb out of the tank unassisted. He then removed the respirator mask and both the victim and co-worker walked approximately 300 feet to the office. There they explained to office personnel what had happened. Office personnel notified the local Emergency Medical Service (EMS). Police officers who were in the area heard an emergency call concerning the explosion and arrived at the scene in 3 minutes. A rescue squad ambulance arrived 10 minutes after being notified and transported the victim to a local hospital emergency room. The co-worker was taken to the same hospital in another worker's car. Both workers were fully conscious and able to converse while being transported to the hospital and while medical care was being administered in the emergency room. The victim suffered second and third degree burns on 40% of his body (thighs, hands, arms and chest). The co-worker suffered first and second degree burns on 12% of his body (face and neck), and suffered a broken am from falling off the top of the tank after the explosion. The two workers were transported the same day to a near-by burn center where they were hospitalized. The co-worker recovered sufficiently to be released from the hospital 8 days after the incident. The victim died from burn complications 5 days after the incident.

Cause of Death

The attending physician listed the immediate cause of death as respiratory failure. This was due to respiratory complications as a consequence of thermal burns affecting 40% of the victim's body.

Recommendations/Discussion

Recommendation #1: All employers should develop and implement a safety program to protect their employees.

Discussion: The company did not have a formal safety program established. A logical first step in developing a safety program is to identify all potential hazards. One way is by analyzing the sequential steps in routine operations to identify potential hazards, and attempting to develop procedures or other control measures which effectively eliminate or reduce the hazards. This type of analysis in known as job hazard analysis. Additionally, each specific job involves hazards particular to that job or the working environment. For example, in the steel tank painting process there were two hazards which should have been identified: 1) The flammable epoxy paint being sprayed inside the tank, and 2) the non-explosion-proof floodlight being used to illuminate the spraying process. An evaluation of these hazards should have led to control measures such as changing to an explosion-proof light and/or substituting the epoxy paint for an acrylic base or other non-flammable paint. NIOSH Publication Number 78-100, "Health and Safety Guide for the Fabricated Structural Metal Products Industry" should be used as a guide in developing the safety program.

Recommendation #2: The employer should develop and implement specific confined space entry procedures.

Discussion: Although the company had verbal confined space procedures for entering and working in tanks, the procedures were unsafe and inadequate. The company should therefore immediately develop and implement a comprehensive confined space entry program as outlined in NIOSH Publications Number 80-106, "Working in Confined Spaces," and Number 87-113, "A Guide to Safety in Confined Spaces." At a Minimum, the following items should be addressed:

1. Is entry necessary? Can the assigned task be completed from the outside?

2. Has a confined space safe entry permit been issued by the company?

3. Are confined spaces posted with warning signs and are confined space procedures posted where they will be noticed by employees?

4. If entry is to be made, has the air quality in the confined space been tested for safety based on the following criteria:

– Oxygen supply at least19.5%

– Flammable range less than10% of the lower explosive limit

– Absence of toxic air contaminants

5. Have employees and supervisors been trained in the selection and use of:

– protective clothing

– respiratory protection

– hard hats

– eye protection

– gloves

– lifelines and

– emergency rescue equipment?

6. Have employees been trained for confined space entry?

7. Are confined space safe work practices discussed in safety meetings?

8. Have employees been trained in confined space rescue procedures?

9. Is ventilation equipment available and/or used?

10. Is the air quality tested when the ventilation system in operating?

In addition to the above items, the following should be specifically incorporated into the confined space procedures for work performed inside tanks:

1. The use of explosion-proof lighting and fixtures in and near flammable atmospheres, as required by National Electric Code (NEC) Article 501-9(a)(1) and 501-9(b)(1) and the National Fire Protection Association (NFPA) Standard 33.

2. The use of non-flammable paints (if at all possible) for coating the inside of tanks.

Recommendation #3: The employer should develop and implement a comprehensive respirator program as required by 29 CFR 1910.134, including either quantitative or qualitative fit testing and employee training in the use and limitations of air supplying and air-purifying respirators.

Discussion: Employees were not trained in the use of respirators. Although the victim wore a supplied air respirator, it was not equipped with an auxiliary, escape SCBA. Respirators should be selected according to criteria in the “NIOSH Respirator Decision Logic” (DHSS [NIOSH] Publication No. 87-108). Additional information on the characteristics and use of respirators is available in the “NIOSH Guide to Industrial Respiratory Protection” (DHSS [NIOSH] Publication No. 87-116).

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