AG Cross Exhibit 2

STATE OF ILLINOIS

ILLINOIS COMMERCE COMMISSION

THE PEOPLES GAS LIGHT AND COKE COMPANY Proposed General Increase In Rates For Gas Service	:	No. 09-0167

Direct Testimony of

SALVATORE D. MARANO

Managing Director, Jacobs Utilities Practice

On Behalf of
The Peoples Gas Light and Coke Company

February 13, 2009

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Witness ______
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I. Introduction

A. Identification of Witness

Q Please state your name, employer and business address.

A My name is Salvatore D. Marano, P.E. I am employed by Jacobs Consultancy, Inc. ("Jacobs Consultancy"). My business address is 5995 Rogerdale Road, Houston, TX 77072.

Q What position do you hold at Jacobs Consultancy?

A I am currently the Managing Director of Jacobs Consultancy's Utilities Practice.

Q Please describe the activities of Jacobs Consultancy.

A Jacobs Engineering Group is one of the largest professional service organizations in the world with over 55,000 employees worldwide. Jacobs Consultancy is part of the Jacobs Engineering Group. Jacobs Consultancy's Utilities Practice serves both the public and private sectors, providing management, engineering and operations related advisory services to clients globally. Engagements in the gas and electric utility industries include litigation support, asset integrity, merger and acquisition assistance, management audits, budget reviews, and policy and procedure reviews.

B. Purpose of Testimony

Q Please describe the purpose of your testimony in this proceeding.

A The purpose of my testimony is to provide evidence and analysis in support of The Peoples Gas Light and Coke Company's ("PGL") requested Infrastructure Cost Recovery Rider ("Rider ICR"), which, if granted, PGL will use to implement its Accelerated Infrastructure Replacement Program.

PGL seeks to accelerate the replacement of its gas mains and services infrastructure and achieve modernization of its aging cast iron ("CI") and ductile iron ("DI") (together "CI/DI") as well as its antiquated low-pressure system.

Saddled with this antiquated system, some of which is over one hundred years old, and the risk posed by a cast and ductile iron main system, PGL has prudently managed this system and the risks it poses. PGL's performance in this area is well in line with acceptable industry measures. However, there is a need to pursue a more accelerated approach of upgrading this system to prevent or mitigate foreseeable future risk of system and asset failure.

In its Order for PGL's most recent rate case (Docket No. 07-0242), the Illinois Commerce Commission ("Commission") stated that in order to approve PGL's requested rate recovery mechanism for an accelerated replacement program, PGL needed to establish a record providing specific types of information supporting its request. Specifically, the Commission stated that it required the following information to consider granting PGL's Rider ICR:

- A detailed description and cost analysis of the proposed system modernization;
- An identification and evaluation of the range of technology options considered and analysis and justification of the proposed technology approach;
- A detailed identification and description of the functionalities of the new system, related both to system operation as well as on the customer side of the meter, as well as an identification and justification of functionalities foregone;
- Analysis of the benefits of the system modernization, both to system operation as well as to customers, including reductions in system costs as well as an analysis of the range and benefits of potential new products and services for customers made possible by the system modernization;
- An analysis of regulatory mechanisms to allow companies to both recover their costs of system modernization a well as to flow reduced system costs back to customers; and
- An identification and analysis of legal or regulatory barriers to the implementation of system modernization.

(07-0241/07-0242 Cons. Order at 162.)

My testimony will provide my opinion and support for the accelerated replacement of PGL's gas mains and services infrastructure, based on the need for reduction of future risk to the public, the public good created by a modern asset-based gas distribution system and the economic advantages of an accelerated program. This testimony will address the first four items of information requested above by the ICC. The last two items of information requested by the Commission are addressed by the testimony of James Schott and Valerie Grace.

Q Can you summarize the approach that Jacobs Consultancy utilized in carrying out this work?

