

Municipal Sewer Maintenance Worker Drowns Inside Sewer Wet Well in Illinois

SUMMARY

A municipal sewer maintenance worker (victim) drowned inside a sewer wet well. The victim was part of a four-man sewer maintenance crew assigned to clean out a sewer wet well, which was 20 feet deep and 6 feet in diameter. The victim entered through a 24-inch-diameter manway and climbed down on fixed steel rungs which extended to the bottom. The wet well atmosphere had not been tested nor ventilated before entering. The victim was wearing a full-body harness (secured to a winch cable) and a supplied-air respirator. After descending 8 feet to a grating platform, the victim installed an inflatable sewer plug into the end of an 18-inch-diameter inlet sewer pipe 2 feet below ground level. After inflating the sewer plug the victim climbed down to the bottom of the wet well and began cleaning out the wet well with an 8-inch-diameter sewer vacuum hose. Within a few minutes the victim removed the respirator facepiece, complaining to a co-worker that the respirator was in his way. Approximately 30 minutes later, the sewer plug gave way causing sewage to flood the wet well. Co-workers were unable to rescue the victim and he subsequently drowned.

The NIOSH investigator concluded that, in order to prevent future similar occurrences, employers and employees must:

- follow sewer plug manufacturer recommendations on the installation and use of inflatable sewer plugs
- develop, implement and enforce specific confined space entry procedures
- ensure that appropriate rescue equipment is utilized during confined space entry
- ensure that appropriate personal protective equipment is properly worn
- consider the feasibility of installing self-priming wet well sewer pumps.

INTRODUCTION

On August 31, 1989, officials of the Water Pollution Control Federation (WPCF) notified the Division of Safety Research (DSR) that a 35-year-old male municipal sewer maintenance worker drowned in Illinois on August 25, 1989, while working inside a 20-foot-deep sewer wet well. The WPCF requested technical assistance, and on December 7, 1989, a research industrial hygienist from DSR traveled to the incident site to conduct an investigation. The investigator reviewed the incident with a municipality representative

and the State OSHA compliance officer assigned to this case. Photographs and diagrams of the incident site were obtained during the investigation.

The employer in this incident is a municipality with 46 public works employees, including 10 sewer workers. The victim had been employed by the municipality for 11 months (the entire time as a sewer maintenance worker). The public works department has a safety policy and confined space entry procedures, but no confined space rescue procedures. The director of the public works department is responsible for the safety program. Public works employees attend monthly safety meetings where job safety issues are discussed and training is occasionally given. The victim had previously attended a 1-hour training session on confined space safety, and a 1-hour training session on the use of supplied-air respirators since his employment began with the public works department.

INVESTIGATION

A sewer maintenance crew was assigned the task of cleaning out a sewer wet well. The crew consisted of four sewer maintenance workers (including the victim) and the foreman for the water and sewer department. The wet well is 20-feet deep, 6-feet in diameter and is located next to an underground sewage lift station (Figure). Two feet below the top of the wet well is an 18-inch-diameter sewer inlet pipe. The sewage discharge line (sewer pump intake) forms an elbow with the vertical end 1 foot above the bottom of the wet well. Eight feet below the top of the wet well is a steel grating platform. The grating has three removable sections, which rest on a framework of steel "I" beams. Access into the wet well is through a 24-inch-diameter manway opening located at ground level.

The crew arrived at the site at 8:30 a.m., and turned on the lift station pumps. This lowered the sewage level to approximately 2 feet from the bottom of the wet well. With the foreman present, the victim entered the wet well through the manway (without first testing or ventilating the wet well atmosphere) and climbed down the side on steel rungs. He was wearing a pressure demand supplied-air respirator with an auxiliary, escape-only SCBA, and a full-body harness. The harness was secured to a winch cable. The other end of the cable was attached to a power winch on the front end of a maintenance truck.

After climbing down to the grating level the victim installed an inflatable rubber sewer plug into the inlet sewer pipe. The pipe was flowing about one-third full with sewage. The plug was inflated (using an air hose attached to a cylinder of compressed air) until it closed off the pipe and stopped the flow of sewage.

However, the employer did not ensure that the following sewer plug manufacturer's recommendations were adhered to during the installation of the plug: (1) the pipe be cleaned out prior to insertion of the plug, (2) the plug be installed with a back-up system (i.e., gate valve), (3) the plug be anchored in place, and (4) the plug be checked to ensure proper inflation to 30 PSI.

A co-worker entered the wet well (without any respirator or harness/hoisting device) and assisted the victim in removing the 2-foot by 6-foot center section of grating. Co-workers at the street level lowered an 8-inch-diameter suction hose into the wet well from a sewer vacuum truck. The victim descended below the grating to the bottom of the wet well with the end of the suction hose and began vacuuming out the remaining sewage and solid waste material. Within a few minutes, the victim removed the respirator facepiece, complaining to the co-worker (who was standing directly above him on the grating) that the respirator was in his way.

Approximately 30 minutes later, the sewer plug gave way, causing sewage to flood the wet well. On hearing the noise, the foreman ran to the manway and yelled for the two workers to get out. Another co-worker turned on the winch and began raising the cable. Within 15 seconds the level of sewage inside the wet well was up to the grating. The co-worker who was standing on the grating reached down through the opening in the grating and made an unsuccessful attempt to grab the victim who was submerged. During this rescue effort, the winch cable became entangled in the grating support beams. As the sewage level continued to rise, the co-worker was forced to climb up further and was ultimately helped out of the wet well by other co-workers. An attempt was also made to start up the pumps inside the lift station. However, the pumps were air-locked and therefore, would not pump the sewage out.

