## 2. DAMAGE TO UNDERGROUND PIPELINES AND UTILITIES

Because there are federal and state legal requirements that require reports on particular natural gas leaks, the gas pipeline damage statistics are now more complete. Evaluations for damage to underground facilities of nongas utilities are also presented.

### 2.1 Damage to Natural Gas Pipelines

This damage statistics section is divided into a number of subsections; leak repair, reportable leaks, pipeline system, and pipeline materials.

#### 2.1.1 Pipeline Leaks and Damage Reports –

2.1.1.1 OPSO Reports: In addition to the individual reports on reportable leaks, the natural gas distribution, transmission, and field gathering pipeline operators are required by law to sbumit two other types of reports to OPSO.

One is the Test Failure Report on gas transmission and gathering system (same form as that for reportable leaks) that contains information pertaining to the failure of gas pipelines resulting from hydrostatic or other tests performed by or for the pipeline operators. The second is the Annual Report (Form DOT F7100.1-1 for gas distribution systems and Form DOT F7100.2-1 for gas transmission and gathering systems) that contains statistics pertaining to various types of gas pipeline operations including the mileage of gas pipelines, number of services, the mileage of new gas pipelines added to the systems during the calendar year, the number of new services added during the year, number of leaks repaired during the year, background information of these leaks, etc.

These reports have been received and processed by **OPSO** since 1970 and provided vital data on natural gas pipelines heretofore unavailable. The format of these reports is presently being revised by **OPSO** to facilitate their processing and make them more useful.

In some states, the gas pipeline operators are required by state law or regulations, to submit the reports to OPSO through state commissions or agencies *so* that the state governments can maintain records on the status of gas pipelines under their jurisdiction. In such cases, duplicate reports may be required on the gas pipeline operators. Some states may require the submission of reports that are different from the OPSO reports.

One should be aware of exemptions from reporting requirements. Gas distribution system operators with fewer than 100,000 customers do not have to file reports on leaks (DOT Form F7100.1). All gas distribution system operators must file annual reports (DOT Form F7100.1-1) except for petroleum gas systems which serve less than 100 customers from a single source. Transmission and gathering system operators must file leak reports within 20 days after discovering a leak (DOT Form F7100.2).

2.1.1.2 Company Reports: The utility companies may have developed reporting forms of their own to keep records on repair work performed by maintenance crews or on damages to their facilities. These reporting forms vary from company to company. Some of these forms are more work-oriented while others may be used by their claims department for reestablishing legal responsibilities *so* that the utility companies can collect on the damage inflicted by outside parties. An example of a company report form is presented in Figure 2.1 which is used by a gas-electricity combination utility company in the West.

Comparing the company report form presented in Figure 2.1 to that of OPSO reports will show that they are different. Obviously these report forms were developed for different purposes, though overlapping to some extent. An approximate evaluation is that the OPSO form attempts to affix a cause of pipeline failure (not necessarily blame) and thus requires a fairly complete description of the pipeline involved including its conditions, geometries, and past testing history, while the estimate of property damage cost is confined to a single dollar entry.

Form 3

# CALIFORNIA-PACIFIC UTILITIES COMPANY
## DAMAGE TO COMPANV FACILITIES

**TIME AND PLACE**

Date of accident: _____

lime: _____

Location: _____

_____

**BILLINC INFORMATION**

Name of person to be billed: _____

Address: _____

Name of Insurance Company involved: _____

_____

Address: _____

**NATURE OF DAMAGE**

What kind of structure was damaged? _____

Gas _____ Main _____

Telephone _____ Service _____

Electric _____ Service _____

Other (specify) _____ Other _____

What damage was done? _____

Was there a customer outage ? _____ If so, how mony customers were affected? _____

When was service restored ? _____

**EQUIPMENT**

What kind of equipment was used ? _____

What make ? _____ Model ? _____ License number ? _____

Who owns it ? _____

**PERSONNEL INVOLVED**

Who did the damage? (Name the people directly involved and provide their employer's name and address) _____

_____

What are the names, addresses and telephone numbers of witnesses ? _____

_____

_____

_____

**SUMMARY OF FACTS**

(Indicate any injuries sustained) How did the accident happen? _____

_____

_____

_____ _____

**Date** ***Signature of District Office Manager***

Figure 2.1 Facility Damage Report Form

The company report forms, on the other hand, usually require a description of the extent of the damage and detailed definition of the repairs and repair costs, frequently including the amount of labor involved, vehicle and tool used, and newly installed materials with credit for salvage.

2.1.2 Leak Repair -

2.1.2.1 OPSO Annual Reports: The annual reports submitted to OPSO by natural gas distribution, transmission, and gathering system operators contain information on the mileage of active gas pipelines. Note that the exemption mentioned earlier excludes leak reports of the gas distribution systems with less than 100,000 customers. The annual reports include all operators.

These data were analyzed in this program. Figure 2.2 presents the total mileage of gas distribution mains and number of gas services in the United States reported to OPSO by gas distribution system operators at the end of each of the 6 years. Figure 2.3 presents the total mileage of gas transmission and gathering systems in the United States. The data show that the mileage of gas distribution pipelines and the number of services have been on the rise during the 6-year period (except in 1975) while the total mileage of gas transmission-gathering pipelines has changed very little during the same period.

The number of leaks repaired by natural gas pipeline operators during each of the 6 years is shown in Figures 2.4 and 2.5, in which the number of leaks repaired are broken down according to the reported causal factors. The data show that the number of leaks on the natural gas distribution systems has been on the rise while that of natural gas transmission-gathering systems has been decreasing steadily. If one takes the increase in the mileage of gas distribution mains and in the number of gas services into account, the number of leaks repaired per mile of gas distribution pipelines stayed fairly constant during the 6-year period. Assuming the average length of a gas service to be 50 feet and converting the total number of gas services to miles and combining the figures to that of gas mains, the number of leaks

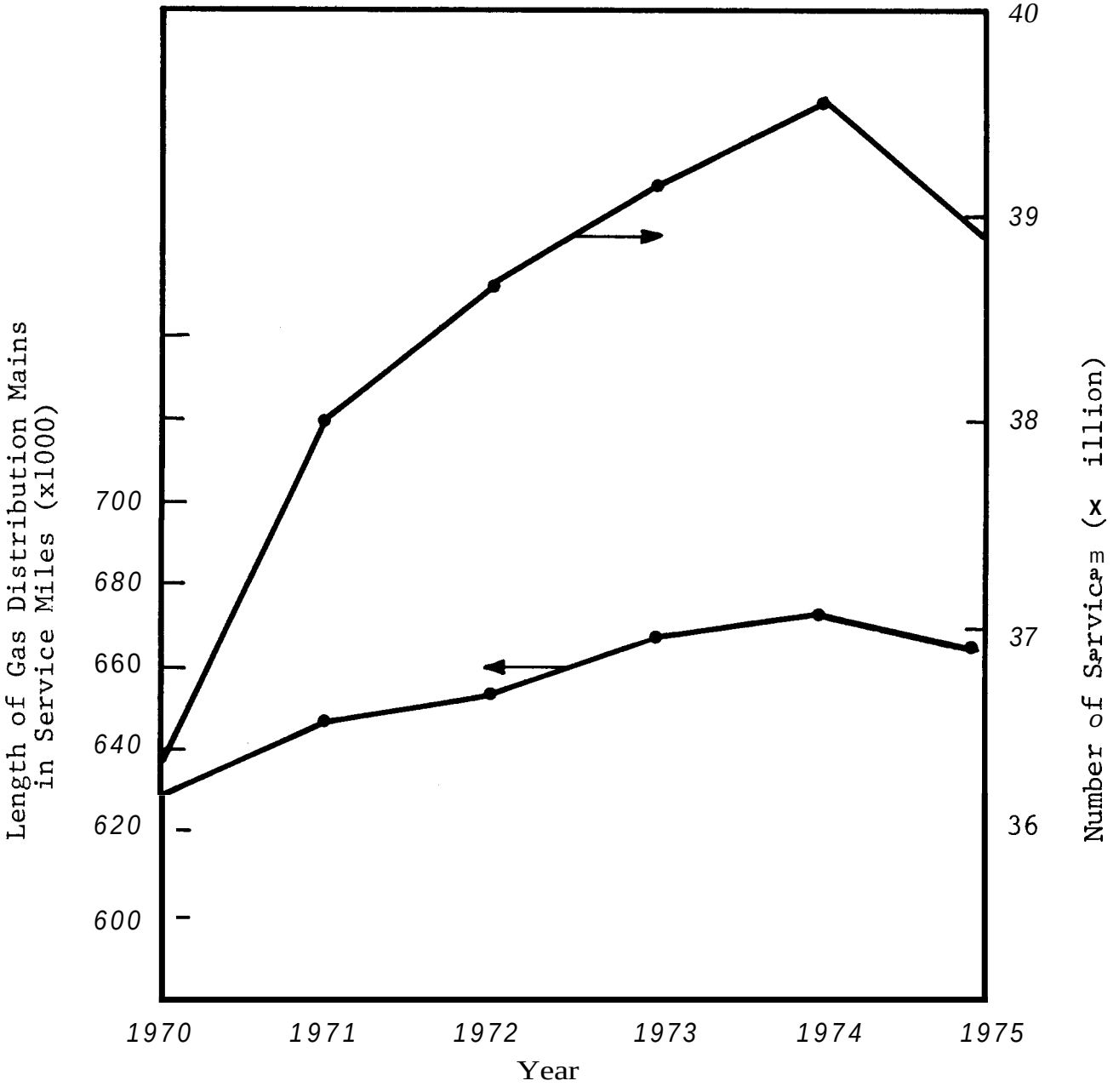


Figure 2.2 Total Mileage of Plains and Number of Services in Gas Distribution Pipelines in the United States

