153

FILE

*OCC EXHIBIT NO.*_____

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of The East Ohio Gas Company d/b/a Dominion East Ohio for Authority to Increase Rates For its Gas Distribution Service.	))))	Case No. 07-829-GA-AIR
In the Matter of the Application of the East Ohio Gas Company d/b/a Dominion East Ohio for Approval of an Alternative Rate Plan for its Gas Distribution Service.	))))	Case No. 07-830-GA-ALT
In the Matter of the Application of the East Ohio Gas Company d/b/a Dominion East Ohio for Approval to Change Accounting Methods.	))))	Case No. 07-831-GA-AAM
In the Matter of the Application of the East Ohio Gas Company d/b/a Dominion East Ohio for Approval of Tariffs to Recover Certain Costs Associated With a Pipeline Infrastructure Replacement Program Through an Automatic Adjustment Clause, And for Certain Accounting Treatment.	))))))))	Case No. 08-169-GA-ALT
In the Matter of the Application of the East Ohio Gas Company d/b/a Dominion East Ohio for Approval of Tariffs to Recover Certain Costs Associated With Automated Meter Reading and for Certain Accounting Treatment.	))))))	Case No. 06-1453-GA-UNC

DIRECT TESTIMONY
of
SCOTT J. RUBIN

ON BEHALF OF THE
OFFICE OF THE OHIO CONSUMERS' COUNSEL
10 West Broad Street, Suite 1800
Columbus, OH 43215-3485

July 25, 2008

TABLE OF CONTENTS

EXHIBITS

ATTACHMENTS

I. INTRODUCTION

Q1. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A1. My name is Scott J. Rubin. My business address is 333 Oak Lane, Bloomsburg, Pennsylvania.

Q2. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A2. I am an independent consultant and an attorney. My practice is limited to matters affecting the public utility industry.

Q3. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS CASE?

A3. I have been retained by the Office of the Ohio Consumers' Counsel ("OCC") to review the proposal of East Ohio Gas Company d/b/a Dominion East Ohio ("DEO" or "Company") to establish an automatic adjustment clause to collect from customers costs associated with its proposed Pipeline Infrastructure Replacement Program ("PIRP"). I have also been asked to review the Report of the Staff of the Public Utilities Commission of Ohio ("PUCO" or "Commission") that evaluated the Company's PIRP proposal.

Q4. WHAT ARE YOUR QUALIFICATIONS TO PROVIDE THIS TESTIMONY?

A4. I have testified as an expert witness before utility commissions or courts in the District of Columbia and in the states of Arizona, Delaware, Illinois, Kentucky,

Maine, Maryland, New Jersey, New York, Ohio, Pennsylvania, and West Virginia. I also have testified as an expert witness before two committees of the U.S. House of Representatives and one committee of the Pennsylvania House of Representatives. I also have served as a consultant to the staffs of the Connecticut Department of Public Utility Control and the Delaware Public Service Commission as well as to several national utility trade associations, and state and local governments throughout the country. Prior to establishing my own consulting and law practice, I was employed by the Pennsylvania Office of Consumer Advocate from 1983 through January 1994 in successive positions of increasing responsibility. From 1990 until I left state government, I was one of two senior attorneys in that Office. Among my other responsibilities in that position, I played a major role in setting its policy positions on water and electric matters. In addition, I was responsible for supervising the technical staff of that Office. I also testified as an expert witness for that Office on rate design and cost of service issues.

Throughout my career, I developed substantial expertise in matters relating to the economic regulation of public utilities. I have published articles, contributed to books, written speeches, and delivered numerous presentations, on both the national and state levels, relating to regulatory issues. I have attended numerous continuing education courses involving the utility industry. I also periodically participate as a faculty member in utility-related educational programs for the Institute for Public Utilities at Michigan State University, the American Water

Works Association, and the Pennsylvania Bar Institute. Exhibit SJR-1 to this testimony is my curriculum vitae.

Q5. DO YOU HAVE ANY EXPERIENCE THAT IS PARTICULARLY RELEVANT TO THE ISSUES IN THIS CASE?

A5. Yes, I do. I have testified concerning the design and use of automatic adjustment clauses for infrastructure replacement before this Commission (*In the Matter of the Application of The Cincinnati Gas & Electric Company for an Increase in Gas Rates in its Service Territory,* Case No. 01-1228-GA-AIR) and before the Pennsylvania Public Utility Commission (*Petition of Pennsylvania-American Water Company for Approval to Implement a Tariff Supplement Revising the Distribution System Improvement Charge*, Docket No. P-00062241). From other research I have done, I am also very familiar with industry trends and data involving issues such as infrastructure management and replacement, pipe costs, work force availability, and related issues. For example, I recently completed work with a colleague that projected to the year 2020 the likely costs and risks facing approximately 40 water and wastewater utilities in a two-county region of Pennsylvania. This included projecting infrastructure management and replacement opportunities and costs, among many other factors.

Q6. WHAT DOCUMENTS AND DATA HAVE YOU REVIEWED?

A6. I have reviewed the Company's Application in Case No. 08-169-GA-ALT, the Supplemental Direct Testimony of Jeffrey Murphy (DEO Ex. 1.1), the Direct Testimony of Tim McNutt (DEO Ex. 10.0), attachments to those testimonies, the Staff Report in Case No. 08-169-GA-ALT, and numerous responses to interrogatories and requests for production of documents related to the PIRP. In addition, I have reviewed and analyzed data from 1994 through 2007 filed by DEO with the U.S. Department of Transportation's Office of Pipeline Safety. I also reviewed and analyzed similar data filed by other natural gas distribution utilities for 2007.

II. SUMMARY

Q7. PLEASE SUMMARIZE YOUR UNDERSTANDING OF DEO'S PROPOSAL.

A7. As I understand it, DEO is requesting PUCO approval for a proposed program that would replace all cast iron, bare steel, wrought iron, and copper gas mains and affected service lines over the next 25 years, without regard to the condition of the pipe or its ability to provide safe and reliable service. For simplicity, I will refer to these four types of mains as "unprotected mains." DEO estimates that this involves the replacement of approximately 4,122 miles of distribution mains. As part of the program, DEO would assume ownership and responsibility for the customer-owned portion of gas service lines, as such lines are replaced as part of the main replacement work.

DEO estimates that this 25-year program would cost approximately $2.662 billion in 2007 dollars.[1] That is, this cost estimate does not include any impacts of general price inflation and it does not assume any cost increases (for materials, labor, energy, or other cost components) different from the general rate of inflation. This investment represents approximately 2.5 times DEO's current level of rate base investment.

As part of its proposal, DEO also is requesting the ability to automatically adjust its rates to recover the costs associated with its replacement program. This aspect of the proposal would permit DEO to recover a return of and return on its investment in new rate base investment without having to file base rate cases.

Q8. WHAT DID THE PUCO STAFF RECOMMEND?

A8. PUCO Staff recommended approval of the PIRP. In addition, Staff recommended that DEO should be permitted to implement an automatic rate adjustment mechanism to recover PIRP costs, but that the automatic adjustment should be allowed to operate for no more than eight years or until DEO files a base rate case, whichever occurs first. At that time, the Commission would review the PIRP and the automatic adjustment mechanism and determine whether any changes need to be made.

[1] DEO estimates the pipeline replacement cost would be $1.656 billion; main-to-curb replacements would cost $0.490 billion; and curb-to-meter replacements would cost $0.516 billion; for a total of $2.662 billion. DEO Application ¶¶ 11 and 12; DEO Ex. 10.0, p. 12.

Q9. DO YOU AGREE WITH THE COMPANY'S PROPOSAL OR THE STAFF'S RECOMMENDATION?

A9. No, I do not agree with either the Company's proposal or Staff's recommendation. As I will describe in more detail in the remainder of my testimony, I conclude as follows:

- It is not reasonable for DEO to replace all of its unprotected mains. DEO has not done the type of study that would be required to determine the prudent, cost-effective approach to managing its buried infrastructure. DEO has not shown that its distribution system is exhibiting any unusual levels of deterioration or increased risk.
- DEO has a higher percentage of bare steel mains, and a lower percentage of plastic mains, than a peer group of similarly sized natural gas distribution utilities. DEO's leak rate is somewhat higher than its peers, but DEO's level of unaccounted for gas is lower than its peers. Moreover, DEO appears to be doing a good job managing its leaks, in that it has a much lower level of known but unrepaired leaks than its peers. Comparing DEO with its peers does not indicate that DEO needs to make radical changes in its management of its buried infrastructure.
- My review of DEO's trends over the past 14 years does not show signs of significant deterioration, or other increases in risks, in its distribution system. In fact, DEO's leak rate has been reduced significantly during that time period, and its level of unaccounted for gas remains essentially

unchanged. Further, DEO's actions during the past two or three years are not consistent with its claims that the replacement of bare steel is a high priority. In fact, since 2005 DEO has replaced essentially no bare steel mains on its system.

- I conclude that DEO has not demonstrated a need for the PIRP. DEO has not conducted the types of studies that would be needed to develop a prudent, cost-effective program and it certainly has not supported the need for a multi-billion dollar, multi-year program like the proposed PIRP.
- I recommend that the Commission should not authorize DEO to undertake the PIRP at this time. If DEO wants to propose such a program again in the future, it must be supported by the types of rigorous studies that others in the industry have performed.
- DEO's estimate of the PIRP costs is grossly inaccurate. Even excluding inflation, the PIRP is likely to have a total cost in excess of $3 billion. When the likely effects of inflation are included, the total cost of the PIRP is more likely to be in the range of $5 billion to $6 billion than the $2.66 billion estimated by the Company.
- In the alternative, if the Commission goes forward with the PIRP, then I recommend that limits must be placed on any infrastructure surcharge for residential customers. Those limits should include a limit on the total magnitude of the charge and a limit on the length of time such a surcharge can remain in effect prior to a base rate case.

- In particular, I recommend that the amount of the surcharge should not be allowed to exceed 5 percent of a typical residential customer's base bill (excluding the cost of gas). The surcharge would be reset to zero in each base rate case, so DEO would be allowed to continue recovering from customers its infrastructure replacement costs to the extent prudently incurred and if DEO appropriately times its base rate case proceedings.

III. IT IS NOT REASONABLE TO REPLACE ALL UNPROTECTED MAINS

Q10. ON WHAT BASIS DOES DEO ATTEMPT TO SUPPORT THE NEED FOR THE PIRP?

A10. Fundamentally, DEO claims that it needs to remove all of the cast iron, bare steel, wrought iron, and copper distribution mains from its system on an accelerated basis without regard to the mains' condition. DEO's primary support for this seems to be that it has more unprotected mains than most other natural gas distribution utilities. DEO never explains why its system is so different from its peers or why those differences are creating a risk to the public, increased costs, or other problems.

Q11. WITHIN THE NATURAL GAS INDUSTRY, ARE THERE ANY GUIDELINES FOR HOW TO APPROACH THE ISSUE OF BURIED INFRASTRUCTURE MANAGEMENT?

A11. Yes, the leading guide in the natural gas industry is the *Pipeline Risk Management Manual: Ideas, Techniques, and Resources* by W. Kent Muhlbauer. This manual was first published in 1992 and is currently in its third edition (published in 2004). The manual sets forth a rigorous approach to assessing and managing the risk of pipelines, including natural gas distribution systems. In fact, one full chapter of the book deals specifically with a risk-assessment methodology for distribution systems.

Q12. WITHOUT REPRODUCING THE ENTIRE COPYRIGHTED WORK OF MR. MUHLBAUER, CAN YOU PROVIDE A GENERAL OVERVIEW OF AN APPROPRIATE RISK ASSESSMENT APPROACH FOR A NATURAL GAS DISTRIBUTION UTILITY?

A12. The key to determining how to manage a distribution network is to understand the risks (such as loss of gas, damage to third parties, and so on) and the various factors that can affect those risks (such as pipe material, types of soils, installation method, operations and maintenance practices, and so on). Risk management should be a continuing-improvement program, or an optimization process, that minimizes the risks through a cost-effective approach to managing the numerous factors that can affect those risks.

Q13. WHAT TYPES OF FACTORS CAN AFFECT GAS LEAKAGE AND THE OTHER RISKS OF OPERATING A GAS DISTRIBUTION SYSTEM?

A13. There are literally dozens of factors that can affect the integrity and life of a natural gas distribution network. Among those listed by Mr. Muhlbauer are: pipe material and coating, pipe diameter, soil corrosivity (including factors such as moisture content, acidity, presence of chemicals such as chlorides and sulfates), joint type, pressure, tree locations, traffic, nearby excavation, level of activity above ground, cathodic protection, type of joint, land movements, maintenance and inspection practices, and construction methods.

Q14. HAS DEO CONDUCTED AN ANALYSIS THAT CORRELATES ANY OF THESE FACTORS WITH GAS LEAKAGE, UNACCOUNTED FOR GAS, REPORTABLE INCIDENTS, MAINTENANCE EXPENDITURES, OR ANY OTHER MEASURE OF RISK?

A14. No. As far as I can tell, DEO based its decision to undertake a multi-billion-dollar program on a leak analysis on part of its system and on a fairly cursory comparison between itself and other gas distribution companies. This is woefully inadequate to justify the massive expenditures DEO proposes to undertake.

Q15. DEO HAS STATED THAT IT HAS MORE UNPROTECTED MAINS THAN MOST OTHER NATURAL GAS DISTRIBUTION UTILITIES. WHY IS THAT IMPORTANT?

A15. That is not a particularly important fact when determining if DEO can provide safe and reliable service. If the pipe materials are not causing an elevated level of risk (for example, a higher level of unaccounted for gas or a larger number of leaks), then it is not particularly meaningful that a company has more or less pipe of a certain material.

Q16. EVEN IF DEO HAD A HIGHER NUMBER OF LEAKS OR MORE UNACCOUNTED FOR GAS, WOULD THAT NECESSARILY MEAN THAT THE PROBLEM WAS CAUSED BY THE PIPE MATERIAL?

A16. No, not necessarily. As I stated, there are numerous factors that could be responsible for pipe failure, including operations and maintenance practices, third party activity, installation methods, and many others. Just because pipes are leaking does not necessarily mean that the cause is related to the pipe material. It requires a detailed study to determine the actual factors that are influencing the risk, and it requires in-depth planning and management to determine how to cost-effectively manage the risk.

Q17. DO ANY NATURAL GAS DISTRIBUTION UTILITIES ACTUALLY DO THIS TYPE OF ANALYSIS AND RISK MANAGEMENT?

A17. Yes. I am not aware of what every gas distribution utility is doing, and many utilities would keep the specific methodology secret, but I have located a report prepared by Puget Sound Energy ("PSE") that describes in some detail its risk analysis approach. I have provided as Attachment SJR-1 an interim report prepared by that utility describing the data collection and analysis method it is using to develop a wrapped steel service line program. PSE is using the type of analytical approach I described to assess the risks and factors related to those risks. PSE will then use that information to develop a program that likely will include a combination of inspection, maintenance, repair, and replacement of assets to cost-effectively manage the risks associated with unprotected service lines.

I also would note that PSE has conducted a similar approach to bare steel and cast iron distribution mains. In a recent report to the Washington Utilities and Transportation Commission, PSE states: "PSE proactively evaluates its active and repaired leak history trends, which is important to ensure that the bare steel and cast iron programs are achieving an appropriate balance of leak repair versus system replacement."[2] The report then notes that the utility's optimization

[2] PSE *System Performance Programs: 2006 Annual Review* (June 14, 2007), p. 21.

program has reduced leaks by nearly 60 percent in ten years. PSE's program does involve the replacement of all cast iron and bare steel mains, but it does so in a manner that prioritizes the mains to be replaced, based on a risk assessment model.

The type and scope of analysis undertaken by PSE would be appropriate for DEO, given the magnitude and cost of the program DEO is proposing.

Q18. ARE THERE ANY OTHER MODELS FOR OPTIMIZING AND MANAGING BURIED INFRASTRUCTURE?

A18. As I said, I am not familiar with every case around the country. But I am aware that just a few months ago, the Connecticut Department of Public Utility Control ("DPUC") issued an order addressing infrastructure management issues for water utilities.[3] While the risks associated with gas and water distribution systems are different, many of the risk factors, causes of infrastructure failure, management processes, and regulatory issues are very similar. In that order, the DPUC stated that before allowing a utility to recover costs through an infrastructure surcharge "it will require that prudent engineering and objectively determined system needs be considered that will benefit reliability of service to customers at reasonable rates and insure that companies do not become overly aggressive in prematurely

[3] *DPUC Review and Investigation of the Requirements for Implementation of a Water Infrastructure and Conservation Adjustment*, Docket No. 07-09-09 (April 30, 2008). A copy of the order is reproduced as Attachment SJR-2.

investing in main renewal or other projects of questionable benefit."[4] The DPUC then stated that the purpose of an infrastructure surcharge, known as WICA, "is to rehabilitate or replace aging underground infrastructure, in particular decaying pipe and valves. The WICA program is not intended to be a substitute for ongoing maintenance of system infrastructure."[5]

The DPUC then listed more than 20 factors that should be used by utilities to prioritize their infrastructure investment.[6] I will not list all of them here, but it is important to note that the DPUC listed many of the same factors evaluated in the Puget Sound model and in the reference work prepared by Mr. Muhlbauer, including main break history, the impact of outages, pipe material and location, information about the installation of the pipe, and many others.

Q19. HOW DOES DEO'S APPROACH TO CAST IRON AND BARE STEEL MAINS COMPARE TO AN APPROPRIATE APPROACH, SUCH AS THE ONE USED BY PUGET SOUND ENERGY OR THE ONE RECOMMENDED BY THE CONNECTICUT DPUC?

A19. DEO's approach could not be more different. DEO has not conducted any comprehensive analysis of its distribution system risks or the factors that might be

[4] *Id.*, page 6

[5] *Id.*

[6] *Id., pages 6-7.*

contributing to those risks. DEO has not engaged in any type of optimization process or other analysis to determine how to manage its buried infrastructure assets.

Q20. HAS DEO CONDUCTED ANY TYPE OF COST-BENEFIT ANALYSIS TO SHOW THAT IT IS REASONABLE TO UNDERTAKE AN INVESTMENT OF THIS MAGNITUDE?

A20. No, the Company has not conducted any type of cost-benefit analysis. Indeed, the only analysis the Company has done is to compare leak rates for distribution mains of different materials. As I discuss below, that analysis fails to consider numerous important factors and falls far short of the type of rigorous analysis that should be conducted to support a multi-billion-dollar investment program.

Q21. HAS THE COMPANY CONDUCTED ANY TYPE OF ANALYSIS TO SUPPORT THE CLAIM OF PUBLIC SAFETY NEED FOR THE PROPOSED PIRP?

A21. No, the Company has not conducted any analysis to show that there is a real public safety need for its proposed program.

Q22. HAS THE COMPANY CONDUCTED ANY TYPE OF ANALYSIS TO SHOW THAT IT IS MORE COST-EFFECTIVE TO REPLACE ITS UNPROTECTED GAS MAINS RATHER THAN TO CONTINUE TO INSPECT, MAINTAIN, AND REHABILITATE OR REPLACE THE EXISTING INFRASTRUCTURE ON AN AS-NEEDED BASIS?

A22. No, the Company has not conducted any analysis that compares the relative costs and benefits of total replacement compared to keeping the existing facilities in service, with appropriate inspection, maintenance, and rehabilitation or replacement programs.

Q23. OTHER THAN A COMPARISON OF LEAK RATES, HAS DEO CONDUCTED ANY OTHER ANALYSIS TO SHOW THAT IT IS REASONABLE TO UNDERTAKE THIS $2.66 BILLION INVESTMENT, AND THAT CUSTOMERS SHOULD UNDERWRITE THAT INVESTMENT?

A23. No. DEO has not provided any information to show that it is a reasonable use of its (or its customers') limited resources to replace all of its unprotected mains and to do so over a 25-year period, regardless of the cost or benefit.

IV. COMPARING DEO TO ITS PEERS

Q24. DEO CLAIMS THAT IT HAS A GREATER PERCENTAGE OF UNPROTECTED MAINS THAN ITS PEERS. DO YOU AGREE?

A24. Yes, I agree, at least in part. I analyzed data filed by each natural gas distribution utility with the US Department of Transportation, Office of Pipeline Safety. From that data, I developed a peer group for DEO, which consists of 13 gas distribution utilities that (at year-end 2007) had between 750,000 and 1,750,000 service lines or that had between 15,000 and 25,000 miles of mains. DEO falls in the middle of these ranges with 1,294,905 service lines and 19,584 miles of mains.

On Exhibit SJR-2, I show that DEO has much more unprotected bare steel mains (17.9 percent of its mains) than its peers (5.0 percent of mains). DEO, however, has a smaller percentage of cast or wrought iron mains than its peers (DEO 0.6 percent; peer group 4.6 percent). Further, in terms of materials that are more protected, DEO actually has a higher percentage of coated steel mains than its peers (DEO 52.5 percent; peer group 37.5 percent). The major difference in protected materials is in the percentage of plastic where DEO has only 26.6 percent of its mains made of this material compared to its peers that have 52.5 percent of mains made from plastic.

In other words, DEO may have more unprotected bare steel than its peers. However, it actually has less cast iron and more protected or coated steel than its peers. The major difference is that DEO's peers have installed a much higher percentage of plastic mains than DEO has installed.

Q25. DID YOU ALSO COMPARE THE COMPANY'S SERVICE LINE MATERIALS TO THOSE USED BY ITS PEERS?

A25. Yes, I did. In Exhibit SJR-3, I show similar data comparing DEO's service line materials to those used by its peers. Here the contrast is even more apparent: DEO uses much more bare steel than its peers (51.9 percent of DEO's service lines compared to only 8.9 percent of its peers' service lines) and much less plastic than its peers (DEO 36.6 percent compared to 64.3 percent for its peers).

Q26. HAS DEO'S HIGHER PREVALENCE OF BARE STEEL MAINS AND SERVICES RESULTED IN A HIGHER LEVEL OF UNACCOUNTED FOR GAS ON THE DEO SYSTEM?

A26. No, it has not. In fact, the data for 2007 shows that DEO actually has a much **lower** level of unaccounted for gas than its peer group. Specifically, on Exhibit SJR-4, I show that in 2007 DEO's unaccounted for gas was only 0.27 percent, compared to its peers that had an average of 1.12 percent.

Q27. DOES DEO HAVE A HIGHER INCIDENCE OF LEAKS THAN ITS PEERS?

A27. Yes, it does. On Exhibit SJR-5 I compare leak data for DEO and its peers for 2007. The schedule shows that DEO experienced 22.9 leaks per 100 miles of mains, compared to 10.6 leaks per 100 miles for its peer group. Significantly, 79.8 percent of DEO's leaks were reportedly due to corrosion, while only 27.2 percent of the peer group's leaks were reported to be from corrosion.

Similarly, for service lines, DEO reported 6.1 leaks per 1000 services, and 51.5 percent of those were due to corrosion. The peer group reported only 4.0 leaks per 1000 services, and only 17.7 percent of the leaks were from corrosion.

Overall, when all leaks are considered (including those that were identified but not fixed at year-end 2007), DEO experienced 10.0 leaks per 1000 customers (service lines), while its peer group experienced 7.3 leaks per 1000 customers. In other words, DEO is experiencing a leak rate approximately 1/3 higher than its peers.

Q28. WHAT IS THE SIGNIFICANCE OF THE LEAK DATA?

A28. The leak data indicate that DEO has more leaks than its peers and that most of DEO's leaks are from corrosion (which would be related to the higher prevalence of unprotected steel on the DEO system). The data also tell us, however, that the leaks are manageable. At year-end 2007, DEO had far fewer known but unrepaired leaks (3.0 leaks per 100 miles compared to its peers with 9.0 leaks per

100 miles) and had a much lower level of unaccounted for gas (0.27 percent compared to 1.12 percent for its peers). So while DEO is expending resources to repair leaks, it seems to be doing so in a fairly efficient manner – the Company appears to be able to manage the leak rate without losing much gas or having to replace the entire segment of the pipeline.

Q29. WHAT DO YOU CONCLUDE FROM YOUR REVIEW OF DATA FOR DEO AND ITS PEERS IN THE NATURAL GAS INDUSTRY?

A29. I conclude that DEO experiences a somewhat higher leak rate than its peers, but it also appears to be doing a good job of managing those leaks. It had far fewer known but unrepaired leaks than its peers did at year-end 2007, and DEO also had a lower level of unaccounted for gas than the peer group. This indicates to me that DEO is taking reasonable actions at the present time to manage its buried infrastructure. Because DEO has more unprotected mains than its peers, it experiences a much higher level of leaks due to corrosion, but DEO also experiences much lower levels of leakage from other factors. Overall I do not see anything in the data to indicate that DEO needs to make radical changes in the way it is managing its buried infrastructure, and certainly not anything as dramatic as replacing all of its unprotected mains and services over the next 25 years.

V. REVIEWING DEO TRENDS OVER TIME

Q30. DID YOU EXAMINE ANY HISTORICAL DATA TO DETERMINE HOW DEO HAS BEEN MANAGING ITS BURIED INFRASTRUCTURE?

A30. Yes, I analyzed the same Department of Transportation database for DEO going back to 1994. I show the data on Exhibit SJR-6. Data for some of the earlier years may not be fully comparable because of mergers that have taken place over the years, but some important trends are apparent from the data.

First, since 2003, DEO has done very little to reduce the amount of bare steel on its system. At year-end 2003, it had 3,598 miles of bare steel. That was reduced by 58 miles in 2004 and by 42 miles in 2005. Then in 2006 and 2007, DEO's reports to the federal government show that it did not eliminate **any** bare steel mains from its distribution system.

Second, the reduction in bare steel mains in 2004 looks like it might be a data problem and not a real reduction. In that same year, DEO showed an **increase** in cast iron mains of 88 miles. It is extremely unlikely that DEO actually installed 88 miles of new cast iron mains. It seems more probable that DEO discovered that

some of what it thought was bare steel or "other" was actually cast iron (there was a reduction in the "other" category of 91 miles in 2004).[7]

Q31. DO THE DATA ON EXHIBIT SJR-6 INDICATE THAT DEO CONSIDERS THE ELIMINATION OF ALL-BARE STEEL AND CAST IRON TO BE A HIGH PRIORITY?

A31. No, it does not. If the removal of bare steel is as important as DEO now claims – or if bare steel were causing serious operational problems – then I would have expected to see that DEO had been removing increasing amounts of bare steel from service. In fact, this has not been happening. In the last five years, DEO has removed only 100 miles of bare steel from its system – and it appears that as much as half of that amount might have been due to a misclassification. In the last two years, essentially none of this supposedly "inadequate" bare steel has been removed from service.

Q32. HOW HAS DEO'S LEAK RATE CHANGED OVER TIME?

A32. DEO's leak rate has **declined significantly** over the past 14 years. On Exhibit SJR-7, I show data on DEO's leak rates (leaks per 100 miles of mains) from 1994 through 2007. The data show that between 1994 and 1999 the Company consistently had at least 145 leaks per 100 miles of main, peaking in 1997 at 195

[7] Data provided by DEO in discovery show that it has not installed any cast iron since the 1960s which reinforces my belief that there is some anomaly in the 2004 data.

leaks per 100 miles. In contrast, during 2006 and 2007 the Company had 65 or 66 leaks per 100 miles – more than a 50 percent reduction in the leak rate experienced between 1994 and 1999. This is the opposite of what one would expect if the infrastructure were so deteriorated that total replacement is the only solution.

Q33. DID YOU ALSO EVALUATE THE CHANGE IN DEO'S LEAKAGE DUE TO CORROSION?

A33. Yes, data about leaks due to corrosion are shown on the same exhibit (the red bars on the graph). The Company's trend in leaks from corrosion is even more dramatic. Between 1994 and 1999, the Company consistently reported more than 100 leaks from corrosion per 100 miles of main (the only exception was 1998 when it reported 88 leaks per 100 miles). For the past two years, however, DEO shows that it had fewer than 40 leaks from corrosion each year per 100 miles of main – a reduction of 60 percent or more from the level it experienced during the 1990s.

Q34. WHY ARE THE REDUCTIONS IN DEO'S LEAK RATES OVER TIME IMPORTANT?

A34. DEO's declining leak rates over time indicates that DEO has either improved the way it is managing its buried infrastructure or that it already has removed or repaired the pipe causing the most serious problems on its system. This trend does not indicate that DEO needs to make some radical change in its distribution

system operations, such as tearing out and replacing all of the bare steel and cast iron mains.

Q35. DID YOU ALSO REVIEW HISTORICAL DATA ON UNACCOUNTED FOR GAS FOR THE COMPANY?

A35. Yes, I did. Exhibit SJR-8 shows DEO's reported level of unaccounted for gas for 1994 through 2007. Once again, the trend does not show any type of deterioration in the operations of DEO's distribution system. Unaccounted for gas, as reported to the US Department of Transportation, has been in the range of 0.25 to 0.50 percent during nine of the past 14 years. There does not appear to be any trend that would show either an increase or decrease in the level of lost gas.

Q36. WHAT DO YOU CONCLUDE FROM YOUR REVIEW OF DEO'S HISTORICAL DATA?

A36. I conclude that the data do not support DEO's request for a radical infrastructure replacement program. DEO's leak rates have declined substantially during the past 14 years; DEO's main replacement data up through the end of 2007 do not show a pressing need to replace bare steel mains; and DEO has not seen a change in the level of unaccounted for gas. These factors all point to the same conclusion: There are no signs of unusual levels of deterioration in DEO's buried infrastructure assets and there are no other indications that DEO needs to make a radical change in the way it is managing its infrastructure.

VI. SUMMARY CONCERNING NEED FOR PIRP

Q37. PLEASE SUMMARIZE YOUR CONCLUSIONS ABOUT THE NEED FOR DEO TO UNDERTAKE A PIRP.

A37. DEO has not conducted the types of studies that would be needed to support a program as radical and costly as its proposed PIRP. DEO has not attempted to determine the reasons why it experiences its current level of leakage and unaccounted for gas, whether those factors (as well as other risks) could be improved in a cost-effective manner, whether it would be more cost-effective and beneficial to the public to continue-inspecting and repairing its buried infrastructure, or whether it needs to change anything from its current practices. Simply, DEO has not done its homework. There is nothing in the record of this case – and nothing provided during discovery – to show that DEO has engaged in the type of studies that one would expect from a utility proposing to collect from customers the costs of a multi-billion-dollar, multi-decade construction program. DEO is essentially asking its customers to underwrite a multi-billion-dollar loan based on no analysis and no business plan.