The fire department rescue squad was notified and arrived within 10 minutes. By this time the sewage was about 2 feet above the grating. Fire department rescuers (wearing SCBA) entered the wet well, freed the entangled winch cable, removed the victim, and began administering cardiopulmonary resuscitation. The victim revived and was transported to the intensive care unit of a local hospital where he died approximately 11 hours later.

CAUSE OF DEATH:

The coroner listed the cause of death as drowning.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer should ensure that workers follow the sewer plug manufacturer's recommendations on the installation and use of sewer plugs.

Discussion: The sewer plug manufacturer recommends the following before performing work upstream or downstream from an inflatable sewer plug:

1. the use of a back-up system such as a gate valve;

2. properly cleaning the pipe where the plug will be installed, since debris inside the pipe (i.e., hard objects, encrustations, grease, etc.) can cause plug damage, an improper seal, and/or plug slippage;
3. securing the plug in place with the use of appropriate restraining rope, cable, etc., to solid anchoring points upstream from the plug; and
4. inflating the plug to the correct air pressure (according to the plug size and using an appropriate air pressure gauge).

Even properly inflated it is questionable that the plug would have been able to withstand the amount of pressure exerted by the sewage without the restraining cable properly anchored in place. At any rate, none of the above recommendations were followed. Had they been followed, this fatality might have been prevented.

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

Discussion: Although the employer had written confined space entry procedures, they were not followed or enforced. For example, the wet well in this incident was not tested prior to entry. This requirement was part of the written confined space entry procedures of the public works department, and the foreman was present during the wet well cleaning procedure. Also, the co-worker entered the wet well without wearing a supplied-air respirator/SCBA and the victim removed the supplied-air respirator/SCBA he was wearing after descending to the bottom of the wet well. The employers' confined space rescue procedures were also deficient. For example, although the victim wore a full body harness secured to a winch cable, confined space rescue was not addressed in the written procedures at all. Confined space entry procedures should be specific to each type of confined space e.g., wet wells, lift stations, utility vaults, sewer manholes, etc. The company should, therefore, develop and implement a confined space entry program as outlined in NIOSH publications 80-106, "Working in Confined Spaces," and 87-113, "A Guide to Safety in Confined Spaces." 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, sewer vacuum cleaning devices are currently available that will allow workers to clean out wet wells from street level.
2. Has a confined space entry permit been issued by the employer?
3. Are confined spaces posted with warning signs (where feasible)?
4. If entry is to be made, has the air quality in the confined space been tested for safety based on the following:
 - Oxygen supply at least 19.5%

- Flammable range less than 10% of the lower explosive limit
 - Absence of toxic air contaminants?
5. Are workers and supervisors being continuously trained in the selection and use of:
 - respiratory protection
 - lifelines
 - emergency rescue equipment
 - protective clothing?
 6. Are workers being properly trained in confined space entry?
 7. Are confined space safe work practices discussed in safety meetings?
 8. Are employees being continuously trained in confined space rescue procedures?
 9. Is ventilation equipment available and/or used?
 10. Is the air quality monitored when the ventilation system is operating?

Recommendation #3: The employer and other municipalities should consider installing self-priming wet well sewer pumps by retrofitting, or replacing old pumps as they are taken out of service.

Discussion: Properly installed, a self-priming sewer pump would prevent an air-lock whenever the wet well is manually pumped out below the level of the pump intake. In this incident, if the pumps in the sewage lift station had been self-priming, they could have been immediately activated, possibly preventing the fatality, which resulted.

Recommendation #4: Rescue equipment should be appropriate for its intended use.

Discussion: Although the victim was wearing a full-body harness secured to a winch cable, the power winch being used was not rated for lifting humans. It is recognized that any type of rescue/lifting device might have become entangled in the grating supports. However, a hoisting device designed for lifting humans will not subject the individual being lifted to crushing hazards. This is especially important if any part of the body becomes caught during an emergency lift (even though in this incident crushing injuries were not apparent).

Recommendation #5: The employer should ensure that workers use the provided respiratory protective equipment in accordance with instructions and training received as required by CFR 1910.134(a)(3).

Discussion: The public works confined space entry procedures require workers to wear a supplied air respirator the entire time while work is being performed inside sewer wet wells. Additionally, the victim had received training on the use of the supplied-air respirator that he wore. In spite of this, the victim removed his respirator facepiece while working at the bottom of the wet well and was allowed to remain in the well and continue working without wearing the respirator (even though the victim's supervisor was present). Also, while the victim was working at the bottom of the wet well, the co-worker entered the wet well and climbed down to the grating level without wearing any respiratory protection. Even though supplied-air respirators are not rated for use under water, if the victim had not removed the facepiece, it may have given him enough time to climb out when the wet well flooded.

REFERENCES

National Institute for Occupational Safety and health, Criteria for a Recommended Standard ... Working in Confined Spaces. DHHS (NIOSH) publication number 80-106, December 1979.

National Institute for Occupational Safety and Health, A Guide to Safety in Confined Spaces. DHHS (NIOSH) publication number 87-113, 1987.