Log P-316F

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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: January 6, 1998

In reply refer to: P-97-25 through -33

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A gas explosion on November 21, 1996, in the Rio Piedras shopping district of San Juan, Puerto Rico, resulted in 33 fatalities and 69 injuries. This accident, one of the deadliest in pipeline history, made 1996 a record year for pipeline fatalities. The San Juan accident accounted for more fatalities than occurred the entire previous year, and it vividly illustrates the tragic potential of a single excavation-damaged pipe.

The National Transportation Safety Board determined that the probable cause of the propane gas explosion, fueled by an excavation-caused gas leak, in the basement of the Humberto Vidal, Inc., office building was the failure of San Juan Gas Company, Inc., to oversee its employees' actions to ensure timely identification and correction of unsafe conditions and strict adherence to operating practices; and to provide adequate training to employees.[1] Also contributing to the explosion was the failure of the Research and Special Programs Administration/Office of Pipeline Safety to effectively oversee the pipeline safety program in Puerto Rico; the failure of the Puerto Rico Public Service Commission to require San Juan Gas Company, Inc., to correct identified safety deficiencies; and the failure of Enron Corporation to adequately oversee the operation of San Juan Gas Company, Inc. Contributing to the loss of life was the failure of San Juan Gas Company, Inc., to adequately inform citizens and businesses of the dangers of propane gas and the safety steps to take when a gas leak is suspected or detected.

The Safety Board has long been concerned about the number of excavation-caused pipeline accidents. In response to six serious pipeline accidents during 1993 and 1994 that were caused by excavation damage and to foster improvements in State excavation damage prevention programs, the Safety Board and the Research and Special Programs Administration (RSPA)

[1] National Transportation Safety Board. 1997. San Juan Gas Company, Inc./Enron Corp. Propane Gas Explosion in San Juan, Puerto Rico, on November 21, 1996. Pipeline Accident Report NTSB/PAR-97/01. Washington, DC.

jointly sponsored a workshop in September 1994.[2] This workshop brought together about 400 representatives from pipeline operators, excavators, trade associations, and local, State, and Federal government agencies to identify and recommend ways to improve prevention programs.

The Safety Board recently completed a safety study that analyzed the findings of the 1994 workshop, discussed industry and government actions undertaken since the workshop, and formalized recommendations aimed at further advancing improvements in excavation damage prevention programs.[3] Safety issues discussed in the study include the essential elements of an effective excavation damage prevention program, including one-call notification centers and employee qualifications and training; accuracy of information regarding buried facilities; technologies for installing buried facilities; and system measures, including risk exposure, reporting requirements, and data collection.

State Excavation Damage Prevention Programs

Specific progress has been made to improve the effectiveness of State excavation damage prevention programs, including efforts to standardize marking symbols, to develop a uniform notification ticket, to develop guidelines for excavation practices and procedures, and to develop minimum standards for training programs. Also, the importance of mandatory participation has been advocated by industry as well as government, yet many entities are granted exemptions to participation in State excavation damage prevention programs. Although many elements of an effective State excavation damage prevention program have been identified, the Safety Board is concerned that these elements have not been uniformly implemented. Some States have realized the benefit of swift, effective sanctions through the administrative process, yet many States are lacking effective enforcement programs. The practices and activities of one-call notification centers have been identified, but these practices have also not been uniformly implemented. The Safety Board concludes that although considerable progress has been made to improve State excavation damage prevention programs, additional efforts are needed to uniformly develop and implement programs that are most effective.

In 1996, RSPA established a joint government/industry Damage Prevention Quality Action Team. Participants include the American Petroleum Institute, the American Gas Association, the American Public Gas Association, the Interstate Natural Gas Association of America, One-Call Systems International of the American Public Works Association (APWA), the National Telecommunications Damage Prevention Council, the National Association of Regulatory Utility Commissioners, the Associated Electrical and Gas Insurance Services, the National Association of Pipeline Safety Representatives, and industry participants. As stated in its charter, "the purpose of that team is to assess the status of current excavation damage prevention efforts and their effectiveness, and to identify additional efforts that would lead to

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[2] National Transportation Safety Board. 1994. Proceedings of the Excavation Damage Prevention Workshop. NTSB/RP-95/01. Washington, DC.

