EXH. DJL-3 (Apdx. K)
DOCKETS UE-240004/UG-240005
2024 PSE GENERAL RATE CASE
WITNESS: DAVID J. LANDERS

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. PUGET SOUND ENERGY, Respondent.	Docket UE-240004 Docket UG-240005

APPENDIX K (NONCONFIDENTIAL) TO THE SECOND EXHIBIT TO THE PREFILED DIRECT TESTIMONY OF

DAVID J. LANDERS

ON BEHALF OF PUGET SOUND ENERGY

FEBRUARY 15, 2024

Puget Sound Energy
Pipeline Replacement
Program Plan
June 2023

Docket No. UG-120715

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1. Introduction

On December 31, 2012, the Washington Utilities and Transportation Commission (UTC) issued a policy statement under UG-120715 for the accelerated replacement of natural gas pipeline facilities with elevated risk. This policy statement requires each gas company, whether requesting a special pipe replacement cost recovery mechanism (CRM) or not, to file with the Commission a pipe replacement program plan containing the following elements:

1. A “master” plan for replacement or remediation of pipeline facilities that are demonstrated to have an elevated risk of failure
2. A two-year plan that specifically identifies the pipeline facility remediation goals for the upcoming two year period
3. A plan for identifying the location of pipe that presents elevated risk of failure

In accordance with this policy statement, Puget Sound Energy (PSE) prepared pipeline replacement program (PRP) plans beginning in 2013 for pipe that poses an elevated risk of failure. Through PSE’s Distribution Integrity Management Program (DIMP), performance of the distribution system is continually analyzed and detailed analysis is conducted to identify those facilities considered high risk.

On January 21, 2021, PSE announced its Beyond Net Zero Carbon pledge, setting an aspirational goal to reach net zero carbon emissions for natural gas sales by 2045, with an interim target of a 30% emissions reduction by 2030. PSE’s 2021 PRP was expanded to include actions that aid in the reduction of methane emissions as envisioned by RCW 80.28.420[1]. Subsequently, PSE was approved for a multi-year rate plan (MYRP) beginning in 2022 and is no longer using the Cost Recovery Mechanism (CRM) allowed in the policy statements. The methane emission programs that were included in PSE’s 2021 PRP are incorporated into the MYRP. PSE’s 2023 PRP removes the methane tactics and reports on the pipeline assets and programs with the highest risk of failure. The methane tactics are being addressed outside of the PRP.

2. PSE’s Distribution Integrity Management Program (DIMP)

As required by the DIMP regulations, PSE analyzes many aspects of system performance including trends on identified system threats. The threats that are identified and evaluated in DIMP include:

- Corrosion Failure
- Natural force Damage
- Excavation Damage
- Other Outside Force Damage
- Pipe, Weld or Joint Failure
- Equipment Failure
- Incorrect Operations
- Other Cause

[1] On June 11, 2020, the Washington Legislature passed House Bill 2518 for natural gas transmission and distribution that added a new section to chapter 80.28 of the Revised Code of Washington (RCW). The intent of the new code is to encourage safer and more efficient natural gas transmission and distribution system through investments that address and minimize leaks in the natural gas pipeline system. The new code allows a natural gas company to seek interim recovery between rate cases as part of a commission-approved interim rate treatment mechanism for equipment and new facilities that aid in the reduction of methane emissions including a list of projects and changes to operational procedures including, but not limited to, venting, blowdowns, and others, to expedite the replacement of pipeline facilities that present an elevated risk of failure and expedite the repairs of hazardous leaks and nonhazardous leaks. Requirements of this new section of the RCW include:

1. A list of projects ranked according to risk, severity, complexity, and impact to the environment and public health
2. A proposed spending cap using percent of rate base, percent of revenues, or total expenditures

The analysis includes reviewing active and repaired leak data, failure analysis information, and system condition reports to identify trends affecting the distribution system. Results and conclusions of the review are reported in PSE's Continuing Surveillance Annual Report. A copy of the report is provided to the UTC after each annual update. The analysis provides insight into the risks associated with pipe and assets identified as having an elevated risk of failure that are included in the PRP plan. In addition, PSE reviews the emissions from natural gas facilities to report out the estimated methane emissions amounts from repaired and active leaks. A report is provided to the UTC per RCW 81.88.420. PSE is currently evaluating the impact of methane emissions to the environment and public health and determining how it will be incorporated into DIMP.

PSE continues to improve pipeline safety and system reliability through the ongoing iterations of its integrity management activities. The assessment, prioritization, and mitigation of system risks continue to be refined as new and additional risk knowledge is incorporated into DIMP through normal O&M and DIMP activities. Activities related to DIMP include gathering data, conducting targeted inspections, and completing remediation and replacement work associated with integrity management driven programs. Based on additional risk knowledge and the results of the system trends analysis, the Master Plan may be modified to further accelerate or decelerate pipe replacement and mitigation schedules consistent with the identified risk. Additionally, PSE is actively monitoring system threats and performance and may identify additional materials or assets that have an elevated risk of failure. If any material changes are made to the PRP plan, PSE will submit the changes to the Commission as required by the Commission's Policy Statement.

3. PSE's Master Plan and Progress

Master Plan

The following programs/assets were identified through PSE's risk modeling to have an elevated risk of failure relative to other assets in its system:

Table 1. Pipeline Integrity Risk Programs/Assets

Program/Asset	Pipeline Integrity Risk	Program Status
DuPont Aldyl "HD" Plastic Pipe	High consequence of fusion failure and brittle like cracking	Master Plan Active
Buried Meters	High consequence of external corrosion failure in close proximity to a building wall	Master Plan Active
Sewer Cross Bores	High likelihood of failure and consequence of gas migration directly into a structure	Master Plan Active
No Record Facilities	High likelihood of outside force damage failure in close proximity to building wall	New
Older Vintage wrapped steel mains	Elevated risk reduced through implementation of master plan	Removed from PRP
Older Vintage wrapped steel services	Elevated risk reduced through implementation of master plan	Removed from PRP

PSE's 2021 PRP also identified programs/assets with an elevated risk of methane emissions in accordance with RCW 80.28.420. These programs were removed from this PRP and are incorporated into the MYRP.

Table 2. Methane Emission Risk Programs/Assets

Program/Asset	Methane Emission Risk	Pipeline Integrity Risk	Program Status
Active Leak Reduction Program	Nonhazardous belowground leaks (Grade B & C)	Low	Removed from PRP and incorporated into MYRP
Damage Prevention Program	Excavation Damage from improper excavation practices and from unmapped facilities	High	Removed from PRP and incorporated into MYRP
Above Ground Meter Set Remediation	Nonhazardous releases of gas (NARG)	Low	Removed from PRP and incorporated into MYRP

Master Plan Progress

The following table summarizes the miles of pipe, number of meters, number of cleared sewer segments, and the number of services replaced under the replacement programs according to the Master Plan since 2013.

Table 3. Summary of Programs from 2013-2022

	DuPont Aldyl "HD" Plastic Pipe (Active)		Buried Meter Remediation (Active)		Sewer Cross Bore Remediation (Active)		Older Vintage Wrapped Steel Mains (Removed)		Older Vintage Wrapped Steel Services (Removed)	
Program (Calendar) Year	Miles of Pipe	Expenditures (Millions)	Number of Meters	Expenditures (Millions)	Cleared Sewer Segments	Expenditures (Millions)	Miles of Pipe	Expenditures (Millions)	Services	Expenditures (Millions)
2013	6.5	$6.9					3.2	$3.7	163	$1.6
2014	10.5	$13.5					4.5	$7.1	187	$2.1
2015	28.6	$41.4					4.0	$6.5	208	$2.7
2016	27.4	$32.7					5.0	$7.9	215	$2.8
2017	27.9	$41.9					5.2	$10.3	212	$3.3
2018	38.8	$64.5								
2019	27.7	$62.8								
2020	14.6	$44.5	7,525	$5.3	8,009	$3.3				
2021	15.5	$42.0	8,505	$5.0	9,316	$3.5				
2022	13.0	$38.2	8,446	$6.1	7,180	$3.6				
Total	**210.5**	**$388.4**	**24,476**	**$16.4**	**24,505**	**$ 10.4**	**21.9**	**$35.5**	**985**	**$12.5**

The following table summarizes the leak repairs, avoided damages, NARG repairs, and emission reduction under the methane emission programs as part of PSE's Master Plan. These programs were removed from the 2023 PRP and incorporated into the MYRP. PSE will continue to report on this information through 2023.

Table 4. Summary of Programs Addressing Methane Emissions starting in 2022

	Active Leak Reduction			Excavation Damage Prevention Measures			NARG Repairs		
Program (Calendar) Year	Leak Repairs	Emission Reduction (tCO2e)	Expenditures (millions)	Avoided Damages	Emission Reduction (tCO2e)	Expenditures (millions)	NARG Repairs	Emission Reduction (tCO2e)	Expenditures (millions)
2022	258	925	$3.4	35	490	$0.4	0	0	$0
2023	TBD			TBD			TBD		
Total	**258**	**925**	**$3.4**	**35**	**490**	**$0.4**	**0**	**0**	**$0**

4. DuPont Aldyl "HD" Plastic Pipe

Master Plan

Pipeline Integrity Risk Assessment

PSE identified an increased risk of premature, brittle-like cracking of the larger diameter (1-1/4" and larger) Aldyl "HD" plastic pipe manufactured by DuPont. PSE installed this pipe in the 1970s and early 1980s and originally estimated there to be approximately 400 miles remaining in service as of 2013. After further review, PSE estimates the total to be nearly 435 miles in service at the beginning of 2013, prior to any pipe replacement completed under the PRP plan.

The brittle-like cracking is due to slow crack growth (SCG) at locations where there is a stress concentration. Based on PSE's experience, the brittle-like cracking is primarily due to rock impingement but also occurs where the pipe has been squeezed or where other stress concentrations have been introduced due to inconsistent joining practices. The failure is referred to as brittle-like cracking because it occurs without any localized plastic deformation. While the failure occurs without plastic deformation, the pipe is not brittle. Even when a failure occurs due to SCG, the PE pipe is still resistant to crack propagation preventing it from becoming a larger crack. A study by GTI (Gas Technology Institute) performed at PSE's request provides additional insight into how installation and operating practices, environmental conditions, and operating pressures impact the life expectancy of the pipe.

PSE developed and implemented a program in 2010 to prioritize larger diameter DuPont Aldyl "HD" plastic pipe for replacement based on the likelihood and consequence of failure. The program was incorporated into DIMP and evaluates the risk of brittle-like cracking based on installation and operating practices and environmental conditions. These segments of larger diameter DuPont Aldyl "HD" plastic pipe have an elevated risk of failure as validated by DIMP system performance data.

Industry Experience

PSE's experience with the larger diameter DuPont Aldyl "HD" material is similar to industry experience with many of the older PE materials. This is highlighted by many of the Safety Recommendations issued by the National Transportation Safety Board (NTSB) on April 30, 1998. These recommendations were based on findings from NTSB's investigation of PE pipe following several natural gas distribution accidents that involved plastic piping that cracked in a “brittle-like” manner. The following summarizes many of the issues identified in the NTSB’s investigation that correlate to PSE’s experience with the DuPont Aldyl “HD” material:

- Nationally, brittle-like failures represent a frequent failure mode for older plastic piping.
- The procedure used to rate PE materials from the 1960s through the early 1980s may have overrated the materials long term strength and resistance to brittle-like cracking.
- The test methods used at the time did not reveal the susceptibility of many early PE materials to brittle-like cracking.
- Plastic pipe was assumed to perform in a ductile manner; therefore, plastic pipe design focused primarily on stress due to operating pressure. As a result, little consideration was given to stress due to external loading as it was assumed that these stresses would be reduced by localized yielding.
- Experts in gas distribution plastic piping indicate that some of the PE pipe manufactured from the 1960s through the early 1980s has demonstrated poor resistance to brittle-like cracking. There is evidence that some early vintage PE materials have a lower SCG resistance than other PE materials. Newer test methods more accurately predict the pipe’s resistance to SCG.

Aldyl “HD” vs Aldyl “A”

In addition to the Aldyl “HD”, DuPont also manufactured a medium density PE pipe marketed under the name Aldyl “A”. While PSE only purchased and installed the Aldyl “HD” pipe, information on both Aldyl “A” and Aldyl “HD” pipe is included to highlight the similarities and differences in the risks of these two materials. Similar to PSE’s experience with Aldyl “HD”, the Aldyl “A” pipe has been found to be susceptible to brittle-like cracking.

The Aldyl “A” pipe manufactured from 1970 through early 1972 had a manufacturing issue that resulted in a brittle inside surface also referred to as low ductile inner wall (LDIW). This characteristic resulted in premature failures. In early 1972, DuPont changed the manufacturing process to address the LDIW phenomena. While only early 1970s vintage Aldyl “A” pipe had the LDIW inner surface, both Aldyl “HD” and later vintage Aldyl “A” have exhibited brittle-like cracking failure characteristics in pipes 1 ¼” and larger in diameter. The smaller diameter piping is more flexible and not as susceptible to the brittle-like cracking experienced in larger diameters.

Both Aldyl “HD” and Aldyl “A” were made with state-of-the-art PE resins at the time of manufacture and met applicable industry standards and complied with federal regulations. However, by today’s standards they both have low resistance to SCG and are susceptible to SCG field failures. This is particularly true when these pipes are subjected to secondary loads, such as rock impingement and squeeze-off.

