BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

Docket Nos. UG-110723
Puget Sound Energy, Inc.'s
Tariff Filing for Pipeline Integrity Program

WUTC STAFF DATA REQUEST NO. 22

WUTC STAFF DATA REQUEST NO. 22:

(a) The reply to Staff Informal Data Request No. 05 is not responsive. Please provide complete copies of any documents that detail any improvement to pipeline safety and/or reliability.

(b) Please provide all supporting documents such as memos, meeting minutes, and internal reports that lead to the conclusion that absent the requested accounting treatment the reliability and safety of PSE's natural gas system is compromised.

(c) In the Response to UTC Staff Informal Data Request No. 5, PSE states, "Absent this tariff, PSE will continue to manage pipeline safety programs as it has done in the past." Does this imply that PSE's current management of pipeline safety programs results in an unsafe or unreliable pipeline system?

(d) Please provide direct evidence that the replacement of bare steel pipes from 2003 through 2010 has reduced leaks and/or disastrous events.

(e) Please address the specific ways the requested accounting treatment will enhance the safety and reliability of PSE's pipeline system.

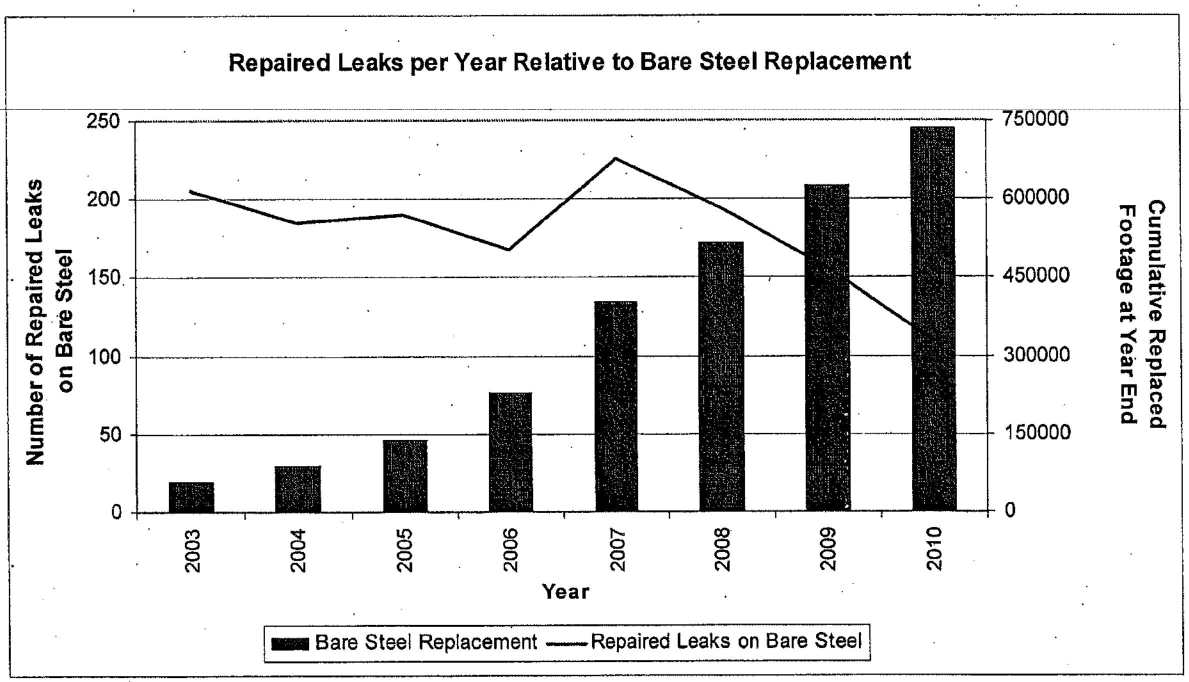
Response:

(a) Attached is a copy of PSE's 2010 Continuing Surveillance Report. This report documents PSE's review of system performance and operational measures related to the safety and reliability of the gas distribution system. This report also analyzes data to identify any emerging trends, describes the plan to initiate any new proactive measures in response to these trends, and tracks subsequent progress related to addressing these issues. The System Performance Measures and Trends section in the Executive Summary of the report starting on page 7 provides a high level overview of safety and reliability trends and improvements. In addition, figure 6 on page 22 of the report illustrates the improvement in the number of active leaks in the system over time. Of particular note is the continued reduction in grade "B" leaks.

(b) PSE does not believe that absent the requested accounting treatment that the reliability and safety of our natural gas distribution system will be compromised. Per the information provided in the response to (a) above, PSE's system performance has been improving due to existing integrity programs. PSE will continue these programs and continue to improve the safety and reliability of our distribution system even without the approval of the PIP tariff. PSE is requesting the PIP tariff to enhance improvements in system reliability and safety.

(c) This statement is not intended to imply any concern with the current management of PSE's pipeline safety programs. This statement is intended to communicate that PSE believes the current program will continue to improve pipeline reliability and safety, albeit at a potentially slower pace than would be allowed if the PIP tariff is approved.

(d) This request asks for evidence that the replacement of bare steel pipes from 2003 through 2010 has reduced leaks and/or disastrous events. The leakage reduction is illustrated by reviewing both the new leaks found as well as leak repair trends. Since 2003, we have had a 20% decrease in the number of new leaks found per mile of bare steel leak surveyed. The following graph illustrates the number of leak repairs per year relative to the cumulative footage of bare steel main replaced. As shown in this graph, there has been almost a 50% reduction in the number of leak repairs since 2003.



(e) Approval of the PIP tariff will enhance the safety and reliability of PSE's pipeline system by providing the opportunity to replace additional aging infrastructure. For example, PSE now targets replacement of any steel wrapped main that has a risk score above 0.8 per foot. The risk score is based on repaired leaks, active leaks, indications of corrosion or coating degradation found during pipe inspections and is normalized by the number of feet of main in the candidate section. With the PIP tariff approved, PSE would work collaboratively with Staff to determine a lower threshold for pipe replacement such as a risk score of 0.6 per foot allowing additional segments of main to be replaced as well as larger segments.

ATTACHMENT A to PSE's Response to WUTC STAFF Data Request No. 22

PUGET SOUND ENERGY
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2010 Continuing Surveillance Annual Report

May 2011

Gas System Integrity Department

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Forward

The following report provides the results of PSE's review of system performance and operational measures of the gas distribution system in 2010. This is the second annual Continuing Surveillance Report on PSE's system. This report expands on the 2009 report incorporating additional analysis and detail to provide insights into PSE's system performance. The additional detail incorporates new and expanded ways of analyzing the data based on insight gained from PSE's development of its Distribution Integrity Management Program, PHMSA reporting and data quality initiatives and discussions with consultants involved with the third party audit of our gas safety activities.

The focus of this ongoing review is to identify any emerging trends, describe the plan to initiate any new proactive measures in response to these trends, and track subsequent progress. This report documents that the reviews required in Section 5 of Gas Operating Standard (GOS) 2575.2700, Continuing Surveillance, have been performed and additional measures have been implemented where appropriate.

This report also documents the following elements as required by GOS 2425.2600 Distribution Integrity Management Program (DIMP):

- Documents the present system knowledge specifically related to risks,
- Presents data on threats to the system and ranks these risks,
- Discusses what is being done to mitigate those risks and whether additional mitigative measures should be implemented,
- Presents historical system performance, and
- Documents the plans to continue to improve system performance if appropriate.

Timely identification and remediation of individual issues that require immediate action is accomplished through existing processes such as those established in GOS 2575.2700 Continuing Surveillance, GOS 2575.3100 Patrolling Program, GOS 2575.2800 Examining Buried Pipelines, and GOS 2625.1300 Leakage Action Program.

Additionally, identification of trends that may emerge during the year is important and is being addressed through monitoring gas system metrics. These metrics are monitored on an ongoing basis and action will be taken as a result of any emerging trends or concerns.

Included in this report is a broad review of system data and a detailed discussion of what this data indicates including: validation and confirmation of previously identified trends and the identification of emerging trends; a description of plans to initiate new proactive measures; any plans to continue or enhance existing proactive measures and provides a format for tracking and reporting on subsequent progress. If additional or enhanced measures are needed, these plans will be incorporated in the budget process for funding for the following calendar year.

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This report is divided into five main parts:

1. Executive Summary
2. System Summary
3. System Performance Measures and Trends
4. Gas Maintenance Programs
5. System Data

Part 1: Executive Summary
The Executive Summary provides a high level overview of the most significant trends identified and the measures that have been implemented or are proposed to address these trends and maintain system integrity.

Part 2: System Summary
The second part is a System Summary which provides background on PSE's distribution system. This includes a description of the various materials used in PSE's system as well as information on the relative amounts of pipe by material, vintage, and facility type.

Part 3: System Performance Measures and Trends
The third part details the key System Performance Measures and Trends. This section presents data that has been analyzed to determine if existing programs are adequately addressing system risks or whether there are any emerging trends that indicate additional or revised measures are appropriate to consider implementing to address the potential trend. This analysis includes a discussion of whether the performance metrics validate the current direction PSE has taken or identify areas that warrant increased activities.

Part 4: Gas Maintenance Programs
The fourth section reports on Gas Maintenance Programs. This includes providing information on programs that have previously been identified through similar system reviews and other system integrity drivers, as well as newly identified programs or enhancements to existing programs that were identified as part of this review. This section reports on the accomplishments of each program as well as the future program plans.

Part 5: System Data
The final section contains a summary of the system data that is presented in Appendix A. The system data presents information on vintages and classes of materials installed in the distribution system, leak repairs by cause (hazardous and total), leak repairs by material and cause (hazardous and total), and data on the frequency of each threat.

Part 1: Executive Summary

System Summary

PSE's gas distribution system consists of over 12,000 miles of main and provides gas service to more than 750,000 customers. As shown in the table below, more than 2/3 of the system is plastic, almost 1/3 of the system is wrapped steel pipe, and less than 1% of the system is bare steel.

Material Type	Mains	Services
Plastic	67%	78%
Wrapped Steel (Protected)	32%	19%
Bare Steel and Wrought Iron (Unprotected and Protected)	1%	2%

Materials and vintage are both important predictors of system performance. More than 3/4 of the system was installed after the initial federal pipeline safety regulations were adopted and more than 1/2 was installed after 1990 when plastic pipe materials and construction practices had significantly improved.

System Performance Measures and Trends

As required by the DIMP regulation, PSE has developed and will monitor its performance measures from an established baseline to evaluate the effectiveness of its integrity management program. While PSE established a moving 5-year average baseline, additional analysis may be required to accurately interpret whether performance is improving. The number of hazardous and total leaks repaired in 2010 due to corrosion and excavation damage has continued to decline. These decreases indicate that the overall system performance has improved as excavation damage and corrosion have been the largest threats to PSE's system. The number of hazardous leaks in each material type has also declined. Excavation damages and tickets also show a positive trend.

The active leak review indicates generally positive trends in system performance. As shown in the following graph, total active leaks have decreased by 50% since 1995 and active grade "B" leaks have decreased by 65% over the same timeframe. One of the primary reasons for this reduction in the total active leaks is attributed to cast iron main replacement which was completed in 2007. The reduction in grade "B" leaks has been accomplished primarily through replacing cast iron, bare steel, and older vintage PE pipe as well as a focus on more prompt repair of "B" leaks that were not associated with planned pipe replacement areas.

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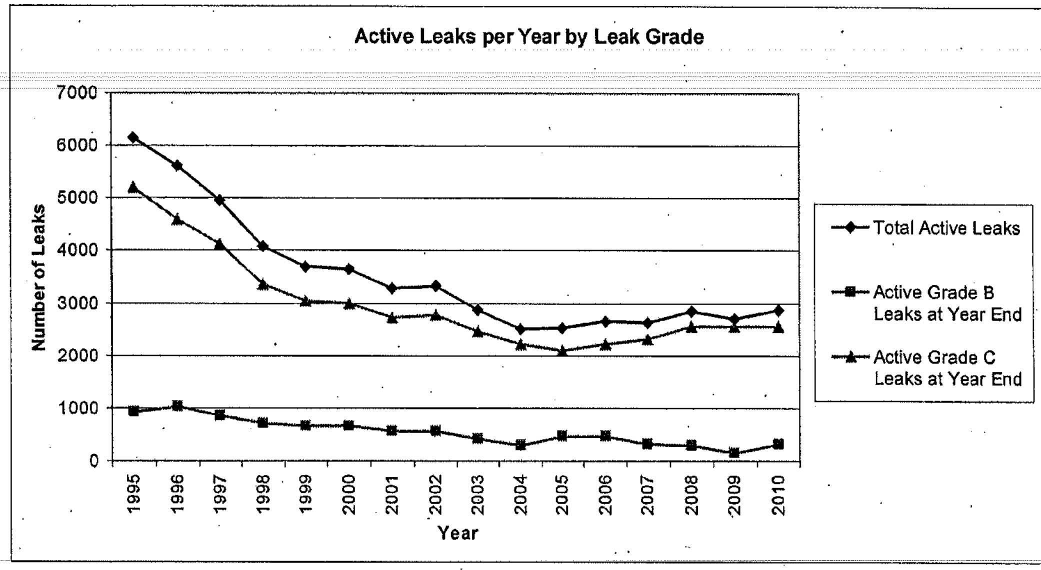
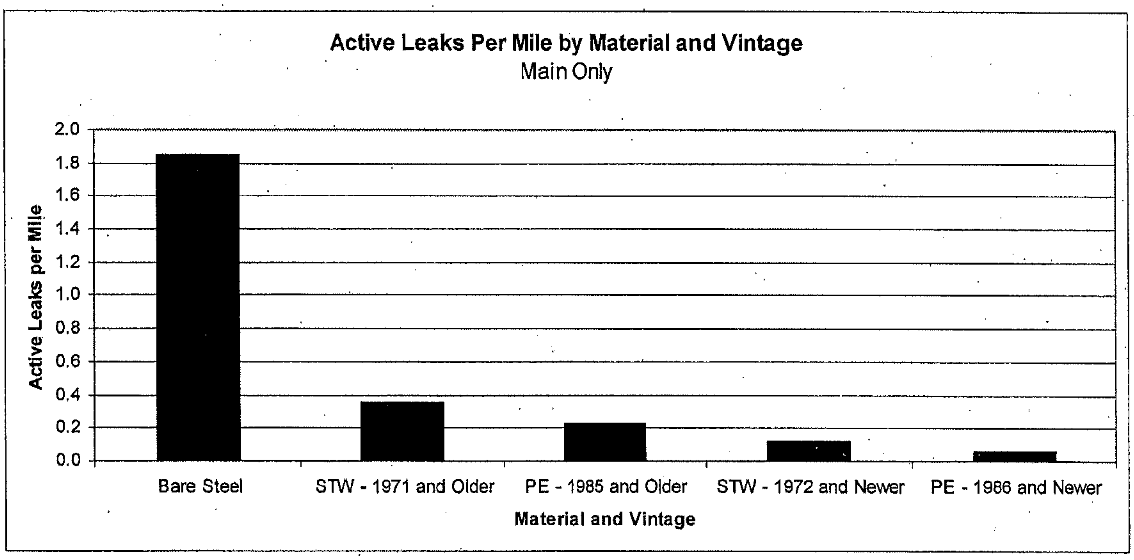


With the completion of cast iron replacement, bare steel pipe is PSE's next highest priority for system-wide replacement. This is highlighted by the fact that bare steel has the highest number of new leaks found per mile as shown in the following graph. In addition, bare steel has the highest number of active leaks per mile, the highest number of repaired leaks per mile, and the highest number of leaks scheduled for repair per mile. The Bare Steel Replacement Program is focused on replacing all bare steel and wrought iron main and services in PSE's system by the end of 2014.

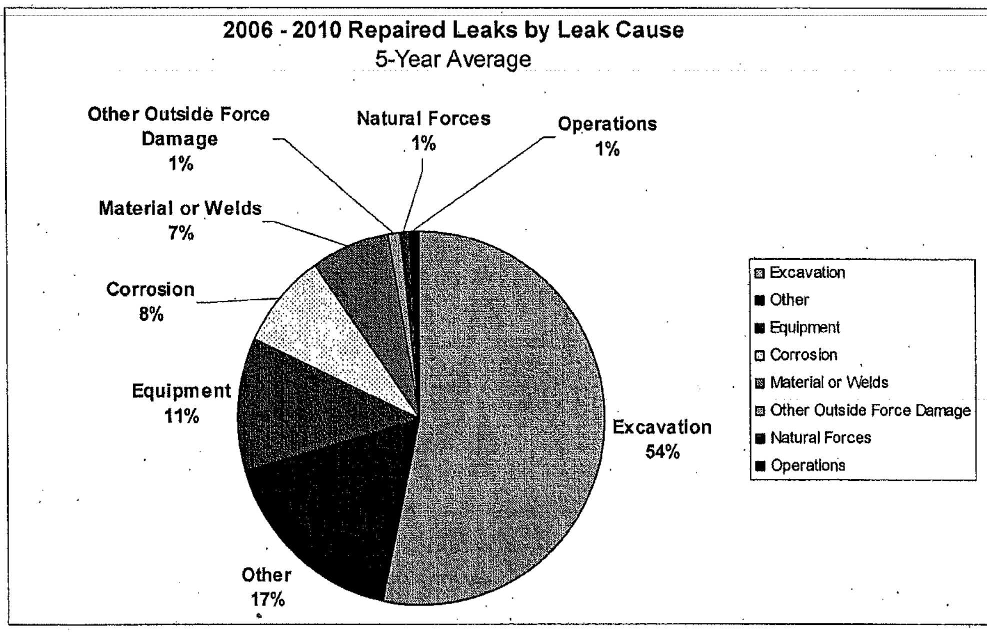


The graph also shows that after bare steel, wrapped steel pipe older than 1972 and plastic pipe older than 1986 have the next highest number of active leaks per mile. PSE has three programs; the Wrapped Steel Service Assessment Program (WSSAP), the Pre-1972 STW Main Replacement

Program, and the Older PE Pipe Replacement Program; that are focused on identifying facilities within these populations for replacement and/or increased leak survey.

While replacing facilities that have integrity issues is an important part of maintaining and improving system integrity, an effective leak management program is also an important part of system safety. PSE's review of leakage data indicates positive trends relative to leak management. Leak survey trends illustrate that PSE's leak survey frequencies are appropriately assigned for the different types of facilities. The highest concentration of new leaks has been found on the facilities that are leak surveyed the most frequently and the lowest concentration of new leaks has been found on those facilities that are surveyed the less frequently. The trends relative to leaks discovered by source and grade indicate PSE's leak survey program, odorization program, and public education program are effective in detecting and proactively mitigating leaks.

Leak repair data also indicates that excavation damage remains the leading threat to the system. As shown in the following graph, 3rd party damage was the cause of more than ½ of the leaks repaired during the last 5 years. In addition, 3rd party damage is the leading cause of federally reportable incidents. These trends are consistent throughout the industry.



Even though 3rd party damage remains the leading cause of leaks on our system, PSE has achieved a significant reduction in 3rd party damage since 2003. The Common Ground Alliance and industry in general has accepted representing the ratio of damages per 1,000 locates to better normalize the impact of increasing and decreasing excavation activity. As shown in the graph below, PSE has been very successful in reducing damages per 1,000 locate requests. This positive trend has been achieved through a combination of efforts. The most significant reductions have been achieved by excavators using more careful excavation practices and increased public awareness of and adherence to the regulations that require excavators to call for locates prior to excavating.

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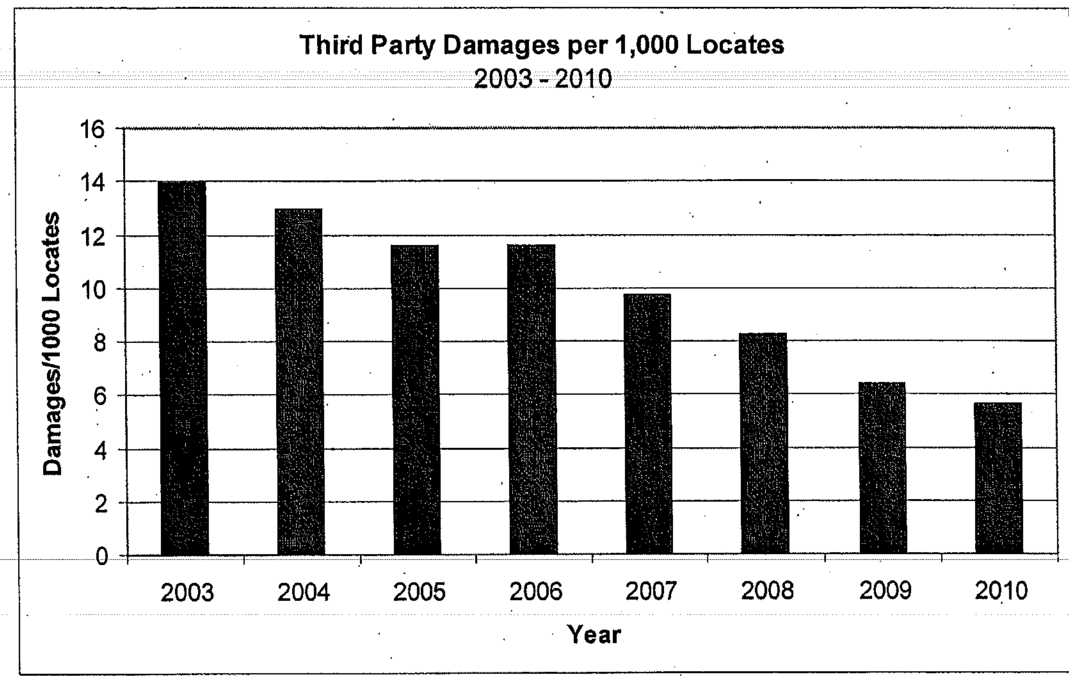

Gas Maintenance Programs
PSE has identified and established a number of gas maintenance programs through system reviews and by other system integrity drivers. New programs and enhancements to existing programs continue to be identified and made through these reviews. PSE continues to monitor system data to validate previously identified trends and to recognize changes or newly emerging trends. At this time, the data confirms PSE is focusing on the highest priority areas including reducing third party damage and replacing and leak surveying pipe where there are integrity concerns. The following lists these pipe integrity programs along with the additional maintenance programs designed to mitigate or prevent safety and compliance risks and those programs that have been completed.

The following are existing programs that address pipe integrity:

- Bare Steel Replacement Program
- Wrapped Steel Service Assessment Program (WSSAP)
- Pre-1972 STW Main Replacement
- Older PE Pipe Replacement

The following are existing maintenance programs developed to mitigate and prevent safety and compliance risks:

- Isolated Facilities Extension Programs
- Sidewalk Regulators
- Above Ground Regulators
- Steel Services in Casing
- Extended Service Lines in Mobile Home Communities
- Regulator Station Remediation

- Converted Single Service Farm Tap Program
- Regulator Station Pipe Support Mitigation
- Regulator Station Over Pressure Protection
- Industrial Meter Set Remediation
- Buried MSA Remediation
- Traffic Protection Enhancements
- Rocks and Debris on Buried Pipe
- Shallow Main and Service Remediation
- Mobile Home Community (MHC) Encroachment Surveys
- Docks and Wharves Assessment
- Bridge and Slide Remediation
- Atmospheric Corrosion at Hard-to-Reach Bridges
- Aging High Pressure Valve Mitigation
- Double Insulated Flange Valve Mitigation
- High Voltage Alternating Current (HVAC) Mitigation Program
- High Pressure Main Evaluation and Assessment
- Transmission Integrity Management Program

The following programs have been completed:

- Isolated Facilities Program
- Cast Iron Replacement Program
- Critical Bond Program

Overall, PSE's distribution system performance has improved over the years. PSE will monitor its system performance and continue analyzing its trends on leaks, failure analysis, system condition reports, federally reportable incident, and third party damage. As new emerging trends are identified, PSE will develop strategies and programs where appropriate to mitigate these risks to meet the requirements of DIMP.

