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# A BENEFIT/COST ANALYSIS OF THE NATIONAL TRANSPORTATION SAFETY BOARD'S SAFETY RECOMMENDATION P-01-2

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# 1. INTRODUCTION

## 1.1 OVERVIEW

On June 22, 2001, the National Transportation Safety Board (NTSB) issued Safety Recommendation P-01-2, which recommended that the U.S. Department of Transportation's (U.S. DOT's) Research and Special Programs Administration (RSPA) require that excess flow valves (EFVs) be installed in all new or renewed natural gas services that are compatible with readily available EFVs.[1] This report examines whether NTSB's recommended requirement would be cost-beneficial.

## 1.2 SOUTH RIDING GAS SERVICE LINE INCIDENT

On July 7, 1998, a natural gas explosion and fire at the residence at 25905 Rickmansworth Lane in South Riding, Loudoun County, Virginia, resulted in one death, one serious injury, two minor injuries, the complete destruction of the residence, and damage to five other homes and two vehicles. The destroyed residence was a newly built house, and its occupants had just moved in and were spending their first night there.

NTSB undertook an investigation of the South Riding incident.[2] That investigation found that gas from some source had accumulated in the basement of the residence, where it probably was ignited by the water heater's pilot light. The most likely source of the gas was a hole in the ¾-inch polyethylene gas service line to the residence. Evidence indicated that heat generated by a nearby electrical service line that had been damaged sometime prior to the gas incident weakened the wall of the gas service to the point where the internal pressure of the gas in the service created this hole.

On the basis of its analysis of the South Riding incident, NTSB concluded that an EFV in the service line would have helped mitigate the consequences of the incident. NTSB argued that the flow rate per hour from the hole in the gas service line would have been more than adequate to trip an EFV, had one been installed in the gas service line to the residence. NTSB believed it likely that the explosion at the Rickmansworth Lane residence would not have occurred had an EFV been installed in the line.[3]

As a result of the South Riding incident, NTSB made four safety recommendations, two of which were directed at RSPA. The focus of one of these, Safety Recommendation P-01-2, was on EFVs. That recommendation urged RSPA to

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[1] Safety Recommendation from Carol J. Carmody, Acting Chairman, National Transportation Safety Board, Washington, D.C., to Elaine Joost, Acting Deputy Administrator, Research and Special Programs Administration, Washington, D.C., June 22, 2001, p. 5. The recommendation is also found in NTSB, "Natural Gas Explosion and Fire in South Riding, Virginia, July 7, 1998," Pipeline Accident Report NTSB/PAR-01/01, Washington, D.C., 2001, p. 26.

[2] NTSB, "Natural Gas Explosion and Fire in South Riding, Virginia, July 7, 1998," Pipeline Accident Report NTSB/PAR-01/01, Washington, D.C., 2001.

[3] NTSB, "Natural Gas Explosion and Fire in South Riding, Virginia, July 7, 1998," p. 21.

> Require that excess flow valves be installed in all new and renewed gas service lines, regardless of a customer's classification, when the operating conditions are compatible with readily available valves.[4]

Thus, NTSB would like RSPA, through the Office of Pipeline Safety (OPS), to require the installation of EFVs in all new and renewed services serving any type of customer – residential, commercial, or industrial[5] – provided valves appropriate for the specific operating conditions of those customers are readily available.

## 1.3 CURRENT FEDERAL REGULATIONS RELATING TO EFVS

Currently, Federal pipeline safety regulations contain provisions pertaining to (1) EFV performance standards – 49 *Code of Federal Regulations* (CFR) 192.381 – and (2) EFV customer notification – 49 CFR 192.383.

### 1.3.1 EFV Performance Standards

Federal pipeline safety regulations establish certain minimum performance standards for EFVs that are to be used in single-family residential gas services operating continuously throughout the year at not less than 10 psig (pounds per square inch gage). The performance standards address both bleed-by[6] and positive shut-off EFVs.[7] Bleed-by EFVs allow a small amount of natural gas to pass the valve when it is closed. That gas enables an EFV to reset automatically once repairs have been made after an incident has closed the valve. Positive shut-off EFVs do not allow any gas to bleed by when they are closed. Gas utility personnel must manually reset positive shut-off EFVs after an incident.

The Federal minimum performance standards stipulate, among other things, that each EFV must function properly "up to the maximum operating pressure at which the valve is rated"[8] and "at all temperatures reasonably expected in the operating environment of the service line."[9] Furthermore EFVs must "[n]ot close when the pressure is less than the manufacturer's minimum specified operating pressure and the flow rate is below the manufacturer's minimum specified closure rate."[10]

According to the Federal minimum performance standard regulations, gas utilities must establish procedures for identifying service lines upon which EFVs have been installed.[11] In addition, gas utilities must install EFVs as near as practicable to the gas distribution main (or to the gas

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[4] See Footnote 1.
[5] For purposes of exposition, all gas services are categorized as residential, commercial, or industrial in this report. Residential services are those connected to single-family residences and to multi-family residences, including apartment buildings. Commercial and industrial services are those connected to any non-residential business establishment.
[6] 49 CFR 192.381(a)(3)(ii)(A).
[7] 49 CFR 192.381(a)(3)(ii)(B).
[8] 49 CFR 192.381(a)(1).
[9] 49 CFR 192.381(a)(2).
[10] 49 CFR 192.381(a)(4).
[11] 49 CFR 192.381(c).

transmission line in those cases where services are directly attached to transmission pipelines).[12] EFVs should not be installed in service lines where contaminants could interfere with the proper operation of the valve, or where the EFV could interfere with the necessary operation and maintenance of the line.[13]

### 1.3.2 EFV Customer Notification

Beginning February 3, 1999, Federal pipeline safety regulations required that natural gas utilities provide certain customers with written notification of the availability of EFVs whenever a new gas service is installed or an existing gas service is replaced (i.e., renewed).[14] Furthermore, the gas utilities must install EFVs in the lines of those notified customers who request them and agree to pay their associated costs.[15]

The customers who must be notified are those with single-family residential services operating continuously throughout the year at not less than 10 psig (pounds per square inch gage).[16] The gas utilities must provide these customers with information on the safety benefits of EFVs[17] and on the costs associated with the installation, maintenance, and operation of EFVs, to the extent that those costs are known.[18]

Gas utilities may choose to voluntarily install EFVs in new and renewed gas services. When this approach is chosen, notification of customers is not required.[19] In this case, customers are not directly charged for the EFVs.

Gas utilities are not required to notify customers about EFVs when (1) EFVs meeting the performance standards set out in 49 CFR 192.381 are not available to the gas utilities,[20] (2) prior experience indicates to the gas utilities that contaminants in the service lines could interfere with the proper operation of the EFVs,[21] or (3) special situations make "it impractical for the operator to notify a service line customer before replacing a service line."[22]

## 1.4 COMPARISON OF CURRENT FEDERAL REGULATIONS WITH NTSB SAFETY RECOMMENDATION P-01-2

Both current Federal regulations and NTSB's Safety Recommendation P-01-2 address EFV installation in certain situations. There are two significant differences in the way EFV installation is addressed, however, by the regulations and the safety recommendation. Those

[12] 49 CFR 192.381(d).
[13] 49 CFR 192.381(e).
[14] 49 CFR 192.383(d)(1).
[15] 49 CFR 192.383(d)(2).
[16] 49 CFR 192.383(b).
[17] 49 CFR 192.383(c)(2).
[18] 49 CFR 192.383(c)(3).
[19] 49 CFR 192.383(f)(1).
[20] 49 CFR 192.383(f)(2).
[21] 49 CFR 192.383(f)(3).
[22] 49 CFR 192.383(f)(4).

differences relate to (1) when installation is required and (2) the gas utility customer categories covered.

### 1.4.1 When to Install

Current Federal regulations do not require the installation of EFVs in all gas services, but rather require installation only in certain situations in selected new and renewed services operating consistently throughout the year at not less than 10 psig. Those situations are (1) the customer requests it and agrees to pay all associated costs or (2) the gas utility chooses to voluntarily install EFVs rather than notify customers of the availability of EFVs.

In contrast, NTSB's Safety Recommendation P-01-2 would require installation of EFVs in all new and renewed gas services meeting certain conditions. Gas customers would not be given an option of choosing not to have an EFV installed. Furthermore, if readily available EFVs could reliably handle the operating conditions on some gas services operating at less that 10 psig, then EFVs would be required in those services, as well as in services operating at not less than 10 psig.

### 1.4.2 Gas Utility Customers Getting EFVs

Under current Federal regulations, EFV installation is required only in certain new and renewed single-family residential services. EFV installation is not required in new or renewed services connected to any other category of customer (i.e., commercial or industrial).

In contrast, NTSB's Safety Recommendation P-01-2 would require that EFVs be installed in all services for which readily available EFVs could reliably handle the operating conditions, without regard to the type of utility customer. Consequently, it could be expected that NTSB's safety recommendation would lead to installation of EFVs not only in single-family residential services, but in commercial and potentially other types of services, as well.

## 1.5 PURPOSE OF THIS STUDY

The purpose of this study is to estimate and compare the benefits and costs associated with NTSB's Safety Recommendation P-01-2 to determine if the actions that are recommended would be cost-beneficial. That is, this study seeks to determine whether the benefits resulting from Safety Recommendation P-01-2 would exceed its costs.

Safety Recommendation P-01-2 has been made on the basis of safety alone. NTSB has not evaluated whether the safety recommendation would be cost-beneficial. Whether or not the safety recommendation is cost-beneficial, however, is an important consideration. It would be questionable policy to spend on safety improvements that are not cost-beneficial until and unless all safety improvements that are cost-beneficial have been made. This is a point that has not yet been reached.

## 1.6 FOCUS OF THE STUDY

The focus of this study is on EFVs in gas services connected to single-family residences. While Safety Recommendation P-01-2 covers all types of services compatible with readily available EFVs, adequate information does not appear to be available to support an analysis of EFVs installed in gas services other than single-family residential services.

## 1.7 APPROACH

The approach taken by this study was to estimate the expected benefits and costs of implementing the Safety Recommendation P-01-2, and then to use those estimates to calculate a benefit/cost ratio.

For the purposes of this analysis, gas utilities are assumed to only install bleed-by EFVs in new or renewed services. Since almost all of the EFVs that have been installed in gas service lines are of the bleed-by type,[23] this assumption should have no significant impact on the results of the analysis.

Also for the purposes of this analysis, EFVs are assumed to only impact incidents caused by outside forces damage. EFVs generally trip only when there has been a substantial or catastrophic break in a service. While substantial or catastrophic breaks can result from a number of causes, such breaks are rare except in the case of outside forces damage. It is not expected that focusing on incidents caused by outside forces damage will substantially impact the results of the analysis, particularly since the consequences of outside forces incidents (i.e., the deaths, injuries, and property damage associated with those incidents) with substantial or catastrophic breaks should be nearly identical to the consequences associated with incidents with substantial or catastrophic breaks resulting from other causes.

Data and information for this study was collected from a number of sources. The primary source was contacts with EFV manufacturers and with gas utilities. Some was also obtained from publications and reports. Where appropriate, additional data and information was obtained from previous benefit-cost analyses looking at the installation of EFVs, of which there have been several.

As with most analyses of benefits and costs, the analysis developed for this study includes uncertainties. These uncertainties are identified, and where practicable, the impact of each significant source of uncertainty on the analytical results was noted.

All dollar values used in this study are given in nominal dollars, unless otherwise noted. Where deflation of nominal dollars has been performed, the Producer Price Index, All Commodities, has been used,[24] with the base changed from 1982 to 2001.

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[23] J. McGowan, "Putting the Gas Company on the Offensive Through the Use of Excess Flow Valves," UMAC, Inc., Exton, PA, March 1991, p. 3.
[24] U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Index, All Commodities, 1982=100, www.bls.gov/ro9/9320.pdf.

## 1.8 STRUCTURE OF THE REMAINDER OF THIS REPORT

The remainder of this report is organized as follows. Chapter 2 presents a brief overview on EFVs. Chapter 3 examines the benefits that would be attributable to the implementation of Safety Recommendation P-01-2. The uncertainties of the estimates used in the derivation of those benefits are also considered. Chapter 4 examines the costs associated with Safety Recommendation P-01-2, along with the uncertainties inherent in the estimates used to derive those costs. Chapter 5 compares the benefits and costs of Safety Recommendation P-01-2. It also examines the impacts of benefit and cost uncertainties on the results of the analysis. Following Chapter 5, selected references and a list of those consulted during the study are presented.

