The Missouri Department of Health, in co-operation with the National Institute for Occupational Safety and Health (NIOSH), is conducting a research project on work related fatalities in Missouri. The goal of this project, Missouri Occupational Fatality Assessment and Control Evaluation (MO FACE), is to show a measurable reduction in traumatic occupational fatalities in the State of Missouri. This goal will be met by identifying causal and risk factors that contribute to work related fatalities. The identification of these factors will enable more effective intervention strategies to be developed and implemented by employers and employees. This project does not determine fault or legal liability associated with a fatal incident nor with current regulations. All MO FACE data will be reported to NIOSH for trend analysis on a national basis. This will help NIOSH provide employers with effective recommendations for injury prevention. All personal/company identifiers are removed from all reports sent to NIOSH to protect the confidentiality of those who voluntarily participate with the program.

FACE INVESTIGATION # **92MO03301**

SUBJECT:

Municipal Water-line Inspector Dies After Entering Oxygen-Deficient Vault in Missouri.

SUMMARY:

A 31-year-old municipally employed inspector for the city's water and pollution control department died as a result of the lack of oxygen in a water-main maintenance vault. At the time of the incident, the victim was working alone inspecting the recent construction of a water main. The victim climbed into the eight-foot-deep water maintenance vault which contains the water main and an air relief valve. The victim was overcome by the lack of oxygen and did not survive. The Missouri Department of Health investigator concluded that, in order to prevent future similar occurrences, employers should:

* **recognize that confined-space atmospheres are dynamic environments subject to unexpected changes, and address those dynamics in all written and practiced safe work procedures and subsequent worker training.**

* **develop and implement a comprehensive confined-space entry program to address all provisions outlined in NIOSH publications 80-106, "Working in Confined Spaces," and 87-113, "A Guide to Safety in Confined Spaces."**

In addition, Municipalities should ensure that:

* **fire, rescue and police personnel are trained in confined-space entry and rescue procedures.**

INTRODUCTION:

On September 3, 1992, a 31-year-old inspector for a municipal water and pollution control department died as a result of entering a water main maintenance vault with an oxygen deficient atmosphere. The MO FACE investigator was notified of the fatality by a newspaper clipping service on September 17, 1992. The Occupational Safety and Health Administration (OSHA) did not investigate this incident because incidents involving municipal employees are out of there legal jurisdiction. The MO FACE investigator conducted interviews with the assistant director of the water and pollution control department, chief of engineering services, his assistants, and the victims immediate supervisor.

The employer in this incident was a municipal public water and pollution control department which is responsible for the purification and distribution of drinking water and the treatment of waste water. The municipality was founded about the year 1850, and the water department was founded approximately 1895. At the time of the incident, the department employed 845 persons. The division employ's 69 persons, with 24 persons in the construction survey section. The victim's job title was Inspector/Engineer Aid III. He had been employed by the municipality for approximately seven years. There were seven persons with similar positions as the victim. The employer had a written safety policy, safety program, safety and health committee, and established safe work procedures. They did not employ a full-time safety officer, and enforcing workplace safety was the responsibility of the supervisors.

INVESTIGATION:

This municipality had contracted to a private firm the construction of a new eight inch water main. This construction consisted of approximately 4800 feet of new main and three maintenance vaults. As part of the victims duties and responsibilities, he was to represent his department by providing extensive on-site observations of work in progress and field checks of material and equipment against defects and deficiencies. These inspectors normally work alone, and the victim was not working with any co-workers on this day. On the day of the incident, the victim reported to his office during his normal working hours of 7:30 a.m. to 4:00 p.m. He then left the office in route to two separate construction sites where he had visited with the contractors and met with a public works inspector at these sites. At approximately 9:30 a.m., he arrived at the incident site in a city-owned-and-marked-truck to conduct a preliminary inspection of the completed work. This inspection was in addition to a final inspection later that day with the contractor and water department personnel. During the period of 9:30 a.m. to 11:00 a.m., the victim removed the cover of the manhole and entered the eight-foot-deep-48-inch-diameter vault by way of a 24-inch-diameter entry hole and an embedded rung ladder.

A resident of the area had driven past this incident site during this time and had noticed the truck parked on the side of the road and the lid of the manhole was removed. The resident passed by the area again at approximately 11:15 a.m. and became concerned that he had not seen any

activity in the area. The resident then went to the vault access and noticed the victim at the bottom. He observed the victim seated on the floor of vault with his legs straddled on and over the water main air release valve. The resident then spoke to the victim with no response. The resident then entered the vault himself and found the victim non-responsive. He then immediately climbed out of the vault. He estimated his time in the vault was less than one minute.