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Part 2: System Summary

PSE's gas distribution system spans 6 counties in Washington State. The majority of the system is located in western Washington and a small portion is located in Kittitas County in eastern Washington. The system includes over 12,000 miles of main and more than 800,000 services. PSE serves residential, commercial and industrial customers throughout our service territory. PSE also has peak-shaving plants including a propane-air plant in Renton and a LNG plant in Gig Harbor.

PSE's distribution system includes mains and services of the following materials:

- bare steel
- wrought iron
- wrapped steel (STW)
- plastic or polyethylene (PE)
- copper (this includes a limited number of services only)

Additional information on PSE's Gas System Description can be found in the *System Data* section of this report as well as Gas Operating Standard (GOS) 2400.0500 Gas System Description. The following table and graph, Table 1 and Figure 1, summarizes the mains and services in PSE's system by material type as of the beginning of 2011.

Table 1. Percent of Mains and Services by Material Type

Material Type	Mains	Services
Plastic	67%	78%
Wrapped Steel (Protected)	32%	19%
Bare Steel and Wrought Iron (Unprotected and Protected)	1%	2%

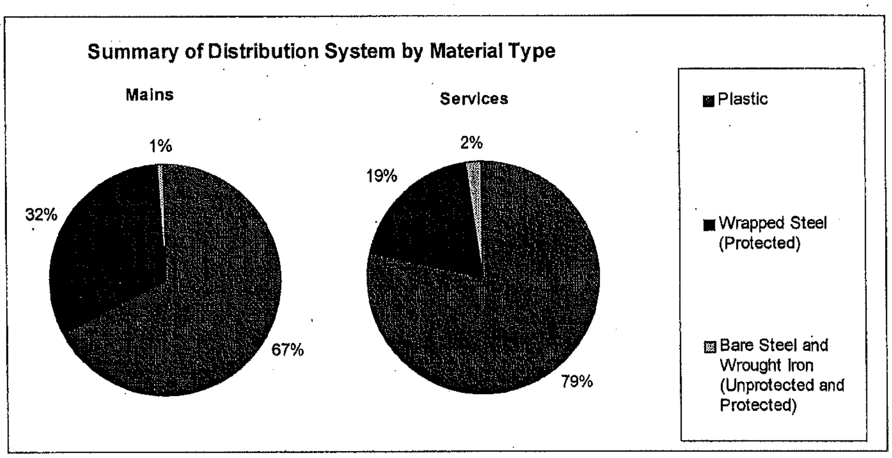

Figure 1. Summary of Distribution System by Material Type

Table 2 summarizes the miles of main categorized by maximum operating pressure of both the transmission and distribution systems as of the beginning of 2011.

Table 2. Maximum Operating Pressure of Mains[1]

Maximum Operating Pressure	Miles of Main	% of Miles of Main
Low Pressure (1 PSIG or Less)	9	0.1%
Intermediate Pressure (60 PSIG or Less)	11,095	94.9%
High Pressure (greater than 60 PSIG)	557	4.8%
Transmission	28	0.2%
Total	11,689	100.0%

[1] Total miles of main in the Low Pressure, Intermediate Pressure, and High Pressure categories are approximations and are based on system modeling data. The difference between the total miles reported on the annual DOT report in 2010 and as provided from the system model is less than 10%.

More than 99% of PSE's gas main is distribution piping with approximately 95% being operated at or below 60 psig (intermediate pressure). Less than 5% of the system operates at pressures above 60 psig (high pressure) and less than 1% of the system operates below 1 psig (low pressure).

The year the facilities were installed is also significant due to varying material types, construction practices, and operation and maintenance practices. The different material and vintages include bare steel pipe, wrapped steel pipe installed prior to 1972, wrapped steel pipe installed in 1972 and later, PE pipe installed prior to 1986, and PE installed since 1986. For steel pipe, 1972 is an important year as the federal regulations governing pipeline safety were adopted in 1971. Pipelines installed prior to the adoption of the federal regulations did not require cathodic protection and were not installed to the same stringent standards as subsequent installations. PE pipe installed prior to 1986 included early generations of plastic pipe resins that have demonstrated less resistance to installation techniques followed at the time, namely backfill and pipe joining. Material properties and construction practices have improved over time and by 1986, these materials and construction practices had matured and significantly improved.

Table 3 and Figure 2 summarize the distribution of mains and services by installation period in PSE's system as of the beginning of 2011.

Table 3. Percent of Mains and Services by Installation Period

Installation Period	% Mains	% Services
Pre-1970	17%	13%
1970-1989	28%	23%
Since 1990	55%	57%
Unknown	1%	7%

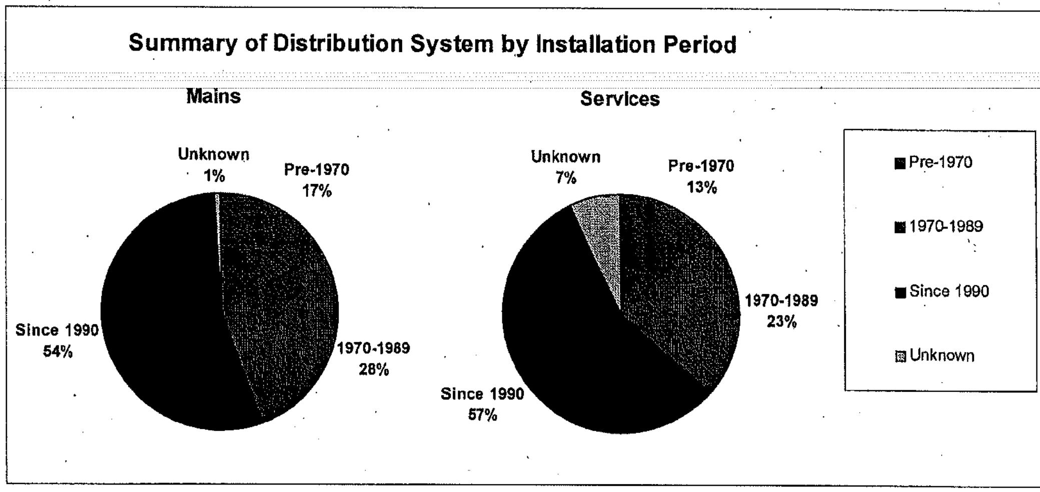

Figure 2. Summary of Distribution System by Installation Period

As this information indicates, over half of PSE's system has been installed since 1990 using newer high performance materials that are more resistant to slow crack growth and brittle-like cracking and modern construction practices including improved fusion and backfill procedures. Additionally, more than 70% of the system has been installed since 1972 when the Federal regulations that govern pipeline safety were adopted.

Many programs have already been implemented and some completed to address the risk associated with the older vintage materials and construction practices. These programs are described in the section titled *Gas Maintenance Programs*. Programs that have already been completed that address older vintage material and construction practices include the Cast Iron Replacement Program, Critical Bond Program and Isolated Facilities Program. Programs that are currently in progress include the Bare Steel Replacement Program, the Wrapped Steel Service Assessment Program (WSSAP), Pre-1972 STW Main Replacement, and Older PE Pipe Replacement.

Part 3: System Performance Measures and Trends

This section of the report presents data that has been analyzed to gain insight into system performance. This includes reporting on specific performance measures as specified in the DIMP rule as well as more detailed analysis of system performance indicators. PSE has evaluated a wide variety of data to determine if existing programs are adequately addressing system risks and if there are any emerging trends for which implementation of additional or revised preventive measures should be considered. The data presented in the following sections focuses on communicating where this review identified a meaningful trend or where the information was so significant in understanding system performance that it merited discussion even if no trend is evident.

In some instances, changes to how the data is categorized have been implemented to enhance the usefulness of the data. In other instances, additional training has been conducted to improve data accuracy. For example, a reference sheet of leak cause code definitions and examples was created and distributed to field personnel to help clarify the different leak cause codes and promote more consistent and accurate reporting. These changes are at times so substantial that they impact the ability to perform meaningful trend analysis but provide extremely valuable insight into our system knowledge and system risks. With additional years of data, the trending of this data will be more valuable.

System Performance Measures and Trends section includes information on the following:

- System Performance Measures
- Leak Trends
- Failure Analysis Trends
- System Condition Report Trends
- Federally Reportable Incident Trends
- Third Party Damage Prevention Program Trends

System Performance Measures

The following tables present the performance measures specifically required in the DIMP regulation. This data shows that the overall distribution system performance is improving significantly. This is due to continued work on damage prevention as well as gas maintenance programs that are designed to improve the integrity of the distribution system.

The data in Table 4 illustrates that there continues to be a decline in the number of hazardous leaks and the total number of leaks repaired that are attributable to corrosion and excavation damage. These decreases are important in realizing the improvement on the overall system performance as excavation damage and corrosion have been the largest threats to PSE's system. These positive trends are the result of pipe replacement programs and damage prevention activities. Efforts to improve leak cause classification has reduced the number of leaks reported as "Other". In addition, there is a decrease in the number of hazardous leaks repaired due to natural forces and the total number of leaks due to natural forces has remained relatively constant.

For all other categories of leak causes, there is an increase in both the hazardous and total leaks repaired. PSE believes these increases are due to improvements in leak cause reporting and not an

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increase in failures. This is supported by the decrease in leaks classified as "Other" as well as the decrease in the total number of both hazardous and total leaks repaired.

Table 4. Performance Measure – Leaks Repaired, Categorized by Leak Cause

Leak Cause	[illegible]			[illegible]		
	5-Year Average	2010	5 Year Average / Facility Mile	5-Year Average	2010	5 Year Average / Facility Mile
Corrosion	69	62	0.010	203	114	0.029
Natural Forces	29	19	0.001	22	23	0.001
Excavation Damage	1,213	707	0.049	1,294	716	0.053
Other Outside Force Damage	50	63	0.002	24	64	0.001
Material, Weld or Joint Failure	58	116	0.002	174	212	0.007
Equipment Failure	47	56	0.002	275	230	0.011
Incorrect Operation	17	31	0.001	19	55	0.001
Other	187	112	0.008	422	312	0.017
Total	1,671	1,166	0.009	2,433	1,726	0.015

The DIMP regulation requires operators to develop and monitor performance measures from an established baseline to evaluate the effectiveness of its integrity management program. The 5-year average leaks repaired per mile of pipe by leak cause in Table 4 and by material type in Table 5 are PSE's baseline for these performance measures. While this is the baseline from which future performance will be measured, additional analysis may be required to accurately interpret whether performance is improving. This is due primarily to improvements in data accuracy especially as it relates to classifying leak causes.

Table 5 shows there has been a decrease in the number of hazardous leaks repaired on each type of material. While bare steel has the fewest number of leaks repaired, it makes up less than 1% of the pipe in the distribution system. As a result, the 5 year average leaks repaired per mile of main for bare steel and wrought iron is higher than wrapped steel or plastic.

Table 5. Performance Measure – Hazardous Leaks Repaired, Categorized by Material

Material	[illegible]		
	5 Year Average	2010	5 Year Average/ Mile
Bare Steel and Wrought Iron	45	34	0.091
Wrapped Steel	257	220	0.040
Plastic	1,357	865	0.077

As shown in Table 6, there has been a decrease in both the number of damages due to excavation as well as the number of locate requests. The decrease in locate requests is most likely due to the significant reduction in construction activity attributed to the economic slowdown. Even with the decrease in the number of locate requests, the number of damages per 1,000 locate requests has decreased significantly.

The baseline performance measure for the excavation damage prevention program is the 5-year average number of damages per 1,000 locate requests.

Table 6. Performance Measure – Excavation Damage

Performance Measure	[illegible]	
	5 Year Average 2006-2010	2010
Number of Excavation Damages	1,410	824
Number of Excavation Tickets received from the notification center	167,544	146,549
Number of Excavation Damages per 1,000 Excavation Tickets	8.42	5.62

System Performance Measures Conclusion

The current system performance measures compared to the average of previous years shows significant improvement. The number of hazardous and total leaks repaired due to corrosion and excavation damage has continued to decline. The number of hazardous leaks in each material type has also declined. Excavation damages and tickets also show a positive trend. In addition to the system performance measures showing the general trends of the overall system, the following sections on leaks, failure analysis, system condition report, federally reportable incident, and third party damage prevention program trends provide additional detail on a variety of system performance indicators that further validate the policies and mitigation activities that are in place.

Leak Trends

Several leak trends are reviewed in the following graphs. These include trends relative to:

New and Active Leak Trends

- New Leaks Found per Mile Surveyed by Leak Survey Type
- New Leaks by Leak Grade
- Percent of Leaks Discovered by Source and Grade
- Active Leaks by Leak Grade
- Active Leaks Relative to Program Work
- Active Leaks per Mile by Material and Vintage

Leak Repair Trends

- Repaired and Active Leak Trends
- Repaired Leak by Leak Cause
- Corrosion Leak Trends
- Material, Weld or Joint Failure Leak Trends
- Leak Repairs by Material, Vintage, and Grade
- Leak Repair Methods

New and Active Leak Trends

New and active leaks can be impacted by many factors, but are generally an indicator of how a system is performing as it ages, i.e. whether more new leaks are being discovered on a particular facility type or whether the severity (leak grade) is increasing over time, in combination with reflecting the effect of maintenance versus replacement strategies. PSE has evaluated new leak trends from a variety of perspectives. The following sections discuss why these data analyses are important, what the trends are, and what PSE is doing as a result of these trends.

New Leaks Found per Mile Surveyed by Leak Survey Type

PSE has an extensive Leakage Survey Program which is documented in GOS 2625.1100. This standard specifies the frequency of leak survey for each type of facility. Unprotected steel pipe and copper pipe is leak surveyed twice annually and the results of these surveys are depicted in Figure 3 as "Unprotected Survey 1" and "Unprotected Survey 2", representing the first and second survey each year, respectively. Pipe within areas that are designated as business districts, high occupancy structure or area, and supply mains operating above 250 psig are leak surveyed annually. The results of these surveys are depicted in the same graph as "Annual (Business District)". With the exception of a few specialized leak surveys, all other surveys are required by pipeline safety regulations to be performed at least once every 5 years. In 2006, PSE began performing these surveys every 3 years and has continued to maintain this schedule due to efficiencies of combining leak survey activities with atmospheric corrosion monitoring. These surveys are depicted as "5-year (3-year)" on the graph.

As shown in this graph, the highest concentration of new leaks is found on the facilities that are leak surveyed the most frequently and the lowest concentration of new leaks is found on those facilities that are surveyed the least frequently. This chart demonstrates that the different survey frequencies are appropriately distributed for the different types of facilities.

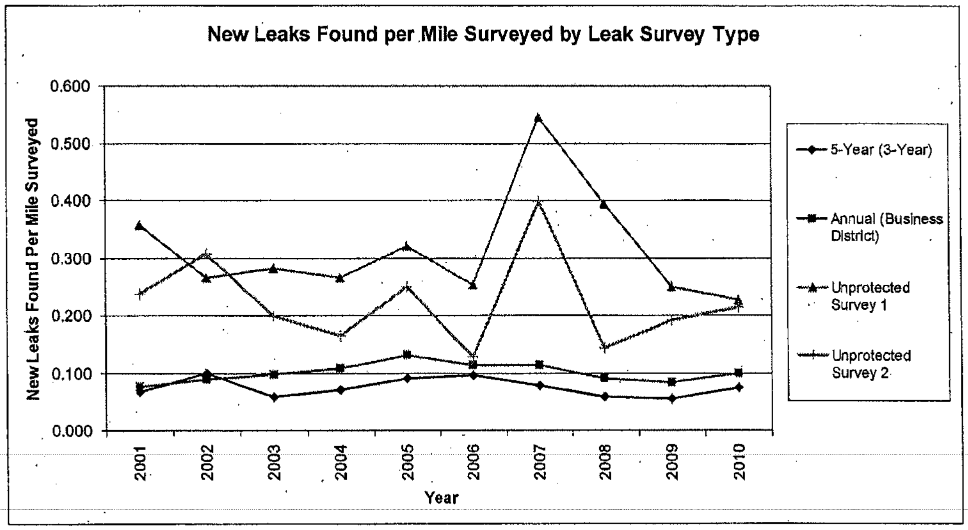

Figure 3. New Leaks Found Per Mile Surveyed by Leak Survey Type

In addition to demonstrating that the different survey frequencies are appropriately assigned to the different types of facilities, this graph shows a significant increase in new leaks found in 2007 on the unprotected pipe leak surveys. PSE noticed this increase in new leaks being found and took steps to ensure personnel were trained to properly indentify and grade leaks as well as trained in PSE's phantom leak procedure. Subsequently, the number of new leaks found returned to more typical values.

The graph also shows that for most years, the first unprotected pipe survey of the year finds more leaks than the second survey. PSE has explored this trend and found that while there continues to be variability between the new leaks found from the 1st and 2nd survey of the year, the number of new leaks found per survey cycle has decreased dramatically. In 2001, there were over 330 new leaks found on one survey cycle and in 2010 there were only 61 new leaks found on one survey cycle. This shows a very positive trend related to reducing leakage through bare steel pipe replacement.

As the Bare Steel Replacement Program continues, PSE expects to see a decline in the number of new leaks found because the pipe with the highest concentration of active and repaired leaks ranks high in the risk model used to prioritize the replacement work. PSE will continue to monitor this data to identify if any changes are necessary over the remaining 4 years of the Bare Steel Replacement Program. At this point, PSE believes this graph does not indicate a trend warranting a revision to this program.

As PSE has reviewed the performance of its individual wrapped steel systems, some systems have been identified for increased leak survey based on system performance including elevated numbers of active and repaired leaks and exposed pipe condition information. Some of these systems are targeted for replacement while others are being leak surveyed to gain additional system performance information as a method of addressing indications in locations with potentially increased risk. More information on this is provided in the Gas Maintenance Programs section under Pre-1972 STW Main Replacement Program.

New Leaks Found by Leak Grade

PSE's leak grading scale is documented in Gas Operating Standard 2625.1300, Leakage Action Program. The leak grade determines what action shall be taken to monitor and repair the leak. Leak grades include grades "A", "BA", "B1", "B2", and "C" in order of highest to lowest risk priority. Grade "A" leaks are leaks that represent an existing or probable hazard and require prompt action, immediate repair, or continuous action until conditions are no longer hazardous. Grade "B" leaks are leaks that are non hazardous at the time of detection but justify scheduled repair based on potential future hazard. These leaks vary in how frequently they are monitored but all B leaks are required to be repaired within a specified timeframe. Grade "C" leaks are leaks that are considered nonhazardous at the time of detection and are expected to remain nonhazardous. These leaks are reevaluated each year until the leak is re-graded or repaired.

Figure 4 shows trends over the past 5 years related to the grade of new leaks found each year. This trend shows that most new leaks found each year are "C" leaks; the lowest grade leak. It also shows a similar trend as seen in the previous graph with a large increase in the leaks identified in 2007. Again, this large increase was mostly due to "C" leaks. In subsequent years, the number of new "C" leaks found returned to previous levels.

The general trend for new grade "A" and "B" leaks shows a general decline in the number of new leaks found per year with a slight increase in 2010. PSE will continue to monitor this trend but believes the overall decrease in the past 5 years is more indicative of an overall improvement in system performance and does not see any indication that warrants additional measures at this time.

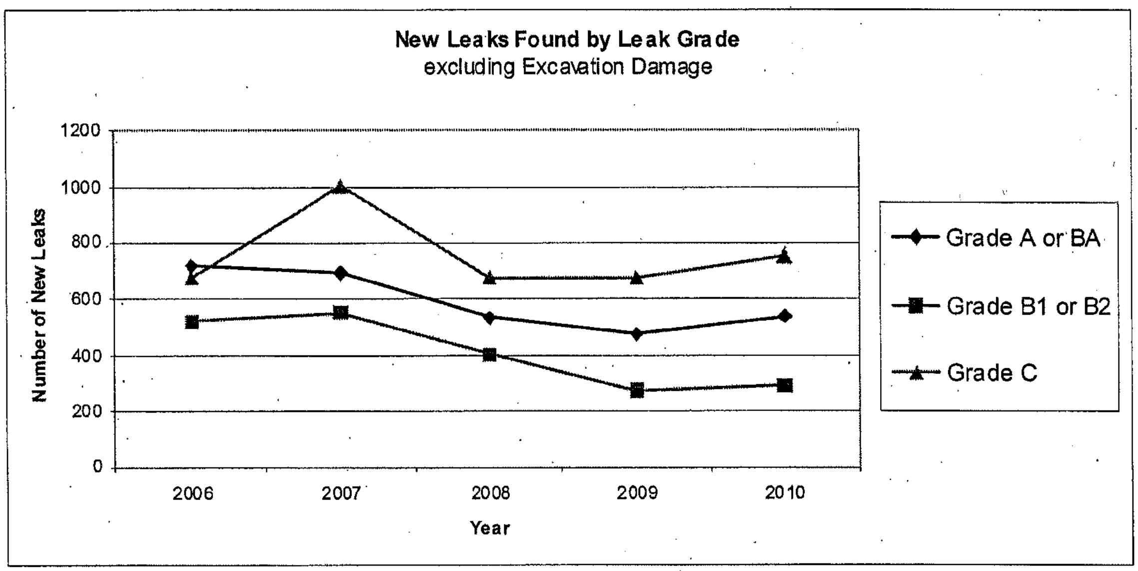

Figure 4. New Leaks Found by Leak Grade

Leaks Discovered by Source and Grade

Figure 5 shows additional data that provides insight into the effectiveness of PSE's leak survey program. As shown by this graph, over 70% of all "B1" and lower grade leaks are found by leak survey. This graph also illustrates the effectiveness of PSE's odorization and public awareness programs for the higher grade leaks (grade "A" and "BA") that are found predominantly by the public.

The data presented in this graph is a 5-year average. PSE has reviewed the annual data to determine if there are any changes over time that indicate a potential trend. This evaluation concluded that the representation of the data using a 5-year average is consistent with the annual data.

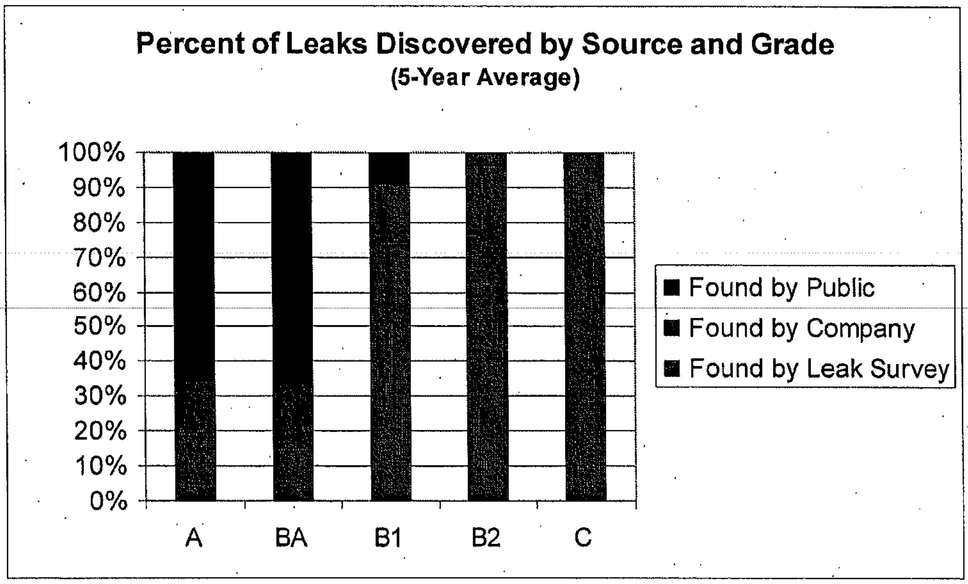

Figure 5. Percent of Leaks Discovered by Source and Grade

Active Leaks by Leak Grade

Figure 6 illustrates the active leak trends over the past 16 years. Active leaks are leaks that are being monitored but have not yet been repaired. This graph shows the total number of active leaks at the end of each calendar year as well as the number of "C" and "B" leaks that make up this total.