[3] National Transportation Safety Board. 1997. Protecting Public Safety Through Excavation Damage Prevention. Safety Study NTSB/SS-97/01. Washington, DC.

reduction of excavation damage." However, rather than assessing the status of damage prevention efforts, the group set as its goal to "conduct a national pipeline awareness campaign." As of June 1997, the team had developed and distributed surveys to assess the awareness of one-call systems. Because the critical elements of an effective excavation damage prevention program have not been uniformly implemented at the State level, the Safety Board believes there is a need to review and evaluate existing damage prevention programs and to highlight deficiencies in existing programs so that corrective action can be taken. The Safety Board supports current legislative interest in provisions for a review of existing excavation damage prevention programs but does not believe there is a need to await Congressional action before such an evaluation is undertaken. The Damage Prevention Quality Team appears to be an appropriate mechanism for accomplishing a detailed evaluation of existing programs. Therefore, the Safety Board believes that the APWA, in conjunction with RSPA, should initiate and periodically conduct detailed and comprehensive reviews and evaluations of existing State excavation damage prevention programs and recommend changes and improvements, where warranted, such as full participation, administrative enforcement of the program, pre-marking requirements, and training requirements for all personnel involved in excavation activity.

One-Call Notification Centers.—The important elements of an effective one-call notification center have been generally identified by industry organizations. For example, the position of the Associated General Contractors of America on one-call systems[4] is summarized in six elements: mandatory participation; statewide coverage; 48-hour marking response; standard marking requirements; continuing education; and a fair system of liability. Participants at the Safety Board's 1994 workshop, on the other hand, developed detailed lists of elements they believed are essential for an effective one-call notification center, other elements a center should have, and elements it could have. All agreed, however, that first and foremost was the need for mandatory participation and use of notification centers by all parties.

A record of a locate request at one-call notification centers is generally called an excavation notification ticket, but there is no standard format for one-call excavation notification tickets. One-call centers track excavation activity based on the number of notification tickets they handle for their members, but they do not necessarily track how many of those digging activities result in excavation hits. For the centers that do maintain a record of hits, one-call members must report their hits to the center; the center then compiles the information.

The APWA's One-Call Systems International (OCSI) Committee on Communication Standards is developing a universal ticket format to address the problem of underground facility owners who work in different States and who receive tickets from more than one notification center.[5] For large companies working in different one-call areas, information that is organized into different formats can be confusing and can lead to unsafe activities at the excavation site. According to discussions at the Safety Board's 1994 workshop, the format needs to be consistent

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[4] Transportation Research Board, National Research Council. 1988. Pipelines and Public Safety. Special Report 219 (p. 133). Washington, DC.

[5] Underspace Bulletin 2(11): 2. August 1996. Spooner, WI: Center for Subsurface Strategic Action (CSSA).

between centers, both in terms of ticket information and the work unit represented by a ticket. For example, a ticket from one center might encompass work for all utilities at a given two-block construction site, whereas another might separate tickets for each utility, or by smaller geographic areas. Damage reports must also be consistent, and OCSI is considering the feasibility of including damage information in the universal ticket format. The committee expects to finalize a universal ticket format in January 1998. The Safety Board encourages the OCSI members and all other notification centers to adopt a universal ticket format and to maintain ticket data. Standard ticket information would be an essential first step in developing performance measures for damage prevention programs; these performance measures are discussed later in this letter.

Employee Qualifications and Training.—Training to prevent excavation damage to the underground infrastructure is not limited to the pipeline industry and operating personnel. Excavators need to be trained and educated about safe work conditions, good excavation practices, relevant State laws, and one-call procedures. In this context, the excavator is not only the backhoe operator at the construction site, but also the project manager, the scheduler, company officials—anyone connected to excavation work. In an effort to ensure that excavators are aware of their responsibilities to protect underground facilities, some States have licensing requirements that assess professional knowledge. For example, Florida law (in Section 556.104 of the Florida Statutes) requires contractors who work near buried facilities to be licensed, a process that involves passing a written examination. Excavators should fully understand the one-call notification process: the meaning of facility markings, requirements for hand digging near underground facilities, notification responsibilities when the scope of work changes, and emergency response procedures. Many one-call centers offer outreach training programs designed for excavators. Some one-call center personnel have met with local union organizations and industry associations to explain the notification process and State damage prevention laws.