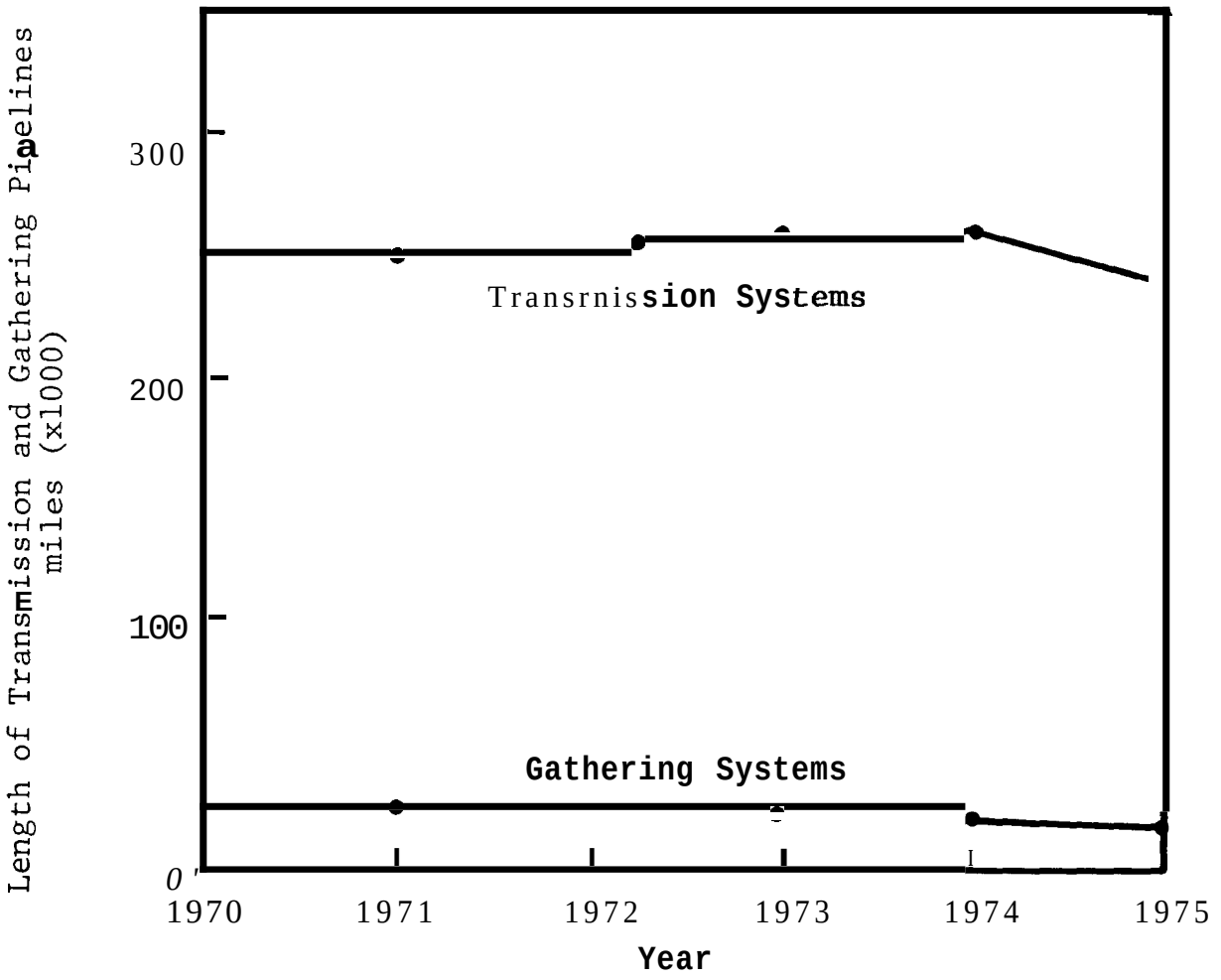


**Figure 2.3 Total Mileage of Gas Transmission and Gathering Pipelines in the United States**

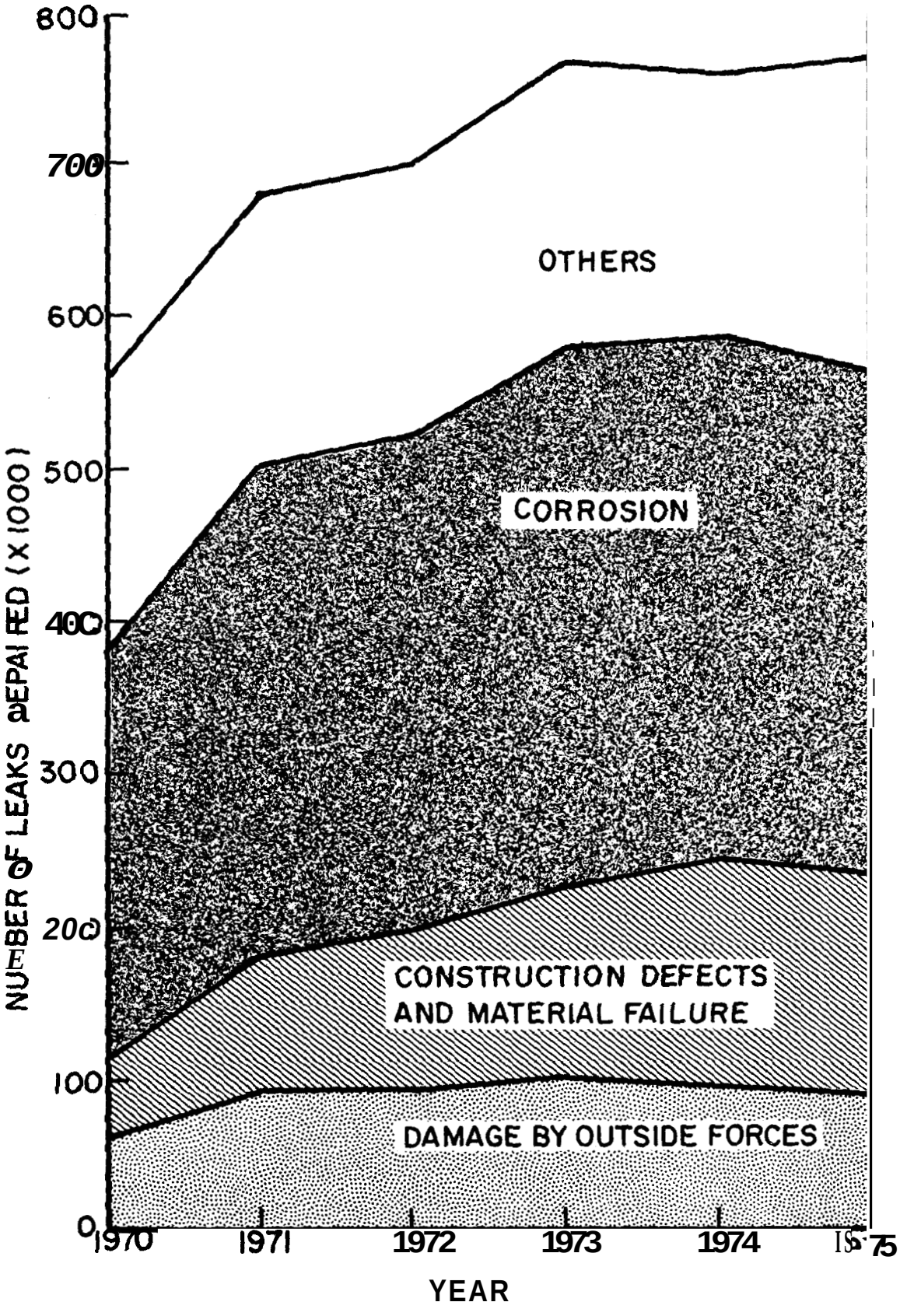


*Figure 2.4* ***Number*** **of** Leaks Repaired on Gas **Distribution Systems (OPSO** data: 1970-1975)

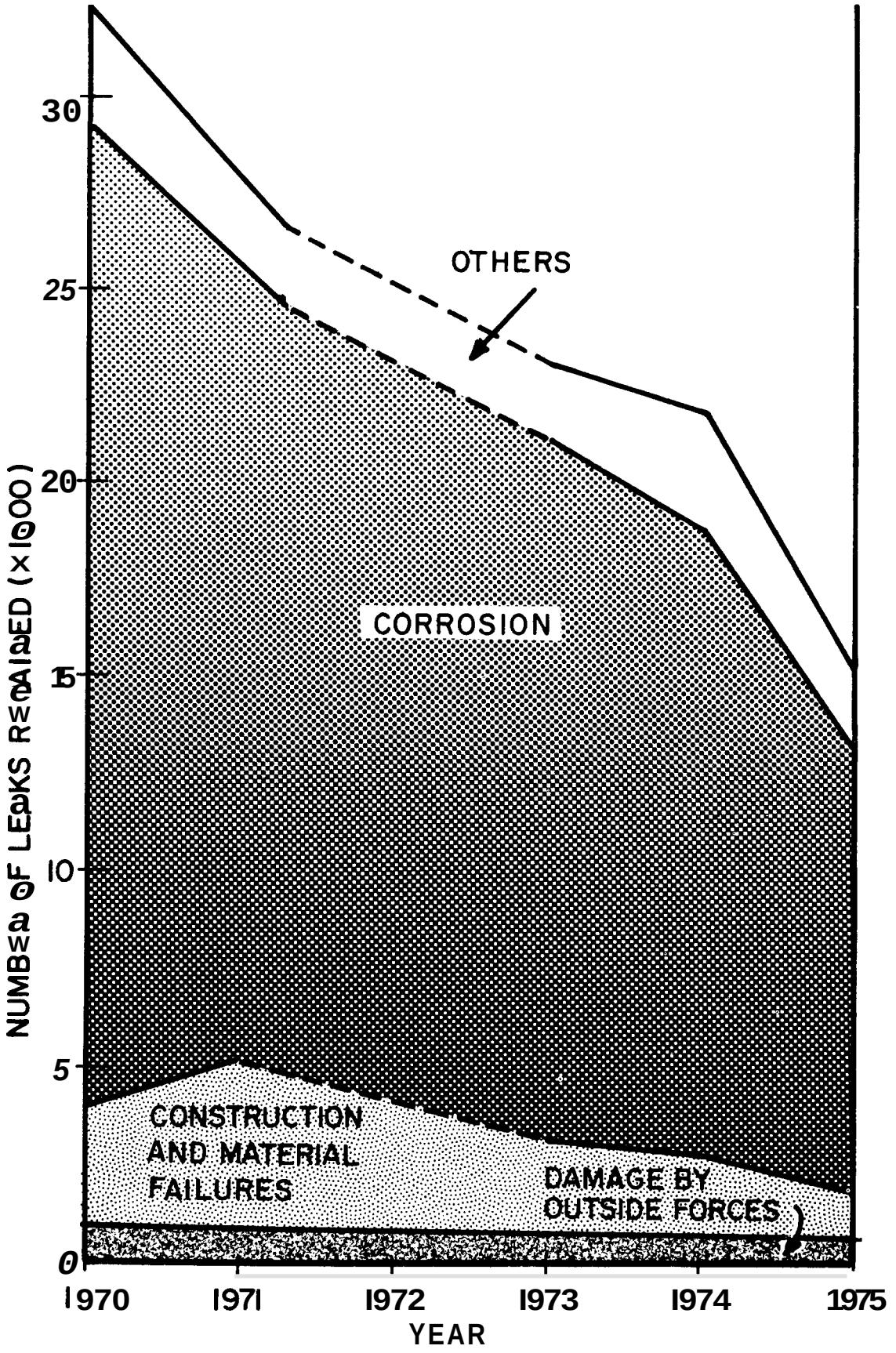


**Figure 2.5 Number of Leaks Repaired on Gas Transmission-Gathering Systems (OPSO data: 1970-1975)**

repaired per mile of gas distribution pipelines in each of the 6 years are shown in Table 2.1, which also contains the similar figures for the gas transmission-gathering systems.

TABLE 2.1 ESTIMATED LEAK REPAIR FREQUENCY OF GAS DISTRIBUTION AND TRANSMISSION-GATHERING PIPELINE SYSTEMS

| | Number of Leaks Repaired per Mile of Pipeline | | | | | |
|---|---|---|---|---|---|---|
| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
| Distribution Mains and Services | 0.58 | 0.67 | 0.69 | 0.74 | 0.73 | 0.75 |
| Transmission–Gathering Systems | 0.12 | 0.093 | 0.083 | 0.083 | 0.077 | 0.056 |

The data in Table 2.1 basicially show:

- Leak repair frequency of gas distribution systems is considerably higher than that of gas transmission-gathering systems
- Leak repair frequency of gas distribution systems has been steadily rising during the 6-year period
- Leak repair frequency of gas transmission-gathering systems has been steadily decreasing during the same period.