Predictions on the Remaining Useful Life Expectancy

PSE consulted with Gas Technology Institute (GTI) to develop data, information, and predictions on the remaining useful life expectancy based on samples of DuPont Aldyl “HD” plastic pipe extracted from PSE’s distribution system. The purpose for the evaluation performed by GTI is to provide additional risk knowledge into the failure mode of DuPont Aldyl “HD” plastic pipe and information on the pipe characteristics, operating conditions, and environmental factors that may impact the material’s performance. This study also provides a means to predict the remaining useful life expectancy of the pipe to validate the current remediation schedule or determine the appropriate remediation timeframe. Based on the testing and analysis performed, the study concludes that the expected useful life is impacted by temperature, operating pressure, and the severity of stress risers.

Based on the evaluation, there may be specific pipelines operating at relatively low pressures that even under extreme stress risers pose minimal risk. These facilities may be deemed to be low risk and not replaced as part of the Master Plan. The overall pipe replacement strategy will continue to prioritize based on the highest risk pipe from historical performance, however may be adjusted considering the new risk knowledge.

DuPont Aldyl "HD" Plastic Pipe Replacement Program Plan

PSE is actively replacing the larger diameter DuPont Aldyl "HD" plastic pipe that poses an elevated risk of failure. The current plan is to replace this pipe within 20 years beginning in 2013. PSE will continue monitoring the performance of larger diameter DuPont Aldyl "HD" pipe. By acquiring new risk knowledge through DIMP, PSE will update the replacement schedule and timeframe as necessary.

Based on current risk knowledge and historical performance, PSE currently plans to replace approximately 245 miles of larger diameter DuPont Aldyl "HD" plastic pipe within the first 12 years of the 20-year plan beginning in 2013. The plan was updated from 10 years to 12 years due to rising unit costs increasing the time needed to replace 245 miles. The pipe replacement in the first 12 years targets the higher risk population with a history of brittle-like cracking and fusion failures. The schedule should not create an undue burden on rate payers. Throughout the program duration, PSE is able to secure valuable contractor resources to keep a normalized work load while reducing the overall risk. Upon completion of the high risk population, the Master Plan will be reviewed to determine the appropriate replacement schedule for the remaining pipe in service. The current replacement schedule is provided in the Table 5 and Figure 1.

Table 5. DuPont Aldyl "HD" Plastic Pipe Replacement Schedule, Miles, and Estimated Expenditures

Program Years	Total Planned Replacement Miles	Estimated Expenditures[1]
1 – 12	245 Miles	$500.4 million
12 – 20	190 Miles	$547.6 million
Total	**435 Miles**	**$1,048.0 million**

1 Estimated expenditures are in 2023 dollars and do not include AFUDC

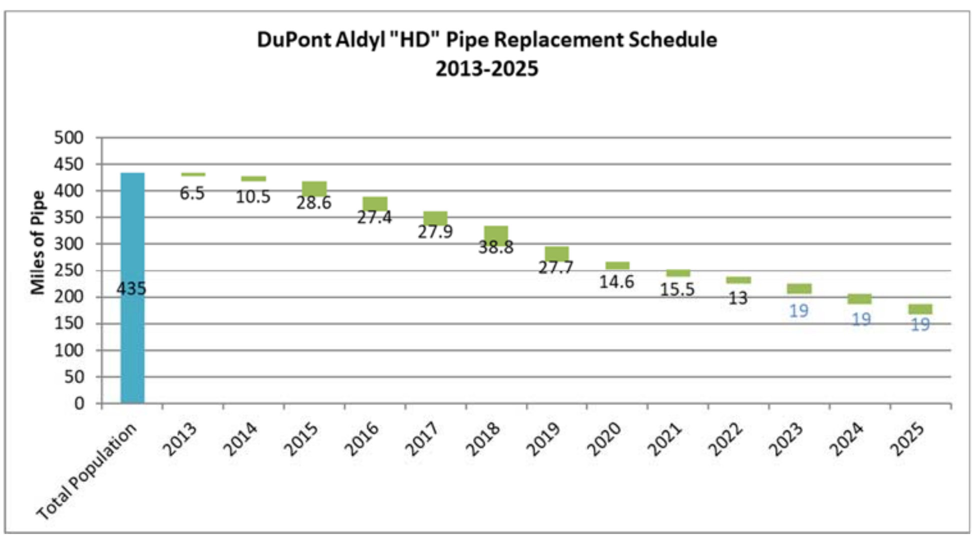


Figure 1. DuPont Aldyl "HD" Plastic Pipe Replacement Schedule
(Black – actuals, Blue – proposed)

Two-Year Plan

The two-year plan is to continue replacing DuPont Aldyl "HD" plastic pipe according to the Master Plan. The following table shows the planned replacement miles and expenditures of DuPont Aldyl "HD" plastic pipe for the current year and in calendar years 2024 and 2025.

Table 6. Planned Replacement Miles and Expenditures

Year	Planned Replacement Miles	Planned Expenditures[1]
2024	19 Miles	$56.4 million
2025	19 Miles	$57.6 million
Total	38 Miles	$110.4 million

1 Estimated expenditures are in 2023 dollars and do not include AFUDC

Adjustments to projects and specific locations will be made as required while managing to the Master Plan and overall system risk.

Identification Plan

PSE purchased and installed DuPont Aldyl "HD" plastic pipe in the 1970s and early 1980s. During this timeframe, PSE also purchased and installed Phillips Driscopipe M8000 and Plexco pipe. PSE's historical construction records did not capture the pipe manufacturer and only indicated the location of the pipe, material type, pipe size, and date the pipe was installed. As a result, PSE developed and implemented a plan in 2013 to identify the manufacturer of larger diameter HDPE pipe installed in the 1970s and early 1980s. The plan focused only on identifying candidate pipe installations that may pose an elevated risk of failure.

Completion of Targeted Excavations

By the end of 2016, PSE completed the targeted excavations to identify locations of DuPont Aldyl "HD" plastic pipe in the system. Locations of the targeted excavations were strategically selected to identify all original installation jobs that potentially contain DuPont Aldyl "HD" plastic pipe. The identification effort confirmed that approximately 2,700 original installation jobs contain some amount of DuPont Aldyl "HD" plastic pipe and finalize the total population.

Ongoing Verification through Routine Operations and Planned Projects

PSE currently captures information on the pipe manufacturer through the Exposed PE Pipe Report whenever plastic pipe is exposed during routine operations and maintenance activities. Additional information is also gathered from confirmation excavations when refining the scope of DuPont Aldyl "HD" pipe replacement projects and opportunities through other planned pipe replacement projects. The information is used to further refine and verify the amount and location of DuPont Aldyl "HD" pipe remaining in service.

5. Buried Meters

Master Plan

Pipeline Integrity Risk Assessment

PSE has identified an increased risk on meter set assembly (MSA) piping where pipe, fittings, or equipment intended for above ground exposure are unintentionally buried. Referred to as "Buried Meters", this condition occurs when the homeowner/building owner makes changes to the ground elevation in the area of the MSA and may result in hazardous leaks due to corrosion occurring at or near a building wall. Buried meters are identified from routine leak surveys and subsequent field inspections. The remediation strategy may include recontouring the landscaping around the MSA, or complete pipe replacement/MSA relocation, depending on the situation. There are approximately 40,000 reports of buried MSAs in the system and approximately 5,000 new reports are identified each year.

The Buried MSA Remediation Program was first initiated in 2007 in response to increased reports of buried meters through the Abnormal or Unusual Operation Condition Report (Blue Card) as they were identified during routine leak surveys. Through the implementation of DIMP in 2010 the program was identified as a moderate risk relative to other assets in the distribution system. In recent years, there has been an increase in buried meter reports through continuing surveillance activities. Also, more hazardous leaks have occurred due to corroded meter set components over the same time period. In 2018, the risk model identified the buried meter program as a high risk and a new program strategy was developed to reduce the backlog of buried meters. A taller riser design was developed with greater ground clearance to prevent the burial of additional meter sets.

Buried Meter Replacement Program Plan
PSE is actively remediating/replacing buried meters that pose an elevated risk of failure. PSE will continue monitoring the performance of buried meters through DIMP and appropriately update the replacement schedule and timeframe as necessary. For meter sets currently not identified as having an elevated risk of failure, PSE will continue to incorporate new risk knowledge and evaluate whether this population warrants replacement under PRP in the future.

Based on current risk knowledge and historical performance, PSE will remediate approximately 40,000 buried meters within 6 years beginning in 2020. The 6 year term was chosen based on prioritizing higher risk locations first and remediating the remaining identified locations at an accelerated rate. New reports of buried meters will be added to the program as they are found, but adjustments to the program will be made as the impacts of installing the new taller riser are realized to reduce the number of new reports of riser burial or re-burial. The schedule should not create an undue burden on rate payers. Throughout the program duration, PSE is able to secure valuable contractor resources to keep a normalized work load while reducing the overall risk. The current replacement schedule is provided in Table 7.

Table 7. Buried Meter Replacement Schedule, Quantity, and Estimated Expenditures

Program Years	Number of Meters	Estimated Expenditures[1]
1-6	40,000	$35 million

1 Estimated expenditures are in 2023 dollars and do not include AFUDC

Two-Year Plan

The two-year plan is to continue to replace/remediate buried meters according to the Master Plan. The following table shows the planned buried meter remediation and expenditures for 2024 and 2025.

Table 8. Planned Buried Meter Remediation and Estimated Expenditures

Year	Number of Meters	Planned Expenditures[1]
2024	7,000	$6.2 million
2025	7,000	$6.5 million
Total	14,000	$12.7 million

1 Estimated expenditures are in 2023 dollars and do not include AFUDC

Adjustments to projects will be made as required while managing to the Master Plan and overall system risk.

Identification Plan

Meter set assemblies that present an elevated risk of failure are continually monitored by reviewing system information that includes leak survey and patrol data. The population of 40,000 buried meters with an elevated risk of failure was identified in 2019 through continuing surveillance activities. In conjunction with reviewing system performance data, PSE's geographic information system (GIS) is being utilized to proactively identify any new areas that may present an elevated risk of failure. Upon completion of the original population of 40,000 buried meters, the program will be expanded to remediate the new population of buried meters that have been identified since 2019. As of year-end 2022, the population of newly identified buried meters is approximately 53,000.

6. Sewer Cross Bores

Master Plan

Pipeline Integrity Risk Assessment

The threat of sewer cross bores was identified through DIMP as an elevated risk to certain pipe installations. A sewer cross bore is a gas pipeline that has been inadvertently installed through an unmarked sewer pipe. Sewer cross bores occur when trenchless construction methods are utilized to install new natural gas pipe in areas where unmarked sewer lines exist. The state of Washington Damage Prevention Law requires excavators to use a One-call number locator service to alert underground facility owners of intended excavation activities and requires the marking of underground facilities in the area. However, sewer lines, and in particular, sewer laterals have proven to be difficult to locate. Sewer systems are often comprised of pipe that is not electronically locatable and sewer records are lacking in many areas. In addition, sewer lines on private property are the responsibility of the property owner, who does not possess the technology or records to be able to locate their sewer line. Sewer cross bores pose an elevated risk of failure due to the high consequence that would result if damage to the pipe occurs causing gas to leak into the sewer. If there is a sewer cross bore and it causes a blocked sewer, plumbers typically use a drain cleaning machine to clear the blocked sewer which could damage the gas line endangering people and property. Based on PSE's experience, it is more likely for plastic service lines in residential urban areas to be cross bored through sewers. Since 2013, more than 871 cross bores have been found in PSE's system.

A sewer cross bore pilot program was conducted in 2012 and in 2013 the Sewer Cross Bore Program was officially established. Hydromax USA ("HUSA") was selected as PSE's service provider to conduct sewer inspections that would help identify and remediate cross bores associated with new construction as well as sewer cross bores from legacy installations. A public awareness program was also launched to publicize PSE's cross bore safety program to make customers and plumbers aware of the sewer cross bore issue and to call PSE before clearing a sewer. The

Sewer Cross Bore Program activity is tracked in the Continuing Surveillance Annual Report and has identified sewer cross bore as one of the highest risks in PSE's distribution system.

Sewer Cross Bore Replacement Program Plan

PSE is actively remediating pipe that poses an elevated risk from sewer cross bore. Based on detailed analysis of the characteristics associated with previously identified sewer cross bores, PSE, in concert with HUSA, has developed a computer model which assesses the likelihood that a sewer cross bore exists in an area. Utilizing the output of this model, PSE has developed a prioritized and systematic approach for alleviating the elevated risk that sewer cross bores pose. PSE will remediate the risk of sewer cross bore at the identified locations by documenting through inspection that no pipe is installed in the sewer and remediating any pipe that is found to have been cross bored through the sewer. PSE is also reducing the risk of future occurrences of new sewer cross bores being installed by contracting with HUSA to inspect sewer lines at a location after installation of any new gas line by trenchless methods.

The computer model utilizes machine learning algorithms to predict the likelihood that a cross bore exists. The model adjusts and learns as individual locations are confirmed and remediated. Additional locations are incorporated into the model as information is gathered on new side sewer segments, and the highest risk locations are recalibrated by the model. Using the model, PSE identified the top 10% of the model results to clear of risk, which is a population of 60,000 areas where the likelihood of a cross bore is higher. PSE revised the master plan to incorporate information learned during the last two years that a parcel may have multiple sewer segments. The original plan accounted for each parcel having one sanitary sewer. PSE will continue to focus on individual sewer segments and not whole parcels due to the lack of sewer lateral information in many areas. PSE has developed a plan to remediate the risk of sewer cross bore at these identified locations within 9 years beginning in 2019. The schedule should not create an undue burden on rate payers. Throughout the program duration, PSE will continue to incorporate new information to refine the program and adjust the plan as needed. The current schedule is provided in Table 9.