Because marking the position of an underground line is a safety-critical job, training is necessary to ensure that locators are well prepared to perform this function. The National Utility Locating Contractors Association (NULCA) has defined a set of minimum standards for its members to adopt as part of their training programs.[6] The program includes 118 hours of structured training in the topics of system design, construction standards, equipment techniques, recognition of line type, locating theory, and safety procedures. In addition to recommending the use of written tests, the program recommends field training and annual re-testing.

The NULCA has also developed guidelines for excavation practices and procedures for damage prevention. These guidelines, which were revised in September 1997, incorporate Occupational Safety and Health Administration (OSHA) requirements and identify best practices applicable to excavation work. Use of the guidelines is voluntary, but NULCA's brochure explains that legislation in most States requires contractors who plan to excavate to notify the appropriate one-call center and non-member facility owners before the job begins. The

[6] National Utility Locating Contractors Association. 1996. Locator Training Standards & Practices. Spooner, WI.

guidelines address pre-planning and job site activities for both large and small projects. Instructions for handling damage, along with a construction facility damage report form, are also included. The Safety Board has commended NULCA's efforts in promulgating good practices among its members and the excavation community.

Participants at the Safety Board's workshop recommended that excavator associations work in conjunction with operators of buried facilities and one-call notification centers to provide buried-facility damage-prevention training as part of their safety training programs. The participants acknowledged that the Associated General Contractors of America and many contractor organizations are very safety conscious and have produced several videotapes about safety issues. Few of these education efforts, however, include testing. The current negotiated regulation process at RSPA has addressed the issue of training verification and testing, but the scope of that work is limited to only oil and gas operators subject to Federal regulations.

The Safety Board has long been concerned that all personnel involved in excavation activity be properly trained and qualified and has issued several recommendations in this area as a result of its accident investigations. Following the investigation of an accident in Derby, Connecticut, in December 1985, the Safety Board recommended that Northeast Utility Service Company

> Emphasize in its training of operating personnel the importance of following the company procedures for patrolling and protecting its gas mains in proximity to excavation projects. (P-86-19)[7]

The Safety Board's investigation of an accident that occurred 3 months later in Chicago Heights, Illinois, also generated a recommendation concerning training. The Board recommended that Northern Illinois Gas Company

> Emphasize in company training the importance of following company procedures for making areas near gas pipeline leaks safe for the public by evacuation or other means. (P-87-38)[8]

As a result of an explosion and gas-fueled fire that occurred on July 22, 1993, when a backhoe of the city of St. Paul Department of Public Works hooked and pulled apart a high-pressure gas service line, the Safety Board asked the APWA to

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[7] National Transportation Safety Board. 1986. Northeast Utilities Service Co. Explosion and Fire; Derby, Connecticut; December 6, 1995. Pipeline Accident Report NTSB/PAR-86/02. Washington, DC. As a result of the Northeast Utility Service Company's positive response to Safety Recommendation P-86-19, the recommendation was classified "Closed—Acceptable Action" on May 14, 1987.

[8] National Transportation Safety Board. 1987. Chicago Heights, Illinois; March 13, 1986. Pipeline Accident Summary Report NTSB/PAR-87/01-SUM. Washington, DC. Safety Recommendation P-87-38 was classified "Closed—Acceptable Action" on September 29, 1988.

Advise its members of the circumstances of the July 22, 1993, explosion in St. Paul, Minnesota, and urge them to develop and implement written procedures and training to prevent excavation-caused pipeline damages. (P-95-24)[9]

In 1987, RSPA first issued a notice of proposed rulemaking (NPRM) to improve the competency of operator personnel and to set minimum training and testing standards for employees of pipeline operators. A notice issued in October 1991 stated that a second proposal, based on comments received earlier, would be forthcoming. By 1993, RSPA still had not acted to implement any employee qualification and testing standards, and the Safety Board urged that this issue become a priority in the regulatory agenda. Ten years after its original NPRM in 1987, RSPA has addressed this issue through the Negotiated Rulemaking Advisory Committee on Pipeline Personnel Qualifications, which completed its fourth meeting in August 1997. It has prepared three drafts of a proposed operator qualification regulation for committee consideration. The Committee has not reached consensus and is still considering draft regulatory language. Action on this issue is long overdue. The Safety Board concludes that employee qualification and training is an integral component of an effective excavation damage prevention program, and industry has recognized the need for employee training but has not implemented training uniformly. Inadequate employee training was highlighted in the Safety Board's report of the San Juan accident. In that report, the Safety Board recommended (P-97-7) that RSPA complete a final rule on operator employee qualification, training, and testing standards within 1 year. The Safety Board further stated in that recommendation that the final rule should require operators to test employees on the safety procedures they are expected to follow and to demonstrate that they can correctly perform the work.