Further, from my review of industry data and DEO trends over the past 14 years, I conclude that there are no signs that DEO's buried infrastructure is deteriorating. In fact, just the opposite is true. DEO is experiencing far fewer leaks today than it did during the 1990s, including far fewer leaks from corrosion. The Company has not seen any meaningful change in the level of unaccounted for gas during the

past 14 years either. In addition, DEO has not replaced any significant amount of bare steel mains during the past two years, but its leak rates in those years have been the lowest it has experienced in the past 14 years. In conclusion, my review of DEO's historical data indicates that the buried infrastructure is being operated and maintained in a manner that is superior to what the Company was doing in the 1990s. There are no indications that the system is deteriorating or that dramatic changes are necessary to ensure the safe operation of the distribution system.

Q38. BASED ON YOUR REVIEW OF THESE DATA, WHAT DO YOU RECOMMEND?

A38. I recommend that the Commission reject DEO's request to implement a PIRP of this magnitude at this time. DEO should not undertake – and the Commission should not obligate customers to pay for – a multi-billion-dollar program of this nature without conducting a rigorous analysis to determine the costs and benefits of such a program. That type of analysis should consider not only the costs and benefits of replacing unprotected mains and services, but it also should evaluate the costs and benefits of current and enhanced levels of inspection, maintenance, and repair. Managing buried infrastructure in a safe and cost-effective manner requires a balancing (or optimization process) between operations and maintenance activities and construction activities.

Q39. ARE YOU SUGGESTING THAT DEO SHOULD NEVER REPLACE ANY MAINS OR SERVICES?

A39. No, I am not suggesting that at all. Certainly, there will be areas of pipe that need to be repaired or replaced, just as they have in the past decade when DEO has been replacing 30 to 40 miles of pipe per year. But that is very different from saying that all unprotected pipe must be replaced during the next 25 years – requiring an annual level of replacement 300 to 400 percent greater than DEO has been doing historically. Such a radical, and extremely expensive, program should be undertaken only if it can be demonstrated that it is cost-effective and needed to ensure the provision of safe and reliable service to the public. Neither DEO nor PUCO Staff have made any such demonstration in this case.

Q40. IN ADDITION TO RECOMMENDING THAT THE COMMISSION REJECT THE REQUEST FOR A PIRP AT THIS TIME, DO YOU HAVE ANY OTHER RECOMMENDATIONS?

A40. Yes. If DEO continues to believe that a PIRP would be in the public interest, then it should be required to conduct the type of analysis that has been undertaken by Puget Sound Energy. Such a study would include a rigorous analysis of its system, designed to identify the causes of risks (such as leaks) and determine how best to manage those risks in a safe and cost-effective manner. The Commission should require DEO to provide this type of study with any future filing that DEO makes for a PIRP or similar type of program.

VII. DEO'S ESTIMATE OF COSTS IS GROSSLY INACCURATE

Q41. DO YOU HAVE ANY CONCERNS WITH THE ACCURACY OF DEO'S $2.66 BILLION COST ESTIMATE FOR THE PIRP?

A41. Yes, I have several major concerns with that estimate. First, and most importantly, the estimate was prepared without any consideration for inflation. DEO states that the estimate is in 2007 dollars, which means that DEO ignored any impacts from inflation, including any costs that might increase differently from the general rate of inflation (usually measured by the Consumer Price Index).

I find DEO's analysis to be significantly flawed by its failure to consider inflationary impacts, particularly as they might affect materials prices, utility labor, and other cost components. To illustrate the problem, I have prepared Exhibit SJR-9. This exhibit shows the change in the Consumer Price Index (in the Midwestern US), the Construction Cost Index (for Cleveland), and wages in the natural gas distribution utility industry from 2001 through 2007 (gas utility wage data is only available through the end of 2006).

DEO's cost projection assumes that all prices will increase with the general rate of inflation (the Consumer Price Index). In fact, both construction costs and average gas utility wages have increased much faster than the general rate of inflation since 2001. Thus, from 2001 through 2007, general inflation increased

by 14.6 percent, but construction costs increased by 23.0 percent and gas utility wages increased by 19.3 percent just through the end of 2006. In other words, construction costs and gas utility wages have been increasing at a rate that is 32 percent faster than the overall rate of inflation.

Q42. WHAT WOULD BE THE IMPACT ON DEO'S COST PROJECTIONS IF YOU ASSUMED THAT CONSTRUCTION COSTS INCREASED FASTER THAN THE GENERAL RATE OF INFLATION?

A42. I have prepared an analysis that assumes construction costs increase one percentage point above the general rate of inflation in each year. For example, if general inflation is 3 percent, then my approach would assume that construction costs increase by 4 percent in that year. This is a fairly conservative assumption. Between year-end 2001 and year-end 2007 (a six-year period) general inflation increased by 2.3 percent per year and construction costs increased by 3.5 percent per year. So my assumption of a 1 percent difference annually is conservative and understates the level of inflation actually experienced in the Cleveland region from 2001 through 2007.

On Exhibit SJR-10, I show the results of my analysis. Rather than the $2.66 billion cost that DEO estimated, -my analysis shows that the likely capital cost of the PIRP, in 2007 dollars (that is, excluding general inflation) would be closer to $3.08 billion.

Q43. DO YOU HAVE ANY OTHER CONCERNS WITH DEO'S COST PROJECTIONS?

A43. Yes. I also have a general concern about the accuracy of any cost projection that goes out for 25 years. There is so much uncertainty it is nearly impossible to predict with any degree of accuracy what will happen over the next 25 years. As just one more example, how will oil prices change over that time period? If oil prices continue to increase dramatically, that would affect not only the general rate of inflation, but also costs for materials (most plastics use petroleum or its byproducts as a feed stock), transportation, paving, and other aspects of PIRP-related work.

Q44. WHY DOES THE INHERENT INACCURACY OF LONG-TERM PROJECTIONS AFFECT YOUR VIEW OF THE PIRP?

A44. DEO is asking the PUCO to sign a blank check for this 25-year program. The cost estimate of $2.66 billion before inflation appears to be understated. But even more importantly, DEO's actual costs – and the rates customers actually will be asked to pay – will be based on the actual inflation that occurs. If inflation increases to 5 or 6 percent per year, or more, then consumers could be looking at extraordinarily high increases in utility bills from the PIRP program. For instance, at 5 percent inflation, costs would double every 14 or 15 years, while at 6 percent inflation they would double in about 12 years.

In the normal ratemaking context, utilities have a strong incentive to control costs – their rates are locked in between rate cases (meaning that cost savings flow to the bottom line), and when a rate case is filed the utility's expenditures are subject to intense scrutiny. In contrast, under an unlimited, automatic rate adjustment mechanism, the utility has little if any incentive to control costs. The utility will be allowed to recover what it spends, including a return on that investment, with a comparatively low level of scrutiny and very little incentive for it to control costs.

Q45. WHAT DO YOU CONCLUDE ABOUT DEO'S COST ESTIMATES?

A45. I conclude that the cost of the PIRP is likely to be significantly higher for customers than DEO estimated. I would estimate the program to cost on the order of at least $3 billion before inflation. When inflation is considered over the proposed 25-year period for the PIRP, I estimate that the additional rate base investment will total approximately $5 billion to $6 billion.[8]

[8] Using the same methodology I used on Exhibit SJR-10, I calculate that if the general inflation rate is 4 percent and the PIRP experiences one percentage point higher inflation, the total investment would be approximately $5.7 billion over the 25-year period.

VIII. REASONABLE LIMITS MUST BE PLACED ON AN INFRASTRUCTURE SURCHARGE

Q46. HAS DEO PROPOSED ANY LIMITS ON THE PIRP?

A46. No.

Q47. DOES THE PUCO STAFF REPORT PROPOSE ANY LIMITS ON THE PIRP?

A47. Yes, the Staff Report recommends that the PIRP should be limited to eight years or the time when DEO files a new base rate case (whichever occurs first). At that time, the Commission would determine whether the PIRP should continue.

Q48. IN YOUR OPINION, IS IT REASONABLE TO HAVE A PIRP WITHOUT ANY LIMITS ON THE TIME PERIOD AND AMOUNT OF INCREASE?

A48. No, absolutely not. According to well-established ratemaking principles, utility rates are set based on a synchronized examination of all aspects of the utility's cost of service and sources of revenue, as well other considerations such as the quality of service and efficiency of management. That synchronization is the reason why we use a test year when a rate case is filed. One treatise on utility regulation discusses this synchronization, or the matching principle, as follows:

> If the utility proposes a change, particularly a major change, in the test year rate base, it is required also to consider the related changes in other costs or in revenue. Additional investments may result in efficiencies that reduce operating costs or quality

> improvements that will increase sales. Unless the utility shows that it has taken such matters into account, its revenue requirement is likely to be out of balance or overstated.[9]

The PUCO has determined in the past that an accelerated main replacement program should be treated as an exception to the matching principle. I do not agree with that conclusion because efficiencies and cost reductions should be an integral part of any main replacement program. Indeed, if such efficiencies and cost reductions are not occurring, then the main should be kept in service and not replaced.

If one accepts, for the sake of argument, that a main replacement program should be an exception to the general ratemaking rule, however, there still must be some limits on its use. Limits are necessary to ensure that the utility is not abusing the mechanism (for example, by attempting to include ineligible costs); that the utility is acting prudently in the ongoing analysis, prioritization of work, and the procurement process; and that the utility is not inappropriately reducing expenditures – and harming the quality of service – in other areas of its operations (for example, by reducing preventative maintenance programs that could extend the life of facilities).

[9] Leonard Saul Goodman, *The Process of Ratemaking* (1998), vol. II, p. 735.

Q49. WHAT TYPES OF LIMITS HAVE OTHER UTILITY COMMISSIONS AND STATE LEGISLATURES IMPOSED ON THE USE OF INFRASTRUCTURE REPLACEMENT SURCHARGES?

A49. I am familiar with a few of those limits, but I expect there are others in place. In Pennsylvania, the Public Utility Commission has imposed two tests for its water distribution system improvement charges: (1) that the total amount of the surcharge cannot exceed 7.5 percent of revenues, and (2) if the utility earns in excess of its allowed rate of return in any calendar quarter, the surcharge is reset to zero. If the surcharge reaches 7.5 percent of revenues the surcharge remains frozen at that level until the next base rate case, at the conclusion of which the costs are rolled into rate base and the surcharge is reset to zero.[10]

In Connecticut, the Department of Public Utility Control has limited the Water Infrastructure and Conservation Adjustment surcharge to no more than 5 percent in any one year and 7.5 percent overall.[11]

[10] *Petition Of Pennsylvania-American Water Company For Approval To Implement A Tariff Supplement To Tariff Water-PA P.U.C. No. 4 Revising The Distribution System Improvement Charge*, Docket No. P-00062241 (Aug. 14, 2007).

[11] *DPUC Review and Investigation of the Requirements for Implementation of a Water Infrastructure and Conservation Adjustment*, Docket No. 07-09-09 (April 30, 2008).

Here in Ohio, the legislature has limited a water or wastewater infrastructure surcharge (the System Improvement Charge) to no more than 3 percent per year and 9 percent total.[12]

The Illinois Commerce Commission limits the Qualifying Infrastructure Plant Surcharge for water and wastewater utilities to no more than 5 percent of revenues.[13] If the cap is reached, no additional costs can be recovered through the surcharge until the utility files a base rate case, at the conclusion of which the surcharge is reset to zero.

The public utility law in Missouri authorizes an Infrastructure System Replacement Surcharge for natural gas utilities that is limited to 10 percent of base revenues and can remain in effect for no more than three years before a base rate case must be filed.[14]

Q50. HAVE THE COMPANY OR PUCO STAFF PROPOSED A SIMILAR LIMIT ON THE SIZE OF THE PIRP SURCHARGE?

A50. No, they have not. In my opinion, that is a serious deficiency in the Company's proposal and Staff's recommendation. Even if a PIRP were justified – which as I

[12] 49 Ohio Rev. Code § 4909.172.

[13] 83 Ill. Admin. Code § 656.30.

[14] Rev. Stat. of Mo. § 393.1012.

discussed above, it is not – in my opinion it would be irresponsible and unreasonable to allow the unfettered use of the surcharge mechanism. There should be some reasonable limit placed on the size of the surcharge as a percentage of base rates (excluding the cost of gas), and on the amount of time it can stay in effect.

Q51. WHY IS THIS TYPE OF LIMIT IMPORTANT?

A51. Limits on the size of the surcharge and its duration are important because they essentially force a process through which all elements of the rate will be brought back into balance. If a reasonable limit is set on the size of the surcharge (such as 5 percent of base revenues) and its duration (such as three years), then DEO would need to file a base rate case once its PIRP cost recovery would approach that level. A base rate case would bring all elements of the utility's costs, revenues, and investment back into balance. A rate case also would serve as an important opportunity to ensure that DEO is performing the work appropriately, continuing to re-evaluate the costs and benefits of the program, and not neglecting other aspects of its inspection, operations, and maintenance activities.

IX. CONCLUSION

Q52. PLEASE SUMMARIZE YOUR CONCLUSIONS AND RECOMMENDATIONS.

A52. I summarize my conclusions and recommendations as follows:

- It is not reasonable for DEO to replace all of its unprotected mains. DEO has not done the type of study that would be required to determine the prudent, cost-effective approach to managing its buried infrastructure. DEO has not shown that its distribution system is exhibiting any unusual levels of deterioration or increased risk.
- DEO has a higher percentage of bare steel mains, and a lower percentage of plastic mains, than a peer group of similarly sized natural gas distribution utilities. DEO's leak rate is somewhat higher than its peers, but DEO's level of unaccounted for gas is lower than its peers. Moreover, DEO appears to be doing a good job managing its leaks, in that it has a much lower level of known but unrepaired leaks than its peers. Comparing DEO with its peers does not indicate that DEO needs to make radical changes in its management of its buried infrastructure.
- My review of DEO's trends over the past 14 years does not show signs of significant deterioration, or other increases in risks, in its distribution system. In fact, DEO's leak rate has been reduced significantly during that time period, and its level of unaccounted for gas remains essentially

unchanged. Further, DEO's actions during the past two or three years are not consistent with its claims that the replacement of bare steel is a high priority. In fact, since 2005 DEO has replaced essentially no bare steel mains on its system.

- I conclude that DEO has not demonstrated a need for the PIRP. DEO has not conducted the types of studies that would be needed to develop a prudent, cost-effective program and it certainly has not supported the need for a multi-billion dollar, multi-year program like the proposed PIRP.
- I recommend that the Commission should not authorize DEO to undertake the PIRP at this time. If DEO wants to propose such a program again in the future, it must be supported by the types of rigorous studies that others in the industry have performed.
- DEO's estimate of the PIRP costs is grossly inaccurate. Even excluding inflation, the PIRP is likely to have a total cost in excess of $3 billion. When the likely effects of inflation are included, the total cost of the PIRP is likely to be in the range of $5 billion to $6 billion than the $2.66 billion estimated by the Company.
- In the alternative, if the Commission goes forward with the PIRP, then I recommend that - limits must be placed on any infrastructure surcharge for residential customers. Those limits should include a limit on the total magnitude of the charge and a limit on the length of time such a surcharge can remain in effect prior to a base rate case.

- In particular, I recommend that the amount of the surcharge should not be allowed to exceed 5 percent of a typical residential customer's base bill (excluding the cost of gas). The surcharge would be reset to zero in each base rate case, so DEO would be allowed to continue recovering its prudently incurred infrastructure replacement costs if it appropriately times its base rate case proceedings.

Q53. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A53. Yes, it does. However, I reserve the right to incorporate any new information that may subsequently become available. I also reserve the right to supplement my testimony in the event that the PUCO Staff fails to support any recommendations made in the Staff Report, and/or makes changes in any positions in the Staff Report.

CERTIFICATE OF SERVICE

It is hereby certified that a true copy of the foregoing the *Direct Testimony of Scott J. Rubin on Behalf of the Office of the Ohio Consumers' Counsel* has been served via First Class US Mail (electronically upon DEO & DEO Counsel), this 25th day of July, 2008.

Joseph P. Serio
Assistant Consumers' Counsel

PARTIES OF RECORD

Stephen Reilly
Anne Hammerstein
Attorney General's Office
Public Utilities Section
180 East Broad Street, 9th Floor
Columbus, Ohio 43215

David A. Kutik
Dominion East Ohio
Jones Day
North Point, 901 Lakeside Ave.
Cleveland, Ohio 44114-1190

Barth E. Royer
Dominion Retail, Inc.
Bell & Royer Co., LPA
33 South Grant Avenue
Columbus, Ohio 43215-3900

Mark A. Whitt
Andrew J. Campbell
Dominion East Ohio
Jones Day
P.O. Box 165017
Columbus, Ohio 43216-5017

John W. Bentine
Mark S. Yurick
Interstate Gas Supply
Chester, Willcox & Saxbe LLP
65 East State St., Ste. 1000
Columbus, Ohio 43215-4213

M. Howard Petricoff
Stephen Howard
Integrys Energy Services, Inc.
Vorys, Sater, Seymour &Pease LLP
52 East Gay St., P.O. Box 1008
Columbus, Ohio 43216-1008

Joseph P. Meissner
Legal Aid Society of Cleveland
1223 West Sixth Street
Cleveland, Ohio 44113

David Rinebolt
Colleen Mooney
Ohio Partners for Affordable Energy
P.O. Box 1793
Findlay, Ohio 45839-1793

John M. Dosker
General Counsel
Stand Energy Corporation
1077 Celestial St., Ste. 110
Cincinnati, Ohio 45202-1629

Stephen M. Howard
Ohio Gas Marketers Group
Vorys, Sater, Seymour &Pease LLP
52 East Gay St., P.O. Box 1008
Columbus, Ohio 43216-1008

Todd M. Smith
Utility Workers Union Of America
Local G555
Schwarzwald & McNAir LLP
616 Penton Media Building
1300 East Ninth Street
Cleveland, Ohio 44114

David F. Boehm
Michael L. Kurtz
Ohio Energy Group
Boehm, Kurtz & Lowry
36 East Seventh Street, Suite 1510
Cincinnati, Ohio 45202

W. Jonathan Airey
Gregory D. Russell
Ohio Oil & Gas Association
Vorys, Sater, Seymour &Pease LLP
52 East Gay St., P.O. Box 1008
Columbus, Ohio 43216-1008

Samuel C. Randazzo
Daniel J. Neilsen
Joseph M. Clark
Industrial Energy Users-Ohio
McNees, Wallace & Nurick
21 East State St., Ste. 1700
Columbus, Ohio 43215

Steven Beeler
Robert J. Triozzi
Julianne Kurdila
City of Cleveland
Cleveland City Hall
601 Lakeside Avenue, Room 206
Cleveland, Ohio 44114-1077

Puget Sound Energy Wrapped Steel Service Assessment Program (WSSAP) Report

Progress through May 2006

Revision 2.0

Table of Contents

PSE Wrapped Steel Service Assessment Program (WSSAP) Report
Progress through May 2006

Executive Summary

The Wrapped Steel Service Assessment Program (WSSAP) was implemented by Puget Sound Energy (PSE) in accordance with the Spiritridge Settlement Agreement. As part of the Spiritridge Settlement Agreement PSE and the WUTC agreed that PSE would conduct a risk assessment and appropriate mitigation of all wrapped steel services that were without cathodic protection for 5 or more years. PSE has simplified this criterion to mean any wrapped steel service that was installed prior to 1972. Services installed in 1972 and later had cathodic protection from the date of initial installation in accordance with the requirement in 49 CFR Part 192.

PSE has gathered data related to system leakage, area soil types, Exposed Pipe Condition Reports (EPCRs), and anecdotal information that was used to prioritize a review of system operation maps. The prioritization was complete in mid February 2006. The higher priority maps were those that had the most corrosion related leaks, evidence of corrosion from EPCRs, and those thought to contain the highest concentration of pre-1972 wrapped steel services. The second tier of priority included maps with the most corrosive soils. The remaining maps were considered to be lower priority. This allows the risk assessment and subsequent mitigation as appropriate to be completed for the higher risk areas and services first.

PSE has developed a risk assessment model with assistance from W. Kent Muhlbauer of WKM Consultancy. The risk model is developed and PSE is continuing to tune the model to ensure the risk ranking of the individual services is consistent with the operating history of PSE's distribution system. A risk management decision criteria has also been developed to identify how PSE will address the results of the risk assessment. This decision criteria identifies various conditions for services that would require repair or replacement, electrical surveys, leak surveys, or no further action.

The PSE Maps, Records and Technology (MRT) department initiated a comprehensive review of PSE's system maps in January 2006. The maps are reviewed in order based on the priorities established above. As of May 2006 PSE has reviewed approximately 550,000 services (est. 650,000 total) and identified approximately 87,000 pre-1972 wrapped steel services (est. 90,000 total). The completion date for the map review and service identification will be June 30, 2006.

Additional data gathering work includes capturing the 36 different data points (risk variables) for each service that are necessary to run the risk model. The PSE Information Technology (IT) department will be developing 13 different types of list edit queries within 9 existing databases. To provide this information a Senior Applications Analyst has been assigned to assist with the development and implementation of this phase of the project as well as additional support from numerous departments. Additional pipeline data for use in the risk assessment is being gathered utilizing historical PSE construction standards, material purchase specifications, United States Department of Agriculture (USDA) soil maps, and county population information. Where data for the model is missing or unknown the most conservative data values are used.

PSE has conducted a pilot risk assessment using data gathered on wrapped steel services from a single operations map in the City of Bellevue in order to tune the risk assessment model and validate the models effectiveness at ranking wrapped steel services according to risk. This pilot has been completed and the risk model was further tuned as a result. There are 2,700 wrapped steel services installed prior to 1972 within the boundaries of this map. The risk results from the pilot operations map will now result in follow-up field action to assess the effectiveness of the proposed decision criteria. PSE is planning on conducting electrical surveys and leak surveys on

approximately 150 services identified in the pilot. Upon completion of this field action PSE may revise the decision criteria as appropriate.

On December 20, 2005 and March 20, 2006 PSE briefed WUTC Pipeline Safety Staff on the program development and progress to date. In addition on March 14, 2006 PSE briefed WUTC Pipeline Safety Staff on the risk model development to date. At these times PSE also received feedback from Staff on our approach. Based on this input we have continued to develop the risk model and decision criteria outlining follow-up mitigation action as appropriate.

This report offers the program plan and project update for PSE's Wrapped Steel Service Assessment Program (WSSAP). The following sections of this report are fully developed and implemented as of May 2006:

- Section 1. Scope
- Section 2.1. Identification of Threats
- Section 2.2. Risk Model Development
- Section 2.3. Identification of Pre-1972 Services and Data Gathering (portions complete – see section for specific details)
- Section 2.4. Analysis of Risk Results for Trends and Areas of Concern (portions complete – see section for specific details)
- Section 3. Schedule

Additional sections are expected to be fully developed and implemented by the next progress report to be delivered in August 2006. The remaining sections will be completed and fully implemented by September 30, 2006.

1. Scope

As required by the 2005 Spiritridge Settlement Agreement with the Washington Utilities and Transportation Commission (WUTC), PSE is conducting a risk assessment and performing appropriate mitigation of wrapped steel service lines that were without cathodic protection for 5 or more years. PSE has simplified this criterion to mean any wrapped steel service that was installed prior to 1972 (in late 1971 the federal pipeline safety rule was implemented requiring that all wrapped steel pipe be cathodically protected).

The intent of this program is to conduct a detailed risk assessment to prioritize for further evaluation all wrapped steel services installed prior to 1972 based on the predicted condition of the service and depending on the predicted condition, perform any necessary follow-up action such as electrical surveys or service replacements. The overall objectives of the risk model are as follows:

- Fulfill obligations under the Spiritridge Settlement Agreement
- Create useful overall risk assessment system (to support risk management and resource allocation)
- Create processes and begin to move toward data-centric risk-based integrity management systems

At this time it is estimated that there are approximately 90,000 active wrapped steel services installed prior to 1972, according to initial research efforts by PSE. PSE presently performs a 3-year leak survey on each wrapped steel service. These services should be cathodically protected and monitoring is either on a 9-year cycle for each separately protected service, or monitored annually as part of a CP system if electrically continuous with one. This program may identify services that are considered isolated facilities not under cathodic protection. These services will be given a higher priority for follow-up action.

2. Program Plan

The proposed approach for assessing the condition of PSE's wrapped steel services aligns with the integrity management program that was developed for PSE's transmission pipelines in 2004. The proposed approach will be conducted on a prioritized basis beginning with those services believed to represent a higher level of risk, see Section 2.3 for additional detail on prioritization methodologies. In summary, this proposed approach relies on a variety of information (measurable, subjective, and anecdotal) to identify services that may constitute an area of concern for PSE.

2.1. Identification of Threats

Failure likelihood, as it relates to pipeline integrity, is the relative measure of the likelihood of the pipeline failing as a result of a design or operating condition (threat). For the purposes of evaluating the susceptibility of pipelines to failure relative to one another, a probability of failure algorithm will be used categorize and classify appropriate distribution pipeline threats. ASME/ANSI B31.8S, *Managing System Integrity of Gas Pipelines*, classifies threats to pipelines in terms of "Time Dependant", "Stable" and "Time Independent" categories.

Time Dependant threats include:

1. External Corrosion;
2. Internal Corrosion; and,
3. Stress Corrosion Cracking (SCC);

Stable threats include:
4. Manufacturing Defects;
5. Welding/Fabrication Related; and,
6. Equipment Failure;

Time Independent threats include:
7. Third Party Damage;
8. Incorrect Operations; and,
9. Weather and Outside Force (Geotechnical)

PSE analyzed all of the above threat categories as they pertain to the PSE distribution system, and as a result of this exercise, the following threats were classified as being potentially viable, and therefore will be addressed in the risk model described in Section 2.2 of this document.

- External Corrosion
- Internal Corrosion
- Third Party Damage
- Incorrect Operations
- Weather/Outside Force (Geotechnical)

The remaining threats were not considered viable to PSE's distribution system or the scope of this project as explained below:

- Stress Corrosion Cracking (SCC) – industry research includes data indicating that certain conditions must be present in order for SCC to be a viable threat to a pipeline. An analysis of these required conditions indicates that SCC is not a viable threat to PSE's distribution pipe. The conditions required are as follows:
    - Age of pipe (>10 years old);
    - Operating stress level (>45% SMYS);
    - Operating Temperature (>100 degrees F);
    - Proximity to Compressor Stations (highest incidences within 20 miles of compressor stations, although significant SCC has been found further downstream of compressor stations);
    - Coating Type (all coating types other than FBE);
    - Environment (seasonally wet/dry or poorly drained conditions in shielding coating systems, and dry, high resistivity soils in non-shielding coatings; and,
    - Susceptible Seam types (e.g., low frequency electric resistance welded (ERW) pipe seams)

- Manufacturing Defects – the primary manufacturing defect related threats on natural gas pipelines are hard spots and seam defects. The susceptibility to hard spots and seam defects is confined to a limited subset of pipe manufacturers, eras and method of manufacture. In addition, higher operating stress levels have greater potential for hard spot and seam failure, and industry experience has demonstrated that stress levels below 60% SMYS are below the levels which are required to precipitate hard spot or seam failures. Industry experience also indicates that pipe that is tested at values of at least 1.25 times the maximum operating pressure is sufficient to prevent operational failures due to seam defects. Though PSE may have installed pipe in the susceptible era and manufactured by companies that are known to be susceptible to manufacturing defects, due to the low stress level and PSE's historical testing

standards it was determined that manufacturing defects are not a viable threat to PSE's distribution pipe.

- Welding/Fabrication Related – the data needed to support the threat of welding and fabrication of services is not being gathered during the initial phase of this program. In future phases of this program and as new programs within PSE are implemented this data (obtained from D-4 cards) may be incorporated into this risk analysis.

- Equipment failure – the data needed to support the threat of equipment failure as it relates to services is not being gathered during the initial phase of this program. In future phases of this program and as new programs within PSE are implemented this data (obtained from D-4 cards) may be incorporated into this risk analysis.

In the future as Distribution Integrity Management develops, the applicable threats listed above may be incorporated into this risk analysis.

2.2. Risk Model Development

The final outcome from the risk assessment approach will be a relative prioritization of the threats that contribute to the highest risk in PSE's distribution system with respect to wrapped steel services installed prior to 1972.

2.2.1. Risk Assessment Scope

This risk assessment shows the relative risks to the public created by service pipelines during their operation. The focus is on abnormal situations, specifically the unintentional releases of natural gas. Risks from normal operations or potential construction risks associated with new pipeline installations are not considered.

1. The risk model recognizes time dependent failure modes of corrosion. The model also recognizes more random failure modes of third party strikes, human error (incorrect operations), and geohazards.
2. Random failure modes are assumed to either cause immediate failure or create a defect that leads to a time-dependent failure mechanism.
3. Time-dependent failure mechanisms of corrosion and fatigue are measured in mils-per-year (mpy) pipe wall metal loss. This mpy is used to determine the time to fail (TTF) with the assumption that failure occurs just below the wall thickness required for maximum internal pressure.
4. Integrity verification re-sets the clock at the measured wall thickness. Mpy is then applied to the new measured wall thickness to determine again when failure theoretically occurs.
5. A previous incident impacts the degree of belief about future failure potential in proportion to its relevance as a predictor. Historical incident information, properly adjusted for relevance, is used to tune or calibrate the model's probability of failure estimates when absolute estimates of risk are needed.
6. Increased uncertainty is treated the same as increased risk. This is conservative, ensures model credibility, and shows the value of acquiring information.

2.2.2. Risk Assessment Model

Risk can be defined as the probability of likelihood of failure of a pipeline segment and the consequences of such failure. It can therefore be expressed in terms of the product of failure likelihood (PoF) and consequences (CoF).

Risk = PoF x CoF

Each piece of information used in the risk assessment will fall into one of the following three categories:

1. Exposure = likelihood of force or mechanism reaching the pipe when no mitigation applied
2. Mitigation = keeping the force or mechanism off the pipe
3. Resistance = ability to resist a force or mechanism applied to the pipe

Probability of Failure (PoF)

This model is designed to encompass virtually all conceivable failure rates. It is then calibrated using historical incident rates, tempered by knowledge of changing conditions. This results in current failure probabilities that match the judgment and intuition of those most knowledgeable about the pipelines, in addition to recent failure experience.

