Pipelines and Public Safety

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Damage Prevention, Land Use, and Emergency Preparedness

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Preface

The pipeline industry has a good safety record in comparison with other modes of transportation. This good performance is attributable, in part, to the fact that an important component of the pipeline network—transmission pipelines that carry natural gas, crude oil, and petroleum products over long distances at high pressures—was constructed in undeveloped areas and buried with $2 \frac{1}{2}$ to 3 feet or more of cover to prevent disturbance of the lines.

Today, development threatens to intrude on transmission pipelines and increase the risk of failures from excavation damage, which is already the leading cause of pipeline accidents. However, because most transmission pipelines are still located in rural or undeveloped areas, there exists an opportunity for preventive action. In response to a request of the National Transportation Safety Board to examine the adequacy of public policies for land use near pipelines, the Transportation Research Board (TRB) of the National Research Council funded a study to examine public and private policies and practices to improve public safety near transmission pipelines.

To carry out the study, the TRB formed a study committee under the leadership of Dr. John W. Fuller, Professor of Economics, Geography, Urban and Regional Planning at the University of Iowa. Committee members, drawn from state and local government, industry, universities, and research institutions, have expertise in pipeline operations, accident analysis, land use planning, and safety program management. The results of their study—a synthesis of policies and practices to enhance public safety near pipelines and recommendations for strengthening these practices—are presented here.

The study was performed under the overall supervision of Robert E. Skinner, Jr., Director for Special Projects. Nancy Humphrey managed the
study and, with Thomas Menzies, drafted the final report under the guidance of the committee.

Special thanks are due to The Office of Pipeline Safety (OPS) of the U.S. Department of Transportation for assistance in providing access to the OPS pipeline accident data base, to Battelle Memorial Institute for assistance on technical issues, and to the many state and local governments that provided examples of good practice. Special appreciation is expressed to Nancy A. Ackerman, TRB Director of Publications, and Elizabeth W. Kaplan, Associate Editor, for editing and publishing the final report, and to Marguerite E. Schneider and Frances E. Holland for assistance in typing the many drafts and the final manuscript.
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Executive Summary

Pipelines provide a vital transportation service. Approximately one-half of the nation’s supplies of crude oil and petroleum products, and virtually all of its natural gas supplies, are transported through a network of 1.7 million miles of pipelines.

The materials that pipelines carry are flammable, explosive, or toxic, which means that pipelines pose a danger to people and property if these materials are released to the environment because of a pipeline failure. The development of residences, work places, and shopping areas near once-isolated transmission pipelines, which carry gas and liquids at high pressures from producing areas to refineries or distribution networks, threatens to increase the risk of pipeline failure caused by inadvertent excavation damage. Historically such excavations have been a major cause of transmission pipeline accidents. Accidents in the future could also be more severe because new development means more people and property would be affected in the event of a failure.

The National Transportation Safety Board (NTSB) has questioned the adequacy of measures taken to protect public safety near pipelines. The NTSB’s concern was heightened by an investigation of a severe pipeline failure caused by unintentional drilling on a liquids pipeline by a contractor planting trees in a rapidly growing subdivision located next to the pipeline. Because this type of accident could become more prevalent as development intrudes on pipelines, the NTSB recommended that the
Transportation Research Board (TRB) of the National Research Council examine ways that such accidents could be averted by more effective land use policies. In response to this request the TRB formed a study committee to examine land use measures for controlling development near pipelines. The committee broadened its inquiry to include other approaches to reducing intrusion on pipelines, such as damage prevention programs, and methods of mitigating the consequences of pipeline failures from all causes, such as more responsive emergency preparedness programs.

SAFETY RECORD OF THE PIPELINE INDUSTRY

The safety performance of transmission pipelines is good in comparison with that of other transportation modes that carry hazardous materials. When total fatalities and injuries from accidents are combined, and adjusted for the volume of product carried and the distance over which it is moved, casualty rates for transportation of hazardous liquids by transmission pipeline are significantly lower than rates for transport of similar hazardous materials by rail or truck, and only slightly higher than for transport by water. (Similar comparisons cannot be made for natural gas because this product is transported almost exclusively by pipeline.)

