Pipeline Replacement Program Plan

Puget Sound Energy

2013

in accordance with

Policy Statement in Docket No. UG-120715

Required Contents: Checklist and Table of Contents

Policy Statement		Section/Page
The pipe replacement program plan should consist of three parts: (1) a "master" plan for replacing all pipes with an elevated risk of failure;	In support of its pipe replacement program plan, each gas company should demonstrate that the type of pipe to be replaced under its program presents an elevated risk of cracking, leakage, breakage or other failure. The gas company should explain why the particular type(s) of pipe presents an elevated risk, such as the physical qualities of the pipe as manufactured (e.g., low ductile plastic pipe), the condition of the pipe as installed (e.g., poor soil conditions) or as maintained (e.g., no cathodic protection), the age of the pipe, etc. The gas company should also provide detailed analysis and explanation demonstrating why the pipe it seeks to replace is appropriate for replacement, compared to other pipe. To the extent practical, the gas company should quantify and explain the degree to which risk of failure is elevated for such pipe, compared to other pipe.	**Section 1 -** DuPont ALDYL "HD" Page 3 Wrapped Steel Mains Page 7 Wrapped Steel Services Page 9
(2) a two-year plan that specifically identifies the pipe replacement program goals for the upcoming two year period;	The first pipe replacement program plan shall be filed by June 1, 2013, covering planned pipe replacement through 2015.	**Section 2** DuPont ALDYL "HD" Page 6 Wrapped Steel Mains Page 8 Wrapped Steel Services Page 9
and (3) if applicable, a plan for identifying the location of pipe that presents elevated risk of failure.	A prudent pipe replacement program should contain a plan for identifying the location of elevated risk pipe; to the extent the gas company does not presently know the location. The plan should include a timetable under which the gas company will know the location of its elevated risk pipe. The Commission will not require a gas company to know the location of all of its elevated risk pipe as a prerequisite for having a pipe replacement program consistent with the policy statement. A pipe replacement program may focus initially on pipe for which the gas company knows the location.	**Section 3 –** DuPont ALDYL "HD" Page 6 Wrapped Steel Mains Page 8 Wrapped Steel Services Page 10
The pipe replacement program plan must be in the public interest		**Section 4 –** Page 10

Introduction

On December 31, 2012, the Washington Utilities and Transportation Commission filed a policy statement for the accelerated replacement of natural gas pipeline facilities with elevated risk. This policy statement requires each gas company requesting a special pipe replacement cost recovery mechanism (CRM) to file with the Commission a pipe replacement program plan containing the following elements:

1. *A "master" plan for replacing all pipes with an elevated risk of failure*
2. *A two-year plan that specifically identifies the pipe replacement 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, the following is PSE's proposed pipe replacement program plan for pipe that poses an elevated risk of failure. PSE continually analyzes the performance of its distribution system and documents the results of this analysis in the Continuing Surveillance Annual Report. Based on this analysis, PSE's distribution system is performing well. While the system is performing well as a whole, detailed analysis indicates some subsets of materials that have an elevated risk of failure. These subsets include bare steel, larger diameter older vintage plastic pipe (specifically the DuPont Aldyl "HD" plastic pipe), older vintage steel wrapped mains, and older vintage steel wrapped services.

PSE is on target to complete the replacement of bare steel piping by the end of 2014 in accordance with a settlement agreement. The settlement agreement details the target replacement plan and requires PSE to report progress to the WUTC. As a result, no additional information on the bare steel replacement plan is included with this filing. The sections below provide the information required by the policy statement for the DuPont Aldyl "HD" plastic pipe, older vintage steel wrapped mains, and older vintage steel wrapped services.

DuPont ALDYL "HD" Plastic Pipe

Section 1 - Master plan for replacing pipe with an elevated risk of failure

Through the Distribution Integrity Management Program (DIMP), PSE has identified an increased risk of premature, brittle-like cracking of the larger diameter (1 ¼" and larger) Aldyl "HD" plastic pipe. The Aldyl "HD" is a polyethylene (PE) resin that DuPont used to manufacture plastic pipe. PSE installed this pipe in the 1970s and early 1980s.