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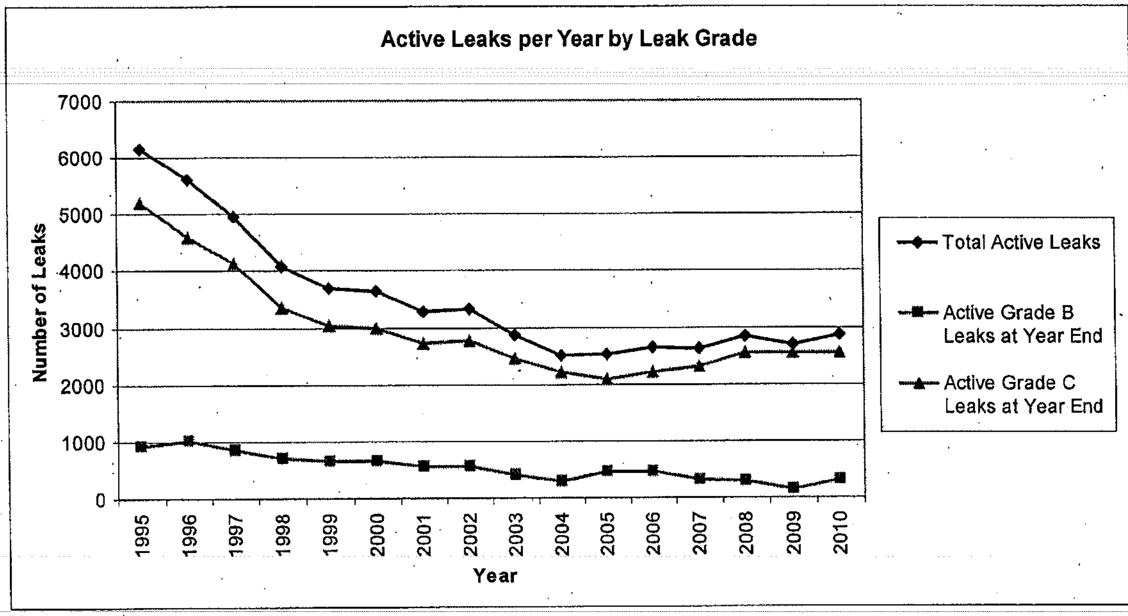

Figure 6. Active Leaks per Year by Leak Grade

Since 1995, PSE has reduced the total number of active leaks by over 50 percent and the number of "B" leaks by over 65 percent. One of the primary reasons for this reduction in total active leaks can be accredited to the cast iron replacement program which was completed in 2007. As seen in the graph, there was a significant reduction in active leaks each year until it leveled off just prior to the completion of the cast iron replacement program.

While the overall active leaks have trended downward over the 16-year period represented in the graph, there has been a slight increase between 2004 and 2010. As seen in the graph, this increase is due to an increase in grade "C" leaks as the "B" leaks have remained fairly constant during this timeframe. PSE will continue to monitor this trend but believes the overall decrease in the past 5 years is more indicative of an overall improvement in system performance and does not see any indication that warrants additional measures at this time.

Active Leaks Relative to Program Work

As shown in Figure 7, the replacement of cast iron resulted in a substantial decrease in the number of active leaks until 2005, at which point the trend leveled out. This graph also shows that as the cast iron replacement was completed, PSE increased its bare steel replacement efforts. While the amount of bare steel replaced each year is similar to the footage of cast iron replaced each year during the cast iron replacement program, the number of active leaks on bare steel are significantly fewer than on cast iron. As a result, the number of active leaks are not expected to decrease as significantly due to continued bare steel replacement as they did during the cast iron replacement program.

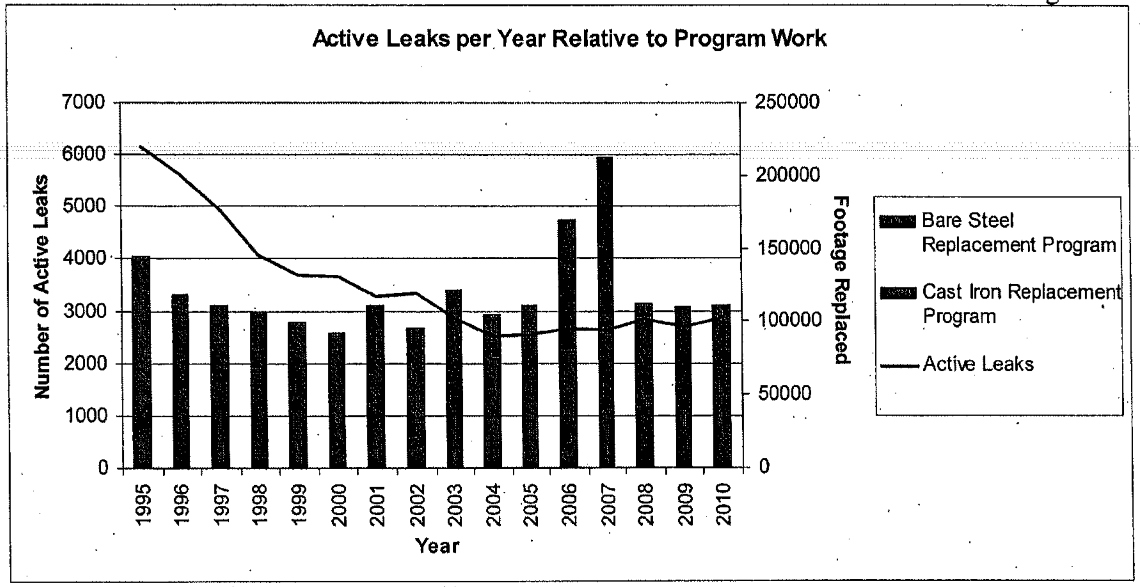

Figure 7. Active Leaks per Year Relative to Program Work

Active Leaks per Mile by Material and Vintage

In 2008 and 2009, PSE undertook an initiative to gain more information on the material and vintage of active leaks. This information has not historically been available on active leaks as it is typically not populated until the leak is repaired. The results of this review are presented in Figure 8 and confirm the direction PSE is headed in continuing the Bare Steel Replacement Program as well as developing and enhancing the Wrapped Steel Service Assessment Program, the Pre-1972 STW Main Replacement Program, and the Older PE Pipe Replacement Program. These programs are all described in the *Gas Maintenance Programs* section of this report.

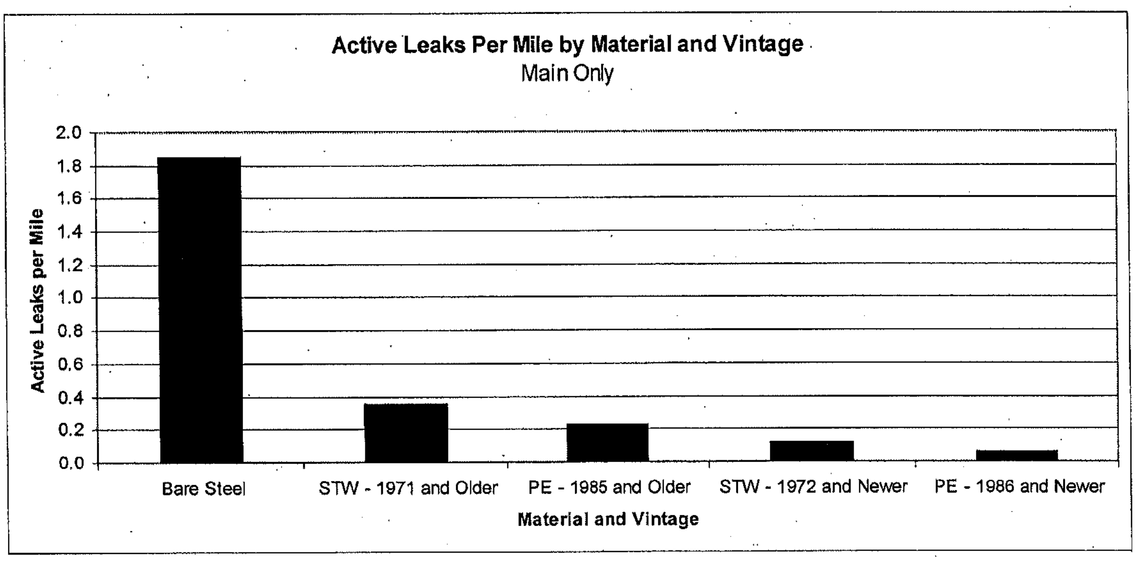

Figure 8. Active Leaks per Mile by Material and Vintage

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New and Active Leak Trends Conclusion

The review of new and active leak data indicates several positive leak trends. This includes a 50% reduction in active leaks since 1995 and a 65% reduction in "B" leaks over the same timeframe. This reduction has been accomplished primarily through replacing cast iron pipe. As the cast iron pipe replacement was completed, PSE increased its bare steel pipe replacement efforts; replacing similar footage per year. While this will have a positive impact on system integrity, bare steel leaks are not as dense as cast iron leaks and these replacement activities have not resulted in a decrease in active leaks as experienced during the cast iron replacement program.

Bare steel pipe as a total population is now PSE's highest priority for replacement. This is confirmed by the data that shows bare steel as having the highest number of new leaks found per mile and the highest number of active leaks per mile. The data also shows that after bare steel, wrapped steel pipe older than 1972 and plastic pipe older than 1986 have the next highest number of active leaks per mile. PSE has three programs; the Wrapped Steel Service Assessment Program (WSSAP), the Pre-1972 STW Main Replacement Program, and the Older PE Pipe Replacement Program; that are focused on identifying facilities within these populations for replacement and/or increased leak survey.

While replacing facilities that have integrity issues is an important part of maintaining and improving system integrity, an effective leak management program is also an important part of system safety. PSE's review of leakage trends indicates positive trends relative to leak management. Leak survey trends illustrate that PSE's leak survey frequencies are appropriately assigned for the different types of facilities. The highest concentration of new leaks has been found on the facilities that are leak surveyed the most frequently and the lowest concentration of new leaks has been found on those facilities that are surveyed the least frequently. The trends relative to leaks discovered by source and grade indicate PSE's leak survey program, odorization program, and public education program are effective in detecting and proactively mitigating leaks. The trends relative to new leaks found by leak grade show that most of the new leaks are grade "C" leaks. It also shows a general trend of fewer leaks found each year since 2007.

Leak Repair Trends

In addition to evaluating new and active leak trends, PSE has looked at leak repair data from many different perspectives to gain insight into trends related to leak causes, leak severity, and material performance. The following sections discuss the results of this analysis and PSE's plans to incorporate this information into its system integrity plans.

Repaired and Active Leak Trends

Figure 9 shows repaired and active leak trends since 1998. This graph excludes leaks repaired due to third party damage as this trend is impacted by different factors than other leak causes. Detailed analysis of leaks caused by third party damage is presented in the *Third Party Damage Prevention Program Trends* section.

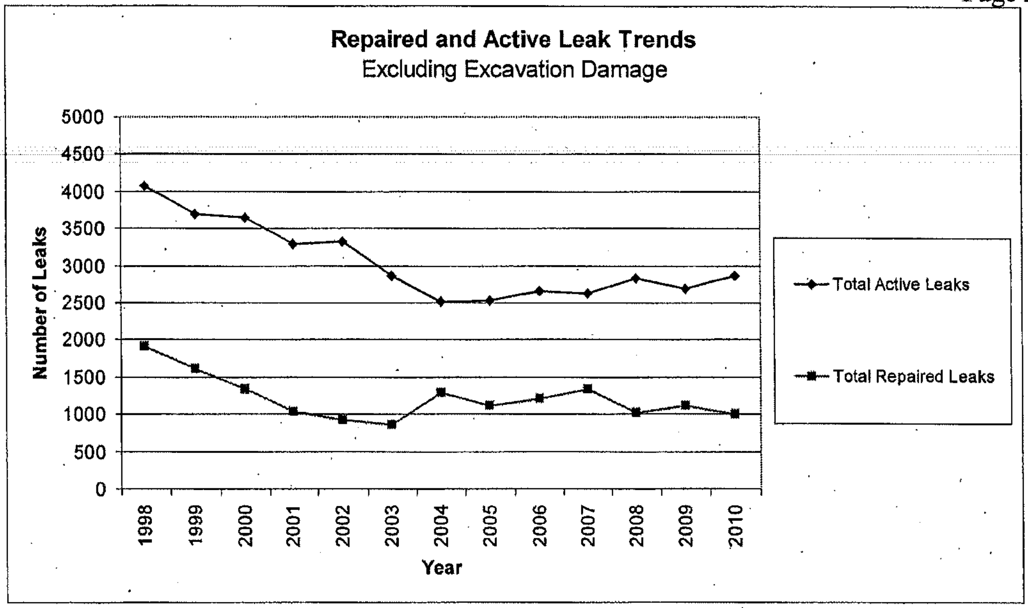

Figure 9. Repaired and Active Leak Trends

As shown in this graph, both active and repaired leaks were steadily decreasing from 1998 until 2004. This is largely due to fewer new leaks occurring as cast iron mains with the largest leak concentrations were replaced. In 2004, the number of leak repairs increased slightly and has remained fairly steady in subsequent years. In 2005, the number of active leaks began increasing and continued to slowly increase over the next few years. This trend is discussed in detail in the *New and Active Leak Trends* section of this report. As described in this section of the report, PSE will continue to watch this trend but expects that active leaks will remain stable or begin to decrease as additional pipe replacement is performed.

Repaired Leak by Leak Cause

Figure 10 shows the trends related to leak repairs by leak cause over the past 5 years. As shown in this graph, leaks repaired due to excavation damage and corrosion have decreased significantly. While there have been slight increases in the remaining leak cause categories, the overall number of leaks has continued to decrease. Where there was an increase in the number of leak repairs, these increases are due mostly to the fact that during this timeframe significant efforts were made to improve the consistency in designating the leak cause. These efforts have resulted in more accurate and useful data and will assist in future trending of these threats.

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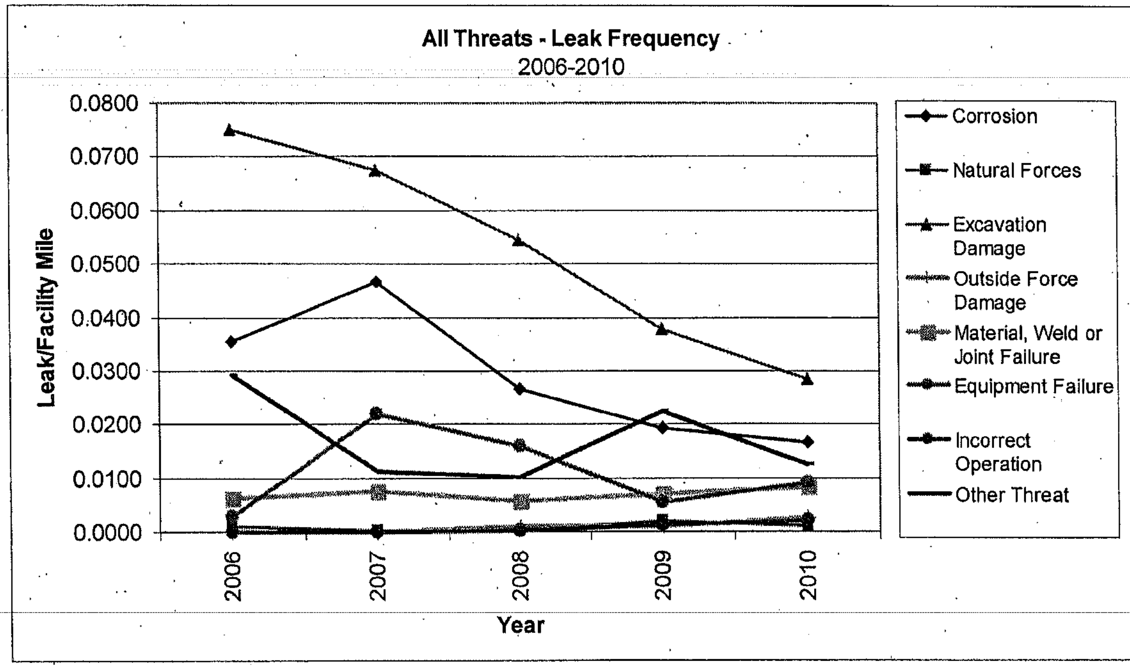

Figure 10. Leak Frequency of All Threats

Figure 11 shows similar information but represents the percent of leaks repaired over the same 5 year period by leak cause. As shown in this graph, excavation damage has consistently remained the leading cause of leaks on the system. PSE's 3rd party damage data aligns with industry trends and highlights the importance of a robust Damage Prevention Program. PSE's Damage Prevention Program is working to reduce the damage caused by excavation. There is additional data presented on these efforts in the *Third Party Damage Prevention Program Trends* section.

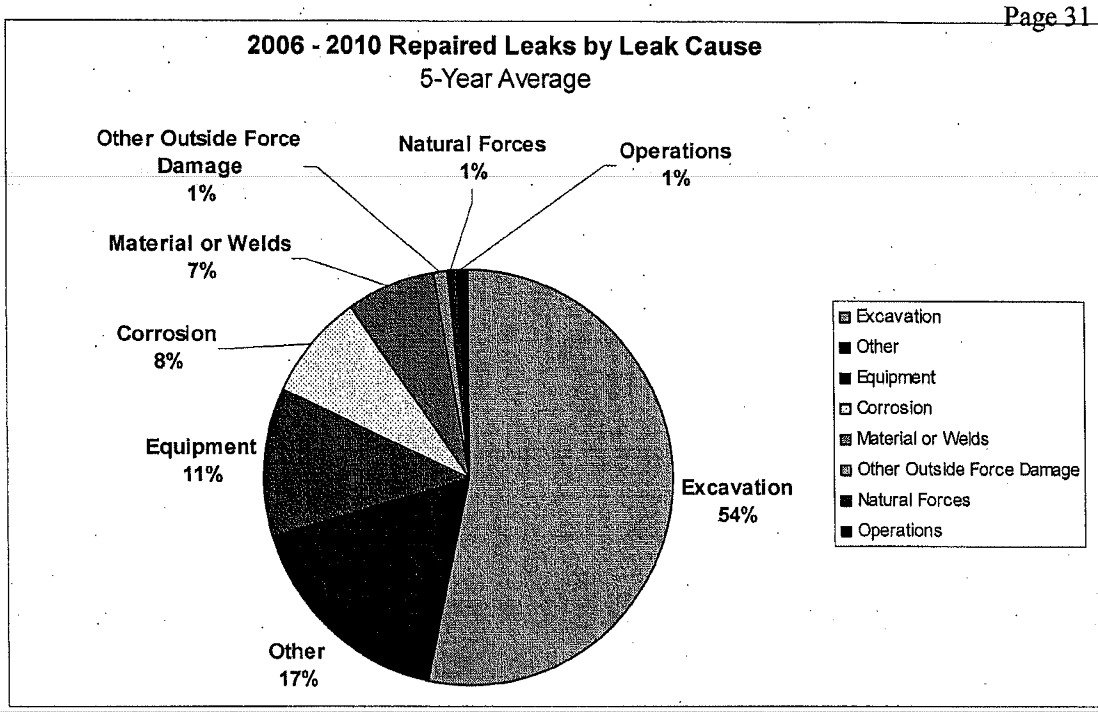

Figure 11. 2006-2010 Repaired Leaks by Leak Cause

The second leading cause of repaired leaks on PSE's system is from the leak cause code category of "Other". Analysis of the 5-year average leaks in this category indicates that more than half of these leaks were on pipe that was repaired by replacement and a leak cause was not identified. For 2010, only 10% of the leaks reported as "Other" were due to repairs without exposing the leak. Analysis of the remaining leaks in this category as well as the leaks in the "Equipment" category indicate that the majority of these leaks were due to a variety of different causes and were frequently repaired by greasing or replacing leaking valves, tightening fittings, and repairing meter set assembly leaks. The leaks in this category are typically found in a distribution system that was constructed with threaded and flanged joints and plug valves. As a result, newer systems are constructed with welded joints and ball valves which are less susceptible to leakage. While the data does not indicate an emerging trend, PSE will continue to look for opportunities to proactively mitigate these leaks.

The next leading cause of repaired leaks on PSE's system includes corrosion and material and welds. The root cause and more detailed trends for each of these leak repair causes are discussed in more detail below. The remaining three leak cause categories include Natural Forces, Other Outside Force Damage, and Operations and each make up approximately 1% of the leaks. There are no trends identified at this time relative to these categories.

Corrosion Leak Trends

PSE has approximately 84 miles of bare steel and wrought iron pipe the majority of which is not cathodically protected. PSE also has over 3,800 miles of wrapped steel pipe which is all cathodically protected. As seen in Figure 10. Leak Frequency of All Threats, the number of corrosion leaks per mile has significantly decreased over the past 3 years. This is largely due to replacing older vintage steel pipe through the Bare Steel Replacement Program, Wrapped Steel Service Assessment

Program, and Pre-1972 STW Main Replacement. These programs are described in more detail in the *Gas Maintenance Programs* section of this report.

Material, Weld or Joint Failure Leak Trends

As shown in Figure 12, almost 85% of leaks repaired due to material or weld failures were on older vintage plastic pipe and older vintage STW pipe.