# 2. EXCESS FLOW VALVES

## 2.1 INTRODUCTION

The first EFV for use in gas services in the United States was introduced in 1964.[25] Since then, the use of EFVs has grown dramatically. Only a portion of that growth is attributable to Federal pipeline regulations relating to EFVs. Even before those regulations were implemented, many gas utilities found EFVs to be of value.

EFVs are generally located in a gas service line as close to the distribution main as possible. Frequently, they can be found installed in the service tee, which is where the service connects to the main. When a substantial or catastrophic break occurs downstream of the EFV and upstream of the meter/regulator assembly, the EFV trips, automatically shutting off the flow of gas through the service. EFVs do not generally trip and shut off the flow of gas when there is a slow leak on the service line, such as pinhole leak caused by corrosion. Also, EFVs do not generally trip and shut off the flow of gas when there is a break, even a catastrophic one, downstream of the gas meter.

EFVs, it should be noted, do not prevent gas service line incidents. Rather, they help mitigate the consequences of those incidents where there have been substantial or catastrophic breaks. That is, they help reduce the deaths, injuries, and property damage associated with those incidents.

## 2.2 TYPES OF EFVS

There are two basic types of EFVs: bleed-by (also known as bypass) and positive shut-off.

Bleed-by valves are designed to automatically reset after a break in a service line has been repaired. A small amount of gas is allowed, by design, to bypass the closed valve. The automatic resetting of the valve is caused by back-pressure created by this gas.[26] Almost all EFVs that have been installed in gas service lines to date have been of the bleed-by type.[27]

Bleed-by valves most commonly use either a ball and magnet design or a spring and plunger design. The first bleed-by valves installed in gas service lines used the ball and magnet design. EFVs using the spring and plunger design were introduced in 1975. Bleed-by EFVs using both of these designs have been installed by gas utilities in their services.[28]

Positive shut-off valves appear to be based on a spring and plunger design.[29] Unlike bleed-by valves, positive shut-off valves do not automatically reset. Instead, they must be manually reset

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[25] Submission by UMAC to Docket RSPA-03-14455, Notice 1, 2003.
[26] Communications with various EFV manufacturers and other industry sources.
[27] Communications with industry sources, 2002.
[28] Communications with various EFV manufacturers and other industry sources.
[29] Communications with various EFV manufacturers and other industry sources.

once they close. To date, relatively few positive shut-off EFVs have been installed by gas utilities in service lines.

## 2.3 EFV CONFIGURATION

EFVs are generally made of steel or molded plastic. Most EFVs sold today are made of molded plastic. Steel EFVs are sometimes used when steel piping is used in the renewal of steel service lines. Steel EFVs are also used in farm taps, which are generally in rural areas and which tend to operate at fairly high pressures.[30]

EFVs are frequently installed in the service tee where the service line joins the distribution main or in the service line pipe near the tee. Gas utilities can buy (1) an EFV and install it in the service tee or pipe using their own personnel or (2) a service tee or a short pipe (sometimes referred to as a "stick") in which an EFV has already been installed.

Branch services are sometimes installed by gas utilities. These are two services connected to a common tapping tee on the main. Sometimes one of the services is hung off the other, and sometimes the two services instead branch off the same common connector to the main. In the case of branching services, EFVs are installed after the two services branch (i.e., separate from each other).[31]

Gas utilities appear to prefer buying EFVs already installed in a service tee or a stick to buying EFVs and installing them in tees or pipe using their own personnel. It should be noted, however, that some gas utilities buy EFVs and do all the installation in the tee or stick themselves.

## 2.4 PERFORMANCE CONSIDERATIONS

To perform properly, EFVs must be properly installed. Not only must EFVs be oriented correctly in the service tee or pipe, but they also must be properly sized for the service upon which they are installed. An EFV must be capable of operating without tripping at both the maximum potential load of the customer and the minimum normal operating pressure for the line.[32]

EFV effectiveness can be diminished on long service lines. On these lines, even catastrophic breaks at the downstream end may not cause EFVs installed near the distribution main to trip and close. For this reason, EFVs are sometimes considered by gas utilities to be inappropriate for installation on long services.[33]

EFV performance can be adversely impacted by the presence of contaminants in a service line. Grit, sand, slag, rust, or other debris found in some service lines can prevent EFVs from closing

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[30] Communications with industry sources, 2002.

[31] Communication with industry sources, May 2, 2002; Submissions by the American Public Gas Association and the American Gas Association to Docket No. RSPA-03-14455, Notice 1, 2003.

[32] Communications with various EFV manufacturers and other industry sources.

[33] Submissions to U.S. DOT/RSPA/OPS Docket No. PS-118 by Niagara Mohawk Power, Washington Gas Light, and Colonial Gas Company, as well as communications with other gas utilities and others in the gas industry.

or, alternatively, can cause false closures. In addition to debris, natural gas contaminants, such as pipeline liquids and condensates, have reportedly interfered with the proper function of EFVs.[34]

## 2.5 THE NUMBER OF EFVS CURRENTLY INSTALLED

The exact number of EFVs currently installed is unknown. In 1995, it was estimated by NTSB that there were more than two million EFVs installed in gas service lines.[35] The number of installed EFVs has grown since then, of course, at least in part because of the requirements of 49 CFR 192.383. As a result of these requirements, some EFVs have been installed in new and renewed services at the request of customers. Many more are likely to have been installed by gas utilities that have chosen to voluntarily install EFVs in new and renewed services rather than to notify customers. Based on a recent American Gas Association survey, it appears that approximately 50 percent of all gas utilities may be voluntarily installing EFVs.[36]

It is estimated by EFV manufacturers that currently around 500 thousand EFVs are sold per year.[37] Assuming that around 2 million EFVs had been installed by the effective date of 49 CFR 192.383 (February 3, 1999) and that 500 thousand per year have been installed since then, currently there may be over 4 million EFVs installed in gas service lines.

## 2.6 TYPES OF SERVICES WITH EFVS

EFVs are primarily installed in single-family residential services. Few EFVs are currently installed in multi-unit residential services. The same is true for services connected to commercial and industrial customers.

For customers other than those in single-family residences, gas utilities are reluctant to install EFVs because of the potential for gas loads to change dramatically. That is, while an EFV properly sized to meet the current requirements of the customer might be installed in a service, there is a very real potential that the customer's gas load may increase significantly. A laundromat, for example, might double the number of gas dryers, an insurance office might be converted to a fast food outlet, or a factory might install an additional production line that uses gas for heating or drying. The increase in the gas load resulting from such a change could cause an existing EFV in the customer's service line to trip and close. The customer experiences downtime, while the gas utility digs up the EFV and replaces it with a new one or removes it

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[34] Communications with Ohio gas utility, August 27, 1991; Submissions to U.S. DOT/RSPA/OPS Docket No. PS-118 by Connecticut Natural Gas and Colonial Gas Co.

[35] Charles Batten of NTSB, meeting at OPS in Washington, DC, on March 16, 1995.

[36] Letter from Lori S. Traweek, American Gas Association (AGA), to Rodney I.J. Dyck, NTSB, June 14, 2000. According to the letter, "[s]urvey results show that roughly 50 percent of the respondents have elected to voluntarily install EFVs on service lines. The other 50 percent of this group have developed a procedure for customer notification." It should be noted that the AGA does not say that approximately 50 percent of all gas utilities are voluntarily installing EFVs, but rather that approximately 50 percent of their gas utility survey respondents are voluntarily installing EFVs. The extension of the survey results to the universe of gas utilities has been made by the U.S. Department of Transportation. The same extension of the survey results has been made by NTSB (see NTSB, "Natural Gas Explosion and Fire in South Riding, Virginia, July 7, 1998," p. 23).

[37] Communications with various EFV manufacturers, 2002.

from the line altogether. Both the customer and the gas utility incur additional expense because of the EFV.

Another reason that gas utilities do not install EFVs in services other than those connected to single-family residences is that it would significantly complicate the work of the utilities' field crews. Field crews that have been trained to install EFVs in all new and renewed single-family residential services would need to be trained to distinguish between the various types of customers and to install EFVs based the specific requirements of each customer group.[38]

Despite the foregoing, some gas utilities do currently install EFVs in new and renewed services connected to multi-family residential and commercial customers. In some cases, utilities do not distinguish between customer types, per se. Instead, they install EFVs in all new and renewed EFVs meeting certain specific criteria with respect to load, etc.[39]

While EFVs are currently installed in services other than single-family residential services by relatively few gas utilities, it might be noted that EFV manufacturers believe that, from a technical standpoint, the valves needed for commercial services are currently available. [40] This may be true for valves for use in industrial services, as well.

It might be noted that some gas utilities voluntarily install EFVs only in new or renewed farm taps. Farm taps are generally services connected to transmission lines. They tend to be high pressure services, because the pipelines they draw gas from operate at high pressures. Some farm taps in Illinois, for example, are reported to operate at between 125 and 500 psig. Farm taps tend to be located in rural areas, where a break in a service line can easily go unnoticed for a while, and where it may take more time for emergency responders and gas company personnel to reach the site than it would in urban or built-up areas.[41]

## 2.7 INDUSTRY STANDARDS FOR EFVS

Industry has established two sets of standards for EFVs. These are (1) "Standard Test Method for Performance Testing of Excess Flow Valves," F 1802, American Society for Testing and Materials (ASTM), and (2) "Excess Flow Valves, 1¼ NPS and Smaller, for Fuel Gas Service," MSS SP-115, Manufacturers Standardization Society (MSS) of the Valve and Fitting, Industry, Inc. Both of these standards were originally published in 1995, and both have been updated since then. The ASTM standard focuses, as it name indicates, on the testing of EFVs. The MSS standard practice covers both the manufacture and testing of EFVs. Where the two standards overlap, they are somewhat similar.[42]

Industry sources indicate that these standards have had no impact up to the present on the sales, demand, or acceptance of EFVs. In fact, it is uncertain whether these standards are regularly

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[38] Communication with a Massachusetts gas utility, 2002.
[39] Communications with industry sources, 2002.
[40] Communications with industry sources, 2002.
[41] Communication with an Illinois gas utility, March 15, 2002.
[42] Communication with an EFV manufacturer, March 19, 2002.

being cited in the purchase orders that gas utilities use to acquire EFVs.[43] This means that many if not most gas utilities are not asking for EFVs built or tested as stipulated by the standards (at least not directly).[44]

## 2.8 EFV PROBLEMS

Over the years, gas utilities have reported experiencing problems with EFVs. The most common problems have been (1) false closures (i.e., closing when there has been no incident) and (2) failure to close when there has been an incident. These problems have many times, although not always, been the result of improper installation of the EFVs. That is, the EFVs have been installed incorrectly, or improperly sized for the service, or installed in lines containing debris or contaminants, etc. Experience with EFVs has helped gas utilities overcome these problems. Generally, problems traceable to the EFVs themselves have now reportedly been worked out.[45]

One indirect problem that has been noted with respect to EFVs is related to damage prevention. Sometimes when gas service lines with EFVs are damaged and the EFV activates, those damaging the pipe perform unauthorized "repairs" without ever notifying the local gas utility. These ad hoc repairs to service lines can be inadequate, leading to serious problems later on. Furthermore, failure to notify the local gas company can potentially cause immediate problems, since pilot lights frequently need to be relit in buildings impacted by damage to service lines. Until those pilot lights are relit, the buildings and their occupants can be at serious risk, since gas is collecting in the buildings.

## 2.9 EFV ACTIVATIONS

Table 2-1 presents information on EFV activations from an EFV manufacturer and several gas utilities. Very few gas utilities appear to collect information on the activations experienced by the EFVs installed on their service lines, it should be noted.[46] The last column of Table 2-1 presents the approximate number of activations per EFV per year for each company.[47] These range from a high of 0.0120 to a low of 0.0003, with the majority around 0.0010.

There would appear to be considerable variation in the EFV activation rates listed in Table 2-1. This may be the result of local conditions with respect to outside forces damage, which can and do vary considerably.[48] For instance, areas experiencing rapid growth would likely have significantly higher outside forces damage than areas that are stable or declining. Large construction projects in more stable areas are likely to have a similar effect.

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[43] Communication with an EFV manufacturer, 2002.

[44] Some gas utilities are using the standards, it should be noted. Southwest Gas, for instance, reports in its submission to U.S. DOT Docket No. RSPA-03-14455, Notice 1, 2003, that it's "...regular practice is to request verification that the valves are manufactured and testing according to these standards as part of determining which valve to approve for use in our piping system."

[45] Communications with various gas utilities and EFV manufacturers, 2002.