Table 9. Sewer Cross Bore Remediation Schedule, Units, and Estimated Expenditures

Program Years	Cleared Sewer Segments	Estimated Expenditures
1-9	60,000	$40.9 million

Two-Year Plan

The two-year plan will continue to prioritize the highest risk identified locations to remediate the risk of sewer cross bore. The following table shows the planned sewer cross bore remediations and expenditures for calendar years 2024 and 2025.

Table 10. Planned Sewer Cross Bore Remediations

Year	Cleared Sewer Segments	Estimated Expenditures
2024	7,300	$4.7 million
2025	7,300	$4.7 million
Total	14,600	$9.4 million

Adjustments to projects and specific locations will be made as required while managing to the Master Plan and overall system risk.

Identification Plan

The identification of the location of sewer cross bores utilizes a computer model to identify the higher risk pipe segments. Model inputs include pipe installation year, manufacturer, nominal diameter, material, pressure, install method, actual length, and who installed the pipe. Those inputs are then used along with sewer cross bores found in the gas system to identify the higher likelihood pipe segments for cross bore risk. Those segments are the identified locations with higher sewer cross bore risk.

Remediating the risk of a sewer cross bore is performed with a camera inserted in the sewer pipe and then repair or replacement of pipe when a cross bore is found. The program includes sewers in proximity to new gas trenchless installations to confirm that new cross bores are not created and at risk sewers in proximity to legacy trenchless gas installations are identified through the risk model.

7. No Record Facilities

Master Plan

Pipeline Integrity Risk Assessment

No Record Facilities (NRFs) are services that are shown as being active in the mapping system but the aboveground portion cannot be found in the field. If the aboveground portion of the service is not able to be located during leak surveys and patrols then the facility is mapped as “NR” to indicate that no record exists for the cut and cap. NRF’s were predominantly identified through the SKIP Program starting in 2016 where the inspection was “skipped” when nothing was found. The remaining ones were identified through the Deactivated Gas Line Inspection Program (DGLI). Through SKIP and DGLI inspections, many NRFs were investigated and found to be live idle risers in very difficult to locate locations or unintentionally bent over and buried. Many of these facilities may still be active and in unknown condition, which poses an elevated risk for Outside Force Damage, and Corrosion adjacent to the building wall.

No Record Facilities Program Plan

An initial population was established based on leak survey and patrols and subsequent inspections through the SKIP and DGLI programs. The program strategy is to excavate at the tie-in to perform a cut and cap or to verify that a previous cut and cap was completed. The current schedule is provided in Table 11.

Table 11. No Record Facilities Remediation Schedule, Units, and Estimated Expenditures

Program Years	Number of Remediations	Estimated Expenditures
1-5	3,000	$15 million

Two-Year Plan

The two-year plan will continue to prioritize the highest risk identified locations to remediate the risk of no record facilities. The following table shows the planned no record facility remediations and expenditures for calendar years 2024 and 2025.

Table 12. Planned No Record Facilities Remediations

Year	Number of Remediations	Estimated Expenditures
2024	100	$0.5 million
2025	400	$2.0 million
Total	500	$2.5 million

Adjustments to projects and specific locations will be made as required while managing to the Master Plan and overall system risk.

Identification Plan

The original population of 3,000 NRFs was identified based on the results of SKIP and DGLI inspections. The ongoing identification of NRFs will also be from the SKIP program when aboveground piping cannot be found during leak survey.

8. Active Leak Reduction

Master Plan – Removed from 2023 PRP

Methane Emissions Risk Assessment

PSE has identified nonhazardous leaks, which include Grade "B" and "C" leaks, occurring in the natural gas distribution system as a high risk for methane emissions due to a potentially longer time leaking. A Grade "B" leak is a leak recognized as being not hazardous at the time of detection, but that justifies scheduled repair based on the potential for creating a future hazard. A Grade "C" leak is a leak that is not hazardous at the time of detection and can reasonably be expected to remain nonhazardous. PSE is committed to eliminating its backlog of active Grade "C" leaks and to reduce the time needed for repairing Grade "B" leaks in order to reduce methane emissions from nonhazardous leaks.

Active Leak Reduction has been removed from the 2023 PRP. The program will continue to be implemented through the multi-year rate plan.

9. Excavation Damage Prevention Measures

Master Plan – Removed from 2023 PRP

Methane Emissions Risk Assessment

Excavation Damage is PSE's leading cause of natural gas leaks and methane emissions in the distribution system and the highest risk from PSE's DIMP risk model. Approximately 800-900 damages occur each year to the gas system, releasing approximately 12,000 metric tons of CO2e in 2020. The majority of the tactics to reduce damage prevention are not asset based, so they have been removed from the plan but continue to be a focus for PSE.

Excavation Damage Prevention Measures has been removed from the 2023 PRP. The program will continue to be implemented through the multi-year rate plan.

10. Aboveground Meter Set Remediation

Master Plan – Removed from 2023 PRP

Methane Emissions Risk Assessment
PSE has found that the common construction practice of using threaded joints at natural gas meter sets may create more methane release opportunities. In an effort to reduce methane releases, PSE has targeted repair of nonhazardous releases of gas (NARGs) occurring at meter set threaded joints and unions. The gas release is very small and typically only produces small bubbles when leak detection soap is applied. Very sensitive leak detection instruments can also detect the NARG, but normally they are not detectable by people in the area. NARGs are transient based on air temperature and rain can also affect their detection. PSE currently has two leak grades for aboveground facilities, Grade “A” hazardous leaks, and NARG for nonhazardous releases of gas.

Aboveground Meter Set Remediation has been removed from the 2023 PRP. The program will continue to be implemented through the multi-year rate plan.

11. Public Interest

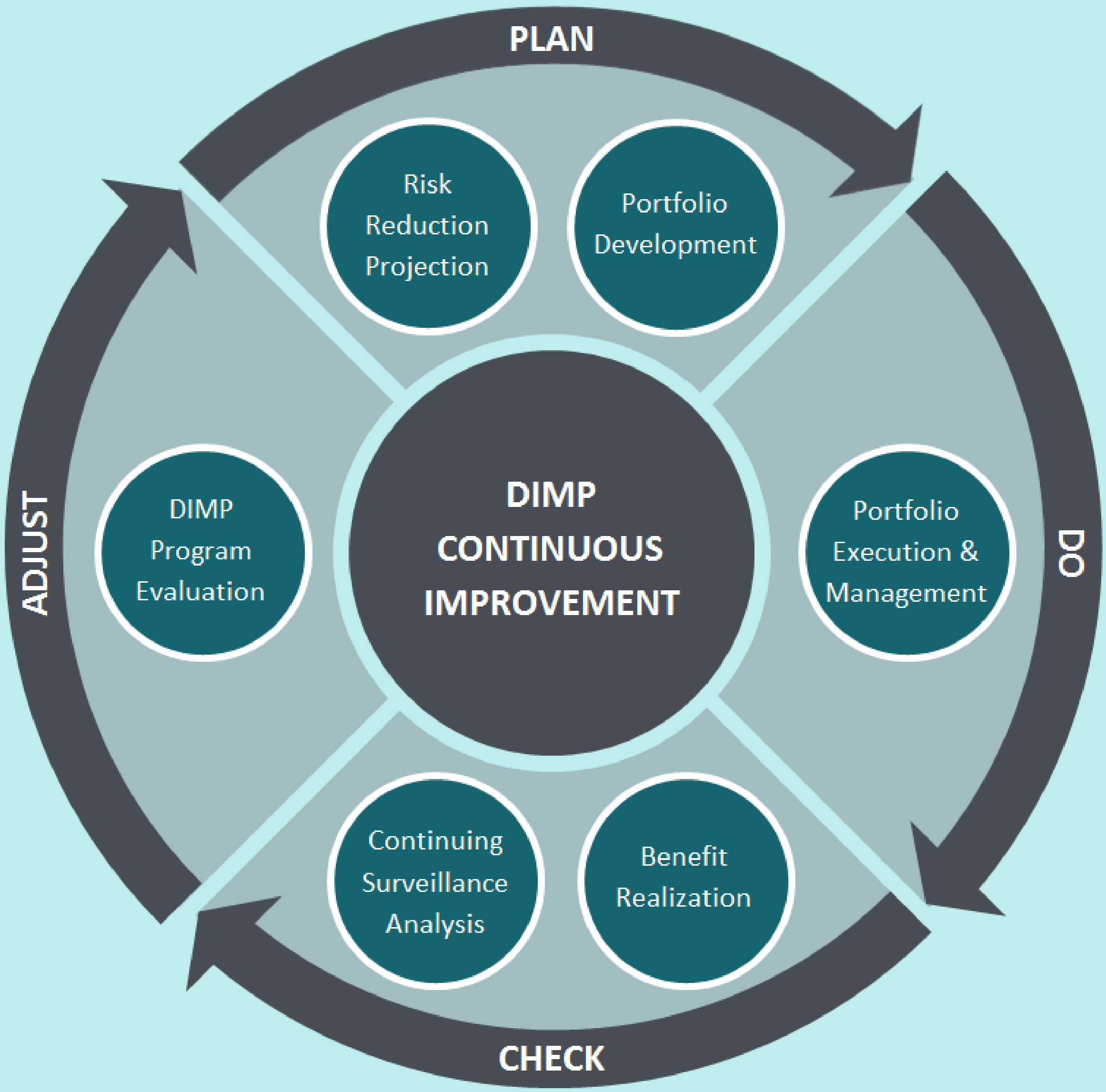
The pipe replacement plans for the materials that pose an elevated risk of failure included in this PRP plan have been developed considering many factors. These factors include:

- Improving the safety of the distribution system by replacing pipe based on the relative level of risk presented for each material and location
- Minimizing the replacement costs by maximizing efficiencies and productivity
- Minimizing the impacts to municipalities and the general public
- Minimizing the methane emissions to protect the environment and public health

12. Rates Impact

There is no immediate incremental impact on rates from this plan as the Company is not asking for a cost recovery mechanism for the identified programs. While there is no immediate impact on rates, future impacts could occur due to identification and replacement of pipelines with an elevated risk of failure and would be incorporated into a future Multi-Year Rate Plan.

CALENDAR YEAR - 2022



JUNE 2023

Part 1: Executive Summary

The Continuing Surveillance Annual Report (CSAR) documents how PSE complies with federal Distribution Integrity Management Program (DIMP) regulations. PSE's DIMP monitors and trends system integrity data and uses it to identify the threats in the gas distribution system that pose the most risk. Additional and Accelerated Actions are then developed and implemented to inspect the condition of higher risk assets and repair any defects that could challenge pipeline integrity. System trends and performance measures are reviewed to identify if any adjustments are required for established Additional and Accelerated Actions.

Along with DIMP, Pipeline Safety Management System (PSMS), a framework established to build upon the pipeline safety code requirements and expand existing safety processes and procedures to improve safety performance, promote a learning environment, and reinforce internal safety culture, is also being implemented.

The reduction of methane emissions through accelerated leak repair is also a focus in DIMP. The Protecting Our Infrastructure of Pipelines and Enhancing Safety (PIPES) Act of 2020 reinforces safety to the environment and supports PSE's inclusion of methane emission reduction tactics into DIMP. Non-hazardous leaks have been prioritized for replacement since 2012 and the backlog of non-hazardous leaks was eliminated in early 2023. PSE is currently among the top companies in the American Gas Association (AGA) for number of active belowground leaks.

Overall Condition of PSE's Distribution System

DIMP is effectively mitigating risk based on the 2022 review of data and trends. The condition of the distribution system continues to improve every year since DIMP was implemented in 2011. Recent improvements include:

- 71% reduction in new leaks in the distribution system since DIMP was implemented
- 28% reduction in 5-year average of excavation damages since DIMP was implemented
- 98% reduction in monitored nonhazardous leaks through accelerated leak repairs since DIMP was implemented

See Appendix D for additional information about the distribution system.

Figure 1 shows the number of active leaks in the distribution system is decreasing. The Active Leak Reduction Program has focused on expediting leak repairs to reduce the inventory of active leaks in the system. Pipe at risk of future leaks is also prioritized for replacement through existing Additional and Accelerated Actions.

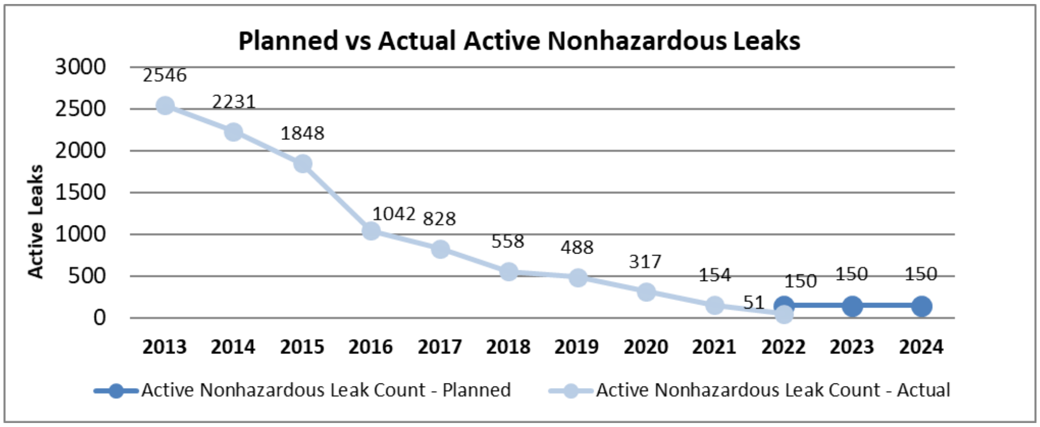


Figure 1. Planned vs Actual Active Nonhazardous Leaks

Figure 2 shows the number of new leaks has decreased over the last 10 years. The baseline five-year average of new leaks was 1,748 annually when DIMP was implemented in 2011. The current five year average of new leaks is 608 (a 65% reduction) annually.