Probabilities are combined to give an overall failure probability for the segment. PoF values are combined using the widely accepted premise in probability theory that the "chance of one or more failures by any cause" is equal to 1 minus "the chance of surviving cause A" times "the chance of surviving cause B" times … etc. Therefore this model functions as follows:

$$PoF_{overall} = 1-[(1-PoF_{thdpty}) \times (1-PoF_{time\text{-}dep}) \times (1-PoF_{incops}) \times (1-PoF_{geohazard})\ldots]$$

Probability of failure (PoF) for time independent threats is calculated differently than for time dependent threats.

$$PoF_{time\text{-}indep} = [\text{unmitigated event frequency}] / 10^{[\text{threat reduction}]}$$

Where:

[threat reduction] = f(mitigation, resistance)

$$PoF_{time\text{-}dep} = f(TTF)$$

Where:

TTF = "time to failure"
= 1 / [(available pipe wall) - (wall loss rate) x (1 – mitigation)]

And then:

$$PoF = f(PoF_{time\text{-}indep}, PoF_{time\text{-}dep})$$

Time-dependent mechanisms of corrosion and fatigue are expressed as metal degradation rates, mils-per-year (mpy) of pipe wall loss (1 mil = 1/1000th of an inch). Theoretically, this rate applies to every square centimeter of a pipe segment – the degradation could be occurring everywhere simultaneously. The probability of failure (PoF) calculation estimates the time to failure, measured in years since the last integrity verification, by using the estimated metal loss rate and the theoretical pipe wall thickness and strength. A TTF estimate is an intermediate calculation in this estimate. TTF and converting a TTF estimate to a year one PoF are discussed in Appendix B. The relationship used in the current PoF estimates is:

PoF = 1- EXP(-1/TTF)

For time-independent failure mechanisms such as third party damage, weather, human error, and earth movement events, the process is a bit simpler. Constant failure rate or random failure rate events are assessed with a simple 'frequency of occurrence' analysis. The estimated frequency of occurrence of each time-independent failure mechanism can be directly related to a failure probability and then combined with the failure probabilities from the time-dependent mechanisms. As a matter of fact, the frequency values and probability values are numerically the same at the low levels that should be seen in most pipelines. For example, a failure frequency of once per 1000 mile-years for third party damage is approximately a 0.001 or 0.1% probability of failure per mile year.

These modeling protocols are valid for all pipe materials. Initial risk assessments will focus on wrapped steel services per the scope of this program. Future assessments may be expanded to cover additional materials.

Consequence of Failure (CoF)
Potential consequences from a pipeline leak or rupture include loss of product, property damage, environmental damages, human injuries and fatalities, service interruption costs, legal costs, regulatory costs, and others. The focus of this assessment is on consequences to public safety and property primarily and service interruptions secondarily. In the current assessment, potential consequences are expressed in relative terms only.

Hazards associated with the subject pipelines are primarily thermal effects—burning natural gas that has escaped from a leaking or ruptured pipeline. Although most leaks and ruptures from distribution systems do not ignite, in the unlikely instance of ignition, torch fires or flame jets are considered the more likely thermal events, with fireballs more rare possibilities. A confined vapor cloud explosion is another possible scenario if escaped gas accumulates and is subsequently ignited. This is a more remote possibility.

Assumptions driving the consequence assessment include:

- Higher population density leads to higher consequences since more individuals might be impacted. Associated with the higher population density are a higher density of service lines and more opportunities for slow leaks to accumulate in confined spaces.
- More critical services are those that are classified as firm customers (not interruptible)

The algorithms used by PSE that make up the risk model for probability of failure and consequence are located in Appendix B.

2.2.3. Data to Support Risk Assessment
The data contained in Table 1 in Appendix A shall be assimilated into the risk assessment model. Risk scores by plat and/or by service address only are anticipated for preliminary risk assessments. Whenever data supports better resolution, smaller segments shall be created.

The following variables are included in the risk model but, due to difficulties in data acquisition and/or their current limited ability to discriminate differences across the pipeline systems, they are not used in this first phase of this risk assessment:

- Signs and markers
- Locating and marking processes
- Patrol
- Training systems
- Pipe material
- Manufacturing and construction flaws
- Other geohazard information
- Elevations
- Liquid accumulation calculations

In many cases, PSE performed preliminary calculations and screenings to establish values of variables that were subsequently used in the risk calculations. For instance, PSE personnel used historical references and other information to infer wall thicknesses and coating types from dates of installation.

Each piece of information used in the assessment will fall into one of the following three categories, as defined above

- Exposure
- Mitigation
- Resistance

When importances are judged or weightings assigned, these values come from studies and expert opinion, or engineering judgment when study data is unavailable.

A facilitated meeting with subject matter experts (SME's) was the method used by PSE to set the exposure values for time-independent threats. For time-dependent threats, the mpy values for corrosion were set using published values and/or engineering analysis of specific environmental and metallurgical factors.

2.3. Identification of Pre-1972 Services and Data Gathering

2.3.1. Identified Areas of Higher Priority

The prioritization effort was implemented as a way of prioritizing PSE's approach to the program in that areas deemed as a higher priority will be reviewed and analyzed first, recommended for follow-up action first, and budgeted and planned for ahead of lower priority areas.

Data related to system leakage, area soil types, Exposed Pipe Condition Reports (EPCRs), and anecdotal information was gathered and used to prioritize a review of system operation maps. The map prioritization was complete in mid February 2006. The higher priority maps were those that had the most corrosion related leaks, evidence of corrosion from EPCRs, and those thought to contain the highest concentration of pre-1972 wrapped steel services. The second tier of priority included maps with the most corrosive soils. The remaining maps were considered to be of equal but lower priority.

2.3.2. Data Gathering

The PSE Maps, Records and Technology (MRT) department initiated a comprehensive review of PSE's system maps in January 2006. The maps are reviewed based on the priorities established above. As of May 2006 PSE has reviewed approximately 550,000 services (est. 650,000 total) and identified approximately 87,000 pre-1972 wrapped steel

services (est. 90,000 total). The completion date for the map review and service identification will be June 30, 2006.

In addition to the work being done by MRT, additional data gathering work includes:

- There are 36 data points (risk variables) for each service identified that are used to populate the risk model. Existing databases were identified and evaluated for content.
- The PSE Information Technology (IT) department will be developing 13 different types of list edit queries within 9 existing databases. A Senior Applications Analyst has been assigned to assist with the development and implementation of this phase of the project as well as additional support from numerous departments. The implementation progress for these data bridges is on-going and estimated to be complete by May 2006.
- Additional pipeline data for use in the risk assessment is being gathered utilizing historical PSE construction standards, material purchase specifications, United States Department of Agriculture (USDA) soil maps, and county population information.
- Where data for the model is missing or unknown the most conservative data values are used.

2.4. Analysis of Risk Results for Trends and Areas of Concern

Data recorded from the system maps and various maintenance databases will be processed into the risk analysis programmed into a SQL server database using the risk model described in Section 2.2. The process and decision criteria to determine the appropriate follow-up action based on the risk model results are located in Appendix C, Figure 1 and Table 1. This criterion will be further developed and completed by July 31, 2006. The determination of what constitutes higher versus lower risk will be determined and integrated into the process by July 31, 2006.

- The data will come from the highest priority areas first.
- The data will be imported in the risk analysis software and the services will be ranked in order of higher risk.
- This analysis is ongoing as long as Section 2.3 is being performed.

2.5. Recommendations for Follow-up Action

A review of the risk analysis data will be performed to make a determination as to the significance of the information as it relates to the possible condition of the subject services. Using the decision criteria described in Section 2.4 of this document, the following recommendations for follow-up action may be made:

- Repair or replace service
- Conduct coating and cathodic protection surveys (more data needed for determination)
- No follow-up action required
- Increased or additional leak surveys
- Some recommendations will be confirmed in the field to validate analysis methodology
- If the service analysis warrants, some recommendations may be expanded to include surrounding PSE facilities (i.e. mains)

2.6. Budgeting and Planning of Follow-up Actions

PSE will develop the budget requirements and plan needed to carry out the follow-up actions. The following steps will be accomplished when budgeting and planning for follow-up actions:

- Develop refined cost estimates necessary to carry out work
- Review budget impacts for current budget year and beyond
- Develop a preliminary schedule for construction, leak surveys and electrical surveys
- Develop resource needs to carry out follow-up activities per the preliminary schedule

2.7. Performing Follow-up Actions

PSE personnel in addition to PSE Service Provider crews will work to carry out any necessary remediations and follow-up actions on the services. The following steps will be accomplished when conducting follow-up action:

- Replace or repair service
  - If the as-found condition does not match predictions, the analysis process will be reviewed and modified as required.
- Perform further testing
  - Coating and cathodic protection surveys. (DCVG or ACVG in combination with CIS).
  - Services will be selected for direct examination or no further action required.
  - If the as-found condition does not match predictions, the analysis process will be reviewed and modified as required.
  - Additional or increased leak surveys may be performed
- If the condition of services in a certain area warrants it, PSE will consider performing an inspection of surrounding facilities (i.e. mains).

2.8. Validation of Program Effectiveness

PSE personnel will perform various field actions to validate the risk results and decision criteria described in Section 2.4. In addition, PSE may also analyze data as this program is implemented to determine the effectiveness of the mitigative measures employed. These actions may include any of the following:

- Electrical surveys on some services identified as not needing further action
- Potholing and examination of the condition of some services identified as not needing further action
- Analysis of leakage survey data to determine if the number of corrosion leaks on steel services has decreased as a result of the implementation of this program
- Analysis of leakage repair data to determine if the number of excavation damages on services has decreased
- Analysis of one call data to determine if number of locates for services has increased

3. Program Schedule

Additional detail on the program schedule can be found in Appendix D, Figure 1. The schedule summary is as follows:

- The following actions will be completed before September 30, 2006:
  - All pre-1972 wrapped steel services identified (plat review)
  - All pre-1972 wrapped steel services and associated data points will assimilated into the risk analysis software and ranked
  - Follow-up recommendations made for all services requiring follow-up action
  - Field validation of selected recommendations

- Budgeting and planning for all services requiring follow-up action

- The following actions will be completed after September 30, 2006:
  - Electrical surveys
  - Repairs/replacements
  - Identification, analysis, recommendations, budgeting, and remediation for services not identified as part of the initial plat review

4. Conclusions

This program as outlined in Sections 1-3 of this document have been implemented to ensure PSE performs a detailed assessment on the condition of all wrapped steel services that were without cathodic protection for 5 or more years. Furthermore, implementing this program as outlined will ensure any services found requiring follow-up action are investigated and remediated as necessary.

Appendix A – Data Dictionary

Appendix A
Data Dictionary

Table 1. Data Dictionary for the Risk Model

Variable	Phase 1 data	Phase 2 data	Source	Comments/Scoring method	Default Scores	Additional Comments
Service address	Address		Maps/records			
Long/Short side service	Service length		Maps/records	L or S		
Service size	Pipe size		Maps/records	Size		
Pipe date	Installation date		Maps/records	Year	Default required	
Main size	Pipe size		Maps/records	Size		
Main material	Pipe material		Maps/records	S, I, P or CI		
Main pressure	Pressure		Maps/records	IP , LP or HP		
Main Date	Date		Maps/records	Date	Default required	
Pipe wall thickness	Pipe wall in inches/mils		Scoring mechanism	See scoring mechanism. Input inches/mils based on pipe size and year of install	Multiple sizes default to smallest diameter	The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Coating type	Default "coal tar"		Scoring mechanism	See scoring mechanism. Score by date range 0, 4 or 7	Default coal tar	The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Soil corrosivity	Corrosive score 0 - 3		GIS	0 - 3 See scoring mechanism	Default score "0"	The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Soil movement potential	Slide area		GIS	Yes/No		

Appendix A
Data Dictionary

Variable	Phase 1 data	Phase 2 data	Source	Comments/Scoring method	Default Scores	Additional Comments
Atmospheric type score	Atmospheric characteristics		Scoring mechanism	SME to identify critical areas - default "2" if no information	Default "2"	The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Criticality of supply	Interruptible customers		Industrial meters	Yes for Firm - No for an interruptible customer		This data comes from whether the customer is billed as an "Interruptible Customer" (No) or a "Firm Customer" (Yes). There are only 656 interruptible customers in PSE's service territory
Isolated CP services	Ind/SVC		SAP - object type GDUT110	Yes/No		
CP system scoring	CP test sites		SAP - object type GDUT100 & GDUT140	Scoring mechanism (1 - 10)		The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Third party damages	Hit rate		LMS	Number of third party hits per plat annually		
Third party activity level	Growth rate		TESP	Growth percent annually by op map		
Cover attributes	Hard surface/Non hard surface		Maintenance Programs Leak Survey of Business districts	Yes/No		This data comes from the business district leak survey records where a business district is defined as an area where the facilities are under wall to wall paving. If the service is located within a business district it was given a "Yes" if the service is not on the business district leak survey then it was given a "No".
Depth of cover	Service line depth		EPCR or default score	EPCR recorded depth or default to 12"	Default score 12"	

Appendix A
Data Dictionary

Variable	Phase 1 data	Phase 2 data	Source	Comments/Scoring method	Default Scores	Additional Comments
Population density	High occupancy		Maintenance Programs HOS leak survey data and Critical valve inspection data	High density/Low density		Population Density (BD/HOS/IDS/HOS-IDS/LOW): This score is based on the high occupancy structure (HOS) leak survey database, the business district (BD) database, and the critical service valve inspection database. Where an HOS is defined as a building or outside area that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period. A critical service valve is defined as a service to facilities occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate, this is noted in this column as IDS (identified site). An HOS-IDS score in this column indicates that the service is to a structure that meets the definition of both HOS and critical service valve. LOW in this column indicates lower population density typically for residential areas and low occupancy structures.
Active service leak	Unknown service leak		LMS active leaks	Yes/No by address		
Air-soil interface	Pre 1966/post 1966		Maps/records by installation date	Pre 1966 (Yes) Post 1966 (No)		Quality of tape wrap method at MSA. Based on historical standards indicating that prior to 1966 tape wrap only was required, post 1966 primer and tape wrap were required.
Repaired corrosion service leaks by plat	Historical service leakage		LMS by plat map	Total number per plat		
Repaired service leak	Service leakage		LMS by service address	Yes/No		Leak clamp or other method of repair
Atmospheric protection score						No scoring method at this time

Appendix A
Data Dictionary

Variable	Phase 1 data	Phase 2 data	Source	Comments/Scoring method	Default Scores	Additional Comments
Coating condition	Service coating condition		EPCR or default score	EPCR scoring mechanism or default to 6	Default score 6	The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Internal corrosion	LP services		Maps/records	LP (Yes) IP or HP (No)		
Prior Atmospheric condition score	Atmospheric corrosion		Meter Network service	1 - 3 score by address		Prior #3 corrosion rating could have paint over pitted surface
Current Atmospheric score	Atmospheric corrosion		Meter Network service	1 - 3 score by address		
Surface pitting depth score	Surface corrosion		EPCR or default score	Pit description score mechanism or default to 6	Default score 6	The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Surface pitting frequency score	Surface corrosion		EPCR or default score	Pit description score mechanism or default to 6	Default score 6	The scoring mechanism explanation is located in Appendix B – Risk Assessment Model
Pipe SMYS	Default score 30,000 – 35,000 psi		Construction standards	N/A	Default score of 30,000 psi	Currently not part of the model
Introduction of potential corrosive agents		Internal Corrosion: Yes/ No	SME			
Low spots		Yes/No	SME	EPCR		GIS
Joint type		Weld/mechanical coupling	D4			
DCVG	No data at this time	Survey data				Survey database

Appendix A
Data Dictionary

Variable	Phase 1 data	Phase 2 data	Source	Comments/Scoring method	Default Scores	Additional Comments
CIS	No data at this time	Survey data				Plats, D4, SAP, LMS, EPCR (pipe and CP)
Casings	No data available	Service casings	D4			D4, SAP

Appendix B – Risk Assessment Model

PSE Risk Assessment Model
for
Wrapped Steel Service Assessment Program

Rev. 2.1

April 14, 2006

WKM Consultancy, LLC

1. Measuring Exposure Level

The concept of measuring a threat as if there was absolutely no mitigation applied is a part of this process and is probably a new idea to most. It requires a bit of imagination. For example, in the case of third party damage in a rural area, one must envision the pipeline in an unmarked ROW (actually indistinguishable as a ROW), with no one-call system, no public education, and buried with only a few millimeters of cover. Then, a 'hit rate' is estimated—how often would such a pipe be struck by nearby utility work, homeowner activity, new construction, agricultural equipment, etc.?

This exercise is actually very illuminating in that it forces one to recognize the inherent threat exposure without the often taken-for-granted role of mitigation. A facilitated meeting with historical data and SME's is the recommended method of finalizing most exposure values for time-independent threats.

A brief discussion of some assigned exposure rates for the current risk assessment follow:

Third party damage rate: total incidences per plat range from 0 to 2. A base hit rate of 1.0 is assumed. This implies that, in an unmitigated environment, each service per plat would be damaged by a third party once every year. This value is multiplied by (historical hit rate of the corresponding plat) + 1. The resulting range of exposures is 1 to 3 'hits' per year.

Soil movement potential (yes/no): all rated 'no' in this op map, so no distinction among services. In the current assessment, the accumulation of all geotechnical threats are assigned a default value of 0.0001 failures per year for each service. This suggests one annual failure for each 10,000 services and is very conservative since actual failure rates are much lower.

For time-dependent threats, mpy values for corrosion and cracking are used. These can be set using published values and/or engineering analysis of specific environmental and metallurgical factors. An unmitigated threat level is first measured—the aggressiveness of soil corrosion, atmospheric corrosion, crack growth rate under assumed loadings, etc. Then all mitigation measures are independently considered.

Assumptions in Assignment of Exposure Levels

1. All services have some atmospheric exposure
2. Human error potential not yet included in model
3. Geotechnical exposure is currently default

2. Measuring Mitigation

Each mitigation measure is assigned a maximum effectiveness, indicating that factor's ability to independently reduce the exposure that would otherwise occur. The maximum effectiveness levels are judged by envisioning the mitigation being 'performed' as well as can be envisioned. For example, the model reflect the belief that "depth of cover", when done as well as can be envisioned, can independently remove almost all threat of third party damage. It is a variable that can theoretically mitigate 99% of the third party damage exposure. If buried deep enough, there is very little chance of third party damage, regardless of any other mitigative actions taken. "Public Education" on the other hand, is recognized as an important mitigation measure but the model reflects the belief that, independently, it cannot be as effective as depth of cover in preventing third party damages. Some currently assigned mitigation effectiveness values are shown in Table 1.

Table 1: Mitigation Effectiveness Values

Mitigation Measure	Description of Best Case	Max Mitigation Benefit
Depth of cover	80" or more of earth or equivalent pavement	99%
Signs/markers	easily and readily identified as buried utility location; visible from any possible dig site; redundancy in case of lost markers	50%
Public Education	Extremely robust program involving many media	20%
Line Locate	Strict and conservative procedures; extensive training, redundancy	50%
One-call	The most effective system: mandated and enforced by law; exceptionally well communicated, etc.	85%
Patrol	24/7 surveillance	90%
Cathodic Protection	Complete coverage with certainty; verified continuously	99%
Coating	Perfect barrier from electrolyte	90%

In the case of time-independent failure mechanisms, the percentage implies the proportion of exposures that do not reach the pipe because of the mitigation. To capture the reality of orders of magnitude spans in failure probability, the mitigation percentage is applied to a logarithmic span.

In the case of time-dependent mechanisms, the percentage is applied to the modeled metal loss rate, mpy.

Assessment Rules: Corrosion

Cathodic Protection (CP) (Scoring Tables E-5, E-7, E-8, E-8a)

- If active leak, then CP = 0% effective (until root cause analysis)
- If EPCR pitting, then CP = 0% effective (until root cause analysis)
- If IND/SVC, then CP effectiveness reduced by 50%.
- If service is off of STW main and not IND/SVC, then CP effectiveness-is determined by scoring the CP system that the service is electrically continuous with in accordance with the scoring method in Tables E-7, E-8, and E-8a. These scores are then added together to achieve a CP effectiveness score ranging from 0 to 10 points for each service.
- If service off ST, PE or CI which are not IND/SVC are assumed to have no CP then CP = 0% effectiveness

Coating (Scoring Tables E-2, E-4, E-6, E-10)

- If active leak, then coating effectiveness = 0% (until root cause analysis)
- If EPCR pitting, then coating = 0% effective (until root cause analysis)
- If EPCR evaluation done, use table E-10a where BON = 95% effective coating
- Otherwise, use date to infer coating type to infer condition (Scoring Table E-2) for soil exposures
- Use date to infer protocol and effectiveness of atmospheric corrosion prevention (Scoring Table E-4)

EPCR information is a key part of the current assessment. Since there are apparent inconsistencies in data gathering on EPCR's, several checks are performed to ensure conservative interpretations are made. If any pit depth was noted or any pit frequency was noted, then CP and coating were both assessed at 0%, even when coating was noted as 'bonded'.

A higher incidence rate (per plat range of 0 to 14) of corrosion leak repairs reduces mitigation effectiveness by up to 20% in proportion to plat leak count.

Cover: business districts are assumed to have 'wall-to-wall' pavement. Pavement is modeled as having the same benefit as an additional 12" of cover. If under 'wall-to-wall' pavement service is assumed to be mostly in ROW where depth of cover is 18". Pending depth of cover information (to be extracted from EPCR's), a default of 12" is used. Therefore, possible cover values under the current protocols are either 12" or 30".

Other mitigation measures against third party damage are used in the assessment as described below:

Signs/markers: this variable is not yet used, might be appropriate only for rural areas mains and transmissions. 0% benefit assigned in current assessment.
Public education: defaulted to 20% of best possible program.
Locating and marking protocols: defaulted to 20% of best possible program.
One-call effectiveness: defaulted to 20% of best possible program.
Patrol: might be appropriate only for rural areas with mains and transmissions: possible credit for informal observations; defaulted to 10% of best possible program.

No mitigations included yet for geotechnical issues.

Assumptions Underlying Mitigation Measure Assessments

1. Active leaks or previous damage indicate conditions conducive to corrosion and breakdown of corrosion control mechanisms. Even though usually very localized, this will be evidence of failed mitigation until root cause analysis and appropriate follow-up actions prove otherwise.
2. All active leaks and pitting are on buried portions—no atmospheric damages.
3. High repair rate suggests more aggressive corrosivity and/or weakened mitigation systems, until a root cause analysis removes this penalty.
4. EPCR inspection of one point on service reflects conditions on entire service
5. Ignore apparent inconsistencies when, in EPCR, pitting or surface rust noted, but coating shown as 'bonded' (bonded is otherwise interpreted to mean 'good condition').
6. Maximum benefits have not yet been verified by PSE SME's and should be considered preliminary only.
7. Default values assigned are preliminary and not yet verified by PSE SME's.

3. Measuring Resistance

Resistance, as previously defined, is measured according to the rules discussed here.

- When a service has multiple diameters, the largest diameter with the thinnest wall is used.
- Wall thicknesses are inferred from date of construction and service diameter (Scoring Table E-13)
- D/t is the ratio of diameter to wall thickness and is a rough measure of the structural strength of the pipe as a beam—its ability to withstand external forces. A simple proportional relationship is used to show up to a 20% benefit.
- Casing: no casing locations are currently identified. Once input into the model, these locations will show greatly increased external force resistance. They will also show increased chance of ineffective CP, in the assessment of corrosion potential.

- Stress level: lower stress levels suggest more resistance to external forces, currently modeled to a maximum benefit of 20% when stress is very low, as is the case for service lines.
- For external loadings, a wall thickness of 0.3" or more warrants an 80% resistance to external resistance and 0.1" or less warrants no resistance. Values in between are proportional.
- For available wall to resist time-dependent mechanisms, Final wall thickness estimate is based on:

  If active leak, then wall = 0"
  Otherwise, larger of
  - wall required for NOP (minimum of 0.01"),
  - wall at last pressure test minus wall loss since;
  - wall at last inspection minus wall loss since.

  minus the metal potentially lost before CP was applied (conservatively assumed to be 1972). This value is based on soil corrosivity and coating effectiveness (bare pipe has no mitigation).

Wall thickness potentially lost since last integrity verification (pressure test or robust inspection) is based on soil corrosivity and mitigation applied (CP and, in most cases, coating also). There are currently no integrity verifications applied to these services after their installation, so metal loss is based on time since installation.

The minimum of 0.01" for wall thickness estimate based on NOP is thought to be a reasonable minimum, even though strict application of the Barlow stress formula indicates that wall thickness could be less than 1 mil (0.001") for small diameter, low pressure pipe. While theoretically, less than 1 mil of wall could remain, it is thought that assuming 10 mils actually remain is still conservative and better reflects more probable conditions.

Adjustment factor based on possible strength-limiting manufacturing and construction issues, conservatively assumes the following limitations:

Table 2: Adjustment Factors

Issue	**Factor**
wrinkle bend	0.98
miter joint	0.98
injurious lamination	0.98
stress concentrator	0.95
seam	0.98
joint type	0.98

Since all could theoretically be present, overall adjustment factor is the product of all together for a value of 0.86. This means that only 86% of the previously-estimated available wall thickness is carried forward to the TTF calculation.

Assumptions Underlying Resistance Estimates

1. Soil corrosion and atmospheric corrosion are not additive at any location
2. No anomalies present at installation (but conservatively assume weaknesses—see adjustment factor).

3. Default values assigned are preliminary and not yet verified by PSE SME's.

4. Measuring Relative Consequences

Potential consequences from a service failure are estimated on a relative basis, based on two variables:

- Criticality of supply (yes or no, based on volume usage, assigned a value of 1 or 2)
- Population density (Scoring Table E-15)
- CoF = [criticality of supply] x [pop] and ranges from 1 to 22.

This is a large span, suggesting that real consequences can vary widely.

5. Conservatism

This analysis intentionally contains many layers of conservatism. This is done to encourage data collection and to protect the model's credibility. Sources of conservatism include:

- Assuming largest diameter, thinnest wall
- Using historical incidence rates without adjusting for relevance
- Assuming observed poor conditions still exist, although permanent repairs were the norm.
- Using very aggressive corrosion rates
- Assuming no mitigation benefit for entire service when evidence shows only a single location has reduced mitigation (active leak, previous repair).
- Assuming poor performance of older coatings and coatings of a certain type, even though, in the vast majority of cases, most coatings continue to perform very well.
- Large range of potential consequences, even though potential for larger consequence events is extremely small.
- Assuming weaknesses in pipe strength
- Choice of relationship in predicting PoF from TTF

Less conservative assumptions are sometimes needed for practical reasons. For instance, a defect as much as 95% through a pipe wall could exist and not be leaking under normal internal pressures. It would be counter-productive to assume that such rare defects exist everywhere, even though such as assumption would be very conservative. Rather, the wall thickness implied by a Barlow stress calculation is used as the primary means to estimate the probable—and still conservative—wall thickness when no other confirmatory integrity information is available.