The data presented in Figures 2.4 and 2.5 also show that among the leaks detected and repaired by gas pipeline operators during the 6-year period, only a small percentage of them were attributed to damage by outside forces; the percentage is particularly small in leaks of gas transmission-gathering systems. The total number of leaks repaired because of outside force damage remained relatively constant during the 6-year period; corrosion failures were predominant in both gas distribution and transmission-gathering systems. Therefore, from the point of reducing the gas pipeline maintenance costs, corrosion control seems to be the most effective approach.

Figure 2.6 presents the number of outside force damages to gas pipelines per mile of pipeline. These data were constructed by converting the number of gas services to miles of gas pipelines by assuming each gas service is 50 feet in length. The data show that the number of outside force damages per mile of gas pipelines has been relatively constant for gas distribution systems and has been steadily decreasing for gas transmission and gathering systems.

2.1.2.2 Industrial Input: As indicated, many gas pipeline operators have kept records on pipeline damage. These records are generally devoted to dig-in types of damage, namely, outside party damages; corrosion and other leaks are not included. Figure 2.7 presents the annual damage statistics of several gas distribution companies of various sizes and geographical locations. These data show that the seven gas utilities fared differently in outside party damage. Utility number 1 has had the highest number of damages but the number has been declining steadily since 1968. For utility number 2, the number of damages has been increasing steadily since 1971. The data of several other gas utilities show that the number of damages on gas pipelines has been fairly constant during the last 6 years.

The identities of the utilities shown in Figure 2.7 (also 2.8 and 2.25) are:

1. A large northern state gas-electric combined utility
2. A large west coast gas utility
3. A northwestern state gas utility
4. A southern state gas utility
5. A large northern city gas utility
6. A southwestern state gas-electric utility
7. Data from Ohio Public Utility Commission, Gas Systems

Figure 2.8 presents data on the annual damage incidents per mile of gas distribution mains of four selected gas companies.