Because RSPA's rulemaking would cover only those employees of oil and gas operators subject to Federal regulations, additional efforts are needed by industry to provide training materials to those employees not covered by the regulations. The OCSI's Training Committee—which develops educational materials for use by notification center employees, facility owners, and excavators—would appear to be the appropriate organization to accomplish this goal. Therefore, the Safety Board believes that the APWA should review existing training programs and materials related to excavation damage prevention and develop guidelines and materials for distribution to one-call notification centers.

Emergency Response Planning.—Pipeline operators are required by law to establish written emergency procedures for classifying events that require immediate response, communicating with emergency response officials, and responding to each type of emergency.[10] Although the extent of emergency response planning may vary depending on the type of excavation activity, emergency response planning should involve a definition of responsibilities,

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[9] NTSB accident DCA93FP004. Safety Recommendation P-95-24 is currently classified "Open—Acceptable Response" pending receipt of further information from the APWA.

[10] 49 CFR Part 192.615, "Emergency plans" [for gas pipelines]; and Part 195.402, "Procedural manual for operations, maintenance, and emergencies" [for hazardous liquids].

a flow chart of actions, execution criteria, systems inventory and resource information, coordination procedures (internal and external), and simulation exercises of response actions.

Federal regulations require no emergency response plan for excavators; however, these are the very people that often have responsibility for first response at an excavation disaster. The Safety Board has addressed the need for emergency response plans and procedures in many of its reports of accidents involving excavation damage. One such accident was an explosion in Cliffwood Beach, New Jersey, on June 9, 1993, that occurred as a result of a utility contractor's trenching operation. The Safety Board's investigation determined that a failure in training was causal to the accident.[11] The utility operator did not brief or determine whether the contractor knew what procedures to follow should the crew damage a main or service line. In addition, the Safety Board found no record or evidence of the contractor being properly trained in emergency procedures, and the facility operator's procedures did not include emergency response training for contractors. As a result of its investigation, the Safety Board recommended that the gas company take the following actions:

> Train all gas operations construction contractors for emergencies involving struck pipelines; training should stress immediately reporting natural gas pipeline strikes to New Jersey Natural Gas's emergency phone number. (P-94-01)[12]

As a result of the previously mentioned accident in St. Paul, Minnesota, on July 22, 1993, the Safety Board recommended that the APWA

> Urge your members to call 911 immediately, in addition to calling the gas company, if a natural gas line has been severed. (P-95-25)[13]

The Safety Board concludes that, at a minimum, excavators should formulate an emergency response plan appropriate for the specific construction site and ensure that employees working at that site know the correct action to take if a buried facility is damaged. The local one-call center can also play an important role in planning with local officials to define the best emergency response appropriate for its communities. The local one-call centers also are in a good position to disseminate this information on a regular basis. Therefore, the Safety Board believes that the APWA should develop guidelines and materials that address initial emergency actions by excavators when buried facilities are damaged and then distribute this information to all one-call notification centers.

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[11] NTSB accident DCA93FP008.

[12] On August 1, 1995, the Safety Board classified this recommendation "Closed—Acceptable Action."

[13] This recommendation is currently in an "Open—Acceptable Response" status pending further action by the APWA.

Directional Boring/Trenchless Technology

Excavation work is frequently for the purpose of installing additional facilities. General practices require digging an open trench from the surface down to the installation depth. However, trenchless technology offers a different method for installing underground facilities. Directional boring "snakes" a new line that follows a drill bit horizontally through the subsurface. This method is particularly advantageous for traversing below waterways, ecologically sensitive wet lands, or major traffic arteries. But there are practical limits to the depth that lines are installed. Eventually, additional depth becomes infeasible because of the cost of the extended line runs, geologic changes at lower stratum, or practical concerns for future maintenance. New lines must then go through the areas that have had line laid by directional boring.

Differences in soil density, rock formations, and variable torque on the drilling head often result in a directional line that does not run along a straight route. Drilling heads can be deflected by hard rock or unknown underground objects. The operational accuracy of directional boring depends on the accuracy of sensors located on the drill bit and the drilling unit's resolution and correlation to a common base map. Though they do not involve sensors, similar problems can be found with the use of pneumatic drills and mechanical augers.