6. Specific Variables and Algorithms

Table 3: Calculated values from risk assessment model

Category	Variable	Calculation	Notes
Summary	Risk	=PoF*CoF	Overall risk value; can be monetized units
Summary	PoF	=1-(1-TTF-PoF)*(1-ThdPty)*(1-Geotech)	OR gate to combine individual threats
Summary	CoF	=IF([critical svc]="yes",2,1)*(11-[pop])	
Summary	TTF-PoF	See below	
Summary	Geotech	0.0001	default
Summary	ThdPty	See below	
TTF	psig	60	Fetch from database; Fixed

Category	Variable	Calculation	Notes
TTF	dia	=IF(diameter=34,0.75,IF(diameter=12,0.5,IF(diameter =114,1.25,IF(diameter=58,0.64,1))))	Convert text series into a numerical diameter; note default is 1" when multiple diameters listed
TTF	wall	=wall thickness	Fetch data from database
TTF	wall - man tol	=wall*0.92	Not currently used
TTF	SMYS	35000	Specified min yield stress;; Fetch from database
TTF	test press	90	Fetch from database; fixed
TTF	test date	=test date	Installation date
TTF	%SMYS press test	=[test press]*dia/(2*wall*SMYS)	Barlow formula
TTF	min wall def	=wall-(wall*(1-%SMYS/1.1))	Wall after max defect depth; not currently used
TTF	date	=[insp date]	Date of last inspection
TTF	anom depth (%)	=IF(ISBLANK([EPCR pit depth]),0,VLOOKUP([EPCR pit depth],[table E-11 value],2,FALSE))	From EPCR reports
TTF	min wall	=IF(date=0,0,wall*(1-[anomaly depth %]))	Wall after pit depth subtracted
TTF	ext corr atm	=VLOOKUP([atm type],[table E-3],2,FALSE)*(1-[coating atm])	Estimate of atmospheric corrosion
TTF	ext corr soil	=IF([soil corrosivity score],[table E-1])*(1-[mit (soil))	Estimate of soil corrosion
TTF	int corr	=IF([int corr LP]="yes",[1 mpy],[1 mpy]/5)	Estimate of internal corrosion
TTF	cracking	0.1	Default
TTF	mpy (after coat mit)	=IF([coating type score]=0,1,[coating type score]/10)*IF(,[soil corrosivity score]=0,[10.7 mpy],[6.6 mpy])	Corrosion rate if only coating, no CP
TTF	years of no CP	=IF(DATE>1972,0,(1072-DATE))	Assume all lines have CP as of 1972
TTF	mils lost	=[years of no CP]*[mpy after coat mit]	Mils lost prior to application of CP
TTF	NOP wall	=IF([PSIG]*[DIA]/(2*[SMYS])<0.01,0.01,[PSIG]*[DIA]/(2*[SMYS]))	Min wall estimate based on NOP
TTF	press test minus mils lost	=[min wall]-[mils lostl]/1000-(2006-MAX(1972,[test datel]))*(MAX([ext corr soil]*(1-[mit soill])/1000,[ext corr atm]*(1-[mit atm])/1000)+([int corr]+[cracking])/1000)	Est wall based on last press test and mils lost since
TTF	Insp minus mils lost	=IF(date=0,0,[min wall]-[mils lostl]/1000-(2006-MAX(1972,date))*SUM([ext corr soil]:[cracking]:[int corr])*(1-[mit soil])/1000)	Est wall based on last inspection and mils lost since
TTF	final est wall	=IF([active leak]="No",MAX([NOP wall],[press test minus mils lost wall],[insp minus mils lost wall]),0)	If not leaking, then use maximum of inferred wall thickness estimates
TTF	wall_adj	=[wrinkle bend]*[miter joint]*[lamination]*[stress concen]*[seam]*[joint type]	
TTF	wall_avail	=([final est wall]-[min wall at non-leaking NOP])*[wall_adj]	
TTF	TTF	=[wall_avail]*1000/SUM([ext corr soil]:[cracking]:[int corr])	

Category	Variable	Calculation	Notes
TTF	PoF_time	=IF(TTF<=0,0.999,1-EXP(-1/TTF))	Conservative relationship between TTF and year-one-PoF is assumed
TTF	min wall at non-leaking NOP	=[min wall for NOP (Barlow)]-[max def surviving at NOP]	
TTF	min wall for NOP (Barlow)	=[PSIG]*[DIA]/(2*[SMYS])	
TTF	max defect depth surviving at NOP	=([min wall for NOP]*(1-[max % SMYS at NOP])/1.1)	
TTF	max % SMYS at NOP	=[PSIG]/(2*P18)*[DIA]/[SMYS]	
TTF	wrinkle bend	0.98	Default
TTF	miter joint	0.98	Default
TTF	injurious lamination	0.98	Default
TTF	stress concentrator	0.95	Default
TTF	seam	0.98	Default
TTF	joint type	0.98	Default
TTF	mit (soil)	=[assessed mit (soil)]*[adj to mit from repair hist]	
TTF	adj to mit from repair hist	=1-([repaired corr leak count by plat]/14)*0.2	0.2 is max 'penalty' for previous repair history
TTF	assessed mit (soil)	=1-(1-[coating soil])*(1-CP)	
TTF	coating soil	See 'assessment rules for corrosion' in previous text paragraphs	
TTF	CP	See 'assessment rules for corrosion' in previous text paragraphs	
TTF	coating atm	=IF(ISNUMBER([svc year date]),IF([svc year date]<1966,4/10,7/10),0)	
Thd Pty	PoF	=10^((LOG(exposure)-LOG(10/10E-5)*([threat red)))	10/10E-5 establishes scale range of exposure
Thd Pty	Exposure (hit rate)	=[thd pty hit rate for plat] + 1	
Thd Pty	threat_red	=1-(1-mitigation)*(1-resistance)	
Thd Pty	resistance	=1-(1-[pipe_wall_nom])*(1-[D/t])*(1-casing)*(1-[stress %max])	OR gate all resistance variables
Thd Pty	pipe_wall_nom	=(1-(0.3-[nom wall])/(0.3-0.1))*80%	
Thd Pty	D/t	=(1-(IF([D/t-data]>=100,0,IF([D/t-data]<=25,1,([D/t-data]-25)/75))))*20%	
Thd Pty	casing	=casing-data*100%	No casing info avail
Thd Pty	stress % max	=(1-[stress-data])*20%	
Thd Pty	pipe_wall_nom -data	=wall nom	
Thd Pty	D/t-data	=dia/[nom wall]	
Thd Pty	Casing-data	0	
Thd Pty	Stress-data	=[%SMYS]	

Category	Variable	Calculation	Notes
Thd Pty	mitigation	=1-(1-patrol)*(1-[one-call])*(1-locate)*(1-[pub ed])*(1-[signs/markers])*(1-cover)	OR gate all mitigation variables
Thd Pty	patrol	[assessed value]*[max benefit of mitigation]	
Thd Pty	one-call	[assessed value]*[max benefit of mitigation]	
Thd Pty	locate	[assessed value]*[max benefit of mitigation]	
Thd Pty	pub ed	[assessed value]*[max benefit of mitigation]	
Thd Pty	signs/markers	[assessed value]*[max benefit of mitigation]	
Thd Pty	cover	=IF([cover-data]<=6,0,IF([cover-data]>80,0.99,0.99*([cover-data])/(80-6)))	Set benefit based on scale parameters and data
Thd Pty	patrol	0.1	Default
Thd Pty	one-call	0.2	Default
Thd Pty	locate	0.2	Default
Thd Pty	pub ed	0.2	Default
Thd Pty	signs/markers	0	Default
Thd Pty	Cover-data	=IF([cover attribute hard surface]="Yes", 30, 12)	

7. Scoring Protocols

Threat Variables

Scoring Table E-1: Soil Corrosivity

Corrosivity Codes:	Score	Soil Resistivity	MPY (mils per year)
Not Corrosive	3	>20,000 Ohm.cm	1
Slightly Corrosive	2	10,000 - 20,000 Ohm.cm	5
Moderately Corrosive	1	3,000 - 10,000 Ohm.cm	10
Very Corrosive	0	< 3,000 Ohm.cm	16

Scoring Table E-2: Mainline Coating Type

Coating Type	Score
Bare	0
Unknown	0
Thermally-insulated without Primary Coating	0
Single-wrap PE Tape (line travel)	4
Asphalt (cold applied)	4
Double-wrap PE Tape Coatings (line travel)	5
Wax Coatings	6
Cold-applied PE tape with primer	6
Coal Tar Enamel (hot applied)	7
Liquid Polyurethane/Moisture cured liquid urethane Coatings	7
Hot Applied Tape (e.g. Tapecoat 20)	7
Cold- applied self priming PE tape	7
Extruded Polyethylene (e.g. Yellow Jacket)	8
Thermally-applied PE Powder	8
Thermally-applied metallic coatings (85% Zn/15% Al)	9
FBE	9

Liquid epoxy coating	9
Thermally-insulated with Primary Coating	9
Three-Layer Polyurethane Coatings	10

Scoring Table E-3: Atmospheric Type

Atmospheric Type	**Score**	mpy
Chemical & Marine	0	10
Chemical & high humidity	0.5	8
Marine, swamp, coastal	0.8	6
High humidity and high temperature	1.2	5
Chemical and low humidity	1.6	3
Low humidity and low temperature	2	1
No exposures	2	0.1

1. Atmospheric type: Reference Pipeline Risk Management Manual - Third Edition - W. Kent Muhlbauer

Scoring Table E-4: Atmospheric Coating Scoring

Installation year	**Score**
Unknown	0
1956 - 1965	4
1966 - 1972	7

1. Ref. Steel service history coating specifications
2. Measure of performance and reliability of wrap/coating used to prevent corrosion at air/soil interfaces.
3. Date of installation and SME experience used as surrogate for probable effectiveness in corrosion prevention/reduction.

Scoring Table E-5: CP System Performance by Gas Plat Map

CP System Performance by Gas Plat Map (0 - 10)
Good Performance: 8 - 10
Fair Performance: 5 - 7
Poor Performance: 0 - 4

1. CP System Scoring: See CP scoring legend. Scored all the systems within a plat and used the lowest (worst) score.

Scoring Table E-6: Field Joint/Fitting Coating Type

Coating Type	**Score**
Bare or Unknown	0
Thermally-insulated without Primary Coating	0
Single-wrap PE Tape	4
Asphalt (cold applied)	4
Double-wrap PE Tape Coatings	5
Cold-applied Liquid Mastic	6
Wax Coatings	6
Cold-applied PE tape with primer	7
Coal Tar Enamel (hot applied)	7

Liquid Polyurethane Coatings	7
Hot Applied Tape (e.g. Tapecoat 20)	7
Cold- applied self priming PE tape	8
Shrink Sleeves	8
Thermally-applied PE Powder	9
Liquid epoxy coating	9
Thermally-insulated with Primary Coating	9
Thermally-applied metallic coating	9
Field-applied FBE	9
No Oxide	10

Scoring Table E-7: CP Critical Bond Status

System Critically Bond Tested: 20%	
Variable	Score
Yes	2
No	0

Scoring Table E-8: Average CP Level

Average System CP Level: 30%	
Variable	Score
> -.950	3
> -.850 & < -.950	2
< -.850	0

Scoring Table E-8a: Average CP System Remediation Time

Average CP System Remediation Time: 50%	
Variable	**Score**
No Remediation Required	5
< 30 days to remediate	3
> 30 & < 90 days to remediate	2
> than 90 days to remediate	0

1. System scoring to be validated through SME discussions with Corrosion Technicians.
2. Scored all the systems within a plat and used the lowest (worst) score.
3. Scores for separately protected services (IND/SVC) are penalized: 0.5 X CPS score.
4. All services off STW main and not IND/SVC are assumed to be protected by a CPS. All services off ST, PE or CI which are not IND/SVC are assumed to have no CP.

Scoring Table E-9: Internal Corrosion

Internal Corrosion LP Yes/No
0 = LP svc
1 = other than LP svc

1. Data from MRT main pressure field.
2. Low pressure services (LP) are assumed to be more susceptible to internal corrosion.

Exposed Pipe Condition Report Score

Scoring Table E-10: Coating Condition Score

Coating Descriptor	Score
Bonded	10
Cracked	8
Not filled out or "N/A"	6
Damaged	6
Missing or None	4
Disbonded	1

1. The coating condition description score will be assigned on the basis of the information filled out in the "Coating" field of the Exposed Pipe Condition Report.

Scoring Table E-10a: Coating Adhesion Score

Abrev used	% effective
BON	0.95
DAM	0.1
DIS	0

Scoring Table E-11: Pit Description Score

Pit Frequency Descriptor => / Pit Depth Descriptor (Vertical)	No Pitting	Isolated Pits	Frequent Pits	No Original Surface Left	
Not filled out or "N/A"	10	5	3	2	0.3
Surface Rust	10	7	4	3	0.1
Shallow Pits	6	5	3	2	0.3
Deep Pits	4	3	2	1	0.5

Scoring Table E-12

Pit Description	Assumed % thru wall
DP	0.5
non-blank	0.3
SP	0.3
SR	0.1

1. Scoring Table E-11 was converted to the above table to support more absolute quantification of available pipe wall. These values are used in the risk calculations for TTF.

Scoring Table E-13: Pipe Wall Thickness

Year	Service Sizes (inches)	Wall Thickness (inches)
1956	3/4	0.113
	1	0.133
	1 1/4	0.14
	1 1/2	0.145
	2	0.154
	3	0.216
	4	0.237
	6	0.25
1960	Same spec as 1956	Same spec as 1956
1966	1/2	0.109
	3/4	0.113
	1	0.133
	1 1/4	0.14
	1 1/2	0.145
	2	0.154
	4	0.188
1971	Same spec as 1966	Same spec as 1966
1972	1/2	0.035
	1/2	0.109
	3/4	0.113
	1	0.133
	1 1/4	0.14
	1 1/2	0.145
	2	0.154
	4	0.188
1977	Same spec as 1972	Same spec as 1972
1980	Same spec as 1972	Same spec as 1972
1986	1/2	0.109
	3/4	0.113
	1	0.133
	1 1/4	0.14
	1 1/2	0.145
	2	0.154
	4	0.188

1. Addresses with multiple sizes used smallest diameter.
2. The ones identified as 5/8 (plastic) the services had unknown size of steel; defaulted to smallest size pipe based on year.

Scoring Table E-14: Cover Attributes Hard Surface

Attribute	Score
In Business District (wall to wall paving)	yes
not in Business District	no

1. Data from Business District Leak Survey.

Consequence Variables

Scoring Table E-15: Population Density

Factor	Score
LOW=Low population density	10
High Occupancy Structure 6 = IDS=Identified Site	3
HOS-IDS=High Occupancy Identified Site	2
BD=Business District	0

1. These values are subtracted from 11 since the model requires higher consequences to be higher numerical values.

8. Discussion of Modeling Approach

The following paragraphs discuss some of the features of the model used in this application. Specifically, the features that are a departure from previous ranking or scoring approaches are highlighted here.

Risk Triad

The basis for this model is an examination of each failure mechanism (threat) in three parts for:

- Exposure (unmitigated),
- Mitigation effects, and
- Resistance to failure.

These three elements make up the Risk Triad, for evaluating probability of failure (PoF). They are generally defined as follows:

- Exposure = likelihood of force or failure mechanism reaching the pipe when no mitigation applied,
- Mitigation = actions that keep the force or failure mechanism off the pipe, and
- Resistance = the system's ability to resist a force or failure mechanism applied to the pipe.

The evaluation of these three elements for each pipeline segment results in a PoF for that specific segment.

An intermediate level, termed "Probability of Damage"—damage without immediate failure—also emerges from this approach. Using the first two terms without the third—exposure and mitigation, but not resistance—yields the probability of damage.

- Probability of Damage (PoD) = f(exposure, mitigation)
- Probability of Failure (PoF) = f(PoD, resistance)

This avoids a point of confusion sometimes seen in previous assessments. Some older models are unclear as to whether they are assessing the likelihood of damage occurring or the likelihood of failure—a subtle but important distinction since damage does not always result in failure.

Calculation of both PoD and PoF values creates an opportunity to gain better understanding of their respective risk contributions.

This three part assessment also helps with model validation and most importantly, with risk management. Fully understanding the exposure level, independent of the mitigation and system's ability to resist the failure mechanism, puts the whole risk picture into clearer perspective. Then, the role of mitigation and system vulnerability are both known independently and also in regards to how they interact with the exposure. Armed with these three aspects of risk, the manager is better able to direct resources more appropriately.

9. Model Features

Other characteristics of this model distinguish it from previous risk assessment approaches and include the following.

Measurement Scales

Mathematical scales that simulate the logarithmic nature of risk levels are employed to fully capture the orders-of-magnitude differences between "high" risk and "low" risk. The new scales better capture reality and are more verifiable—to some extent, at least. Some exposures are measured on a scale spanning several of orders of magnitude—"this section of pipeline could be hit by excavation equipment 10 times a year, if not mitigated (annual hit rate = 10)" and "that section of pipeline would realistically not be hit in 1000 years (0.001 annual hit rate)."

The new approach also means measuring individual mitigation measures on the basis of how much exposure they can independently mitigate. For example, most would agree that "depth of cover", when done as well as can be envisioned, can independently remove almost all threat of third party damage. As a risk model variable, it is theoretically perhaps a variable that can mitigate 95-99% of the third party damage exposure. If buried deep enough, there is very little chance of third party damage, regardless of any other mitigative actions taken. "Public Education" on the other hand, is recognized as an important mitigation measure but most would agree that, independently, it cannot be as effective as depth of cover in preventing third party damages.

Improved valuation scales also means a more direct assessment of how many failures can be avoided when the pipeline is more resistant or invulnerable to certain damages.

Variable Interactions

This model uses combinatorial math that captures both the influences of strong, single factors as well as the cumulative effects of lesser factors. For instance, 3 mitigation measures that are being done each with an effectiveness of 20% should yield a combined mitigation effect of about 49%. This would be equivalent to a combination of 3 measures rated as 40%, 10%, and 5% respectively, as is shown later. In other cases, all aspects of a particular mitigation must simultaneously be in effect before any mitigation benefit is achieved. An example is high patrol frequency with low effectiveness or a powerful ILI but with inadequate confirmatory investigations.

These examples illustrate the need for OR and AND "gates" as ways to more effectively combine variables. Their use eliminates the need for "importance-weightings" seen in many older models.

The new approach also provides for improved modeling of interactions: for instance, if some of the available pipe strength is used to resist a threat such as external force, less strength is available to resist certain other threats.

Meaningful Units
The new model supports direct production of absolute risk estimates. The model can be calibrated to express risk results in consistent, absolute terms: some consequence per some length of pipe in some time period such as "fatalities per mile year." Of course, this does not mean that such absolute terms must be used. They can easily be converted into relative risk values when those simpler (and perhaps less emotional) units are preferable. The important thing is that absolute values are readily obtainable when needed.

10. Mathematics
Orders of Magnitude
As noted, logarithmic scales are used to better characterize the range of failure probabilities. This is a departure from how most older scoring models approach risk quantification. It is a necessary aspect to properly mirror real-world effects and express risk estimates in absolute terms.

Since logarithms are not a normal way of thinking for most, a more intuitive substitute is to speak in terms of orders of magnitude. An order of magnitude is synonymous with a factor of 10 or "10 times" or "10X." Two orders of magnitude means 100X, and so forth, so an order of magnitude is really the power to which ten is raised. This terminology serves the same purpose as logarithms for the needs of this model. So, a range of values from 10E2 to 10E-6 (10^2 to 10^{-6}) represents 8 orders of magnitude (also shown by: log(10E2) – log(10E-6) = 2-(-6) = 8). This PoF model measures most mitigation effectiveness and resistance to failure in terms of simple percentages. The simple percentages apply to the range of possibilities: the orders of magnitude. So, using an orders of magnitude range of 8, mitigation that is 40% effective is reducing a an exposure by 40% of 8 orders of magnitude which has the effect of reducing PoF by 3.2 orders of magnitude. For example, if the initial PoF was 0.1—the event was happening once every 10 years on average—it would be reduced to $0.1 / 10^{(40\% \times 8)} = 0.1 / 10^{3.2} = 6.3E\text{-}5$. The mitigation has reduced the event frequency by over 1000 times—only one in a thousand of the events that would otherwise have occurred will occur under the influence of the mitigation.

Numbers for mitigated PoF will get very, very small whenever the starting point (unmitigated PoF) is small: 1000 times better than a "1 in a million" starting point is very small; 1000 times better than a "1 in a 100" starting point is not so small. See also mitigation.

It might take some out of their comfort zone to begin working with numbers like this. If so, relative scales are easily created to be surrogates for the complex numbers. However, having access to the complex—and more correct—values at any time will add greatly to the risk model's ability to support a wide range of applications.

Creating a correct range of orders of magnitude for a model is part of the tuning or calibration process.

AND gates OR gates
The probabilistic math used to combine variables to capture both the effects of single, large contributors as well as the accumulation of lesser contributors is termed "OR" & "AND" "gates." Their use in pipeline risk assessment modeling represents a dramatic improvement over most older methods. This type of math better reflects reality since it uses probability theory of accumulating impacts to:

- Avoid masking some influences;

- Captures single, large impacts as well as accumulation of lesser effects;
- Shows diminishing returns;
- Avoids the need to have pre-set, pre-balanced list of variables;
- Provides an easy way to add new variables; and
- Avoids the need for re-balancing when new info arrives.

OR Gates

OR gates imply independent events that can be added. The OR function calculates the probability that any of the input events will occur. If there are *i* input events each assigned with a probability of occurrence, P_i, then the probability that any of the *i* events occurring is:

$$P = 1 - [(1-P_1) * (1-P_2) * (1-P_3) * \ldots * (1-P_i)]$$

OR Gate Example:

To estimate the probability of failure based on the individual probabilities of failure for stress corrosion cracking (SCC), external corrosion (EC) and internal corrosion (IC), the following formula can be used.

$$\begin{aligned} P_{failure} &= OR[P_{SCC}, P_{EC}, P_{IC}] = P_{SCC} \text{ OR } P_{EC} \text{ OR } P_{IC} \\ &= OR\ [1.05E\text{-}06, 7.99E\text{-}05, 3.08E\text{-}08] \\ &= 1\text{-}\ [(1\text{-}1.05E\text{-}06)*(1\text{-}7.99E\text{-}05)*(1\text{-}3.08E\text{-}08)] \\ &= 8.10E\text{-}05 \end{aligned}$$

The OR gate is also used for calculating the overall mitigation effectiveness from several independent mitigation measures. This function captures the idea that probability (or mitigation effectiveness) rises due to the effect of either a single factor with a high influence or the accumulation of factors with lesser influences (or any combination).

$$\begin{aligned} \text{Mitigation \%} &= M_1 \text{ OR } M_2 \text{ OR } M_3 \ldots\ldots \\ &= 1 - [(1-M_1) * (1-M_2) * (1-M_3) * \ldots\ldots * (1-M_i)] \\ &= 1 - [(1-0.40) * (1-0.10) * (1-0.05)] \\ &= 49\% \end{aligned}$$

or examining this from a different perspective,

Mitigation % = 1 – [remaining threat]

Where remaining threat = [(remnant from M_1) AND (remnant from M_2) AND (remnant from M_3)] …

AND Gates

AND gates imply "dependent" measures that should be combined by multiplication. Any sub-variable can alone have a dramatic influence. This is captured by multiplying all sub-variables together. For instance, when all events in a series will happen and there is dependence among the events, then the result is the product of all probabilities. In measuring mitigation, when all things have to happen in concert in order to gage the mitigation benefit, this means a multiplication—therefore, an AND gate instead of OR gate. This implies a dependent relationship rather than the independent relationship that is implied by the OR gate.

AND Gate Example:

Here, the modeler is assessing a variable called "CP Effectiveness" (cathodic protection effectiveness) where confidence in all sub-variables is necessary in order to be confident of the CP Effectiveness—[good pipe-to-soil readings] AND [readings close to segment of interest] AND [readings are recent] AND [proper consideration of IR was done] AND [low chance of interference] AND [low chance of shielding] . . . etc. If any sub-variable is not satisfactory, then overall confidence in CP effectiveness is dramatically reduced. This is captured by multiplying the sub-variables.

When the modeler wishes the contribution from each variable to be slight, the range for each contributor is kept fairly tight. Note that four things done pretty well, say 80% effective each, result in a combined effectiveness of only ~30% (0.8 x 0.8 x 0.8 x 0.8) using straight multiplication.

TTF

This represents the time period before failure would occur, under the assumed wall loss and available strength assumptions. TTF = 1 / [(available pipe wall) - (wall loss rate) x (1-mitigation effectiveness)]. For these time-dependent mechanisms, TTF is an intermediate calculation leading to a PoF estimate.

A new integrity inspection can "reset the clock" for this calculation as can any new information that would lead to a revised wall thickness estimate.

From TTF to PoF

The PoF is calculated as the chance of one or more failures in a given time period. The degradation rate is assumed to be occurring everywhere simultaneously. Therefore, the number of degradation points in a segment does not theoretically impact the estimate. In reality, there is an uncertainty associated with each degradation estimate and larger segments will have more possible degradation points and increased chance of outliers—locations having larger than estimated degradation rates. The calculated probability assumes that at least one point in the segment is experiencing the estimated degradation rate and no point is experiencing a more aggressive degradation rate.

The relationship between TTF and year one PoF is an opportunity to include segment length as a consideration, at the modeler's discretion. A relationship that shows increasing PoF as segment length increases is defensible since the longer length logically means more uncertainty about consistency of variables and more opportunities for deviation from estimated degradation rates.

The PoF calculation estimates the time to failure, measured in time units since the last integrity verification, by using the estimated metal loss rate and the theoretical pipe wall thickness and strength. It is initially tempting to use the reciprocal of this days-to-failure number as a leak rate—failures per time period. For instance, 1800 days to failure implies a failure rate of once every (1800/365) = 4.9 years or 1/(1800/365) = 0.202 leaks per year. However, a logical examination of the estimate shows that it is not really predicting a uniform leak rate. The estimate is actually predicting a failure rate of ~0 for 4 years and then a nearly 100% chance of failure in the fifth year.

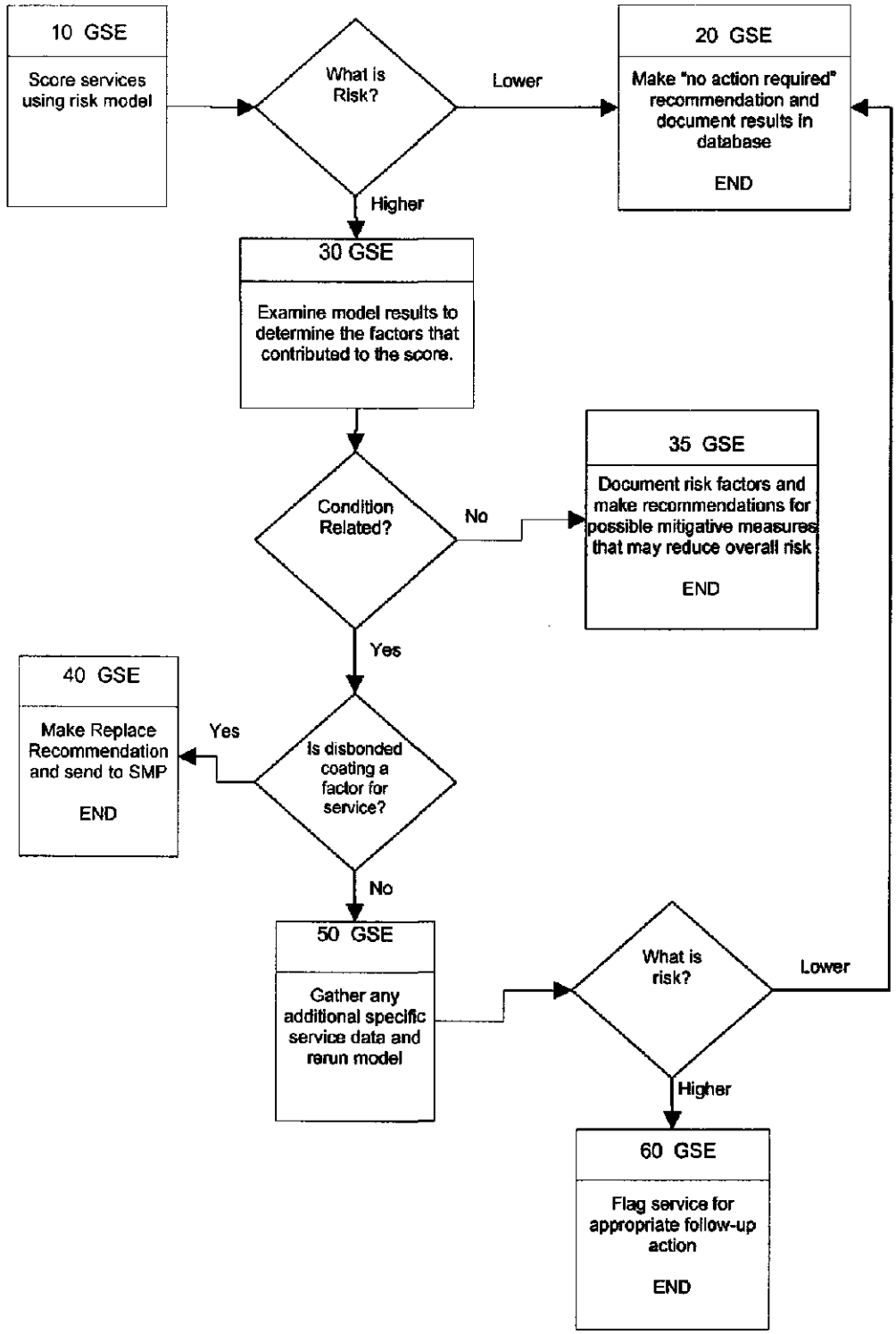
Some type of exponential relationship can be used to show the relationship between PoF in year one and TTF. The relationship: PoF = 1-EXP(-1/ TTF) where PoF = (probability of failure, per mile, in year one) produces a smooth curve that never exceeds PoF = 1.0 (100%), but produces a fairly uniform probability until TTF is below about 10 (i.e., a 20 yr TTF produces ~5% PoF). This does not really reflect the belief that PoF's are very low in the first years and reach high levels only in the very last years of the TTF period. The use of a factor in the denominator will shift the curve so that PoF values are more representative of this belief. A Poisson relationship or Weibull function can also better show this, as can a relationship of the form PoF = 1 / (fctr x TTF^2) with a

logic trap to prevent PoF from exceeding 100%. The relationship that best reflects real world PoF for a particular assessment is difficult if not impossible to determine. Therefore, the recommendation is to choose a relationship that seems to best represent the peculiarities of the particular assessment, chiefly the uncertainty surrounding key variables and confidence of results. The relationship can then be modified as the model is tuned or calibrated towards what is believed to be a representative failure distribution.

Appendix C – Decision Criteria

Appendix C
Decision Criteria

Figure 1. Decision Criteria Process



Appendix C
Decision Criteria

Table 1. Decision Criteria

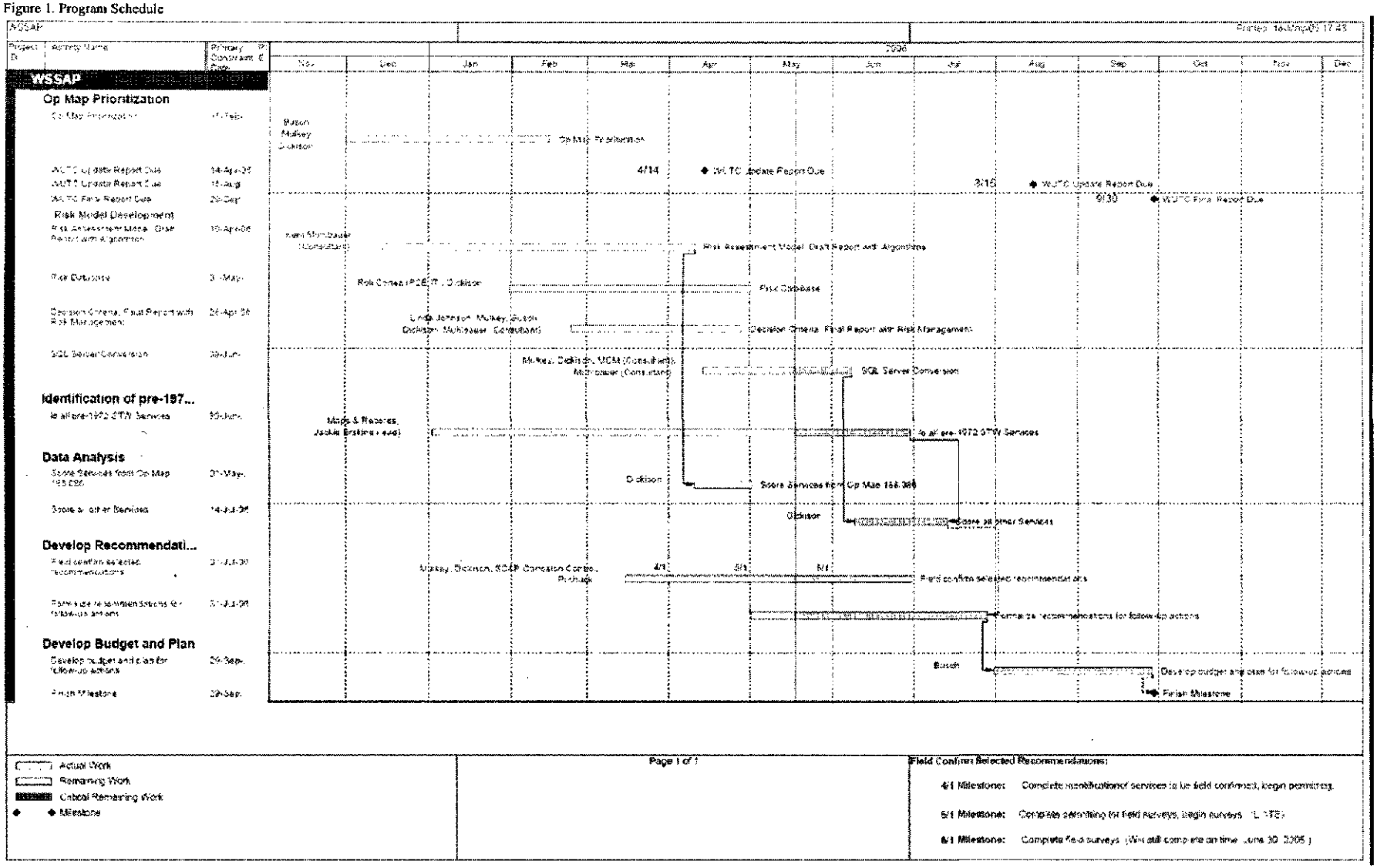
	Action	Description	Resource
10	Score services using risk model	The Gas System Engineering (GSE) subject matter expert (SME) will use scrubbed data taken from a central database that is linked to various other databases such as SAP, LMS, and the EPCR database. That data will be used to populate the ProActive risk model which will yield results indicating potential risk the service poses. The risk "score" will include such considerations as pipe condition, soil conditions, potential for third party damage and population density, among others. The output of the model will be risk based and indicate whether the service is categorized as higher or lower risk.	Gas System Engineering (GSE)
20	Make "no action required" recommendation and document results in central database	The SME has analyzed the results of the risk model for a given service and made the determination that the service requires no follow-up action. This determination is made because the variables and threats used in the model indicate a lower level of risk. The WSSAP central database will be updated with this determination.	GSE
30	Examine model results to determine the factors that contributed to the score.	For services categorized as higher risk, the SME examines the risk drivers to determine whether or not the drivers (threats and variables) are related to the predicted condition of the service.	GSE
35	Document risk factors and make recommendations for possible mitigative measures that may reduce overall risk.	If the service has a higher risk due to factors unrelated to the predicted service pipe condition, the service will be flagged and recommended for further investigation into possible mitigative measures that will reduce the overall risk. SMEs will be responsible for deciding the proper mitigative measures (if any).	GSE System Maintenance Planning Standards and Compliance
40	Disbonded coating - Make Replace Recommendation and send to SMP	Evidence of disbonded coating will be flagged for replacement because of the following: • Historical evidence of inadequate coating specification. • CP is not effective • Electrical surveys will not detect corrosion on pipe with disbonded coating	GSE

	Action	Description	Resource
50	Gather any additional specific service data and rerun model	For those services that are categorized as higher risk due to the predicted condition related factors (not including disbonded coating evidence), then the model will be populated with as much relevant (as determined by the SME) service specific data as is available via existing records (e.g. D-4) and possible site visits. This may be a combination of new data entered into the model and validation of the "plat-level" data that may have driven the risk higher.	GSE
60	Flag service for appropriate follow-up action	The risk model is rerun with any updated data. Those services categorized as having a higher level of risk will be flagged for appropriate follow-up actions (as determined by the SME) which may be in the form of replacements, electrical surveys, and leak surveys among others. Any services that are categorized as having a lower level of risk will be documented as described in Task 20.	GSE

Appendix D – Program Schedule

Appendix D
Program Schedule

Figure 1. Program Schedule



STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC UTILITY CONTROL
TEN FRANKLIN SQUARE
NEW BRITAIN, CT 06051

DOCKET NO. 07-09-09 DPUC REVIEW AND INVESTIGATION OF THE REQUIREMENTS FOR IMPLEMENTATION OF A WATER INFRASTRUCTURE AND CONSERVATION ADJUSTMENT

April 30, 2008

By the following Commissioners:

John W. Betkoski, III
Anne C. George
Donald W. Downes

DECISION

DECISION

I. INTRODUCTION

A. SUMMARY

In this Decision, the Department of Public Utility Control (Department) establishes a process for administrating a rate adjustment mechanism for the purpose of funding eligible water infrastructure improvement projects by Department-regulated water companies.