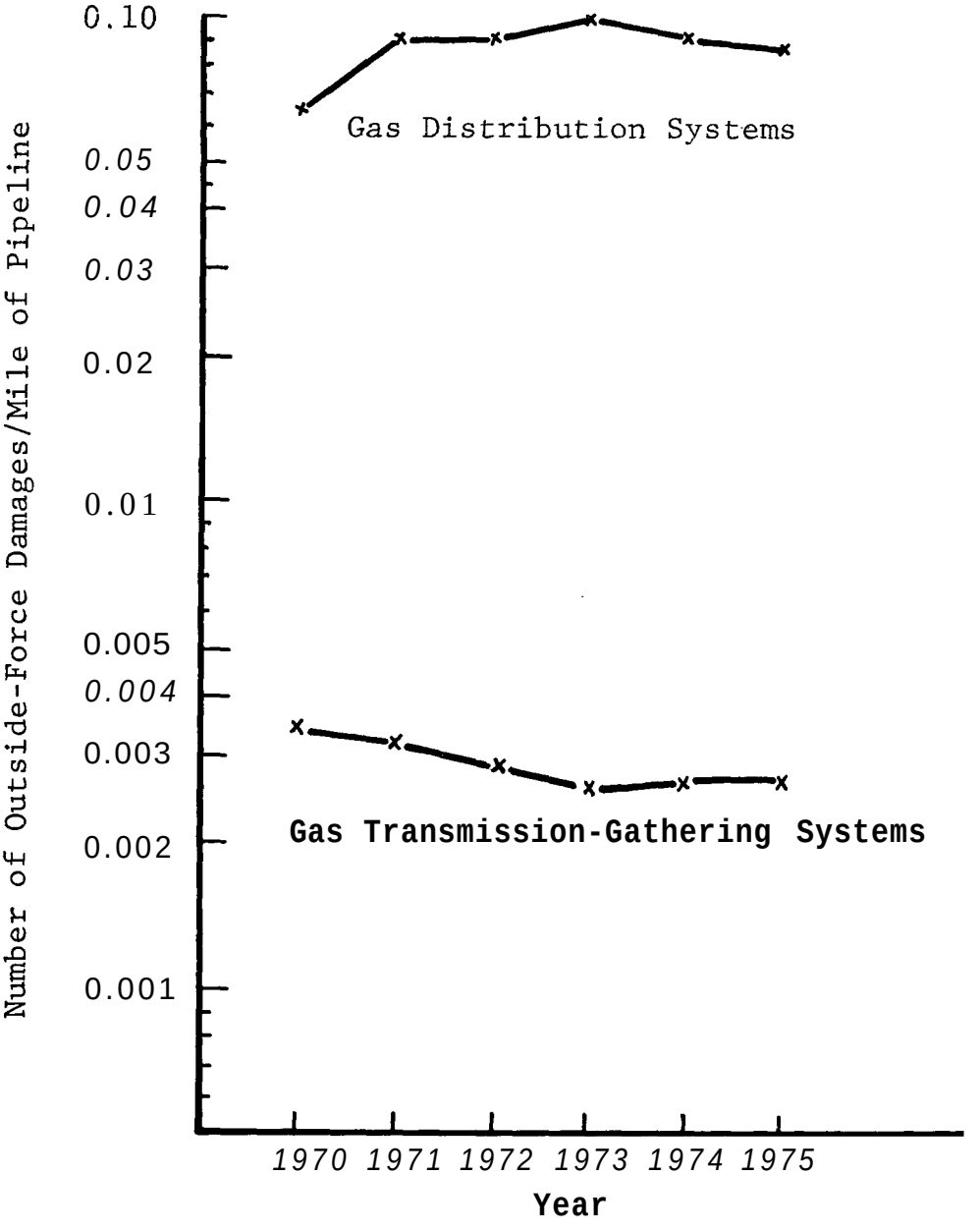


**Figure** *2.6* **Annual Outside Force Damage to Gas Pipelines in the United States (OPSO data:** *1970-1975)*

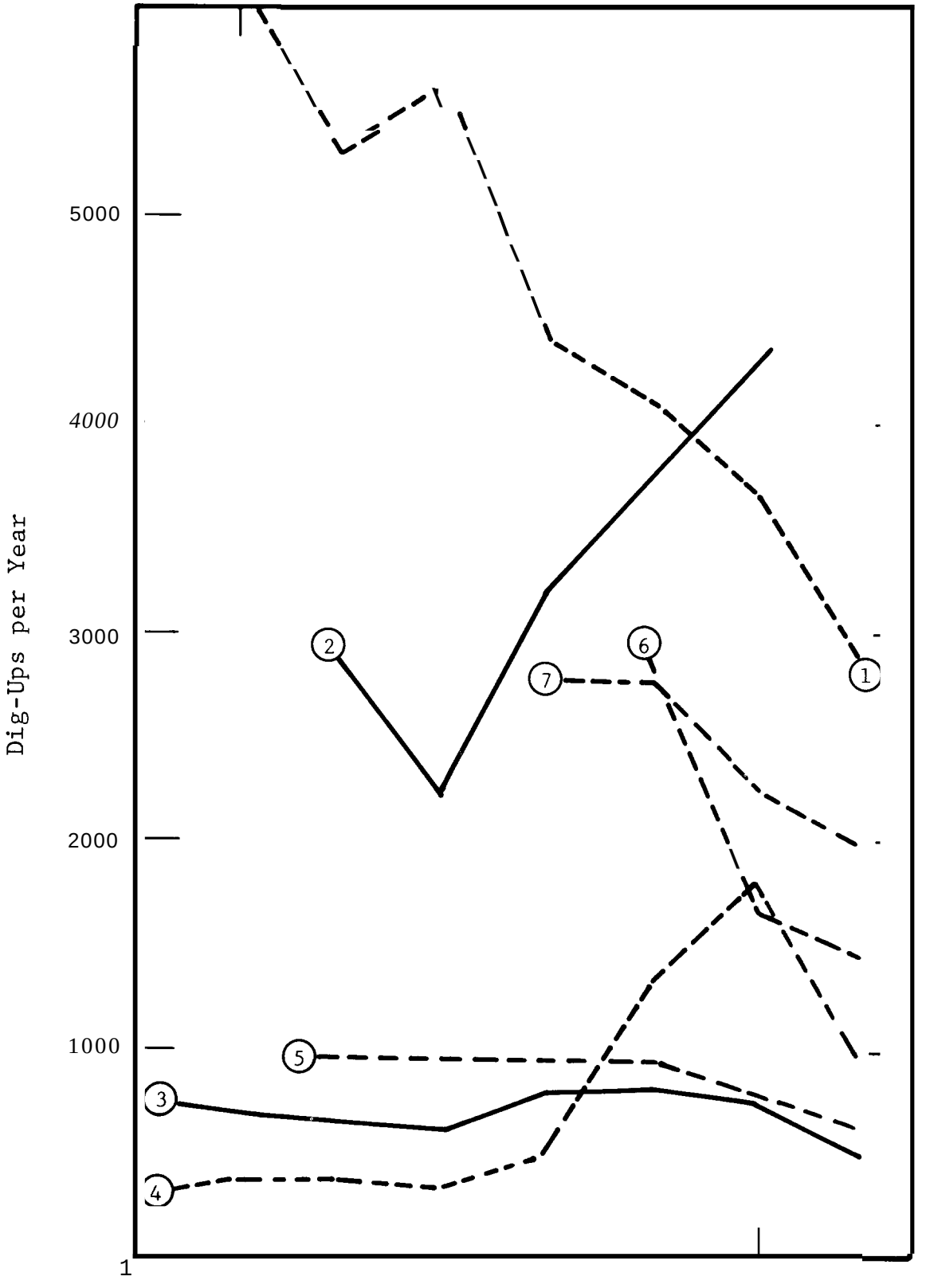


**Figure 2.7 Annual Damages to Seven Gas Distribution Operators**

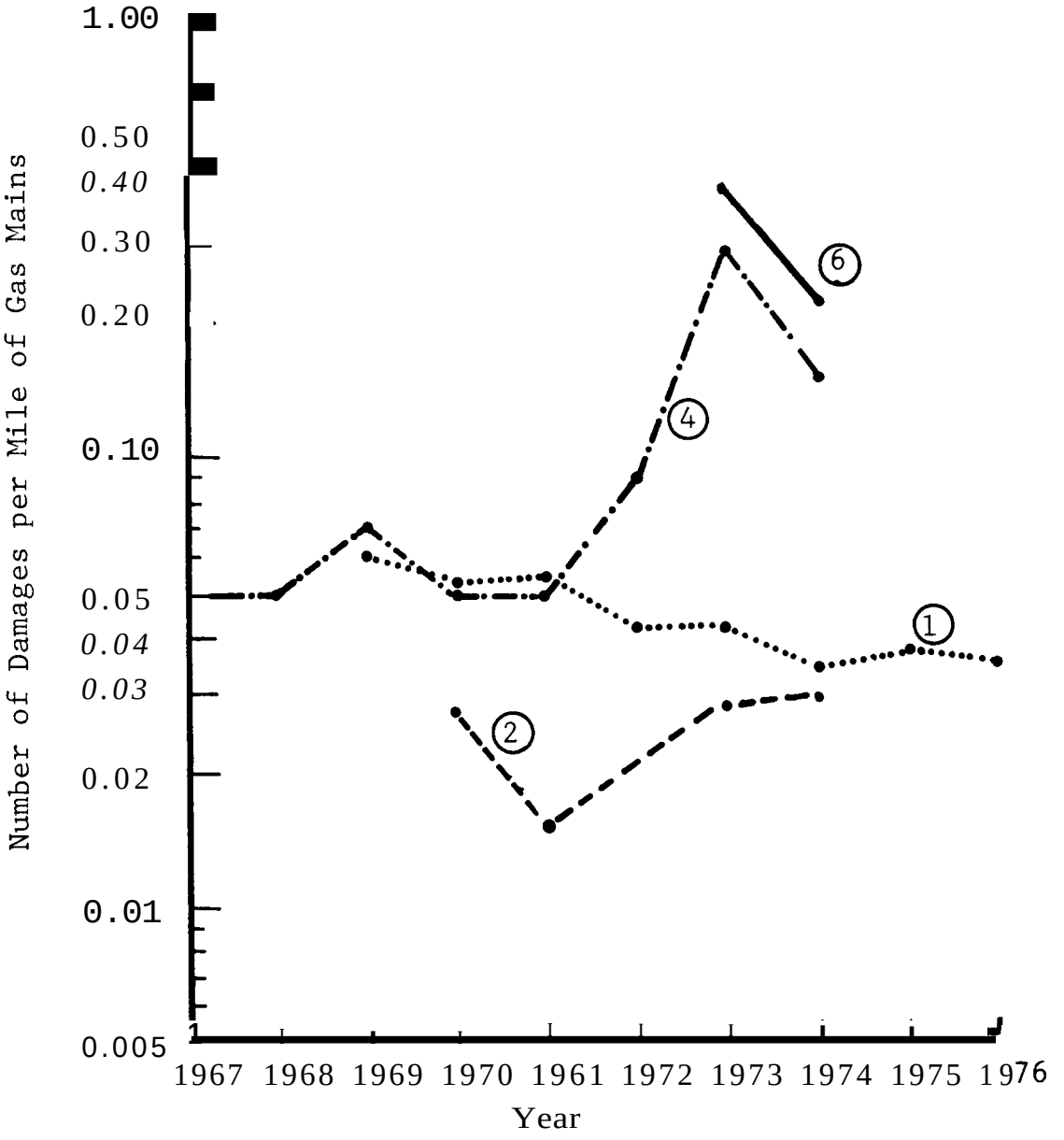


Figure 2.8 Annual Outside Party Damage to Selected Gas Distribution Operators

The data show that utility number 4 (a southern gas distribution company) and utility number 6 (a southwestern state gas-electric utility) have comparatively higher damage rates and both utilities are located in cities that have been known in recent years to have a high intensity of construction activities. The high damage rate of gas distribution mains of utility number 4 has been blamed on the type of state laws that were enacted just before the significant increase in damage rate shown in Figure 2.8. The law specifically exempted certain utilities from being required to join a one-call system. In the case of utility number 6, there has been a great deal of praise for the effectiveness of their damage prevention programs.

The national average damage rate (hit per mile) for gas distribution systems due to outside parties is not known because of data reporting; some operators report hits on services and some report only hits on mains because the operator does not own the services. It is estimated that damage is equally divided between service pipes and mains. Thus for distribution mains the damage rate is $\approx 0.1 \div 2 = 0.05$ (Figure 2.6). The damage rate of both utility 4 and 6 (Figure 2.8) are much higher than the assumed national average of 0.05. Both are in the sunbelt area where construction rates are high.

2.1.3 Reportable Leaks – The OPSO supplies a form on which all of the required reportable leaks data are defined. Figures 2.9 and 2.10 are reproductions of the required forms for distribution systems and transmission and gathering systems.

Each of the gas utilities has developed reporting forms of its own, and usually these forms are used by the claims department. These forms are slanted in the direction of establishing legal responsibility so that the utility can rightfully be reimbursed for the damages. The utility form develops a perfunctory background description of damage to the pipeline by requiring a detailed entry of the various items including labor, vehicle and tool use, and newly installed material with credit for salvage.

The OPSO forms were developed to report on system safety; the system operators must use these forms for reportable leaks. The utility forms were developed to support their claims departments. There is overlap between the OPSO and utility forms.

The utility specifically does not record: corrosion (i.e., not dig-in type damage) though they do report to OPSO on leak repairs, at least the number of leaks repaired; much detail on construction or material failure, hence little on pipe geometry or pipe testing history; operating pressure; method of leak or failure detection, type of repair; personal injury; or environmental description.

Neither the OPSO form nor the utility damage report form requires a description of the excavation size (i.e., trench depth and width) at which the damage occurred. Neither requires a description of the size of any excavation machinery which was in use, and neither requires a description of the extent of damage. Indirectly the utility does describe the extent of damage in that it does require a detailed definition of the repairs and repair costs.

Many, in fact most, of the gas utility damage reports are not concerned with reportable leaks. The gas utilities, and others, are concerned that a report form might be required as part of a damage reduction program. They claim that presently about 80 percent of the data that should be desired is recorded. The larger gas utilities now use computer information retrieval systems, and state that they would like to see a yearly report made for data base development. If a more general report form was in use, it would seem to be an attractive solution.

2.1.3.1 Classification of Reportable Leaks: The OPSO Individual Leak Report data show that during the 6-year period of 1970 to 1975, a total of 5230 reportable leaks occurred on natural gas distribution systems (for an average of 872 cases per year) and a total of 2459 reportable leaks on natural gas transmission and gathering systems (for an average of 410 cases per year).

Form Approved: Budget Bureau No. 04-R5604

DEPARTMENT OF TRANSPORTATION

# LEAK REPORT — DISTRIBUTION SYSTEM

REPORT DATE

**INSTRUCTIONS:** Complete this side of this form for each incident regardless of cause.
Check appropriate box for specific cause of leak or failure and complete the pertinent part(s) on the reverse side,

☐ CORROSION PART-A ☐ DAMAGE BY OUTSIDE FORCES—PART-B ☐ CONSTRUCTION DEFECT OR MATERIAL FAILURE—PART-C ☐ OTHER *(Describe incident in detail in writing and attach to this form where parts are no: applicable.)*

If material to answer an applicable question is not available this should be stated. Only such portions of the form as apply to the particular leak are to he completed. In all parts of the form which are not applicable, the letters "NA" should be insened so that every item is completed. If additional instruction is needed to complete this form, the operator may telephone the Department of Transportation, Officeof Pipeline Safety, **Area** Code ***202,962–*** 0, Monday through Friday, 8:30 A.M. to 5:00 P.M. Eastern Time.

GE

RAL

**1. OPERATOR INFORMATION**

NAME OF OPERATOR

NUMBER & STREET

CITY & COUNTY

STATE & ZIP CODE

REPORTING OFFICIAL'S TELEPHONE NUMBER *(Include Area Code)*

**2. LOCATION AND TIME OF LEAK OR FAILURE**

a NUMBER & STREET

CITY & COUNTY

STATE & ZIP CODE

b. TIME OF DETECTION (1) DATE (2) HOUR

c HOURS & MIUUTES BETWEEN TIME OF DETEC-TION & TIME ESCAPE OF GAS WAS STOPPED

d. ESTIMATED PRESSURE AT POINT AND TIME OF INCIDENT *(PSIG)*

e MAXIMUM ALLOWABLE OPERATING PRESSURE *(PSIG)*

(3) ☐ Customer

**A. PART OF SYSTEM WHERE LEAK OR FAILURE OCCURRED**

a. ☐ Main c. ☐ Other *(Specify)*
b. ☐ Service

**5. PART OF SYSTEM WHICH LEAKED OR FAILED**

**a.** Part

**(1)** ☐ Pipe **(4)** ☐ Drip (7) ☐ Other *(Specify)*
(2) ☐ Valve **(5)** ☐ Regulator
(3) ☐ Fitting (6) ☐ Tap connection

b. Date installed

**b. MATERIAL WHICH LEAKED OR FAILED**

**a.** Material

(1) ☐ Steel **(4)** ☐ Copper (7) ☐ Other *(Specify)*
**(2)** ☐ Plastic **(5)** ☐ Ductible iron
(3) ☐ Cast iron **(6)** ☐ Wrought iron

b. Was the material that leaked or failed the same material as adjoining pipe or component? (1) ☐ Yes **(2)** ☐ No
**(If "No," describe *material in* the *adjoining component or* parts)**

c. Is a metallurgical analysis planned?
**(1)** ☐ **Yes** (2) ☐ **No**

**7 ORIGIN OF LEAK OR FAILURE**

**a.** ☐ Base material fracture e. ☐ Corrosion
b. ☐ Longitudinal weld f. ☐ Other *(Specify)*
c. ☐ Girth weld
d. ☐ Other field weld

| | |
|---|---|
| ı. Nominal Diameter (Inches) | b. Nominal wall thickness *(Inches)* |
| :. Specification and grade | d. Grade |

**2. ADDITIONAL DESCRIPTION OF INCIDENT OR FOR CONTINUATION OF EX NATION OF ITEMS ABOVE**

**NAME AND TITLE OF REPORTING OFFICIAL**

**SIGNATURE OF REPORTING OFFICIAL**

**). TYPE OF REPAIR**

a. Pipe
(1) ☐ Weld over sleeve **(4)** ☐ Replace pipe (Length) ____, fee
**(2)** ☐ Patch-welded
(3) ☐ Clamp (5) ☐ Other repair or dispositio *(Specify)*
b. Component
(1) ☐ Replaced (3) ☐ Other *(Specify)*
**(2)** ☐ Reconditioned

**0. PERSONAL INJURY OR PROPERTY DAMAGE RESULTING FROM ESCAPE OF GAS**

a. Number of employee(s)
(1) Fatalities
(2) Suffering lost-time injuries
b. Number of non-employee(s)
(1) Fatalities
**(2)** Injured and requiring medical treatment other than on-site first aid

| | Yes | No |
|---|---|---|
| c. Rupture occurred. (1) | ☐ | (2) ☐ |
| d. Gas ignited.. (1) | ☐ | (2) ☐ |
| e. Explosion occurred.. (1) | ☐ | (2) ☐ |
| f. Incident induced any secondary explosions or fires. (1) | ☐ | (2) ☐ |

g. Estimated value of operator's property damage $

**1 ENVIRONMENTAL DESCRIPTION**

a. Predominant type of area
(1) ☐ Commercial **(4)** ☐ Rural
(2) ☐ Industrial **(5)** ☐ Unknown
(3) ☐ Residential (6) ☐ Other *(Specify)*

b. Predominant above-ground structure adjacent to leak

| | Multi-story | Single-story |
|---|---|---|
| (1) Commercial | *a* ☐ | *b* ☐ |
| **(2)** Industrial | *a* ☐ | *b* ☐ |
| (3) Residential | *a* ☐ | *b* ☐ |
| **(4)** Other *(Specify)* | *a* ☐ | *b* ☐ |

c. Approximate distance to nearest above ground structure I ***Within*** *1* mile *of leak)* feet

d. Did other underground facility(ies) contribute to occurrence of leak in any manner? ☐ Yes ☐ No

e. If **so,** what was effect of existence of other facility(ies)?