[46] Communications with various gas utilities, 2002.

[47] In calculating the rates, the mid-points of all ranges were used.

[48] Communications with industry sources, May 2, 2002.

**TABLE 2-1. REPORTED EFV ACTIVATIONS**

| Company | EFV Activations | No. of EFVs | Time Period | Annual Activation Rate |
|---|---|---|---|---|
| East Coast Gas Utility | c. 100* | 70,000 - 80,000 | Year | 0.0013 |
| EFV Manufacturer** | c. 900 | c. 800,000 | Year | 0.0011 |
| Pennsylvania Gas Utility** | more than 17*** | 50,000 | Year | 0.0003 |
| Massachusetts Gas Utility** | more than 40*** | more than 40,000 | Year | 0.0010 |
| Ohio-based Gas Utility Operator** | 144*** | 8,000 | 1.5 years | 0.0120 |

*As a result of third party damage.
** Information from NTSB pipeline accident report.
***As a result of outside forces damage.

Sources of information: Communication with an East Coast gas utility, March 2002, and NTSB, "UGI Utilities, Inc., Natural Gas Distribution Pipeline Explosion and Fire, Allentown, Pennsylvania, June 9, 1994," Pipeline Accident Report NTSB/PAR-96/01, Washington, D.C., 1996, pp. 69, 70.

Based on the values in the second and third columns of the table, the average annual EFV activation rate in Table 2-1 is 0.0012.[49] That rate includes both reportable and non-reportable gas service line incidents. It should be indicative of the rate at which outside forces damage is being experienced by all gas services, including single-family residential services, whether they have EFVs or not.

[49] In calculating the rate, the mid-points of all ranges were used.

# 3. BENEFITS

## 3.1 INTRODUCTION

The benefits that would be expected to result if Safety Recommendation P-01-2 were to be implemented are reduced incident consequences when there has been a substantial or catastrophic break in a service line. The primary incident consequences that would be reduced are deaths, injuries, and property damage. Additional benefits would be expected to result from a reduction of the number of fires and explosions occurring at incidents, the number of evacuations resulting from incidents, and the quantity of gas lost during incidents. With the exception of those attributable to a reduction in the number of fires and explosions, these additional benefits are not considered in this analysis.

## 3.2 APPROACH

The approach taken to approximate the benefits that would be expected to result from the implementation of Safety Recommendation P-01-2 was as follows. Estimates were obtained for (1) the number of added EFVs that would be installed annually under the safety recommendation, (2) the number of single-family residential services that might potentially be impacted over a 50-year time horizon by the safety recommendation, and (3) the incidents (and their consequences) that might be potentially impacted by the safety recommendation. Using the latter two of these estimates, the expected benefits that might result if the safety recommendation were to be implemented were calculated. The present value of the expected benefits stream was then derived using the expected benefits and the estimated number of added EFVs that would be installed under the safety recommendation. Uncertainties associated with the derivation of the benefits were identified, alternative benefit assumptions were specified, and the present value of the expected benefits stream for each of those alternatives was calculated. The alternative present values were then compared with the present value calculated for the base case.

## 3.3 THE NUMBER OF ADDED EFVS TO BE INSTALLED ANNUALLY

If Safety Recommendation P-01-2 were to be implemented, the number of EFVs installed annually on single-family residential services would increase. This would be due to requiring EFV installation in all new and renewed single-family residential services for which there are readily available valves that could reliably handle the operating conditions.

Currently, approximately 500 thousand EFVs are being installed each year.[50] Although some of those EFVs are being installed in multi-family residential or commercial services (and possibly in service lines connected to industrial consumers of gas, as well), most are being installed in single-family residential services. The number of EFVs being installed in other services is believed to be small. Most of these valves are being installed by gas utilities that have chosen voluntary installation of EFVs.

The American Gas Association (AGA) believes that, if Safety Recommendation P-01-2 were to be implemented, an additional 750 thousand EFVs would be installed annually on new and

[50] Communications with various EFV manufacturers, 2002.

renewed residential services.[51] The AGA estimate is based on information it has about AGA members that have chosen customer notification rather than voluntary installation. For the purposes of this analysis, it is assumed that an additional 750 thousand EFVs would be installed annually if Safety Recommendation P-01-2 were to be implemented.

## 3.4 POTENTIALLY IMPACTED SINGLE-FAMILY RESIDENTIAL SERVICES

If Safety Recommendation P-01-2 were to be implemented and EFVs were to be installed on all new and renewed single family residential services for which there are readily available valves compatible with the operating conditions of the service lines, then it is likely that all existing single-family residential services would eventually have EFVs installed in them. While it might be argued that there are currently many single-family residential services for which there are no readily available valves compatible with the operating conditions of the service lines, this analysis looks at the situation over a 50-year time period. During that time it is likely that many, if not most, existing incompatibilities between EFVs and services could be overcome.

The American Gas Association reports that there were 60,252,745 residential customers receiving natural gas in 2001.[52] These include all types of residential customers in addition to single-family residential customers. For instance, apartment dwellers receiving gas are included in this number.

To estimate the number single-family residential services receiving gas, information from U.S. Census Bureau's American Housing Survey for the United States, 2001, was used.[53] In the U.S. in the year 2001, there were a total of 81,855,000 single-family residential units.[54] Over all in U.S. in 2001, there were a total of 119,117,000 residential units. Thus, single-family residential units made up 69 percent of all residential units.

Assuming that single-family residences make up 69 percent of all residential customers of gas utilities, it is estimated that there are 41,574,000 single-family residential customers of gas utilities. For the purposes of this analysis, these are each assumed to have one service line.[55] Of the single-family residential customers, an estimated 4,000,000 already have EFVs installed in their service lines. Consequently, if Safety Recommendation P-01-2 were to be implemented, it is expected that 37,574,000 single-family residential services would potentially be impacted over the 50-year time horizon of this analysis.

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[51] Submission by the American Gas Association to Docket No. RSPA-03-14455, Notice 1, 2003.

[52] American Gas Association (AGA), State Profiles, 2001, obtained from the AGA website, www.aga.org, on July 24, 2003.

[53] U.S. Census Bureau, American Housing Survey Branch, American Housing Survey for the United States: 2001, obtained from the Census Bureau website at page www.census.gov/hhes/www/housing/ahs/ahs01/ahs01.html on July 24, 2003.

[54] This includes single-family detached residences and single-family attached residences, but does not include any mobile homes or similar types of residences. A residential unit is a dwelling place and not necessarily a structure. Thus, a single-family residence and an apartment in a 500-unit apartment building would both be residential units.

[55] It should be noted that developers building single-family houses will frequently own several houses with active gas services at the same time, but this situation is generally temporary.

## 3.5 POTENTIALLY IMPACTED INCIDENTS

If Safety Recommendation P-01-2 were to be implemented and added EFVs installed on all new and renewed single-family residential services for which there are readily available valves compatible with the operating conditions of the service lines, the consequences of some portion of the gas service line incidents that currently occur would be mitigated. Those incidents would need to have had a significant or catastrophic service line break. In most cases, such a break or rupture would be the consequence of outside forces damage. For the purposes of this analysis, as mentioned previously, outside forced damage is assumed to be the only cause that would result in the substantial or catastrophic break needed to trip an EFV.

Both reportable and non-reportable incidents could potentially be impacted by the presence of an EFV, since service line ruptures can result in either. Reportable incidents will be addressed first, followed by non-reportable.

### 3.5.1 Reportable Incidents

The consequences of reportable incidents resulting from catastrophic or substantial breaks in service lines would be expected to experience a reduction if Safety Recommendation P-01-2 were to be implemented. The most notable consequences that would be mitigated are deaths, injuries requiring hospitalization, and property damage when it is $50,000 or more. Fires and explosions and the need for would also be mitigated. These will be addressed later in this chapter.

Table 3-1 presents information on all the reportable service line incidents on single-family residential services caused by outside forces damage that occurred from February 3, 1999, the date that 49 CFR 192.383 first became effective, through September 30, 2001.[56] There are 39 incidents included in Table 3-1. Only one incident in the table is known to have occurred on a service line in which an EFV was installed. In total, the incidents in Table 3-1 resulted in 3 deaths, 13 injuries requiring hospitalization, and $7,265,884 (nominal) in property damage.

The consequences of some of the incidents in Table 3-1 would not have been mitigated had an EFV been installed as a consequence of Safety Recommendation P-01-2. First, of course, the consequences of the incident that occurred on the service line with an EFV already installed would have certainly not been impacted. Second, there are a number of incidents that EFVs would not have helped, primarily incidents that did not result from substantial or catastrophic breaks in service lines. Finally, there are a number of incidents for which there is not enough information to say whether an EFV was installed.

Table 3-2 identifies the incidents that probably would not have been mitigated had an EFV been installed. In identifying the incidents that EFVs would not have helped, some of those were voluntarily identified by gas utility representatives during telephone conversations or other communications (contact with the relevant gas utility was attempted for all listed incidents). Others were identified through a review of the incident reports submitted to the Office of

[56] The services identified as "Residential" in Table 3-1 are probably single-family residential services.

**TABLE 3-1. REPORTABLE RESIDENTIAL GAS SERVICE LINE INCIDENTS* CAUSED BY OUTSIDE FORCES DAMAGE, FEBRUARY 3, 1999, THROUGH SEPTEMBER 30, 2001**

| OPS RPTID** | Incident State | Incident Date | Fatalities | Injuries | Property Damage | Type of Service | EFV? |
|---|---|---|---|---|---|---|---|
| 19990068 | FL | 3/12/1999 | 0 | 1 | $0 | Residential | No |
| 19990090 | NC | 3/31/1999 | 0 | 0 | $100,000 | Residential | No |
| 19990098 | AL | 5/1/1999 | 0 | 1 | $90,000 | Residential | No |
| 19990118 | MI | 7/7/1999 | 0 | 0 | $90,000 | Residential | No |
| 19990126 | AK | 8/7/1999 | 0 | 0 | $100,000 | Single-Family Residential | No |
| 19990185 | CA | 10/21/1999 | 0 | 0 | $75,000 | Residential | No |
| 19990186 | ID | 10/27/1999 | 0 | 1 | $1,000,000 | Residential | No |
| 19990204 | NJ | 11/29/1999 | 0 | 0 | $300,000 | Residential | No |
| 20000005 | NC | 12/9/1999 | 0 | 0 | $75,000 | Residential | No |
| 20000009 | AK | 1/10/2000 | 0 | 0 | $75,000 | Single-Family Residential | No |
| 20000015 | TX | 12/12/1999 | 1 | 0 | $100,000 | Residential | No |
| 20000049 | FL | 3/6/2000 | 0 | 1 | $3,500 | Residential | No |
| 20000065 | CA | 2/29/2000 | 0 | 0 | $60,000 | Residential | No |
| 20000066 | FL | 3/7/2000 | 0 | 1 | $0 | Single-Family Residential | Yes |
| 20000070 | AL | 3/17/2000 | 0 | 0 | $400,000 | Residential | No |
| 20000108 | MA | 5/12/2000 | 0 | 0 | $500,000 | Single-Family Residential | No |
| 20000109 | AK | 6/6/2000 | 0 | 0 | $1,000,000 | Single-Family Residential | No |
| 20000114 | MA | 5/15/2000 | 0 | 0 | $250,000 | Single-Family Residential | No |
| 20000115 | NY | 5/19/2000 | 0 | 0 | $400,000 | Single-Family Residential | No |
| 20000121 | VA | 5/30/2000 | 0 | 1 | $0 | Single-Family Residential | No |
| 20000138 | NY | 6/12/2000 | 0 | 0 | $450,000 | Residential (Radio Station) | No |
| 20000147 | AK | 8/15/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20000154 | MO | 7/24/2000 | 0 | 1 | $40,000 | Residential | No |
| 20000164 | WV | 8/11/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20000168 | TX | 8/1/2000 | 0 | 2 | $0 | Residential | No |
| 20000186 | AL | 9/28/2000 | 1 | 0 | $0 | Single-Family Residential | No |
| 20000188 | CA | 9/13/2000 | 0 | 0 | $51,500 | Single-Family Residential | No |
| 20000208 | NV | 10/26/2000 | 0 | 1 | $451,884 | Residential | No |
| 20000222 | AK | 12/7/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20010004 | AK | 12/25/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20010045 | CO | 1/31/2001 | 0 | 0 | $100,000 | Residential | No |
| 20010047 | WI | 2/3/2001 | 1 | 1 | $185,000 | Residential | No |
| 20010067 | NJ | 2/23/2001 | 0 | 0 | $300,000 | Single-Family Residential | No |
| 20010079 | MO | 3/25/2001 | 0 | 0 | $350,000 | Single-Family Residential | No |
| 20010104 | TX | 5/2/2001 | 0 | 0 | $200,000 | Residential | No |
| 20010163 | AK | 9/10/2001 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20010164 | AZ | 8/30/2001 | 0 | 0 | $269,000 | Residential | No |
| 20010173 | IL | 8/29/2001 | 0 | 1 | $0 | Single-Family Residential | No |
| 20010180 | GA | 9/30/2001 | 0 | 1 | $0 | Residential | No |

## TABLE 3.1 (CONTINUED)

Notes:

*Reportable gas service line incidents: incidents resulting in a death, an injury requiring hospitalization, or $50,000 or more in property damage.
**OPS RPTID = unique number assigned to each incident report filed with the Office of Pipeline Safety.