Directional boring is not always sensitive to line hits; it is possible for a boring equipment operator to hit a facility without being aware of the hit. The drill bits, designed to go through rock, experience little change in resistance when going through plastic pipe or cable. This sets up a situation for hitting a gas line without knowing it; migrating gas can then collect, creating conditions for an explosion. The Safety Board recently investigated an accident involving directional boring in Indianapolis, Indiana.[14] The explosion resulted in one fatality, one injury, and extensive damage to a residential subdivision.

Over the past year, the trade literature has documented several accidents, not investigated by the Safety Board, that resulted from horizontal directional boring. For example:

- In Seattle, directional boring caused a gas explosion that destroyed a home;
- A major traffic artery in northern New York State was closed for several days to determine if a water main break resulting from directional boring had seriously weakened the roadbed; and
- Two people were hospitalized in Overland Park, Kansas, when a gas explosion, caused by directional boring, destroyed four homes.[15]

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[14] NTSB accident DCA97FP005; the accident occurred on July 21, 1997.

[15] (a) Underground Focus 10(6): 16–19; 22–23. September/October 1996. (b) Underground Focus 10(7): 18–19. November/December 1996.

manufacturers have tried to address the problem of recording the position of lines installed by directional boring. Sensors, generally magnetic guidance-type sensors attached to the drill bit, record location information for mapping the line. The relative position of the drill bit is plotted on a real-time display at the drilling operator's control position.[16] Stored as an electronic data file, this information can be archived in facility data records. Conceptually, this accounts for "recording the course of a new line." Associated issues, however, can affect the accuracy of information gathered in this manner. First, accuracy depends on sensor calibration. Operators must know how to check for and correct calibration error. Second, the drill's sensor may know where it is in relation to some global positioning system (GPS) coordinates, but it may not know its location in relation to ground surface. Depth of line, an important fact, is dependent on accurately orienting the drilling activity on a topographic survey map. The accuracy of the topographic map is, in turn, affected by erosion and grade changes over time.

The Safety Board concludes that facility maps should have a standard depiction for underground facilities that were installed using directional boring techniques. The Safety Board believes that the APWA should work in conjunction with the American Society of Civil Engineers to develop standards for map depiction of underground facilities that were installed using directional boring techniques.

Subsurface Utility Engineering

Subsurface utility engineering (SUE) is a process for identifying, verifying, and documenting underground facilities. Depending on the information available and the technologies employed to verify facility locations, a level of the quality of information can be associated with underground facilities. These levels indicate the degree of uncertainty associated with the information; level A is the most reliable and level D the least reliable. This categorization is a direct result of the source of information and the technologies used to verify the information.

A comprehensive map and automated computer diagram of a construction site is developed as a SUE product; it depicts co-registered information for all utilities in that area. The SUE process identifies all utilities during a single coordinated effort. In this way, information known about one facility can beneficially affect the mapping of other utilities, and unknown facilities are more likely to be documented. By signing the SUE product, a professional engineer warrants the maps against errors and omissions and assumes liability for the accuracy of the information.

The Federal Highway Administration (FHWA) considers SUE an integral part of preliminary engineering work on highway projects receiving Federal aid. It has the potential to reduce facility conflicts, relocation costs, construction delays, and redesign work. In 1984, the State of Virginia began a SUE program, called the Utility Designation and Locating Program, and determined that there were substantial cost savings. A highway project in the city of

[16] Configuration of the Mole Map System developed by McLaughlin Boring Systems.

Richmond used SUE work costing $93,553 to avoid an estimated $731,425 wo
move utilities had the highway projects not been designed to avoid conflict w
facilities. Virginia's estimate of cost savings, just in terms of avoiding utility relocations, was $7
saved for each dollar spent. Additionally, Virginia credits the process with reducing design time by 20 percent.[17] The utility coordinator for Maryland's State Highway Administration estimates a savings of $18 for each dollar spent. The Florida Department of Transportation found that it saved $3 in contract construction delay claims for each dollar spent on SUE. Variations in these estimates reflect different cost assumptions, geographic conditions, and system configurations. Twenty-six highway agencies have used SUE at some level on some projects;[18] FHWA estimates a nationwide savings of $100 million a year as a result of SUE.[19]

Compiling comprehensive information on underground facilities can be expensive and labor intensive. Small contractors generally do not have the resources or expertise available to accomplish SUE on a regular basis; consequently, SUE is generally used on large construction projects such as those typical of highway development.