B. BACKGROUND OF THE PROCEEDING

On June 19, 2007, Public Act 07-139, An Act Concerning Water Company Infrastructure Projects (Act or Public Act), became Connecticut law. The intended purpose of the Act is to enable the acceleration of the rate of replacement and/or rehabilitation of existing water system infrastructure to mitigate the effect of decay of aging water systems and promote conservation measures. The Act empowers the Department, in consultation with the Office of Consumer Counsel (OCC), to authorize a water company to use a rate adjustment mechanism, such as a water infrastructure and conservation adjustment (WICA), for eligible projects completed and in service for the benefit of the water company's customers.

Section 2(b) of the Act directs that:

> On or before ninety days after the effective date of this section, the [D]epartment shall initiate *a generic docket on what shall be included in a water company's infrastructure assessment report and annual reconciliation reports and the criteria for determining priority of eligible projects*. The [D]epartment shall provide public notice with a deadline for interested parties to submit recommendations on the report contents and criteria. The [D]epartment may hold a hearing on the generic docket but shall issue a decision on the docket not later than one hundred eighty days after the deadline for interested parties to submit their recommendations on the report contents and criteria. (Emphasis added.)

Accordingly, the Department established the instant generic docket as an uncontested proceeding.

C. CONDUCT OF THE PROCEEDING

By Notice of Request for Written Comments dated September 13, 2007, the Department requested interested parties (participants, as identified in Section I.D, below) to present their recommendations on what the infrastructure assessment report and annual reconciliation reports should contain, and the criteria for determining priority

of eligible projects. In addition, the Department requested that, as applicable, participants provide the following:

1. An overview of the respective utility's infrastructure, specifically transmission and distribution mains; the level of detail that the utility has regarding in-service dates, materials used, and its main break history; and, if the level of detail varies throughout the utility's system(s), an explanation of why that is so;

2. An overview of the utility's experience in main cleaning and relining as well as other available trenchless methods of main replacement; a commentary on the utility's ability to utilize these technologies; and a commentary on the applicability of these methods in the utility's service area;

3. The utility's current method of prioritizing main replacement; and, if different, the method proposed by the utility under a WICA approach;

4. An explanation of how the utility will perform a cost/benefit analysis of replacement rather than repair; and a copy of the model that the utility would utilize to make the replacement/repair determination;

5. The exhibits and other filing requirements that the utility proposes to constitute the annual reconciliation, as referenced in Section 2(j) of the Act; and

6. The correspondence to customers proposed by the utility for the implementation of a rate adjustment, as referenced in Section 2(j) of the Act.

Participants were given until November 9, 2007, to submit their respective filings to the Department in response to a Notice of Request for Written Comments.

By Notice of Hearing dated January 4, 2008, the Department held a public hearing on January 23, 2008, at its offices, Ten Franklin Square, New Britain, Connecticut. That hearing was held and continued to February 1, 2008. By Notice of Rescheduled Meeting dated January 25, 2008, the Department rescheduled the February 1, 2008 hearing and held it on February 25, 2008. At the conclusion of that hearing, the Department closed the record in this proceeding.

D. PARTICIPANTS

The Department designated the OCC, 10 Franklin Square, New Britain, Connecticut, 06051, and the following regulated water utilities as participants to this uncontested proceeding: Aquarion Water Company of Connecticut (Aquarion), The Avon Water Company (Avon), Bethel Consolidated Water Company, Brookfield Water Company, The Connecticut Water Company (CWC), The Ellington Acres Company, The Hazardville Water Company, Hawks Nest Beach Water Company, Heritage Village Water Company, The Jewett City Water Company, Judea Water Company, Inc., Old

Newgate Ridge Water Company, Inc., Olmstead Water Supply Company, Preston Plains Water Company, Rural Water Company, Inc., Topstone Hydraulic Company, The Torrington Water Company, Tyler Lake Water Company, United Water Connecticut, Inc. (United), Valley Water Systems, Inc., and West Service Corporation.

The Department also granted participant status to the South Central Connecticut Regional Water Authority (RWA)[1], 90 Sargent Drive, New Haven, Connecticut 06511; and The Connecticut Water Works Association, Inc. (CWWA)[2], 25 Capitol Avenue, Hartford, Connecticut 06106.

In response to the Notice of Request for Written Comments, the Department received submissions from: OCC; CWWA; Aquarion, 835 Main Street, Bridgeport, Connecticut, 06601-2353; CWC, 93 West Main Street, Clinton, Connecticut 06413-0562; and United, 110 Kent Road, New Milford, Connecticut 06776-3416.

The following participants provided responses to the Department's interrogatories and contributed testimony during the hearings: OCC, Aquarion, CWC, CWWA, United and Avon, P.O. Box 424, Avon, Connecticut, 06001. The Department received briefs and/or reply briefs from the OCC, Aquarion, CWC and United.

E. PUBLIC COMMENT

Aside from testimony provided by some of the participants identified above, the Department received no public comment on this matter.

II. DEPARTMENT ANALYSIS

A. INFRASTRUCTURE ASSESSMENT AND PLANNING

1. General

The topic of reinvesting in water infrastructure is not new. There is agreement among all participants involved, that a significant portion of many water utilities' infrastructure is approaching or exceeding what was once considered its useful life. The issue has taken on a national perspective. The Federal Environmental Protection Agency estimates water infrastructure needs over the next 20 years to be $276.8 billion[3].

Based on the age and the anticipated life of infrastructure, the current level of infrastructure investment is generally inadequate. Most water companies are not rehabilitating or replacing infrastructure on an annual basis commensurate with the

---

[1] While the RWA is a political subdivision of the State of Connecticut that provides water utility services throughout the greater New Haven region, it is generally not subject to the Department's jurisdiction; it is governed by its enabling legislation. Motion No. 2 (RWA letter dated October 1, 2007, to the Department).

[2] CWWA is an association of public water supply utilities serving more than 500,000 customers throughout Connecticut. Motion No. 4 (CWWA letter dated October 31, 2007, to the Department).

[3] EPA Drinking Water Infrastructure Needs Survey and Assessment Third Report to Congress, dated June 2005.

estimated useful life of each underground asset. That being said, the participants indicated that age alone is not a particularly useful indicator of the life of any given main. Indeed, certain underground assets have proven to serve customers well past useful service life estimates. In order to allow a relevant prioritization of system rehabilitative work to be undertaken, an inventory of existing system infrastructure needs to be performed, and criteria must be established to determine eligible projects based on factors including but not limited to age.

a. Inventory of Existing System Components

Before a thoughtful schedule of work can be established, an accurate inventory of existing system infrastructure is vital. A comprehensive inventory of the age, condition and environment of infrastructure and an estimate of remaining service lives should be an essential precursor to any meaningful replacement/rehabilitation program. Estimates should be based on updates, especially with pipe activity, etc. that extend useful life past that of previously established useful life estimates at installation.

To this end, the Department requested participants to provide the following details:

(a) An overview of the respective utility's infrastructure, specifically transmission and distribution mains;

(b) The level of detail that the utility has regarding in-service dates, materials used, and its main break history; and

(c) If the level of detail varies throughout the utility's system(s), an explanation of why that is so.

Notice of Request for Written Comments, Issue #1, p. 2.

As many of the comments confirmed, past practices involving record keeping have resulted in differing levels of information on the installation date, material type, and even exact location of existing underground infrastructure. In many cases, this circumstance is not the fault of present system operators. Many current water companies are comprised of an aggregation of earlier water systems, and frequently the case is that historical records on system infrastructure are not comprehensive. However, past record keeping practices should not prevent forward progress in infrastructure planning. In some cases, infrastructure inventories will need to be estimated based on the best information available and updated as more accurate knowledge becomes documented.

The development of an accurate inventory of the existing system infrastructure is essential to the protection and improvement of the system to assure reliability of service to customers. Therefore, the Department will require the collection and assembly of accurate infrastructure inventory on an ongoing basis. To this end, the Department has developed WICA-01 as the form to be used by a water company to compile relevant data on its current infrastructure to facilitate appropriate determinations on the criteria for prioritizing repair and replacement.

b. Eligible Projects

The Act identifies projects that are eligible for WICA treatment. The Department intends to review each project for eligibility in accordance with Section 1(1) of the Act, which defines eligible projects as:

> ... those water company plant projects not previously included in the water company's rate base in its most recent general rate case and that are intended to improve or protect the quality and reliability of service to customers, including (A) renewal or replacement of existing infrastructure, including mains, valves, services, meters and hydrants that have either reached the end of their useful life, are worn out, are in deteriorated condition, are or will be contributing to unacceptable levels of unaccounted for water, or are negatively impacting water quality or reliability of service if not replaced; (B) main cleaning and relining projects; (C) relocation of facilities as a result of government actions, the capital costs of which are not otherwise eligible for reimbursement; and (D) purchase of leak detection equipment or installation of production meters, and pressure reducing valves.

The WICA program is intended to accelerate asset replacement for infrastructure for the purpose of improving or protecting the water quality and the reliability of service to customers. However, the WICA program is not intended to replace or reduce the scrutiny of conduct of general rate increase hearings. The level of review for prudency in a WICA proceeding is less than that of a rate proceeding. Therefore, an approval by the Department of a proposed project would be an indication that the proposed project is eligible under the WICA program; however, it would not necessarily be an indication that the Department endorses the prudency of the project as constructed.

The WICA program is also not intended to replace current practices of asset management and infrastructure replacement. While reviewing WICA applications, the Department will evaluate and consider the level of infrastructure rehabilitation and replacement spending by the company in prior years. The Department anticipates that the WICA application will include cost/benefit analysis by the company.

Section 2(d)(4) of the Act calls for a sufficient level of investment in infrastructure. In keeping with the intent of accelerating infrastructure investment, the Department will require a showing by applicants that the level of investment made through use of the WICA program actually accelerates infrastructure replacement. The Department will commence a technical meeting within thirty days of this Decision to establish guidelines for what constitutes a showing of sufficient investment in the WICA program.

c. Criteria for Determining Priority of Eligible Projects

In addition to a relevant system inventory, the enabling legislation requires objective project prioritization criteria. Based on the present condition of their system infrastructure, it is likely that multiple potential rehabilitation and replacement projects will exist for many water companies. In the past, water companies have generally not performed cost/benefit analyses for particular projects or developed predictive planning

models. While the Department does not intend to usurp the management prerogative of the water companies in project planning, it will require that prudent engineering and objectively determined system needs be considered that will benefit reliability of service to customers at reasonable rates and insure that companies do not become overly aggressive in prematurely investing in main renewal or other projects of questionable benefit. In particular, the Department will thoroughly evaluate any proposed projects that potentially involve revenue enhancement.

The Department reiterates that the overarching intention of the WICA program is to rehabilitate or replace aging underground infrastructure, in particular decaying pipe and valves. The WICA program is not intended to be a substitute for ongoing maintenance of system infrastructure. The WICA program should not distract water companies from performing ongoing maintenance of system infrastructure.

The Department acknowledges that the timing of specific projects is often unrelated to remaining physical life or strict economics, such as the replacement of undersized mains for improvement in pressure or fire protection, and subject to factors beyond a company's control, such as road paving schedules. Moreover, such unrelated factors may change from year to year.

The Department, with input from participants, has formulated a process by which eligible projects will be prioritized. The process utilizes eight prioritization criteria, as reflected in Section 2 of WICA-01. The specific guidelines to be used in the review of these criteria are listed below.

1. Main Breaks

a. Main break history
   - Break frequency
   - Break repair cost

b. Outage impact history
   - Duration of outage
   - Customer impact, including number and type of customers, need for extraordinary flushing, disinfection, complaints, etc.

2. Pipe Age / Useful Life

a. Approaching or exceeding expected useful life
b. Range of expected useful life
c. Material, e.g., cast iron, cement, steel, ductile iron
d. Location or conditions of installation
e. Installation date / age
f. Pressure or other factors known to affect useful life

3. Material Integrity

a. Undesirable materials
b. Known internal or external corrosion
c. Batch, vintage or manufacturer with known problems
d. Unaccounted for water losses
e. Leaks identified by survey activity

4. Critical System Impact

a. Transmission or other large diameter main
b. Potential failure impact on customers
   - Total number and type of customer(s) affected
   - Priority customers (schools, health / day care, senior center, hospital, significant commercial or industrial users)
   - Nature and magnitude of impact of failure (low pressure, no water)
c. Valve operation / location issues

5. Water Quality Issues

a. Customer complaints related to water quality (dirty / rusty water)
b. More frequent flushing needs
c. Mains utilizing bleeders for quality control
d. Pipe material contributing to water quality problems

6. Hydraulic Capacity

a. Does not meet hydraulic needs of the system
b. Customer complaints or operational issues related to flow and/or pressure
c. Hydrants on mains less than desired diameter
d. Fire flow adequacy

7. Scheduled Work Coordination

a. State or town or other government agency project
b. Required government agency relocations
c. Potential for restoration / paving savings due to third party work

8. Other (To be Specified by the Applicant)

a. Unique customer or community considerations
b. Other mitigating or unanticipated factors or conditions

Details must be provided in narrative form with the filing.

Each prioritization factor will have a weight assigned to it as follows: 0 = non-priority, 1 = low priority, 2 = moderate priority, 3 = high priority. Companies will need to assign weights to prioritization factors for each project. The total for any particular project on WICA-01, Section 2, will be the basis for a company's prioritization

of projects. Companies should be prepared to justify any particular weight assigned to any project when presented to the Department for WICA approval.

2. Filings

a. Infrastructure Assessment Report (IAR)

The IAR is the initial application in which a water company shall furnish the best available information on its system inventory. It is also where a company first proposes projects for WICA eligibility, including the prioritization criteria and criteria for inclusion of these projects. A company is not eligible to apply for a WICA surcharge unless the Department has approved an IAR for the company.

Main break history shall be provided for projects included in the prioritization based on main break frequency (WICA-01, Section 3). The project list is not intended to include all projects, in perpetuity, under consideration by the company, since such a listing, in many cases, would be exhaustive and serve little practical use for the purposes of administrating the WICA program. The project list should be expansive enough to include all projects that could reasonably be expected to be completed prior to the next anticipated general rate case filing and, to be reasonable, be based on the company's annual retail water revenues as approved in its most recent rate filing and the financial limitations of WICA recovery (5%/year, 7.5% caps). As an additional exhibit, the company's IAR shall include a draft of the customer notification material the company intends to issue (or letter), as further discussed in Section II., B., 1., below. Upon receipt of a company's IAR, the Department will designate a new docket for that company, docket #xx-xx-xxWI01, and initiate an administrative proceeding Subsequent filings between rate cases for Semi-Annual Filing Report's and Annual Reconciliation Report's will use the same docket number with the extension WI02, WI03, etc. The minimum filing requirements for an IAR consist of the following:

1) WICA-01;

2) Proposed project list with narrative;

3) Draft of customer notification material;

4) Proposed bill form reflecting WICA adjustment; and

5) Training materials for customer service staff.

Section 2(d) of the Act reads, in part:

> The [D]epartment may hold a hearing to solicit input on a water company's individual infrastructure assessment report provided a decision on the assessment is made not later than one hundred eighty days after filing. Any such report not approved, rejected or modified by the [D]epartment within such one-hundred-eighty day period shall be deemed to have been approved.

As the above states, the Department will act on an IAR filing within a 180-day time period. Upon approval of the IAR, the administrative proceeding will be concluded.

After the initial IAR is approved, all subsequent project proposals will be included in the Semi-Annual Filing Report (SAFR).

b. Semi-Annual Filing Report

Subsequent to IAR approval, utilities will complete Department-approved projects. When those projects are used and useful, a company may apply for a surcharge to collect allowed costs associated with these completed projects. Upon receipt of the SAFR, the Department shall conduct an administrative proceeding.

Allowed costs are defined as depreciation and property tax expense and associated return on completed projects. Property taxes must have been billed by the taxing authority in order to be recoverable. Depreciation expense must be calculated using Department-approved depreciation rates from the company's most recent rate case. In order to track company earnings and in keeping with §16-19(g)(1) of the General Statutes of Connecticut (Conn. Gen. Stat.)[4], each company shall also provide a calculation of its earned return on equity for the previous twelve months on a rolling twelve-month basis. For WICA purposes, this requirement applies to rate base regulated, class A water companies.

The SAFR filing will consist of Department-adopted forms accompanied by a narrative document which outlines each project for which recovery is sought. The SAFR filing shall include an updated inventory of the system infrastructure (WICA-01) to reflect changes to inventory as a result of completed projects. Upon receipt of a complete SAFR filing, the Department shall conduct an administrative proceeding which shall typically be concluded within thirty days of the filing, except in such cases where the Department may deem that a time extension is warranted. The time extension shall not exceed an additional thirty-day period for a total of sixty days in which to render a decision.

The minimum filing requirements for an SAFR are:

1) WICA-02: WICA Semi-Annual Filing Report (SAFR);

2) Updated WICA-01;

3) WICA-04: Eligible Projects Placed In Service;

4) WICA-05: Calculation of Surcharge or Credit;

---

[4] Conn. Gen. Stat. §16-19(g)(1) reads: "The Department shall hold either a special public hearing or combine an investigation with an ongoing four-year review conducted in accordance with section 16-19a or with a general rate hearing conducted in accordance with subsection (a) of this section on the need for an interim rate decrease (1) when a public service company has, for six consecutive months, earned a return on equity which exceeds the return authorized by the department by at least one percentage point, ..."

5) Customer complaint log; and

6) Calculation of its earned return on equity for the previous twelve months on a rolling twelve month basis.

These forms, accompanied by narrative and optional additional exhibits, shall be completed and submitted to the Department by the applying company. The accompanying narrative shall detail the benefit to ratepayers of the proposed project(s) and, where applicable, a cost/benefit analysis. The narrative should also address the applicability of newer technologies to the project(s).

A company's updated WICA-01, while being an update to inventory based on completed projects, is also an opportunity for a company to propose new projects for consideration. After the initial IAR, project proposals will be included in the SAFR. Changes to the project prioritization section of WICA-01 (Section 2) shall be clearly noted and provide justification for the change. Aquarion, states that projects not identified as priorities in an IAR should not preclude WICA recovery if circumstances require that a project be moved up in the replacement/rehabilitation queue due to unforeseen circumstances. Aquarion Written Exceptions, p. 3. The Department reiterates that an updated WICA-01, as part of the SAFR process, is the opportunity to present new projects to a company's project priority list.

Aquarion also takes issue with the Department's review of projects in that such review may hinder programmatic investment such as hydrant or service line replacement. Aquarion states that, in a WICA filing, it would become unwieldy to attempt to identify and specify upfront which specific hydrants and service lines will be replaced or rehabilitated. Aquarion Written Exceptions, p. 3. The Department expects there to be an ongoing capital improvement program for items that are among other things, not suitable or fall within the framework of the WICA application process. The Department cautions against utilities trying to fit all future capital investment within the WICA program and expects items such as programmatic investment to go forward to go forward.

c. Annual Reconciliation Report

The Annual Reconciliation Report (ARR) shall be completed by a company and submitted to the Department on or before February 28th of each year to reconcile the WICA charges or credits applied to customer bills in the prior year. Upon receipt of the ARR, the Department shall conduct an administrative proceeding.

The minimum filing requirements for an ARR are:

1) WICA-05: Annual Reconciliation Report;

2) WICA-06: Surcharge Reconciliation; and

3) WICA-07: Revenue Allocation Adjustment

Samples of all form templates are appended to this Decision. At its discretion, the Department may, from time to time, modify or alter these templates. The latest versions of these form templates are available at the Department's website: http://www.state.ct.us/dpuc.

3. WICA Calculation

Section 2(a) of the Act enables the Department to authorize a water company to impose a WICA surcharge or credit for eligible projects completed and in service for the benefit of customers. The method by which the WICA surcharge or credit is calculated is set forth in Section 2(f) of the Act, which reads:

> The WICA adjustment shall be calculated as a percentage, based on the original cost of completed eligible projects multiplied by the applicable rate of return, plus associated depreciation and property tax expenses related to eligible projects and any reconciliation adjustment calculated pursuant to subsection (j) of this section as a percentage of the *retail water revenues* approved in its most recent rate filing for the regulated activities of said water company. (Emphasis added.)

While the Act is silent on what constitutes retail water revenues, the Department has generally recognized that a company's retail water revenues are its total annual revenues less revenues from sales for resale and miscellaneous charges, most recently in the Decision dated March 26, 2008, in Docket No. 06-07-08PH02, Application of The Connecticut Water Company to Amend Rate Schedules - Adjustment to Annual Revenues. More accurately, retail water revenues consist of revenues generated by a water company's metered rates (meter service charges and commodity charges) and fire protection charges, and, if applicable, unmetered service rates (flat rates and/or fixture charges).

In anticipation of WICA applications, the Department has sought to clearly denote a given company's approved level of retail water revenues, beginning with recent rate case decisions issued since the passage of the Act. By and large, however, the last rate case decisions for most companies determine what the approved level of annual revenues is, but not the approved level of retail water revenues. Therefore, the Department shall require, at least for each company's first SAFR filing, an exhibit that demonstrates the company's calculation of retail water revenues for the purposes of determining the applicable WICA surcharge or credit.

An approved WICA surcharge (or credit) for eligible projects would be imposed on customers' bills at intervals of not less than six months. These intervals must commence on either January 1st, April 1st, July 1st or October 1st in any year. Generally, the WICA surcharge or credit should be applied across-the-board for all customers in all divisions of a company. The burden of timely filing to meet the billing intervals is the responsibility of the applicant. As mentioned in Section 2.b. of this Decision, the Department may extend the time frame for rendering a decision in a SAFR administrative proceeding to sixty days.

Aquarion commented that it should be at the company's discretion after it has an approved IAR whether to impose the WICA adjustment in any calendar quarter, or to accumulate a reasonable amount of eligible projects before imposing the WICA, provided the amount requested does not exceed 5% in any calendar year or 7.5% between rate cases. Aquarion Written Comments, p. 8. The Department does not put a requirement on the frequency of filing WICA adjustments. The parameters of the filing are clearly stated in the Act. When determining the frequency of WICA filings, the Department expects a company to weigh the work involved with filing for a WICA surcharge with the associated WICA surcharge sought.

4. Calculation of Return

Section 2(f) of the Act requires that the WICA surcharge percentage calculations be based upon the applicable rate of return, plus associated depreciation and property tax expenses related to eligible projects. In their written comments, the Participants universally interpreted the applicable rate of return as a company's most recent Allowed Return on Rate Base, i.e., the Weighted Average Cost of Capital (WACC). A company-specific allowed WACC is determined by the Department in each company's rate case proceeding assuming a company files with the Rate Base Methodology. CWC and Aquarion addressed this computation in their written comments for Issue #5. Both companies also suggested that the final worksheets used to calculate the WICA surcharge should include a separate computation for the Income Tax on Equity Component. CWC Written Comments; Aquarion Written Comments. The concern regarding the income tax component is reiterated by CWC, Aquarion and CWWA in their respective responses to Interrogatory WA-26. These three Participants suggested the following computation:

Income Tax on Equity Component:

Component	(a)	(b)	(c)		(d)= (c) – (a)
	Weighted Cost	Tax Multiplier	Pre-tax Cost		Tax Gross Up
Debt			0.00%		0.00%
Equity			0.00%		0.00%
	0.00%		0.00%		0.00%

Source: CWC Written Comments, Issue #5-Schedule 2 and Aquarion Written Comments, WICA Schedule 2.

The Department concurs with their position that the income tax on equity component is necessary. It was inadvertently omitted by the Department in its initial request for Written Comments. The Department has incorporated the Income Tax on Equity Component in the attached WICA worksheets (Appendix B, Section 2).

There are several companies from the smaller Class B and Class C categories whose last rate case was not promulgated using the Rate Base Methodology. A few Class B companies used the Department's Net Income Approach in their last rate case. In the Net Income Approach, the Department establishes an allowed Net Income by

granting a an allowed ROE, but does not clearly establish an allowed capital structure. Hence the WACC, which is necessary for the WICA computation is not explicitly determined. In the event a non-Rate Base company applies for WICA, the Department believes a reasonable approach is to use that company's latest allowed ROE from its last rate case and use an assumed capitalization mix of 50% long-term debt to 50% common equity to determine a WACC that can be used for the purposes of WICA calculation.

There are some Class C companies whose rates were determined prior to the establishment of the Net Income Approach. These companies do not have an allowed ROR or an allowed capitalization mix. If a company does not have an allowed ROE, then the Department will use the 50% Long-term Debt to 50% Common Equity mix convention and review the allowed ROE on a case by case basis.

Certain calculations for the purpose of WICA rate adjustments are made based on consideration of the weighted cost of capital of the applying company based on its most recent general rate case. In instances where the company does not have a weighted cost of capital established in a rate filing (Net Income Method), the Department will typically assume a capital structure of 50/50 debt/equity for the purposes of WICA calculation.

5. Interest Rate for Refunds of Any Overcollection

Section 2(j) of the Act reads, in part:

> If upon completion of the review of the annual reconciliation report the [D]epartment determines that a water company overcollected or undercollected the WICA adjustment, the difference between the revenue and costs for eligible projects will be recovered or refunded, as appropriate, as a reconciliation adjustment over a one-year period commencing on April first. *The company shall refund the customers with interest for any overcollection* but shall not be eligible for interest for any undercollection. (Emphasis added.)

The interest rate is undefined by the Act, so the Department asked for recommendations from participants on what method to use to determine the interest rate to be applied to any overcollection.

The OCC advocates using a water company's last allowed overall rate of return when applying interest to any overcollection. OCC Response to Interrogatory WA-24. The OCC believes this is consistent with the interest rate applied to any under- and overcollection in adjustment clause proceedings involving energy utilities. OCC Response to Interrogatory WA-24; Tr. 1/23/08, pp. 37-38.

Alternatively, Aquarion, CWC and CWWA support using a method similar to the standard method provided under Conn. Gen. Stat. §16-262j(d). Aquarion, CWC and CWWA Responses to Interrogatory WA-24; Tr. 1/23/08, p. 37. Conn. Gen. Stat. §16-262j(d) reads:

> The deposit index for each calendar year shall be equal to the average rate paid on savings deposits insured by commercial banks as last published in the Federal Reserve Board bulletin in November of the prior year. The Banking Commission shall determine the deposit index for each calendar year and publish such index in the Department of Banking news bulletin no later than December 15th of the prior year. For purposes of this section, "Federal Reserve Bulletin" means the monthly survey of selected deposits published as a special supplement to the Federal Reserve Statistical Release Publication H.6 published by the Board of Governors of the Federal Reserve System or, if such bulletin is superseded or becomes unavailable, a substantially similar index or publication.

CWC states that it applies the resulting interest rate under this method when it refunds security deposits to customers. CWC Response to Interrogatory WA-24, Tr. 1/23/08, p. 37. It is the Department's understanding that other water companies similarly do so.

CWC argues that any overcollection would only be on a short-term basis; therefore, CWC believes that the applicable interest rate should be a short-term rate. Tr. 1/23/08, p. 37. CWC considers an interest rate equivalent to a company's overall rate of return is more of a long-term rate. Ibid.

The Department, for purposes of WICA, views any overcollection as being similar to a borrowing by the Company. As such, the rate to be applied to a surcharge overcollection shall be the borrowing rate approved in its previous rate case. As the WICA process evolves, the Department may revisit the interest rate issue.

B. CUSTOMER SERVICE

1. Customer Notice

CWC proposes that companies should provide advanced notice to municipal officials in the event they receive inquiries from their residents. Response to Interrogatory CSU-06. The Department agrees with CWC that this outreach to municipalities is necessary and is a consumer friendly initiative. Therefore, companies applying for WICA shall provide a special notice to the municipal officials in its service areas. A copy of the municipal notification shall be filed with the Company's IAR.

All of the Companies that responded agreed that customer notification of the WICA charges require notification through a bill insert or other direct means of correspondence when an adjustment is initially applied and that the charge appear on a customer's bill as a separate item on the bill.

