

FINAL REPORT



ACCIDENT DESCRIPTION

CAUSES OF THE ACCIDENT

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In a city; for maintenance, reconstruction and strengthening of an urban gas network facility, a team of contractors were tasked to clean, unblock and paint ventilation opening of a 250psi gas line manhole with an already installed 16-inch valve. They finished their work but the gas company inspector later observed one of the ventilation openings was still blocked and has not been cleaned. The ladder of the manhole was also in an inappropriate situation which causing difficulty in entering and exiting the manhole.

Eight days later, while the team was working within 25-meters of the same manhole, the gas company inspector asked the team supervisor to complete the work including replace the manhole ladder and unblocking the ventilation opening.

The team decided to come back after lunch and quickly wrap up the manhole work by making a new ladder. Firstly, the team supervisor and then the welder entered into the manhole and checked inside for potential gas smell or leakage. Once they felt confident that there were no immediate hazards, they started the job by evaluating the location of the new ladder.

Later, the third worker turned on the electric generator and gave the rectifier and the welding pliers to the welder in the manhole. The welder sat on the gas pipeline and determined the location of the ladder to strike the first weld joint, but as soon as the electrode contacted the joint, the entire place got exploded

The supervisor quickly covered his face and sat on the manhole floor. The severity of the explosion was so high that ruptured the road surface within 2.5m radius. The third worker standing above the manhole was strongly thrown towards the sidewalk, so fortunately was not run over by passing cars. A fracture in one of his backbones and displacement of two others were the unfortunate consequences of this accident for him.

After a few seconds, the supervisor thought it all ended well as he had only got slight burn on his face and hands. However, he was not able to find the welder in the manhole so he came out and only saw the third worker on the sidewalk, who did not know about the welder. The welder was thrown out more than 20m away on to the middle of the highway and unfortunately lost his life.

CAUSES OF THE ACCIDENT

The investigation revealed a 6-inch valve of the 60psi gas network within 14m of the manhole, which had been buried due to civil works. After excavations, the valve spindle had been found severely damaged due to collision with civil construction machinery, which led to gas leakage.

The leaked gas had entered the manhole from under the road asphalt layer and trapped there until reached its explosion concentration due to blocked ventilation opening.



Figure 1. The gas leak entered the gas manhole from under the asphalt layer

The most important root cause for this accident was the lack of training and correct implementation of the permit-to-work system, leading to conducting operations before obtaining the necessary permits. While the gas company obligated maintenance teams to issue permit to work but upon investigation, it was observed that the permit-to-work system implementation had some failures. Here are some examples of the above:

- There is a misconception amongst maintenance contractors that the gas leak and its dangerous concentration levels can always be detected by its smell, while the only sure way to detect gas leak is to use a calibrated gas tester.
- Lack of awareness on the importance of the hot work permit and the conditions upon issuance of this type of permit is another contractor's weakness about the permit-to-work system. In other words, the contractor team neither received a confined space entry permit, nor the hot work permit.

- Another misconception amongst the maintenance contractors is ignoring the expiry of an issued permit to work. The maintenance team thought since they already had a permit for painting, cleaning and unblocking ventilation openings in that urban gas manhole 8 days before, they did not require to get a new permit anymore and therefore they entered the manhole at the day of accident, without informing the officials. This is while, due to possibility of changes in the initial site conditions, each permit to work has limited validity period. Permit to work also emphasizes the presence of the site manager and the project executive at the work site so they can assess the risks and determine the considerations, precautions and appropriate personal protective equipment for the maintenance team.
- All organizations involved in the urban development should announce any excavations in common monthly meetings for review of each member's facilities within the excavation area and their approval. Unfortunately, 2 years before this accident, the municipality built a side road in that area without informing the gas company, which damaged and buried the concerned valve.

According to the regulations, confined space permit for every entry and hot work permits, each requires gas testing. If they had done gas testing, could have prevented this accident and the unfortunate fatality.