f. Was other utility(ies) imperiled by the leak? **(1)** ☐ Yes **(2)** ☐ NO

g. Distance of other facility(ies) or utility(ies) from leak or failure location

| Other facility(ies) contributing to | | Other utility(ies) impaired |
|---|---|---|
| Ft. (1) ☐ | Other gas | **(8)** ☐ Ft. |
| Ft. **(2)** ☐ | Telephone | (9) ☐ Ft. |
| Ft. (3) ☐ | Electric | (10) ☐ Ft. |
| Ft. **(4)** ☐ | Sewers *(Storm)* | **(11)** ☐ Ft. |
| Ft. **(5)** ☐ | Sewers **(Other)** | **(12)** ☐ Ft. |
| Ft. (6) ☐ | Water | (13) ☐ Ft. |
| Ft. (7) ☐ | Other *(Specify)* | **(14)** ☐ Ft. |

h. Location of leak or failure
(1) ☐ Within building (5) ☐ Below other paved area *(Specify)*
**(2)** ☐ Above ground **(6)** ☐ Below walkway
(3) ☐ Below ground (7) ☐ Below road
(4) ☐ **Below** water **a** ☐ Paved **h** ☐ Median **or** unpaved

i. Depth of cover inches

j. Soil information at pipe depth (1) ☐ Soil **(2)** ☐ **Rock**
**(3)** Estimated soil temperature at point of leak " F

DEPARTMENT OF TRANSPORTATION

# LEAK OR TEST FAILURE REPORT — TRANSMISSION & GATHERING SYSTEMS

REPORT DATE

☐ LEAK REWRT ☐ TEST FAILURE REPORT ☐ NEW CONSTRUCTION ☐ EXISTING FACILITY *(Specify reason for test)*

**INSTRUCTIONS:** Complete chis ride of this form for each incident regardless of cause.
Check appropriate box for specific cause of leak or failure and complete the pertinent part(s) on the reverse side.

☐ CORROSION PART—A ☐ DAMAGE BY OUTSIDE FORCES—PART—B ☐ CONSTRUCTION DEFECT OR MATERIAL FAILURE—PART—C ☐ OTHER *(Describe incident in detail in writing and attach to this form where parts are not applicable.)*

If material to answer an applicable question is not available this should be stated. Only such portions of the form as apply to the particular leak are to be completed. In all parts of the form which are not applicable, the letters "NA" should be inserted so that every item is completed. If additional instruction is needed to complete this form, the operator may telephone the Department of Transportation, Office of Pipeline Safety, Area Code **202, 96–26000,** Monday through Friday, 8:30 AM to 5:00 PM Eastern Time.

## GENERAL

**1. OPERATOR INFORMATION**

NAME OF OPERATOR

NUMBER & STREET

CITY & COUNTY

STATE & ZIP CODE

REPORTING OFFICIAL'S TELEPHONE NUMBER *(Include Area Code)*

**2. LEAK WITH RUPTURE**

a. Shear fracture *(feet)* | b. Cleavage fracture *(feet)*

c. Has a fracture toughness test been made on the material that failed? (1) ☐ Yes (2) ☐ No

d. Is a metallurgical analysis planned? (1) ☐ Yes (2) ☐ No

**3. LOCATION AND TIME OF LEAK OR FAILURE**

a. Sumber & Street

City & County

State & ZIP Code | b. Mile Post | c. Survey Station No.

d. Time of Detection (1) Date (2) Hour | e. HOURS & MINUTES BETWEEN TIME OF DETECTION AND TIME ESCAPE OF GAS WAS STOPPED

f. Estimated pressure at point and time of incident *(PSIG)* | g. Maximum allowable operating pressure *(PSIG)*

**4. LEAK OR FAILURE OCCURRED ON**

a. ☐ Transmission system c. ☐ Gathering system
b. ☐ Transmission line of distribution system

**5. PART OF SYSTEM WHICH LEAKED OR FAILED**

a. Part
(1) ☐ Pipeline (2) ☐ Compressor station (3) ☐ Dehydration plant (4) ☐ Regulator station (5) ☐ Meter station (6) ☐ Other *(Specify)*

b. Date installed

**6. ORIGIN OF LEAK OR FAILURE**

a. ☐ Body of pipe b. ☐ Girth weld c. ☐ Longitudinal weld d. ☐ Other held weld e. ☐ Compressor f. ☐ Valve g. ☐ Scraper trap h. ☐ Tap connection i. ☐ Fitting *(Type)* j. ☐ Gas cooler k. ☐ Other *(Specify)*

**7. MATERIAL WHICH LEAKED OR FAILED**

a. ☐ Steel b. ☐ Plastic c. ☐ Other *(Specify)*

a. Nominal diameter *(Inches)* | b. Nominal wall thickness *(Inches)*

c. Pipe specification | d. Grade

**9. TYPE OF REPAIR**

a. Pipe
(1) ☐ Weld over-sleeve (2) ☐ Patch-welded (3) ☐ Clamp (4) ☐ Replace pipe *(length)* feet (5) ☐ Other repair or disposition *(Specify)*

h. Component
(1) ☐ Replaced (2) ☐ Reconditioned (3) ☐ Other *(Specify)*

**10. PERSONAL INJURY OR PROPERTY DAMAGE RESULTING FROM ESCAPE OF GAS**

a. Number of employee(s)
(1) Fatalities
(2) Suffering lost-time injuries

b. Number of non-employee(s)
(1) Fatalities
(2) Injured and requiring medical treatment other than on-site first aid

| | | No |
|---|---|---|
| c. Rupture occurred | (1) ☐ | (2) ☐ |
| d. Gas ignited.. | (1) ☐ | (2) ☐ |
| e. Explosion occurred | (1) ☐ | (2) ☐ |
| f. Incident induced any secondary explosions or fires | (1) ☐ | (2) ☐ |

g. Estimated value of operator's property damage $

**11. ENVIRONMENTAL DESCRIPTION**

a. Predominant type of area

| (1) At time of construction | (2) At time of incident |
|---|---|
| a ☐ Commercial | a ☐ Commercial |
| b ☐ Industrial | b ☐ Industrial |
| c ☐ Residential | c ☐ Residential |
| d ☐ Rural | d ☐ Rural |
| e ☐ Undeveloped | e ☐ Undeveloped |
| f ☐ Unknown | f ☐ Other *(Specify)* |
| g ☐ Other *(Specify)* | |

b. Predominant above-ground structure adjacent to leak

| | Multi-story | Single-story |
|---|---|---|
| (1) Commercial | a ☐ | b ☐ |
| (2) Industrial | a ☐ | b ☐ |
| (3) Residential | a ☐ | b ☐ |
| (4) None ☐ | | |
| (5) Other *(Specify)* | a ☐ | b ☐ |

c. Approximate distance to nearest above-ground structure *(Within 1 mile of leak),* ..... feet

d. Did other underground facility(ies) contribute to occurrence of leak in any manner? (1) ☐ Yes (2) ☐ No

e. If so, what was effect on existence of other facility(ies)?

f. Was other utility(ies) imperiled by the leak? (1) ☐ Yes (2) ☐ No

g. Distance of other facility(ies) or utility(ies) from leak or failure location

| Other facility(ies) contributing to | | Other utility(ies) Impaired | | |
|---|---|---|---|---|
| Ft. | (1) ☐ | Other gas | (8) ☐ | Ft. |
| Ft. | (2) ☐ | Telephone | (9) ☐ | Ft. |
| Ft. | (3) ☐ | Electric | (10) ☐ | Ft. |
| Ft. | (4) ☐ | Sewers *(Storm)* | (11) ☐ | Ft. |
| Ft. | (5) ☐ | Sewers *(Other)* | (12) ☐ | Ft. |
| Ft. | (6) ☐ | Water | (13) ☐ | Ft. |
| Ft. | (7) ☐ | Other *(Specify)* | (14) ☐ | Ft. |

h. Location of leak or failure
(1) ☐ Within building (2) ☐ Above ground (3) ☐ Below ground (4) ☐ Below water (5) ☐ Below walkway (6) ☐ Below road → a ☐ Paved b ☐ Median or unpaved, (7) ☐ Below other paved area *(Specify)*

(i) Depth of cover *inches*

(j) Soil information at pipe depth (1) ☐ Soil (2) ☐ Rock
(3) Estimated soil temperature at point of leak °F

NAME AND TITLE OF REPORTING OFFICIAL

SIGNATURE OF REPORTING OFFICIAL

Reportable leaks are also classified, according to the contributing factors outlined by OPSO, into four groups:

- Damage by outside forces
- Corrosion
- Construction defects and material failure
- Others

Table 2.2 presents such a breakdown for both gas distribution and transmission-gathering systems for the period of 1970 to 1975. In contrast to the data of the total number of leaks repaired by gas pipelines (Figures 2.4 and 2.5), over 70 percent of the reportable leaks in gas distribution systems and over 56 percent of those in gas transmission-gathering systems were attributed to damage by outside forces as is shown in Figures 2.11 and 2.12. It it clear that leaks caused by outside forces are more likely to release a large amount of gas, and thus are much more hazardous to the safety of the public.

TABLE 2.2 PIPELINE REPORTABLE LEAKS
(OPSO data: 1970-1975, 6-year cumulative total)

| Cause Identification | Gas Distribution Systems | | Transmission & Gathering Systems | |
|---|---|---|---|---|
| | I* | % of Total | I* | % of Total |
| 1. Damage by Outside Forces | 3704 | 70.8 | 1384 | 56.3 |
| 2. Corrosion | 674 | 12.9 | 366 | 14.9 |
| 3. Contruction Defect or Material Failure | 519 | 9.9 | 540 | 21.9 |
| 4. Other | 333 | 6.4 | 169 | 6.9 |
| Total | 5230 | 100.0 | 2459 | 100.0 |

* Incidents

Table 2.3 shows a comparison of the total number of leaks repaired with the number of reportable leaks. Outside force damage reportable leaks account for nearly 1 percent of the total number of outside force damage repaired leaks.