A The approach to conducting this independent review and analysis included:

- Identification and review of relevant documents from previous rate cases for both PGL and other operating companies;
- Identification and review of PGL records and filings;
- Conducting discussions with the appropriate subject matter experts from PGL, who have responsibility for gas operations, engineering, and accounting;
- Examination of PGL gas operations and engineering policies, procedures and practices regarding the conversion of the low-pressure portion of the system to medium-pressure, and the replacement of higher-risk pipe materials (e.g., cast iron, ductile iron, bare steel, polyvinylchloride (PVC) plastic pipe);
- Review of gas operations and engineering policy, procedures and practices regarding the Main Ranking Index program;
- Application of my knowledge of and experience with the industry generally and, in particular, with specific comparable utilities; and
- Field visits and assessments of operating conditions for the implementation of PGL's pipe replacement policies.

Q **Who performed this work?**

A This independent review was performed by me and, under my direct supervision; Jacobs Consultancy staff member Christopher Pioli supported the review of documents and the development of the cost benefit model. Copies of our resumes are included in EXHIBIT SDM-1.23.

C. Summary of Conclusions

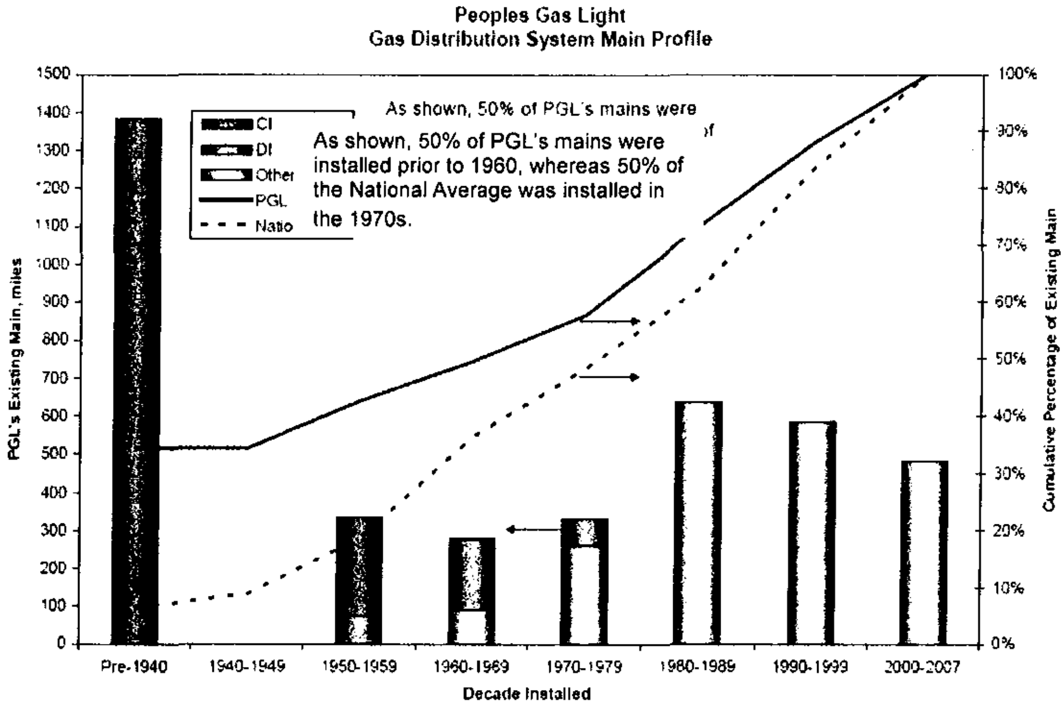
Q **Please summarize your specific conclusions, based on the findings of your detailed review and analysis.**

A PGL operates a gas distribution system, which serves residences and businesses located in the City of Chicago. These customers are served through a network of low and medium-pressure pipe. This system is comprised of 4,029 miles of main is comprised of 1,629 miles of cast iron and 300 miles of ductile iron, the balance being steel or polyethylene pipe. Over 50% of these gas distribution mains were installed prior to the November 12, 1970 effective date of Title 49 Part 192 of the Code of Federal Regulations "Transportation of Natural and Other Gas by Pipelines: Minimum Federal Safety Standards." Indeed, some existing pipe was installed as early as the 1860s.