Architects, engineers, and contractors should have ready access to information on the location of underground facilities to plan construction activities. The advantage of this information was recognized at the 1994 damage prevention workshop. The Safety Board concludes that providing construction planners with information on the location of underground facilities, referred to as "planning locates," can reduce conflicts between construction activities and existing underground facilities. The Safety Board believes that the APWA should encourage one-call notification centers to work with their members to provide facility location information for the purpose of construction planning.

The Standards Committee of the American Society of Civil Engineers (ASCE) is developing standards for depicting underground facilities on construction drawings. The Board thus believes that the APWA and the ASCE should address the accuracy of information that depicts subsurface facility locations on construction drawings. Further, the Safety Board is recommending that the Associated General Contractors of America promote the use of subsurface utility engineering practices among its members to minimize conflicts between construction activities and underground systems.

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[17] U.S. Department of Transportation, Federal Highway Administration. 1995. Subsurface Utility Engineering Handbook. FHWA-PD-96-004 (p. I–14). Washington, DC. November.

[18] According to the FHWA, Maryland, Pennsylvania, Delaware, North Carolina, and Arizona use SUE on an extensive basis.

[19] U.S. Department of Transportation, Federal Highway Administration. 1995. Subsurface Utility Engineering Handbook. FHWA-PD-96-004 (p. I–29). Washington, DC. November.

Risk Exposure

A critical component of excavation damage data is the total number of excavations that present a chance for damage. These data, however, are not available. The number of excavations presented in the Board's study are industry estimates; they did not result from a national data collection system. To quantify the number of accidents in relation to how many could have occurred, it is necessary to determine some frequency of exposure. In the context of excavation damage, exposure can be measured by the number of excavations. This measure can be approximated by the number of locate tickets issued by one-call centers, although that number will capture only those excavations that were reported to one-call centers.

One-call centers offer the best opportunity for the industry as a whole to determine the rate of excavation damage. The OCSI Delegate Committee is developing a process to standardize and collect one-call center information from its members. To be useful, the information will need to be qualified by reporting criteria. Categories will need to be clearly defined: what is an excavation activity, what constitutes a facility hit, how is the level of damage categorized, what caused the damage?

Many facility operators, particularly companies that transport gas and hazardous liquids, investigate and record "line hits," in terms of damages per thousand locate requests. But because of proprietary interests, these numbers are rarely compiled across companies. The Gas Research Institute's (GRI) 1995 study made an effort to determine risk exposure for the gas industry.[20] The study surveyed 65 local distribution companies and 35 transmission companies regarding line hits. Less than half (41percent) of the companies responded, and several major gas-producing States were poorly represented (only one respondent from Texas and one from Oklahoma). The GRI estimate was determined by extrapolation and may be subject to a large degree of error because the data sample was not representative. Based on survey responses, however, GRI calculated an approximate magnitude of risk. For those companies that responded, a total of 25,123 hits to gas lines were recorded in 1993; from that, the GRI estimated total U.S. pipeline hits in 1993 to be 104,128. For a rate of exposure, this number can be compared to pipeline miles: for 1993, *Gas Facts* reported 1,778,600 miles of gas transmission, main, and service line, which calculates to a risk exposure rate of 58 hits per 1,000 line miles.[21]

Because the risk of excavation damage is associated with digging activity rather than system size, "hits per digs" is a useful measure of risk exposure. For the same year that GRI conducted its survey, one-call systems collectively received more than an estimated 20 million

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[20] Doctor, R.H.; Dunker, N.A.; Santee, N.M. 1995. Third-Party Damage Prevention Systems. *GRI-95/0316*. Final report, contract 5094–810–2870. Chicago, IL: Gas Research Institute. 67 p., plus appendixes.