Sources of information: Incident reports filed with the Office of Pipeline Safety and contacts with various gas utilities.

## TABLE 3-2. REPORTABLE* INCIDENTS REMOVED FROM DATASET

| OPS RPTID | Incident State | Incident Date | Fatalities | Injuries | Property Damage | Type of Service | EFV? |
|---|---|---|---|---|---|---|---|
| INCIDENTS WITH EFVS | | | | | | | |
| 20000066 | FL | 3/7/2000 | 0 | 1 | $0 | Single-Family Residential | Yes |
| INCIDENTS THAT WOULD NOT HAVE BEEN HELPED BY EFVS | | | | | | | |
| 19990126 | AK | 8/7/1999 | 0 | 0 | $100,000 | Single-Family Residential | No |
| 19990185 | CA | 10/21/1999 | 0 | 0 | $75,000 | Residential | No |
| 19990186 | ID | 10/27/1999 | 0 | 1 | $1,000,000 | Residential | No |
| 20000005 | NC | 12/9/1999 | 0 | 0 | $75,000 | Residential | No |
| 20000009 | AK | 1/10/2000 | 0 | 0 | $75,000 | Single-Family Residential | No |
| 20000109 | AK | 6/6/2000 | 0 | 0 | $1,000,000 | Single-Family Residential | No |
| 20000114 | MA | 5/15/2000 | 0 | 0 | $250,000 | Single-Family Residential | No |
| 20000147 | AK | 8/15/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20000154 | MO | 7/24/2000 | 0 | 1 | $40,000 | Residential | No |
| 20000168 | TX | 8/1/2000 | 0 | 2 | $0 | Residential | No |
| 20000208 | NV | 10/26/2000 | 0 | 1 | $451,884 | Residential | No |
| 20000222 | AK | 12/7/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20010004 | AK | 12/25/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20010104 | TX | 5/2/2001 | 0 | 0 | $200,000 | Residential | No |
| 20010163 | AK | 9/10/2001 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20010164 | AZ | 8/30/2001 | 0 | 0 | $269,000 | Residential | No |

Notes:

*Reportable gas service line incidents: incidents resulting in a death, an injury requiring hospitalization, or $50,000 or more in property damage.
**OPS RPTID = unique number given to each incident report filed with the Office of Pipeline Safety.

Sources of information: Incident reports submitted to the Office of Pipeline Safety; communications with various gas utilities.

**TABLE 3-3. REPORTABLE* RESIDENTIAL GAS SERVICE LINE INCIDENTS* CAUSED BY OUTSIDE FORCES DAMAGE THAT MIGHT HAVE BEEN HELPED BY AN EFV, FEBRUARY 3, 1999, THROUGH SEPTEMBER 30, 2001**

| OPS RPTID** | Incident State | Incident Date | Fatalities | Injuries | Property Damage | Type of Service | EFV? |
|---|---|---|---|---|---|---|---|
| 19990068 | FL | 3/12/1999 | 0 | 1 | $0 | Residential | No |
| 19990090 | NC | 3/31/1999 | 0 | 0 | $100,000 | Residential | No |
| 19990098 | AL | 5/1/1999 | 0 | 1 | $90,000 | Residential | No |
| 19990118 | MI | 7/7/1999 | 0 | 0 | $90,000 | Residential | No |
| 19990204 | NJ | 11/29/1999 | 0 | 0 | $300,000 | Residential | No |
| 20000015 | TX | 12/12/1999 | 1 | 0 | $100,000 | Residential | No |
| 20000049 | FL | 3/6/2000 | 0 | 1 | $3,500 | Residential | No |
| 20000065 | CA | 2/29/2000 | 0 | 0 | $60,000 | Residential | No |
| 20000070 | AL | 3/17/2000 | 0 | 0 | $400,000 | Residential | No |
| 20000108 | MA | 5/12/2000 | 0 | 0 | $500,000 | Single-Family Residential | No |
| 20000115 | NY | 5/19/2000 | 0 | 0 | $400,000 | Single-Family Residential | No |
| 20000121 | VA | 5/30/2000 | 0 | 1 | $0 | Single-Family Residential | No |
| 20000138 | NY | 6/12/2000 | 0 | 0 | $450,000 | Residential (Radio Station) | No |
| 20000164 | WV | 8/11/2000 | 0 | 0 | $50,000 | Single-Family Residential | No |
| 20000186 | AL | 9/28/2000 | 1 | 0 | $0 | Single-Family Residential | No |
| 20000188 | CA | 9/13/2000 | 0 | 0 | $51,500 | Single-Family Residential | No |
| 20010045 | CO | 1/31/2001 | 0 | 0 | $100,000 | Residential | No |
| 20010047 | WI | 2/3/2001 | 1 | 1 | $185,000 | Residential | No |
| 20010067 | NJ | 2/23/2001 | 0 | 0 | $300,000 | Single-Family Residential | No |
| 20010079 | MO | 3/25/2001 | 0 | 0 | $350,000 | Single-Family Residential | No |
| 20010173 | IL | 8/29/2001 | 0 | 1 | $0 | Single-Family Residential | No |
| 20010180 | GA | 9/30/2001 | 0 | 1 | $0 | Residential | No |

Notes:

*Reportable gas service line incidents: incidents resulting in a death, an injury requiring hospitalization, or $50,000 or more in property damage.
**OPS RPTID = unique number assigned to each incident report filed with the Office of Pipeline Safety.

Sources of information: Incident reports filed with the Office of Pipeline Safety and contacts with various gas utilities.

Pipeline Safety, particularly the incident descriptions included with the reports. Reasons for dropping incidents included statements or conclusions in those incident descriptions that

- Natural gas did not cause or contribute to the fire
- The cause was damage by tree root growth
- The cause was the failure of threaded pipe in the meter set assembly
- The service broke inside the structure
- A boring rod (or similar) poked a hole in the service line
- The cause was a leak from below ground riser

Table 3-3 identifies the incidents whose consequences might possibly have been mitigated had an EFV been installed on the service line. These incidents were the ones left after the incidents that EFVs would not have helped had been removed. The incidents in Table 3-3, 22 in all, resulted in 3 deaths, 7 injuries requiring hospitalization, and $3,598,572 (in 2001) in property damage.

It is somewhat curious to note that for five incidents in Table 3-3 there was no property damage. It is unknown how there could be gas service line incidents caused by outside forces with no damage to the property of the gas utility or anyone else.[57]

### 3.5.2 Non-Reportable Incidents

The Office of Pipeline Safety does not collect specifics on non-reportable incidents. From 1970 to mid-1984, however, the definition of a reportable incident was different than it is today, and some information concerning non-reportable incidents can be gleaned from the incident reports for these years.[58]

There were three primary differences between the current incident reports and those from 1970-1984 that are relevant for this current analysis. The first was that the property damage threshold was $5,000 (nominal), rather than $50,000; the second was that it was noted if a pipeline rupture occurred; and the third was that it noted if a fire, explosion, or secondary fire or explosion occurred.

**Significant Non-Reportable Incidents.** Information from the 1970 to mid-1984 incident reports can be used to estimate (1) the number of the more significant non-reportable incidents per reportable incident, (2) the property damage resulting from the more significant of the non-reportable incidents, and (3) the numbers of reportable and non-reportable incidents that are accompanied by fires or explosions. These will all be used later in the estimation of the benefits that would result if Safety Recommendation P-01-2 were to be implemented.

**Significant Non-Reportable Incidents Per Reportable Incident.** From 1970 to mid-1984, there were 388 incidents where the following conditions were reported:

- The incident occurred on a residential service
- The incident cause was damage by outside forces
- A rupture occurred

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[57] According to the descriptions accompanying the incident reports from the gas utilities,

- 19990068 was caused by the use of a torch on a telephone line immediately adjacent to and below a gas service line (and by inference probably resulted in a breached gas service line)
- 20000121 resulted in a melted plastic gas service line
- 20000186 resulted in a broken gas service line
- 20010173 resulted in a valve being broken off a regulator
- 20010180 resulted in a melted 5/8" plastic gas line

[58] The incident reports can be found in OPS file PD7084.TXT, Natural Gas Distribution Incident Data - 1970 to mid 1984, which is posted on OPS' web site.

Of those, 31 had a death, major injury, or $50,000 (nominal) or greater in property damage, and thus would be reportable under today's current requirements. The remaining 357 incidents would not be reportable today. Thus, for every reportable incident, there were 11.5 serious non-reportable incidents. This assumed to be the case currently, as well.

**Property Damage Resulting from Significant Non-Reportable Incidents.** From 1970 to mid-1984, the 357 incidents that would not be reportable today had reported property damage of $413 (nominal), or $575 (in 2001 dollars). Property damage on significant non-reportable incidents is assumed currently to be $575 (in 2001 dollars).

**Fires and Explosions with Reportable and Significant Non-Reportable Incidents.** From 1970 to mid-1984, in 28 of the 31 incidents with a death, major injury, or property damage of $50,000 (nominal) or greater, gas ignition, an explosion, or a secondary fire or explosion occurred. Thus, 90 percent of the incidents that would be reportable today experienced gas ignition, an explosion, or a secondary fire or explosion. This is assumed to currently be the case today, as well.

From 1970 to mid-1984, 213 of the 357 incidents that would not be reportable today experienced gas ignition, an explosion, or a secondary fire or explosion. Thus, 60 percent of the serious non-reportable incidents experienced gas ignition, an explosion, or a secondary fire or explosion. This is assumed to currently be the case, as well.

Finally, based the incident data collected by OPS from 1979 through mid-1984, for every reported incident with a death, injury, or property damage of $50,000 (nominal) or greater, there were 7.6 (= 213 / 31) incidents without a death, injury, or $50,000 (nominal) in property damage that experienced gas ignition, an explosion, or a secondary fire or explosion. This ratio is assumed to hold today.

**Other Consequences of Significant Non-Reportable Incidents.** In addition to property damage, fires and explosions, significant non-reportable incidents can result in minor injuries (i.e., injuries that do not require hospitalization). Information on minor injuries is resulting from significant non-reportable incidents is unavailable.

**Other Non-Reportable Incidents.** Information on the minor injuries, property damage, and other consequences resulting from other non-reportable incidents (i.e., from non-reportable incidents that are not significant) is unavailable.

## 3.6 AVOIDED CONSEQUENCES

If Safety Recommendation P-01-2 were to be implemented, the number of incidents that occur on single-family residential gas services would be unchanged, since EFVs do not prevent incidents. The consequences of some of those incidents, however, would be less than they would have been in the absence of EFVs. Furthermore, this would be expected to be the case for both reportable and non-reportable incidents. Those reduced or avoided consequences are the benefits that would result if Safety Recommendation P-01-2 were to be implemented.

The proportion of incident consequences that would be mitigated by EFVs is unknown. The single incident identified in Tables 3-1 and 3-2 where an EFV was installed provides insufficient information to estimate that proportion. Although the incident does indicate that consequences can occur even in the presence of an EFV, for the purposes of this analysis, it will be assumed that all consequences will be mitigated if there is an EFV on a service line. The effect of relaxing this assumption will be addressed the discussion of benefit uncertainties later in this chapter.

The primary incident consequences that can be reduced by the installation of EFVs are

- Deaths
- Injuries
- Property damage
- Fires and Explosions
- Lost gas
- Evacuations

Information on injuries not requiring hospitalization and evacuations resulting from gas incidents are not considered in this analysis. More will be said about this later.

A reduction of fires and explosions occurring as a result of incidents on single-family residential services will reduce calls for emergency responders to the incident sites, thereby reducing the local cost of emergency response. Local emergency response at fires and explosions will primarily consist of fire suppression and related services provided by local professional or volunteer fire departments, but can also include police and emergency medical services.