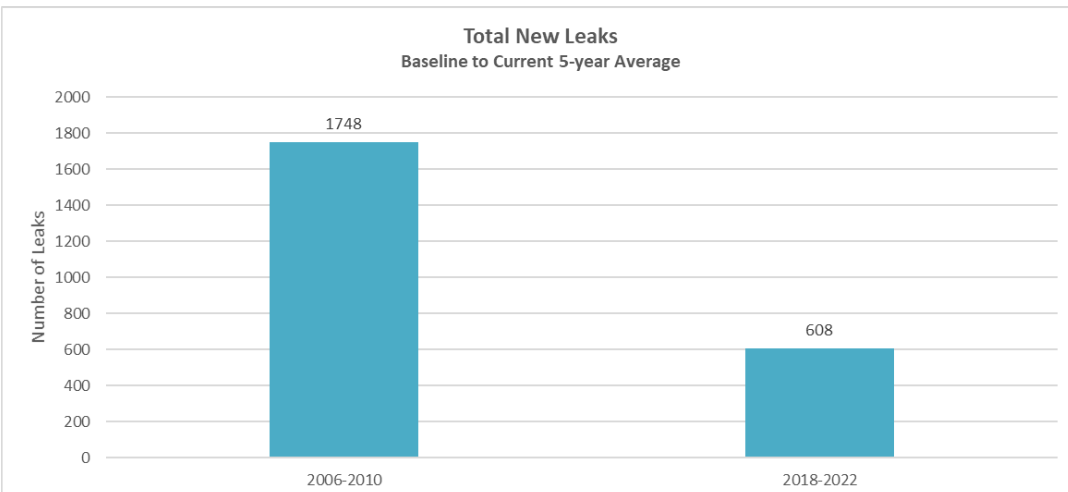


Figure 2. Total New Leaks

There are fewer new leaks each year due to pipe replacement programs that replace pipe with the highest risk for future leaks. The majority of leak repairs excluding leaks from excavation damage are on older vintage wrapped steel mains and newer plastic services. The population of leaks is small relative to the number of leaks historically found on the legacy cast iron and bare steel systems that have since been fully retired.

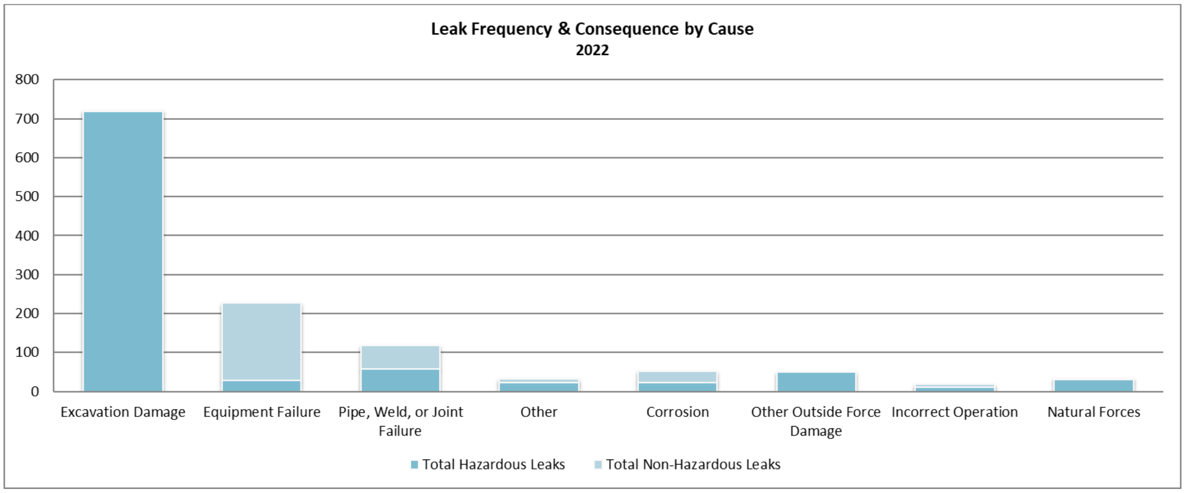


Figure 3. 2022 Leak Frequency & Consequence by Cause

Figure 3 shows Excavation Damage continues to be the largest threat to the distribution system, accounting for over half of the leaks in the system. Leaks caused by Excavation Damage are typically hazardous.

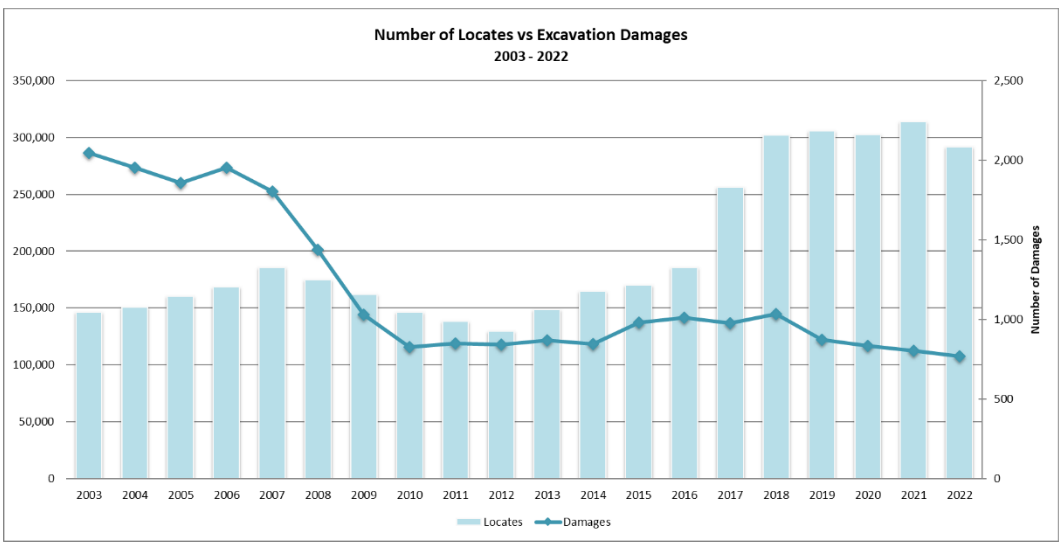


Figure 4. Number of Locates vs Excavation Damages

Since the implementation of Damage Prevention Representatives in 2017, leaks due to Excavation Damage have reduced by approximately 25% despite an increase in locate tickets which could have resulted in additional damages as shown in Figure 4. Damage Prevention Representatives work in the field to emphasize the importance of utility locates and safe excavation practices. Prior to adding Damage Prevention Representatives, Excavation Damage was at approximately 1,000 leaks per year. In 2022, the number of leaks due to Excavation Damage was 720.

Performance Measures

Performance measures implemented by DIMP show that total hazardous leaks have decreased on wrapped steel and PE pipe. However, some performance measures by sub-cause are higher than the baseline. The trend has been monitored and the increase is attributed to field personnel assigning leak categories more accurately. Leaks assigned the Other Leak cause category decreased by approximately 89% since 2010. No actions are required at this time for the performance measures that are currently higher than baseline.

Highest System Risks and Top Priority Additional and Accelerated Actions

The following primary threats have been identified in the distribution system: Corrosion; Natural Forces; Excavation Damage; Other Outside Force Damage; Pipe, Weld, or Joint Failures; Equipment Failure; Incorrect Operations; and Other. Each threat and corresponding assets in the system have been evaluated and prioritized. There are currently 31 Additional and Accelerated Action programs that mitigate risks to the distribution system. The five programs that have been identified as having the highest risk are summarized in Table 1.

Table 1: Highest Risk Threats to the Distribution System

Threat	Asset Family	Program	Remaining Population	2022 Results	Overall Program Results	2023 Proposed Work	2023 Risk Change
Incorrect Operations	Mains and Services	Sewer Cross Bore Program	34,800 High risk locations	59 discovered and repaired	1,004 discovered since 2013	7,420 sites to be inspected	-2%
Excavation Damage	Mains and Services	Damage Prevention Program	300,000+ locate requests annually	769 damages	28% reduction in damages	Contractor outreach and additional Damage Prevention field reps	-5%
Material Failure	DuPont Pipe	Older Vintage PE Pipe Mitigation Program	224.5 miles	13 miles replaced	210.5 miles replaced	25 miles to be replaced	-11%
Corrosion Failure	Meter Set Assembly	Buried MSA Remediation Program	67,000 buried meters	8,628 remediated	41,173 remediated	7,000 buried meters to be remediated	+5%
Outside Force Damage	Services	No Record Facilities	3,000 services	8 remediated (program pilot)	8 remediated (new program)	400 services to be remediated	-14%

A review of 2022 data and trends found no new sub-threats needed to be added. Based on the 2022 continuing surveillance data and trending and SME validation, DIMP is still effectively managing risk in the distribution system.

Operational Threats

Operational Threats are areas of concern identified by subject matter experts during data review and validation. In 2022, six new operational threats were identified including: System Design and Operations, Emergency Response, Critical Valves, Environmental Contaminants, Eco-Terrorism, and Temporary Encampments. Evaluation of Industrial Meter Operations (IMO) Discrepancies and Engineering and Operations Training and Development is still in progress.

Conclusion

Based on the 2022 review of data and trends and the overall condition of the distribution system, DIMP is effective in mitigating risk. As an enhancement to DIMP, Pipeline Safety Management System is being implemented to manage risk, promote learning, and continuously improve pipeline safety and integrity. System trends and performance measure outcomes continue to support the current Additional and Accelerated Actions as appropriate areas to focus on risk reduction.

The number of active leaks in the distribution system is decreasing. The current 5 year average for number of new leaks has decreased 65% from the baseline 5 year average due to pipe replacement programs that replace the pipe with the highest risk for future leaks. Excavation Damage is still the largest threat to the distribution system, and additional effort is being taken to reduce this risk. In 2022, an enhancement to the locate ticket risk model was purchased to include the type of pipe and pressure of the system as part of the risk ranking for which locate tickets should be prioritized for active monitoring during excavation.

The existing performance measures are adequately measuring the effectiveness of DIMP and accelerated actions.

Part 2. Risk Evaluation, Prioritization, and Additional and Accelerated Actions

The risks to the distribution system are evaluated and prioritized to determine when Additional and Accelerated Actions are required. The risk evaluation and prioritization is based on design and construction records, incident and leak history, corrosion control records, continuing surveillance records, patrolling records, maintenance history, excavation damage experience, and input from subject matter experts. The risk evaluation is updated annually using new system data and those results are validated by subject matter experts.

Threats and Assets

The assets in the distribution system are subjected to the following primary threats:

- Excavation Damage
- Pipe, Weld or Joint Failure
- Other Outside Force Damage
- Incorrect Operations
- Equipment Failure
- Corrosion Failure
- Natural Force Damage
- Other Cause

Assets and threats are further sub-divided to allow for more effective risk assessment where the risks are related or similar. Assets are sub-divided by material type, vintage, operating pressure, and other unique characteristics. The two stoplight charts in Appendix A summarize the overall risk prioritization in the distribution system for each sub-threat and sub-asset.

In 2020, an interactive threat matrix was developed to determine how threats interact when combined and how combinations may create a higher risk. A review of interactive threats was performed to determine any potential threat interactions where additional mitigation may be required. The results of the review are summarized in the table below with the applicable programs currently addressing the threat. The interactive threat review in 2022 compared the newly added sub-threats with the existing sub-threats.

Table 2: Interactive Threat Review

First Threat	Second Threat	Threat Interaction	Primary Programs Addressing Threat Interaction
Seismic Activity/Earth Movement	Pipe, Weld, or Joint Failure	Increased pipe, weld or joint failure caused by seismic activity/ earth movement	Older STW Pipe Mitigation program, Older Vintage PE Pipe Mitigation Program
Corrosion	Excavation Damage, Other Outside Force Damage	Increased corrosion caused by excavation damage or other outside force damage	Damage Prevention Program, Traffic Protection Program, Continuing Surveillance Program
Pipe, Weld, or Joint Failure/Equipment Failure	Operator Error	Pipe, weld, or joint failure or equipment failure caused by operator error	Quality Control Program, Gas Operations Training Program, Contractor Training Program and Qualifications Requirement
Cyber Security	Incorrect Operations	Incorrect operations caused by the SCADA system being compromised	Continuing Surveillance Program, Physical Security Enhancements at Aboveground Stations, Training and Tabletop Exercises
Wildfire	Structure fire	Increased structure fires caused by adjacent wildfires	Emergency Action Plans, Training and Tabletop Exercises

Additional and Accelerated Actions

There are currently 31 Additional and Accelerated Actions that mitigate risks to the distribution system. Information about each Additional and Accelerated Action including program status, program strategy, background, asset management and funding, recent improvements, performance measures, program effectiveness, and future initiatives can be found in the Distribution Integrity Management Program Summary of Additional and Accelerated Actions. The table in Appendix B summarizes the program status of each Additional and Accelerated Action.