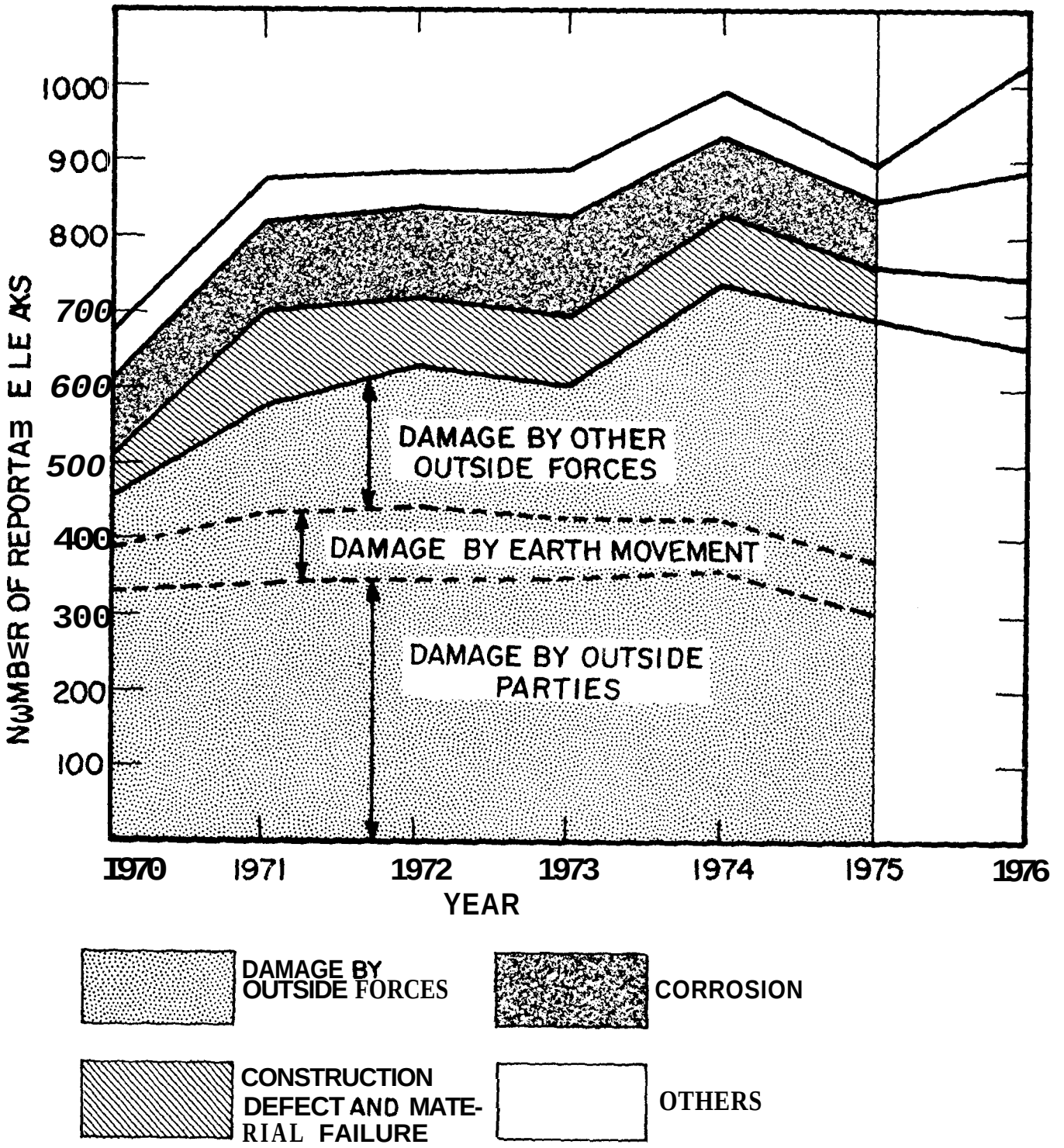


Figure 2.11 **Cause Composition of** Reportable **Leaks;** Gas **Distribution Systems** (OPSO **data: 1970-1975)**

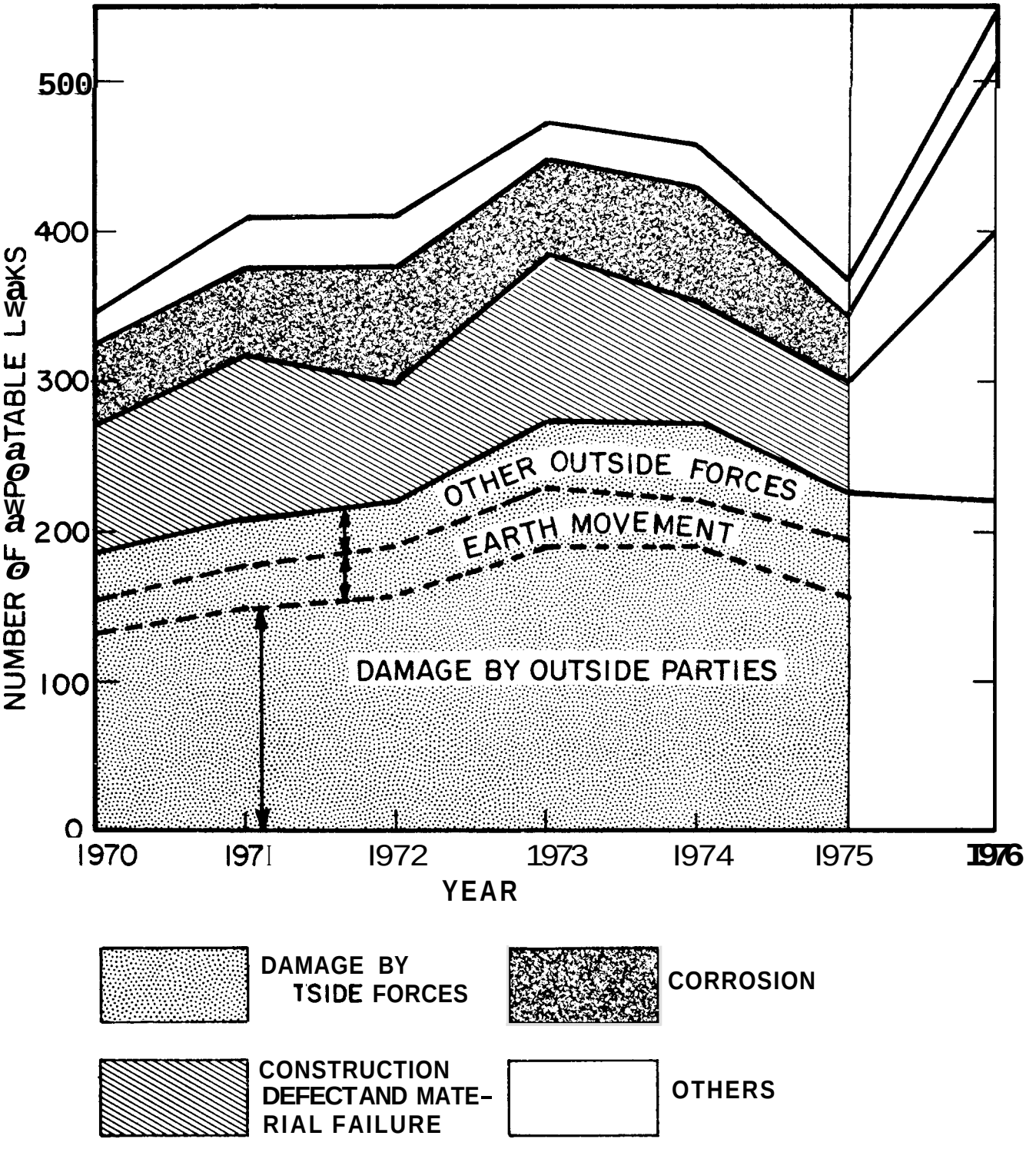


Figure 2.12 Cause Composition of Reportable Leaks; Gas Transmission and Gathering Systems (OPSO data: 1970-1975)

TABLE 2.3 PERCENTAGE OF REPORTABLE LEAKS REPAIRED ON GAS DISTRIBUTION SYSTEMS (OPSO data: 1970-1975, 6-year cumulative totals)

| Cause Factors | Number of Leaks Repaired (N) | Number of Reportable Leaks (n) | % Reportable 100(n/N) |
|---|---|---|---|
| 1. Corrosion | 1,934,870 | 674 | 0.035 |
| 2. Outside Force Damage | 532,769 | 3704 | 0.695 |
| 3. Construction Defect of Material Failure | 667,480 | 519 | 0.078 |
| 4. Others | 1,103,802 | 333 | 0.030 |

A similar treatment will show that leaks of gas transmission-gathering systems are more likely than that of gas distribution systems to become reportable due to the higher operating pressures. The leaks caused by outside force damage to gas transmission-gathering systems are particularly likely to be reportable; more than one-fourth of these leaks were reportable as shown by OPSO data.

The data presented in Table 2.4 indicate that the majority of the damage to gas pipelines was caused by earthmoving equipment operated by or for parties other than the pipeline operators - the so-called outside party damage. The identifications of these parties were not revealed in the OPSO computer data but could well include other utility system operators. If the utilities had accumulated more complete data they could confirm or refute this statement. The utility representatives note that contractors cause the damage but it is not spelled out as to who hires the contractors.

The number of reportable leaks, damage by outside forces, and damage by outside parties occurring in each of the 50 states, (plus the District of Columbia) during each of the 6 years are tabulated to obtain the geographical distribution of these data. The tabulated data for gas distribution systems are presented in Table 2.5; the data for gas transmission-gathering systems are presented in Table 2.6. Note that these OPSO reportable leak

data were received only from gas distribution systems with more than 100,000 customers. The pipeline mileage (of mains) is for all of the gas companies in the particular state. Thus any damage rate per mile statistic that is developed will be on the low side since the mileage is correct but the actual damages that occurred are greater than the damages reported in the table.

TABLE 2.4 PIPELINE DAMAGE BY OUTSIDE FORCES
(OPSO data: 1970-1975, 6-year cumulative total)

| Cause Factor | Gas Distribution Systems | | Transmission & Gathering Systems | |
|---|---|---|---|---|
| | I* | % of Total | I* | % of Total |
| 1. Equipment Operated by/for Outside Parties | 2033 | 54.9 | 957 | 69.1 |
| 2. Equipment Operated by/for Pipeline Operator | 110 | 3.0 | 86 | 6.2 |
| 3. Earth Movement | 463 | 12.5 | 192 | 13.9 |
| 4. Weather | 199 | 5.4 | 74 | 5.3 |
| 5. Willful Damage | 56 | 1.5 | 20 | 1.5 |
| 6. Vehicle | 309 | 8.3 | 31 | 2.2 |
| 7. Other | 530 | 14.3 | 23 | 1.7 |
| 8. Not Applicable or Not Specified | 4 | 0.1 | 1 | 0.0 |
| Total | 3704 | 100.0 | 1384 | 100.0 |

* Incidents

A review of these data showed that the damage to gas pipelines in the United States is concentrated in relatively few states. Specifically, about 81 percent of the national reportable leaks in gas distribution systems during the past 6 years occurred in 17 states, with California, Michigan, and Texas leading the list. Likewise, over 80 percent of the national reportable leaks in gas transmission-gathering systems during the past 6 years occurred in 15 states, with Texas, Louisiana, and Oklahoma leading this list. These findings are summarized in Tables 2.7 and 2.8.