Despite this good safety record, pipeline operators reported more than 10,000 failures to liquids and gas transmission and gathering lines between 1971, the first full year of federally required reporting, and 1986, the latest year for which data are available. These failures resulted in total estimated property loss of approximately $300 million in 1986 dollars, and commodity loss of nearly 5 million barrels of crude oil and petroleum products plus an unquantified amount of natural gas. Approximately 3 percent of the 10,000 failures resulted in 178 fatalities and 770 injuries.

The single largest cause of pipeline failure is damage from outside forces, which represents 40 percent of all reported failures. Two-thirds of these reported outside force failures are caused by excavation damage by a party other than the pipeline operator. Natural causes, such as land subsidence, account for most other reported outside force failures.

Since 1980 outside force failures have declined. Over the same period, industry-sponsored "one-call systems," which provide a centralized number for contractors to use to notify pipeline companies and other utilities of intended excavation, have expanded. However, recent changes in pipeline accident reporting criteria and slowdowns in construction during the early 1980s may account for part of the decline; several more years of accident data will be needed to determine if the downward trend in outside force failures will persist. Moreover, the committee was unable to document conclusively that the establishment and extension of one-call systems has had a causal effect on reducing excavation incidents.
Corrosion, the second major cause of pipeline failure, accounted for 20 percent of all reported transmission and gathering line incidents between 1971 and 1986. The number of failures attributable to corrosion has stabilized since the mid-1970s, in part because of improvements in corrosion control methods. Construction and material defects, equipment failures, incorrect operation, and unidentified causes accounted for the remaining 40 percent of reported failures and showed no discernible trend during this period.

REGULATING PIPELINE SAFETY

Because of the dangers posed by pipeline accidents, the federal government and state and local governments regulate various aspects of pipeline activity. Federal safety regulations, first required by legislation passed in 1968, focus on the pipeline operator and cover such broad areas as pipeline design, construction, testing, and operation. Although the regulations do not control the use of land near pipelines, they are concerned with the safety of people living and working near pipelines. For example, the natural gas regulations require higher pipeline design and operating standards in areas of high building density, and the liquids regulations mandate additional depth of cover for pipelines constructed within 50 feet of private dwellings, industrial buildings, and places of assembly. Because excavation damage is a major cause of pipeline accidents, federal regulations also require operators of natural gas lines that are located in areas of high-density development to initiate damage prevention programs. A major limitation of all of these federal regulations is that the design and construction provisions are not retroactive.

The federal government has preempted state regulation of pipeline operators, but states play a major role in implementing federal safety regulations. Thirty-eight states and the District of Columbia have enacted their own damage prevention statutes, which require contractors to give advance notification of intent to excavate so that pipeline operators and other affected utilities can identify and mark their lines.

Local governments are the primary governmental units that have the authority to regulate land use. Through comprehensive plans and zoning, local governments may designate appropriate land uses for parcels located near pipelines and specify the configuration of lots and setbacks from pipeline rights-of-way.

RECOMMENDATIONS FOR ENHANCING PIPELINE SAFETY

The study identified a wealth of policies and practices that could be employed to enhance public safety near pipelines but found that these measures are
unevenly applied throughout the country by government and industry. The range of efforts reflects, in part, different perceptions of accident risk, differences in organizational capacity and resources to implement safety measures, and inadequate information about appropriate practices.

The study focused on ways to strengthen and extend existing practice. Because of the relatively good safety record of the industry, the benefits that can be obtained by improved pipeline safety do not warrant massive investment in new initiatives. However, modifications in existing federal safety regulations and improved communication among those responsible for preventing or responding to pipeline accidents can yield improvements in safety at costs commensurate with expected benefits. Major recommendations for improving practice are highlighted in each of the three areas examined by the study. Several recommendations concern ways to improve communication to address an important shortcoming of current practice.

**Damage Prevention and Public Awareness Programs**

Government and industry have concentrated on damage prevention and public awareness programs to avert pipeline accidents that result from excavation damage, a major cause of transmission pipeline failure. The most common measures are (a) state damage prevention statutes that require contractors to notify pipeline operators and other affected utilities of intended excavation and (b) one-call systems that provide a mechanism for coordinating notification and utility location.

