NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

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Forwarded to:
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SAFETY RECOMMENDATION(S)

P-85-4 and -5

On June 19, 1984, six employees of a contractor working for Washington Gas Light Company (WGL) in Rockville, Maryland, were using mechanical saws to cut a section of 22-inch-diameter, coated and cathodically protected, steel pipeline when residual gas at atmospheric pressure in the isolated section of the pipeline was ignited. A flashfire ensued, and four contractor employees who were operating the saws and a WGL superintendent were burned.

A section of the pipeline was being removed because of a road-widening project for Route 28 (Norbeck Road). To prepare for removal of the section, a plug valve in the pipe 72 feet upstream of the west end of the section was closed and bags 1/ were inserted in the pipe 17 feet downstream of the east end of the section. A pressure gauge was installed upstream of the plug valve, and a vent line and a pressure gauge were installed downstream of the plug valve. Then, the bags were inflated and the pressure in the isolated section of pipe was reduced to atmosphere by opening a vent.

The pipeline was coated and cathodically protected, the nearest rectifier being located about 1,000 feet north of Norbeck Road. The 12 volts direct current (d.c.) of the rectifier was left on during the cutting operations. Before the workers began cutting, the coating was removed from four small areas of the pipe on either side of two cutting marks and electric bonding cables were attached magnetically to maintain the electrical continuity of the pipeline to prevent stray electrical currents (a.c.) from arcing across the gaps at the sawcuts. At the east cut, the bonding cable was connected with horseshoe magnets, and at the west cut, the bonding cable was connected with flat saucer disc magnets.

1/ Bags are devices inserted into a pipe through specially cut holes made in the pipe; they then are inflated to a predetermined pressure, depending upon the gas pressure and the diameter of the pipe, to block the pipe at the point of insertion and to prevent the flow of gas.

About 4:20 p.m., cutting operations at both ends began, but a few minutes later, the WGL superintendent, to prevent the simultaneous separation of both ends of the section from the pipeline, ordered the cutting on the west end suspended until the cutting at the east end was completed. As the cutting on the east end was completed, the east end of the section to be removed sprang 12 inches down and 2 inches to the side. A side boom was used to pull the cut section back into position to allow cutting on the west end to resume. While the side boom was aligning the east end of the cut section with the rest of the pipe, the west end, which had been cut almost through, snapped off. Instantly, the residual gas in the pipe section was ignited at the east end, and the flames traveled through the 60-foot-long section to the west end. The four contractor employees who were in the ditch at the west end were burned and the WGL superintendent who was standing at the edge of the excavation on Bel Pre Road also was burned. The small flashfire lasted for 20 to 30 seconds.

When a pipeline is to be mechanically cut, good electrical continuity must be provided across the cut; otherwise, there is a potential for ignition. Therefore, continuity of temporary electrical bonds should be tested before any cutting operations begin. WGL's General Procedures require that, "Before any gas line is cut, an electric bond shall be installed across the section to be cut." Additionally, "one magnet shall be attached to the pipe on each side of the section to be cut. An area the size of the face of the magnet shall be cleaned on the pipe where the magnet is to be attached so that the metal is bare (free of all dirt, wrapping and coating) to assure a satisfactory electrical connection." However, the procedures do not require or caution that, to assure effective conductivity, the area on the pipe to which the magnet is to be connected must be cleaned until the metal is free of dirt, such as rust, scale, slag, grease, and paint, nor do the procedures require testing of the bond to assure electric continuity.

On June 21, 1984, field tests confirmed that a stray electrical current (a.c.) of 12 volts was present on the pipeline in the area where the cuts were made. This voltage persisted whether the d.c. current rectifier was turned on or off. The source of the a.c. voltage has not been determined; however, there were many potential sources in the area for stray electrical currents, such as telephone cables, commercial electrical cables and transformers, and residential electrical systems.