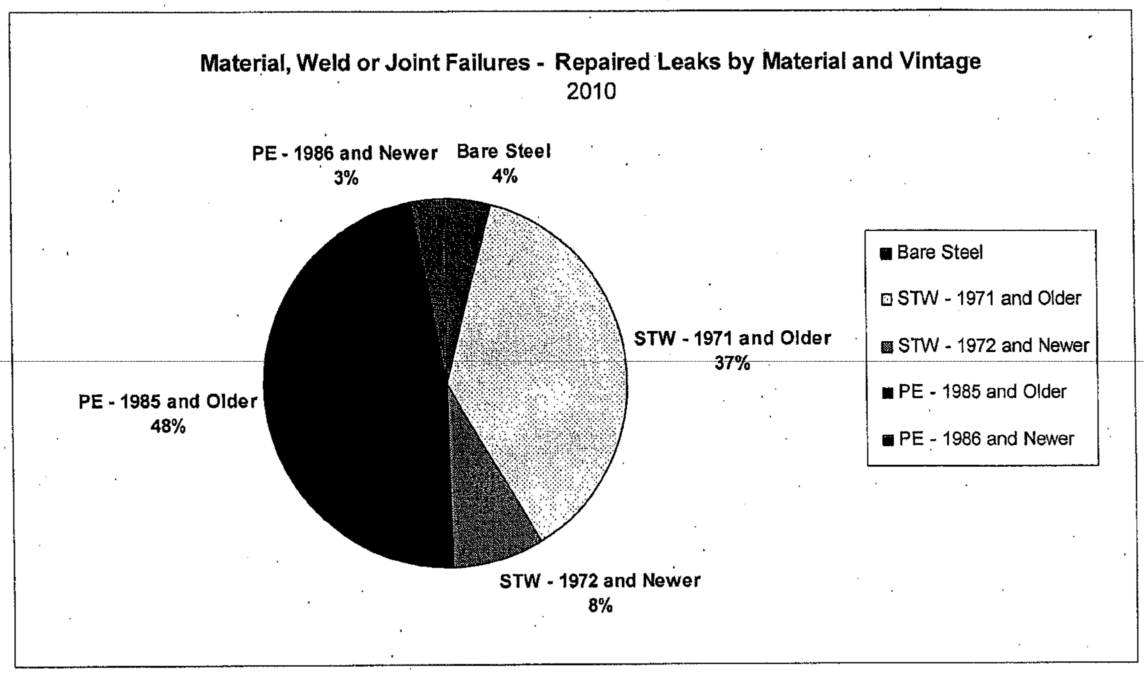

Figure 12. Material, Weld or Joint Failures – Repaired Leaks by Material

Additional information is provided regarding these failures in the *Failure Analysis Trend* section.

Leak Repairs by Material, Vintage and Grade

In addition to looking at trends related to leak causes, PSE has looked at its trends related to leak repairs by material and vintage. As shown in the following chart below, the number of leaks repaired per mile of each type of pipe material and vintage is consistent with the trend observed for active leaks per mile by material and vintage.

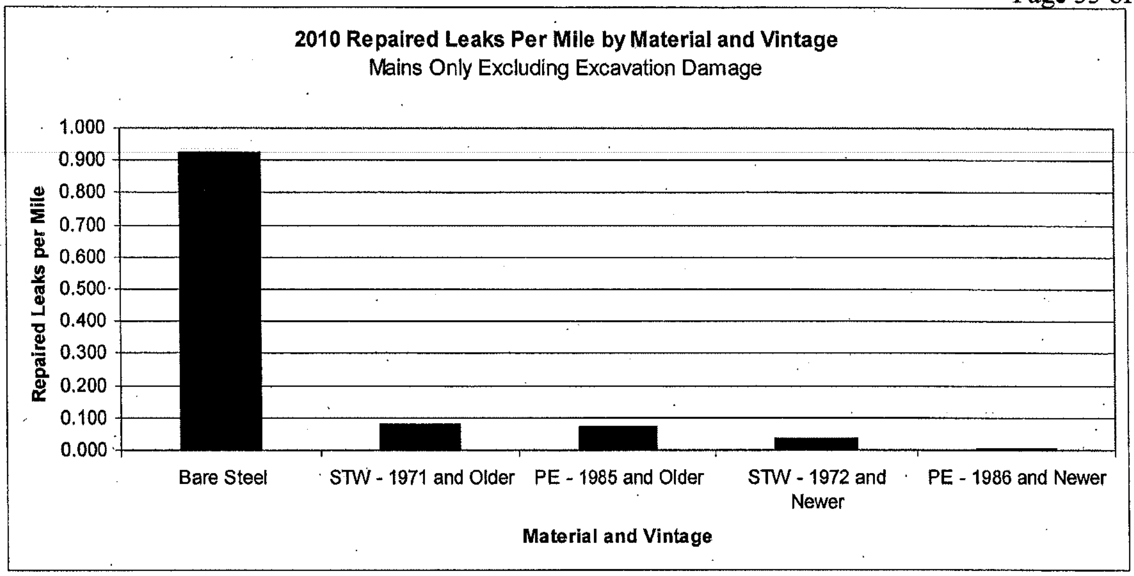

Figure 13. 2010 Repaired Leaks per Mile by Material and Vintage

PSE has also looked at trends related to the grade of leaks repaired by pipe material and vintage. As shown in Figure 14, bare steel has the highest concentration of "A" or "BA" leaks repaired per mile followed by older vintage PE and older vintage wrapped steel.

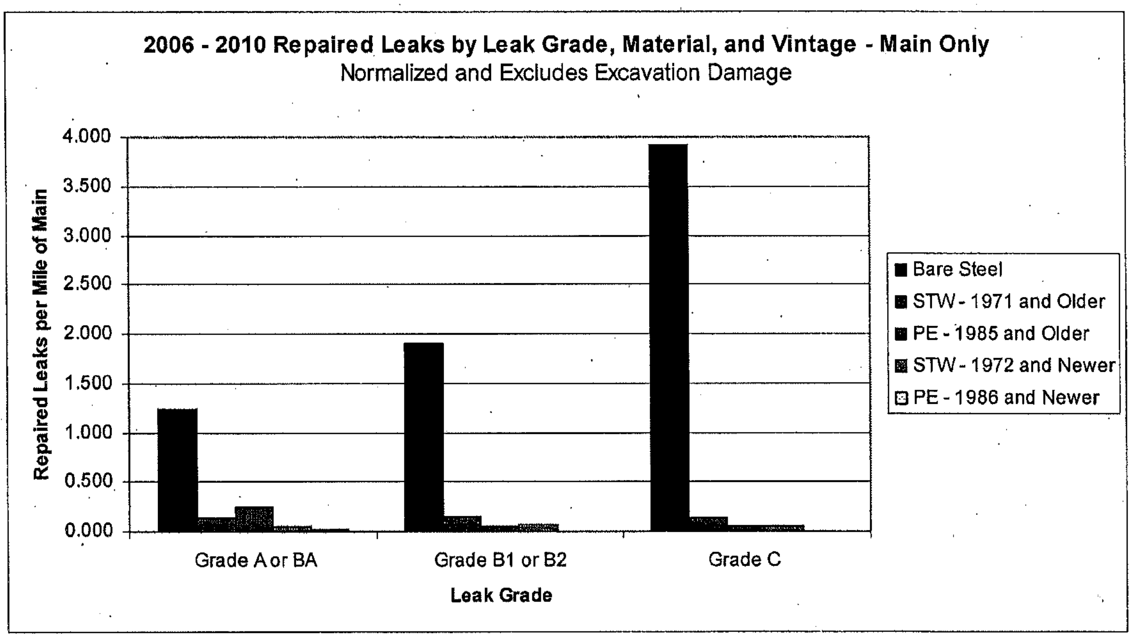

Figure 14. 2006-2010 Repaired Leaks by Leak Grade, Material, and Vintage – Mains Only

As this chart shows, bare steel has the highest likelihood of leaks. However, analysis of leak grades shows that a leak requiring repair on older PE is 50% more likely to be a hazardous leak when found than a leak requiring repair on any vintage or type of steel. Further analyzing the leak repairs on older PE, the data shows that most fusion and brittle-like cracking failures result in a higher leak grade than leak repairs on older STW due to corrosion, weld, and equipment failures. This trend provides insight into the consequence of a PE leak. Both the likelihood and consequence of a leak are part of risk analysis and this knowledge will be incorporated into future risk assessments.

PSE has also analyzed leak grade trends for mains and services. Figure 15 presents data on the leak grade and facility type for leaks that require repair. As discussed earlier, leaks that require repair include all leaks that are graded as an "A" or "B" leak. As shown in the graph, service leaks that require repair are more frequently found with a higher grade than main leaks requiring repair.

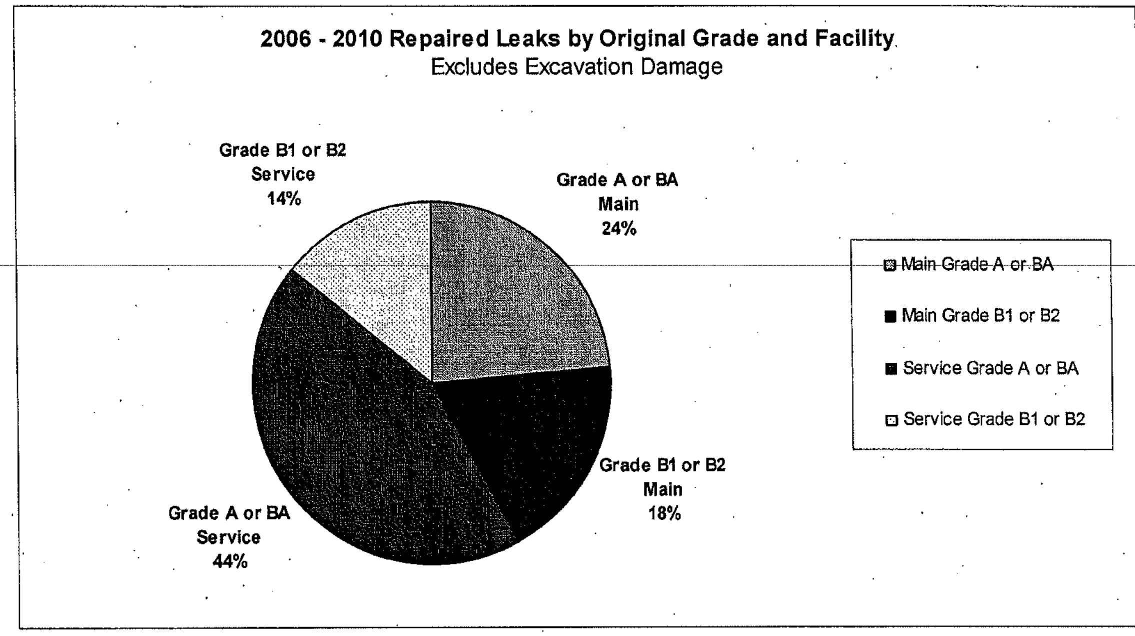

Figure 15. 2006-2010 Repaired Leaks by Original Grade and Facility

These trends further support the direction PSE is headed in implementing programs to assess pipe of these materials and vintages and implement further actions including pipe replacement and increased leak surveys as determined based on these assessments.

Leak Repair Methods

In addition to looking at trends related to leak causes and leak repairs by material and vintage, PSE has looked at trends related to how leaks are repaired. As discussed in the *Leak Trends* section of this report, approximately half of the leaks in the system that are repaired each year are due to excavation damage. Those leaks are repaired by a combination of maintenance and replacement. For the remainder of the leaks, Figure 16 illustrates the mix of leak repairs performed by replacing or retiring mains and services or by maintenance activities (i.e. greasing valves, tightening fittings, etc.) This graph shows that about 60% of leaks are repaired by replacing or retiring the facility and approximately 40% through maintenance activities. For leaks that are repaired on mains, there is almost an equal distribution between those that are repaired by replacement and by maintenance.

For services, significantly more leaks are repaired by replacement rather than maintenance. This data shows that PSE has well-balanced repair strategies that are appropriate for the root cause.

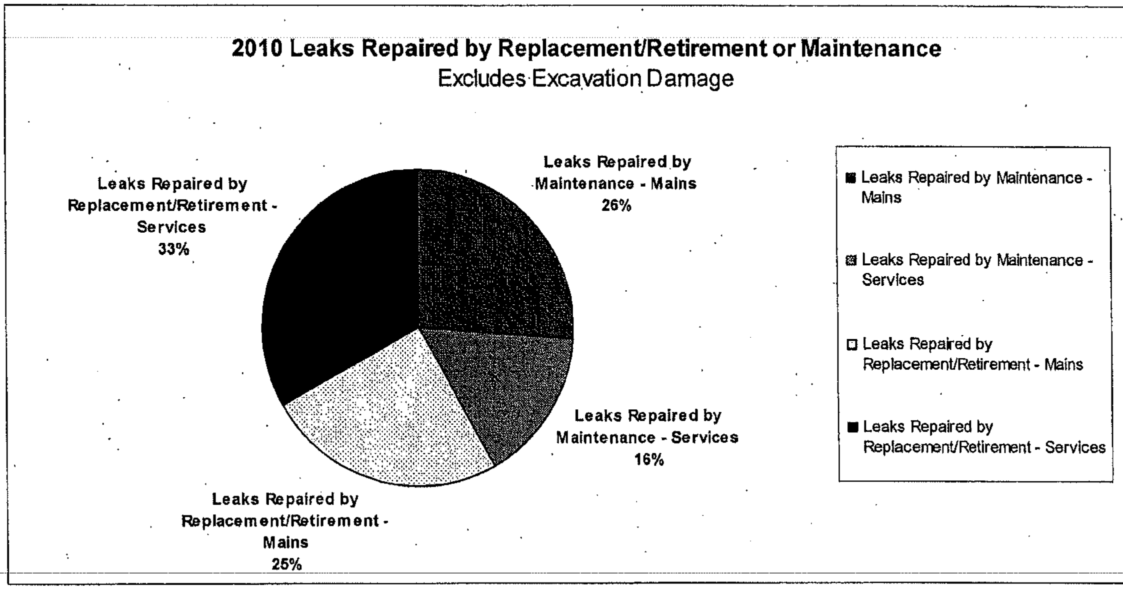

Figure 16. 2010 Leaks Repaired by Replacement/Retirement or Maintenance

While most leaks are eliminated by replacement, retirement or maintenance, leaks can also be eliminated when it is determined that there was not actually a leak present. These leaks are classified as phantom leaks. The Figure 17 shows there has been a decrease in the number of phantom leaks since 2007. This decrease is attributed to improvements in the leak repair documentation process that more accurately tracks leaks that are repaired through replacement and reduces those that may have been classified as a phantom leak.

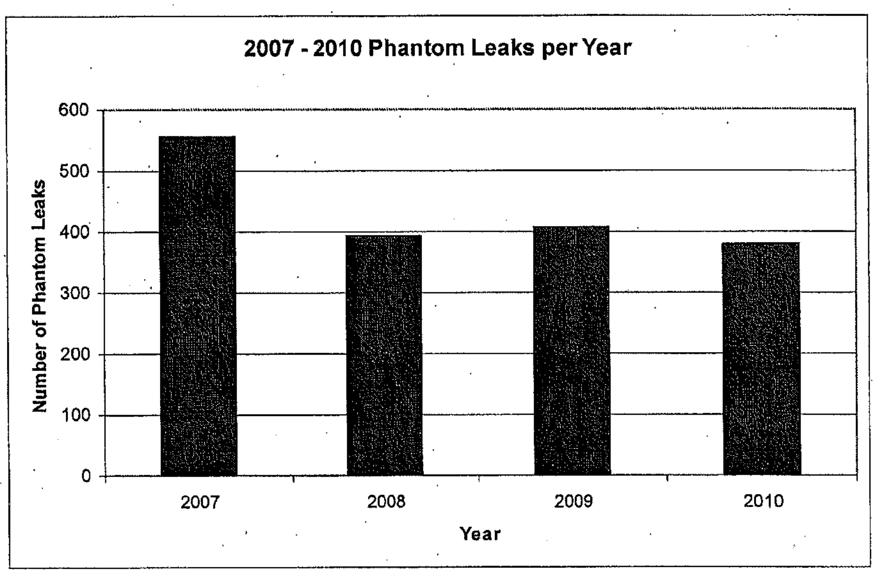

Figure 17. 2007-2010 Phantom Leaks per Year

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Leak Repair Trends Conclusion

The review of leak repair data indicates that Excavation or 3rd party damage has consistently remained the leading cause of leaks on the system which is consistent with industry trends. After 3rd party damage, the next leading cause of leaks is attributed to "Other" and "Equipment". The leaks in this category are typical to find on a distribution system of PSE's age and are not indicative of any emerging trend.

Corrosion and material and weld failure are the next leading causes of leaks on the system representing 8% and 7% of the repaired leaks, respectively. The actual number of corrosion leak repairs is higher than represented in this data as most corrosion leaks on bare steel are repaired by replacing the pipe. As a result, the leak is not exposed and the leak cause is not able to be conclusively determined.

The leak repair trends support the direction PSE is headed in implementing programs to assess wrapped steel and older vintage PE pipe in addition to the Bare Steel Replacement Program. The data shows that bare steel has the highest likelihood of leaks and that PE is 50% more likely to be a hazardous leak when found than a leak requiring repair on any vintage or type of steel. These trends provide insight into both the likelihood and consequence of failures that will be incorporated into future risk assessments and help determine where pipe should be replaced or leak surveyed at an increased frequency.

Failure Analysis Trends

To provide additional understanding of leakage and failure trends, PSE has developed and implemented a failure analysis program as described in GOS 2575.1900 Investigating Failures of Pipeline Facilities. This program uses a combination of detailed failure analysis that is performed on physical specimens that are obtained from the field after a leak has been repaired and data that is obtained from the Leak Management System (LMS) when the repair does not involve removal of a failed specimen. Physical specimens are not obtained for a variety of reasons including leaks that are not exposed when the leak is repaired by replacement or the facility is repaired in place with a leak clamp or by greasing, tightening, etc.

The detailed failure analysis provides additional data beyond the high level leak cause category. LMS information, such as material type, is confirmed and more detail on the failure such as failure type and failure category is obtained. The failure type includes classifying the failure as a weld failure, fusion failure, brittle-like cracking failure, mechanical joint failure or equipment failure. The failure category classifies the failure as a material failure, construction defect or a corrosion failure when there is enough information to make this determination. This information is the basis for the annual Construction Defect and Material Failure Report that PSE prepares for the WUTC. Beginning in 2011, this data will also be used to report mechanical fitting failures that result in a hazardous leak to PHMSA as required under DIMP.

Since joining procedures and mechanical fitting designs are dramatically different for steel and plastic systems, each material type will be reviewed separately, beginning with steel pipe. Figure 18 illustrates the construction defect and material failure data from the failure analysis findings for steel pipe and fittings.

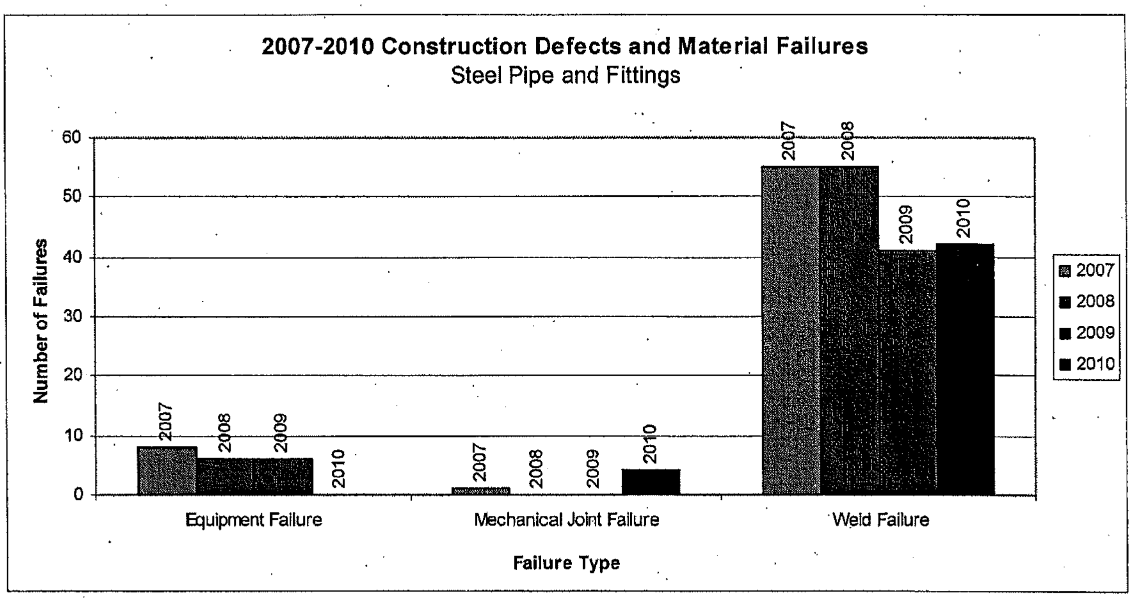

Figure 18. 2007-2010 Construction Defects and Material Failures - Steel

While this graph shows a decrease in the weld failures in 2009 and 2010 relative to 2007 and 2008, weld failure remains the leading cause of construction defect and material failure on steel pipe. Mechanical joint failures have increased in 2010 compared to previous years, but still represent a very small number. In 2010, these failures are due to two (2) dresser type fitting failures and two (2) failed gaskets. This increase may be due to the improvements made to the Failure Analysis program to capture more relevant and accurate data in preparation of reporting mechanical fitting failures. There are no trends apparent in this data that indicate any new or revised mitigative measures are necessary.

Figure 19 shows the construction defect and material failure data on steel pipe by year the pipe was installed. As shown in this graph, steel pipe installed prior to 1972 has experienced the majority of failures due to these causes.

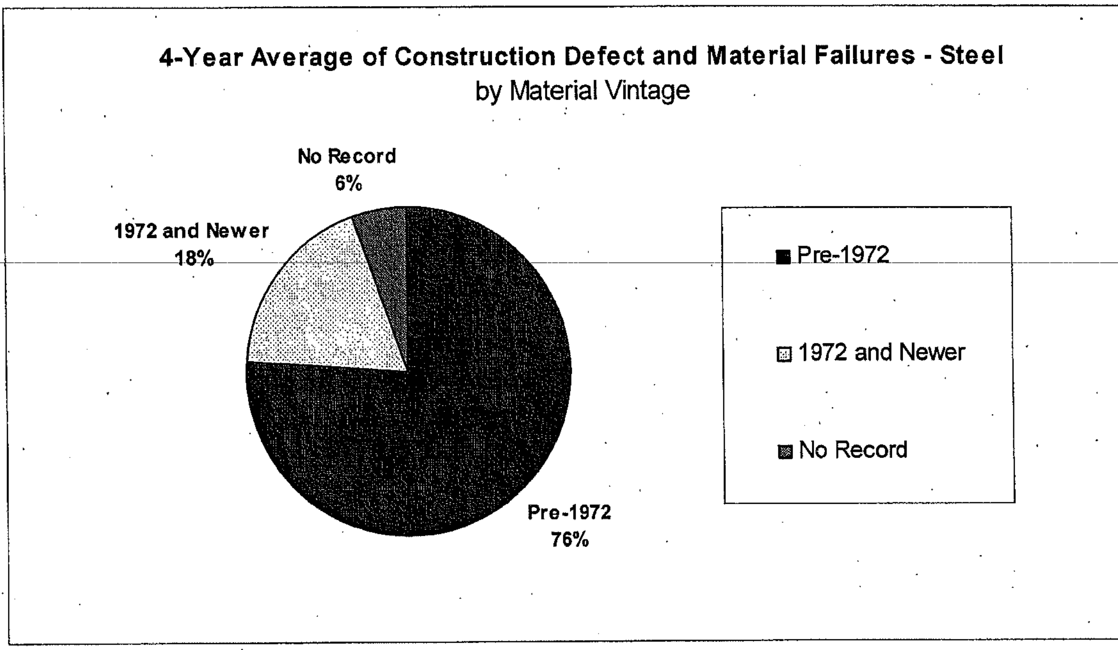

Figure 19. 4-Year Average of Construction Defect and Material Failures - Steel

A similar review of construction defect and material failures was also analyzed for plastic pipe. This data initially showed a significant increase in the number of failures due to brittle like cracking. As a result, a detailed review of the data that this report was based on was performed and it was determined that the increase in brittle like cracking was due to a change in the way cracks on plastic service tee caps were reported. In prior years, these failures had been reported as equipment failures and in 2010 they were reported as brittle like cracking failures. When these failures were categorized as an equipment failure consistent with previous reporting, there was actually a decrease in the number of failures due to brittle like cracking as well as a decrease in the number of equipment failures as shown in Figure 20. As a result of this analysis, PSE will evaluate whether an additional category should be added to more accurately track the number of cracks on service tee caps and to ensure more consistent categorization of failure causes. Most of these PE service tee caps that failed due to cracking occurred on Plexco Celcon caps installed between 1986 and 1997. This is consistent with industry trends. Plexco changed the material of their caps from Celcon to MDPE in 1996.