The brittle-like cracking is due to slow crack growth (SCG) at locations where there is a stress concentration. 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 slow crack growth,

the PE pipe is still resistant to crack propagation preventing it from becoming a larger crack.

As part of its DIMP, PSE analyzes many aspects of system performance including leak trends and reports on these trends in the Continuing Surveillance Annual Report. A copy of the Continuing Surveillance Annual Report for 2012 is attached. This report highlights some important trends that provide insight into the cause of failures and the elevated risk of failures from the larger diameter DuPont pipe.

While leak repairs on DuPont pipe are less frequent than on steel pipe, the leaks repaired on older vintage PE main are more than twice as likely to be Grade "A" or "BA" leaks requiring immediate or next day repair than leaks repaired on older STW main or bare steel main. Specifically, the original grade of repaired leaks on older PE main are hazardous approximately 65% of the time compared to 30% and 20% on older STW main and bare steel main respectively. This trend provides insight into the elevated risk from leaks on older vintage PE mains.

The Continuing Surveillance Annual Report also highlights that brittle-like cracking on PE pipe is primarily due to rock impingement but also occurs where the pipe has been squeezed. The model used to prioritize replacement of DuPont Aldyl "HD" pipe assigns risk weightings to historical failures that may predict future failures including fusion failures, brittle-like cracking, and reports of rock in the vicinity of PE pipe.

PSE's experience with the larger diameter Aldyl "HD" material is similar to industry experience with many of the older PE materials. This is highlighted by many of the Safety Recommendations reports 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 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, not much 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. This occurs is some early vintage PE materials that have a lower slow crack growth resistance than other PE materials. Newer test methods more accurately predict the pipe's resistance to slow crack growth.

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 in this filing 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. This characteristic resulted in premature failures. In early 1972, DuPont US changed the manufacturing process to address the low ductile inner wall 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 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 slow crack growth 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.

PSE plans to replace the larger diameter Aldyl "HD" pipe that poses an elevated risk of failure. PSE will continue to monitor the performance of the larger diameter Aldyl "HD" pipe to determine the appropriate timeframe for completing the replacement of this pipe. Based on historical performance, PSE currently plans to replace this pipe within 20 years beginning in 2013. PSE plans to increase the amount of pipe replaced each year in the first few years of the program and replace fewer miles per year in the last few years of the program. The plan is to replace approximately 100 miles of pipe in years one through five, 150 miles in years six through ten, 100 miles in years eleven through fifteen, and 50 miles in years sixteen through twenty. Based on this plan, PSE expects to spend approximately $150 million in the first five years of the program, $225 million in years six through ten, $150 million in years eleven through fifteen, and $75 million in years sixteen through twenty. These expenditures are in 2013 dollars and do not include AFUDC.

PSE will continue to monitor the performance of the Aldyl "HD" material and report on the trends in the Continuing Surveillance Annual Report. This targeted schedule may be modified to either further accelerate the pipe replacement or decelerate the replacement if

these trends indicate it is appropriate to adjust the replacement schedule. If any material changes are made to this plan, PSE will submit them to the Commission as required by the Commission's Policy Statement.

Section 2: Two-year plan that specifically identifies the pipe replacement goals for the upcoming two year period

Appendix A lists the Aldyl "HD" projects that are planned for completion in the current CRM year, 2013, as well as the current prioritization for projects in the CRM years 2014 and 2015. Adjustments to the specific projects may be made for a variety of reasons including new risk knowledge, permitting issues, customer issues, and public improvement opportunities. New projects will be substituted for any projects that are delayed with a goal to keep on track with the target replacement schedule discussed in the Master Plan.

Section 3: A plan for identifying the location of pipe that presents elevated risk of failure

PSE purchased and installed Aldyl "HD" pipe in the 1970s and early 1980s. During this timeframe, PSE primarily purchased and installed both Aldyl "HD" and Phillips M8000.

PSE's construction records indicate the location of the pipe as well as the material, size, and date the pipe was installed. The construction records did not capture the pipe manufacturer. As a result, PSE has developed and begun implementing a plan to identify the manufacturer of larger diameter PE pipe installed in the 1970s and early 1980s.