The Additional and Accelerated Actions that address the highest risks within each threat are described below:

Table 3: Highest Risk Threats and Additional and Accelerated Action Description

Threat	Description	Primary Programs Addressing Threat	Program Description
Excavation Damage	Leaks caused by Excavation Damage account for more than half the leaks that occur in the distribution system and are typically hazardous. In 2022, 720 leaks from excavation damages occurred.	Damage Prevention Program	The largest source of leaks in the distribution system is pipeline damage caused by excavators who dig carelessly and fail to request locates. A field inspection program was launched in 2016 to reduce damages by interacting with contractors and customers who cause damage.
Equipment Failure	Equipment Failure is the second leading cause of leaks in the distribution system and is generally non-hazardous. In 2022, 76 leaks were attributed to cap failures. The Active Leak Reduction Program is increasing the repair numbers in the short term as active leaks are targeted for repair.	Celcon Cap Program, Bolt-on Tee Program	As Celcon Caps are found in the field they are replaced with current caps reducing the likelihood of a future leak. In addition, Bolt-On Service Tees are now checked for leaks when exposed since these also contribute to Equipment Failure leaks.
Pipe, Weld, or Joint Failure	Pipe, Weld, or Joint Failure is the third leading cause of leaks in the distribution system and is hazardous about half the time. In 2022, 31 leaks were attributed to DuPont pipe fusion failure and/or brittle-like cracking failure.	Older Vintage PE Pipe Replacement Program	Pipe manufactured by DuPont has an increased risk of premature brittle-like cracking and fusion failures which typically results in hazardous leaks. In 2022, approximately 13 miles of older vintage polyethylene (PE) pipe was replaced. Approximately 25 miles of older vintage PE replacement is planned for 2023.

Other Outside Force Damage	Other Outside Force Damage leaks are typically low likelihood but may be hazardous where the damage occurs near a structure. In 2022, 17 leaks were due to vehicle damage and 19 leaks were due to other impacts.	No Record Facilities Remediation Program, Idle Riser	In 2022, the No Record Facilities Remediation program was initiated to address services that are shown as active in GIS but nothing can be found in the field and no retirement record exists. These facilities have an elevated risk of outside force damage in close proximity to a structure as the customer may be unaware the pipe is gas carrying. The program has a population of approximately 3,000 services to cut and cap or confirm an existing cut and cap. A program pilot was completed in 2021.
Incorrect Operations	Sewer Cross Bores has the highest consequence from a leak due to Incorrect Operations. In 2022, 59 Sewer Cross Bores were discovered during new installation, legacy inspections, or blocked sewer call response. Leaks from Sewer Cross Bores are hazardous because gas from a leak can flow directly into a home through the sewer.	Sewer Cross Bore Program	Sewer Cross Bores were identified as a high risk and the Sewer Cross Bore Program was launched in 2013. In 2022, 59 Sewer Cross Bores were discovered and remediated. Legacy inspections were included in the Pipeline Replacement Plan starting in 2020. The PRP goal is to eliminate pipe with an elevated risk of failure and sewer cross bores have a very high risk if a plumber clears a sewer line with a gas line in it. The inspection of locations that have a high probability of cross bore based on a computer model are being accelerated.
Corrosion Failure	Buried Meter leaks are due to corrosion and are typically hazardous because meter sets are located up against building walls.	Buried MSA Remediation Program	Meters that have been inadvertently buried have resulted in hazardous corrosion leaks up against the building. Approximately 7,000 buried meters are scheduled for remediation in 2023 as part of the Pipeline Replacement Plan.

Potential Threats

Potential threats are threats that are not yet confirmed to be a systemic risk requiring risk evaluation and prioritization, but that could become a future risk. Monitoring potential threats ensures that any emerging trends are identified and that the appropriate risk mitigation can be implemented to reduce risk. See Appendix C for the list of potential threats that are currently being monitored.

Operational Threats

Operational Threats are areas of concern that have been identified either by subject matter experts during data validation or by industry news and/or events. They are typically company-wide initiatives that require action outside of integrity management. Some Operational Threats are current concerns, others have been recently identified. Each Emerging Operational Threat is reviewed on an annual basis to determine whether they should be incorporated into the risk model or developed into a greater initiative.

Table 6: Identified Operational Threats

Operational Threat	Description	Year Identified
System Design and Operations	Over the years, the workforce for both engineering and operations has become increasingly less experienced through retirements and other attrition. Many engineering and operational practices were historically dependent on a highly skilled and knowledgeable workforce with a majority of employees having years of relevant experience. Increased efforts are underway to provide the training and skills necessary to ensure the current workforce has the knowledge needed to work safely and effectively. However, fundamental changes to the way the system is designed and operated may need to be implemented to account for reduced experience levels.	2022
Emergency Response	The current Emergency Response metrics are showing an increasing trend in response times. The contributing factors are still being researched but early indications point to fewer operations resources relative to increasing customers and pipeline assets, increased population growth that affects traffic congestion and travel times, and implementation of a new Emergency Response Plan (ERP) where “on-duty” personnel may not live close to a given emergency. Additional Gas Workers were hired in 2022 to help with the resource deficiency.	2022
Critical Valves	The distribution system contains countless valves that were installed for ease of construction or other temporary needs and are not considered “critical valves.” Non-critical valves are not typically inspected or maintained with any periodic frequency. In an emergency situation, non-critical valves cannot be reliably used to aid in system shutdown or isolation. The population of critical valves, including critical service valves, that require inspection and maintenance may need to be expanded to provide greater flexibility during an emergency. For valves that are inspected and maintained, further definition is needed to determine what makes a valve inoperable versus just hard to turn.	2022
Environmental Contaminants	The former Asarco Copper smelter in Tacoma potentially contaminated 1,000 sq. miles within the Puget Sound region with arsenic, lead, and other heavy metals over its 100 year operation. A large portion of the distribution system is located within the contaminated area. Environmental contaminations may have an impact on worker health and safety, project timelines, and onsite disposal requirements.	2022
Eco-terrorism	The threat of vandalism and/or tampering of natural gas facilities in the distribution system is already accounted for within the DIMP Risk Model. However, there has been increased media attention recently about possible coordinated efforts to intentionally damage or destroy natural gas facilities for environmental reasons.	2022

Temporary Encampments	The expansion of homeless encampments and homeless activities in the area has been identified as a contributing factor in a number of recent natural gas emergencies that involved tampering/vandalism or unintentional ignition of gas. Homeless encampments have also caused the delay of some compliance inspections of natural gas facilities due to direct encroachments and the potential threat to worker safety.	2022
IMO Discrepancies	In 2020, several discrepancies were identified between the engineered design drawing for Industrial Meter Set Assemblies and what is installed in the field. The discrepancies include missing FRP shields at pipe supports and incorrect relief valve springs installed. **2022 Update**: Gas Field Engineering is still determining the extent of this threat and is currently helping train personnel to document and install the facilities as shown on the design.	2020
Engineering and Operations Training and Development	Knowledge transfer is a critical aspect of all parts of a natural gas utility. Recent retirements in gas operation positions has made the transfer of generational knowledge more difficult to pass naturally to newer employees. Key training material should be captured and made readily accessible in the field. It is also important for field employees to understand the reasoning behind the steps in a procedure or process. In addition, Engineering training has been identified as potential growth area and a training plan is currently in development. The consequence of this threat would be the possibility of more incorrect operations failures in the gas system. **2022 Update**: Gas Field Engineering recently lead the Pressure Control training to help with knowledge transfer and consistency of training for new personnel.	2019

Part 3. Performance Measures

Performance measures compare the current state of the distribution system to a baseline that was established when the DIMP program was implemented. The baseline is a 5-year average (2006-2010). Performance measures also determine if changes are required to DIMP or if any Additional and Accelerated Actions should be implemented.

Table 7: DIMP Performance Measure – Hazardous Leaks by Material Type

Material Type	5-yr Average Hazardous Leaks	Baseline 5-yr Average	Performance Measure
Steel	80	183	< Baseline
PE	160	232	< Baseline

In Table 7, the 5-year average of hazardous leaks for both steel and PE are performing well at less than the baseline values. No changes to DIMP or implementation of Additional and Accelerated Actions are required.

Table 8: DIMP Performance Measure – Hazardous Leaks by Threat

Leak Cause	5-yr Average Hazardous Leaks	Baseline 5-yr Average	Performance Measure
Corrosion	25	69	< Baseline
Natural Forces	33	29	> Baseline
Other Outside Force Damage	56	50	> Baseline
Pipe, Weld, or Joint Failure	77	58	> Baseline
Equipment Failure	54	47	> Baseline
Incorrect Operation	17	17	= Baseline
Other	31	187	< Baseline
Excavation Damage	812	1,213	< Baseline
Total Leaks (Minus Excavation)	292	458	< Baseline
Total leaks	1,104	1,671	< Baseline

In Table 8, the total hazardous leaks 5 year average has decreased approximately 34% below the baseline. Better leak categorization has resulted in an 83% decrease in the Other leak cause category which results in more accurate trending. Pipe, Weld, or Joint Failure and Equipment Failure trends have increased above the baseline mostly due to service bolt-on tee and PE cap failures. The trend will be monitored and existing Additional and Accelerated Actions are addressing risks at this time.

Table 9: DIMP Performance Measure – Total Leaks by Threat

Leak Cause	5-yr Average Total Leaks	Baseline 5-yr Average	Performance Measure
Corrosion	55	185	< Baseline
Natural Forces	38	62	< Baseline
Other Outside Force Damage	57	56	> Baseline
Pipe, Weld, or Joint Failure	139	157	< Baseline
Equipment Failure	256	132	> Baseline
Incorrect Operation	32	51	< Baseline
Other	60	528	< Baseline
Excavation Damage	815	1,223	< Baseline
Total Leaks (Minus Excavation)	636	1,173	< Baseline
Total leaks	1,452	2,396	< Baseline

In Table 9, the 5 year average total number of leaks (hazardous and non-hazardous) has decreased approximately 39% below the baseline. Better leak categorization has resulted in an 89% decrease in the Other leak cause category which results in more accurate trending of other categories. The performance measures that are greater than the baseline leaks been monitored the last few years and will continue to be monitored. No changes are recommended at this time.

Table 10: Total Leaks by Threat and Sub-cause

Leak Cause	Sub-cause	2019	2020	2021	2022
Equipment Failure	Cap Failure	94	75	87	76
Equipment Failure	Valves	107	93	89	84
Equipment Failure	Bolt-On Service Tee	34	28	17	19
Other Outside Force Damage	Vehicle Damage	15	18	20	17
Pipe, Weld, or Joint Failure	Fusion Failure	26	24	30	37
Pipe, Weld, or Joint Failure	Weld Failure	33	36	39	32

In Table 10, the sub-causes are identified for the leak causes and the number of leaks are shown for each year since 2019. The trends will continue to be monitored. See the DIMP Summary of Additional and Accelerated Actions for mitigation programs implemented to address each threat.

Table 11: DIMP Performance Measure – Excavation Damage

Metric	5-yr Average	Baseline 5-yr Average	Performance Measure
Number of Excavation Damages	862	1410	< Baseline
Number of Excavation Tickets	303,174	167,544	> Baseline
Number of Excavation Damages/1000 Tickets	2.8	8.3	< Baseline

In Table 11, the 5 year average number of excavation damages has decreased approximately 39% below the baseline due to the Damage Prevention Program preventative measures. The 5-year average for the number of excavation damages per 1,000 locates is below the baseline, but the current average warrants additional action to achieve less damages per year. The number of excavation damages per 1,000 locate tickets increased by 3% in 2022 compared to 2021 despite damages decreasing by 6%.

Table 12: DIMP Performance Measure – Response Time to Emergency Calls

Metric	5-yr Average	Baseline	Performance Measure
Number of Emergencies	21,439	22,867	< Baseline
Percentage of Emergencies Responded to Within 60 min	95.07%	92.54%	> Baseline
Average Response Time (Minutes)	32	33	< Baseline

In Table 12, the 5 year average number of emergencies and average response time is currently below the baseline. Relative to the baseline the performance measures are good, but the numbers are beginning to trend in the wrong direction. The total number of emergencies decreased in 2022 but the average response time increased to around 34 minutes and the percentage of emergencies responded to within 60 minutes decreased to about 93.6. The trends will continue to be monitored and no additional mitigative measures are required at this time. However, the trend was added as an Operational Threat.

Part 4. Periodic Evaluation and Improvement

Periodic evaluation ensures that current Additional and Accelerated Actions are appropriately and effectively mitigating system risks. The evaluation is a holistic review of the components of DIMP including identifying new threats to the system, identifying new potential threats, monitoring emerging trends, reviewing the evaluation and prioritization of risks, reviewing the effectiveness of Additional and Accelerated Actions, and adjusting Additional and Accelerated Actions where necessary. Table 13 summarizes the periodic evaluation for 2022.

Table 13: Periodic Evaluation and Improvement Summary for 2022

Category	2022 Summary
Re-Evaluation	The 2022 evaluation of DIMP is complete. The DIMP plan requires re-evaluation at a minimum of once every five years. However, the plan is typically reviewed annually. No significant updates were identified in 2022 and only minor updates to the risk model thresholds were required. A 2022 version of the DIMP Plan was published in May 2022.
New Threats	There were no new threats identified in 2022. One Potential Threat and six Operational Threats were identified.
Industry Knowledge	• Industry Presentation on Pinhole leaks – Static electricity from the gas flow can lead to pinhole leaks in PE pipe. Pinhole leaks have not been identified in the PSE distribution system and are likely not an applicable threat. Failure analysis data will continue to be monitored for future occurrences. • Aquidneck Island Outage in 2019 – Historic cold weather lead to highest daily delivery in 10-year period. High demand led to 7,455 customer outages for seven days. No improvement activities were identified. • San Francisco PG&E Third Party Damage and Fire in 2021 – Third party damage led to ignition of natural gas and several structure fires. In 2022 improvement activities were identified surrounding emergency response coordination with outside agencies, 2-way feed verification processes, and valve planning. • Hood River Outage in 2020 – A driver crashed into a district regulator station resulting in a massive outage of 5,500 customers during cold weather. Several improvement activities from this event were identified and completed in 2022. Traffic protection design and standards were evaluated. A review of traffic protection at existing gate and limit stations was conducted and improvements are recommended for each station. Processes, training, and documentation when foreign crews are used for emergency response were reviewed and implemented. Material stocking requirements for emergency response were evaluated.

