

5. The flow of gas through the failed service line was not shut off expeditiously, because the necessary valve key was on a service truck miles from the scene. Two other local valves to stop the gas flow were inoperable for the same reason.

6. It is questionable whether the designation by NSP of only one emergency valve for the entire Lake City distribution system complies with the general intent of 49 CFR 192.181(a). That regulation, however, does not establish objective criteria for the number and location of such valves.

7. A preconstruction meeting was not held between the gas company and the contractor nor was one required to be held. Such a meeting, however, might have shown what gas lines were in the work area and might have averted this accident.

8. The Safety and Health regulation contained in 29 CFR 1926.651(a) does not require that a definite determination be made whether any underground facilities exist in the immediate area of construction work. This part of the regulation appears unenforceable as presently written.

9. The compression coupling pulled out as a result of the line being hit and displaced by the bulldozer.

10. The Federal pipeline regulations (49 CFR 192) are vague insofar as establishing the conditions under which compression-type couplings may be used. The decision of whether to use such couplings, in effect, is left to the individual gas-company design engineer.

11. The Lake City Fire Department, Police Department, and Office of Civil Defense combined effectively to extinguish the fire, evacuate the dead and injured, and maintain order in the affected area.

V. PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the explosion and fire in the department store basement was the ignition of an accumulation of natural

gas leaking from the unmarked service line which had been struck by the bulldozer.

Contributing to the accumulation of gas was the failure of the NSP representative to realize that the 15-foot displacement of the pipe meant that another break had occurred elsewhere.

Contributing to the migration and permeation of gas from the leak into the department store was the wooden plug which was inserted in the broken pipe end in an effort to stop the flow of gas, but which sealed off the escape route for the gas.

Contributing to the amount of gas released was the unavailability of the required valve key, which necessitated a time-consuming excavation and exposure of the buried valve before it could be shut off.

VI. RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Office of Pipeline Safety of the Department of Transportation:

(a) Undertake a study of fail-safe devices which will stop the flow of gas from ruptured lines. Based on the results of this study, OPS should consider amending 49 CFR 192 to require the installation of such devices at appropriate locations in gas distribution systems. (Recommendation No. P-73-2)

(b) Undertake a review of 49 CFR 192.367(b) relative to the uncertainty as to the conditions which permit the use of compression couplings, and initiate a rulemaking which will definitely identify conditions which permit or prohibit the use of compression couplings. If necessary, the review should include a study of objective methods of readily identifying conditions which could produce forces or loads which cannot be sustained. (Recommendation No. P-73-3)

(c) Amend 49 CFR 192.181(a) to include requirements which express clearly the intent

of OPS concerning the number and the location of emergency valves in high-pressure gas distribution systems and which treat the need for keys in the hands of local authorities. (Recommendation No. P-73-4)

2. The Department of Labor review its Occupational Safety and Health Regulation 29 CFR 1926.651(a) to require that a positive determination be made as to the location of underground facilities at the proposed excavation site. (Recommendation No. P-73-5)

3. The American Society of Mechanical Engineers Gas Piping Standards Committee develop guidelines to be used by distribution pipeline operators in designating the location of emergency valves to be used to assure a minimum time to shut down a section of main in an emergency. (Recommendation No. P-73-6)

4. The Northern States Power Company:

(a) Revise the Gas Operating and Maintenance Procedures Manual to emphasize more fully and clearly the importance of rapidly shutting down failed pipelines, evacuating persons from the affected area, checking buildings adjacent to the leak area, and notifying police and fire officials. Attention

should be given to the importance of having the proper valve keys immediately available. (Recommendation No. P-73-7)

(b) Designate emergency valves in its distribution systems to permit rapid shutdown of failed sections without interrupting gas service to an entire community. (Recommendation No. P-73-8)

(c) Emphasize to the maintenance personnel the importance, need, and desirability of supplying pipeline location information and clearly marking existing lines. (Recommendation No. P-73-9)

(d) Undertake to inform the public more fully as to the nature, characteristics, and hazards of natural gas and the steps to be taken when it is encountered. (Recommendation No. P-73-10)

5. The Department of Public Works of Lake City, Minn., require coordination between the contractors and the affected owners and operators of underground facilities in the city as a prerequisite for obtaining a construction permit. (Recommendation No. P-73-11)