PSE estimates approximately 400 miles of Aldyl "HD" remain in service of which PSE has already identified 166 miles. This identification is based on post construction reports of pipe manufacturer. PSE plans to identify the remaining Aldyl "HD" pipe for all the candidate locations by the end of 2016. This is being accomplished by identifying PE pipe manufacturer when the pipe is exposed through normal operation and maintenance activities as well as targeted excavations of candidate pipe installations.

PSE had previously captured information on pipe manufacturer on the Exposed Pipe Condition Report and has recently implemented a new PE Pipe Report to continue capturing this information. This information is being recorded in a database and analyzed to identify locations where the pipe manufacturer is already known and areas that require targeted excavation to determine the manufacturer.

Targeted excavations shall be performed in accordance with the criteria specified below until Aldyl "HD" is identified. Once Aldyl "HD" is identified on any job, the targeted excavations are complete and the location will go on the list for planned replacement. Additional excavations may be performed as required to gather information to scope the

replacement job. If Aldyl "HD" is not identified on the initial targeted excavation, additional excavations will be performed until Aldyl "HD" is identified or all targeted excavations are complete per the following criteria:

- One positive non-Aldyl "HD" identification is required for each pipe size installed under the same job
- More than one positive identification of non-Aldyl "HD" is required for jobs that are greater than 1,000 feet in length
- PE services not off of candidate mains shall have at least one positive identification of non-Aldyl "HD"

These criteria will be evaluated and adjusted if necessary based on manufacturer data gathered through the ongoing replacement of the Aldyl "HD" and PE Pipe Reports.

Based on the information gathered to date as well as the current criteria for manufacturer identification, PSE expects to perform approximately 5,000 targeted excavations. The targeted excavations are being planned and prioritized considering many factors including risk and accessibility. Risk focuses on areas with higher consequence and accessibility focuses on completing work prior to paving activities and subsequent paving moratoriums. Additional planning considerations focus on maximizing efficiencies and productivity, minimizing costs, and minimizing impacts to municipalities and the general public.

Based on the existing information, PSE plans to complete the identification of the larger diameter Aldyl "HD" locations by the end of 2016. While PSE's methodology prioritizes performing targeted excavations in the vicinity of paving improvements, existing paving moratoriums or significant changes in the number of targeted excavations required could result in a change to this schedule. PSE will submit any material changes to this plan as required by the Commission's Policy Statement.

Wrapped Steel Mains

Section 1 - Master plan for replacing pipe with an elevated risk of failure

PSE has identified, through its Distribution Integrity Management Program (DIMP), an increased risk of leakage on some of the older steel wrapped mains. This risk is due to a combination of factors including corrosion, existing third party damage to the pipe coating, welds, and equipment including vintage valves. The majority of the wrapped steel mains are performing very well and we expect they will continue to reliably provide gas service for years to come. However, ongoing reviews of the distribution system continue to identify areas that have had leaks repaired, are experiencing new leaks, and have reports of corrosion and/or damaged pipe coating. These segments of main and the

associated service piping have an elevated risk of failure as indicated by the system performance data.

PSE plans to replace the wrapped steel mains and associated service pipe that is identified as having an elevated risk. As previously discussed, the majority of the wrapped steel mains are performing very well and we expect they will continue to reliably provide gas service for years to come. As a result, PSE's plan does not include replacing all steel wrapped pipes but only that pipe that presents an elevated risk of failure based on the system performance data.

The plan for replacing steel wrapped mains is driven by risk knowledge. Based on current risk knowledge, PSE expects to replace approximately 20 miles of steel wrapped main over the next 5 years. Based on this plan, PSE expects to spend approximately $30 million replacing steel wrapped mains and associated services over the next 5 years. These expenditures are in 2013 dollars and do not include AFUDC.

PSE will continue to monitor the performance of the wrapped steel mains and report on the trends in the Continuing Surveillance Annual Report. Based on these trends, the replacement plan may be modified to either further accelerate main replacements or decelerate main replacements if these trends indicate it is appropriate to adjust the schedule. If any material changes are made to this plan, PSE will submit them to the Commission as required by the Commission's Policy Statement.