### 3.6.1 Reportable Incidents

In Table 3.3, the 22 incidents over the 31-month period resulted in resulted in 3 deaths, 7 injuries requiring hospitalization, and $3,598,572 (in 2001) in property damage. Put in per service per year terms, the incidents and consequences in Table 3.3 are

- Incidents = 0.000000227
- Deaths = 0.000000031
- Injuries = 0.000000072
- Property damage = $0.04 (in 2001 dollars)

For these estimates, it is assumed, as discussed previously, that there are 37,547,000 single-family residential services that do not currently have EFVs installed on them.

The Office of Pipeline Safety currently makes the following assumptions concerning the value of a statistical life and the value of an injury requiring hospitalization:

- The value of a statistical life is $3,000,000 (in 2001 dollars)

- Injuries requiring hospitalization are valued at $562,500 [59] (in 2001 dollars).

Put into dollar terms, the consequences avoided when a reportable incident does not occur are expected to be

- Deaths = $0.09
- Injuries = $0.04
- Property damage = $0.04

all in 2001 dollars.

### 3.6.2 Non-Reportable Incidents

As mentioned previously, for every reportable incident, there are expected to be 11.5 significant non-reportable incidents, along with an untold number of other non-reportable incidents. The other non-reportable incidents are not considered in this analysis. Also, the numbers and cost to society of injuries not requiring hospitalization that might have occurred as a result of non-reportable incidents are not considered in this analysis.

If there are 11.5 significant non-reportable incidents for every reportable incident, then the number of such incidents and the cost of the property damage that they cause, both put on a per service per year basis, are

- Significant non-reportable incidents = 0.0000026
- Property damage from significant non-reportable incidents = $0.00 (in 2001 dollars)

The cost of the property damage for significant non-reportable incidents was estimated previously to be $575 (in 2001 dollars) per incident.

### 3.6.3 Emergency Response

Emergency responders, such as police, emergency medical personnel, and particularly firefighters, can be called to the scene when a natural gas service line incident occurs. This is most likely to occur when an incident has resulted in a fire or explosion. When fires or explosions occur, not only are emergency responders put at risk, but also local emergency response resources are expended. If Safety Recommendation P-01-2 were implemented, the need for emergency responders at single-family residential gas service incidents would be expected to be reduced, saving emergency responder lives, as well as local emergency response resources.

Emergency responder deaths and major injuries are included in the deaths and major injuries reported to the Office of Pipeline Safety, and thus the benefits that might result from their reduction are addressed elsewhere in this report.

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[59] The average injury requiring hospitalization is assumed to be a "Severe injury," as defined by the U.S. Department of Transportation. The cost to society of a "Severe injury" is assumed to be equal to 0.1875 times the cost to society of a lost life.

The expenditure of local emergency response resources includes the cost of the salaries of the emergency responders (or in the case of volunteer firefighters, the cost of foregone salaries or other earnings), the cost of equipment use, and the cost of fire suppression and other materials that are used or otherwise expended. They also include a share of the cost of maintaining the equipment, of administering and training the emergency responders, and of housing the equipment and of providing work facilities (such as fire, stations, police stations, etc.) for the emergency responders.

Information that can be used to develop estimates of the costs of independent emergency medical services[60] and police responding to gas service line incidents is unavailable. Information on the costs of fire services, however, is available. The focus in this report, as a consequence, will be on fire suppression and related activities. It does not include costs for independent emergency medical services or for police.

**The Cost of Fighting a Fire or Responding to an Explosion** - According to "A First Pass at Computing the Cost of Fire Safety in A Modern Society," the fully loaded cost of local fire service (i.e., fire fighting and other activities and services provided by local fire departments) was estimated for 1986, the most recent year for which such information appears to be available, to be between $25.8 billion and $46.4 billion, with $39.6 billion being the "Most Likely Estimate".[61] These estimates consist of the total annual cost of local career fire departments, plus an imputed annual cost for the services provided by volunteer fire departments.[62]

In 1986, according to the National Fire Protection Association, there were a total of 11,890,000 fire department calls.[63] These include calls for fires, medical aid, false alarms, mutual aid, hazardous materials, other hazardous conditions, and other assistance.

Based on the best estimate (i.e., the "Most Likely Estimate") of the cost of local fire service in 1986 and the total number of fire department calls in 1986, a call cost, on average $3331 in 1986. For the purposes of this analysis, the cost of fighting a fire or responding to an explosion is assumed to be equal to the fully loaded average cost of a fire department call, $3331 in 1986 dollars or $4360 in 2001 dollars.

**Significant or Catastrophic Service Line Breaks Resulting in Fires and Explosions** - When a significant or catastrophic service line break occurs, they sometimes result in fires or explosions. The fires must be put out and the explosions must be responded to.

As mentioned previously, based on incident data collected by OPS from 1970 through mid-1984 for residential service line incidents caused by outside forces damage where there was a rupture, the following is expected to be the case currently:

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[60] Emergency medical services not provided by local police or fire organizations.
[61] Meade, pp. 344-345.
[62] Meade, p. 344.
[63] Communication from Nancy Swartz, National Fire Protection Association, to Diane Sutherland, Volpe Center, July 8, 1994.

- 90 percent of all reportable incidents are expected to experience gas ignition, an explosion, or a secondary explosion

- 60 percent of all significant non-reportable incidents are expected to experience gas ignition, an explosion, or a secondary explosion

- For every reportable incident experiencing gas ignition, an explosion, or a secondary fire or explosion, 7.6 significant non-reportable incidents are expected to experience gas ignition, an explosion, or a secondary fire or explosion.

With the information presented above, an estimate can be developed for the cost to fire departments of fires and explosions at incidents on residential gas service lines.

For reportable incidents, the number of incidents per service per year with fires or explosions is expected to be

- $0.000000227 \times 0.9 = 0.000000203$

where 0.000000227 is the number of reportable incidents per service per year and 0.9 is the expected proportion of reportable incidents with a fire or explosion.

For significant non-reportable incidents, the number of incidents per service per year with fires or explosions is expected to be

- $0.000000227 \times 0.9 \times 7.6 = 0.00000155$

where 7.6 is the number of significant non-reportable incidents with a fire or explosion per reportable incident with a fire or explosion.

The total cost of fire suppression support per service per year will therefore be

- $((0.000000227 \times 0.9) + (0.000000227 \times 0.9 \times 7.6)) \times \$4360 = \$0.01$ (in 2001 dollars)

where $4360 (in 2001 dollars) is the expected per call cost of fire suppression services.

### 3.6.4 <u>Lost Gas</u>

As a consequence of catastrophic ruptures occurring on single-family residential services, natural gas will be lost. EFVs can dramatically limit the amount of gas lost in the case of a catastrophic rupture of a service. Reducing lost gas would reduce the costs incurred by gas utilities (or the owners of the impacted service line, if not a gas utility) when there has been a substantial or catastrophic service line break, as well as help conserve a non-renewable natural resource.

The quantity of gas that is lost in an incident is not collected by the OPS. The American Gas Association, however, estimates that, for incidents with a catastrophic rupture, the average amount of gas lost will be no more than 11,000 cubic feet.[64] Others have suggested that the average amount lost in an incident would be considerably larger.[65]

For the purposes of this analysis, it is assumed that

- On average, 5,000 cubic feet of gas will be lost in an incident with a catastrophic rupture on a service with no EFV,[66] while only a nominal quantity of gas will be lost in an incident with a catastrophic rupture on a service with an EFV.
- The average annual activation rate for EFVs will be 0.0012.[67]
- The average annual activation rate is representative of the rate at which catastrophic ruptures occur on all residential gas services.
- The value of any gas lost as the result of a break in a residential service will be $7.81 per thousand cubic feet (in 2001 dollars).[68]

Using the assumptions given above, the value of the gas saved annually for each EFV installed on single-family residential service lines is estimated to be

- 0.0012 x 5 x $7.81 = $0.05 per service per year (in 2001 dollars).

This estimate includes the value of lost gas during all incidents, reportable and non-reportable, occurring on single-family residential services.

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[64]See submission to U.S. DOT/RSPA/OPS Docket PS-118 by the by the American Gas Association, October 3, 1994, p. 27.

[65]The Alabama Gas Corporation indicates that, for incidents with a catastrophic rupture, 50,000 cubic feet is the appropriate estimate of the amount of gas lost (see submission to U.S. DOT/RSPA/OPS Docket PS-118 by the Alabama Gas Corporation, July 1, 1993, p. 2). The Gas Safety Action Council appears to believe that 60,000 cubic feet is the appropriate estimate for the amount of gas lost during an incident (see submission to U.S. DOT/RSPA/OPS Docket PS-118 by the Gas Safety Action Council, July 6, 1993, p. 12).

[66]The amount of gas lost during an incident resulting from a catastrophic rupture will vary by the size of line, the operating pressure, whether the gas is escaping into the air or into the soil, and the amount of time that elapses before the escaping gas can be stopped, among other things. The average response time for leaks by gas utilities is reported to be 20 minutes (Presentation of Chief Stephen D. Halford of the Nashville Fire Department on behalf of the International Association of Fire Chiefs and the National Fire Department at the U.S. Department of Transportation's Technical Pipeline Safety Standards Committee Meeting, Washington, DC, May 29, 2003). According to the OPS, a ¾ inch residential service line operating at 10 psig could lose over 10,000 cubic feet of gas per hour if the break in the pipe were clean and the discharge was directly to air (not into soil). For this analysis, the mid-point between 10,000 cubic feet and 0 cubic feet was selected for the loss due to a catastrophic service line break.

[67]See Section 2.9 of this report for information on the derivation of this value.

[68]The average price of gas for residential consumers in 2001 was $9.64 per thousand cubic feet (see Energy Information Administration price data on the Internet at tonto.eia.doe.gov/dnav/ng/hist/n3010us3A.htm). In 2001, residential consumers appear to have experienced exceptionally high prices, since the average prices for 2000 and 2002 were $7.76 and $7.86, respectively, and the prices for 2000 and 2002 appear consistent with the historical trend in residential gas prices. Rather than use a price that appears to be an outlier, $7.81, the mid-point between $7.76 and $7.86 was used.

### 3.6.5 Other Avoided Consequences

As mentioned previously, in addition to potentially reducing deaths, injuries, property damage, and emergency response costs, the installation of EFVs may also reduce the number of injuries not requiring hospitalization, and the number and size of evacuations needed when there are service line incidents.

Reducing the number of injuries not requiring hospitalization can reduce lost time at work and improve worker efficiency. Just because a worker does not need to visit the hospital after an injury does not mean that that worker will feel well enough to continue to work the day of the injury or to return to work the day after the injury. Furthermore, pain and bandages can keep some workers from achieving their standard level of performance for some time after an injury.

Reducing the number of evacuations would reduce the amount of lost time, lost revenue, and lost access to resources experienced by those living, working, or traveling in the vicinity of a service line incident at which there has been a substantial or catastrophic break.

Unfortunately, information needed to evaluate the reduction of injuries not requiring hospitalization and evacuations is unavailable. Consequently, the reductions in minor injuries and evacuations that might occur as a result of the installation of EFVs are not considered in this analysis. This means that the benefits calculated in this report will tend to understate the full benefits that would be realized if Safety Recommendation P-01-2 were to be implemented.

## 3.7 TOTAL BENEFITS OF EFVS

The total benefits of the EFVs that would be installed if Safety Recommendation S-01-2 were to be implemented are the sum of the estimated values of the avoided reportable incidents, non-reportable incidents, emergency response, and lost gas, or

- $0.17 + $0.00 + 0.01 + 0.05 = $0.23 (in 2001 dollars) per installed EFV per year.

## 3.8 PRESENT VALUE OF THE BENEFITS OF EFVS

The present value of the total benefits attributable to the EFVs that would be installed if Safety Recommendation S-01-2 were to be implemented is calculated using a 50-year time horizon, a discount rate of 7.0 percent, and an estimate of 750,000 for the number of EFVs that would be installed every year as a result of the safety recommendation. The discount rate is the current value recommended for use in Federal benefit-cost analyses.[69] The present value of the total benefits of the safety recommendation is

- 750,000 x (present value of $0.23 per installed EFV per year) = $31,770,000 (in 2001 dollars).

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[69] The current OMB Circular No. A-94, Revised (see http://www.whitehouse.gov/omb/circulars/a094/a094.html).

Note that the benefits accruing to a valve (=$0.23 per installed EFV per year) are realized in the year that the valve is installed and in every subsequent year thereafter up through the 50th year. An EFV does not just help mitigate incidents on a service line the first year that it is installed, but continues to do so throughout its operational life.