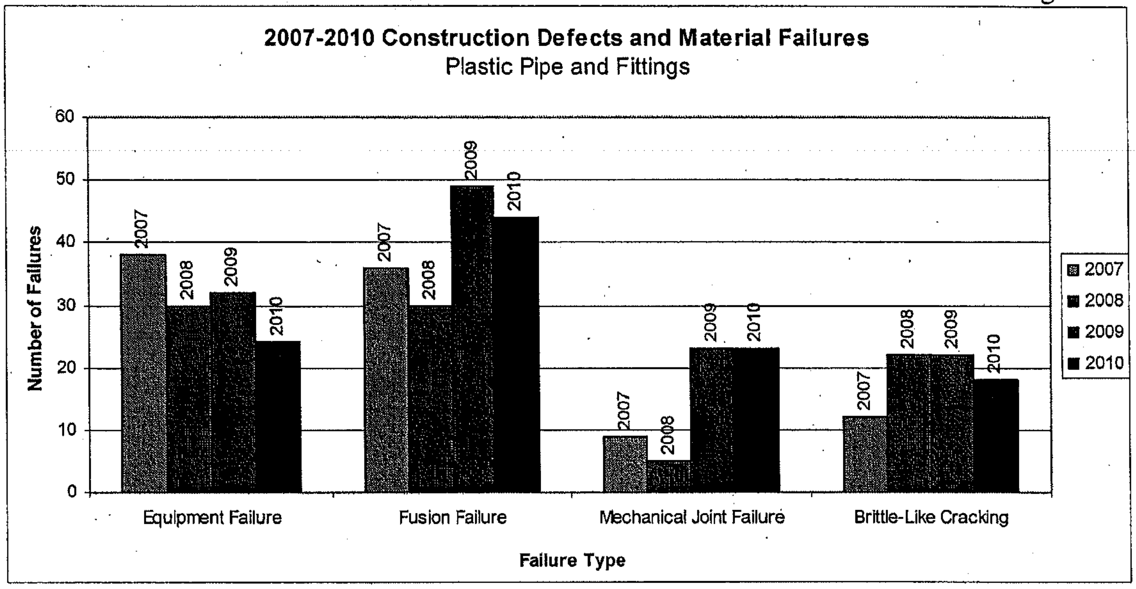

Figure 20. 2007-2010 Construction Defects and Material Failures - Plastic

A more detailed look at mechanical joint failures indicates that most of these failures are on service bolt-on tees. Most of the leaks occurred at the location where the O-ring in the saddle makes contact with the main. A more in depth failure analysis performed in January 2010 concluded that the root cause of failure was due to surface defects in the pipe surface that weakened the integrity and seal of the O-ring over time. As a result of the analysis, the importance of proper surface preparation was communicated through a company newsletter.

As a result of incidents that occurred around the country due to pull-out of mechanical compression couplings, PSE reviewed its historical and current use of compression and mechanical fittings. Based on this review, PSE concluded that it has only installed pull-out resistant couplings to join PE to PE or PE to steel. More detail on couplings used in PSE's distribution system can be found in the *System Data* section.

A more detailed look at 2010 failures due to brittle-like cracking on pipe, as shown in Figure 21, indicates that all brittle-like cracking failures occurred on older vintage plastic pipe. Beginning in mid-2010, PSE began collecting additional data on the root cause of brittle like cracking. This includes identifying whether there was a rock or a foreign facility adding external point loads to the pipe or whether the crack occurred in a location that had previously been squeezed. Based on the data collected in 2010, rock impingement is the leading cause of brittle-like cracking on plastic pipe. These root causes will continue to be monitored for trends as more years of data are collected.

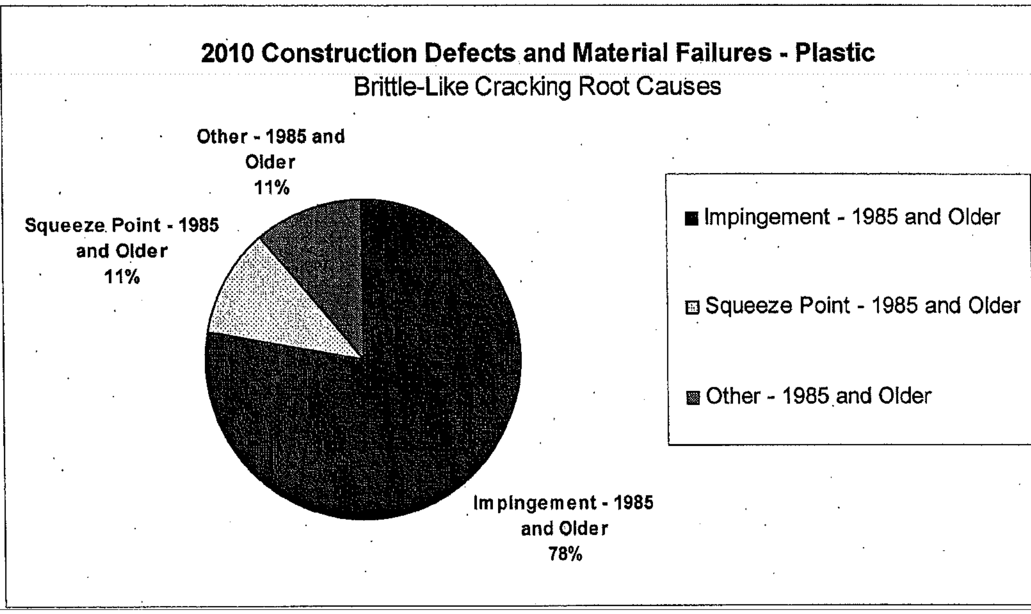

Figure 21. 2010 Construction Defects and Material Failures - Plastic

Figure 22 provides additional information on construction defect and material failures on plastic pipe by year the pipe was installed.

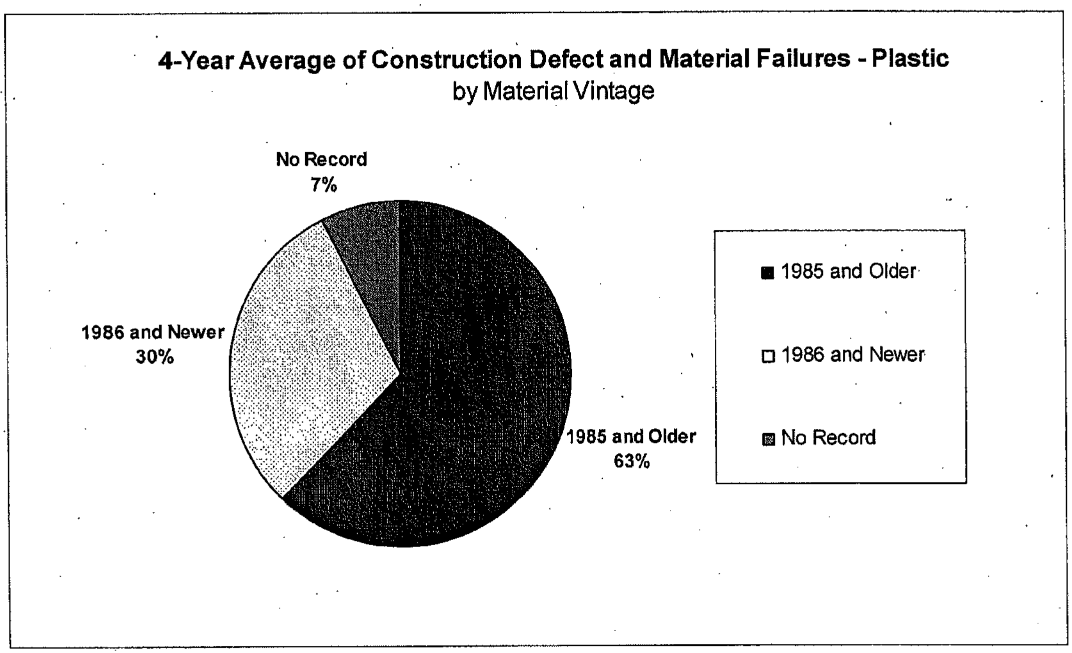

Figure 22. 4-Year Average of Construction Defect and Material Failures - Plastic

As shown in this graph, plastic pipe installed prior to 1986 has experienced the majority of failures due to construction defects and material failures. PSE's Older PE Pipe Replacement Program is discussed in the *Gas Maintenance Programs* section and is focused on identifying and replacing segments of pipe that are susceptible to these types of failures. PSE will continue to monitor these trends as additional years of data is obtained to determine if these trends indicate that adjustments should be made to this program.

Failure Analysis Trends Conclusion

A review of the failure analysis data indicates the year of installation is a significant factor in determining the likelihood of failure. The data indicates that steel pipe installed prior to 1972 and plastic pipe installed prior to 1986 have experienced the majority of failures due to construction defects and material failures. Other potential trends relative to wrapped steel and plastic pipe and fitting failures will continue to be evaluated and monitored, but at this time PSE's Pre-1972 STW Main Replacement Program and Older PE Pipe Replacement Program are focused on identifying and replacing segments of pipe that are susceptible to these types of failures and should be addressing any potential future trends related to these failures.

System Condition Report Trends

PSE obtains information about the condition of the distribution system through a variety of means. This includes information recorded during routine inspection and maintenance activities such as leak surveys, leak repairs, cathodic protection test site monitoring, valve inspections, regulator station inspections, etc. Where these inspections have identified issues requiring action or trends that warrant attention, information has been included in this report in the System Performance Trends and Gas Maintenance Programs. The following sections discuss information that is gained about PSE's system through two specific reports; the System Condition Report (Blue Cards) and Exposed Pipe Condition Reports (EPCR). The System Condition Report is filled out anytime an employee or contractor observes a nonstandard condition. The EPCR is filled out every time steel pipe is exposed. The sections below summarize information gained about the system condition from each of these reports.

System Condition Reports (Blue Cards)

In 2010, 42,452 System Condition Reports (Blue Cards - Form 3704) were forwarded to the GSI department for disposition. These reports are grouped by the degree of potential hazard as required by GOS 2575.2700, Section 3.1. Since all company and contract personnel are involved in reporting, the conditions are considered *suspected* until reviewed by either Gas First Response (GFR) or GSI.

- *Suspected Unsafe Conditions* are routed to and addressed by GFR to expedite resolution. A small number of reports requiring complex resolution are received in GSI. GSI received and documented 66 such reports in 2010.
- GSI received and documented 20,179 reports of *Suspected Unsatisfactory Conditions* in 2010, primarily pertaining to MSAs with some portion of the aboveground piping or meter in contact with the soil.
- GSI received and documented 22,207 reports of *Suspected Nonstandard Conditions* in 2010 for a variety of issues. Many of these reports identify installations that do not meet current construction standards yet met the standard when installed and continue to provide acceptable service.

In addition to grouping these reports by degree of potential hazard, each report is classified by the specific condition identified. GSI reviews the reports annually to identify any trends. Table 7 describes these trends based on reported conditions from 2010 as well as a brief description of plans to address each trend.

Table 7. List of Conditions As Reported on System Condition Reports

Reported Condition	Reports	Planned Approach
Buried MSA components (meters, shut off valves and transition fittings)	19,200	The reports received in 2010 add to our knowledge of a known trend. Additional information about this established program is detailed in the *Gas Maintenance Programs* section.
MSAs inaccessible for complete atmospheric corrosion inspection	21,125	Because this condition prevents the timely completion of a required inspection, PSE is reviewing the best approach to address this situation to ensure these issues are addressed in a timely manner.
MSAs and Services with access obstructed by property modifications	413	Because this condition may interfere with leak surveys or atmospheric corrosion inspections, PSE is reviewing the best approach to address this situation to ensure these issues are addressed in a timely manner.
MSA service regulator vents located less than standard distance from other construction features	870	GFR responds to suspected unsafe conditions as required by GOS 2575.2700, Section 2.4. Because operating standards have changed over time, many of the reports represent installations that met the standard at the time of installation, while other reports speak to a change in the environment since installation. GSI is developing a pilot program to further investigate a portion of the reports to further evaluate this trend, identify which conditions merit remediation, what remediation is required and refinement of the reporting requirements.
Missing MSA regulator vent screens	476	Because PSE limits the time allowed for the replacement of missing vent screens, CS reports are no longer used to report missing vent screens. GSI has returned these reports to Maintenance Programs for prompt resolution of the missing screens.
Traffic protection does not meet current standard	212	The reports received in 2010 add to our knowledge of a known trend. GSI reviews reports of substandard traffic protection and forwards priority concerns to the service provider for reinspection and resolution. Additional information about this established program is detailed in the *Gas Maintenance Programs* section.
Rocks or debris on buried pipelines	65	The reports received in 2010 add to our knowledge of a known trend. Reports are forwarded to and considered by the program managers for cathodic protection and the Older PE Pipe Replacement Program. Additional information about this established program is detailed in the *Gas Maintenance Programs* section.
Shallow mains and services	91	GSI prioritizes its response to reports of shallow facilities based on the reported depth, the facility type and the facility environment. Priority reports of shallow services are forwarded to the service provider for replacement. Priority reports of shallow mains are forwarded to GFR for further evaluation of the severity and extent of the condition. Additional information about this established program is detailed in the *Gas Maintenance Programs* section.

Exposed Pipe Condition Reports

On average, wrapped steel pipe is exposed at more than 5,000 locations each year due to routine maintenance, system expansion, and new customer hook-ups. Each of these exposures provides an opportunity to examine and report on the condition of the pipe. Figure 23 presents data obtained each time a section of wrapped steel pipe is exposed.

This data shows that 98% of the time wrapped steel pipe is exposed there is no corrosion or only minor surface rust. Less than 2% of the time wrapped steel pipe is exposed there is corrosion found and of those times less than half require remediation.

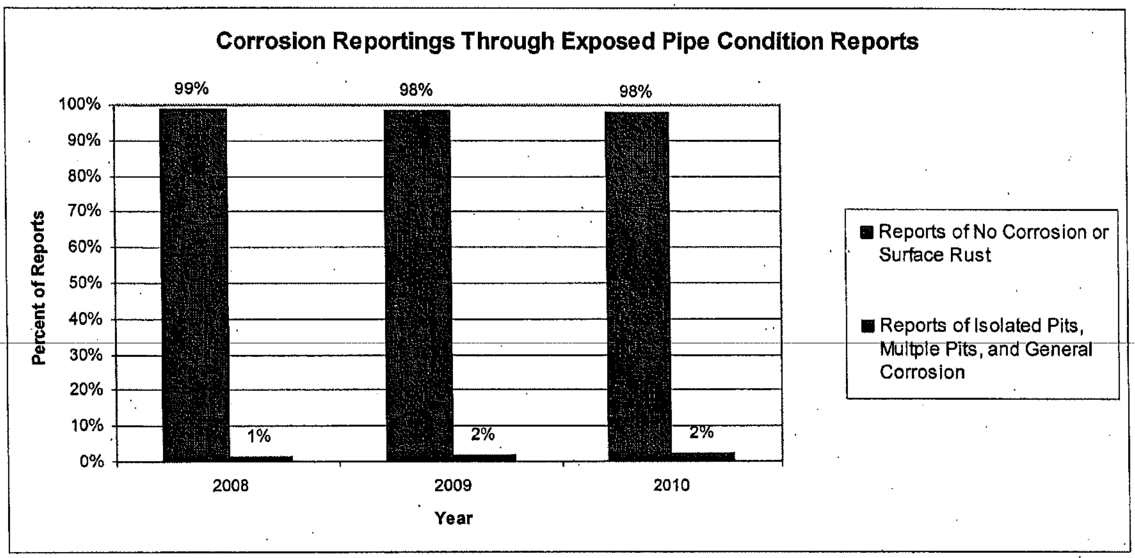

Figure 23. Corrosion Reportings through Exposed Pipe Condition Reports

PSE has limited the number of years of data that has been presented as additional training and emphasis on reporting corrosion has been undertaken since 2008 to provide consistency and additional clarity in the data. Data reported continues to improve and provide a more accurate representation of pipe condition. This makes it difficult to determine if there is a historical (pre-2008) trend related to corrosion, but will result in more accurate data in future years. PSE will continue to monitor this data to determine if there is a trend that warrants additional or modified mitigation activities.

Anytime corrosion is found on wrapped steel pipe, the Gas System Integrity (GSI) department is notified and collects additional data. This data is then analyzed to determine if there are any trends that warrant attention. The results of this analysis are presented in Figure 24.

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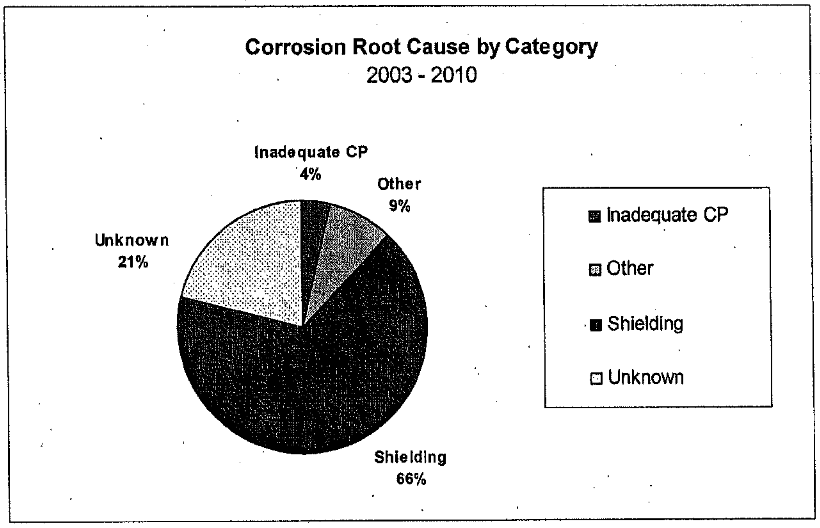

Figure 24. Corrosion Root Cause by Category

As shown in this graph, the most common cause of corrosion is due to the pipe being shielded from cathodic protection (CP). Shielding occurs when rocks or disbonded coatings prevent CP current from reaching the pipe. Figure 25 provides additional information on the root cause of corrosion due to shielding. The cause of the coating becoming disbonded varies, but as shown in this graph, the most common causes are the coating being damaged by 3rd party excavation, by rocks in the backfill or because the coating was incorrectly applied or the incorrect coating used for the application.

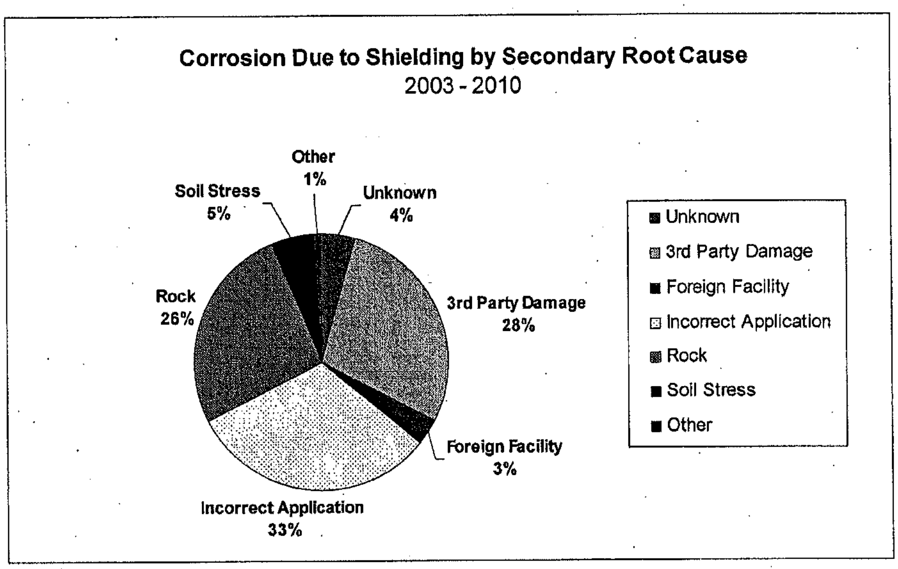

Figure 25. Corrosion Due to Shielding by Secondary Root Cause

Several measures have been implemented to address these issues. The Damage Prevention Program helps minimize additional damages that could cause future failures, backfill procedures have improved so rocks should not damage the coating or shield the pipe from CP, and improved coatings are used to provide for better coating application. Further research into the incorrect application indicates that most of these failures occur where a field applied coal tar enamel tape (referred to as hot wrap) coating has been used. These failures also occur most frequently on service tees. This coating is difficult to correctly apply especially on irregular shaped surfaces such as service tees. Newer coatings that are now used for service tees include wax tape, mastic or epoxy. In addition, PVC or vinyl backed tape is primarily used for girth welds. These coatings are easier to apply and increase the likelihood of correct application. Hot wrap is still used in environments where there are hydrocarbons present that are not compatible with other types of coatings and only on fittings with smooth contours.

Along with these improved processes and materials, PSE includes past failures in its risk model to assess the risk of additional failures occurring in an area.

Since shielding is a large contributor to corrosion failures, the soil types and pipe vintages are further analyzed to understand what combinations of factors may lead to shielding. This data will continue to be monitored and may be incorporated into PSE's risk models if the data indicates this is appropriate. Figure 26 shows the different soil types that have been found in the backfill of where shielding has occurred.

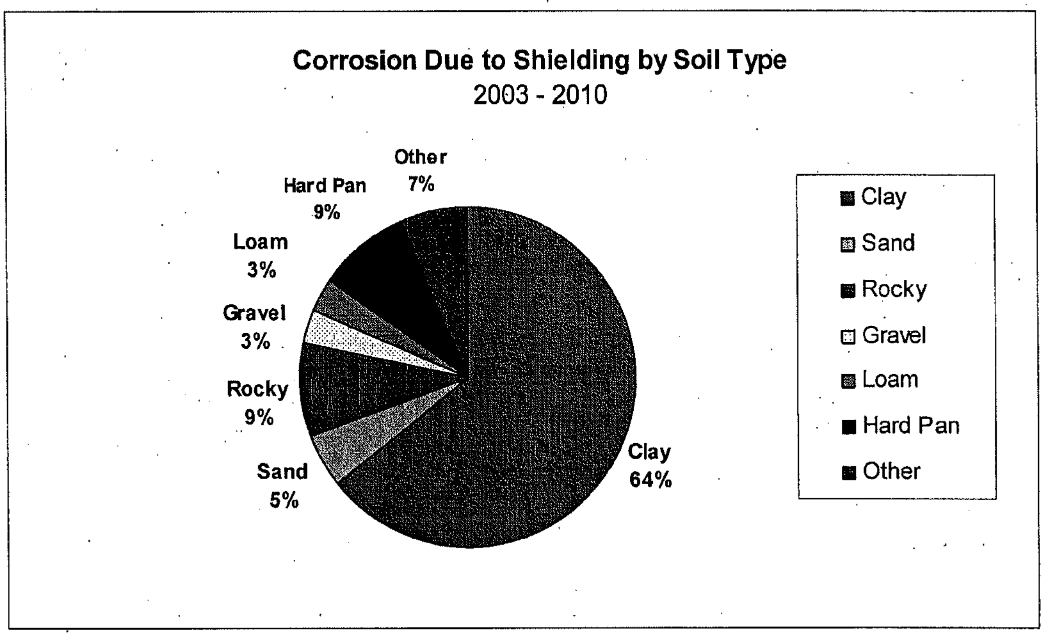

Figure 26. Corrosion Due to Shielding by Soil Type

Clay is the most dominant soil type found near corrosion failures due to shielding. Clay is suspected to worsen the condition of the disbonded coating as it binds to the coating and expands and contracts with changes in moisture. Rocky and hard pan soils also coincide with the next largest percentage of corrosion due to shielding. As seen in Figure 27, shielding occurred mostly on older vintage wrapped steel.