Section 2: Two-year plan that specifically identifies the pipe replacement goals for the upcoming two year period

Appendix B lists the wrapped steel main projects that are planned for completion in the current CRM year, 2013, as well as the current prioritization for projects in the CRM years 2014 and 2015. Adjustments to the specific projects may be made for a variety of reasons including new risk knowledge, permitting issues, customer issues, and public improvement opportunities. New projects will be substituted for any projects that are delayed with a goal to replace mains to with an elevated risk of failure.

Section 3: A plan for identifying the location of pipe that presents elevated risk of failure

The location of steel wrapped pipe that presents an elevated risk of failure is continually monitored by reviewing system information including corrosion leak repairs, active leak data, and exposed pipe condition reports. This system performance data will continue to be monitored to identify any new areas that present an elevated risk of failure.

Wrapped Steel Services

Section 1 - Master plan for replacing pipe with an elevated risk of failure

PSE has developed and implemented a program to assess the risks on wrapped steel services installed prior to 1972. Since this program began, more than 10,000 of the original population of approximately 100,000 services have been remediated. The majority of the remaining wrapped steel services are performing very well and we expect they will continue to reliably provide gas service for years to come. However, ongoing review of the risk factors indicates an elevated risk of failure for some of the services. These risk factors include services in casing where the gas carrying pipe within the casing may not be adequately protected from corrosion and services where a combination of risk factors such as inactive risers or buried meters increase the total risk.

PSE plans to replace the pre-1972 wrapped steel services with an elevated risk. As previously discussed, the majority of the wrapped steel services are performing very well and are expected to continue to reliably provide gas service for years to come. As a result, PSE's plan does not include replacing all steel wrapped services but only those that present an elevated risk of failure based on the risk knowledge. Based on current risk knowledge, PSE is targeting to replace approximately 1,100 services over the next 5 years. Based on this plan, PSE expects to spend approximately $10 million replacing steel wrapped services over the next 5 years. These expenditures are in 2013 dollars and do not include AFUDC.

PSE will continue to monitor the performance of the pre-1972 wrapped steel services and report on the trends in the Continuing Surveillance Annual Report. This targeted schedule may be modified to either further accelerate service replacements or decelerate service replacements if these trends indicate it is appropriate to adjust the schedule. If any material changes are made to this plan, PSE will submit them to the Commission as required by the Commission's Policy Statement.

Section 2: Two-year plan that specifically identifies the pipe replacement goals for the upcoming two year period

Appendix C lists the wrapped steel service projects that are planned for completion in the current CRM year, 2013. Adjustments to the specific services that will be replaced may be made for a variety of reasons including new risk knowledge, permitting issues, customer issues, and public improvement opportunities. New projects will be substituted for any projects that are delayed with a goal to replace services with an elevated risk of failure.

PSE plans to replace approximately 250 wrapped steel services in both the CRM years 2014 and 2015. These projects will be determined based on the results of the risk model that is updated annually with new risk knowledge as well as additional risk knowledge that is gained from on-going review of additional risk knowledge that is gained from on-

going review of wrapped steel service installation records. A list of these services will be completed by October 1st of the year proceeding planned replacement.

Section 3: A plan for identifying the location of pipe that presents elevated risk of failure

PSE has identified the location of pre-1972 wrapped steel services and has recorded this information in a database. While this database is a useful tool in managing these services, PSE is working towards a plan to utilize the new geographic information system (GIS) as the data source for the ongoing identification and tracking of these services. This is targeted to be completed by the end of 2013.

Utilizing the GIS will facilitate data integration allowing additional risk information to be analyzed in conjunction with service data. Currently the risk information is available to identify locations where wrapped steel services have been installed in casing, have inactive risers, and have buried meters. This information is currently available in multiple databases and requires integration with the service location information. Once the GIS system is able to be used, there will be improved risk knowledge and tracking of wrapped steel service risks.

In accordance with distribution integrity management principles, PSE will continue to evaluate the risk of wrapped steel services. If additional risk factors are identified, these will be integrated into the remediation plan.

Section 4: The pipe replacement program plan must be in the public interest

The pipe replacement plans for the DuPont Aldyl "HD" plastic pipe, older vintage steel wrapped mains, and older vintage steel wrapped services included in this filing 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

Consistent with the requested potential rate impact analysis discussed in paragraph 55 of the policy statement, PSE's best estimate at this time, based on the estimated program spending for DuPont Aldyl "HD" plastic pipe, older vintage steel wrapped mains, and older vintage steel wrapped services replacement programs (included on pages 5, 8, and 9 of the Plan) could result in an average annual increase of .75% in overall customer rates, beginning with the 2014 period.