## 3.9 BENEFIT UNCERTAINTIES

The key assumptions made in the calculation of the benefit estimates developed in this chapter are summarized in Table 3-4.

**TABLE 3-4. SUMMARY OF KEY ASSUMPTIONS IN THE BENEFIT CALCULATIONS**

| Assumption | Value |
|---|---|
| Number of added EFVs installed per year | 750,000 |
| Percent of consequences mitigated | 100% |
| Cost of emergency response | $4360 |
| Number of significant non-reportable incidents per reportable incident | 11.5 |
| Deaths per service per year | 0.0000000309 |
| Injuries requiring hospitalization per service per year | 0.0000000721 |
| Property damage from reportable incidents per service per year | $0.04 |
| Property damage from non-reportable incidents per service per year | $0.0015 |
| EFV activation rate | 0.0012 |
| Average amount of gas lost per incident | 5000 cubic feet |
| Value of lost gas per thousand cubic feet | $7.81 |
| Statistical value of a life | $3,000,000 |
| Value of injuries requiring hospitalization | $562,500 |

There are a several obvious uncertainties related to these assumptions:

- The value for the number of added EFVs installed per year if Safety Recommendation P-01-2 were to be implemented may over or understate the actual number of valves that would be installed. It should be noted that the number of EFVs installed per year will have no impact on the benefit-to-cost ratio since it appears as a multiplicand in both the numerator and denominator of that ratio. Thus, although uncertain, that uncertainty will not impact the question of whether Safety Recommendation P-01-2 is cost beneficial.

- The value used for the percentage of consequences avoided almost certainly overstates the actual capability of EFVs to mitigate the consequences of incidents. Almost by definition, any incident, even in the presence of an EFV, will result in some damage. If nothing else, the service line upon which the incident occurred will need to be repaired.

- The value used for the amount of gas lost per catastrophic break may understate or overstate the actual average amount lost. Likewise, the value used for the EFV activation rate may understate or overstate the actual EFV activation rate.

- The estimates used for

    - The cost of emergency response
    - The number of significant non-reportable incidents per reportable incident
    - Deaths per reportable incident
    - Injuries requiring hospitalization per reportable incident,
    - Property damage per reportable incident
    - Property damage per non-reportable incident

  were all based on relatively old data or limited numbers of observations.

- The estimated benefits do not include anything for avoided injuries not requiring hospitalization. Such injuries can lead to missed days of work and other costs to society.

- It has been noted that the property damage figures reported by NTSB in their pipeline accident reports are significantly higher than the property damage figures reported to OPS for the same gas utility incidents. On average, the property damage figures reported by NTSB might be as much as one-third more than those reported to OPS. That means that the benefits calculated in this analysis may be understated, all other things equal.

- The figures used in this analysis for the statistical value of a life and the value of injuries requiring hospitalization may overstate or understate their true values. The same can undoubtedly be said for the value of injuries requiring hospitalization.

Table 3-5 shows how changing the values used in the benefits calculations would change the present value of the benefits attributable to Safety Recommendation P-01-2. For

- The cost of emergency response
- Deaths per service per year
- Injuries requiring hospitalization per service per year
- Property damage from reportable incidents per service per year
- Property damage from non-reportable incidents per service per year
- Average amount of gas lost during an incident resulting from a catastrophic rupture of a single-family residential gas service line

alternatives were arbitrarily chosen to be 50 percent and 150 percent of the values given in Table 3-4. For the percent of consequences mitigated, an alternative that was half the value given in Table 3-4 was arbitrarily chosen.[70]

The value for the EFV activation rate is used only in the estimation of the value of lost gas. Since the equation used for lost gas is multiplicative, the estimated benefits when the rate is 50 percent or 150 percent of the value given in Table 3-4 will be exactly the same as those when the average amount of lost gas is 50 or 150 percent of the value given in Table 3-4. The same can be

[70] For this alternative, it was assumed that the cost and need for emergency response services would not change from the base case. Consequently, the cost of emergency response services was not reduced to half its base case value.

said of the price used to estimate the value of lost gas. Consequently, separate benefit estimates are not developed for variations in the EFV activation rate or the estimated price of gas.

For the statistical value of a life, an alternative that was double the value given in Table 3-4 was arbitrarily chosen. Finally, for injury requiring hospitalization, the alternatives considered were (1) the estimated loss to society assigned by the U.S. Department of Transportation to a "Critical injury" (i.e., 76.25 percent of the statistical value of a life) and (2) the estimated loss to society assigned by the U.S. Department of Transportation to a "Serious injury" (i.e., 5.75 percent of the statistical value of a life).[71] It should be noted that all present values in Table 3-5 were calculated for a period of 50 years.

**TABLE 3-5. BENEFIT SENSITIVITIES**

| Alternative Assumption | Present Value of Benefits (2001 Dollars) | Percent of Base Case Present Value |
|---|---|---|
| 50 percent of consequences mitigated | $20,565,000 | 65% |
| Cost of emergency response = $6540 | $31,770,000 | 100% |
| Cost of emergency response = $2180 | $30,367,500 | 96% |
| Number of significant non-reportable incidents per reportable incident = 17.3 | $31,770,000 | 100% |
| Number of significant non-reportable incidents per reportable incident = 5.8 | $31,770,000 | 100% |
| Deaths per service per year = 0.0000000463 | $38,767,500 | 122% |
| Deaths per service per year = 0.0000000155 | $26,167,500 | 82% |
| Injuries requiring hospitalization per service per year = 0.000000108 | $34,567,500 | 109% |
| Injuries requiring hospitalization per service per year = 0.0000000361 | $28,965,000 | 91% |
| Property damage from reportable incidents per service per year = $0.06 | $34,567,500 | 109% |
| Property damage from reportable incidents per service per year = $0.02 | $28,965,000 | 91% |
| Property damage from non-reportable incidents = $0.00225 | $31,770,000 | 100% |
| Property damage from non-reportable incidents = $0.00075 | $31,770,000 | 100% |
| Amount of gas lost=7500 cubic feet | $35,047,500 | 170% |
| Amount of gas lost=2500 cubic feet | $28,485,000 | 90% |
| Statistical value of a life = $6,000,000 | $45,772,500 | 144% |
| Value of injuries requiring hospitalization = $2,287,500 | $48,570,000 | 153% |
| Value of injuries requiring hospitalization is $172,500 | $27,562,500 | 87% |

[71] The U.S. Department of Transportation's categories of injury and their assumed values are

- Critical injury: 76.25% of fatal injury
- Severe injury: 18.75% of fatal injury
- Serious injury: 5.75% of fatal injury
- Moderate injury: 1.55% of fatal injury
- Minor injury: 0.20% of fatal injury

The selected alternatives for the value of an injury requiring hospitalization are "Critical injury", which is the next step up from "Severe injury," the category used in the base case of this analysis, and "Serious injury" which is the next step down from "Severe injury".

As can be seen by comparing the values in Table 3-5 with the base case estimate for the present value of the benefits of Safety Recommendation P-01-2, $31,770,000 (in 2001 dollars), the following alternatives resulted in less than a 10 percent change in the present value of benefits:

- Changing the cost of emergency response
- Changing the number of injuries requiring hospitalization
- Changing the number of significant non-reportable incidents per reportable incident
- Changing the property damage for reportable incidents
- Changing the property damage for non-reportable incidents

The following alternatives resulting in a change in the present value of benefits that was greater than 10 percent but less than 20 percent:

- Decreasing the deaths per service per year
- Decreasing the amount of gas lost
- Decreasing the value of injuries requiring hospitalization

The remaining alternatives all resulted in a change in the present value of benefits that was greater than 20 percent. There were

- Decreasing the percentage of consequences mitigated
- Increasing the deaths per service per year
- Increasing the amount of gas lost
- Increasing the statistical value of a life
- Increasing the value of injuries requiring hospitalization

The most significant change resulted from increasing the amount of gas lost, followed by increasing the value of injuries requiring hospitalization, decreasing the percent of consequence mitigated, and changing the statistical value of a life.

# 4. COSTS

## 4.1 INTRODUCTION

If Safety Recommendation P-01-2 were to be implemented, additional EFVs would be installed in new and renewed gas services connected to single-family residential services. The costs associated with the installation and maintenance of these added EFVs would be attributable to implementing the safety recommendation. Those costs are addressed in this chapter, as are the uncertainties associated with them.

## 4.2 THE COST OF INSTALLING EFVS

The cost of installing an EFV in a new or renewed service that would be attributable to implementing Safety Recommendation P-01-2 includes at least part of the cost of the EFV assembly (more will be said about this later in this section), as well as any installation costs attributable to the EFV. It also includes, but is not necessarily limited to, the costs to gas utilities of (1) evaluating and selecting EFVs, (2) purchasing EFVs, (3) stocking and internally distributing EFVs, and (4) establishing EFV installation procedures and training field crews in those procedures.

### 4.2.1 The Cost of EFVs

Gas utilities typically purchase EFVs in the following configurations: (1) EFVs alone, (2) EFVs in sticks, or (3) EFV/tee combinations. An EFV in a stick is essentially an EFV pre-installed in a short piece of pipe. An EFV/tee combination is an EFV pre-installed in a service tee. A sampling of the costs associated with the configurations purchased by gas utilities is presented in Table 4-1.

All of the gas utilities listed in Table 4-1 install EFVs voluntarily on at least some of their services, and the costs listed are for those situations where installation is voluntary. The costs of EFVs in Table 4-1 are expected by the Office of Pipeline Safety to be representative of the costs that all utilities would experience if Safety Recommendation P-01-2 were to be implemented. The EFV manufacturers listed in Table 4-1, it might be noted, represent more than 40 percent of the EFV to gas utility market.[72]

In Table 4-1, the reported current costs of EFVs alone range from $5 to $12 each. The average for all entries for EFVs alone in Table 4-1 is $7.[73] The reported current costs for EFVs in sticks in Table 4-1 range from $8.50 to $25.47. The average for all entries for EFVs in sticks in Table 4-1 is $13.[74] The reported current costs of EFV/tee combinations in Table 4-1 range from $11 to

[72] Communication with EFV manufacturer, 2002.
[73] Costs for mixed configurations of EFVs were not included in the calculation of the average value.
[74] In calculating the average, the mid-point was used for any relevant cost ranges. Costs for mixed configurations of EFVs were not included in the calculation of the average value.

$55. The average for all entries for EFV/tee combinations in Table 4-1 is $33.[75] The $55 EFV in a steel tee in Table 4-1 is used for high-pressure farm taps.[76] EFV/tee combinations used in single-family residential services will generally cost less than this, especially when purchased in volume. The reported current costs of EFV/tee combinations, excluding the EFV in a steel tee, range from $11 to $29. The average for these is $22.[77]

**TABLE 4-1. REPORTED COST OF EFVS**

| Company | EFV Configuration | Cost Per EFV |
|---|---|---|
| | GAS UTILITIES | |
| 1st Illinois Gas Utility | EFV in stick | $8.50 |
| | EFV/tee combination* | $28-29 |
| 2nd Illinois Gas Utility | EFV only or EFV in stick | $8-10 |
| 3rd Illinois Gas Utility | Steel EFV in stick | $25.47 |
| 2nd East Coast Gas Utility | EFV in stick | c. $10 or less |
| 3rd East Coast Gas Utility | All configurations | $13.50 - $20.00 (average: $14.00) |
| 5th East Coast Gas Utility | 3/4 inch EFV only | $5.40 |
| 6th East Coast Gas Utility | EFV only | $12 |
| | EFV MANUFACTURERS | |
| 1st EFV Manufacturer | EFV in stick | $7-$12 |
| | EFV/tee combination | $11-$18 |
| 2nd EFV Manufacturer | Steel EFV only | c. $5 |
| | EFV/steel tee combination | c. $55 |
| 3rd EFV Manufacturer | All configurations | $7-$12 |
| 4th EFV Manufacturer | All configurations | $8-$25 |

*Cost of tee only = c.$20.
Sources of information: Communications with (1) various gas utilities, March-April 2002 and (2) various EFV manufacturers, March-April 2002.

Based on the cost information presented in Table 4-1, it would appear that EFVs in sticks cost less than EFV/tee combinations, while EFVs alone cost less than either of the other two configurations. This comparison does not take into consideration (1) the cost of tees alone (if an EFV/tee combination is purchased, there is no need to purchase a tee alone), (2) the costs associated with the installation of EFVs alone in tees or service line pipe, or (3) the costs associated with the installation of EFVs in sticks in service lines. When these costs are considered, it is expected that the cost of EFV/tee combinations would be the lowest.