	• Dallas Durango Drive Explosion in 2018 – The NTSB found that Atmos Energy had inadequate pipeline management and insufficient leak investigation which lead to three gas-related incidents, one of which included a fatal explosion. Based on SME review, no changes are recommended to the DIMP Plan or Leak Management systems. In 2022 a presentation was given to train Engineering and Operations of the possibility of odorant being stripped from gas slowly leaking horizontally and being absorbed in saturated soils. • Merrimack Valley Incident in 2018 – Columbia Gas of Massachusetts had a series of explosions due to over-pressurization of a Low Pressure distribution system. Based on SME review, Low Pressure system risk was re-evaluated and several changes were implemented. Low Pressure systems in Everett and Tacoma were retired and the Low Pressure system in Seattle was upgraded with a redundant over-pressure protection device. • Silver Springs Incident in 2016 - Washington Gas had an explosion due to failure of an indoor service regulator with an unconnected vent line. Based on SME review, no changes to the DIMP Plan were required. However, inside regulators will be risk ranked and evaluated to determine if they can be moved outside. In 2022, inspection training including inside regulator vent line inspection criteria and documentation was updated.
Threat/Asset Status Change	The DIMP Risk Matrix was updated based on 2022 Continuing Surveillance data. The following changes resulted from the update: • 1985 and older PE main was changed from High to Moderate risk • Newer STW and PE valves was changed from Low to Moderate risk • Facility Not Platted/Other was changed from Low to Moderate risk • Brittle-like Cracking Failure was changed from Moderate to Low risk • Fusion Failure was changed from Moderate to Low risk • Rockwell IPH Failure was changed from Moderate to Low risk
Additional and Accelerated Actions	The number of active Additional and Accelerated Actions was reduced from 32 to 31 due to completion of the Rockwell IPH Mitigation Program. The following Additional and Accelerated Actions had a change in program status: • Bridge and Slide Program was changed from Substantially Developed and Implemented to Developed and Implemented • Shallow Main and Service Remediation Program was changed from Substantially Developed and Implemented to Developed and Implemented • High Voltage AC Mitigation Program changed from Routine Operations to In Initial Stages of Development
Leak Management Effectiveness	The effectiveness of the leak management program is established through reporting of key performance indicators on specific leak related activities and through quality oversight of products and processes via audits and assessments. Metrics that are tracked monthly include leak surveys performed per the leak survey plan and leaks re-evaluated and repaired in required time frame. Based on the 2022 review, the leak management program is effective.

Performance Measures	Existing performance measures were evaluated and determined to be adequately measuring the effectiveness of DIMP and Additional and Accelerated Actions. New performance measures or revisions to existing performance measures are not required at this time.
DIMP Effectiveness	The evaluation of DIMP indicates that current Additional and Accelerated Actions are effectively mitigating system risks. Ongoing review will continue to identify where Additional and Accelerated Actions need to be developed and implemented to further mitigate risks. Based on the 2022 continuing surveillance data trending and SME review and validation, DIMP is still effectively mitigating risk in the distribution system.

Improvements - Initiatives Supporting DIMP

Other ongoing significant initiatives also support risk reduction on the gas distribution system and improve overall pipeline safety. Table 14 describes current initiatives supporting DIMP to improve pipeline safety.

Table 14: Initiatives Supporting DIMP

Initiatives	Description
Methane Emission Reduction	The methane reduction plan that was developed in 2016 identified reducing excavation damages, repairing non-hazardous leaks, and reducing blow down releases as the most effective ways to reduce methane emissions. In 2021, an Emissions Reduction Plan was filed in conjunction with the PRP to identify additional measures to further reduce methane emissions. The plan included enhancements to the Active Leak Program to expedite repair of Grade B leaks, adding additional field representatives for the Damage Prevention Program, and a targeted effort to eliminate nonhazardous aboveground leaks at meter sets. The field representatives are planned to be hired in 2023 and the strategy for eliminating aboveground leaks at meter sets was recently changed to include utilizing LLFA tape to enable faster repairs. The proposed Leak Detection and Repair (LDAR) rule for updated leak survey requirements to minimize methane emissions is currently being reviewed.
Pipeline Safety Public Awareness Program	In 2022, there were five small audits of Public Awareness and Damage Prevention programs which showed no areas of concern. Also, on a four year cycle, a comprehensive evaluation of the effectiveness of the Public Awareness Program is federally required. The 2021 comprehensive evaluation generally showed continued progress since the first study was conducted in 2013. The reach of the emergency responder training program and the consistency of communications with fire departments continues to improve. Approximately 55 safety trainings with first responders and public works departments were conducted last year. Continuing a trend that began in 2017, there was a 22% decrease in blocked sewer calls and a 4% decrease in the number of sewer cross bores found as a result of blocked sewer calls. Funding for the public awareness and damage prevention programs in 2022 enabled the programs to satisfy regulatory requirements, and in the area of damage prevention, to improve public safety.

Pipeline Safety Management Systems	Pipeline Safety Management Systems (PSMS) has been implemented companywide per the requirements of API 1173. PSMS is a recommended practice that provides pipeline operators with safety management system requirements that when applied provide a framework to reveal and manage risk, promote a learning environment, and continuously improve pipeline safety and integrity. In 2022, progress continued improvement activities identified as part of the PSMS gap assessment. Notable highlights included ongoing engagement with stakeholders supporting the implementation of various PSMS concepts, coordination with the Safety Department to sync PSMS requirements with existing efforts around employee safety, completion of training and process mapping for Gas Real-Time Operations, the completion of ongoing continuous improvement activities associated with event investigation, and the completion of mock exercises supporting emergency preparedness enhancements. At the end of 2022, the implementation of PSMS with a project team changed to it be integrated as part of the core processes. A PSMS Program Manager is planned to be hired in 2023 to help facilitate the improvement activities and ensure risk is reducing and ensure public, workforce, and system safety.

Improvements - Data Initiatives

Areas where there are opportunities to capture additional data and/or improve data accuracy to improve system risk understanding have been identified. With additional or more accurate data, the information results in better decision making for risk evaluation and prioritization which also ensures that appropriate risk mitigation activities are implemented. Table 15 describes current data initiatives to improve data integrity and risk knowledge.

Table 15: Data Initiatives

Initiatives	Responsible Department (Timeframe)	Description
Data Integration	Integrated Work Management (Ongoing)	As more field data is collected through operations and maintenance activities, there is an increased need to develop and implement a strategy to manage, consolidate, and integrate this information. The strategy should address how to link data to specific gas assets and to the GIS system. Improvements will help data analysis efficiency and result in better pipeline integrity decision-making.

Mapping Task Management	Maps, Records, and Technology	Mapping task management via SAP was implemented to enhance the capabilities for monitoring and to improve existing processes for efficiency and timeliness. Through the monitoring, a population of 3,000 field completed SAP work orders not added to the maps was discovered. If the location of a facility has been modified by a field completed work order without a completed mapping task category, an elevated risk of excavation damage exists due to reduced mapping accuracy for locating and could result in additional methane emissions. The program will identify field activity types that are prone to excluding a mapping notification and help to ensure mapping updates are submitted if the work is significantly modifying the location of facilities. An additional mapping analyst was hired in early 2023 to review the backlog of completed jobs without a mapping task.
Mapping Accuracy Program	Maps, Records, and Technology	The enterprise mapping and records systems continue to improve through the Mapping Accuracy Program. Some common themes that were identified in 2022 include errors during GIS conversion and incorrect construction method. The initiative to replace paper-based workflows with more accurate data processes utilizing GIS data and ESRI technology continued to be developed in 2022. A move toward more digital data and maps was incorporated into the Material Tracking and Traceability (MTT) project. The MTT project is being driven by a proposed PHMSA rule requirement to identify pipe, installer location, and components of the installation. The current requirement only applies to plastic pipe, but it is anticipated that the requirement will extend to steel pipe and components in the future. Additional recent improvements to reduce the risk of map data errors include: • Robust training for new employees and cross training for current employees • New reporting and auditing to better track incoming and processed map data • A dashboard that provides greater visibility to the progress of map updates

Part 5: System Trends

The following section is an analysis of the system trends that are most representative of the performance of the system. The system trends support the identification and prioritization of risks and where Additional and Accelerated Actions are needed to reduce system risks.

New Leaks

New leaks are evaluated to determine how the system performs over time. The trend of new leaks is an indicator of whether the system is improving or new risks are emerging. Leaks due to excavation damage are not included in the evaluation because they are independent of age and condition.

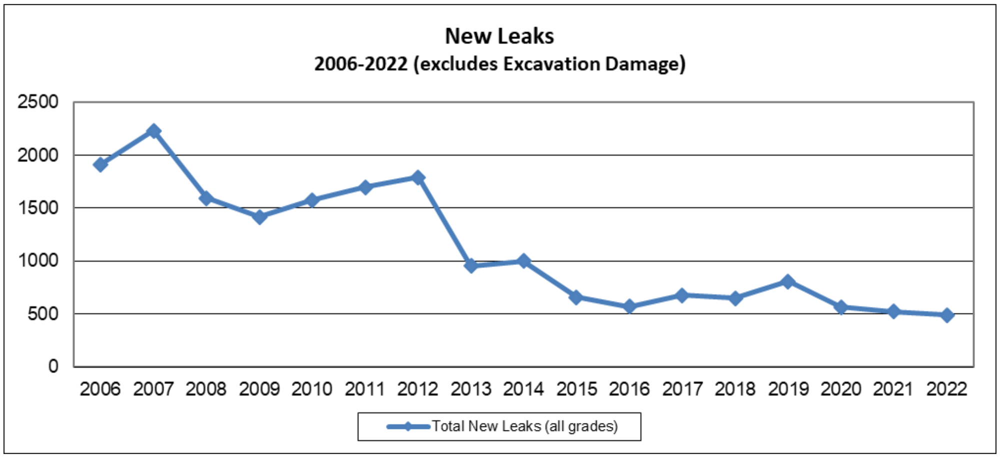


Figure 5. New Leaks

Figure 5 shows over time new leaks are decreasing in the distribution system due to pipe replacement, but now that most of the leakiest pipe has been replaced, new leaks have started to plateau. Cast Iron was eliminated from the system in 2007 and Bare Steel was eliminated in 2014. The reduction in leaks leading up to the elimination of both pipe assets can be seen on the graph of New Leaks above.

Active Leaks

Active leaks are evaluated to provide insight into non-hazardous leaks and the backlog of existing leaks.

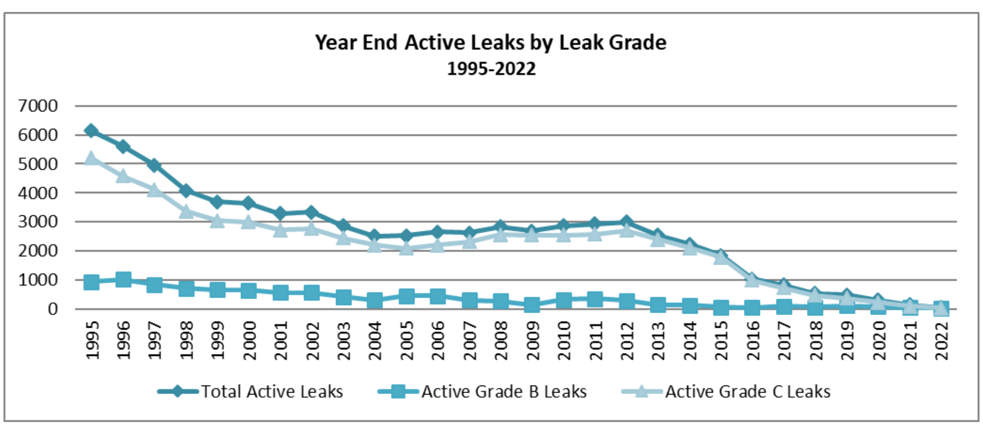


Figure 6. Year End Active Leaks by Leak Grade

Figure 6 shows Active leaks are also decreasing in the distribution system. The decrease is attributed to pipe replacement projects and a dedicated effort to reduce and expedite repair of non-hazardous (Grade B and Grade C) active leaks. Active Grade B leaks are at the lowest level in 10 years and the inventory of Grade C leaks has decreased 99% due to targeted leak repairs that began in 2012.

Failure Analysis Trends

The detailed failure analysis provides additional data beyond the high level leak cause category. Weld failure continues to be the leading cause of construction defects and material failures on steel pipe and fittings. The number of steel mechanical joint failure is up slightly compared to the last three years. The change can be attributed to the increase in repair of non-hazardous leaks. The trend will continue to be monitored. Older PE (1985 and older) failures are primarily caused by fusion failure, mechanical joint failure, and brittle-like cracking failure. The number of brittle-like cracking failures is trending at about the 5-year average. Newer PE (1986 and newer) failures are primarily caused by service tee cap cracking on Plexco Celcon caps and mechanical joint failures.