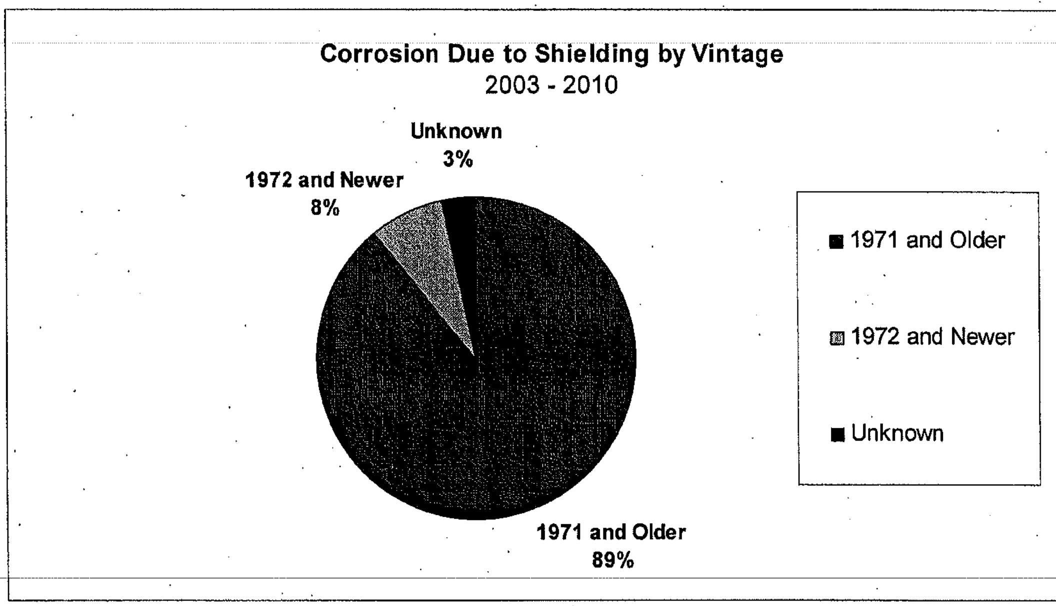

Figure 27. Corrosion Due to Shielding by Vintage

While shielding of cathodic protection is responsible for the majority of corrosion leaks, only 4% of the corrosion found on steel pipe is attributed directly to inadequate cathodic protection as shown in the earlier graph, Figure 24. Corrosion Root Cause by Category. Inadequate cathodic protection is documented as the cause only if the cathodic protection criterion is not met at the time the pipe is exposed.

PSE has reviewed recent years history of the number of corrosion systems passing inspection (i.e. found to be meeting cathodic protection criterion) and found the number to be fairly stable from year to year. One trend that has been identified is that the galvanic systems pass inspection far more frequently than impressed current systems; 97% passing versus an average of 75% passing. This is likely to be attributed to the relative size difference of the individual systems. Impressed current systems are much larger than galvanic systems. As shown in Table 8, impressed current systems protect 90% of the wrapped steel pipe while comprising less than 10% of the total number of CP systems. In recent years, PSE has been working to make the impressed current systems smaller. This is beneficial as it makes troubleshooting low CP reads easier, thus decreasing the length of time a system is down. It also provides better CP current distribution, resulting in more even cathodic protection throughout the system.

Table 8. Number of CP Systems and Miles of Pipe Protected

CP System Type	Number of Systems	Miles of Pipe Protected
Impressed Current	296	3,600
Galvanic	3,106	400
Total	3,402	4,000

Another interesting trend is the increase in the number of individual test sites that passed inspection. These are test sites for individually protected wrapped steel services that are inspected every 9-10 years. As shown in Table 9, the percent of test sites passing inspection was fairly steady from 2000 – 2004. In 2005 the number passing began increasing and has remained above previous levels.

Table 9. Number of Individual Test Sites Inspected and Passed Inspection

Year Inspected	Number of Individual Test Sites Inspected	Number of Individual Test Sites that Passed Inspection	% of Individual Test Sites that Passed Inspection
2000	4024	3788	94%
2001	3635	3420	94%
2002	3932	3702	94%
2003	2953	2750	93%
2004	3220	3037	94%
2005	2707	2581	95%
2006	3787	3670	97%
2007	5850	5659	97%
2008	9335	9198	99%
2009	7416	7277	98%
2010	5472	5335	97%

While only a small percentage of these individual test sites did not pass inspection, these test sites are only inspected every 9-10 years compared to system test sites that are inspected annually. As a result, PSE is considering whether additional measures should be taken such as more frequent inspections or replacing or inspecting services found with low reads.

System Condition Report Trends Conclusion

The review of information obtained from the System Condition Reports (Blue Cards) reveals that changes in the environment are the most significant concern in efforts to inspect or maintain facilities nearby. Reduced ability to inspect or maintain facilities is the prominent concern in 51% of observable conditions reported. Changes in the environment also reduce the margin of protection around facilities from 3rd party damage, vehicular damage and vent locations in 1% of observable conditions. Programs which are described in the *Gas Maintenance Programs* section have been put in place and are being developed to address trends identified in these reports.

Analysis of the data gained from Exposed Pipe Condition Reports and data obtained when corrosion is found indicates that our cathodic protection is adequately protecting the wrapped steel pipe from corrosion. Over 98% of the time wrapped steel pipe is exposed there is no corrosion or only minor surface rust. When corrosion is found, the cause is typically related to shielding due to a local issue that is not indicative of system wide issues. Enhancements to backfill procedures, improved materials, and reduced 3rd party damages are all helping reduce future failures. In addition, the risk models PSE uses to evaluate STW systems incorporate these trends.

Federally Reportable Incident Trends

There are very few federally reportable incidents over the past 10 years, thus no trends have been identified. However, these incidents are still worth examining as they represent specific situations where the consequence of a risk is significant. In each of these instances, PSE has examined the root cause and where appropriate PSE has implemented additional measures as described below to reduce future risks.

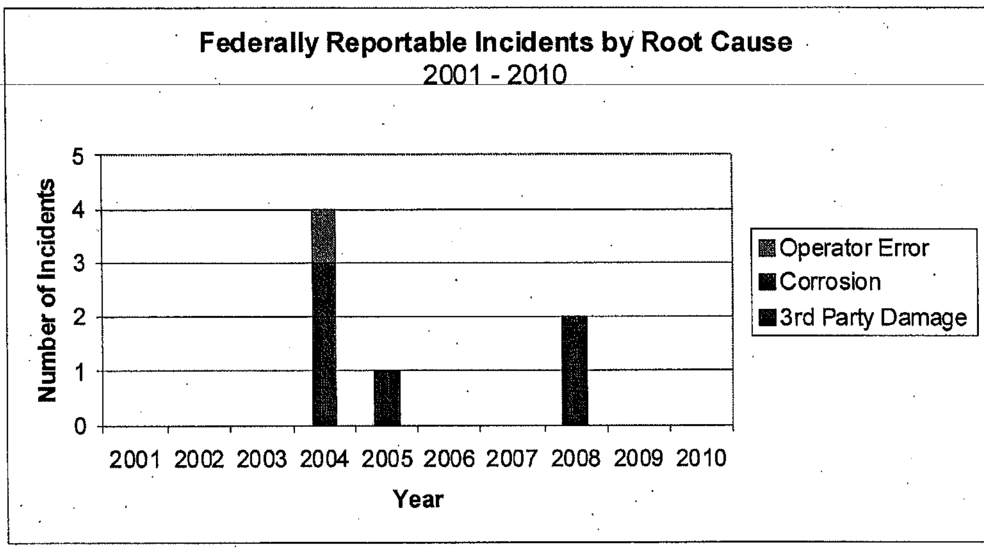

Figure 28. Federally Reportable Incidents by Root Cause

This data illustrates that 3rd party damage is not only the leading cause of leaks on PSE's system but is also the leading cause of reportable incidents. The *Third Party Damage Prevention Trends* section discusses PSE's Damage Prevention Program and the efforts to continue to reduce 3rd party damage.

There were only two incidents that were not caused by third party damage in the period from 2001 to 2010. The corrosion incident resulted in the Wrapped Steel Service Assessment Program (WSSAP) that is discussed in the *Gas Maintenance Programs* section of this report. This program addresses the additional risk knowledge gained from this corrosion incident.

The operator error incident caused personal injury requiring hospitalization. PSE's review of this incident concluded that PSE's operating standards and procedures in place at the time were adequate and would have prevented that incident if followed. Both PSE personnel and its contractors reviewed the incident with their employees at safety meetings and reinforced the need and importance of following operating standards and procedures.

Federally Reportable Incidents Trends Conclusion

There are very few federally reportable incidents over time and as a result, there is not a significant trend shown in this data. The data does show that 3rd party damage is the leading cause of reportable incidents.

Third Party Damage Prevention Program Trends

Through Damage Prevention and Public Awareness Programs, PSE proactively works with public officials, contractors and homeowners to increase awareness of RCW 19.122, Washington State's call-before-you-dig statute. PSE uses a variety of methods to communicate these messages including bill inserts, direct mailings, on-site safety meetings, training sessions, contractor dinners, home-shows and memberships in state and local utility coordinating councils.

As shown by Figure 29, through 2007, locate requests had been surging as a result of the region's active growth and focused "call-before-you-dig" awareness programs. Since 2008, the number of locate requests has steadily decreased, most likely due to the significant reduction in construction activity attributed to the economic slowdown.

The number of excavation damages is also presented on the graph to compare trends. This comparison reveals that excavation damage has generally made a steady decline over this same period of time, continuing a trend that began during the "boom" cycle prior to 2008. In addition, the number of third party damages in 2010 was the lowest reported in the prior 8 years.

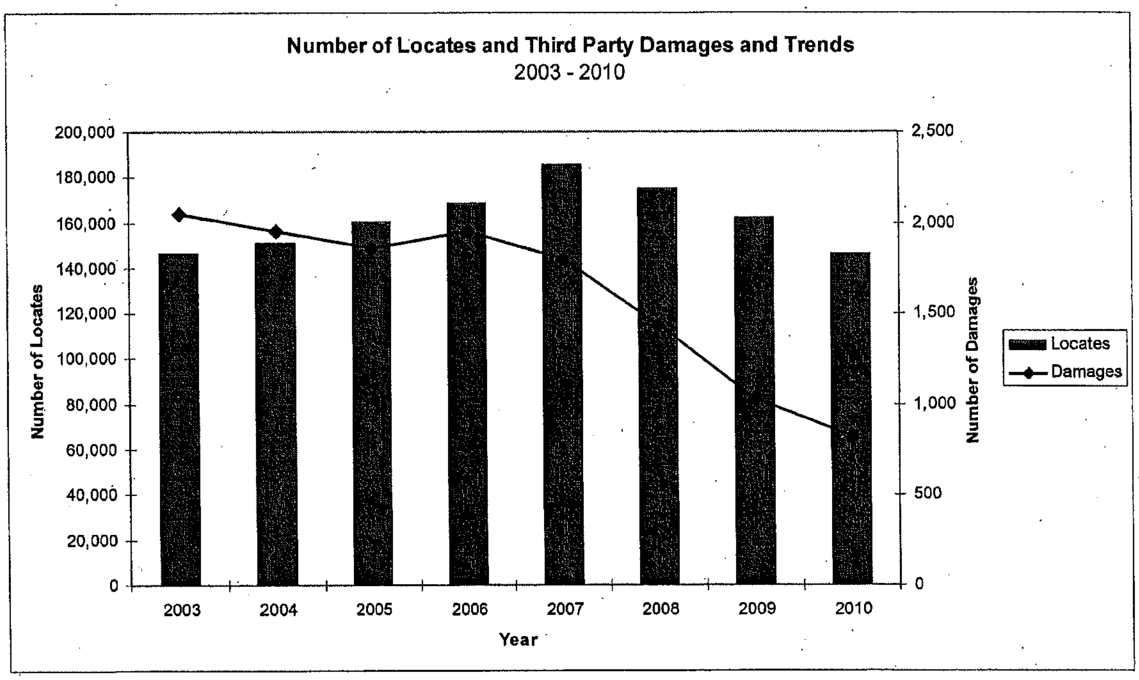

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Figure 29. Number of Locates and Third Party Damages and Trends

Figure 30 is another way to look at the data and gain insight into 3rd party damage trends. This graph presents the data as a ratio of number of damages per 1,000 locate requests. The Common Ground Alliance and industry in general has accepted representing the ratio of damages to locates in this normalized method in order to better reflect the impact of increasing and decreasing excavation activity on 3rd party damage metrics.

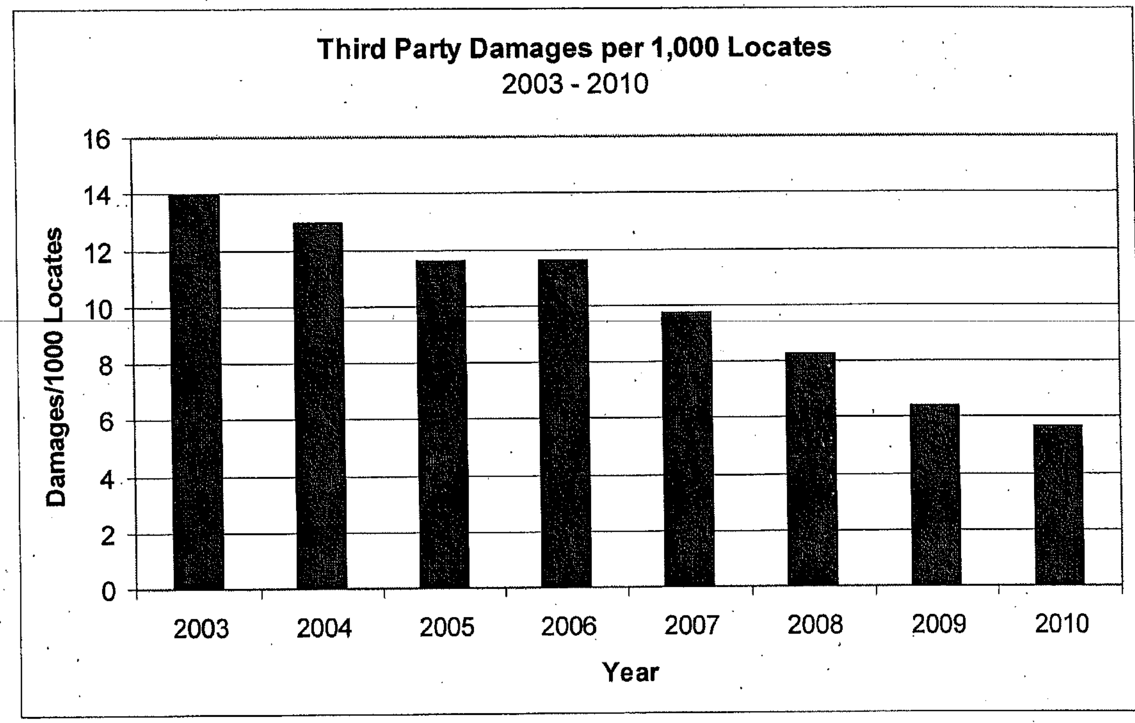

Figure 30. Third Party Damages per 1,000 Locates

This graph illustrates the success PSE has had in reducing damages per locate request. This positive trend has been achieved through a combination of efforts. The most significant reductions have been achieved by excavators using more careful excavation practices and increased public awareness of and adherence to the regulations that require excavators to call for locates prior to excavating as illustrated in Figure 31.

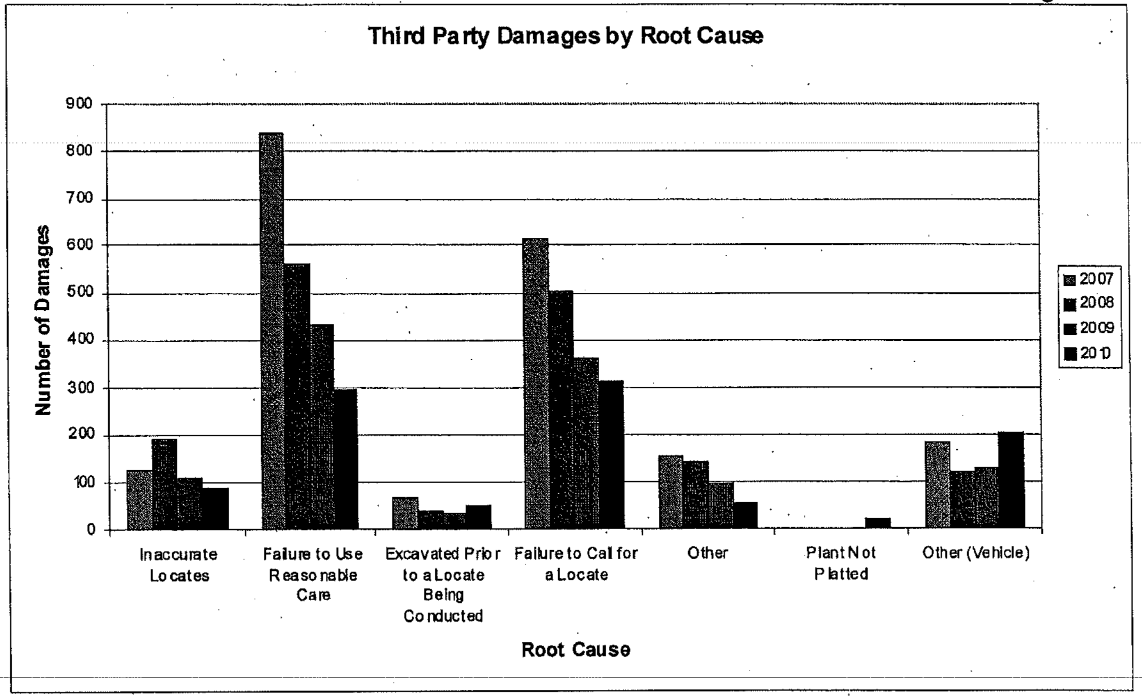

Figure 31. Third Party Damages by Root Cause

While there have been significant reductions in the number of damages due to "Failure to Use Reasonable Care" and "Failure to Call for a Locate", these two categories are still the leading cause of third party damages. PSE recognizes that a key element required to further reduce these damages will require an enhanced approach to enforcing the requirements of RCW 19.122 relative to both calling before excavation and careful excavation practices. This is supported by research AGA has done to benchmark damage prevention programs across the country. Based on this research, distribution companies operating in states that have mechanisms to enforce damage prevention legislation are able to achieve the lowest number of damages per 1,000 locates. Currently, there is proposed legislation in Washington State that would create a safety committee whose purpose would be to reduce damages to underground and above ground facilities through cooperation, coordination, and promoting safe excavation practices. As proposed in the draft legislation, this committee would also assist in resolving disputes related to possible violations of RCW 19.122. This safety committee may result in an improved approach to enforcing compliance with damage prevention regulations.

The graph also indicates there was an increase in 2008 in the number of damages due to inaccurate locates. While there was an increase in 2008, PSE took measures to provide clear expectations of its locating contractors relative to timely and accurate locating and also implemented additional oversight of their performance. As a result, a significant reduction in the number of damages due to inaccurate locating was achieved in 2009 and further improvement made in 2010.

Sewer Cross Bores

Another aspect of 3rd Party Damage that has been of national interest and of interest to PSE is damage that occurs as a result of gas facilities installed using trenchless methods that intersect a sewer line. To help prevent this from occurring, PSE has been working with the WUTC and other

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stakeholders to revise RCW 19.122 to require sewer laterals within the public right-of-way to be located. In conjunction with this, PSE is reinforcing the requirement to window all utilities when using trenchless construction methods. PSE is also exploring the use of camera inspections and other technologies that may be used to confirm that the sewer has not been cross bored after construction using trenchless methods. To identify where existing cross bores may exist, PSE has begun a pilot program working in collaboration with the City of Tacoma. This program will explore a variety of methods that may be used to identify where existing installations may exist. In addition to these efforts, PSE will continue to monitor developments in the industry that may help identify best practices for preventing and remediating existing sewer cross bores.

Third Party Damage Prevention Program Trends Conclusion

PSE has achieved significant reductions in 3rd party damage over the past several years. Even with these improvements, 3rd party damage remains the leading cause of leaks on our system. This trend is consistent throughout industry and highlights the need to continue to work to reduce these damages with a focus on collaborating with all stakeholders to improve awareness of and compliance with the damage prevention regulations. PSE is continuing to increase and refine its damage prevention awareness and education activities. One primary way this is being accomplished is by reaching out to all groups, organizations, and associations who either directly or indirectly participate in construction activities. Further PSE is committed to meeting the requirements of RP 1162 specifically as it relates to Damage Prevention.

Part 4: Gas Maintenance Programs

Gas maintenance programs are designed to address the overall condition of the natural gas system and to take corrective action where necessary to mitigate or prevent safety and compliance risks. PSE performs ongoing gas system maintenance as a centralized, planned activity aimed at maximizing cost benefits and meeting compliance requirements. PSE relies on routine activities such as calibrations, patrols, surveys and inspections to assess the performance of components of the natural gas delivery system. This process identifies conditions that require corrective action, such as equipment repair or replacement. When a maintenance issue is identified, it is either addressed through an immediate corrective action or evaluated for follow-up action. This method for addressing maintenance issues is common across most of PSE's maintenance programs. Unless otherwise noted below, gas maintenance programs are ongoing. The overall scope of a non-mandated program will vary from year to year based on the number of maintenance issues reported from field observations and the overall risk those issues present.

Current Programs

Bare Steel Replacement Program

PSE is currently working to replace all bare steel and wrought iron facilities in PSE's system by the end of 2014. In 2010, a total of 111,127 feet of bare steel and wrought iron main were retired. Since 2005, 646,491 feet (122.4 miles) have been taken out of service leaving approximately 446,469 feet (84.6 miles) to be completed by the end of 2014. A summary of program progress is provided in the chart below.

In 2009, PSE identified opportunities to reduce overall system risks by integrating the risk of WSSAP Priority and Scheduled Replacement services with the Bare Steel Risk Model. This proposal was presented and WUTC Staff approved the concept. This approach was incorporated in prioritizing the replacement plans for 2010 and resulted in reducing disruption for our customers, fewer paving cuts in the streets, and lower program costs by replacing main and services concurrently rather than replacing the services in 2010 and the main in later years.

Table 10. 2005-2011 Bare Steel Replacement Footages

Year	2005	2006	2007	2008	2009	2010	2011
Planned Replacement (feet)	46,995	99,205	99,205	99,205	99,205	99,205	120,000
Actual Replacement (feet)	48,078	90,272	175,386	112,253	109,375	111,127	N/A
Cumulative Actual Replacement (feet)	48,078	138,350	313,736	425,989	535,364	646,491	N/A

Wrapped Steel Service Assessment Program (WSSAP)

The Wrapped Steel Service Assessment Program (WSSAP) was initiated in 2006 to evaluate the risk of the wrapped steel services installed prior to 1972 and ensure those with high risk are mitigated. The program uses a risk model to categorize approximately 90,000 WSSAP services into four mitigation categories: Priority Replacement, Scheduled Replacement, Increased Leak Survey, and Standard Mitigation. These categories specify what mitigation is required.