Cast and ductile iron pipe are higher-risk materials because of their unpredictable and catastrophic failure mode. The potential consequences of cast or ductile iron pipe failure increases with operating pressure. PGL has the largest percentage of cast and ductile iron pipe in its gas distribution system (47.9%) when compared to any other gas distribution system operator serving the five largest U.S. metropolitan areas. Of the eleven largest cast and ductile iron gas distribution systems, PGL has the second largest percentage of cast and ductile iron pipe. In the U.S., PGL has the fifth largest cast iron and the largest ductile iron content. PGL has about 16% of its cast and ductile iron pipe operating at medium-pressure; this is more than Public Service Electric and Gas in New Jersey, which has the largest cast and ductile iron system in the U.S. Finally, the average age of PGL's system is about 15 to 20 years older than the national average.

Accelerating the replacement of these higher-risk materials will increase system safety and reduce the likelihood of subjecting the public and customers to the adverse effects of pipe failures.

Exhibit SDM – 1.1 – Gas Distribution System Main Profile



No beneficial functionalities of a low-pressure system will be foregone by eliminating the low-pressure system. The low-pressure system is a legacy system from the days when customers received manufactured gas. No new low-pressure systems are installed today. Modernizing the gas distribution system by the elimination of the low-pressure system and replacement of higher-risk cast and ductile iron main will improve system safety (e.g., expand the use of excess-flow valves, a technology that can prevent incidents caused by damage to service lines) and reliability (e.g., eliminate gas outages caused by water infiltration of low-pressure mains).

In addition to increasing safety and reliability, PGL's system modernization, will provide many other benefits. The customers will benefit from having a greater selection of gas appliances to choose from, including more efficient and environmentally-friendly models, a reduction in PGL's inside safety inspections and the customer inconvenience they cause, reduced gas costs associated with lost gas and more accurate gas volume metering. Operationally, PGL will benefit from the elimination of an entire class of gas pressure regulator stations, a potential reduction in third party excavation damage, an ability to isolate smaller portions of the system, a reduction in leak repairs and increased safety for maintenance crews.

The accelerated replacement program also has environmental benefits. Replacing cast and ductile iron pipe will reduce the amount of lost gas, thereby lowering greenhouse gas emissions. Upgrading the low-pressure system to a medium-pressure system will eliminate water infiltration and the need to dispose of water collected from the low-pressure system as a hazardous material. Furthermore, if the City of Chicago approved the use of coring and vacuum excavation technology and the re-use of soil, the amount of soil that must be hauled away and disposed of in landfills would be further reduced.

The replacement of mains and associated service lines made from higher-risk materials and the relocation of inside meter sets to the outside will provide the benefits stated above to the general public, the customers located in the City of

Chicago and the workers that maintain the vast utility infrastructure. Additionally, our cost analysis shows that the cost of modernizing the legacy gas pipe system can be reduced if the current replacement program is accelerated. The accelerated replacement program will continue to replace mains due to of unacceptable risk (condition replacement) and public works projects (enforced replacement). The proposed zonal replacement approach will eliminate higher-risk pipe, while reducing the inconvenience to the public. As stated in my testimony, accelerated programs such as the one proposed by PGL are in progress in numerous states domestically, which are supported by the state regulatory agencies for several types of high risk materials. Internationally, in the United Kingdom ("UK"), the regulator has supported the accelerated programs for systems containing very large amounts of cast iron and ductile iron.

In summary, my testimony supports the fact that PGL prudently operates one of the oldest gas distribution systems that contains some of the largest portions of high risk materials -- both cast iron and ductile iron – in the country. However, because of the unpredictable and catastrophic failure modes of these materials, the total benefits identified that will accrue to all stakeholders by accelerating the upgrade and modernization of PGL's system support the proposed request by PGL.

D. Attachments to Testimony

Below is an index itemizing the Exhibits to my testimony. While images of certain of these Exhibits are embedded in my testimony, copies of each also are attached separately.