Corrosion Reporting Trends

An average of 3,200 Exposed Pipe Condition Reports are completed each year. Figure 7 shows the number of reports that indicate no corrosion found, corrosion was discovered and did not require remediation, or corrosion was discovered that required remediation.

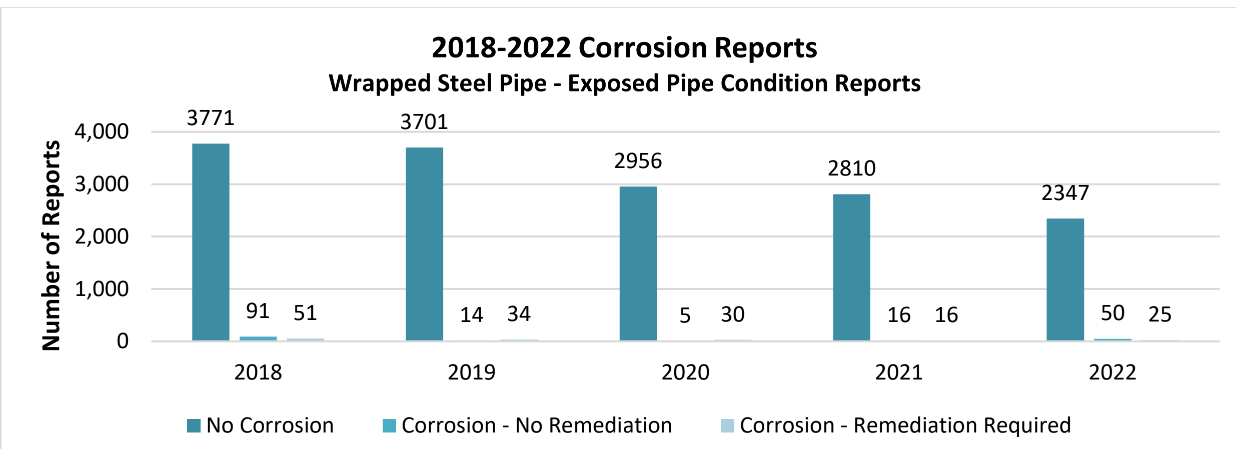


Figure 7. Exposed Pipe Condition Reports

Over the past 5 years, no corrosion was discovered about 98% of the time when wrapped steel pipe was exposed. When corrosion was discovered, remediation typically was required. The trends indicate that wrapped steel pipe in the distribution system is generally performing well.

Excavation Damages Trends

Excavation Damages are the highest risk and most common threat to the distribution system. Figure 8 shows Excavation Damages by root cause.

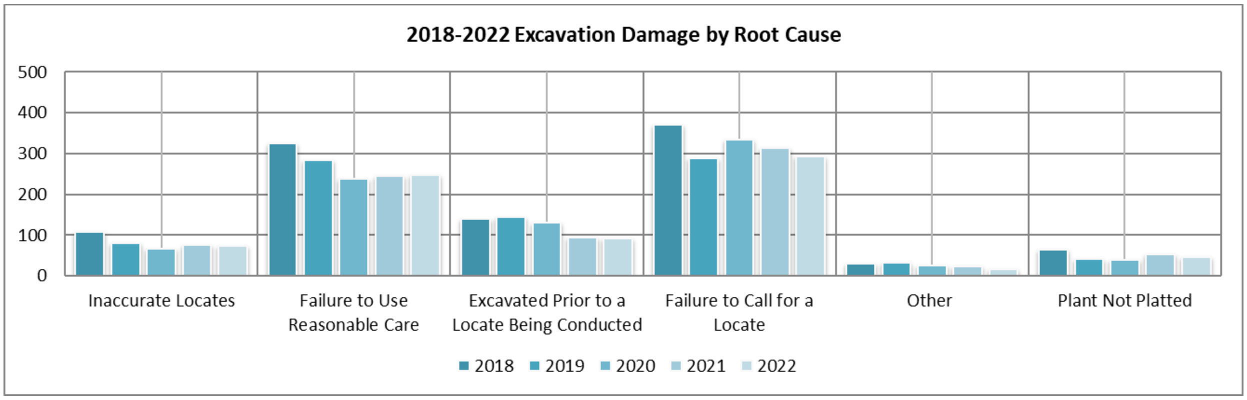


Figure 8. Excavation Damage by Root Cause

The majority of Excavation Damages are caused by failure to use reasonable care and failure to call for locates.

Continuing Surveillance Abnormal Operating Conditions Reporting

Over 7,700 Abnormal Operating Conditions were reported in 2022 from both PSE resources and from service providers. As part of PSMS, a report was created for Gas Operations to see the type of Abnormal Operating Conditions that are being reported in each respective area. Further improvement is needed to better track field work requests and the resolution of specific Abnormal Operating Conditions.

Table 16: 2022 Abnormal Operating Condition Reports by Primary Issue

Primary Issue	2020 Number of Reports	2021 Number of Reports	2022 Number of Reports
MSA Fuel Line Proximity	2,190	0	1,197
Risk of Outside Force Damage	2,870	955	1,105
Encroachment	670	448	760
Unplatted Meter	545	931	352
Other	144	2,758	1,343
Unknown	22	3,073	1,787
Pipeline Appears Stressed	1	0	0
Damaged Regulator at MSA	1	0	0
Relief Vent Issue	0	0	261
Foreign Bond	0	0	233
Traffic Protection Required	0	0	665
Total	5,411	8,165	7,703

Table 16 shows Abnormal Operating Conditions reported in 2020 through 2022. Reports of Abnormal Operating Conditions are typically remediated through existing DIMP Additional and Accelerated Actions or are collected for information to be used for future programs once a reported issue becomes systemic. In 2021 and part of 2022, there was an increased number of Abnormal Operating Condition reports in the Other and Unknown categories that were inappropriately categorized due to training issues and other data inconsistencies. However, the issue has largely since been resolved through system enhancements to capture additional data in each category and updated inspection.

Of the remaining reports, the two highest categories were MSA Fuel Line Proximity and Risk of Outside Force Damage. MSA Fuel Line Proximity is when customer fuel line is in contact or within ¼" of the meter set assembly which can affect the cathodic protection and cause a potential ground. Risk of Outside Force Damage includes potential vandalism and tampering or heavy objects stored in close proximity to the MSA. Reports of Relief Vent Issue, Foreign Bond, and Traffic Protection Required increased in 2022 because they were categorized incorrectly in previous years.

Methane Emissions Reporting

A new reporting requirement was implemented as part of House Bill 2518 in Washington State that requires Natural Gas Operators to report methane emissions for the previous year starting on March 15th, 2021.

Table 17: Methane Emissions by Leak Cause

Leak Cause	2020 Metric Tons CO2e	2021 Metric Tons CO2e	2022 Metric Tons C02e
Excavation Damage	11,489	17,069	10,391
Natural Force Damage	1,443	298	178
Pipe, Weld, or Joint Failure	1,226	1,135	332
Other Outside Force Damage	1,050	781	517
Active Non-hazardous Leaks	874	271	92
Equipment Failure	387	543	238
Other Cause	374	362	251
Incorrect Operations	125	46	17
Corrosion Failure	90	98	112
Total	**17,077**	**20,602**	**12,128**

The data in Table 17 shows that Excavation Damage is the number one cause for leaks in the distribution system and also the biggest emitter of methane to the atmosphere. The largest specific methane emitters in 2022 were the following:

- 1-1/4 in. PE service break caused by homeowner
- 2 in. PE High Volume Tapping Tee break taking over 7 hours to shut down

- 2 in. PE Service break caused by a contractor exposing sewer laterals
- 4 in. PE main break caused by a contractor excavating for sewer taking 2 hours to shut down
- 6 in. PE main break caused by a directional drill at 46 inches deep taking 3 hours to shut down

Pipeline Safety Management Incident/Gas Event Trend Review

Part of the adoption of Pipeline Safety Management Systems is to conduct trending and analysis of pertinent incidents and events that occurred during the previous year. A new report form was established in 2019 with three tiers of incident/event types. Immediately following an incident/event, a possible root cause is investigated as necessary and important lessons learned and improvement activities are documented and shared with other employees. For 2022, there were 11 incidents/events, as shown in Table 18.

Table 18: 2022 Post Incident/Event Review

Date Location	Event Type	Event Tier	Sub Cause	How Future Risk Is Addressed	Lessons Learned
1/2/22 12655 120th Ave NE, Kirkland	Material Failure	Major (Tier 2)	Seized Rotary Meter	IMO Program	Ensure all changes to IMO meters are captured on data sheet
1/6/22 4244 Bullfrog Rd, Cle Elum	Unintentional ignition	Major (Tier 2)	Unsupported Relief Vent	Design/ Engineering	Review and update snow country requirements and remediate high risk installations
1/17/22 5008 139th Pl SE, Bellevue	Natural Force Damage	Major (Tier 2)	Broken Water Main	Patrol Program	Identify landslide areas and consider large scale options for make safe
2/2/22 6712 104th Ave NE, Kirkland	Accidental Release of Gas	Major (Tier 2)	Pipe Verification	Training	Window steel pipe to check if there is inserted pipe and provide training on safest way to deactivate pipe
2/15/22 2003 Western Ave, Seattle	Other – Unknown Pipe Verification	Near Miss (Tier 3)	Pipe Verification	Training	Verify pipe through records before performing physical pipe verification
3/31/22 S Seattle Gate Odorant	Odorant Issue	Major (Tier 2)	Williams over Odorizing	Training	Monitor odorizer injection rate when gas pipeline is temporarily shut-in or low flow conditions
7/20/22 4318 15th Ave NE, Lacey	Excavation Damage	Near Miss (Tier 3)	Pipe Verification	Training	Make a plan to shut off gas if cutting into pipe for verification
8/31/22 16461 Ambaum Blvd S, Burien	Gas-Electric Interaction	Major (Tier 2)	Ground Fault Damage	Training	Ensure the emergency response and repair for ground fault events identify the entire scope of damage
9/15/22 Georgetown DR	Personal Injury	High Consequence (Tier 1)	Field Procedures	Process Improvement/ Engineering	Review removal of deactivated pipe requirements and field procedures changes

10/28/22 1003 Main St, Sumner	Unintentional ignition	Major (Tier 2)	Structure Fire	Training	Improve communication between field, Dispatch, and with Fire Department; and provide better access to curb valves
11/8/22 19000 Canyon Rd, Tacoma	Significant Outage	Major (Tier 2)	Significant Customer Outage	Damage Prevention Program	Ensure locates are maintained and contractor potholes before drilling, excavate downstream of break first to lock in remaining gas, and ensure materials for emergency response are stocked

Lessons learned, improvement activities, and event cause are being tracked to identify any trends. Pipe verification and the risk associated with determining if a pipeline is active or not was one recent theme identified in the lessons learned. A new Gas Field Procedure will be developed in 2023 to address the issue. No other relevant trends have been identified so far but the data will be continued to be monitored.

APPENDIX A

LEGEND
Risk Ranking

Low Risk | Moderate Risk | High Risk

New Facility Type/Threat | Status Change Facility Type/Threat

Level of Risk by System-Wide Assets and Sub-Assets	Current Relative Risk Ranking (2022)	Current Relative Risk Ranking Considering Existing Mitigative Measures	Mitigative Measures	Corresponding Additional and Accelerated Action (If Required)
Main				
Bare Steel Main (LP-IP)	Low	Low	A/A Complete	N/A
1971 and Older Wrapped Steel Main (LP - IP)	Moderate	Moderate	A/A	1, 6, 9, 10, 13, 17, 25
1972 and Newer Wrapped Steel Main (LP - IP)	Low	Low	Code	N/A
1985 and Older Polyethylene Main (LP - IP)	Moderate	Moderate	A/A	1, 6, 9, 10, 13, 24, 28
1986 and Newer Polyethylene Main (LP - IP)	Moderate	Low	Code	N/A
Wrapped Steel Main (HP)	Moderate	Moderate	A/A	6, 10, 13, 15
Wrapped Steel Main in Casing	Moderate	Moderate	A/A	31
Shallow Main	Moderate	Moderate	A/A	6, 29
Main in Wall-to-Wall Paving/HOS	Moderate	Moderate	A/A	6, 15, 24
Main Subject to Movement and/or Exposure	Moderate	Low	A/A	3, 7
Water Crossing	Low	Low	Code	N/A
Main in Slide Area	Low	Low	A/A	3
Service				
Bare Steel Service (LP-IP)	Low	Low	A/A Complete	N/A
1971 and Older Wrapped Steel Service (LP - IP)	Moderate	Moderate	A/A	1, 6, 9, 10, 13, 17, 21, 23, 25
1972 and Newer Wrapped Steel Service (LP - IP)	Low	Low	Code	N/A
1985 and Older Polyethylene Service (LP - IP) - 1-1/4" and Larger	Moderate	Moderate	A/A	1, 2, 5, 6, 9, 10, 13, 21, 23, 24, 28
1985 and Older Polyethylene Service (LP - IP) - Smaller than 1-1/4"	Moderate	Moderate	A/A	1, 2, 5, 6, 9, 10, 13, 21, 23, 28
1986 and Newer Polyethylene Service (LP - IP)	Moderate	Moderate	Code	N/A
Wrapped Steel Service (HP)	Moderate	Moderate	A/A	6, 10, 13, 21, 22, 23
Wrapped Steel Service in Casing	Low	Low	A/A	21, 23
Shallow Service	Moderate	Moderate	A/A	6, 21, 23, 29
Service in Wall-to-Wall Paving/HOS	Moderate	Moderate	A/A	6, 11, 21, 23, 24
Extended Service Line in Mobile Home Community	Low	Low	A/A Complete	N/A
Service Subject to Movement and/or Exposure	Moderate	Moderate	A/A	3, 7, 11, 21, 23
Service in Slide Area	Low	Low	A/A	3, 11, 21, 23
Extended Utility Facility (EUF)	Moderate	Moderate	A/A	6, 12, 21, 23
Inside Service	Low	Low	Code	N/A
MSA				
Residential MSA	Moderate	Moderate	A/A	30
Buried MSA	High	High	A/A	4
Commercial and Industrial MSA	Moderate	Moderate	A/A	19, 26, 30
Sidewalk and Street Vault Regulator	Low	Low	Code	N/A
Inside Meter and/or Regulator	Low	Low	Code	N/A
Aboveground Regulators	Low	Low	Code	N/A
Idle Riser	Moderate	Moderate	A/A	9, 18, 23
Valve				
Newer Wrapped Steel and Polyethylene Valve	Moderate	Low	Code	N/A
Older Wrapped Steel Valve (HP)	Moderate	Low	A/A	1, 16
Older Wrapped Steel Valve (IP)	Moderate	Low	A/A	1
Double Insulated Flanged Valve	Low	Low	A/A	1, 8
Farm Tap				
Single Service Farm Tap	Low	Low	Code	N/A
Modified Farm Tap (Farm Tap on Riser)	Moderate	Moderate	A/A	22
Farm Tap	Moderate	Moderate	A/A	27
Regulator Station				
Gate Station, Town Border Station, Limiting Station	Moderate	Moderate	A/A	14, 26, 27
HP-IP District Regulator Station	Moderate	Moderate	A/A	27
IP-LP District Regulator Station	Low	Low	A/A	20, 27
Propane Peak-Shaving Plant and Distribution System				
Propane Distribution System - Sumner	Low	Low	A/A Complete	N/A
Swarr Propane-Air Plant	Moderate	Low	Code	N/A