Section 2(h) of the Act reads:

> Water companies shall notify customers through a bill insert or other direct communications when the adjustment is first applied and the WICA charge or credit shall appear as a separate item on customers' bills. The first notice to customers shall be sent upon Departmental approval of a

> Company's specific IAR. The Department will require that the notice of the Department's approval of a WICA charge(s) provide an overview of the associated statute with an explanation of its benefits. The notice shall be a direct mailing or bill insert depending on a Company's capability. The notice should also be posted on company websites, newsletters or press releases. It should provide an example of the impact to customers by applying a hypothetical WICA adjustment to a typical customer's bill. The customer notice shall include information on where to obtain additional information on the WICA surcharge.

The second notice will be sent to consumers 30 days prior to the implementation of WICA. The 30-day notice can also be a separate mailing or a bill insert. Additionally, the Act specifies that the WICA adjustment appear as a separate item on customers' bills. The message will need to be tailored to meet the individual ability of each utility. Depending on a company's capability, the notices should also be posted on company websites, newsletters or press releases. The companies are directed to file copies of its notices and bill inserts and any educational pamphlets, etc. for the Department's review and approval.

Pursuant to Section 2(d) of the Act, the Department may hold a hearing to solicit input from customers on an individual company's IAR. Should a hearing be scheduled, the Department will require the company to provide its customers with advance notification. Due to the uncontested nature of WICA proceedings, company's may coordinate with the Department with respect to distribution of the customer notice. This notice shall follow the same guidelines as the notice requirements for a rate case proceeding as provided in Conn. Gen. Stat. §16-19(a). The notice should include the date, time and location of the hearings and the Company's website address where applicable. The notice shall also reference the docket number. The notice shall also include the Department's website, toll free telephone number and email address, an overview of the statutory requirements with a hypothetical adjustment to a typical residential customer's bill.

2. Bill Form

The charges associated with WICA shall be a separate line item on a customer's bill indicating the charges, a brief explanation of the charges and any changes. Companies are ordered to submit samples of a bill form as part of the IAR approval (see IAR filing requirements). The bill form shall be submitted as if it were being sent to a typical residential customer.

3. Training

The Companies all agreed that special training would be necessary to inform customer service staff of the WICA charges. The companies will be required, as part of the IAR, to produce talking points for staff including at what point in a customer inquiry a call would be escalated should customers request additional information regarding WICA. The companies are also required to file complaints and calls that the companies receive from customers regarding the WICA charges as part of the SAFR (refer to SAFR filing requirements).

IV. CONCLUSION

The WICA program is intended to increase the level of spending on and accelerate the rate of infrastructure replacement and rehabilitation and conservation measures beyond the level in the company's existing practices. This Decision outlines a program and process to allow a water company to apply to the Department for consideration under the WICA program for system developments and improvements.

In order to enable prudent and thoughtful planning, the Department shall require the development of a relevant, standardized, and complete inventory of existing infrastructure by each company applying for WICA. While the Department recognizes the challenges that may exist due to a lack of historical record keeping in the industry, the development and improvement of infrastructure inventory is necessary to the success of the WICA program.

Contained within the Decision is the process by which water utilities shall file for eligibility in the WICA program. While the Department has compiled information and made determinations regarding engineering, finance, accounting, rates and customer service issues, actual experience with the program may lead to alterations in the future.

DOCKET NO. 07-09-09 DPUC REVIEW AND INVESTIGATION OF THE REQUIREMENTS FOR IMPLEMENTATION OF A WATER INFRASTRUCTURE AND CONSERVATION ADJUSTMENT

This Decision is adopted by the following Commissioners:

John W. Betkoski, III

Anne C. George

Donald W. Downes

CERTIFICATE OF SERVICE

The foregoing is a true and correct copy of the Decision issued by the Department of Public Utility Control, State of Connecticut, and was forwarded by Certified Mail to all parties of record in this proceeding on the date indicated.

Louise E. Rickard
Acting Executive Secretary
Department of Public Utility Control

May 1, 2008
Date

WATER INFRASTRUCTURE & CONSERVATION ADJUSTMENT										STATE OF CONNECTICUT			
WATER INFRASTRUCTURE ASSESSMENT REPORT										DEPARTMENT OF PUBLIC UTILITY CONTROL			
DPUC WICA-01 WICA PART 1 (REV 3/08)													
SECTION 1: WATER COMPANY INFORMATION													
	COMPANY NAME:												
	STREET ADDRESS:												
	CITY:			STATE:		ZIP CODE:							
	CLASS A, B, C		DOCKET NUMBER OF MOST RECENT RATE FILING:										
	REPORT DATE:		DECISION DATE OF MOST RECENT RATE FILING:										
	ANNUAL RETAIL WATER REVENUES *				5 % OF ANNUAL SALES	$0.00							
	COMPANY CONTACT:				7.5 % OF ANNUAL SALES	$0.00							
	* PER MOST RECENT RATE FILING												
SECTION 2: PROJECT PRIORITIZATION													
INSTRUCTIONS:	For each factor, rate as: 0 = non-priority or N/A, 1 = low priority, 2 = moderate priority, 3 = high priority												
ANTICIPATED PROJECTS					**PRIORITIZATION FACTORS**								
					1	2	3	4	5	6	7	8	

#	PIPE SEGMENT OR PROJECT NAME	LENGTH (FEET)	PIPE DIAMETER (INCHES)	ESTIMATED PROJECT COST	ESTIMATED COMPLETION DATE	MAIN BREAK HISTORY	PIPE AGE / USEFUL LIFE	MATERIAL INTEGRITY	CRITICAL / SYSTEM IMPACT	WATER QUALITY ISSUES	HYDRAULIC CAPACITY	SCHEDULED WORK COORDINATION	OTHER FACTOR (SPECIFY)
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
X	**TOTALS**	0		$0									

SECTION 3: MAIN BREAK FREQUENCY CALCULATION

ANTICIPATED PROJECTS

#	PIPE SEGMENT OR PROJECT NAME	LENGTH (FEET)	PIPE DIAMETER (INCHES)	PIPE MATERIAL	INSTALLATION YEAR	# OF MAIN BREAKS DURING PAST TEN YEARS	AVERAGE BREAKS PER YEAR	BREAKS PER YEAR PER FOOT	
1							0.00	#DIV/0!	
2							0.00	#DIV/0!	
3							0.00	#DIV/0!	
4							0.00	#DIV/0!	
5							0.00	#DIV/0!	
6							0.00	#DIV/0!	
7							0.00	#DIV/0!	
8							0.00	#DIV/0!	
9							0.00	#DIV/0!	
10							0.00	#DIV/0!	

WATER INFRASTRUCTURE & CONSERVATION ADJUSTMENT
WATER INFRASTRUCTURE ASSESSMENT REPORT
DPUC WICA-01 WICA PART 2 (REV 3/08)

STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC UTILITY CONTROL

SECTION 4: EXISTING PIPE MAIN MATERIAL BY DIAMETER AND INSTALLATION DECADE (LENGTH IN FEET)

Installation Decade		prior 1890	1890-1899	1900-1909	1910-1919	1920-1929	1930-1939	1940-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009	TOTAL
Pipe Material	Pipe Diameter														
Asbestos Cement	< 4 inch														0
Asbestos Cement	4 inch														0
Asbestos Cement	6 inch														0
Asbestos Cement	8 inch														0
Asbestos Cement	10 inch														0
Asbestos Cement	12 inch														0
Asbestos Cement	14 inch														0
Asbestos Cement	16 inch														0
Asbestos Cement	20 inch														0
Asbestos Cement	24 inch														0
Asbestos Cement	30 inch														0
Asbestos Cement	other (specify)														0
Asbestos Cement	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reinforced Concrete	< 4 inch														0
Reinforced Concrete	4 inch														0

Reinforced Concrete	6 inch														0
Reinforced Concrete	8 inch														0
Reinforced Concrete	10 inch														0
Reinforced Concrete	12 inch														0
Reinforced Concrete	14 inch														0
Reinforced Concrete	16 inch														0
Reinforced Concrete	20 inch														0
Reinforced Concrete	24 inch														0
Reinforced Concrete	30 inch														0
Reinforced Concrete	other (specify)														0
Reinforced Concrete	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ductile Iron, Unlined	< 4 inch														0
Ductile Iron, Unlined	4 inch														0
Ductile Iron, Unlined	6 inch														0
Ductile Iron, Unlined	8 inch														0
Ductile Iron, Unlined	10 inch														0
Ductile Iron, Unlined	12 inch														0
Ductile Iron, Unlined	14 inch														0
Ductile Iron,	16 inch														0

Unlined															
Ductile Iron, Unlined	20 inch														0
Ductile Iron, Unlined	24 inch														0
Ductile Iron, Unlined	30 inch														0
Ductile Iron, Unlined	other (specify)														0
Ductile Iron, Unlined	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ductile Iron, cement lined	< 4 inch														0
Ductile Iron, cement lined	4 inch														0
Ductile Iron, cement lined	6 inch														0
Ductile Iron, cement lined	8 inch														0
Ductile Iron, cement lined	10 inch														0
Ductile Iron, cement lined	12 inch														0
Ductile Iron, cement lined	14 inch														0

Ductile Iron, cement lined	16 inch														0
Ductile Iron, cement lined	20 inch														0
Ductile Iron, cement lined	24 inch														0
Ductile Iron, cement lined	30 inch														0
Ductile Iron, cement lined	other (specify)														0
Ductile Iron, cement lined	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cast Iron, Unlined	< 4 inch														0
Cast Iron, Unlined	4 inch														0
Cast Iron, Unlined	6 inch														0
Cast Iron, Unlined	8 inch														0
Cast Iron, Unlined	10 inch														0
Cast Iron, Unlined	12 inch														0
Cast Iron, Unlined	14 inch														0
Cast Iron, Unlined	16 inch														0
Cast Iron, Unlined	20 inch														0
Cast Iron, Unlined	24 inch														0

Cast Iron, Unlined	30 inch														0
Cast Iron, Unlined	other (specify)														0
Cast Iron, Unlined	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cast Iron, factory lined	< 4 inch														0
Cast Iron, factory lined	4 inch														0
Cast Iron, factory lined	6 inch														0
Cast Iron, factory lined	8 inch														0
Cast Iron, factory lined	10 inch														0
Cast Iron, factory lined	12 inch														0
Cast Iron, factory lined	14 inch														0
Cast Iron, factory lined	16 inch														0
Cast Iron, factory lined	20 inch														0
Cast Iron, factory lined	24 inch														0
Cast Iron, factory lined	30 inch														0
Cast Iron, factory lined	other (specify)														0
Cast Iron, factory lined	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Galvanized Steel	< 4 inch														0
Galvanized Steel	4 inch														0
Galvanized Steel	6 inch														0
Galvanized Steel	8 inch														0
Galvanized Steel	10 inch														0
Galvanized Steel	12 inch														0
Galvanized Steel	14 inch														0
Galvanized Steel	16 inch														0
Galvanized Steel	20 inch														0
Galvanized Steel	24 inch														0
Galvanized Steel	30 inch														0
Galvanized Steel	other (specify)														0
Galvanized Steel	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stovepipe	< 4 inch														0
Stovepipe	4 inch														0
Stovepipe	6 inch														0
Stovepipe	8 inch														0
Stovepipe	10 inch														0
Stovepipe	12 inch														0
Stovepipe	14 inch														0
Stovepipe	16 inch														0
Stovepipe	20 inch														0
Stovepipe	24 inch														0
Stovepipe	30 inch														0

Stovepipe	other (specify)														0
Stovepipe	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polyvinyl Chloride	< 4 inch														0
Polyvinyl Chloride	4 inch														0
Polyvinyl Chloride	6 inch														0
Polyvinyl Chloride	8 inch														0
Polyvinyl Chloride	10 inch														0
Polyvinyl Chloride	12 inch														0
Polyvinyl Chloride	14 inch														0
Polyvinyl Chloride	16 inch														0
Polyvinyl Chloride	20 inch														0
Polyvinyl Chloride	24 inch														0
Polyvinyl Chloride	30 inch														0
Polyvinyl Chloride	other (specify)														0
Polyvinyl Chloride	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polyethylene	< 4 inch														0
Polyethylene	4 inch														0
Polyethylene	6 inch														0
Polyethylene	8 inch														0
Polyethylene	10 inch														0
Polyethylene	12 inch														0
Polyethylene	14 inch														0

Polyethylene	16 inch														0
Polyethylene	20 inch														0
Polyethylene	24 inch														0
Polyethylene	30 inch														0
Polyethylene	other (specify)														0
Polyethylene	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper	< 4 inch														0
Copper	4 inch														0
Copper	6 inch														0
Copper	8 inch														0
Copper	10 inch														0
Copper	12 inch														0
Copper	14 inch														0
Copper	16 inch														0
Copper	20 inch														0
Copper	24 inch														0
Copper	30 inch														0
Copper	other (specify)														0
Copper	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other: specify	< 4 inch														0
Other: specify	4 inch														0
Other: specify	6 inch														0
Other: specify	8 inch														0
Other: specify	10 inch														0

Other: specify	12 inch														0
Other: specify	14 inch														0
Other: specify	16 inch														0
Other: specify	20 inch														0
Other: specify	24 inch														0
Other: specify	30 inch														0
Other: specify	other (specify)														0
Other: specify	TYPE TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAND TOTAL		0	0	0	0	0	0	0	0	0	0	0	0	0	0

To be updated with each subsequent SAFR

WATER INFRASTRUCTURE & CONSERVATION ADJUSTMENT
SEMIANNUAL FILING REPORT
DPUC-WA-02 WICA PART 2 (REV 3/08)

STATE OF CONNECTICUT
DEPARTMENT OF PUBLIC UTILITY CONTROL

SECTION 1: WATER COMPANY INFORMATION

COMPANY NAME:	0					
STREET ADDRESS:	0					
CITY:	0		STATE:	0	ZIP CODE:	0
CLASS A, B, C	0	DOCKET NUMBER OF MOST RECENT RATE FILING:			0	
REPORT DATE:	01/00/00	DECISION DATE OF MOST RECENT RATE FILING:			01/00/00	
ANNUAL RETAIL WATER REVENUES *		$0.00		5 % OF ANNUAL SALES		$0.00
WEIGHTED COST OF CAPITAL *		0.00%		7.5 % OF ANNUAL SALES		$0.00

* PER MOST RECENT RATE FILING

SECTION 2: COMPLETED PROJECTS

#	PIPE SEGMENT OR PROJECT NAME **	ESTIMATED COMPLETION DATE **	ACTUAL COMPLETION DATE	ESTIMATED PROJECT COST **	ACTUAL PROJECT COST	DEPRECIATION EXPENSE	PROPERTY TAX EXPENSE	INCOME TAX EXPENSE	RATE OF RETURN	ANNUAL RETAIL REVENUES	WICA ADJUSTMENT DOLLARS
1									0.00%	$0.00	$0.00
2									0.00%	$0.00	$0.00
3									0.00%	$0.00	$0.00
4									0.00%	$0.00	$0.00
5									0.00%	$0.00	$0.00
6									0.00%	$0.00	$0.00
7									0.00%	$0.00	$0.00
8									0.00%	$0.00	$0.00
9									0.00%	$0.00	$0.00
10									0.00%	$0.00	$0.00
X	TOTALS			$0.00	$0.00	$0.00	$0.00	$0.00			$0.00

	* * PER INFRASTRUCTURE ASSESSMENT REPORT									

1	**WICA-03**												
2	**WATER INFRASTRUCTURE AND CONSERVATION ADJUSTMENT**												
3	**ELIGIBLE PROJECTS PLACED IN SERVICE**												
4													
5		1	2	3	4	5	6	7	8	9 = (7 -8) x 2	10	11	12 = (7 - 8) x 10 x 11
6		**DPUC**	**Depr**	**Type of**	**Criteria**	**Date In**	**Date of**	**Eligible**		**Depreciation**	**Property**	**Mill**	**Prop. Tax**
7	**Description of Project**	**Acct**	**Rate**	**Project***	**Met****	**Service**	**1st Filing**	**Capital Costs**	**Retirements**	**Expense**	**Tax Factor**	**Rate**	**Expense**
8													
9										$ -			$ -
10										$ -			$ -
11										$ -			$ -
12										$ -			$ -
13										$ -			$ -
14										$ -			$ -
15										$ -			$ -
16										$ -			$ -
17										$ -			$ -
18										$ -			$ -
19										$ -			$ -
20										$ -			$ -
21										$ -			$ -

22											$ -			$ -
23											$ -			$ -
24											$ -			$ -
25											$ -			$ -
26								$ -	$ -	$ -				$ -
27								to Exhibit 2,		to Exhibit 2,				to Exhibit 2,
28								*line 2*		*line 22*				*line 24*
29	To be recoverable, property taxes must have been billed by the taxing authority													
30	Depreciation rates must be those approved by the Department in the Company's most recnt rate case													
31	*** Type of Project (designations will be given for various types of projects)**													
32	**** Criteria (designations will be given to particular driving factors for improvement/replacement)**													
33														
34	† Represents Company funded portion of capital projects.													

WICA-04

WATER INFRASTRUCTURE AND CONSERVATION ADJUSTMENT
CALCUATION OF SURCHARGE

Line						Schedule Ref.	
1							
2	**Total Investment through XX/XX/XX**					1 - Col 7 Ln 26	-
3							
4	**Allowed Return on Rate Base**						0.00%
5							
6	**Allowed Return on Investment (Line 2 times Line 4)**						$ -
7							
8	**Income Tax on Equity Component**						
9							
10		(a)	(b)	(c)	(d)		
11		Weighted	Tax	Pre tax	Tax Gross Up		
12		Cost	Multiplier	Cost	Col (c) - Col (a)		
13							
14	Debt			0.00%	0.00%		
15	Equity			0.00%	0.00%		
16		0.00%		0.00%	0.00%		
17							
18	Total Eligible Investment (Line 2 above)				-		
19							
20	**Income Tax Expense (Line 16 (d) times Line 18)**						$ -
21							
22	**Depreciation Expense**					1 - Col 9 Ln 26	$ -
23							
24	**Property Tax Expense**					1 - Col 12 Ln 26	$ -
25							
26	**Reconciliation Shortfall(Surplus) from prior period**					3 - Ln 23	$ -
27							
28	**Adjustment: Annual Revenues Allowed (Lines 6 through 26)**						$ -
29							
30							
31	**Base Revenues on which Adjustment will be applied**						
32	**Revenues allowed last rate case**						
33	**Misc Charges not subject to WICA**						
34	**SALES for RESALE**						
35							
36							$ -
37							
38	**Surcharge Percent (Line 28 divided by Line 36)**						

WATER INFRASTRUCTURE & CONSERVATION ADJUSTMENT					STATE OF CONNECTICUT		
WICA ANNUAL RECONCILIATION REPORT					DEPARTMENT OF PUBLIC UTILITY CONTROL		
WICA-05 (REV 3/08)							
	REPORT PERIOD: Enter Year						
	Report for year ending December 31,			Report filing deadline February 28,			
SECTION 1: WATER COMPANY INFORMATION							
	COMPANY NAME:	0					
	STREET ADDRESS:	0					
	CITY:	0		STATE:	0	ZIP CODE:	0
	CLASS A, B, C	0	DOCKET NUMBER OF MOST RECENT RATE FILING:			0	
	REPORT DATE:	01/00/00	DECISION DATE OF MOST RECENT RATE FILING:			01/00/00	
	ANNUAL RETAIL WATER REVENUES *		$0.00		5 % OF ANNUAL SALES		$0.00
	COMPANY CONTACT:	0			7.5 % OF ANNUAL SALES		$0.00
	* PER MOST RECENT RATE FILING						
SECTION 2: LIST OF COMPLETED PROJECTS							

#	PROJECT NAME	DATE PROJECT COMPLETED; IN SERVICE, USED AND USEFUL	ACTUAL PROJECT COST	WICA CHARGES APPLIED IN REPORT YEAR	ACTUAL WICA REVENUES COLLECTED	WICA REVENUE VARIANCE	WICA REFUND / RECOVERY AMOUNT
1						#VALUE!	#VALUE!
2						#VALUE!	#VALUE!
3						#VALUE!	#VALUE!
4						#VALUE!	#VALUE!
5						#VALUE!	#VALUE!
X	**TOTALS**		**$0.00**	**$0.00**	**$0.00**	**#VALUE!**	**#VALUE!**

SECTION 3: INTEREST RATE ON CUSTOMER REFUND (IF APPLICABLE)							
	THE INTEREST RATE TO BE APPLIED TO CUSTOMER REFUNDS:						

WICA-06							
WATER INFRASTRUCTURE AND CONSERVATION ADJUSTMENT							
SURCHARGE RECONCILIATION							
Line							
1							
2	**Surcharge Period: January to March**						
3							
4	Annual Surcharge Revenues Allowed						
5	Factor						**Schedule 4, Line 25**
6	3 Month Surcharge Revenues Allowed					-	
7							
8	**Surcharge Period: April to September**						
9							
10	Annual =Surcharge Revenues Allowed						
11	Factor						**Schedule 4, Line26**
12	6 Month Surcharge Revenues Allowed					-	
13							
14	**Surcharge Period: October to December**						
15							
16	Annual =Surcharge Revenues Allowed						
17	Factor						**Schedule 4, Line27**
18	3 Month Surcharge Revenues Allowed					-	
19							
20							
21	12 Month Surcharge Revenues Allowed					-	
22	12 Month Surcharge Revenues Achieved						
23	Surcharge Shortfall(Surplus)					-	
24						**to Schedule 2, Ln 26**	

WICA-07				
WATER INFRASTRUCTURE AND CONSERVATION ADJUSTMENT				
REVENUE ALLOCATION ADJUSTMENT				
Line				
1				
2	Month	Base Revenues		
3	Jan-08		0.0%	
4	Feb-08		0.0%	
5	Mar-08		0.0%	
6	Apr-08		0.0%	
7	May-08		0.0%	
8	Jun-08		0.0%	
9	Jul-08		0.0%	
10	Aug-08		0.0%	
11	Sep-08		0.0%	
12	Oct-08		0.0%	
13	Nov-08		0.0%	
14	Dec-08		0.0%	
15			0.0%	
16				

Scott J. Rubin
Attorney + Consultant
333 Oak Lane • Bloomsburg, PA 17815

Current Position

Public Utility Attorney and Consultant. 1994 to present. I provide legal, consulting, and expert witness services to various organizations interested in the regulation of public utilities.

Previous Positions

Lecturer in Computer Science, Susquehanna University, Selinsgrove, PA. 1993 to 2000.

Senior Assistant Consumer Advocate, Office of Consumer Advocate, Harrisburg, PA. 1990 to 1994. I supervised the administrative and technical staff and shared with one other senior attorney the supervision of a legal staff of 14 attorneys.

Assistant Consumer Advocate, Office of Consumer Advocate, Harrisburg, PA. 1983 to 1990.

Associate, Laws and Staruch, Harrisburg, PA. 1981 to 1983.

Law Clerk, U.S. Environmental Protection Agency, Washington, DC. 1980 to 1981.

Research Assistant, Rockville Consulting Group, Washington, DC. 1979.

Current Professional Activities

Member, American Bar Association, Public Utility Law Section.

Member, American Water Works Association.

Admitted to practice law before the Supreme Court of Pennsylvania, the New York State Court of Appeals, the United States District Court for the Middle District of Pennsylvania, the United States Court of Appeals for the Third Circuit, and the Supreme Court of the United States.

Previous Professional Activities

Member, American Water Works Association, Rates and Charges Subcommittee, 1998-2001.

Member, Federal Advisory Committee on Disinfectants and Disinfection By-Products in Drinking Water, U.S. Environmental Protection Agency, Washington, DC. 1992 to 1994.

Chair, Water Committee, National Association of State Utility Consumer Advocates, Washington, DC. 1990 to 1994; member of committee from 1988 to 1990.

Member, Board of Directors, Pennsylvania Energy Development Authority, Harrisburg, PA. 1990 to 1994.

Member, Small Water Systems Advisory Committee, Pennsylvania Department of Environmental Resources, Harrisburg, PA. 1990 to 1992.

Member, Ad Hoc Committee on Emissions Control and Acid Rain Compliance, National Association of State Utility Consumer Advocates, 1991.

Member, Nitrogen Oxides Subcommittee of the Acid Rain Advisory Committee, U.S. Environmental Protection Agency, Washington DC. 1991.

Education

J.D. with Honors, George Washington University, Washington, DC. 1981.

B.A. with Distinction in Political Science, Pennsylvania State University, University Park, PA. 1978.

Publications and Presentations

"Quality of Service Issues," a speech to the Pennsylvania Public Utility Commission Consumer Conference, State College, PA. 1988.

K.L. Pape and S.J. Rubin, "Current Developments in Water Utility Law," in *Pennsylvania Public Utility Law* (Pennsylvania Bar Institute). 1990.

Presentation on Water Utility Holding Companies to the Annual Meeting of the National Association of State Utility Consumer Advocates, Orlando, FL. 1990.

"How the OCA Approaches Quality of Service Issues," a speech to the Pennsylvania Chapter of the National Association of Water Companies. 1991.

Presentation on the Safe Drinking Water Act to the Mid-Year Meeting of the National Association of State Utility Consumer Advocates, Seattle, WA. 1991.

"A Consumer Advocate's View of Federal Pre-emption in Electric Utility Cases," a speech to the Pennsylvania Public Utility Commission Electricity Conference. 1991.

Workshop on Safe Drinking Water Act Compliance Issues at the Mid-Year Meeting of the National Association of State Utility Consumer Advocates, Washington, DC. 1992.

Formal Discussant, Regional Acid Rain Workshop, U.S. Environmental Protection Agency and National Regulatory Research Institute, Charlotte, NC. 1992.

S.J. Rubin and S.P. O'Neal, "A Quantitative Assessment of the Viability of Small Water Systems in Pennsylvania," *Proceedings of the Eighth NARUC Biennial Regulatory Information Conference*, National Regulatory Research Institute (Columbus, OH 1992), IV:79-97.

"The OCA's Concerns About Drinking Water," a speech to the Pennsylvania Public Utility Commission Water Conference. 1992.

Member, Technical Horizons Panel, Annual Meeting of the National Association of Water Companies, Hilton Head, SC. 1992.

M.D. Klein and S.J. Rubin, "Water and Sewer -- Update on Clean Streams, Safe Drinking Water, Waste Disposal and Pennvest," *Pennsylvania Public Utility Law Conference* (Pennsylvania Bar Institute). 1992.

Presentation on Small Water System Viability to the Technical Assistance Center for Small Water Companies, Pa. Department of Environmental Resources, Harrisburg, PA. 1993

"The Results Through a Public Service Commission Lens," speaker and participant in panel discussion at Symposium: "Impact of EPA's Allowance Auction," Washington, DC, sponsored by AER*X. 1993.

"The Hottest Legislative Issue of Today – Reauthorization of the Safe Drinking Water Act," speaker and participant in panel discussion at the Annual Conference of the American Water Works Association, San Antonio, TX. 1993.

"Water Service in the Year 2000," a speech to the Conference: "Utilities and Public Policy III: The Challenges of Change," sponsored by the Pennsylvania Public Utility Commission and the Pennsylvania State University, University Park, PA. 1993.

"Government Regulation of the Drinking Water Supply: Is it Properly Focused?," speaker and participant in panel discussion at the National Consumers League's Forum on Drinking Water Safety and Quality, Washington, DC. 1993. Reprinted in *Rural Water*, Vol. 15 No. 1 (Spring 1994), pages 13-16.

"Telephone Penetration Rates for Renters in Pennsylvania," a study prepared for the Pennsylvania Office of Consumer Advocate. 1993.

"Zealous Advocacy, Ethical Limitations and Considerations," participant in panel discussion at "Continuing Legal Education in Ethics for Pennsylvania Lawyers," sponsored by the Office of General Counsel, Commonwealth of Pennsylvania, State College, PA. 1993.

"Serving the Customer," participant in panel discussion at the Annual Conference of the National Association of Water Companies, Williamsburg, VA. 1993.

"A Simple, Inexpensive, Quantitative Method to Assess the Viability of Small Water Systems," a speech to the Water Supply Symposium, New York Section of the American Water Works Association, Syracuse, NY. 1993.

S.J. Rubin, "Are Water Rates Becoming Unaffordable?," *Journal American Water Works Association*, Vol. 86, No. 2 (February 1994), pages 79-86.

"Why Water Rates Will Double (If We're Lucky): Federal Drinking Water Policy and Its Effect on New England," a briefing for the New England Conference of Public Utilities Commissioners, Andover, MA. 1994.

"Are Water Rates Becoming Unaffordable?," a speech to the Legislative and Regulatory Conference, Association of Metropolitan Water Agencies, Washington, DC. 1994.

"Relationships: Drinking Water, Health, Risk and Affordability," speaker and participant in panel discussion at the Annual Meeting of the Southeastern Association of Regulatory Commissioners, Charleston, SC. 1994.

"Small System Viability: Assessment Methods and Implementation Issues," speaker and participant in panel discussion at the Annual Conference of the American Water Works Association, New York, NY. 1994.

S.J. Rubin, "How much should we spend to save a life?," *Seattle Journal of Commerce*, August 18, 1994 (Protecting the Environment Supplement), pages B-4 to B-5.

S. Rubin, S. Bernow, M. Fulmer, J. Goldstein, and I. Peters, *An Evaluation of Kentucky-American Water Company's Long-Range Planning*, prepared for the Utility and Rate Intervention Division, Kentucky Office of the Attorney General (Tellus Institute 1994).

S.J. Rubin, "Small System Monitoring: What Does It Mean?," *Impacts of Monitoring for Phase II/V Drinking Water Regulations on Rural and Small Communities* (National Rural Water Association 1994), pages 6-12.

"Surviving the Safe Drinking Water Act," speaker at the Annual Meeting of the National Association of State Utility Consumer Advocates, Reno, NV. 1994.

"Safe Drinking Water Act Compliance – Ratemaking Implications," speaker at the National Conference of Regulatory Attorneys, Scottsdale, AZ. 1995. Reprinted in *Water*, Vol. 36, No. 2 (Summer 1995), pages 28-29.

S.J. Rubin, "Water: Why Isn't it Free? The Case of Small Utilities in Pennsylvania," *Utilities, Consumers & Public Policy: Issues of Quality, Affordability, and Competition, Proceedings of the Fourth Utilities, Consumers and Public Policy Conference* (Pennsylvania State University 1995), pages 177-183.

S.J. Rubin, "Water Rates: An Affordable Housing Issue?," *Home Energy*, Vol. 12 No. 4 (July/August 1995), page 37.

Speaker and participant in the Water Policy Forum, sponsored by the National Association of Water Companies, Naples, FL. 1995.