The resident flagged down a passing motorist and instructed them to call 911 for emergency response. He then went to the city owned truck and used the two-way radio to contact the dispatcher. He told the dispatcher that they needed an ambulance to his location. The dispatcher then notified rescue personnel and they responded to the scene.

Upon arrival of the paramedic ambulance personnel, a paramedic and the resident then re-entered the vault, fastened a rope around the victim then exited the vault and hoisted the victim out. The resident estimated the time in the vault was less than one minute. Paramedics checked the victim for vital signs and none were detected. At that time, the responding fire department personnel were canceled and the police department and the medical examiner's office were notified.

The medical examiner's office death investigator arrived at the scene and pronounced the victim dead. He consulted with the police department and requested that the Hazardous Materials Unit of the fire department respond to the scene to test the vault for oxygen, methane, hydrogen sulfide, carbon monoxide and carbon dioxide gas levels.

CAUSE OF DEATH: Oxygen Depravation

RECOMMENDATIONS/DISCUSSION:

RECOMMENDATION #1: **Employers should recognize that confined space atmospheres are dynamic environments, constantly subject to unexpected changes and address those dynamics in all written safe work procedures and worker training.**

DISCUSSION: According to the employer, the victim was following standard operating procedures when he entered the vault. Inspectors for this city department routinely enter confined spaces alone, without prior testing and without continuous air monitoring. The perceived sense of security due to numerous similar entries into this structure, as well as others like it, may have influenced the victim not to test this environment prior to entry.

RECOMMENDATION #2: **Employers should develop and implement a comprehensive confined space entry program and address all provisions outlined in NIOSH publications 80-106, "Working in Confined Spaces," and 87-113, "A Guide to**

Safety in Confined Spaces."

DISCUSSION: As previously mentioned, the employee was following standard operating procedures when he entered the vault. The employer should rewrite their operating procedures to incorporate recommendations in the above-mentioned publications.

Confined-space entry procedures should be specific to each type of confined space; e.g., valve vaults, wet wells, lift stations, utility vaults, sewer manholes, ect. Employers should, therefore, develop, implement and enforce a confined-space entry program as outlined in the recommended NIOSH publications. At a minimum, the following items should be addressed for each type of confined space.

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

For example, in this case, the victim entered the valve vault to inspect the materials and workings of the air relief valve. Could this inspection have been done from the street level.

2. Has a confined-space safe entry permit been issued by the employer before each confined space is entered?

3. 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 of at least 19.5%?
Flammable range less than 10% of the lowest explosive limit (LEL)?
Absence of toxic air contaminants?

4. Are confined spaces posted with warning sign, and are confined space entry procedures posted where they will be noticed by employees and others (e.g. police, rescue personnel)?

5. Are workers and supervisors being continually trained in the selection and use of:
   respiratory protection?
   test equipment, including calibration and maintenance?
   lifelines?
   emergency rescue equipment?
   protective clothing?

6. Have workers been properly trained in working in and around confined spaces?

7. Are confined space entry, safe work practices, and rescue procedures discussed in safety meetings?

8. Is appropriate ventilation equipment available? Does this equipment work properly?

9. Is the air quality monitored when the ventilation system is operating?

10. Is an outside observer posted and appropriate rescue equipment (safety belt/harness and lifeline) used during every confined space entry?

In this incident, the victim entered the confined space without an observer or safety equipment. An observer, outside the confined space and equipped with appropriate rescue equipment, could have assisted the victim when he first lost consciousness.

11. Are employees continuously trained in confined space rescue procedures?

RECOMMENDATION #3: Municipalities should ensure that police, as well as fire and rescue personnel, are trained in confined-space entry and rescue procedures.

Discussion: The rescue personnel who were first on the scene may not have been adequately trained in recognizing the hazards posed by confined spaces and in confined-space entry and rescue procedures. Neither rescuer wore a safety belt, harness or lifeline for this rescue. Fortunately both the ambulance personnel and the resident survived their many entries into this confined space.

REFERENCES:

1. National Institute for Occupational Safety and Health, Criteria for a Recommended Standard... Working in Confined Spaces. DHHS (NIOSH) Publication Number 80-106, December 1979.

2. National Institute for Occupational Safety and Health, Guide to Safety in Confined Spaces. DHHS (NIOSH) Publication Number 87-113, 1987.

3. National Institute for Occupational Safety and Health, Alert - Request for Assistance in Preventing Occupational Fatalities in Confined Spaces. DHHS (NIOSH) Publication Number 86-110, 1979.

4. National Institute for Occupational Safety and Health, Safety and Health in Confined Workspaces- for the Construction Industry. DHHS (NIOSH) Publication, 1985.

5. National Institute for Occupational Safety and Health, Fatal Accident Circumstances and Epidemiology. FACE-91-17. Public Health Service/CDC/NIOSH/DSR, December 6, 1991.

SIGNATURES:

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