After the accident, the areas on the pipe where the magnets had been applied to electrically bond the pipe segments were inspected. It was found that the pipe and magnets had not been cleaned at the attachment points sufficiently to expose bare metal. Preliminary tests made on June 21, 1984, at WGL's laboratory using properly cleaned pipe and magnets revealed that the pipe-to-magnet contact of flat saucer disc magnets involved in the accident provided insufficient electrical conductivity and that of the horseshoe magnet provided adequate electrical conductivity. Although the pipe-to-magnet contact of the horseshoe magnet was found to be adequate under test conditions, it is doubtful that it provided adequate electrical conductivity on the day of the accident because the adhesive material remaining on the pipes lessened the effective area of contact with the pipe.

The laboratory inspection test made on the bonding cables on June 21, 1984, disclosed that the tin copper bonding cable for the flat saucer disk magnet was frayed and in poor condition, while the tin copper bonding cable for the horseshoe magnets was found to be in good condition. A magnet to magnet test of the flat saucer disk magnets indicated a resistance of 63 ohms, which is unacceptable for connection to pipelines for grounding and bonding purposes. The flat saucer disk magnets contained only

33 percent iron as compared to the 100 percent iron on the horseshoe magnets. Furthermore, in disassembling the flat saucer disk magnets from the outer cases, it was found that the cables were fastened to the outer case, not to the magnet itself, and that a glue type epoxy was used which also may have contributed to poor conductivity. The magnet to magnet test of the cable containing the horseshoe magnets indicated a resistance of 0.001 ohm, which is acceptable for electric continuity if proper cleaning procedures are followed.

The danger of spark ignition always is present in an explosive atmosphere. A spark may come from an open flame, hot chips, hot metal, stray currents, falling objects, tools and equipment, and static electricity. The possibility always exists that a pipe will serve as a conductor for static electricity, for stray currents from power lines, or for soil currents, so that a spark may result when the pipe is severed or cut. A bonding cable should be fastened securely to the pipe on both sides of a proposed cut before the pipe is separated. This eliminates one source of ignition.

According to the latest edition of the "Gas Engineers Handbook," if there is a 0.3-volt potential difference between two parallel or intersecting pipelines, permanent cross bonds or other equivalent means are desirable to prevent damaging crossflow or current. It was estimated that, at the time of the June 19, 1984 accident, the d.c. from the rectifier was 1.35 volts and the measured a.c. was 12 volts, many times greater that the 0.3-volt potential difference between two parallel lines.

In the June 19, 1984 accident, ignition might have originated from a spark produced while bringing the section's east end into alignment to continue the cutting operations on the west end or by the sudden separation of the west end while aligning the east end. These contact sparks could have ignited the residual gas in the pipe section. Because of the position of the section, the west end being higher than the east end, the residual gas on the west end was too rich to sustain combustion; however, an explosive mixture would have been present on the east end. Because of the poor condition of the bonding cables installed on the west end, it is concluded that a stray current (a.c.) or the direct current (d.c.) from the rectifier was the probable source of ignition in the June 19, 1984 accident.

The Safety Board is concerned about the use of magnets on bonding cables because a sudden movement on both ends of a section of pipe being cut may displace the attached magnets from their temporary original positions and, therefore, break electrical continuity. Gas companies utilizing magnets should monitor the position of the magnets, which should remain in place until all operations are terminated, on a continuing basis.

Since this accident, WGL has discontinued the use of the flat saucer disc magnets for electrically bonding segments of pipe to be separated. After performing tests on several types of magnets, WGL has determined that a bar-type magnet provides the most effective conductivity, and it is modifying its bonding cables. However, even with these more effective magnets, cleaning the pipe and the magnets to remove coating mastics and oxides at the contact surfaces for the bonding cables remains an important step in providing proper electrical conductivity.

Therefore, as a result of its investigation, the National Transportation Safety Board recommends that the Washington Gas Light Company:

> Require that temporary bonding cables installed to maintain electrical continuity during pipe cutting operations be tested for conductivity before the pipeline is cut. (Class II, Priority Action) (P-85-4)

Require that magnets on temporary bonding cables installed to maintain electrical continuity during pipe cutting operations be checked frequently for proper positioning and checked immediately in the event of a sudden movement of the pipe. (Class II, Priority Action) (P-85-5)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and BURSLEY, Member, concurred in these recommendations.

By: Jim Burnett
Chairman