The data in the risk model is updated each year and a new risk score is calculated for each service. Table 11 shows the results of the annual model run since inception of the program.

Table 11. Historical WSSAP Model Results

Mitigation Category	2006 Model Results	2007 Model Results	2008 Model Results	2009 Model Results	2010 Model Results
Priority	516	216	212	79	91
Scheduled Replacement	8,470	8,092	4,682	2,077	303
Increased Leak Survey	23,100	23,258	22,913	22,760	22,731
Standard Mitigation	69,281	69,742	68,660	68,280	67,658
Subtotal	101,367	101,308	96,467	93,196	90,783

The initial goal of WSSAP was to mitigate all services in the two highest priority categories (Priority and Scheduled Replacement) by December 31, 2010. PSE achieved this goal with the exception of 18 of the scheduled replacement services. These services were not able to be mitigated in 2010 due to permit issues and/or customer issues. As of April 29, 2011 nine of these services had been mitigated. The remaining services will be mitigated after permits are obtained and customer issues resolved.

PSE also conducted more than 1,000 electrical surveys on services from the two lowest risk categories; increased leak survey and standard mitigation. These surveys were evaluated and direct examinations performed based on the analysis of the survey data. These surveys and direct examinations were performed to validate the risk model or determine if adjustments were needed to improve the model. The results of this analysis did not indicate any adjustments were needed to the WSSAP model. As a result, PSE will continue to run this risk model annually and mitigate services that migrate into the priority or scheduled replacement categories. PSE plans to migrate WSSAP into our written Distribution Integrity Management Program (DIMP.)

In 2010, PSE mitigated more than 2,000 WSSAP services from all mitigation categories. Table 12 shows the services mitigated by category as well as the mitigation remaining to be completed in 2010.

Table 12. WSSAP Mitigation in 2010 and 2011 Target Mitigation

Mitigation Category	Mitigated Through WSSAP	Other Mitigation	Total Mitigation	Services Remaining to be Mitigated in 2010
Priority	5	26	31	77
Scheduled Replacement	658	244	902	24
Increased Leak Survey	90	546	636	NA
Standard Mitigation	188	428	616	NA
Subtotal	941	1,244	2,185	101

Pre-1972 STW Main Replacement

Pre-1972 wrapped steel main adjacent to WSSAP priority and scheduled replacement services have been reviewed to determine if there is evidence of corrosion and whether they should also be replaced. These segments are designated as WSSAP mains in Table 13.

Additional pre-1972 wrapped steel mains not adjacent to WSSAP priority and scheduled replacement services were also reviewed to determine if there was evidence of corrosion and whether replacement or other mitigation was appropriate. These segments are designated as DIMP mains in Table 13.

PSE reviewed these using a risk model developed to rank wrapped steel segments as well as subject matter experts input. Based on these reviews, these segments were classified as scheduled replacement, increased leak survey, or standard mitigation. As shown in Table 13, over 6,000 feet of main were replaced in 2010 and over 18,000 feet are targeted for replacement in 2011. The mains that are scheduled for replacement are leak surveyed semi-annually until they are replaced. The mains that are designated as increased leak survey are leak surveyed annually until it is determined that the main should be replaced or moved to standard mitigation. Approximately 10,000 feet of main were designated as increased leak survey for 2010 and over 38,000 feet have been designated as increased leak survey for 2011.

Table 13. WSSAP and DIMP STW Main Replacement Footages

Footage	Planned for 2010	Replaced in 2010	Planned for 2011
WSSAP Mains	4,000 feet	2,422 feet	350 feet
DIMP Mains	14,000 feet	4,062 feet	18,000 feet
Total	18,000 feet	6,484 feet	18,350 feet

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Isolated Facilities Extension Programs

In 2009, the scope of the Isolated Facilities Program was expanded to include potential isolated facilities associated with sidewalk regulators, above ground regulators, steel services in casings, and extended service lines in mobile home communities. More detail on each of these programs is included below. Each of these programs will be completed by the end of 2014.

Sidewalk Regulators – There are 96 sidewalk regulators targeted under this program. The primary maintenance issue is insufficient cathodic protection between the regulator and building wall. In 2009 efforts focused on assessment and investigation of over 600 sidewalk regulators to determine the population of facilities requiring remediation. There were an additional 61 sidewalk regulators found during the initial assessment phase where the only maintenance issue is non-standard venting. These are not required by the 2014 program deadline and will be addressed under a separate initiative. In 2011, 35 sidewalk regulators are planned for remediation.

Above Ground Regulators – The focus of this initiative is on outside, above ground regulators with piping going below ground prior to entering a building. In 2009, several such installations were found to have insufficient cathodic protection on the piping between the regulator and the building wall. In 2010, PSE completed a field assessment on 888 locations to confirm adequacy of cathodic protection and that the facility does indeed meet the scope of the program. By the end of 2010, 636 locations were either remediated or eliminated from the scope of the program leaving 252 total locations requiring remediation between 2011 and 2014. In 2011, 120 locations are planned for remediation.

Steel Services in Casing – As part of the original Isolated Facilities Program records review, 531 wrapped steel services were identified as being installed in steel casing. While not part of the original program casing commitment, it was recognized that a similar risk existed. Given the cost to expose and examine these facilities, it was decided the most effective form of remediation was to replace these services. All 531 services will be replaced by the end of 2014. In 2010, 117 services were remediated or found to not require remediation (already replaced under other work, for instance). In 2011, 354 services are planned for remediation.

Extended Service Lines in Mobile Home Communities – These facilities are defined as buried piping installed to a mobile home in a mobile home park between the gas meter and the mobile home. In 2010, PSE performed inspections of all mobile home communities to develop a complete inventory of all such installations. At the time of inspection, each location was leak surveyed and inspected for atmospheric corrosion. The inspection identified 369 installations that include Extended Service Lines. PSE will mitigate maintenance risks with these facilities through full service replacements. 25 such installations were eliminated through replacement in 2010 with 89 additional locations scheduled for replacement in 2011. All replacement work will be complete by the end of 2014 and prior to replacement each installation will be leak surveyed twice annually.

Regulator Station Remediation

Maintenance issues at regulator stations are typically identified by PSE Pressure Control during the annual inspection required by PSE GOS 2575.1000. During the annual regulator inspection, Pressure Control may be able to address minor maintenance issues such as replacement of small equipment valves. More extensive maintenance issues that may represent a compliance or safety risk, or otherwise impact the proper operation of the station are reported to GSI for remediation. Common issues reported to GSI include leaks, atmospheric corrosion, inoperable equipment/valves, access issues, and vault integrity issues. GSI works with Pressure Control and Gas System Engineering to determine a scope of work to mitigate or remediate the maintenance issue(s) and to assist in prioritizing the work. In 2010, 19 regulator stations were remediated. This included 4 upgrades, 3 replacements, and 12 retirements. A total of 56 district regulators are targeted for remediation in 2011.

Converted Single Service Farm Tap Program

The purpose of this program is to ensure that all single service farm taps (SSFT) that were converted to district regulators meet the more stringent regulatory requirements for pressure regulating stations. In 2006, PSE catalogued the location of each SSFT and a list of potential issues that required remediation as a pressure regulating station. A total of 60 stations were identified requiring remediation. GSI developed a 5-year remediation schedule to bring each SSFT up to current pressure regulating station code beginning in 2008. At the end of 2010, 33 of the 60 stations had been remediated. In 2011, the plan is to remediate 10 stations with all stations scheduled to be remediated by the end of 2013.

Regulator Station Pipe Support Mitigation

In 2008, during the Thurston/Lewis County audit, the WUTC discovered pipe support structures at the Olympia Gate Station which they determined inhibited an adequate inspection for atmospheric corrosion. Subsequently, the WUTC requested that PSE submit a plan for an assessment and remediation program of any similar installations system-wide by March 2009. PSE created a listing of 19 gate stations with concrete pipe supports that contributed to an inability to thoroughly inspect for atmospheric corrosion. More detail on PSE's proposed approach to mitigating pipe supports at the 19 gate stations is included in the white paper titled *"Atmospheric Corrosion Inspection"* dated November 23, 2009.

In 2010, PSE implemented a pilot program to field test the proposed approach of performing an initial, indirect inspection prior to determining what (if any) remediation work is required at a support. The intent of the pilot program was to validate PSE's proposed approach to assessment and remediation at pipe supports at gate stations and to expand the effort to the other 13 gate stations. The Pilot Study inspections (8 regulating stations, 61 pipe supports) were completed on 4/30/2010. The data analysis was summarized in the report, "Puget Sound Energy Pipe Support Atmospheric Corrosion Pilot Study" dated September 21, 2010. The report concluded there is good correlation between the corrosion evidence prior to removing pipe supports and the condition of the pipe after pipe support removal. A third party engineering firm, Kiefner and Associates (KIA), was hired to review the data and critique the study. The KAI document supported the contentions in PSE's report and concluded that "...the absence of visible corrosion deposits indicates a condition that clearly and conservatively meets the requirements of 49 CFR Part 192 regarding atmospheric corrosion, specifically §192.479 and §192.481". The data and conclusions were presented to WUTC staff on April 21, 2011. Staff agreed with the findings and steps are being outlined to move forward with the inspection protocols. The first stage of implementation will be the regulating stations maintained by pressure control. Documents supporting the implementation are scheduled to ready by the end of July 2011. It is believed that this risk-based approach to mitigating atmospheric corrosion concerns can be expanded to other facilities such as pipelines on bridges and industrial meter sets and will in the long run save PSE extensive and costly remediation efforts

Regulator Station Over Pressure Protection

PSE performs an annual review of all of its regulator stations to ensure adequate relief capacity factoring in changes to station configurations and/or system operating pressures. Gas System Engineering (GSE) performs the review in accordance with PSE GOS 2575.1000. Any stations found to have insufficient relief valve capacity are forwarded to GSI for scope development and remediation. In 2010, three stations were remediated for relief capacity issues. In 2011, three more stations will be remediated to ensure adequate relief valve capacity. The stations identified for remediation in 2010 and 2011 were the result of a one-time research effort for the Regulator Station Database Project. Additional data was gathered on attributes related to the regulator stations that led to them failing their relief review – there is no observable trend in stations failing relief reviews at this time.

Industrial Meter Set Remediation

Industrial Meter Operations (IMO) may identify maintenance issues at industrial meters during routine meter work, periodic meter change outs, or when responding to other maintenance issues such as a leak investigation. GSI works with the IMO Supervisor and Gas System Engineering (GSE) to document the maintenance need, prioritize and schedule any remediation work, and to track remediation work to completion. Additionally, there is a separate initiative to all Rockwell 5000 meters from PSE's gas system because they are shown to have a tendency to fail their fixed factor checks. In 2010, 4 industrial meters and 9 Rockwell 5000 meters were eliminated. In 2011, the plan is to remediate 3 industrial meters and 7 Rockwell 5000 meters.

Buried MSA Remediation

The Buried MSA Remediation program commenced following identification of significant numbers of buried meters in 2007. A pilot program was completed with the assistance of GFR in 2008 with a full remediation effort beginning in 2009. The concerns addressed by the program include the corrosive effects of soil in contact with facilities not designed to be buried and the inability to inspect these facilities for corrosion. To date over 50,000 locations have been reported that require reinspection and remediation. Because remediation is a multi-year effort, all locations are mitigated with increased leak survey beginning in 2010. Remediation is prioritized to first address buried meters, then buried shut off valves, then buried transition fittings (both service head adaptors and pre-built risers). The remediation process includes reinspection and possible remediation by GFR. If needed, GFR forwards a work scope to the service provider. GFR efforts include communication with the customer on the need to protect the MSA from reburial. In 2010, GFR reinspected 3030 locations. GFR resolved 2360 of those reports and service provider resolved 171. The remaining 499 were scheduled for remediation in 2010. 2011 plans include 2460 additional inspections with many resolved by landscaping or plumbing. The service provider will continue to participate with approximately 130 riser replacements and 120 service replacements.

Traffic Protection Enhancements

The need for new or improved traffic protection became apparent with an increasing number of reports submitted in 2007. Guard posts or other approved protection are required to protect above ground gas facilities (primarily MSAs) where traffic exists in the area of the facility. GSI reviews all reports of substandard traffic protection. Reports related to gas facilities on property used for industrial, commercial and other public uses are addressed as the highest priority. Other priority work includes reports at multifamily and single family residential property where damage due to vehicle traffic is reported and where regular traffic is reported. Locations with infrequent traffic are lower in priority. GSI forwards requests to install or upgrade traffic protection to the service provider for installation as required to meet the current operating standards. Guard posts were installed at 35 locations in 2010 with plans for 110 locations in 2011.

Rocks and Debris on Buried Pipe

Increased numbers of reports identifying rocks and debris on buried pipe became apparent in 2008. This condition is a concern because a significant amount of rocks near STW pipe can shield the pipe from CP current. Rocks in contact with PE pipe put stress on the pipe that can eventually result in leakage due to cracking. PSE and its service providers remove rocks and debris found on or near buried pipelines upon observation. The condition is reported and reviewed as an indicator of the possible environment around the pipeline nearby. These reports are sorted according to the material impacted and forwarded to either the Cathodic Protection Engineer or the program manager for Older PE Pipe Replacement for evaluation of the potential impact on the pipeline. Reports of improper backfill on older PE pipe are considered in the Older PE Pipe Replacement Program risk model.

Shallow Main and Service Remediation

Shallow main and service reports were first recognized as a trend in 2008 while reviewing CS records from 2007. Concern with shallow pipe focuses on the increased likelihood of damage to the pipe during 3rd party construction. Mains and services are considered shallow where they have less cover than required for new construction in the gas operating standards. Shallow mains are investigated to determine the extent and severity of the condition. The reported depth, type of facility and environment are considered in determining which reports are priorities for investigation. Priorities for remediation are based on the findings of the investigation and consideration of other construction in the area. Shallow services are usually not investigated further but are instead planned for full replacement. Investigations are requested by GSI and performed by GFR. GFR provides approximate depth measurements obtained by instrument readings throughout the shallow area. GSI models the severity of shallow main to determine the risk of a given segment by applying a severity factor that considers the type of main, location of the main and the approximate amount of cover over each part of the main (for example, an HP main with 24" of cover has a higher severity factor than an IP main with 24" of cover and IP main 24" under a bar ditch has a higher severity factor than IP main under the street). The severity score is the sum of the total footage in each severity group by the severity factor for each group. Generally, the highest score/mile is the highest priority project. Replacements of shallow facilities are requested by GSI and performed by the service

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provider. 5 shallow main segments were replaced in 2010 with 7 more planned for 2011. 1 shallow segment of HP was replaced in 2010. 18 shallow services were replaced in 2010 with 14 more planned for 2011.

Older PE Pipe Replacement

Some segments of older (defined as pre-1986) PE pipe have factors that lead to an increased risk of repeat failures including fusion failures and brittle cracking. These factors include substandard fusion and backfill practices and a pipe resin inferior to that in use today. In 2008, PSE implemented improved processes in materials failure analysis that greatly enhanced the ability to identify fusion and brittle-like cracking failures on older PE pipe, especially the HDPE pipe manufactured by DuPont that is most susceptible to these failures. Additionally, in 2010 PSE implemented a new policy to replace pre-1986 PE services included as part of larger main replacement programs such as Bare Steel Replacement. The cost to test-and-tie an existing service is almost 40% of the cost to replace it under these programs -- this policy was put in place to the additional risk these services pose instead of spending additionally money to keep them active and subsequently maintain them. In 2009, PSE developed a risk model for DuPont pipe segments based on their failure history. The risk model was developed to align (as closely as possible) with the risk model used to rank main segments for the Bare Steel Program. This has allowed for a risk comparison between programs to assist in validating the approach and scope of PSE's DuPont pipe replacement efforts. This methodology will continue to be evaluated and refined as both programs progress and PSE's new DIMP is implemented. In 2010, 9541' of DuPont PE pipe were replaced. In 2011 the plan is to replace 23,615' of DuPont PE pipe.

Mobile Home Community (MHC) Encroachment Surveys

Gas First Response (GFR) surveys each mobile home community once very three years for service and main encroachments as well as idle risers. Over time, mobile home units have changed in size, and a number of mobile home communities have reconfigured their lots. As a result, many mobile homes are encroaching on buried natural gas lines. This multi-year maintenance program assesses the extent of the problem and remediates pipeline encroachment and other maintenance issues such as idle risers (risers tied to the pipeline but no longer having a meter). In addition, PSE educates community owners and managers of encroachment issues to prevent recurrence. There are currently 172 MHCs in PSE's operating system and PSE conducted 53 MHC patrols in 2010. The results of each MHC survey are documented; and if encroachments or idle risers are found, that information is sent to GSI for prioritization and scheduling. GSI ranks each MHC based on the extent and type of maintenance issues in order to assist with prioritization and scheduling of any remediation work.

In 2010, remediation was performed in 25 different parks and resulted in elimination of 315 combined main and service encroachments, and the cut and cap of 182 idle risers. In 2011, remediation will be performed in 27 different parks and result in elimination of 244 combined main and service encroachments, and the cut and cap of 86 idle risers.

Docks and Wharves Assessment

In 2011, GSI is beginning a comprehensive assessment of all mains and services installed on docks and wharves. The overall goal of this effort is to permanently document everywhere there exists a main or service installed on a dock or wharf and to establish quarterly patrols at each of those locations. Goals for 2011 include completing an inventory of candidate locations, development of initial inspection criteria/documentation, and inspection of all candidate locations. GSI will be recording the results of each inspection, the condition of PSE facilities, and whether a full inspection is possible or if special equipment or access is needed with the intent of prioritizing each location for follow-up activity. As maintenance concerns are discovered, they will be assessed by GSI and scheduled for remediation as required. It is expected that work under this initiative will continue into 2012 including inspection of the most difficult locations and the majority of remediation activities.

Bridge and Slide Remediation

GFR performs periodic patrols of gas mains and services installed on bridges and within known slide areas. In 2010, 1492 patrols were conducted. The intent of the patrols is to identify maintenance issues associated with pipe coating/wrap, atmospheric corrosion, pipe supports, and other issues with the site or pipe that may present a safety of compliance risk. The patrols are performed quarterly; however, more frequent patrols are established when site conditions warrant such as during periods of heavy rainfall. When GFR identifies a maintenance issue, GSI reviews the issue and develops a plan to mitigate or remediate the concern. In 2010, 16 remediation projects were completed at bridge and slide sites that included the replacement of 2445' of main. Also in 2010, GSI continued to have increased leak surveys at 2 sites where immediate resolution of the maintenance issue was not possible due to project development time. In 2011, 21 bridge/slide projects are scheduled to be completed.

Atmospheric Corrosion at Hard-to-Reach Bridges

In 2006, GSI worked with GFR to identify gas mains and services installed on bridges where access or the configuration of the bridge and pipe prevented a complete atmospheric corrosion (AC) inspection. A total of 38 bridge sites meeting this criterion were identified. AC inspections on pipelines exposed to the atmosphere are required every three years per PSE GOS 2600.1800. The gas facilities included as part of this initiative were determined to pose a potential safety and compliance risk until a complete AC inspection could be conducted.

Each identified site was assessed by GSI, GFR and the PSE Service Provider as to how it could be inspected for AC with initial efforts focused on the use of boom trucks or specialized climbing equipment to allow access to the pipelines. By the end of 2010, 32 of the 38 locations had been completely inspected, determined not to be a hard to reach location (i.e. able to be inspected with current equipment), or the pipeline was replaced due to other, existing maintenance concerns. Of the six sites that remain, four are in casing (and therefore considered to not be applicable for an atmospheric corrosion review), and one will be replaced in 2011. Two sites were inspected for a second time in 2010, and three inspections and one replacement are planned in 2011 for sites that have been previously inspected.

In 2009, upon ongoing review of the AC results for the 38 locations, GSI found that all of the bridge sites were rated at "level 2" or lower and that roughly 90% of the inspections were rated at "level 1". As such, GSI has begun investigation into alternative, less costly forms of inspections for these bridges. Together with GFR and GSE, GSI has begun using video equipment that can be used to get close to pipe surfaces normally not visible to GFR personnel. The inspection results can be saved on DVD as a permanent record of the inspection. GFR is on-site during the inspection and can evaluate the AC rating for the pipeline based on the data collected in the video. Any areas of concern can be flagged and sent to GSI and GSE for further evaluation and possible mitigation. The cost to perform this type of inspection is a fraction the cost of using a boomtruck when permitting, traffic control, and crew time are factored in. In 2010, 2 of the 38 sites were evaluated by video equipment in conjunction with the standard PI inspector site review. In 2011 and going forward, Maintenance Programs in conjunction with Gas First Response will determine what sites should be evaluated by this method, with support from GSI Maintenance Planning as needed.

Aging High-Pressure Valve Mitigation

In recent years, PSE has identified a growing trend of leakage on Rockwell Fig. 1487 valves. These valves were installed on PSE's 16" and 12" high pressure (HP) supply mains in the 1950's and 1960's. The valves have a spur gear that orients vertically and this orientation can allow moisture to collect on the upper bonnet of the valve. Over time this leads to degradation of the steel and leakage can occur. Attempts to repair these valves in place proved not to be practical or cost effective due to the extensive amount of excavation required and that often critical HP supply main pressures have to be lowered in to attempt repairs. Leakage on these valves can temporarily be mitigated by greasing the valve, but longer term, replacement has proven to be the most practical and cost effective way of dealing with the issue. In 2006, GSI compiled a complete list of 62 Fig. 187 Rockwell valves still active in PSE's natural gas system and continually monitors them for leaks and other maintenance issues to determine when replacement is necessary. These valves are also reviewed against other gas system work and public improvement projects to take advantage of potential opportunities for replacement. Given the cost to replace one of these valves there is currently not enough justification to proactively replace these valves short of an existing safety/compliance risk or another cost savings opportunity. In 2010, one Fig. 1487 valve was replaced and in 2011 there are no valves planned for replacement. As leakage or other maintenance issues arise, valves will be planned for replacement.

Double Insulated Flange Valve Mitigation

A double insulated flanged valve is a valve that is isolated from the cathodic protection system. The Double Insulated Flanged Valve program resulted from a year 2000 discovery during the Critical Bond program. Starting in July 2000, all valve bodies at accessible valves were tested during the remainder of the Critical Bond program; inaccessible valves were accessed, tested and remediated only if the plat map showed a double insulated flanged valve. At the close of the Critical Bond program, PSE committed to addressing double insulated flanged valves.

Documentation of the tested and/or remediated valves is limited, and there are several unknowns such as the fact that the double insulated valves are not platted in the legacy Southern Division area. As such, a full plat map review was started in 2009 to identify the population of valves that may be double insulated or otherwise isolated from the cathodic protection system. This plat map review was completed in 2010. The information from this review has been compiled and PSE will determine a long-term strategy on how to mitigate any safety or compliance issues. Currently, these valves are being remediated if there is an opportunity to do so in concert with other maintenance work. Although initial consensus is that these valves do not pose a significant system risk, possible forms of on-going mitigation may include increased monitoring or surveys. PSE is currently developing its written DIMP plan and risk ranking and remediation plans for these valves are being included in this program. Continued field data acquisition under DIMP is also currently being considered to aid in the prioritization and risk assessment of these valves. This includes creating an internal form for valves reviewed during field opportunities, as well as selection of candidate valves for pilot program review based on field and location and operational information.