[75] In calculating the average, the mid-point was used for any relevant cost ranges. Costs for mixed configurations of EFVs were not included in the calculation of the average value.
[76] Communication with an Illinois gas utility, March 15, 2002.
[77] In calculating the average, the mid-point was used for any relevant cost ranges. Costs for mixed configurations of EFVs were not included in the calculation of the average value.

If Safety Recommendation P-01-2 were to be implemented, some EFVs would be installed at the tapping tee on the main, while others would be installed on branching service lines.

When an EFV/tee combination is used, the cost of the combination is assumed to be $22, the average for EFV/tee combinations in Table 4-1 when the EFV in the steel tee is excluded. This figure is assumed to be in 2001 dollars.

Since it is assumed that a tee would need to be installed in any new or renewed service line in which the EFV would be installed at the tapping tee on the main, the entire $22 cost of an EFV/tee combination would not be fully attributable to the implementation of Safety Recommendation P-01-2. Rather, only the portion of that cost over and above the cost of a tee alone would be attributable to its implementation.

The cost of a tee alone will vary according to the nature of the service line. An Illinois gas utility reports that it pays $20 for a tee alone. It also reports that it pays $28 to $29 for each EFV/tee combination.[78] In this case, an EFV/tee combination costs approximately

- 100 x ($28.50 / $20) = 143 percent

of the cost of a tee alone. For the purposes of this study, it is assumed that all EFV/tee combinations cost 143 percent of the cost of a tee alone. If an EFV/tee combination costs $22 on average, then

- 100 x ($22 / Cost of a tee alone) = 143 percent
- Cost of a tee alone = $2200 / 143 = $15

rounded to the nearest whole dollar. Consequently, the total cost of installing an EFV/tee combination that is attributable to the implementation of Safety Recommendation P-01-2 would be

- $22 - $15 = $7.

This figure is assumed to be in 2001 dollars. Coincidentally, $7 is the average cost of the EFVs alone in Table 4-1.

When an EFV/stick combination is used, the cost of the combination is assumed to be $13, the average for EFV/stick combinations in Table 4-1. This figure is assumed to be in 2001 dollars.

For the purposes of this analysis, it is arbitrarily assumed that 50 percent of all EFVs installed on new or renewed service lines will be installed at the tee, while the other 50 percent will be installed on branching service lines.[79] Consequently, the average cost of EFVs attributable to Safety Recommendation P-01-2 would be

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[78] Communication with an Illinois gas utility, April 9, 2002.

[79] According to communications with industry sources, May 2, 2002, about one half of all new services are branch services for at least one major gas utility.

- 50% x $7 + 50% x $13 = $10.

This is assumed to be in 2001 dollars.

### 4.2.2 EFV Installation Cost

For the purposes of this analysis, it is assumed that the installation cost for an EFV in a tee or in a stick would be nominal when installed in a new or renewed gas service line. That is, it is assumed that there would be no additional installation cost over and above what would otherwise be incurred that would be attributable to the EFV.

### 4.2.3 Total Cost of Installing EFVs

The total cost of installing EFVs would be the cost of the EFVs plus the EFV installation cost, or

- $10 + $0 = $10

where the initial $10 is the cost of EFVs attributable to Safety Recommendation P-01-2 and $0 is the expected EFV installation cost.

## 4.3 THE COST OF MAINTAINING EFVS

EFVs do not require any maintenance when working properly. They can fail, however. That failure can occur for a variety of reasons, including incorrect installation of the valve, contaminants in the service line, installation of a valve that is not properly sized for the service, or installation of a defective valve. When EFVs fail, they (1) do not close when they should, (2) close when they are not supposed to, or (3) fail to reset after closing.

### 4.3.1 The Cost of Replacing EFVs

Some of the EFVs that would be installed if Safety Recommendation P-01-2 were to be implemented would probably fail. When they did, they would need to be replaced, and gas utilities would incur costs in replacing those failed valves.

**False Closure** - If an EFV fails by closing when it was not supposed to, a crew will need make a special service call to go out and dig up the EFV and replace it. Table 4-2 presents a sampling of the costs of replacing EFVs in this situation.

In Table 4-2, the cost of replacing EFVs ranges from $100 to $1500. The average value of the entries in the table is $682.[80] With the exception of the estimate from the Illinois gas utility, the Internet postings presented in Table 4-2 all represent the costs of removing or replacing EFVs from existing services (the Illinois gas utility estimate is for installing EFVs in existing services that are not being renewed, which should be identical to the cost of removing or replacing EFVs).

### TABLE 4-2. REPORTED COST OF REPLACING EFVS

| Utility | Cost |
|---|---|
| East Coast Gas Utility † | Cost of work crew ($51/hr.) for three hours<br>+Cost of pavement restoration ($300), if needed<br>+Cost of EFV ($5.40)<br>=$158.40 ($458.40 with pavement restoration)* |
| INTERNET POSTINGS | |
| South Carolina Gas Utility †† | $300-$1500 |
| Arizona Gas Utility †† | $100-$1000** |
| Indiana Gas Utility ††† | $100-$1500*** |
| Illinois Gas Utility †††† | $500-$700 |

*The cost will be higher if the service line is over four feet deep, since the work will require shoring of the excavation and will take at least two days.
**The cost of replacing or removing an EFV, including (1) excavation costs, (2) pavement and landscaping replacement costs, (3) permitting costs, and (4) all labor and materials.
***The cost of replacing or removing an EFV, including (1) excavation costs, (2) pavement and landscaping costs, and (3) all material and labor costs.

Service area:
†Major city
††Small town
†††Small towns
††††Small to medium towns and cities

Sources of information: Communications with an East Coast gas utility, April 2002, and various Internet postings. It should be noted that some of the Internet postings may have been superceded since they were posted.

For the purposes of this analysis, it is assumed that the cost of rectifying a false closure will be $682. This figure is assumed to be in 2001 dollars.

In addition to replacing an EFV that has experienced a false closure, the gas utility will also need to relight any gas appliance pilot lights that may have gone out. Many modern gas appliances do not have pilot lights. Furthermore, in the case of bleed-by EFVs, the gas that is allowed to bypass the valve when it is closed is believed to be sufficient to keep pilot lights lit. For the purposes of this analysis, however, it is assumed that pilot lights will need to be relit by gas

[80] In calculating the average, the mid-points of cost ranges were used.

utility personnel. This is assumed to require an additional service call. That service call is expected to cost somewhere between $35 and $90 per hour, depending on the time of day and the day of the week.[81] For the purposes of this analysis, the cost of the service call is assumed to be the mid-point of this range: $63 per hour. It is assumed that the service call will take no more than one hour. Thus, service calls to relight pilots are assumed to cost $63. This figure is assumed to be in 2001 dollars.

EFVs are expected to experience 0.000016 false closures per installed EFV. This is the false closure rate identified for EFVs by EFV manufacturers in 2003.[82]

The expected cost of false closures per installed EFV is equal to the cost of digging up and replacing an EFV plus the cost of relighting the pilots, all multiplied by the false closure rate, or

- ($682 + $63) x 0.000016 = $0.01 per installed EFV (in 2001 dollars).

**Failure to Close** - The failure of an EFV to close when it should have is generally noted when a service line incident occurs. That is, it is noted when the service line is damaged in some fashion. The cost of replacing the EFV can be minimal, since a gas utility crew is already on site working on the service line if an incident has taken place. On the other hand, if the damage to the service line is not near the location on the service where the EFV has been installed, additional excavation may be needed.

For the purposes of this analysis, it is arbitrarily assumed that 50% of the time when a failure to close occurs no additional excavation is required and 50% of the time an excavation is required. That excavation is presumed to cost $682, the same as the cost of rectifying a false closure. Thus, the additional excavation cost required for a failure to close is

- (50% x $0) + (50% x $682) = $341.

In addition, for the purposes of this analysis, it is assumed that the EFV will need to be replaced at a cost of

- (50% x $22) + (50% x $13) = $18,

rounded to the nearest whole dollar, where $22 is the average cost of an EFV/tee combination and $13 is the average cost of an EFV/stick combination. This figure is assumed to be in 2001 dollars. The total cost of a failure to close will be

- $341 + $18 = $359.

This figure is assumed to be in 2001 dollars.[83]

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[81] According to its Internet posting, a South Carolina gas utility charges residential customers between $35 and $90 per hour for service calls, depending on the time of day and day of the week.

[82] Submissions by Excess Flow Valve Manufacturers of the Natural Gas Industry and UMAC to Docket No. RSPA-03-14455, Notice 1, 2003.

The rate at which EFVs fail to close is expected to be 0.00001 per installed EFV. This is the failure to close rate identified for EFVs by EFV manufacturers in 2003. [84]

The expected cost of failure to close per installed EFV is equal to the cost of replacing an EFV multiplied by the rate of failure to close, or

- 0.00001 x $359 = $0.00 per installed EFV (in 2001 dollars).

**Failure to Reset** - The failure of an EFV to reset once it has closed is generally noted in the aftermath of an incident that has impacted a service line. The cost associated with a failure to reset will be similar to the cost of a failure to close. For the purposes of this analysis, it is assumed that the total cost of replacing an EFV that has failed to reset is $359 (in 2001 dollars), the same as the total cost of replacing an EFV that has failed to close.

The rate at which EFVs fail to reset after closing is expected to be 0.0000042 failures per installed EFV per year.[85] This is based on information about EFVs that were being installed prior to 1991.

The expected cost of failure to reset per installed EFV per year is equal to the cost of replacing an EFV multiplied by the rate of failure to reset, or

- 0.0000042 x $359 = $0.00 per installed EFV per year (in 2001 dollars).

### 4.3.2 The Total Cost of Maintaining EFVs

The total cost of maintaining the EFVs that would be installed if Safety Recommendation S-01-2 were to be implemented is the sum of the cost of false closure plus the cost of the failure to close plus the cost of the failure to reset, or

- $0.01 per installed EFV + $0.00 per installed EFV + $0.00 per installed EFV per year = $0.01 per installed EFV (in 2001 dollars).

## 4.4 TOTAL COST OF EFVS

The total cost of the EFVs that would be installed if Safety Recommendation S-01-2 were to be implemented is the sum of the cost of installing the EFVs that is attributable to Safety Recommendation S-01-2 plus the total cost of maintaining the EFVs, or

- $10 per installed EFV + $0.01 per installed EFV = $10.01 per installed EFV

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[83] This may actually overstate the cost, since the $682 estimate is for replacing EFVs, and therefore already includes the cost of an EFV.

[84] Submissions by Excess Flow Valve Manufacturers of the Natural Gas Industry and UMAC to Docket No. RSPA-03-14455, Notice 1, 2003.

[85] Risk and Industrial Safety Consultants, Inc. (RISC), "Cost Benefit Analysis of Excess Flow Valves: An Update," Prepared for the Gas Research Institute, August 26, 1991, p. 5.

This figure is in 2001 dollars.

### 4.5 PRESENT VALUE OF COSTS

The present value of the total cost of the EFVs that would be installed if Safety Recommendation S-01-2 were to be implemented is calculated assuming an operational life for an EFV of 50 years,[86] a discount rate of 7.0 percent, and the annual installation of 750,000 added EFVs. The discount rate is the current value recommended for use in Federal benefit-cost analyses.[87] The present value of the total cost is

- 750,000 x (present value of $10.01 per installed EFV) = $110,857,500 (in 2001 dollars).

The cost of installing an EFV (= $10 per installed EFV) is assumed to be incurred at the start of a year. All other costs (= $0.01 per installed EFV) are assumed to be incurred at the end of the year.

### 4.6 COST UNCERTAINTIES

The key assumptions made in the calculation of the cost estimates developed in this chapter are summarized in Table 4-3.

**TABLE 4-3. SUMMARY OF KEY ASSUMPTIONS IN THE COST CALCULATIONS**

| Assumption | Value |
|---|---|
| Number of added EFVs installed per year | 750,000 |
| Percent of EFVs on branching services | 50% |
| Cost of an EFV/tee combination | $22 |
| Cost of an EFV/stick combination | $13 |
| Cost of installing an EFV on new or renewed service | nominal |
| Cost of a tee | $15 |
| Cost of relighting pilots | $63 |
| Cost of digging up an EFV | $682 |
| EFV failure to close rate | 0.00001 |
| EFV failure to reset rate | 0.0000042 |
| EFV false closure rate | 0.000016 |
| EFV operational life | 50 years |

There are a several obvious uncertainties related to these assumptions:

[86] See U.S. DOT, "A Report of Reasons for DOT's Decision Not to Issue a Federal Rule Requiring Universal Installation of EFVs in Natural Gas Service Lines."
[87] The current OMB Circular No. A-94, Revised (see http://www.whitehouse.gov/omb/circulars/a094/a094.html).