TABLE 2.5 BREAKDOWN BY STATES OF PIPELINE REPORTABLE LEAKS FOR GAS DISTRIBUTION SYSTEMS

| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | Total |
|---|---|---|---|---|---|---|---|
| 1. **Alabama** | 25 | 32 | 30 | 37 | 22 | 26 | 172[1] |
| 12,4864 | 17 | 23 | 27 | 31 | 19 | 24 | 141[2] |
| | 10 | 6 | 7 | 6 | 5 | 6 | 40[3] |
| 2. **Alaska** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 753 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. **Arizona** | 13 | 41 | 42 | 45 | 37 | 40 | 218 |
| 10,148 | 6 | 36 | 31 | 35 | 28 | 32 | 168 |
| | 3 | 10 | 14 | 16 | 11 | 17 | 71 |
| 4. **Arkansas** | 3 | 5 | 7 | 8 | 4 | 7 | 34 |
| 10,008 | 3 | 4 | 5 | 5 | 2 | 5 | 24 |
| | 3 | 3 | 3 | 3 | 1 | 4 | 17 |
| 5. **California** | 104 | 149 | 143 | 165 | 139 | 154 | 859 |
| 63,848 | 71 | 96 | 101 | 107 | 107 | 120 | 602 |
| | 56 | 63 | 58 | 76 | 80 | 57 | 390 |
| 6. **Colorado** | 5 | 4 | 6 | 9 | 2 | 11 | 37 |
| 11,060 | 5 | 3 | 6 | 7 | 1 | 10 | 32 |
| | 3 | 2 | 5 | 2 | 1 | 4 | 17 |
| 7. **Connecticut** | 13 | 5 | 3 | 2 | 5 | 9 | 37 |
| 5.505 | 10 | 2 | 2 | 1 | 4 | 9 | 28 |
| | 8 | 2 | 0 | 1 | 1 | 4 | 16 |
| 8. **Delaware** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.094 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9. **District of Columbia** | 14 | 9 | 11 | 7 | 14 | 8 | 63 |
| 1,140 | 7 | 5 | 8 | 5 | 10 | 6 | 41 |
| | 3 | 2 | 3 | 4 | 4 | 2 | 18 |
| 10. **Florida** | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 9,962 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 11. **Georgia** | 2 | 11 | 18 | 18 | 24 | 24 | 97 |
| 17,709 | 1 | 6 | 13 | 15 | 19 | 18 | 72 |
| | 1 | 6 | 7 | 7 | 13 | 9 | 43 |
| 12. **Hawaii** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 581 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13. **Idaho** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2,473 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14. **Illinois** | 39 | 60 | 47 | 63 | 51 | 50 | 310 |
| 40,152 | 18 | 41 | 33 | 37 | 34 | 36 | 199 |
| | 12 | 27 | 20 | 23 | 17 | 22 | 121 |
| 15. **Indiana** | 21 | 32 | 16 | 17 | 15 | 25 | 126 |
| 21,074 | 8 | 20 | 14 | 11 | 9 | 15 | 77 |
| | 6 | 12 | 8 | 8 | 4 | 7 | 45 |
| 16. **Iowa** | 10 | 9 | 6 | 12 | 7 | 3 | 47 |
| 11,070 | 7 | 7 | 6 | 10 | 5 | 2 | 37 |
| | 3 | 3 | 3 | 6 | 3 | 2 | 20 |
| 17. **Kansas** | 3 | 7 | 9 | 10 | 12 | 7 | 48 |
| 11,398 | 1 | 5 | 5 | 6 | 9 | 6 | 32 |
| | 0 | 3 | 4 | 3 | 5 | 3 | 18 |
| 18. **Kentucky** | 3 | 7 | 10 | 7 | 4 | 5 | 36 |
| 9,328 | 1 | 5 | 6 | 4 | 2 | 4 | 22 |
| | 0 | 2 | 6 | 4 | 1 | 3 | 16 |

TABLE 2.5 (contd)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19. Louisiana | 19 | 33 | 22 | 14 | 21 | 17 | 126 |
| 15,148 | 18 | 27 | 16 | 12 | 15 | 13 | 101 |
| | 18 | 23 | 12 | 7 | 7 | 10 | 77 |
| 20. Maine | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 381 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21. Maryland | 12 | 22 | 16 | 14 | 19 | 13 | 96 |
| 7,779 | 9 | 14 | 11 | 8 | 17 | 12 | 71 |
| | 7 | 11 | 7 | 8 | 6 | 7 | 46 |
| 22. Massachusetts | 11 | 15 | 13 | 10 | 17 | 17 | 83 |
| 15,663 | 6 | 10 | 8 | 6 | 12 | 11 | 53 |
| | 6 | 9 | 6 | 4 | 5 | 6 | 36 |
| 23. Michigan | 30 | 72 | 97 | 85 | 171 | 158 | 613 |
| 33,497 | 24 | 58 | 73 | 60 | 148 | 140 | 503 |
| | 10 | 24 | 18 | 28 | 34 | 31 | 145 |
| 24. Minnesota | 13 | 19 | 23 | 22 | 28 | 16 | 121 |
| 11,667 | 10 | 11 | 16 | 17 | 21 | 11 | 86 |
| | 9 | 6 | 10 | 9 | 11 | 5 | 50 |
| 25. Mississippi | 5 | 5 | 7 | 6 | 9 | 17 | 49 |
| 7,623 | 4 | 3 | 6 | 4 | 9 | 13 | 39 |
| | 0 | 1 | 4 | 1 | 1 | 5 | 12 |
| 26. Missouri | 2 | 9 | 8 | 14 | 13 | 19 | 65 |
| 16,729 | 1 | 6 | 5 | 10 | 8 | 13 | 43 |
| | 1 | 5 | 4 | 3 | 4 | 8 | 25 |
| 27. Montana | 0 | 0 | 1 | 3 | 2 | 1 | 7 |
| 2,820 | 0 | 0 | 1 | 3 | 2 | 1 | 7 |
| | 0 | 0 | 0 | 3 | 0 | 0 | 3 |
| 28. Nebraska | 16 | 5 | 10 | 10 | 9 | 5 | 55 |
| 5,864 | 7 | 2 | 10 | 8 | 9 | 2 | 38 |
| | 7 | 1 | 7 | 5 | 5 | 1 | 26 |
| 29. Nevada | 0 | 0 | 0 | 5 | 5 | 6 | 16 |
| 1,652 | 0 | 0 | 0 | 4 | 5 | 4 | 13 |
| | 0 | 0 | 0 | 4 | 3 | 2 | 9 |
| 30. New Hampshire | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 964 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31. New Jersey | 23 | 19 | 23 | 14 | 18 | 21 | 118 |
| 20,768 | 17 | 6 | 10 | 7 | 10 | 12 | 62 |
| | 12 | 4 | 5 | 4 | 7 | 4 | 36 |
| 32. New Mexico | 4 | 3 | 12 | 11 | 7 | 6 | 43 |
| 7,433 | 4 | 2 | 10 | 8 | 5 | 6 | 35 |
| | 3 | 2 | 7 | 5 | 0 | 3 | 20 |
| 33. New York | 35 | 66 | 63 | 51 | 62 | 42 | 319 |
| 36,156 | 21 | 25 | 34 | 21 | 35 | 25 | 161 |
| | 10 | 10 | 21 | 7 | 18 | 7 | 75 |
| 34. North Carolina | 5 | 4 | 8 | 3 | 9 | 3 | 32 |
| 8,809 | 5 | 4 | 7 | 3 | 8 | 3 | 30 |
| | 2 | 3 | 6 | 2 | 4 | 2 | 19 |
| 35. North Dakota | 0 | 3 | 1 | 2 | 6 | 2 | 14 |
| 1.403 | 0 | 1 | 0 | 2 | 4 | 2 | 9 |
| | 0 | 1 | 0 | 1 | 1 | 1 | 4 |
| 36. Ohio | 21 | 26 | 30 | 25 | 27 | 18 | 147 |
| 37,757 | 14 | 15 | 21 | 24 | 18 | 9 | 101 |
| | 10 | 7 | 12 | 15 | 13 | 2 | 59 |

TABLE 2.5 (concl)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 37. Oklahoma | 39 | 8 | 9 | 21 | 16 | 17 | 110 |
| 13,413 | 33 | 5 | 6 | 13 | 10 | 14 | 81 |
| | 21 | 5 | 4 | 9 | 7 | 11 | 57 |
| 38. Oregon | 4 | 5 | 1 | 4 | 6 | 4 | 24 |
| 7,675 | 2 | 5 | 0 | 4 | 4 | 4 | 19 |
| | 0 | 4 | 0 | 2 | 2 | 3 | 11 |
| 39. Pennsylvania | 25 | 53 | 61 | 43 | 46 | 28 | 256 |
| 33,639 | 17 | 35 | 49 | 23 | 33 | 22 | 179 |
| | 14 | 25 | 35 | 10 | 11 | 7 | 102 |
| 40. Rhode Island | 1 | 1 | 1 | 0 | 0 | 0 | 3 |
| 2,348 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 41. South Carolina | 1 | 5 | 7 | 7 | 10 | 8 | 38 |
| 7,352 | 1 | 2 | 7 | 7 | 7 | 4 | 28 |
| | 1 | 2 | 2 | 5 | 5 | 4 | 19 |
| 42. South Dakota | 2 | 1 | 1 | 0 | 3 | 1 | 8 |
| 1,612 | 2 | 1 | 1 | 0 | 1 | 1 | 6 |
| | 2 | 0 | 0 | 0 | 1 | 1 | 4 |
| 43. Tennessee | 8 | 13 | 2 | 11 | 9 | 9 | 52 |
| 10,507 | 5 | 8 | 1 | 5 | 5 | 4 | 28 |
| | 3 | 4 | 1 | 1 | 5 | 2 | 16 |
| 44. Texas | 57 | 57 | 68 | 77 | 95 | 72 | 426 |
| 49,971 | 34 | 37 | 43 | 49 | 68 | 53 | 284 |
| | 24 | 27 | 27 | 35 | 42 | 31 | 186 |
| 45. Utah | 4 | 10 | 3 | 8 | 13 | 8 | 46 |
| 5,212 | 3 | 8 | 3 | 6 | 13 | 6 | 39 |
| | 3 | 5 | 2 | 5 | 9 | 4 | 28 |
| 46. Vermont | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 275 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 47. Virginia | 4 | 12 | 22 | 12 | 11 | 6 | 67 |
| 8,489 | 4 | 0 | 17 | 9 | 7 | 4 | 49 |
| | 4 | 4 | 13 | 7 | 3 | 1 | 32 |
| 48. Washington | 14 | 6 | 9 | 8 | 3 | 2 | 42 |
| 9,039 | 10 | 3 | 6 | 6 | 2 | 2 | 29 |
| | 8 | 3 | 3 | 3 | 0 | 0 | 17 |
| 49. West Virginia | 7 | 8 | 7 | 6 | 15 | 5 | 40 |
| 7.544 | 6 | 6 | 3 | 5 | 8 | 4 | 32 |
| | 5 | 3 | 1 | 2 | 3 | 0 | 14 |
| 50. Wisconsin | 56 | 25 | 10 | 7 | 7 | 8 | 113 |
| 17,779 | 52 | 19 | 6 | 6 | 6 | 7 | 96 |
| | 41 | 14 | 3 | 4 | 4 | 4 | 70 |
| 51. Wyoming | 3 | 1 | 2 | 1 | 0 | 0 | 7 |
| 2,182 | 1 | 1 | 2 | 0 | 0 | 0 | 4 |
| | 1 | 0 | 1 | 0 | 0 | 0 | 2 |
| 52. National Total | 676* | 878 | 885 | 894 | 993 | 901 | 5230 |
| 648,939 | 465 | 577 | 630 | 604 | 739 | 689 | 3704 |
| | 330 | 345 | 349 | 348 | 357 | 304 | 2033 |