High Voltage Alternating Current (HVAC) Mitigation Program

PSE operates pipelines in the ROW shared by power transmission. Overhead power may induce voltages on parallel conductors such as steel pipelines. Pipelines that share ROW with overhead power are also at risk of becoming energized when lines are knocked down during storm activity, car-pole accidents and similar incidents resulting in ground faults. Lightning may also energize the pipelines. When the pipelines are energized with a sufficient amount of energy, the result can be damaged coatings, leaks, fires and shock hazards. Energized pipelines can be mitigated through the application of standard industry technologies. Applying these technologies reduces damage to our facilities and creates a safer environment for our employees and the public.

Beginning in 2008, GSE began identifying PSE owned pipelines subject to induced AC voltages or ground faults which could compromise the safety of field personnel or the integrity of the pipeline, pipeline coating, or associated pipeline facilities. This applied to overhead power transmission only. Underground transmission cables have minimal impact on the gas distribution system. This research and investigation effort was largely completed in 2009 and GSE has compiled a list of coated steel pipeline segments at risk for induced AC or ground fault interference from high voltage, overhead power lines. Current efforts are focused on mitigation with one project being completed in 2010. In 2011, three mitigation projects are scheduled to be completed (the remaining three have been rescheduled to 2012).

Looking ahead, the high risk areas have been established and are planned to be mitigated by the end of 2012. New locations will likely be identified in future years and mitigation will be developed and implemented as needed.

High Pressure Main Evaluation and Assessment

Beginning in 2011, high pressure pipelines and non-HCA transmission pipelines will be addressed under DIMP. In the past, PSE has constructed and maintained its high pressure mains to standards that exceed the federal requirements for a distribution pipeline and frequently met the requirements for a transmission pipeline. Currently, PSE is developing a formal strategy on evaluating the risks on high pressure mains and the methodology in assessing those risks. The approach will focus on identifying segments or systems that would likely have a higher consequence of failure and prioritizing those segments for risk ranking. Appropriate mitigative measures will then be implemented based on this risk ranking. As DIMP evolves, performing ECDA and other forms of data gathering on high pressure mains will be considered to gain more knowledge. This strategy will be included in the written DIMP plan and will continue to be developed to address the risks on high pressure mains.

Transmission Integrity Management Program

On December 17, 2003, the USDOT adopted the final rule on Pipeline Integrity Management in High Consequence Areas (HCA) for Gas Transmission Pipelines (49 CFR 192). As a result of this regulation, PSE developed an integrity management program to assess and manage the condition of the approximately 30 miles of transmission pipe on the gas system. PSE has trained field staff to perform an external corrosion direct assessment (ECDA), which is the primary method used to assess the condition of the transmission main. This initial risk assessment was accomplished by the December 17, 2004 deadline.

Based on risk profile data, PSE pipelines were segmented according to the different risk attributes along the pipeline. Each segment was then scored, and a corrosion assessment was scheduled, starting with the higher risk segments. A baseline schedule was established to inspect all 9.5 miles in HCAs over the subsequent seven years. Each HCA is evaluated annually, possibly affecting the inspection schedule. In 2010, the amount of piping in HCAs was reduced from 9.5 miles to 4.4 miles by removing piping operating below 20% SMYS from the HCA requirements.

A summary of 2010 field work and the program plan through 2012 is given in Table 14. The 2012 numbers represent the amount of work required to meet the program required footage assuming the 2011 work is completed as planned.

Table 14. Summary of 2010-2012 TIMP Activity

TIMP Activity	2010	2011 Plan	2012 Plan
ECDA (includes casings)	1.10 miles	0.03 miles	0.00 miles
Casings Examined	3	2	0
Casing Footage Examined	205'	160'	0'

Completed Programs

Isolated Facilities Program

In 2005, PSE agreed to develop the Isolated Facilities Program to identify electrically isolated steel facilities that require cathodic protection. The identification included services, mains, extended utility facilities (EUFs) and casings. After these facilities were identified, they were assessed to verify the ongoing effectiveness of the cathodic protection. Facilities that were not part of the current monitoring program were added and inspected. Facilities that lacked adequate cathodic protection were remediated by adding additional cathodic protection, replacing existing pipe with polyethylene (PE) pipe, or retiring the pipe.

By the end of 2010, PSE had completed inspection of 735,473 service risers (100% of total) and resolved 21,441 isolated facilities (99.9% of total) through service/EUF replacements, riser replacements, or the installation of anodes. One remaining project was completed in early 2011 to get to 100% completion.

Cast Iron Replacement Program

The cast iron replacement program was a 15-year program that began in 1992 and focused on replacing all cast iron pipe system wide. Cast iron was a high risk to the system because as the pipe aged it became more susceptible to leakage. As PSE completed the replacement, records were reviewed to confirm that all documented cast iron was replaced. At the end of the program in 2007, PSE had identified and replaced a total of 1,516,275 feet of cast iron. The footage replaced each year and the cumulative footage replaced over the course of the program is summarized in Table 15.

Table 15. Cast Iron Pipe Replacement Footage

Years	Total Cast Iron Replaced (feet)	Cumulative Replacement (feet)
1993	136,689	136,689
1994	97,933	234,622
1995	143,875	378,497
1996	117,828	496,325
1997	110,909	607,234
1998	106,185	713,419
1999	98,886	812,305
2000	92,572	904,877
2001	111,043	1,015,920
2002	95,039	1,110,959
2003	121,354	1,232,313
2004	105,079	1,337,392
2005	62,539	1,399,931
2006	79,275	1,479,206
2007	37,069	1,516,275

Critical Bond Program

PSE began the Critical Bond Program in 1996 to ensure that all cathodically protected systems had adequate test sites installed. With PSE's system consisting of more than 3,000 individual cathodic protection systems protecting approximately 4,413 miles (23,300,000 feet) of pipe and tens of thousands of services, PSE initiated and completed 100% quality assurance review of all CP systems. More than 270 impressed current systems and 3,000 galvanic systems were reviewed, which included reviewing records and field testing. At the end of the program, more than 23,000 additional test sites were identified and added to PSE's computer system to ensure that these test sites will continue to be monitored. The knowledge and skill obtained through this program ensures that future steel pipe installations are not isolated and are maintained appropriately.

Part 5: System Data

Appendix A presents detailed system data including:

- Summary of Material Types and Years Installed
- Summary of Compression and Mechanical Fittings

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- 2010 Number of Hazardous Leaks Repaired, Categorized by Leak Cause
- 2010 Total Number of Leaks Repaired, Categorized by Leak Cause
- Total Number of Leaks Repaired, Categorized by Material
- Number of Hazardous Leaks Repaired, Categorized by Material
- Threat Leak Frequency by Threat Category
    - Corrosion
    - Natural Forces
    - Excavation Damage
    - Other Outside Force Damage
    - Material, Weld or Joint Failure
    - Equipment Failure
    - Incorrect Operations
    - Other

Appendix A – System Data

Table 16. Summary of Material Types and Years Installed[2]

Material Type	2010 Mains		2010 Services	
	Miles of Main	Years Installed	Number of Services	Years Installed
Cast Iron	Replaced	-	Replaced	-
Bare Steel (Protected and Unprotected)	56	1958 and Older	18,542	1958 and Older
Wrought Iron	30		-	-
Wrapped Steel (Protected)	3,845	1959 - Present	158,837	1959 - Present
Wrapped Steel - 1971 and Older		1959 - 1971		1959 - 1971
Wrapped Steel - 1972 and Newer		1972 - Present		1972 - Present
Plastic	8,059	early 1970s - Present	636,997	early 1970s - Present
Polyethylene - HDPE 3306 - Phillips Driscopipe		early 1970s - 1977		early 1970s - 1977
Polyethylene - HDPE 3406 - Dupont Aldyl HD		1977 - 1985		1977 - 1985
Polyethylene - HDPE 3406 - Phillips Driscopipe M7000		early 1980s - 1984		early 1980s - 1984
Polyethylene - HDPE 3408 - Phillips Driscopipe M8000		1984 - 1988		1984 - 1988
Polyethylene - HDPE 3408 - Plexco (Performance Pipe) Yellowstripe		1988 - Present		1988 - Present
Polyethylene - MD 2406 - Plexco (Performance Pipe) Yellowpipe		1995 - 2008		1995 - 2008
Polyethylene - MD 2406/2708 - Performance Pipe Driscoplex 6500		2008 - Present		2008 - Present
Copper	None	-	40	N/a

[2] Totals in each material type equal the totals reported in the annual 2010 DOT report. Years of installation are approximations for the different material types and are based on available records, notes, and subject matter expert knowledge.

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Table 17. Summary of Compression and Mechanical Fittings[3]

Connection	Approximate Year Installed	Type of Fitting	Manufacturer	Size	Application	Fitting Tested for Pull Out Strength
Steel to Steel	1972 to current	Compression Coupling, Cap, Street Tee	Dresser (Style 90)	½", ¾", 1", 1-1/4", 2"	Join steel service extension to steel service stub	No
Steel to Steel	1972	Compression Coupling	Smith-Blair (Rockwell) (insulated)	¾", 1", 1-1/4", 1-1/2", 2"		No
Steel to Cast Iron or Steel to Steel	1972 to current	Compression Coupling	Dresser (Style 39, 39-62 (insulated))	4", 6", 8", 12"	Join steel main	No
Steel to Steel or Steel to Cast Iron	1983	Compression Coupling	Romac (Style 501 (insulated and non-insulated)	Through 12"	Join steel to steel or steel to cast iron pipe	No
Steel to Plastic		Compression Coupling	Continental	5/8" and 1-1/8"	Join plastic service to: 1. steel gas carrying riser; or 2. to steel service tee w/weld outlet	Yes
Steel to Plastic		Steel Punch-It Service Tee with Compression outlet	Continental	5/8" and 1-1/8"	Main to service tie-in	Yes
Plastic to Plastic	Late 1970's to early 1980's	Mechanical Fittings (coupling, elbow, tee, reducers)	Amp-Fit	5/8",1-1/8",1-1/4", 2"	Join plastic extension to plastic stub	Yes
Plastic to Plastic	1995-current	Mechanical Fittings (coupling, elbow, tee, cap, reducer)	RW Lyall	5/8" and 1-1/8"	Join plastic extension to plastic stub	Yes
Plastic to Plastic	1979 – 1980's	Repair Coupling	Norton McMurray Manufacturing Company (Normac)	1-1/8", 1-1/4", 2"	Repair to damaged plastic mains	Yes
Plastic to Plastic	1970's to early 1980's	Repair Coupling	Dresser (Posi-Hold)	3",4", 6"	Repair to damaged plastic mains	Yes
Plastic to Plastic	1991	Mechanical Fittings (coupling, tee,	Perfection Corporation (Permasert)	5/8", 1-1/8", 1-1/4", 2"	M	Yes

		reducer, end cap)				
Plastic to Plastic	Late 1970's to early 1980's	Mechanical bolt-on service tee	Amp-fit	5/8", 1-1/8", 1-1/4", 2"	Main to service tie-in	Yes
Plastic to Plastic	1998	Mechanical bolt-on service tee with Lycofit mechanical coupling outlet	RW Lyall	5/8", 1-1/8"	Main to service tie-in	Yes

[3] Source: Source: "Mechanical Compression Coupling Fittings", Standards Department

Table 18. 2010 Number of Hazardous Leaks Repaired, Categorized by Leak Cause

Cause of Leak	Mains	Services
Corrosion	16	49
Bare Steel and Wrought Iron (Protected and Unprotected)	6	6
Wrapped Steel (Protected) - 1972 and Newer	0	5
Wrapped Steel (Protected) - 1971 and Older	10	35
Atmospheric Corrosion (includes SAI)	0	3
Natural forces	5	14
Excavation	79	627
Other Outside Force Damage	0	63
Material, Weld or Joint Failure	59	57
Bare Steel and Wrought Iron (Protected and Unprotected)	3	5
Wrapped Steel (Protected) - 1972 and Newer	3	4
Wrapped Steel (Protected) - 1971 and Older	14	16
Polyethylene - 1986 and newer	4	15
Polyethylene - 1985 and older	35	17
Equipment Failure	31	25
Steel	18	12
Polyethylene	13	13
Incorrect Operation	10	21
Steel	3	2
Polyethylene	7	19
Other	22	90
Non-Exposed - Bare Steel and Wrought Iron (Protected and Unprotected)	1	1
Non-Exposed - Wrapped Steel (Protected) - 1972 and Newer	0	3
Non-Exposed - Wrapped Steel (Protected) - 1971 and Older	0	14
Non-Exposed - Polyethylene - 1986 and newer	0	3
Non-Exposed - Polyethylene - 1985 and older	2	5
Other	19	64
Total	222	946

Table 19. 2010 Total Number of Leaks Repaired, Categorized by Leak Cause

Cause of Leak	Mains	Services
Corrosion	53	61
Bare Steel and Wrought Iron (Protected and Unprotected)	16	5
Wrapped Steel (Protected) - 1972 and Newer	1	1
Wrapped Steel (Protected) - 1971 and Older	36	33
Atmospheric Corrosion (includes SAD)	0	22
Natural forces	9	14
Excavation	84	632
Other Outside Force Damage	0	64
Material, Weld or Joint Failure	130	82
Bare Steel and Wrought Iron (Protected and Unprotected)	7	5
Wrapped Steel (Protected) - 1972 and Newer	7	9
Wrapped Steel (Protected) - 1971 and Older	53	28
Polyethylene - 1986 and newer	8	19
Polyethylene - 1985 and older	55	21
Equipment Failure	152	78
Steel	120	31
Polyethylene	32	47
Incorrect Operation	21	34
Steel	11	6
Polyethylene	10	28
Other	138	174
Non-Exposed - Bare Steel and Wrought Iron (Protected and Unprotected)	60	4
Non-Exposed - Wrapped Steel (Protected) - 1972 and Newer	0	7
Non-Exposed - Wrapped Steel (Protected) - 1971 and Older	20	71
Non-Exposed - Polyethylene - 1986 and newer	1	4
Non-Exposed - Polyethylene - 1985 and older	3	10
Other	54	78
Total	587	1139

Table 20. Number of Excavation Damages

Year	Number of Excavation Damages
2010	824
2009	1031
2008	1438
2007	1802
2006	1955

Table 21. Number of Excavation Tickets

Year	Number of Excavation Tickets
2010	146,549
2009	162,108
2008	174,940
2007	185,479
2006	168,643

Table 22. Total Number of Leaks Repaired, Categorized by Material

Material	Mains	Services
Bare Steel and Wrought Iron (Protected and Unprotected)	99	31
Corrosion	16	6
Natural Forces	1	1
Excavation	1	4
Other Outside Force	0	4
Material, Weld or Joint Failure	7	5
Equipment Failure	7	3
Incorrect Operation	0	0
Other	67	8
Wrapped Steel (Protected) - 1972 and newer	38	53
Corrosion	1	9
Natural Forces	0	0
Excavation	1	9
Other Outside Force	0	1
Material, Weld or Joint Failure	7	9
Equipment Failure	21	7

Incorrect Operation	2	1
Other	6	17
Wrapped Steel (Protected) - 1971 and older	259	230
Corrosion	36	46
Natural Forces	3	1
Excavation	13	30
Other Outside Force	0	2
Material, Weld or Joint Failure	53	29
Equipment Failure	92	21
Incorrect Operation	9	5
Other	53	96
Polyethylene - 1986 and newer	83	510
Natural Forces	0	7
Excavation	50	398
Other Outside Force	0	10
Material, Weld or Joint Failure	8	19
Equipment Failure	15	30
Incorrect Operation	6	21
Other	4	25
Polyethylene - 1985 and older	108	272
Natural Forces	5	5
Excavation	19	189
Other Outside Force	0	6
Material, Weld or Joint Failure	55	20
Equipment Failure	17	17
Incorrect Operation	4	7
Other	8	28
Copper	0	2
Excavation	0	2
Aboveground Steel	0	41
Other Outside Force	0	41

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Table 23. Number of Hazardous Leaks Repaired, Categorized by Material

Material	Mains	Services
Bare Steel and Wrought Iron (Protected and Unprotected)	13	29
Corrosion	6	9
Natural Forces	1	1
Excavation	1	5
Other Outside Force	0	3
Material, Weld or Joint Failure	3	5
Equipment Failure	0	2
Incorrect Operation	0	0
Other	2	4
Wrapped Steel (Protected) - 1972 and newer	9	30
Corrosion	0	5
Natural Forces	0	0
Excavation	1	9
Other Outside Force	0	1
Material, Weld or Joint Failure	3	4
Equipment Failure	2	4
Incorrect Operation	1	1
Other	2	6
Wrapped Steel (Protected) - 1971 and older	64	118
Corrosion	10	35
Natural Forces	1	1
Excavation	8	25
Other Outside Force	0	2
Material, Weld or Joint Failure	14	16
Equipment Failure	16	6
Incorrect Operation	2	1
Other	13	32
Polyethylene - 1986 and newer	70	470
Natural Forces	0	7
Excavation	50	396
Other Outside Force	0	9
Material, Weld or Joint Failure	4	15
Equipment Failure	8	9

Incorrect Operation	5	12
Other	3	22
Polyethylene - 1985 and older	66	256
Natural Forces	3	5
Excavation	19	190
Other Outside Force	0	7
Material, Weld or Joint Failure	35	17
Equipment Failure	5	4
Incorrect Operation	2	7
Other	2	26
Copper	0	2
Excavation	0	2
Aboveground Steel	0	41
Other Outside Force	0	41

Table 24. Corrosion Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks/Facility Mile)						Leak Ratio Increasing?
Threat / Sub-Threat	2006	2007	2008	2009	2010	5 Year Ave	
Corrosion	0.0355	0.0465	0.0266	0.0193	0.0168	0.0289	No

Corrosion	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	3949	177419	53	61	114	0.0134	0.0344	0.0168
2009	3987	180567	70	63	133	0.0176	0.0349	0.0193
2008	4009	183571	79	106	185	0.0197	0.0577	0.0266
2007	4045	186655	161	167	328	0.0398	0.0895	0.0465
2006	4087	189263	110	144	254	0.0269	0.0761	0.0356

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Table 25. Natural Forces Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks / Facility Mile)						Leak Ratio Increasing?
Threat / Sub-Threat	2006	2007	2008	2009	2010	5-Year Ave	
Natural Forces	0.0009	0.0002	0.0003	0.0022	0.0009	0.0009	No

Natural Forces	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	12008	814416	9	14	23	0.0007	0.0017	0.0009
2009	11979	811733	27	27	54	0.0023	0.0033	0.0022
2008	11896	805636	2	5	7	0.0002	0.0006	0.0003
2007	11740	792353	1	3	4	0.0001	0.0004	0.0002
2006	11524	775155	0	22	22	0.0000	0.0028	0.0009

Table 26. Excavation Damage Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks / Facility Mile)						Leak Ratio Increasing?
Threat / Sub-Threat	2006	2007	2008	2009	2010	5-Year Ave	
Excavation Damage							
Number of Tickets	168643	185479	174940	162108	146549	167544	No
Number of Leaks	1800	1653	1356	946	716	1294	No
Leaks / Ticket	0.0107	0.0089	0.0078	0.0058	0.0049	0.0076	No
Leaks / Facility Mile	0.0750	0.0675	0.0545	0.0378	0.0285	0.0527	No

Excavation Damage	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	12008	814416	84	632	716	0.0070	0.0776	0.0285
2009	11979	811733	120	826	946	0.0100	0.1018	0.0378
2008	11896	805636	202	1154	1356	0.0170	0.1432	0.0545
2007	11740	792353	251	1402	1653	0.0214	0.1769	0.0675
2006	11524	775155	268	1532	1800	0.0233	0.1976	0.0750

Table 27. Other Outside Force Damage Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks/Facility Mile)						Leak Ratio Increasing?
Threat / Sub-Threat	2006	2007	2008	2009	2010	5-Year Ave	
Outside Force Damage	0.0000	0.0001	0.0011	0.0011	0.0025	0.0010	Yes

Other Outside Force Damage	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	12008	814416	0	64	64	0.0000	0.0079	0.0025
2009	11979	811733	10	18	28	0.0008	0.0022	0.0011
2008	11896	805636	6	21	27	0.0005	0.0026	0.0011
2007	11740	792353	0	2	2	0.0000	0.0003	0.0001
2006	11524	775155	1	0	1	0.0001	0.0000	0.0000

Table 28. Material, Weld or Joint Failure Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks/Facility Mile)						Leak Ratio Increasing?
Threat / Sub-Threat	2006	2007	2008	2009	2010	5-Year Ave	
Material, Weld or Joint Failure	0.0063	0.0076	0.0058	0.0070	0.0084	0.0070	Yes

Material, Weld or Joint Failure	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	12008	814416	130	82	212	0.0108	0.0101	0.0084
2009	11979	811733	113	62	175	0.0094	0.0076	0.0070
2008	11896	805636	96	48	144	0.0081	0.0060	0.0058
2007	11740	792353	125	61	186	0.0106	0.0077	0.0076
2006	11524	775155	121	31	152	0.0105	0.0040	0.0063

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Table 29. Equipment Failure Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks/Facility Mile)						
Threat / Sub-Threat	2006	2007	2008	2009	2010	5-Year Ave	Leak Ratio Increasing?
Equipment Failure	0.0029	0.0220	0.0160	0.0056	0.0092	0.0111	No

Equipment Failure	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	12008	814416	152	78	230	0.0127	0.0096	0.0092
2009	11979	811733	86	54	140	0.0072	0.0067	0.0056
2008	11896	805636	197	201	398	0.0166	0.0249	0.0160
2007	11740	792353	317	221	538	0.0270	0.0279	0.0220
2006	11524	775155	47	23	70	0.0041	0.0030	0.0029

Table 30. Incorrect Operation Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks/Facility Mile)						
Threat / Sub-Threat	2006	2007	2008	2009	2010	5-Year Ave	Leak Ratio Increasing?
Incorrect Operation	0.0001	0.0000	0.0002	0.0012	0.0022	0.0007	Yes

Incorrect Operation	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	12008	814416	21	34	55	0.0017	0.0042	0.0022
2009	11979	811733	20	10	30	0.0017	0.0012	0.0012
2008	11896	805636	2	3	5	0.0002	0.0004	0.0002
2007	11740	792353	0	1	1	0.0000	0.0001	0.0000
2006	11524	775155	0	2	2	0.0000	0.0003	0.0001

Table 31. Other Threat Leak Frequency

Frequency and Trend	Leak Frequency (Total Leaks/Facility Mile)						Leak Ratio Increasing?
Threat / Sub-Threat	2006	2007	2008	2009	2010	5 Year Ave	
Other Threat	0.0292	0.0113	0.0103	0.0224	0.0124	0.0171	No

Other	Quantity		Total Leaks Repaired		Total Leaks	Frequency of Failure		
	Miles Main	# Services	Mains	Services	Mains and Services	Main Leaks/Mile	Service Leaks/100	Total Leaks/Facility Mile
2010	12008	814416	138	174	312	0.0115	0.0214	0.0124
2009	11979	811733	240	322	562	0.0200	0.0397	0.0224
2008	11896	805636	143	112	255	0.0120	0.0139	0.0103
2007	11740	792353	142	135	277	0.0121	0.0170	0.0113
2006	11524	775155	312	390	702	0.0271	0.0503	0.0292