Participant in panel discussion on "The Efficient and Effective Maintenance and Delivery of Potable Water at Affordable Rates to the People of New Jersey," at The New Advocacy: Protecting Consumers in the Emerging Era of Utility Competition, a conference sponsored by the New Jersey Division of the Ratepayer Advocate, Newark, NJ. 1995.

J.E. Cromwell III, and S.J. Rubin, *Development of Benchmark Measures for Viability Assessment* (Pa. Department of Environmental Protection 1995).

S. Rubin, "A Nationwide Practice from a Small Town in Pa.," *Lawyers & the Internet – a Supplement to the Legal Intelligencer and Pa. Law Weekly* (February 12, 1996), page S6.

"Changing Customers' Expectations in the Water Industry," speaker at the Mid-America Regulatory Commissioners Conference, Chicago, IL. 1996, reprinted in *Water* Vol. 37 No. 3 (Winter 1997), pages 12-14..

"Recent Federal Legislation Affecting Drinking Water Utilities," speaker at Pennsylvania Public Utility Law Conference, Pennsylvania Bar Institute, Hershey, PA. 1996.

"Clean Water at Affordable Rates: A Ratepayers Conference," moderator at symposium sponsored by the New Jersey Division of Ratepayer Advocate, Trenton, NJ. 1996.

"Water Workshop: How New Laws Will Affect the Economic Regulation of the Water Industry," speaker at the Annual Meeting of the National Association of State Utility Consumer Advocates, San Francisco, CA. 1996.

E.T. Castillo, S.J. Rubin, S.K. Keefe, and R.S. Raucher, "Restructuring Small Systems," *Journal American Water Works Association*, Vol. 89, No. 1 (January 1997), pages 65-74.

J.E. Cromwell III, S.J. Rubin, F.C. Marrocco, and M.E. Leevan, "Business Planning for Small System Capacity Development," *Journal American Water Works Association*, Vol. 89, No. 1 (January 1997), pages 47-57.

"Capacity Development – More than Viability Under a New Name," speaker at National Association of Regulatory Utility Commissioners Winter Meetings, Washington, DC. 1997.

E. Castillo, S.K. Keefe, R.S. Raucher, and S.J. Rubin, *Small System Restructuring to Facilitate SDWA Compliance: An Analysis of Potential Feasibility* (AWWA Research Foundation, 1997).

H. Himmelberger, *et al., Capacity Development Strategy Report for the Texas Natural Resource Conservation Commission* (Aug. 1997).

Briefing on Issues Affecting the Water Utility Industry, Annual Meeting of the National Association of State Utility Consumer Advocates, Boston, MA. 1997.

"Capacity Development in the Water Industry," speaker at the Annual Meeting of the National Association of Regulatory Utility Commissioners, Boston, MA. 1997.

"The Ticking Bomb: Competitive Electric Metering, Billing, and Collection," speaker at the Annual Meeting of the National Association of State Utility Consumer Advocates, Boston, MA. 1997.

Scott J. Rubin, "A Nationwide Look at the Affordability of Water Service," *Proceedings of the 1998 Annual Conference of the American Water Works Association*, Water Research, Vol. C, No. 3, pages 113-129 (American Water Works Association, 1998).

Scott J. Rubin, "30 Technology Tips in 30 Minutes," *Pennsylvania Public Utility Law Conference*, Vol. I, pages 101-110 (Pa. Bar Institute, 1998).

Scott J. Rubin, "Effects of Electric and Gas Deregulation on the Water Industry," *Pennsylvania Public Utility Law Conference*, Vol. I, pages 139-146 (Pa. Bar Institute, 1998).

Scott J. Rubin, *The Challenges and Changing Mission of Utility Consumer Advocates* (American Association of Retired Persons, 1999).

"Consumer Advocacy for the Future," speaker at the Age of Awareness Conference, Changes and Choices: Utilities in the New Millennium, Carlisle, PA. 1999.

Keynote Address, $1 Energy Fund, Inc., Annual Membership Meeting, Monroeville, PA. 1999.

Scott J. Rubin, "Assessing the Effect of the Proposed Radon Rule on the Affordability of Water Service," prepared for the American Water Works Association. 1999.

Scott J. Rubin and Janice A. Beecher, The Impacts of Electric Restructuring on the Water and Wastewater Industry, *Proceedings of the Small Drinking Water and Wastewater Systems International Symposium and Technology Expo* (Phoenix, AZ 2000), pp. 66-75.

American Water Works Association, *Principles of Water Rates, Fees, and Charges, Manual M1 – Fifth Edition* (AWWA 2000), Member, Editorial Committee.

Janice A. Beecher and Scott J. Rubin, presentation on "Special Topics in Rate Design: Affordability" at the Annual Conference and Exhibition of the American Water Works Association, Denver, CO. 2000.

Scott J. Rubin, "The Future of Drinking Water Regulation," a speech at the Annual Conference and Exhibition of the American Water Works Association, Denver, CO. 2000.

Janice A. Beecher and Scott J. Rubin, "Deregulation Impacts and Opportunities," a presentation at the Annual Conference and Exhibition of the American Water Works Association, Denver, CO. 2000.

Scott J. Rubin, "Estimating the Effect of Different Arsenic Maximum Contaminant Levels on the Affordability of Water Service," prepared for the American Water Works Association. 2000.

Janice A. Beecher and Scott J. Rubin, *Deregulation! Impacts on the Water Industry,* American Water Works Association Research Foundation, Denver, CO. 2000.

Scott J. Rubin, Methods for Assessing, Evaluating, and Assisting Small Water Systems, NARUC Annual Regulatory Studies Program, East Lansing, MI. 2000.

Scott J. Rubin, Consumer Issues in the Water Industry, NARUC Annual Regulatory Studies Program, East Lansing, MI. 2000.

"Be Utility Wise in a Restructured Utility Industry," Keynote Address at Be UtilityWise Conference, Pittsburgh, PA. 2000.

Scott J. Rubin, Jason D. Sharp, and Todd S. Stewart, "The Wired Administrative Lawyer," *5th Annual Administrative Law Symposium*, Pennsylvania Bar Institute, Harrisburg, PA. 2000.

Scott J. Rubin, "Current Developments in the Water Industry," *Pennsylvania Public Utility Law Conference*, Pennsylvania Bar Institute, Harrisburg, PA. 2000.

Scott J. Rubin, "Viewpoint: Change Sickening Attitudes," *Engineering News-Record*, Dec. 18, 2000.

Janice A. Beecher and Scott J. Rubin, "Ten Practices of Highly Effective Water Utilities," *Opflow*, April 2001, pp. 1, 6-7, 16; reprinted in *Water and Wastes Digest*, December 2004, pp. 22-25.

Scott J. Rubin, "Pennsylvania Utilities: How Are Consumers, Workers, and Corporations Faring in the Deregulated Electricity, Gas, and Telephone Industries?" Keystone Research Center. 2001.

Scott J. Rubin, "Guest Perspective: A First Look at the Impact of Electric Deregulation on Pennsylvania," *LEAP Letter*, May-June 2001, pp. 2-3.

Scott J. Rubin, Consumer Protection in the Water Industry, NARUC Annual Regulatory Studies Program, East Lansing, MI. 2001.

Scott J. Rubin, Impacts of Deregulation on the Water Industry, NARUC Annual Regulatory Studies Program, East Lansing, MI. 2001.

Scott J. Rubin, "Economic Characteristics of Small Systems," *Critical Issues in Setting Regulatory Standards*, National Rural Water Association, 2001, pp. 7-22.

Scott J. Rubin, "Affordability of Water Service," *Critical Issues in Setting Regulatory Standards*, National Rural Water Association, 2001, pp. 23-42.

Scott J. Rubin, "Criteria to Assess the Affordability of Water Service," White Paper, National Rural Water Association, 2001.

Scott J. Rubin, Providing Affordable Water Service to Low-Income Families, presentation to Portland Water Bureau, Portland, OR. 2001.

Scott J. Rubin, Issues Relating to the Affordability and Sustainability of Rates for Water Service, presentation to the Water Utility Council of the American Water Works Association, New Orleans, LA. 2002.

Scott J. Rubin, The Utility Industries Compared – Water, NARUC Annual Regulatory Studies Program, East Lansing, MI. 2002.

Scott J. Rubin, Legal Perspective on Water Regulation, NARUC Annual Regulatory Studies Program, East Lansing, MI. 2002.

Scott J. Rubin, Regulatory Options for Water Utilities, NARUC Annual Regulatory Studies Program, East Lansing, MI. 2002.

Scott J. Rubin, Overview of Small Water System Consolidation, presentation to National Drinking Water Advisory Council Small Systems Affordability Working Group, Washington, DC. 2002.

Scott J. Rubin, Defining Affordability and Low-Income Household Tradeoffs, presentation to National Drinking Water Advisory Council Small Systems Affordability Working Group, Washington, DC. 2002.

Scott J. Rubin, "Thinking Outside the Hearing Room," *Pennsylvania Public Utility Law Conference*, Pennsylvania Bar Institute, Harrisburg, PA. 2002.

Scott J. Rubin, "Update of Affordability Database," White Paper, National Rural Water Association. 2003.

Scott J. Rubin, *Understanding Telephone Penetration in Pennsylvania*, Council on Utility Choice, Harrisburg, PA. 2003.

Scott J. Rubin, *The Cost of Water and Wastewater Service in the United States*, National Rural Water Association, 2003.

Scott J. Rubin, What Price Safer Water? Presentation at Annual Conference of National Association of Regulatory Utility Commissioners, Atlanta, GA. 2003.

George M. Aman, III, Jeffrey P. Garton, Eric Petersen, and Scott J. Rubin, Challenges and Opportunities for Improving Water Supply Institutional Arrangements, *Water Law Conference*, Pennsylvania Bar Institute, Mechanicsburg, PA. 2004.

Scott J. Rubin, Serving Low-Income Water Customers. Presentation at American Water Works Association Annual Conference, Orlando, FL. 2004.

Scott J. Rubin, Thinking Outside the Bill: Serving Low-Income Water Customers. Presentation at National League of Cities Annual Congress of Cities, Indianapolis, IN. 2004.

Scott J. Rubin, Buying and Selling a Water System – Ratemaking Implications, *Pennsylvania Public Utility Law Conference*, Pennsylvania Bar Institute, Harrisburg, PA. 2005.

Scott J. Rubin, *Thinking Outside the Bill: A Utility Manager's Guide to Assisting Low-Income Water Customers*, American Water Works Association. 2005.

Scott J. Rubin, "Census Data Shed Light on US Water and Wastewater Costs," *Journal American Water Works Association*, Vol. 97, No. 4 (April 2005), pages 99-110, reprinted in Maxwell, *The Business of Water: A Concise Overview of Challenges and Opportunities in the Water Market.*, American Water Works Association, Denver, CO. 2008.

Scott J. Rubin, Review of U.S. Environmental Protection Agency Notice Concerning Revision of National-Level Affordability Methodology, National Rural Water Association. 2006.

Robert S. Raucher, et al., *Regional Solutions to Water Supply Provision*, American Water Works Association Research Foundation, Denver, CO. 2007.

Scott J. Rubin, Robert Raucher, and Megan Harrod, The Relationship Between Household Financial Distress and Health: Implications for Drinking Water Regulation, National Rural Water Association. 2007.

John Cromwell and Scott Rubin, *Development and Demonstration of Practical Methods for Examining Feasibility of Regional Solutions for Provision of Water and Wastewater Service*, American Water Works Association Research Foundation, Denver, CO. in press.

Testimony as an Expert Witness

Pa. Public Utility Commission v. Pennsylvania Gas and Water Co. - Water Division, Pa. Public Utility Commission, Docket R-00922404. 1992. Concerning rate design, on behalf of the Pa. Office of Consumer Advocate.

Pa. Public Utility Commission v. Shenango Valley Water Co., Pa. Public Utility Commission, Docket R-00922420. 1992. Concerning cost allocation, on behalf of the Pa. Office of Consumer Advocate

Pa. Public Utility Commission v. Pennsylvania Gas and Water Co. - Water Division, Pa. Public Utility Commission, Docket R-00922482. 1993. Concerning rate design, on behalf of the Pa. Office of Consumer Advocate

Pa. Public Utility Commission v. Colony Water Co., Pa. Public Utility Commission, Docket R-00922375. 1993. Concerning rate design, on behalf of the Pa. Office of Consumer Advocate

Pa. Public Utility Commission v. Dauphin Consolidated Water Supply Co. and General Waterworks of Pennsylvania, Inc., Pa. Public Utility Commission, Docket R-00932604. 1993. Concerning rate design and cost of service, on behalf of the Pa. Office of Consumer Advocate

West Penn Power Co. v. State Tax Department of West Virginia, Circuit Court of Kanawha County, West Virginia, Civil Action No. 89-C-3056. 1993. Concerning regulatory policy and the effects of a taxation statute on out-of-state utility ratepayers, on behalf of the Pa. Office of Consumer Advocate

Pa. Public Utility Commission v. Pennsylvania Gas and Water Co. - Water Division, Pa. Public Utility Commission, Docket R-00932667. 1993. Concerning rate design and affordability of service, on behalf of the Pa. Office of Consumer Advocate

Pa. Public Utility Commission v. National Utilities, Inc., Pa. Public Utility Commission, Docket R-00932828. 1994. Concerning rate design, on behalf of the Pa. Office of Consumer Advocate

An Investigation of the Sources of Supply and Future Demand of Kentucky-American Water Company, Ky. Public Service Commission, Case No. 93-434. 1994. Concerning supply and demand planning, on behalf of the Kentucky Office of Attorney General, Utility and Rate Intervention Division.

The Petition on Behalf of Gordon's Corner Water Company for an Increase in Rates, New Jersey Board of Public Utilities, Docket No. WR94020037. 1994. Concerning revenue requirements and rate design, on behalf of the New Jersey Division of Ratepayer Advocate.

Re Consumers Maine Water Company Request for Approval of Contracts with Consumers Water Company and with Ohio Water Service Company, Me. Public Utilities Commission, Docket No. 94-352. 1994. Concerning affiliated interest agreements, on behalf of the Maine Public Advocate.

In the Matter of the Application of Potomac Electric Power Company for Approval of its Third Least-Cost Plan, D.C. Public Service Commission, Formal Case No. 917, Phase II. 1995. Concerning Clean Air Act implementation and environmental externalities, on behalf of the District of Columbia Office of the People's Counsel.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of the Dayton Power and Light Company and Related Matters, Ohio Public Utilities Commission, Case No. 94-105-EL-EFC. 1995. Concerning Clean Air Act implementation (case settled before testimony was filed), on behalf of the Office of the Ohio Consumers' Counsel.

Kennebec Water District Proposed Increase in Rates, Maine Public Utilities Commission, Docket No. 95-091. 1995. Concerning the reasonableness of planning decisions and the relationship between a publicly owned water district and a very large industrial customer, on behalf of the Maine Public Advocate.

Winter Harbor Water Company, Proposed Schedule Revisions to Introduce a Readiness-to-Serve Charge, Maine Public Utilities Commission, Docket No. 95-271. 1995 and 1996. Concerning standards for, and the reasonableness of, imposing a readiness to serve charge and/or exit fee on the customers of a small investor-owned water utility, on behalf of the Maine Public Advocate.

In the Matter of the 1995 Long-Term Electric Forecast Report of the Cincinnati Gas & Electric Company, Public Utilities Commission of Ohio, Case No. 95-203-EL-FOR, and *In the Matter of the Two-Year Review of the Cincinnati Gas & Electric Company's Environmental Compliance Plan Pursuant to Section 4913.05, Revised Cost*, Case No. 95-747-EL-ECP. 1996. Concerning the reasonableness of the utility's long-range supply and demand-management plans, the reasonableness of its plan for complying with the Clean Air Act Amendments of 1990, and discussing methods to ensure the provision of utility service to low-income customers, on behalf of the Office of the Ohio Consumers' Counsel..

In the Matter of Notice of the Adjustment of the Rates of Kentucky-American Water Company, Kentucky Public Service Commission, Case No. 95-554. 1996. Concerning rate design, cost of service, and sales forecast issues, on behalf of the Kentucky Office of Attorney General.

In the Matter of the Application of Citizens Utilities Company for a Hearing to Determine the Fair Value of its Properties for Ratemaking Purposes, to Fix a Just and Reasonable Rate of Return Thereon, and to Approve Rate Schedules Designed to Provide such Rate of Return, Arizona Corporation Commission, Docket Nos. E-1032-95-417, *et al.* 1996. Concerning rate design, cost of service, and the price elasticity of water demand, on behalf of the Arizona Residential Utility Consumer Office.

Cochrane v. Bangor Hydro-Electric Company, Maine Public Utilities Commission, Docket No. 96-053. 1996. Concerning regulatory requirements for an electric utility to engage in unregulated business enterprises, on behalf of the Maine Public Advocate.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Monongahela Power Company and Related Matters, Public Utilities Commission of Ohio, Case No. 96-106-EL-EFC. 1996. Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Cleveland Electric Illuminating Company and Toledo Edison Company and Related Matters, Public Utilities Commission of Ohio, Case Nos. 96-107-EL-EFC and 96-108-EL-EFC. 1996.

Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Ohio Power Company and Columbus Southern Power Company and Related Matters, Public Utilities Commission of Ohio, Case Nos. 96-101-EL-EFC and 96-102-EL-EFC. 1997. Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

An Investigation of the Sources of Supply and Future Demand of Kentucky-American Water Company (Phase II), Kentucky Public Service Commission, Docket No. 93-434. 1997. Concerning supply and demand planning, on behalf of the Kentucky Office of Attorney General, Public Service Litigation Branch.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Cincinnati Gas and Electric Co. and Related Matters, Public Utilities Commission of Ohio, Case No. 96-103-EL-EFC. 1997. Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

Bangor Hydro-Electric Company Petition for Temporary Rate Increase, Maine Public Utilities Commission, Docket No. 97-201. 1997. Concerning the reasonableness of granting an electric utility's request for emergency rate relief, and related issues, on behalf of the Maine Public Advocate.

Testimony concerning H.B. 1068 Relating to Restructuring of the Natural Gas Utility Industry, Consumer Affairs Committee, Pennsylvania House of Representatives. 1997. Concerning the provisions of proposed legislation to restructure the natural gas utility industry in Pennsylvania, on behalf of the Pennsylvania AFL-CIO Gas Utility Caucus.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Cleveland Electric Illuminating Company and Toledo Edison Company and Related Matters, Public Utilities Commission of Ohio, Case Nos. 97-107-EL-EFC and 97-108-EL-EFC. 1997. Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

In the Matter of the Petition of Valley Road Sewerage Company for a Revision in Rates and Charges for Water Service, New Jersey Board of Public Utilities, Docket No. WR92080846J. 1997. Concerning the revenue requirements and rate design for a wastewater treatment utility, on behalf of the New Jersey Division of Ratepayer Advocate.

Bangor Gas Company, L.L.C., Petition for Approval to Furnish Gas Service in the State of Maine, Maine Public Utilities Commission, Docket No. 97-795. 1998. Concerning the standards and public policy concerns involved in issuing a certificate of public convenience and necessity for a new natural gas utility, and related ratemaking issues, on behalf of the Maine Public Advocate.

In the Matter of the Investigation on Motion of the Commission into the Adequacy of the Public Utility Water Service Provided by Tidewater Utilities, Inc., in Areas in Southern New Castle County,

Delaware, Delaware Public Service Commission, Docket No. 309-97. 1998. Concerning the standards for the provision of efficient, sufficient, and adequate water service, and the application of those standards to a water utility, on behalf of the Delaware Division of the Public Advocate.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Cincinnati Gas and Electric Co. and Related Matters, Public Utilities Commission of Ohio, Case No. 97-103-EL-EFC. 1998. Concerning fuel-related transactions with affiliated companies and the appropriate ratemaking treatment and regulatory safeguards involving such transactions, on behalf of the Ohio Consumers' Counsel.

Olde Port Mariner Fleet, Inc. Complaint Regarding Casco Bay Island Transit District's Tour and Charter Service, Maine Public Utilities Commission, Docket No. 98-161. 1998. Concerning the standards and requirements for allocating costs and separating operations between regulated and unregulated operations of a transportation utility, on behalf of the Maine Public Advocate and Olde Port Mariner Fleet, Inc.

Central Maine Power Company Investigation of Stranded Costs, Transmission and Distribution Utility Revenue Requirements, and Rate Design, Maine Public Utilities Commission, Docket No. 97-580. 1998. Concerning the treatment of existing rate discounts when designing rates for a transmission and distribution electric utility, on behalf of the Maine Public Advocate.

Pa. Public Utility Commission v. Manufacturers Water Company, Pennsylvania Public Utility Commission, Docket No. R-00984275. 1998. Concerning rate design on behalf of the Manufacturers Water Industrial Users.

In the Matter of Petition of Pennsgrove Water Supply Company for an Increase in Rates for Water Service, New Jersey Board of Public Utilities, Docket No. WR98030147. 1998. Concerning the revenue requirements, level of affiliated charges, and rate design for a water utility, on behalf of the New Jersey Division of Ratepayer Advocate.

In the Matter of Petition of Seaview Water Company for an Increase in Rates for Water Service, New Jersey Board of Public Utilities, Docket No. WR98040193. 1999. Concerning the revenue requirements and rate design for a water utility, on behalf of the New Jersey Division of Ratepayer Advocate.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Ohio Power Company and Columbus Southern Power Company and Related Matters, Public Utilities Commission of Ohio, Case Nos. 98-101-EL-EFC and 98-102-EL-EFC. 1999. Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Dayton Power and Light Company and Related Matters, Public Utilities Commission of Ohio, Case No. 98-105-EL-EFC. 1999. Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

In the Matter of the Regulation of the Electric Fuel Component Contained within the Rate Schedules of Monongahela Power Company and Related Matters, Public Utilities Commission of Ohio, Case

No. 99-106-EL-EFC. 1999. Concerning the costs and procedures associated with the implementation of the Clean Air Act Amendments of 1990, on behalf of the Ohio Consumers' Counsel.

County of Suffolk, et al. v. Long Island Lighting Company, et al., U.S. District Court for the Eastern District of New York, Case No. 87-CV-0646. 2000. Submitted two affidavits concerning the calculation and collection of court-ordered refunds to utility customers, on behalf of counsel for the plaintiffs.

Northern Utilities, Inc., Petition for Waivers from Chapter 820, Maine Public Utilities Commission, Docket No. 99-254. 2000. Concerning the standards and requirements for defining and separating a natural gas utility's core and non-core business functions, on behalf of the Maine Public Advocate.

Notice of Adjustment of the Rates of Kentucky-American Water Company, Kentucky Public Service Commission, Case No. 2000-120. 2000. Concerning the appropriate methods for allocating costs and designing rates, on behalf of the Kentucky Office of Attorney General.

In the Matter of the Petition of Gordon's Corner Water Company for an Increase in Rates and Charges for Water Service, New Jersey Board of Public Utilities, Docket No. WR00050304. 2000. Concerning the revenue requirements and rate design for a water utility, on behalf of the New Jersey Division of Ratepayer Advocate.

Testimony concerning Arsenic in Drinking Water: An Update on the Science, Benefits, and Costs, Committee on Science, United States House of Representatives. 2001. Concerning the effects on low-income households and small communities from a more stringent regulation of arsenic in drinking water.

In the Matter of the Application of The Cincinnati Gas & Electric Company for an Increase in Gas Rates in its Service Territory, Public Utilities Commission of Ohio, Case No. 01-1228-GA-AIR, *et al.* 2002. Concerning the need for and structure of a special rider and alternative form of regulation for an accelerated main replacement program, on behalf of the Ohio Consumers' Counsel.

Pennsylvania State Treasurer's Hearing on Enron and Corporate Governance Issues. 2002. Concerning Enron's role in Pennsylvania's electricity market and related issues, on behalf of the Pennsylvania AFL-CIO.

An Investigation into the Feasibility and Advisability of Kentucky-American Water Company's Proposed Solution to its Water Supply Deficit, Kentucky Public Service Commission, Case No. 2001-00117. 2002. Concerning water supply planning, regulatory oversight, and related issue, on behalf of the Kentucky Office of Attorney General.

Joint Application of Pennsylvania-American Water Company and Thames Water Aqua Holdings GmbH, Pennsylvania Public Utility Commission, Docket Nos. A-212285F0096 and A-230073F0004. 2002. Concerning the risks and benefits associated with the proposed acquisition of a water utility, on behalf of the Pennsylvania Office of Consumer Advocate.

Application for Approval of the Transfer of Control of Kentucky-American Water Company to RWE AG and Thames Water Aqua Holdings GmbH, Kentucky Public Service Commission, Case No.

2002-00018. 2002. Concerning the risks and benefits associated with the proposed acquisition of a water utility, on behalf of the Kentucky Office of Attorney General.

Joint Petition for the Consent and Approval of the Acquisition of the Outstanding Common Stock of American Water Works Company, Inc., the Parent Company and Controlling Shareholder of West Virginia-American Water Company, West Virginia Public Service Commission, Case No. 01-1691-W-PC. 2002. Concerning the risks and benefits associated with the proposed acquisition of a water utility, on behalf of the Consumer Advocate Division of the West Virginia Public Service Commission.

Joint Petition of New Jersey-American Water Company, Inc. and Thames Water Aqua Holdings GmbH for Approval of Change in Control of New Jersey-American Water Company, Inc., New Jersey Board of Public Utilities, Docket No. WM01120833. 2002. Concerning the risks and benefits associated with the proposed acquisition of a water utility, on behalf of the New Jersey Division of Ratepayer Advocate.

Illinois-American Water Company, Proposed General Increase in Water Rates, Illinois Commerce Commission, Docket No. 02-0690. 2003. Concerning rate design and cost of service issues, on behalf of the Illinois Office of the Attorney General.

Pennsylvania Public Utility Commission v. Pennsylvania-American Water Company, Pennsylvania Public Utility Commission, Docket No. R-00038304. 2003. Concerning rate design and cost of service issues, on behalf of the Pennsylvania Office of Consumer Advocate.

West Virginia-American Water Company, West Virginia Public Service Commission, Case No. 03-0353-W-42T. 2003. Concerning affordability, rate design, and cost of service issues, on behalf of the West Virginia Consumer Advocate Division.

Petition of Seabrook Water Corp. for an Increase in Rates and Charges for Water Service, New Jersey Board of Public Utilities, Docket No. WR3010054. 2003. Concerning revenue requirements, rate design, prudence, and regulatory policy, on behalf of the New Jersey Division of Ratepayer Advocate.

Chesapeake Ranch Water Co. v. Board of Commissioners of Calvert County, U.S. District Court for Southern District of Maryland, Civil Action No. 8:03-cv-02527-AW. 2004. Submitted expert report concerning the expected level of rates under various options for serving new commercial development, on behalf of the plaintiff.

Testimony concerning Lead in Drinking Water, Committee on Government Reform, United States House of Representatives. 2004. Concerning the trade-offs faced by low-income households when drinking water costs increase, including an analysis of H.R. 4268.

West Virginia-American Water Company, West Virginia Public Service Commission, Case No. 04-0373-W-42T. 2004. Concerning affordability and rate comparisons, on behalf of the West Virginia Consumer Advocate Division.

West Virginia-American Water Company, West Virginia Public Service Commission, Case No. 04-0358-W-PC. 2004. Concerning costs, benefits, and risks associated with a wholesale water sales contract, on behalf of the West Virginia Consumer Advocate Division.

Kentucky-American Water Company, Kentucky Public Service Commission, Case No. 2004-00103. 2004. Concerning rate design and tariff issues, on behalf of the Kentucky Office of Attorney General.

New Landing Utility, Inc., Illinois Commerce Commission, Docket No. 04-0610. 2005. Concerning the adequacy of service provided by, and standards of performance for, a water and wastewater utility, on behalf of the Illinois Office of Attorney General.

People of the State of Illinois v. New Landing Utility, Inc., Circuit Court of the 15th Judicial District, Ogle County, Illinois, No. 00-CH-97. 2005. Concerning the standards of performance for a water and wastewater utility, including whether a receiver should be appointed to manage the utility's operations, on behalf of the Illinois Office of Attorney General.

Hope Gas, Inc. d/b/a Dominion Hope, West Virginia Public Service Commission, Case No. 05-0304-G-42T. 2005. Concerning the utility's relationships with affiliated companies, including an appropriate level of revenues and expenses associated with services provided to and received from affiliates, on behalf of the West Virginia Consumer Advocate Division.

Monongahela Power Co. and The Potomac Edison Co., West Virginia Public Service Commission, Case Nos. 05-0402-E-CN and 05-0750-E-PC. 2005. Concerning review of a plan to finance the construction of pollution control facilities and related issues, on behalf of the West Virginia Consumer Advocate Division.

Joint Application of Duke Energy Corp., et al., for Approval of a Transfer and Acquisition of Control, Case Kentucky Public Service Commission, No. 2005-00228. 2005. Concerning the risks and benefits associated with the proposed acquisition of an energy utility, on behalf of the Kentucky Office of the Attorney General.

Commonwealth Edison Company proposed general revision of rates, restructuring and price unbundling of bundled service rates, and revision of other terms and conditions of service, Illinois Commerce Commission, Docket No. 05-0597. 2005. Concerning rate design and cost of service, on behalf of the Illinois Office of Attorney General.

Pennsylvania Public Utility Commission v. Aqua Pennsylvania, Inc., Pennsylvania Public Utility Commission, Docket No. R-00051030. 2006. Concerning rate design and cost of service, on behalf of the Pennsylvania Office of Consumer Advocate.

Central Illinois Light Company d/b/a AmerenCILCO, Central Illinois Public Service Company d/b/a AmerenCIPS, and Illinois Power Company d/b/a AmerenIP, proposed general increases in rates for delivery service, Illinois Commerce Commission, Docket Nos. 06-0070, et al. 2006. Concerning rate design and cost of service, on behalf of the Illinois Office of Attorney General.

Grens, et al., v. Illinois-American Water Co., Illinois Commerce Commission, Docket Nos. 5-0681, et al. 2006. Concerning utility billing, metering, meter reading, and customer service practices, on behalf of the Illinois Office of Attorney General and the Village of Homer Glen, Illinois.

Commonwealth Edison Company Petition for Approval of Tariffs Implementing ComEd's Proposed Residential Rate Stabilization Program, Illinois Commerce Commission, Docket No. 06-0411. 2006. Concerning a utility's proposed purchased power phase-in proposal, in behalf of the Illinois Office of Attorney General.

Illinois-American Water Company, Application for Approval of its Annual Reconciliation of Purchased Water and Purchased Sewage Treatment Surcharges Pursuant to 83 Ill. Adm. Code 655, Illinois Commerce Commission, Docket No. 06-0196. 2006. Concerning the reconciliation of purchased water and sewer charges, on behalf of the Illinois Office of Attorney General and the Village of Homer Glen, Illinois.