1. Reportable leaks, OPSO data
2. Damage by outside forces, OPSO data
3. Damage by outside parties, OPSO data
4. Mileage of pipeline (gas mains only) (AGA Data 1975, from Gas Facts 1976)
* One incident was not identified

TABLE 2.6 BREAKDOWN BY STATES OF PIPELINE REPORTABLE LEAKS FOR GAS TRANSMISSION AND GATHERING SYSTEMS

| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | Total |
|---|---|---|---|---|---|---|---|
| 1. Alabama | 8 | 5 | 5 | 3 | 3 | 4 | 28[1] |
| 5,3464 | 0 | 1 | 1 | 2 | 2 | 0 | 6[2] |
| | 0 | 1 | 1 | 2 | 1 | 0 | 53 |
| 2. Alaska | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3. Arizona | 1 | 1 | 3 | 3 | 3 | 1 | 12 |
| 5,049 | 0 | 1 | 2 | 2 | 3 | 1 | 9 |
| | 0 | 1 | 2 | 2 | 3 | 1 | 9 |
| 4. Arkansas | 15 | 16 | a | 25 | 21 | 16 | 101 |
| 7,466 | 13 | 14 | 6 | 20 | 19 | 16 | 88 |
| | 9 | 12 | 6 | 18 | 15 | 13 | 73 |
| 5. California | 12 | 21 | 23 | 17 | 20 | 16 | 111 |
| 8,645 | 13 | 11 | 13 | 9 | 11 | 12 | 69 |
| | 9 | 9 | 9 | 7 | a | 11 | 53 |
| 6. Colorado | 9 | 10 | 6 | 6 | 6 | 11 | 48 |
| 8,004 | 5 | 3 | 3 | 6 | 6 | 9 | 32 |
| | 2 | 3 | 2 | 5 | 4 | 7 | 23 |
| 7. Connecticut | 1 | 4 | 2 | 9 | 1 | 2 | 19 |
| 486 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 8. Delaware | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 228 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9. District of Columbia | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10. Florida | 2 | 0 | 1 | 2 | 5 | 2 | 12 |
| 2,952 | 2 | 0 | 1 | 2 | 5 | 2 | 12 |
| | 1 | 0 | 1 | 2 | 3 | 2 | 9 |
| 11. Georgia | 2 | 4 | 1 | 2 | 1 | 2 | 12 |
| 4,970 | 0 | 3 | 0 | 2 | 1 | 2 | 8 |
| | 0 | 2 | 0 | 1 | 1 | 2 | 6 |
| 12. Hawaii | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 13. Idaho | 0 | 1 | 0 | 0 | 2 | 0 | 3 |
| 1,312 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 14. Illinois | 6 | 10 | 12 | 9 | 9 | 8 | 54 |
| 10,100 | 0 | 2 | 3 | 3 | 2 | 3 | 13 |
| | 0 | 1 | 2 | 1 | 2 | 1 | 7 |
| 15. Indiana | 3 | 13 | 7 | 5 | 12 | 7 | 47 |
| 6,193 | 1 | 5 | 5 | 2 | 5 | 2 | 20 |
| | 1 | 3 | 4 | 1 | 3 | 1 | 13 |
| 16. Iowa | 8 | 1 | 2 | 4 | 3 | 11 | 29 |
| 6,203 | 2 | 0 | 0 | 2 | 1 | 6 | 11 |
| | 2 | 0 | 0 | 2 | 1 | 4 | 9 |
| 17. Kansas | 24 | 21 | 19 | 21 | 40 | 14 | 139 |
| 22,882 | 9 | 8 | 8 | 10 | 16 | 5 | 56 |
| | 6 | 3 | 5 | 2 | 13 | 3 | 32 |
| 18. Kentucky | 17 | 16 | 15 | 14 | 32 | 27 | 121 |
| 10,488 | 8 | 14 | 12 | 11 | 22 | 18 | 85 |
| | 5 | 6 | 6 | 4 | 9 | 7 | 37 |

TABLE 2.6 (contd)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19. **Louisiana** | 20 | 38 | 26 | 52 | 51 | 26 | 213 |
| 23,966 | 8 | 17 | 14 | 30 | 24 | 18 | 111 |
| | 6 | 14 | 10 | 14 | 16 | 11 | 71 |
| 20. **Maine** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21. **Maryland** | 0 | 2 | 3 | 0 | 0 | 0 | 5 |
| 755 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 22. **Massachusetts** | 1 | 6 | 6 | 3 | 4 | 1 | 21 |
| 784 | 1 | 0 | 1 | 0 | 0 | 0 | 2 |
| | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 23. **Michigan** | 3 | 6 | 7 | 5 | 3 | 4 | 28 |
| 6,706 | 3 | 2 | 2 | 3 | 1 | 1 | 12 |
| | 3 | 1 | 0 | 3 | 1 | 0 | 8 |
| 24. **Minnesota** | 2 | 3 | 0 | 3 | 3 | 7 | 18 |
| 3,985 | 1 | 1 | 0 | 2 | 3 | 4 | 11 |
| | 1 | 0 | 0 | 1 | 1 | 4 | 7 |
| 25. **Mississippi** | 9 | 13 | 12 | 10 | 6 | 9 | 59 |
| 9,433 | 4 | 5 | 6 | 5 | 2 | 4 | 26 |
| | 4 | 4 | 6 | 3 | 2 | 2 | 21 |
| 26. **Missouri** | 4 | 5 | 6 | 1 | 4 | 7 | 27 |
| 4,168 | 2 | 3 | 1 | 0 | 1 | 3 | 10 |
| | 0 | 1 | 1 | 0 | 0 | 1 | 3 |
| 27. **Montana** | 0 | 5 | 0 | 2 | 3 | 2 | 12 |
| 4,615 | 0 | 4 | 0 | 0 | 1 | 1 | 6 |
| | 0 | 3 | 0 | 0 | 1 | 1 | 5 |
| 28. **Nebraska** | 7 | 3 | 6 | 8 | 10 | 8 | 42 |
| 7,469 | 6 | 2 | 3 | 7 | 6 | 5 | 29 |
| | 6 | 2 | 2 | 4 | 5 | 4 | 23 |
| 29. **Nevada** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,293 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30. **New Hampshire** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 129 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 31. **New Jersey** | 3 | 1 | 1 | 1 | 0 | 2 | 8 |
| 1,309 | 1 | 0 | 1 | 0 | 0 | 1 | 3 |
| | 1 | 0 | 1 | 0 | 0 | 1 | 3 |
| 32. **New Mexico** | 3 | 3 | 10 | 7 | 5 | 2 | 30 |
| 14.224 | 3 | 2 | 5 | 3 | 4 | 2 | 19 |
| | 3 | 1 | 5 | 3 | 1 | 2 | 15 |
| 33. **New York** | 4 | 3 | 8 | 5 | 2 | 4 | 26 |
| 4,379 | 2 | 3 | 4 | 1 | 1 | 1 | 12 |
| | 1 | 1 | 0 | 1 | 1 | 1 | 5 |
| 34. **North Carolina** | 5 | 10 | 2 | 9 | 2 | 1 | 29 |
| 2.291 | 3 | 8 | 2 | 8 | 1 | 1 | 23 |
| | 3 | 7 | 1 | 8 | 1 | 1 | 21 |
| 35. **North Dakota** | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1.130 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 36. **Ohio** | 23 | 29 | 12 | 29 | 20 | 13 | 126 |
| 13,748 | 11 | 14 | 9 | 20 | 17 | 8 | 79 |
| | 7 | 10 | 4 | 10 | 10 | 4 | 45 |

TABLE 2.6 (concl)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 37. Oklahoma | 31 | 35 | 30 | 41 | 46 | 22 | 205 |
| 19,385 | 23 | 28 | 20 | 29 | 24 | 19 | 143 |
| | 21 | 25 | 18 | 24 | 21 | 16 | 125 |
| 38. Oregon | 0 | 0 | 1 | 1 | 1 | 0 | 3 |
| 1,163 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| 39. Pennsylvania | 25 | 28 | 20 | 24 | 20 | 15 | 132 |
| 17,742 | 7 | 11 | 6 | 10 | 10 | 7 | 51 |
| | 5 | 6 | 2 | 5 | 4 | 6 | 28 |
| 40. Rhode Island | 2 | 1 | 2 | 4 | 0 | 0 | 9 |
| 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 41. South Carolina | 1 | 3 | 5 | 3 | 8 | 0 | 20 |
| 2,315 | 0 | 3 | 4 | 3 | 6 | 0 | 16 |
| | 0 | 3 | 2 | 3 | 3 | 0 | 11 |
| 42. South Dakota | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| 942 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 43. Tennessee | 2 | 0 | 3 | 3 | 6 | 2 | 16 |
| 5,134 | 0 | 0 | 0 | 3 | 2 | 1 | 6 |
| | 0 | 0 | 0 | 3 | 2 | 1 | 6 |
| 44. Texas | 57 | 55 | 99 | 116 | 73 | 79 | 479 |
| 56,017 | 33 | 27 | 61 | 59 | 49 | 47 | 276 |
| | 27 | 22 | 55 | 50 | 42 | 39 | 235 |
| 45. Utah | 2 | 2 | 1 | 1 | 0 | 1 | 7 |
| 1,365 | 1 | 2 | 1 | 1 | 0 | 1 | 6 |
| | 0 | 1 | 1 | 1 | 0 | 1 | 4 |
| 46. Vermont | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 60 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 47. Virginia | 2 | 3 | 2 | 1 | 1 | 1 | 10 |
| 2,435 | 0 | 1 | 0 | 1 | 1 | 0 | 3 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48. Washington | 1 | 1 | 1 | 0 | 1 | 2 | 6 |
| 1,720 | 1 | 0 | 1 | 0 | 1 | 2 | 5 |
| | 1 | 0 | 0 | 0 | 1 | 2 | 4 |
| 49. West Virginia | 25 | 26 | 38 | 21 | 26 | 33 | 169 |
| 14,443 | 17 | 16 | 23 | 14 | 20 | 22 | 112 |
| | 7 | 2 | 7 | 3 | 5 | 5 | 29 |
| 50. Wisconsin | 1 | 1 | 2 | 0 | 1 | 0 | 5 |
| 3,166 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 51. Wyoming | 1 | 4 | 1 | 1 | 3 | 2 | 12 |
| 4,214 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 52. National Total | 346 | 409 | 409 | 471 | 458 | 366 | 2459 |
| 331,105 | 183 | 212 | 219 | 272 | 272 | 226 | 1384 |
| | 133 | 145 | 154 | 185 | 184 | 156 | 957 |

1. Reportable leaks, OPSO data
2. Damage by outside forces, OPSO data
3. Damage by outside parties, OPSO data
4. Mileage of pipeline (1975 AGA data, Gas Facts 1976)