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Addendum A

Addendum to PSE's Pipeline Replacement Program Plan

Based on current risk knowledge gained from Distribution Integrity Management, PSE has identified the following pipeline facilities that pose an elevated risk of failure where replacement is an appropriate risk mitigation plan:

- Bare steel mains and services
- Older vintage wrapped steel mains and services
- Larger diameter DuPont Aldyl HD mains and services

All of these facilities except bare steel mains and services are included in PSE's Pipeline Replacement Program Plan (PRP Plan). As mentioned in the PRP Plan, PSE is on target to complete the replacement of bare steel piping by the end of 2014 in accordance with a settlement agreement. The settlement agreement details the target replacement plan and requires PSE to report progress to the WUTC. As a result, no additional information on the bare steel replacement plan is included with this filing.

In addition to the three elevated risk materials identified above, the following provides information on materials and construction practices that have been identified for further evaluation and/or mitigation. This information is from PSE's Distribution Integrity Management Program Plan (DIMP Plan) and Continuing Surveillance Annual Report. Pipeline facilities made from these materials are not currently included in PSE's PRP Plan. The information provided below describes PSE's current risk knowledge and existing mitigative measures for these facilities. Where appropriate, it also describes PSE's plans to gain further risk knowledge and determine any additional mitigative measures to reduce the risk in accordance with the continuous improvement requirements of PSE's DIMP Plan.

Copper Services:

PSE is targeting to complete the replacement of the three remaining copper services by the end of 2013. These facilities are being replaced due to operations and maintenance considerations rather than elevated risk. Leak data indicates there has only been one leak on a copper pipe in the last 5 years that was related to the integrity of copper service piping. As a result, these facilities were not included in PSE's PRP Plan.

Celcon Service Tee Caps:

PSE has experienced some failures of service tee caps that have resulted in leaks. As PSE introduced both a new manufacturer of service tees and switched to medium density polyethylene from high density in the mid-1990's, additional investigation is required to determine the root cause of these failures and how to identify, prioritize, and mitigate the risk of additional failures. This work is currently underway.

Bolt-on Service Tees:

Through our failure analysis process, PSE has analyzed the root cause of failure of older vintage bolt-on tees. The results of this analysis are presented in

Appendix B-11 of PSE's DIMP Plan. As discussed in this appendix, the majority of the leaks occurred where the pipe surface was scratched where the saddle makes contact with the pipe. These scratches impacted the ability of the O-ring to maintain an effective seal over time. To minimize the future risks of bolt-on service tee failures, PSE emphasized the requirements in the installation procedures to ensure bolt-on tees were only installed on pipe that is clean and scratch and gouge free.

Mechanical Couplings:

PSE's has analyzed the types of mechanical compression fittings installed in our system in accordance with PHMSA's advisory bulletins. The results of this analysis are presented in Appendix B-8 of PSE's DIMP Plan. In summary, this analysis concluded that PSE has always specified compression couplings that are designed for pull-out resistance when mechanically joining PE pipe. This minimizes the risk of the type of failures that prompted the advisory bulletins. In addition, PSE has not experienced failures from plastic pipe pulling out of a compression outlet end of a coupling.

Sewer Cross Bore:

Gas facilities installed using trenchless methods may intersect a sewer line resulting in a sewer cross bore. These installations can be subject to damage if mechanical drain cleaning equipment is used to clear a blocked sewer. This issue has been of national interest over the past few years due to incidents that have occurred as a result of drain cleaning activities. PSE has begun a multi-pronged effort to increase awareness about sewers cross bored by gas facilities, prevent the installation of new cross bores, and develop a program to inspect sewer lines in areas were previous installations may have resulted in cross bores.

As required by the regulations, PSE's DIMP Plan specifies continuous improvement processes. This includes gathering additional risk knowledge and incorporating that risk knowledge into risk evaluation and implementation of mitigative measures. Based on this continuous improvement process, additional pipeline facilities may be added to the PRP Plan in future years.