Illinois-American Water Company, et al., Illinois Commerce Commission, Docket No. 06-0336. 2006. Concerning the risks and benefits associated with the proposed divestiture of a water utility, on behalf of the Illinois Office of Attorney General.

Joint Petition of Kentucky-American Water Company, et al., Kentucky Public Service Commission, Docket No. 2006-00197. 2006. Concerning the risks and benefits associated with the proposed divestiture of a water utility, on behalf of the Kentucky Office of Attorney General.

Aqua Illinois, Inc. Proposed Increase in Water Rates for the Kankakee Division, Illinois Commerce Commission, Docket No. 06-0285. 2006. Concerning various revenue requirement, rate design, and tariff issues, on behalf of the County of Kankakee.

Housing Authority for the City of Pottsville v. Schuylkill County Municipal Authority, Court of Common Pleas of Schuylkill County, Pennsylvania, No. S-789-2000. 2006. Concerning the reasonableness and uniformity of rates charged by a municipal water authority, on behalf of the Pottsville Housing Authority.

Application of Pennsylvania-American Water Company for Approval of a Change in Control, Pennsylvania Public Utility Commission, Docket No. A-212285F0136. 2006. Concerning the risks and benefits associated with the proposed divestiture of a water utility, on behalf of the Pennsylvania Office of Consumer Advocate.

Application of Artesian Water Company, Inc., for an Increase in Water Rates, Delaware Public Service Commission, Docket No. 06-158. 2006. Concerning rate design and cost of service, on behalf of the Staff of the Delaware Public Service Commission.

Central Illinois Light Company, Central Illinois Public Service Company, and Illinois Power Company: Petition Requesting Approval of Deferral and Securitization of Power Costs, Illinois Commerce Commission, Docket No. 06-0448. 2006. Concerning a utility's proposed purchased power phase-in proposal, in behalf of the Illinois Office of Attorney General.

Petition of Pennsylvania-American Water Company for Approval to Implement a Tariff Supplement Revising the Distribution System Improvement Charge, Pennsylvania Public Utility Commission, Docket No. P-00062241. 2007. Concerning the reasonableness of a water utility's proposal to increase the cap on a statutorily authorized distribution system surcharge, on behalf of the Pennsylvania Office of Consumer Advocate.

Adjustment of the Rates of Kentucky-American Water Company, Kentucky Public Service Commission, Case No. 2007-00143. 2007. Concerning rate design and cost of service, on behalf of the Kentucky Office of Attorney General.

Application of Kentucky-American Water Company for a Certificate of Convenience and Necessity Authorizing the Construction of Kentucky River Station II, Associated Facilities and Transmission Main, Kentucky Public Service Commission, Case No. 2007-00134. 2007. Concerning the life-cycle costs of a planned water supply source and the imposition of conditions on the construction of that project, on behalf of the Kentucky Office of Attorney General.

Pa. Public Utility Commission v. Pennsylvania-American Water Company, Pennsylvania Public Utility Commission, Docket No. R-00072229. 2007. Concerning rate design and cost of service, on behalf of the Pennsylvania Office of Consumer Advocate.

Illinois-American Water Company Application for Approval of its Annual Reconciliation of Purchased Water and Purchased Sewage Treatment Surcharges, Illinois Commerce Commission, Docket No. 07-0195. 2007. Concerning the reconciliation of purchased water and sewer charges, on behalf of the Illinois Office of Attorney General.

In the Matter of the Application of Aqua Ohio, Inc. to Increase Its Rates for Water Service Provided In the Lake Erie Division, Public Utilities Commission of Ohio, Case No.07-0564-WW-AIR. 2007. Concerning rate design and cost of service, on behalf of the Office of the Ohio Consumers' Counsel.

Pa. Public Utility Commission v. Aqua Pennsylvania Inc., Pennsylvania Public Utility Commission, Docket No. R-00072711. 2008. Concerning rate design, on behalf of the Masthope Property Owners Council.

Illinois-American Water Company Proposed increase in water and sewer rates, Illinois Commerce Commission, Docket No. 07-0507. 2008. Concerning rate design and demand studies, on behalf of the Illinois Office of Attorney General.

Central Illinois Light Company, d/b/a AmerenCILCO; Central Illinois Public Service Company, d/b/a AmerenCIPS; Illinois Power Company, d/b/a AmerenIP: Proposed general increase in rates for electric delivery service, Illinois Commerce Commission Docket Nos. 07-0585, 07-0586, 07-0587. 2008. Concerning rate design and cost of service studies, on behalf of the Illinois Office of Attorney General.

Commonwealth Edison Company: Proposed general increase in electric rates, Illinois Commerce Commission Docket No. 07-0566. 2008. Concerning rate design and cost of service studies, on behalf of the Illinois Office of Attorney General.

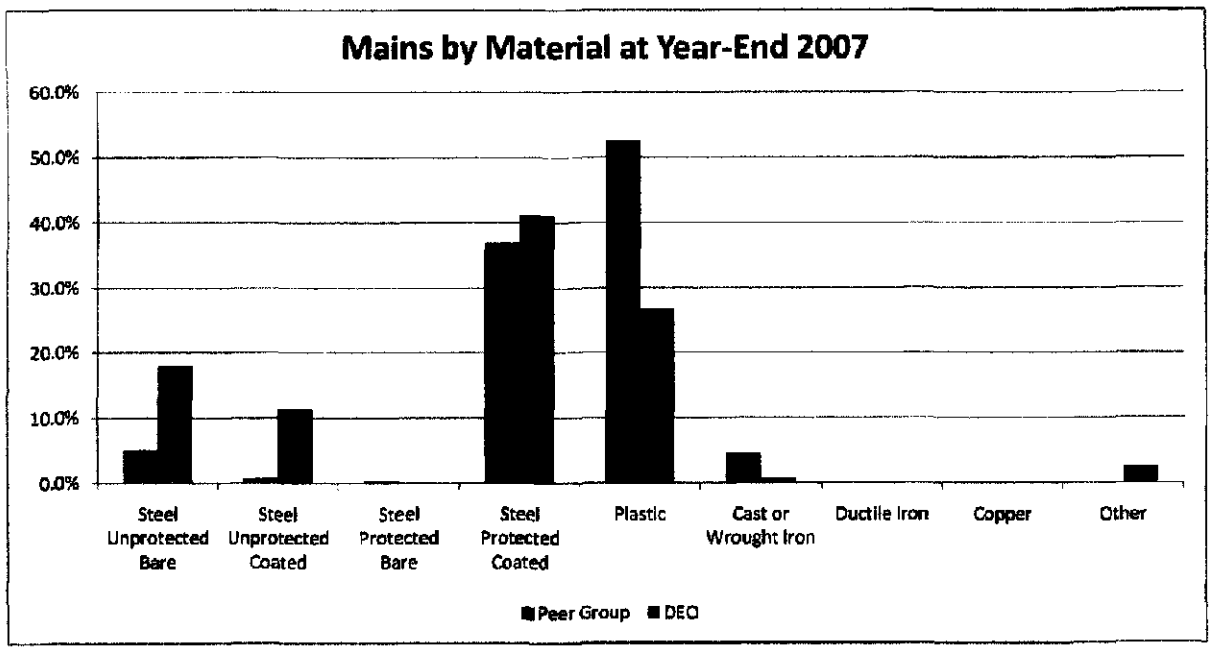
In the Matter of Application of Ohio American Water Co. to Increase Its Rates, Public Utilities Commission of Ohio, Case No. 07-1112-WS-AIR. 2008. Concerning rate design and cost of service, on behalf of the Office of the Ohio Consumers' Counsel.

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-2

Miles of Mains in Service at Year-End 2007, by Material - DEO and Peer Group

	Peer Group	Percent	DEO	Percent
Steel Unprotected Bare	10,213	5.0%	3,498	17.9%
Steel Unprotected Coated	1,297	0.6%	2,227	11.4%
Steel Protected Bare	815	0.4%	14	0.1%
Steel Protected Coated	75,224	36.9%	8,043	41.1%
Plastic	107,109	52.5%	5,213	26.6%
Cast or Wrought Iron	9,287	4.6%	112	0.6%
Ductile Iron	-	0.0%	-	0.0%
Copper	3	0.0%	1	0.0%
Other	7	0.0%	476	2.4%
Total	203,955	100.0%	19,584	100.0%



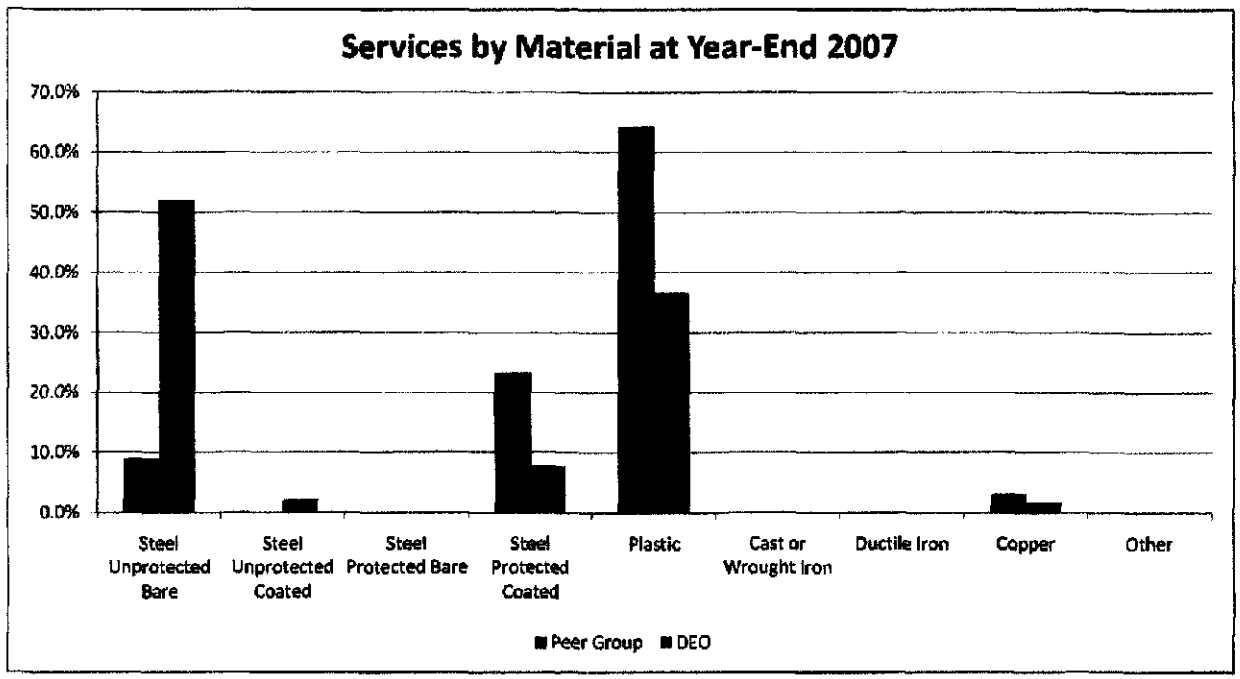
Source: US Office of Pipeline Safety, Annual Reports for Gas Distribution Utilities, http://ops.dot.gov/stats/DT98.htm

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-3

Number of Service Lines in Service at Year-End 2007, by Material - DEO and Peer Group

	Peer Group	Percent	DEO	Percent
Steel Unprotected Bare	1,055,136	8.9%	671,586	51.9%
Steel Unprotected Coated	18,642	0.2%	27,894	2.2%
Steel Protected Bare	22,019	0.2%	-	0.0%
Steel Protected Coated	2,769,770	23.3%	100,494	7.8%
Plastic	7,655,500	64.3%	473,549	36.6%
Cast or Wrought Iron	14	0.0%	-	0.0%
Ductile Iron	-	0.0%	-	0.0%
Copper	361,775	3.0%	21,382	1.7%
Other	26,893	0.2%	-	0.0%
Total	11,909,749	100.0%	1,294,905	100.0%



Source: US Office of Pipeline Safety, Annual Reports for Gas Distribution Utilities, http://ops.dot.gov/stats/DT98.htm

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-4

Unaccounted for Gas (Percent) - DEO and Peer Group, 2007

Peer Group	*Unaccounted for Gas (%)*
ATLANTA GAS LIGHT CO	1.68
COLUMBIA GAS OF OHIO INC	0.10
CONSUMERS ENERGY CO	0.63
MICHIGAN CONSOLIDATED GAS CO (MICHCON)	1.40
NORTHERN INDIANA PUBLIC SERVICE CO	0.23
OKLAHOMA NATURAL GAS CO	1.56
PUBLIC SERVICE CO OF COLORADO	1.67
PUBLIC SERVICE ELECTRIC & GAS CO	0.43
PUGET SOUND ENERGY	0.80
ATMOS ENERGY CORPORATION, MID-TEX DIVISION	2.71
Average	1.12
Dominion East Ohio	**0.27**

Source: US Office of Pipeline Safety, Annual Reports for Gas Distribution Utilities, http://ops.dot.gov/stats/DT98.htm

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-5

Number of Leaks Eliminated or Repaired, by Type, During 2007 - DEO and Peer Group

	Peer Group	% of Total	DEO	% of Total
Corrosion - Mains	5,872	27.2%	3,582	79.8%
Natural Forces - Mains	3,663	17.0%	18	0.4%
Excavation - Mains	4,544	21.1%	161	3.6%
Other Outside Force- Mains	325	1.5%	73	1.6%
Material or Welds - Mains	1,617	7.5%	111	2.5%
Equipment - Mains	1,036	4.8%	51	1.1%
Operations - Mains	1,158	5.4%	10	0.2%
Other - Mains	3,350	15.5%	484	10.8%
Total Leaks in Mains	21,565	100.0%	4,490	100.0%
Total Miles	203,955		19,584	
Leaks per 100 Miles	10.6		22.9	

	Peer Group	% of Total	DEO	% of Total
Corrosion - Services	8,386	17.7%	4,054	51.5%
Natural Forces - Services	3,328	7.0%	38	0.5%
Excavation - Services	14,687	31.1%	634	8.0%
Other Outside Force - Services	910	1.9%	391	5.0%
Material or Welds - Services	4,974	10.5%	203	2.6%
Equipment - Services	4,256	9.0%	281	3.6%
Operations - Services	3,751	7.9%	50	0.6%
Other - Services	6,986	14.8%	2,227	28.3%
Total Leaks in Services	47,278	100.0%	7,878	100.0%
Total Services	11,909,749		1,294,905	
Leaks per 1000 Services	4.0		6.1	
Leaks Awaiting Repair at Year End	18,258		593	
Total Miles	203,955		19,584	
Known Leaks per 100 Miles	9.0		3.0	
Total Leaks	87,101		12,961	
Total Leaks per 100 Miles	42.7		66.2	
Total Leaks per 1000 Services	7.3		10.0	

Source: US Office of Pipeline Safety, Annual Reports for Gas Distribution Utilities, http://ops.dot.gov/stats/DT98.htm

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-6

DEO Miles of Mains in Service at Year-End, by Year and Material

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Steel Unprotected Bare	2,773	2,525	3,185	4,377	4,377	4,067	4,067	3,943	3,937	3,598	3,540	3,498	3,498	3,498
Steel Unprotected Coated	2,706	2,741	2,738	2,636	2,636	2,459	2,459	2,384	2,380	2,254	2,254	2,227	2,227	2,227
Steel Protected Bare	1,479	1,440	1,441	10	10	9	9	9	9	9	9	14	14	14
Steel Protected Coated	7,339	7,125	7,131	7,197	7,197	6,769	6,769	6,563	6,554	7,989	8,025	7,924	7,946	8,043
Plastic	2,727	2,936	3,020	3,579	3,773	3,567	3,567	3,894	4,098	4,586	4,752	4,920	5,056	5,213
Cast or Wrought Iron	104	103	106	51	51	42	42	79	79	40	128	127	115	112
Ductile Iron	-	-	-	-	-	52	52	-	-	-	-	-	-	-
Copper	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Other	134	134	134	134	134	133	133	486	486	581	490	489	480	476
Total	17,263	17,005	17,756	17,985	18,179	17,099	17,099	17,359	17,544	19,058	19,199	19,200	19,337	19,584

Notes:
1994: Data for East Ohio Gas, former River Gas, and West Ohio Gas
1995-1996: Data for East Ohio Gas and West Ohio Gas

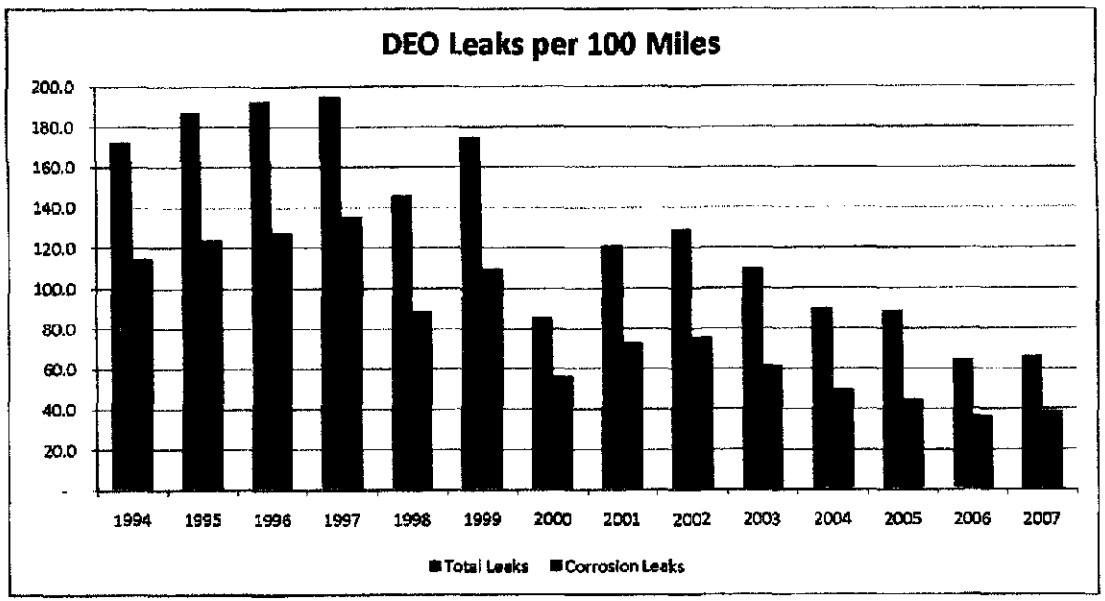
Source: US Office of Pipeline Safety, Annual Reports for Gas Distribution Utilities, http://ops.dot.gov/stats/DT98.htm

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-7

DEO Leaks by Year and Type

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Corrosion Leaks in Mains and Services	19,679	20,986	22,518	24,318	15,987	18,649	9,566	12,602	13,178	11,664	9,432	8,471	7,061	7,636
All Other Leaks in Mains and Services	6,460	7,118	7,721	7,213	7,185	7,036	2,652	5,319	5,345	5,720	4,333	4,320	4,232	4,732
Total Leaks in Mains and Services	26,139	28,104	30,239	31,531	23,172	25,685	12,218	17,921	18,523	17,384	13,765	12,791	11,293	12,368
Known Leaks Unrepaired	3,554	3,674	3,852	3,510	3,274	4,170	2,277	2,961	3,993	3,469	3,406	4,235	1,197	593
Total Leaks	29,693	31,778	34,091	35,041	26,446	29,855	14,495	20,882	22,516	20,853	17,171	17,026	12,490	12,961
Miles of Main	17,263	17,005	17,756	17,985	18,179	17,099	17,099	17,359	17,544	19,058	19,199	19,200	19,337	19,584
Corrosion Leaks per 100 Miles	114.0	123.4	126.8	135.2	87.9	109.1	55.9	72.6	75.1	61.2	49.1	44.1	36.5	39.0
Total Leaks per 100 Miles	172.0	186.9	192.0	194.8	145.5	174.6	84.8	120.3	128.3	109.4	89.4	88.7	64.6	66.2



Notes:
1994: Data for East Ohio Gas, former River Gas, and West Ohio Gas
1995-1996: Data for East Ohio Gas and West Ohio Gas

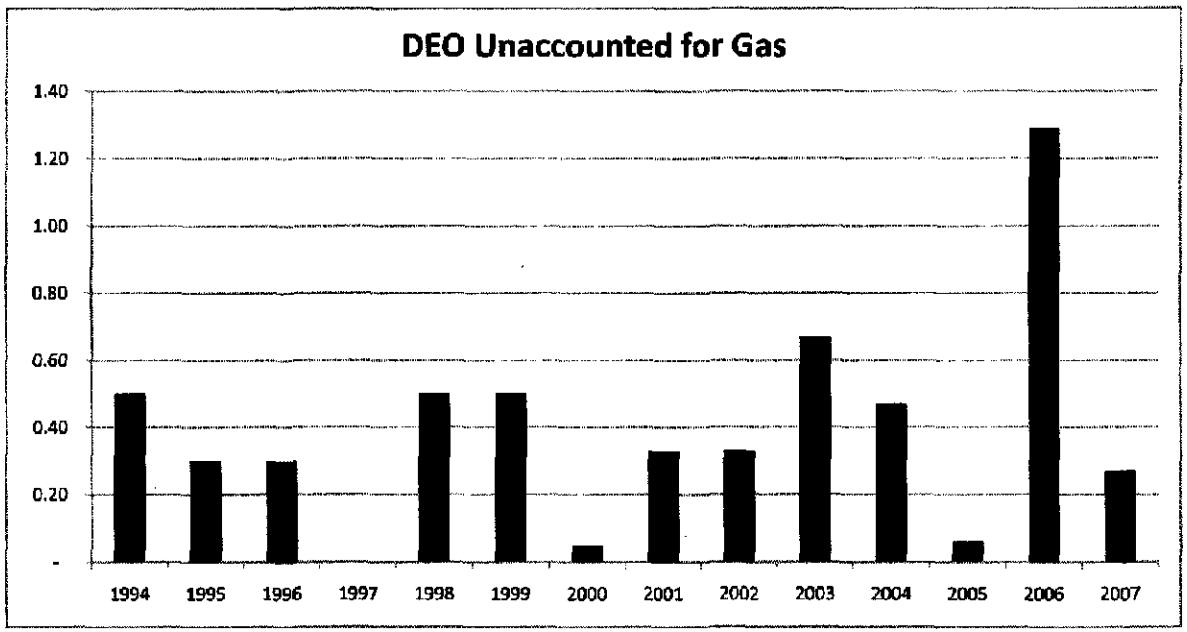
Source: US Office of Pipeline Safety, Annual Reports for Gas Distribution Utilities, http://ops.dot.gov/stats/DT98.htm

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-8

DEO Unaccounted for Gas by Year (Percent)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Unaccounted for Gas	0.50	0.30	0.30	-	0.50	0.50	0.05	0.33	0.33	0.67	0.47	0.06	1.29	0.27



Notes:
1994-1996: Data for East Ohio Gas main system only

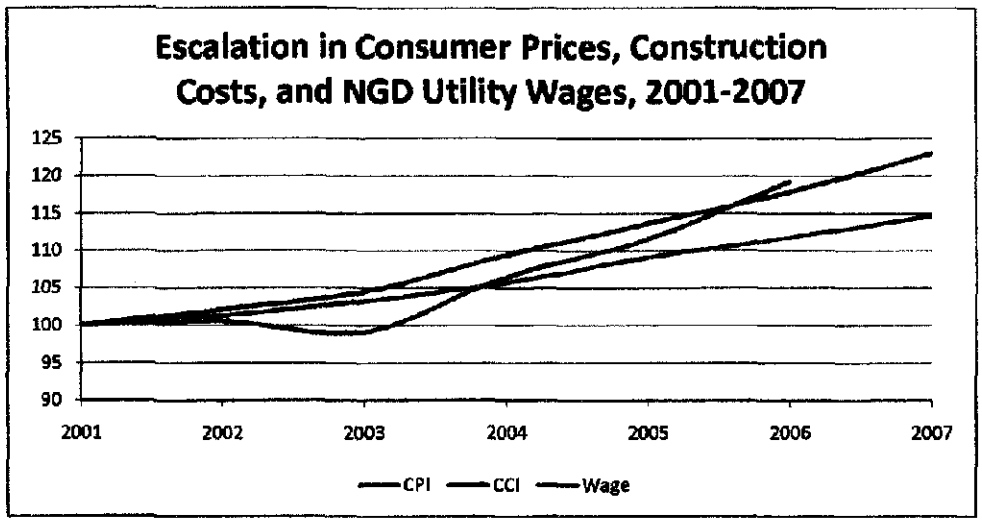
Source: US Office of Pipeline Safety, Annual Reports for Gas Distribution Utilities, http://ops.dot.gov/stats/DT98.htm

Dominion East Ohio Gas Company
Case Nos. 08-169-GA-ALT, et al.

Exhibit SJR-9

Cost Escalation Rates, 2001-2007

Year	Consumer Price Index	% Change	Construction Cost Index	% Change	Average NGD Utility Wage	% Change
2001	172.8		6,920.6		66,924	
2002	174.9	1.2%	7,067.1	2.1%	67,286	0.5%
2003	178.3	1.9%	7,229.0	2.3%	66,341	-1.4%
2004	182.6	2.4%	7,566.9	4.7%	71,265	7.4%
2005	188.4	3.2%	7,861.0	3.9%	74,670	4.8%
2006	193.0	2.4%	8,153.9	3.7%	79,808	6.9%
2007	198.1	2.6%	8,512.7	4.4%		
Cumulative		14.6%		23.0%		19.3%



Sources:

Consumer Price Index for Midwest Region from U.S. Bureau of Labor Statistics, < http://www.bls.gov/CPI/ >

Construction Cost Index for Cleveland from Engineering News-Record (ENR), December of each year

Natural Gas Distribution Utility average annual pay from U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, custom report, < http://data.bls.gov >

PIRP Capital Expenditures Using 1% Real Escalation Rate
(all costs x $1,000)
Escalation rate: 101%

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
LP D Mains	Ongoing	31,310	31,623	31,939	32,259	32,581	32,907	33,236	33,569	33,904	34,243
	Bare Steel	23,639	34,683	48,939	50,912	52,963	55,098	57,318	59,628	62,031	64,531
	Total	54,949	66,307	80,879	83,170	85,545	88,005	90,554	93,197	95,935	98,774
Trans mains	Ongoing	16,968	17,138	15,970	13,944	13,243	13,375	13,509	13,644	13,780	13,918
	Bare Steel	16,373	9,923	0	0	0	0	0	0	0	0
	Total	33,341	27,060	15,970	13,944	13,243	13,375	13,509	13,644	13,780	13,918
Services	Ongoing	12,322	12,445	12,570	12,695	12,822	12,951	13,080	13,211	13,343	13,476
	Bare Steel	6,060	16,467	31,424	32,691	34,008	35,379	36,804	38,287	39,830	41,436
	Total	18,382	28,913	43,994	45,386	46,830	48,329	49,884	51,498	53,173	54,912
HP D Mains	Ongoing	0	0	0	0	0	0	0	0	0	0
	Bare Steel	27,153	16,454	0	0	0	0	0	0	0	0
	Total	27,153	16,454	0	0	0	0	0	0	0	0
Total	Ongoing	60,600	61,206	60,479	58,898	58,646	59,233	59,825	60,423	61,028	61,638
	Bare Steel	73,225	77,528	80,363	83,602	86,971	90,476	94,122	97,916	101,862	105,967
	Grand Total	133,825	138,734	140,842	142,500	145,618	149,709	153,948	158,339	162,889	167,604

Source: DEO's spreadsheet "PIR Cap Ex Breakdown Bare Steel_Ongoing.xls" with all costs escalated by 1% per year beginning in Year 1

PIRP Capital Expenditures U
(all costs x $1,000)
Escalation rate: 101%

		Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
LP D Mains	Ongoing	34,586	34,932	35,281	35,634	35,990	36,350	36,713	37,081	37,451	37,826
	Bare Steel	67,132	69,837	72,651	75,579	78,625	81,794	85,090	88,519	92,086	95,797
	Total	101,717	104,769	107,932	111,213	114,615	118,144	121,803	125,600	129,538	133,623
Trans mains	Ongoing	14,057	14,198	14,340	14,483	14,628	14,774	14,922	15,071	15,222	15,374
	Bare Steel	0	0	0	0	0	0	0	0	0	0
	Total	14,057	14,198	14,340	14,483	14,628	14,774	14,922	15,071	15,222	15,374
Services	Ongoing	13,611	13,747	13,885	14,024	14,164	14,305	14,449	14,593	14,739	14,886
	Bare Steel	43,106	44,843	46,650	48,530	50,486	52,520	54,637	56,839	59,129	61,512
	Total	56,717	58,590	60,535	62,553	64,649	66,826	69,085	71,432	73,868	76,398
HP D Mains	Ongoing	0	0	0	0	0	0	0	0	0	0
	Bare Steel	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0
Total	Ongoing	62,254	62,877	63,506	64,141	64,782	65,430	66,084	66,745	67,412	68,087
	Bare Steel	110,237	114,680	119,301	124,109	129,111	134,314	139,727	145,358	151,215	157,309
	Grand Total	172,491	177,556	182,807	188,250	193,893	199,744	205,811	212,103	218,628	225,396

Source: DEO's spreadsheet "PIR Cap Ex Breakdown Bare Steel_Ongoing.xls" with all costs escalated by 1% per year beginning in Year 1

PIRP Capital Expenditures U
(all costs x $1,000)
Escalation rate: 101%

		Year 21	Year 22	Year 23	Year 24	Year 25	Total
LP D Mains	Ongoing	38,204	38,586	38,972	39,362	39,755	884,295
	Bare Steel	99,658	103,674	107,852	108,931	104,437	1,841,406
	Total	137,862	142,260	146,824	148,292	144,193	2,725,700
Trans mains	Ongoing	15,528	15,683	15,840	15,999	16,159	371,770
	Bare Steel	0	0	0	0	0	26,296
	Total	15,528	15,683	15,840	15,999	16,159	398,065
Services	Ongoing	15,035	15,186	15,337	15,491	15,646	348,013
	Bare Steel	63,991	66,570	69,253	69,945	68,922	1,169,316
	Total	79,026	81,755	84,590	85,435	84,567	1,517,329
HP D Mains	Ongoing	0	0	0	0	0	0
	Bare Steel	0	0	0	0	0	43,607
	Total	0	0	0	0	0	43,607
Total	Ongoing	68,767	69,455	70,150	70,851	71,560	1,604,077
	Bare Steel	163,649	170,244	177,105	178,875	173,359	**3,080,624**
	Grand Total	232,417	239,699	247,255	249,726	244,919	4,684,701

Source: DEO's spreadsheet "PIR Cap Ex Breakdown Bare Steel_Ongoing.xls" with all costs escalated by 1% per year beginning in Year 1