SDM – 1.20	Map of PGL's Low-pressure System and Location of CI/DI Pipe	
SDM – 1.21	Map of PGL's Medium-pressure System and Location of CI/DI Pipe	
SDM – 1.22	Whitepaper-Coring, Vacuum Excavation, and Keyhole Technology	
SDM – 1.23	Resumes of Salvatore D. Marano and Christopher A. Pioli	

E. Background and Experience

Q Please summarize your professional background and your experience in the utility industry.

A I hold a Bachelor of Science degree in Mechanical Engineering from Fairleigh Dickinson University and Master of Science from New Jersey Institute of Technology. I am a registered Professional Engineer in the State of New Jersey.

I began my career in the Gas Engineering Department at Consolidated Edison Company of New York ("Con Edison"). I then moved to Elizabethtown Gas Company ("Elizabethtown Gas") in New Jersey where I spent 16 years in various operating and engineering positions. I then became a Vice President of the parent company of Elizabethtown Gas, NUI Corporation. I have spent the past 12 years in consulting positions, 5 years at Stone & Webster Consultants as the Vice President of the Gas Consulting Group and the past 7 years as Director and now Managing Director of Jacobs Consultancy's Utilities Practice. During these consulting assignments, I have led engagements both domestically and internationally, performing merger and acquisition due diligence assessments for gas and electric utilities for both potential buyers and government agencies. I have led assignments in the area of cast iron, ductile iron, steel and plastic replacement programs and risk model assessments, and I have advised on policy decisions relating to the management of those materials. I have also managed numerous assignments related to operations and safety improvements for gas and electric utilities.

Q In particular, what is your direct experience relating to operating and maintaining cast iron and ductile iron systems?

A During my career I have been intimately involved with the direct management of gas systems at both Con Edison and Elizabethtown Gas that operated in very dense urban areas and contained large amounts of cast iron and ductile iron materials.

Internationally, I have performed numerous assignments for Transco (now National Grid UK), which was the largest operator of cast iron and ductile iron mains in the world. These assignments included: a review of their risk models for both cast iron and ductile iron; a critique of the proposed 30 year replacement program for all the materials that the UK regulator requested they undertake; and involvement in litigation cases involving explosion of cast iron and ductile iron pipe. The litigation involving the replacement of the ductile iron pipe focused on an explosion and demolition of a home in Larkhall Scotland, killing a family of 4. The charges brought against the company were Culpable Corporate Homicide and violation of the UK's Health and Safety Act 1974.

I performed a review of the cast iron gas distribution system for a potential buyer of CEGI in Rio de Janeiro. I conducted a review of the cast iron zone replacement program for the State of Victoria in Australia prior to its privatizing of the networks.

Other domestic experience includes due diligence reviews of the management and operation of the cast iron gas systems of MichCon and Keyspan. I was an expert witness for the New Jersey Board of Public Utilities (NJBPU) in its review of numerous aspects of the gas operation of Public Service Electric & Gas (PSE&G), including the main replacement program related to the potential merger of PSE&G and Exelon. As an expert witness, I also reviewed the main replacement program for and the safety aspects of the gas systems of Yankee Gas for the Connecticut Department of Public Utilities Control. Currently, I am conducting the system safety review of Puget Sound Energy for the Washington Utilities and Transportation Commission.

In summary, my background includes 18 years of operating experience in gas utilities and 12 years of numerous consulting assignments in the gas and electric utility industries. Many of those assignments, both international and domestic, were focused on cast iron and ductile iron mains.

II. General and Background Information

Q Would you describe PGL's system as unique?

A Yes.

Q Why? Please explain in detail.

A PGL has been the sole distributor of natural gas to the people of Chicago for approximately 150 years. PGL's pioneering history as a manufactured gas system, creating gas from coal and supplying it primarily for use as lighting, has resulted in the remaining legacy low-pressure gas distribution system, a subject that I will address at length in my testimony.

The provision of natural gas service for the residential, commercial, transportation and industrial customers of Chicago is indeed a unique responsibility.