[21] Calculated as total hits (104,128) ÷ miles of gas line (1,778,600) = 0.0585 hits per mile or 58.5 hits per 1,000 miles. Note: Different categories of gas lines were added together. Transmission lines have a substantially lower rate than other gas systems: survey respondents reported 201 hits per 36,042 line miles, for a rate of 5.5 hits per 1,000 miles. However, GRI survey numbers account for only 10 percent of the U.S. gas transmission system. If the number of transmission system hits per 1,000 miles is separated from the U.S. total, the rate for local distribution companies increases to 71 hits per 1,000 miles.

calls from excavators. (These calls generated 300 million work-site notifications for participating members to mark many different types of underground systems.) Using GRI's estimate of hits, the risk exposure rate for 1993 was 5 hits per 1,000 notifications to dig.[22] A comprehensive measure of hits per digs tracked over time can be a useful indicator of how well excavation damage prevention programs are performing. Because the measure is expressed as a rate rather than simply a number of hits, it can be used to compare years in which there were different levels of construction activity. The measure can also be used to compare geographic locations or utility systems of different size. Industry is beginning to use such measures of performance; for example, measures of hits per locates have been incorporated into contractual agreements between utilities and their locator services.[23]

The Safety Board is encouraged that attempts are being made to calculate risk exposure data. Without this information, evaluations on the effectiveness of State damage prevention programs cannot be adequately performed. The Safety Board is concerned, however, that these isolated attempts to calculate exposure data are neither standardized nor centrally reported. A "utility" in one State may be defined differently for another State, resulting in inconsistent measures of damage.

If all digging activity were recorded through one-call systems, notification ticket volume would be a useful measure of risk exposure. The Safety Board recognizes that not all excavators currently use one-call notifications systems and that there are 84 separate one-call systems operating in the United States collecting different information in different formats. In spite of this variation, the Safety Board concludes that the one-call notification centers may be the most appropriate organizations to collect risk exposure data on frequency of digging and data on accidents. To standardize how and what information should be collected, the Safety Board believes that the APWA, in conjunction with RSPA, should develop a plan for collecting excavation damage exposure data and then work with the one-call systems to implement the plan to ensure that exposure data are being consistently collected. The universal damage report form developed by Alberta One-Call could be considered by the OCSI. Finally, the Safety Board believes that the APWA and RSPA should use the exposure data in the periodic assessments of the effectiveness of State excavation damage prevention programs described in other safety recommendations in this letter.

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[22] Calculated as total hits (104,128) ÷ excavation notifications (20,000,000) = 0.0052 per notification or 5.2 per 1,000 notifications.

[23] Northern Illinois Gas incorporated a performance incentive based on hits per locates into its most recent locator service contract with Kelly Cable Corporation.

Therefore, the National Transportation Safety Board recommends that the American Public Works Association:

> Initiate and periodically conduct, in conjunction with the Research and Special Programs Administration, detailed and comprehensive reviews and evaluations of existing State excavation damage prevention programs and recommend changes and improvements, where warranted, such as full participation, administrative enforcement of the program, pre-marking requirements, and training requirements for all personnel involved in excavation activity. (P-97-25)
>
> In conjunction with the Research and Special Programs Administration, develop a plan for collecting excavation damage exposure data. (P-97-26)
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> Work with the one-call systems to implement the plan outlined in Safety Recommendation P-97-26 to ensure that excavation damage exposure data are being consistently collected. (P-97-27)
>
> Use the excavation damage exposure data outlined in Safety Recommendation P-97-26 in the periodic assessments of the effectiveness of State excavation damage prevention programs described in Safety Recommendation P-97-25. (P-97-28)
>
> Review existing training programs and materials related to excavation damage prevention and develop guidelines and materials for distribution to one-call notification centers. (P-97-29)
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> Develop guidelines and materials that address initial emergency actions by excavators when buried facilities are damaged and then distribute this information to all one-call notification centers. (P-97-30)
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> Encourage one-call notification centers to work with their members to provide facility location information for the purpose of construction planning. (P-97-31)
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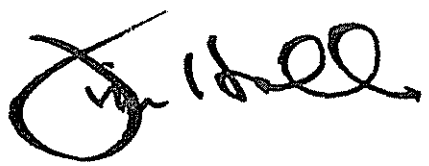
> Develop standards, in conjunction with the American Society of Civil Engineers, for map depiction of underground facilities that were installed using directional boring techniques. (P-97-32)
>
> Address, in conjunction with the American Society of Civil Engineers, the accuracy of information that depicts subsurface facility locations on construction drawings. (P-97-33)

As a result of this safety study, the Safety Board also issued safety recommendations to the Research and Special Programs Administration, the Federal Highway Administration, the Association of American Railroads, the American Short Line Railroad Association, the American Society of Civil Engineers, and the Associated General Contractors of America.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility ". . . to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations P-97-25 through -33 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.



By: Jim Hall
Chairman