LEGEND
Risk Ranking

Low Risk | Moderate Risk | High Risk

New Facility Type/Threat | Status Change Facility Type/Threat

Level of Risk by System-Wide Threats and Sub-Threats	Current Relative Risk Ranking (2022)	Current Relative Risk Ranking Considering Existing Mitigative Measures	Mitigative Measures	Corresponding Additional and Accelerated Action (If Required)
Corrosion				
External Corrosion	Moderate Risk	Moderate Risk	A/A	1, 4, 8, 12, 15, 25, 31
Internal Corrosion	Low Risk	Low Risk	Code	N/A
Atmospheric Corrosion	Moderate Risk	Moderate Risk	A/A	3, 7, 12, 18, 19, 22, 23, 26, 27
Stray/Induced Current	Low Risk	Low Risk	Code	N/A
Natural Forces				
Seismic Activity	Low Risk	Low Risk	Code	N/A
Earth Movement / Landslide	Low Risk	Low Risk	Code	N/A
Frost Heave	Low Risk	Low Risk	Code	N/A
Flooding	Low Risk	Low Risk	Code	N/A
Wildfire	Low Risk	Low Risk	Code	N/A
Over-Pressure due to Snow/Ice Blockage	Low Risk	Low Risk	Code	N/A
Tree Roots	Low Risk	Low Risk	Code	N/A
Animal Damage	Low Risk	Low Risk	Code	N/A
Lightning	Low Risk	Low Risk	A/A	13
Excavation Damage				
Failure to Call	High Risk	High Risk	A/A	6, 11
Improper Excavation Practice	High Risk	High Risk	A/A	6, 11, 29
Facility Not Located or Marked	Low Risk	Low Risk	A/A	6, 11, 23, 29
One-call Notification Center Error	Low Risk	Low Risk	Code	N/A
Locating Error	Moderate Risk	Moderate Risk	A/A	6, 11
Facility Not Platted/Other	Moderate Risk	Moderate Risk	Code	6, 11
Other Outside Force Damage				
Vehicle Damage	Low Risk	Low Risk	A/A	9, 30
Vandalism/Tampering/Unintentional Damage	Moderate Risk	Moderate Risk	A/A	9, 12, 18, 19, 23
Electrical Faults	Low Risk	Low Risk	A/A	13
Cyber Security	Low Risk	Low Risk	Code	N/A
Structure Fire	Low Risk	Low Risk	Code	N/A
Material or Weld				
Brittle-Like Cracking Failure	Low Risk	Low Risk	A/A	24
Fusion Failure	Low Risk	Low Risk	A/A	24
Weld Failure	Moderate Risk	Moderate Risk	A/A	1, 15, 25, 27
Mechanical Fitting Failure	Low Risk	Low Risk	A/A	1
Bolt-on Service Tees	Moderate Risk	Moderate Risk	A/A	1, 2
Equipment Failure				
Celcon Service Tee Caps	Moderate Risk	Moderate Risk	A/A	1, 5
Valves	Moderate Risk	Low Risk	A/A	1, 16, 27
Regulator Failure	Low Risk	Low Risk	Code	N/A
Overpressure Protection Failure	Low Risk	Low Risk	Code	N/A
Rockwell IPH Failure	Low Risk	Low Risk	A/A Complete	N/A
Heater Failure	Moderate Risk	Moderate Risk	A/A	14
Incorrect Operations				
Operating Error	Low Risk	Low Risk	Code	N/A
Sewer Cross Bore	High Risk	High Risk	A/A	28
Other				
Encroachment	Moderate Risk	Moderate Risk	A/A	9, 10
Depth of Cover	Moderate Risk	Moderate Risk	A/A	29
Gas Quality	Low Risk	Low Risk	Code	N/A
Mapping Accuracy	Moderate Risk	Moderate Risk	A/A	21
Other	Low Risk	Low Risk	Code	N/A

Mitigative Measures Legend:
Code = Federal or State Code regulations or PSE Gas Operating Standards are sufficient to reduce risk
A/A = Additional and Accelerated Action program is required to reduce risk
A/A complete = Additional and Accelerated Action program has been completed

APPENDIX B

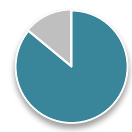
Program Index	Additional and Accelerated Action	Program Status	Risk Priority
1	Active Leak Reduction Program	Substantially Developed and Implemented	Low
2	Bolt-On Service Tee Program	In Initial Stages of Development	Moderate-High
3	Bridge and Slide Remediation Program	Developed and Implemented	Low
4	Buried MSA Remediation Program	Substantially Developed and Implemented	Top Priority
5	Celcon Service Tee Cap Program	Routine Operations	Moderate-High
6	Damage Prevention Program	Developed and Implemented	Top Priority
7	Docks and Wharves Assessment Program	Routine Operations	Low
8	Double Insulated Flanged Valve Program	Routine Operations	Low
9	Encroachment MHC Survey Program	Substantially Developed and Implemented	Low
10	Encroachment Remediation Program	In Initial Stages of Development	Moderate-High
11	Excess Flow Valve Program	Routine Operations	Low
12	Extended Utility Facilities Program	Substantially Developed and Implemented	Moderate-High
13	Ground Faults and Lightning Strike Mitigation Program	In Initial Stages of Development	Moderate-High
14	Heater Maintenance Program	In Initial Stages of Development	Low
15	High Pressure Main Assessment Program	In Initial Stages of Development	Moderate-High
16	High Pressure Valve Mitigation Program	Routine Operations	Low
17	High Voltage AC Mitigation Program	In Initial Stages of Development	Low
18	Idle Riser Program	Substantially Developed and Implemented	Moderate-High
19	Industrial Meter Set Remediation Program	In Initial Stages of Development	Low
20	Low Pressure Distribution Systems Remediation Program	Substantially Developed and Implemented	Moderate-High
21	Mapping Accuracy Program	In Initial Stages of Development	Moderate-High
22	Modified Farm Tap Program	Substantially Developed and Implemented	Moderate-High
23	No Record Facility Remediation Program	In Initial Stages of Development	Top Priority
24	Older Vintage PE Pipe Mitigation Program	Developed and Implemented	Top Priority
25	Older Wrapped Steel Pipe Mitigation Program	Developed and Implemented	Moderate-High
26	Pipe on Pipe Supports Program	Routine Operations	Low
27	Regulator Station Mitigation Program	Developed and Implemented	Moderate-High
28	Sewer Cross Bore Program	Substantially Developed and Implemented	Top Priority
29	Shallow Main and Service Remediation Program	Developed and Implemented	Low
30	Traffic Protection Enhancement Program	Substantially Developed and Implemented	Low
31	Wrapped Steel Main in Casing Program	Substantially Developed and Implemented	Moderate-High

APPENDIX C

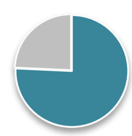
Potential Threat	Potential Consequence	Description
PE Pipe Inserted in STW Not Mapped	High Consequence	In 2019, an unintentional ignition of gas occurred when a bottom-out was welded onto 2-inch steel main. The steel main had been previously deactivated and inserted with newer PE. However, the update was not documented on any maps or as-builts. Upon review, it was determined that the transition from Mid-Mountain contractors to Pilchuck contractors in 1998 may have been the reason for the as-built not being mapped.
Stiffener Corrosion	High Consequence	A relatively small number of leaks have been discovered on Ampfit mechanical stab fittings due to corrosion on the internal stiffener. The corrosion on the internal stiffener causes stress that creates a hairline crack in the fitting and/or pipe.
Anodeless Riser Corrosion	High Consequence	Anodeless residential risers have PE pipe inserted in a steel casing that terminates above ground at a service head adaptor or transition fitting. The service head adaptor transitions from PE pipe to above ground gas carrying pipe before the regulator and meter. Corrosion of the steel casing at the soil-to-air (SAI) interface can result in the riser falling.
Service Stubs	High Consequence	When a service is retired it is mapped as a generic cut and cap symbol off the main. The service could be retired further downstream from the main and not mapped correctly. Service stubs may have been left in the system without good visibility of the location.
Bentonite Contamination of PE Fuses	Moderate to High Consequence	Pipelines that are installed by HDD are susceptible to bentonite contamination which can lead to electrofusion failure.
Gas Lamps	Moderate to High Consequence	Gas lamps were historically installed as a branch off the service or main and have a brass compression fitting at the base. A relatively small number of leaks due to cracking at the brass compression fitting have been discovered but the cause has not been confirmed.
Under-Rated Components/Under-Tested Facilities	Moderate to High Consequence	Under-rated components and/or under tested facilities can be discovered during records research. Under-rated components may include fittings that do not have an ANSI class that matches the operating pressure or the incorrect material type such as a cast iron completion cap. Under tested facilities may include farmtaps that were tested to IP service testing standards or where the pressure test records cannot be produced.
Overpressure Occurrences	Moderate to High Consequence	Overpressure of facilities most commonly results from debris in regulators or incorrect operations of equipment. Overpressure occurrences have resulted in field investigations, special leak investigations, and/or re-testing of the facilities. The facilities that have been affected include industrial meter sets, regulator stations, and high pressure systems.
Insulated Fittings	Moderate to High Consequence	Some legacy mechanical fittings use a rubber component to seal the fitting to the pipe. A metal button then bridges the rubber component to keep the cathodic protection continuous through the fitting. There have been recent reports of these fittings failing and insulating the downstream pipe.
Cracked Seam Welds	Moderate to High Consequence	Three leaks on older vintage wrapped steel mains were discovered in 2016 that were caused by cracked seam welds. The cause of the manufacturing defect has not been determined but it does not appear to be systemic at this time.
Proximity to Steam Lines	Moderate Consequence	PE pipe cannot be installed closer than 50 feet to steam lines and wrapped steel pipe cannot be closer than 10 feet without requiring a special heat resistant coating. There may be locations where PE and wrapped steel pipe are installed closer than the minimum allowed distance and could be subject to damage if there is a steam line failure.

APPENDIX D

The distribution system spans six counties in Washington State (primarily in western Washington with a small portion located in Kittitas County in eastern Washington) and includes two peak-shaving plants (a propane-air plant in Renton and an LNG plant in Gig Harbor). Services include residential, commercial, and industrial customers. The following tables summarize the system by facility type, material, vintage, and operating pressure.

Mains and Services by Material Type					
Material Type	**Graph Color**	**Mains (Miles)**	**Services**	**Mains**	**Services**
PE		8,996 (+0.5%)	723,082 (+0.7%)		
Steel		4,061 (-0.1%)	118,014 (-0.6%)		
Total		13,057 (+0.3%)	841,096 (+0.5%)		

PE Mains and Services by Vintage					
Material Vintage	**Graph Color**	**Mains (Miles)**	**Services**	**Mains**	**Services**
1985 and Older		1,056 (-1.0%)	77,019 (-0.4%)		
1986 and Newer		7,940 (+0.7%)	646,063 (+0.8%)		
Total		8,996 (+0.5%)	723,082 (+0.7%)		

Steel Mains and Services by Vintage					
Material Vintage	**Graph Color**	**Mains (Miles)**	**Services**	**Mains**	**Services**
1971 and Older		3,075 (-0.1%)	92,141 (-0.6%)		
1972 and Newer		986 (+0.1%)	25,873 (-0.4%)		
Total		4,061 (-0.1%)	118,014 (-0.6%)		

Mains by Maximum Allowable Operating Pressure	
Low Pressure - 2 psig or less	5.1 miles (-0.0%)
Intermediate Pressure - 60 psig or less	12,803 miles (+0.4%)
High Pressure - greater than 60 psig	605 miles (+0.0%)
Total	**13,440 miles (+0.4%)**