As the largest city in the United States with a continental climate, the climate and geography of Chicago affords strong factors that could adversely affect pipe integrity. They include poorly drained soils, large temperature variations, and conditions favorable for frost heave, which is when soil expands and contracts due to freezing and thawing.

PGL's long and pioneering history of service to Chicago has also resulted in several other unique characteristics. PGL has the most miles of ductile iron pipe used for natural gas distribution in the United States. The PGL system has the second largest combined mileage of cast iron and ductile iron main as a percent of total miles of main of any gas operator in the United States and the fourth greatest combined mileage of cast iron and ductile iron main. Exhibit SDM-1.2 identifies the top 11 utilities with CI and/or DI pipe.

Exhibit SDM -1.2 - Eleven Largest CI/DI Gas Distribution Systems

NAME	Total Miles of Main	Miles of Cast Iron Main	Miles of Ductile Iron Main	Total Miles of CI & DI Mains	% of CI & DI Systems of Total Miles of Main
PHILADELPHIA GAS WORKS	3023	1607	136	1743	57.7%
PEOPLES GAS LIGHT & COKE CO	4029	1629	300	1929	47.9%
KEYSPAN ENERGY DELIVERY - NY CITY	4033	1767	0	1767	43.8%
BOSTON GAS CO	6219.4	2272.0	0	2272.0	36.5%
CONSOLIDATED EDISON CO OF NEW YORK	4264	1386	0	1386	32.5%
NIAGARA MOHAWK POWER CORP	3102.3	900.1	17.2	917.3	29.6%
PUBLIC SERVICE ELECTRIC & GAS CO	17618	4438	0	4438	25.2%
BALTIMORE GAS & ELECTRIC CO	6832	1363	0	1363	20.0%
MICHIGAN CONSOLIDATED GAS CO (MICHCON)	18520	2728	0	2728	14.7%
PECO ENERGY CO	6658	829	60	889	13.4%
ALABAMA GAS CORPORATION	10518.7	1079.2	1.6	1080.8	10.3%

Source U.S Office of Pipeline Safety 2008

Q Please describe the current distribution system infrastructure that PGL maintains and operates. What are the physical characteristics and material make up of PGL's current distribution system?

A PGL receives odorized gas from four city gate stations, where gas volumes are measured and the pressure is reduced to distribution pressure. My testimony does not discuss the interstation high-pressure network.

PGL operates an integrated gas distribution network comprised of medium-pressure and low-pressure systems. Exhibit SDM-1.3 illustrates the major components of PGL's distribution network. The 1,848 mile medium-pressure system, approximately 47 percent of the distribution network, is operated at a pressure of 20 pounds per square inch (psig) with a maximum allowable operating pressure (MAOP) of 25 psig. The 2,155 miles of low-pressure system, approximately 53% of the distribution network, is normally operated at approximately 0.25 psig (6 inches of water column). The low-pressure system's MAOP is 0.5 psig, or 12 inches of water column. The step-down in pressure from medium-pressure to low-pressure occurs at district regulator stations. The low-pressure system is supplied by approximately 345 medium-pressure to low-pressure district regulator stations. Main lines transport gas from the regulator vaults to individual medium- and low- pressure customers via individual service lines. In all, PGL operates and maintains approximately 4,000 miles of medium and low-pressure gas distribution main, and 508,475 service lines.