This study identified significant gaps in the coverage and enforcement of existing damage prevention measures. To close these gaps, it is recommended that

- The federal regulations that require gas pipeline operators to develop damage prevention programs be extended to operators of liquids pipelines, and that both liquids and gas pipeline operators be required to participate in one-call operations or to create new one-call systems if none exist.
- One-call centers meet minimum standards, such as those established by the Utility Location and Coordination Council of the American Public Works Association, so that they can provide the range of services needed by pipeline operators to satisfy federal damage prevention regulations.
- All states enact damage prevention statutes, incorporate federal regulations requiring pipeline operators to join one-call systems, and improve compliance. Measures for improving compliance include requiring state and local permitting agencies to obtain proof of notification from persons securing building or excavation permits, increasing the liability of contractors and pipeline operators who ignore notification requirements, and clarifying responsibility for enforcement.
Executive Summary

- Federal regulations be clarified to provide pipeline operators with guidelines for satisfying public education requirements, and a demonstration program be initiated by the pipeline industry in cooperation with public safety officials to develop a mechanism for ongoing notification of residents near pipelines.

Land Use Measures

Land use regulation is another approach to enhancing safety near pipelines. Because development has not yet intruded on most transmission pipelines, land use measures offer an important opportunity for preventive action.

There are several actions that could prevent land use conflicts near pipelines. At a minimum, land use control should focus on the pipeline right-of-way. Pipeline operators should

- Review easement agreements to ensure that they contain adequate protection against encroachments that may adversely affect the safe operation of pipelines.
- Develop policies and procedures to remove such encroachments.
- Conduct right-of-way surveillance programs at intervals adequate to identify new encroachments.
- Initiate more frequent liaison with local planning and development officials, particularly in rapidly growing areas, to discuss development plans and preventive measures to ensure pipeline safety.

To reinforce pipeline operators' efforts, state and local governments should

- Enact legislation prohibiting the construction of structures on pipeline rights-of-way and ensuring that access to the lines is not obstructed.
- Establish procedures that require pipeline operators to review proposed land use changes by examining subdivision plans, site plans, and variances for all properties that have a pipeline easement.
- Modernize land records systems to ensure that the types, boundaries, and holders of easements are identified by parcel and can be accessed readily by local governments.
- Prepare planning guidelines, in consultation with pipeline operators and developers, for safely integrating pipelines into development projects and protecting the lines during construction, and then adopt these guidelines as part of comprehensive plans, zoning ordinances, and building codes.

Although more uniform public policies on land use near pipelines might be desirable, differences in local conditions argue against setting definitive standards for building setbacks from pipelines or limits on specific land uses near pipeline rights-of-way.
Emergency Preparedness Programs

Changes in emergency preparedness offer the final prospect for enhanced safety near pipelines. The severity of pipeline accidents can be mitigated by the timely and informed response of local public safety officials working in cooperation with pipeline operators.

This study identified gaps in preparedness for pipeline emergencies, and several measures are recommended to improve current practice:

- The federal government should provide more specific guidelines concerning pipeline operators' responsibilities for satisfying the emergency preparedness requirements of federal safety regulations. At a minimum these should include providing emergency contact numbers as well as pipeline location and product information to local fire departments.

- State pipeline safety officials should coordinate the collection and distribution of this information and also assist in establishing centralized or regional emergency communications systems through which local fire departments and other safety officials and pipeline operators can report and receive information about pipeline accidents and appropriate response measures. Where practical, these systems should be piggybacked onto local emergency communications systems.

- State pipeline safety officials should also encourage increased contact between pipeline operators and emergency planning programs, such as the organizational structure established by the Superfund Amendments and Re-authorization Act of 1986 and the Community Awareness and Emergency Response program established by the chemical industry.

- Federal and state training programs for emergency response to hazardous materials accidents should be modified, with input provided by the pipeline industry, to include information on emergency planning and response procedures for pipeline failures.

Preventive and mitigative measures, sponsored by joint public and private initiatives, can help ensure that the good safety record of the pipeline industry will be maintained and improved in the future.