- The number of added EFVs installed per year is unknown. Because the number appears in both the numerator and denominator of the benefit-to-cost ratio, however, the number used will have no impact on whether Safety Recommendation P-01-2 is cost beneficial.

- The percent of EFVs installed by gas utilities on branching services is uncertain.

- The rate for failure to reset in Table 4-3 is based on information about EFV failures that is over a decade old. The EFVs that are currently being installed may be experiencing a different failure to reset rate. If so, it is likely that that rate is lower than the rate used in this analysis. Because the failure to reset rate, as well as the failure to close rate and the false closure rate, are so small, however, changing them would be expected to have a minimal effect on the total cost attributable to Safety Recommendation P-01-2.

- The cost figures in Table 4-3 are estimates, and those estimates may overstate or understate actual costs.

- EFVs are assumed to last 50 years. The first EFVs for use in gas services were introduced in 1964. As yet, no EFV has been in place in a gas service for 50 years. It may be that EFVs will not generally last that long. Of course, it is also possible that EFVs will generally last longer than 50 years. It might be noted that a design life of 50 years is reported to be a requirement in some contracts for the purchase of EFVs. [88]

Table 4-4 shows how changing the values used for costs and the operational life of an EFV would change the present value of the cost attributable to Safety Recommendation P-01-2. As mentioned above, changing the rates in Table 4-3 would not be expected to have much of an impact because they are so small, so sensitivity analysis was not performed for those rates. With the exceptions of the alternatives for (1) the percentage of EFVs on branching services, (2) the added cost attributable to installing an EFV, and (3) the operational life of an EFV, the values for the alternatives presented in Table 4-4 are the low and high values presented in Tables 4-1 and 4-2. The remaining alternatives were arbitrarily chosen, with only one alternative being selected for the operational life of EFVs. To maintain comparability, all present values in Table 4-4 were calculated for a period of 50 years.

As can be seen by comparing the values in Table 4-4 with the base case estimate for the present value of the cost of Safety Recommendation P-01-2, $110,857,500, the following have relatively little or no impact on the present value of costs:

- Reducing the percentage of new or renewed services that are branching
- Changing the cost of digging up EFVs
- Changing the cost of relighting pilots

The other alternatives result in significant impacts on the present value of costs. By far the most significant impact, which in fact dwarfs all others, results from reducing the assumed operational life of an EFV.

[88] Submission by UMAC to Docket No. RSPA-03-14455, Notice 1, 2003.

## TABLE 4-4. COST SENSITIVITIES

| Alternative Assumption | Present Value of Costs (2001 Dollars) | Percent of Base Case Present Value |
|---|---|---|
| 25% of new or renewed services are branching services | $99,780,000 | 90% |
| 75% of new or renewed services are branching services | $133,005,000 | 120% |
| Added cost attributable to installing an EFV is $5 | $55,477,500 | 50% |
| Added cost attributable to installing an EFV is $15 | $166,230,000 | 150% |
| Cost of digging up an EFV is $100 | $110,752,500 | 100% |
| Cost of digging up an EFV is $1500 | $111,060,000 | 100% |
| Cost of relighting pilots is $35 | $110,857,500 | 100% |
| Cost of relighting pilots is $90 | $110,857,500 | 100% |
| EFVs will last 25 years on average* | $3,394,447,500 | 3062% |

*Assumes EFVs must be dug up and replaced after 25 years at a cost of $682 per replacement. This is in addition to the EFVs that will be installed on new and renewed services.

# 5. COMPARISON OF BENEFITS AND COSTS

## 5.1 THE PRESENT VALUE OF BENEFITS

Using a 50-year time horizon and a discount rate of 7.0 percent, the present value of the benefits that can be expected to result if Safety Recommendation P-01-2 were to be implemented for new and renewed services attached to single-family residences has been estimated in this report to be

- $31,770,000 (2001 dollars).

This estimate assumes that 750,000 additional EFVs will be annually installed on new or renewed single-family residential services as a result of the safety recommendation.

## 5.2 THE PRESENT VALUE OF COSTS

Assuming a 50-year life for EFVs, a 50-year time horizon, and a discount rate of 7.0 percent, the present value of the costs that can be expected to result if Safety Recommendation P-01-2 were to be implemented has been estimated in this report to be

- $110,857,500 (2001 dollars).

As with the benefits estimate, this cost estimate assumes that 750,000 additional EFVs will be annually installed on new or renewed single-family residential services as a result of the safety recommendation.

## 5.3 THE BENEFIT-TO-COST RATIO

The benefit-to-cost ratio for Safety Recommendation P-01-2 is

- $31,770,000 / $110,857,500 = 0.29.

Because this ratio is less than 1.00, the implementation of the safety recommendation is not expected to be cost beneficial.

## 5.4 UNCERTAINTIES

A number of assumptions were made in the calculation of both the present value of benefits and the present value of costs. Those assumptions could potentially impact whether the benefit-to-cost ratio is greater or less than 1.00. Present value estimates have been calculated for various benefit and cost assumption alternatives (see Tables 3-5 and 4-4). Table 5-1 (see next page) presents the benefit-to-cost ratios for those alternatives. Table 5-1 also includes the benefit and cost base cases, so that they can be compared with the alternatives, as well.

There are a total of 190 benefit/cost combinations in Table 5-1. In all cases, the present value of costs exceeds the present value of benefits. That is, the benefit-to-cost ratios for the proposal are all less than 1.00, indicating that under no alternative presented in this report would the implementation of the safety recommendation proposed by NTSB be cost beneficial.

## 5.5 CONCLUSION

On June 22, 2001, the National Transportation Safety Board (NTSB) issued Safety Recommendation P-01-2, which recommended that the U.S. Department of Transportation's (U.S. DOT's) Research and Special Programs Administration (RSPA) require that excess flow valves (EFVs) be installed in all new or renewed natural gas services that are compatible with readily available EFVs. The benefit-to-cost ratio calculated for Safety Recommendation P-01-2 is expected to be less than 1.00. Based on this, the safety recommendation is not expected to be cost beneficial.

Because of potentially significant uncertainties in the benefit and cost estimates upon which the benefit-to-cost ratio is based, alternative benefit and cost estimates were developed and alternative benefit-to-cost ratios were calculated using those estimates. All of the alternative benefit-to-cost ratios were less than 1.00. This would appear to support the conclusion that the safety recommendation would not be cost beneficial.

# TABLE 5-1. BENEFIT-TO-COST RATIOS FOR BASE CASE AND BENEFIT AND COST ALTERNATIVES

| COST ALTERNATIVES<br>BENEFIT ALTERNATIVES | Base case (costs) | 25% of new and renewed service lines are branching | 75% of new and renewed service lines are branching | Added Cost Attributable to installing an EFV= $5 | Added Cost Attributable to installing an EFV= $15 | Cost of digging up an EFV=$100 | Cost of digging up an EFV=$1500 | Cost of relighting pilots=$35 | Cost of relighting pilots=$90 | Life of an EFV=25 Years |
|---|---|---|---|---|---|---|---|---|---|---|
| Base case (benefits) | 0.29 | 0.32 | 0.24 | 0.57 | 0.19 | 0.29 | 0.29 | 0.29 | 0.29 | 0.01 |
| 50 percent of consequences mitigated | 0.19 | 0.21 | 0.15 | 0.37 | 0.12 | 0.19 | 0.19 | 0.19 | 0.19 | 0.01 |
| Cost of emergency response = $6540 | 0.29 | 0.32 | 0.24 | 0.57 | 0.19 | 0.29 | 0.29 | 0.29 | 0.29 | 0.01 |
| Cost of emergency response = $2180 | 0.27 | 0.30 | 0.23 | 0.55 | 0.18 | 0.27 | 0.27 | 0.27 | 0.27 | 0.01 |
| Number of significant non-reportable incidents per reportable incident = 17.3 | 0.29 | 0.32 | 0.24 | 0.57 | 0.19 | 0.29 | 0.29 | 0.29 | 0.29 | 0.01 |
| Number of significant non-reportable incidents per reportable incident = 5.8 | 0.29 | 0.32 | 0.24 | 0.57 | 0.19 | 0.29 | 0.29 | 0.29 | 0.29 | 0.01 |
| Deaths per service per year = 0.0000000463 | 0.35 | 0.39 | 0.29 | 0.70 | 0.23 | 0.35 | 0.35 | 0.35 | 0.35 | 0.01 |
| Deaths per service per year = 0.0000000155 | 0.24 | 0.26 | 0.20 | 0.47 | 0.16 | 0.24 | 0.24 | 0.24 | 0.24 | 0.01 |
| Injuries requiring hospitalization per service per year = 0.000000108 | 0.31 | 0.35 | 0.26 | 0.62 | 0.21 | 0.31 | 0.31 | 0.31 | 0.31 | 0.01 |
| Injuries requiring hospitalization per service per year = 0.000000361 | 0.26 | 0.29 | 0.22 | 0.52 | 0.17 | 0.26 | 0.26 | 0.26 | 0.26 | 0.01 |
| Property damage from reportable incidents per service per year = $0.06 | 0.31 | 0.35 | 0.26 | 0.62 | 0.21 | 0.31 | 0.31 | 0.31 | 0.31 | 0.01 |
| Property damage from reportable incidents per service per year = $0.02 | 0.26 | 0.29 | 0.22 | 0.52 | 0.17 | 0.26 | 0.26 | 0.26 | 0.26 | 0.01 |
| Property damage from non-reportable incidents per service per year = $0.00225 | 0.29 | 0.32 | 0.24 | 0.57 | 0.19 | 0.29 | 0.29 | 0.29 | 0.29 | 0.01 |
| Property damage from non-reportable incidents per service per year = $0.00075 | 0.29 | 0.32 | 0.24 | 0.57 | 0.19 | 0.29 | 0.29 | 0.29 | 0.29 | 0.01 |
| Amount of Gas Lost=7500 cubic feet per incident | 0.32 | 0.35 | 0.26 | 0.63 | 0.21 | 0.32 | 0.32 | 0.32 | 0.32 | 0.01 |
| Amount of Gas Lost=2500 cubic feet per incident | 0.26 | 0.29 | 0.21 | 0.51 | 0.17 | 0.26 | 0.26 | 0.26 | 0.26 | 0.01 |
| Statistical value of life=$6,000,000 | 0.41 | 0.46 | 0.34 | 0.83 | 0.28 | 0.41 | 0.41 | 0.41 | 0.41 | 0.01 |
| Value of reportable injury=$2,287,500 | 0.44 | 0.49 | 0.37 | 0.88 | 0.29 | 0.44 | 0.44 | 0.44 | 0.44 | 0.01 |
| Value of reportable injury=$172,500 | 0.25 | 0.28 | 0.21 | 0.50 | 0.17 | 0.25 | 0.25 | 0.25 | 0.25 | 0.01 |

## SELECTED REFERENCES

McGowan, J., "Putting the Gas Company on the Offensive Through the Use of Excess Flow Valves," UMAC, Inc., Exton, PA, March 1991.

Meade, W.P., "A First Pass at Computing the Cost of Fire Safety in a Modern Society," *Fire Technology*, November 1991, pp. 341-345.

National Transportation Safety Board, "Natural Gas Explosion and Fire in South Riding, Virginia, July 7, 1998," Pipeline Accident Report NTSB/PAR-01/01, Washington, D.C., 2001.

U.S. Department of Transportation, "A Report of Reasons for DOT's Decision Not to Issue a Federal Rule Requiring Universal Installation of EFVs in Natural Gas Service Lines."

U.S. Department of Transportation Dockets:

- U.S. DOT/RSPA/OPS Docket No. PS-118
- U.S. DOT Docket No. RSPA-03-14455, Notice 1, 2003.

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## INTERNET POSTINGS BY UTILITIES USED IN THIS STUDY

Citizens Arizona Gas:
www.citizensaz.com/campverde/docs/EFVsheet.pdf

Community Natural Gas Co.:
www.communitynaturalgas.com/ExcessFlowValves.htm

Greer Commission of Public Works, Greer, SC:
www.greercpw.com/gas.htm.

Illinois Power:
www.illinoispower.com/ip%5Cip.nsf/WebNoFrame/D6238BA23CDF82A8625697D0053B592.