Exhibit SDM -1.3 - Illustrations of Distribution System Pressure Components

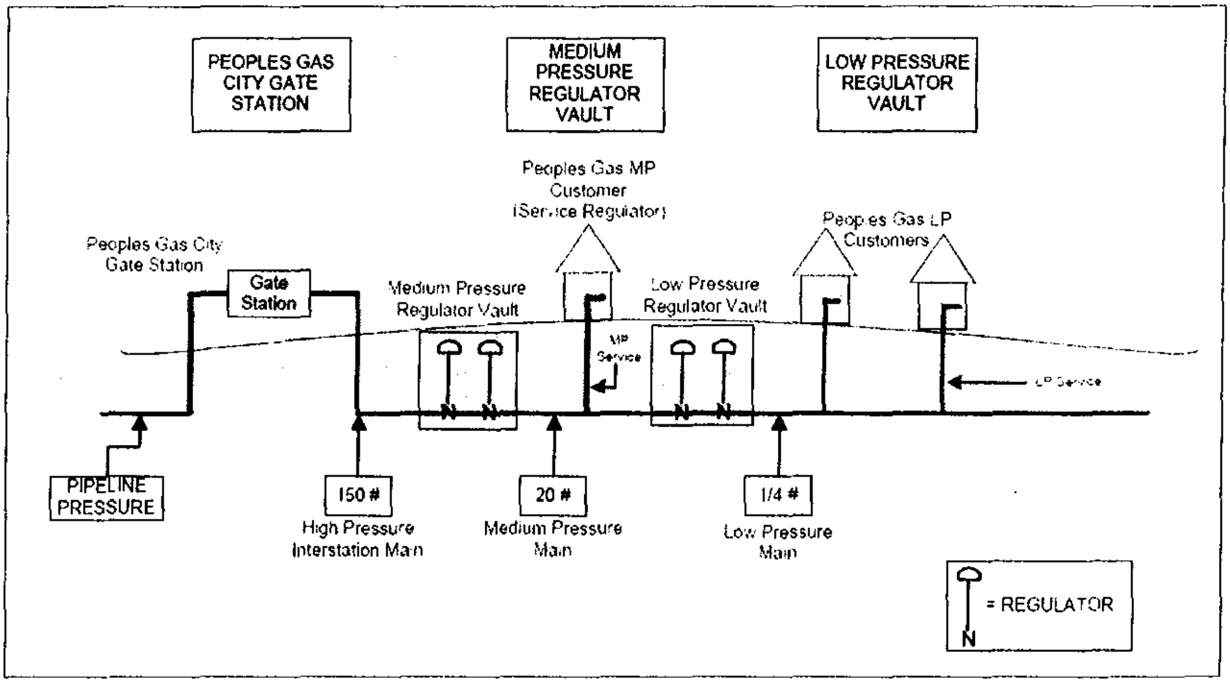


Exhibit SDM-1.4 shows the material makeup of PGL's distribution system, according to its 2008 report to the U.S. Office of Pipeline Safety, which contains system data for year-ending 2007.

Exhibit SDM -1.4 - Material Makeup of PGL Distribution System

	STEEL				PLASTIC	CAST/ WROUGHT IRON	DUCTILE IRON	COPPER	OTHER	OTHER	TOTAL
	UNPROTECTED		CATHODICALLY PROTECTED								
	BARE	COATED	BARE	COATED							
MILES OF MAIN	0	0	0	1202	898	1629	300	0	0	0	4029
NO. OF SERVICES	6497	185	0	42998	415762	71	373	13128	23460	1	503475

Source: U.S. Office of Pipeline Safety, 2008

Often a service line feeds multiple meters. PGL has about 540,678 meters installed inside buildings.

Q How does PGL's distribution system infrastructure compare to those of other utilities in the United States, particularly those in major urban areas such as the City of Chicago?

A Chicago is a world class cultural and commercial city, and likely site of the 2016 Olympic Games. It is therefore instructive to compare PGL's system with the five largest cities in the United States (Exhibit SDM- 1.5). This comparison shows that on a per mile basis PGL has the highest percentage of cast iron and ductile iron mains. This phenomenon is at least partially explained by PGL's history of approximately 150 years as a pioneering gas distribution company.

Exhibit SDM-1.5 – Largest - 5 U.S. Cities and Percentage CI/DI Mains

City	Population	Utilities Name	% CI/DI Mains
New York City	8,274,527	KeySpan Energy Delivery New York	43.81%
		Consolidated Edison Company of NY, Inc.	32.50%
Los Angeles	3,834,340	Southern Callifornia Gas Company	0.00%
Chicago	2,836,658	Peoples Gas Light & Coke Company	47.88%
Houston	2,208,180	Centerpoint Energy	0.17%
Phoenix	1,552,259	Southwest Gas Corporation	0.00%
		City of Mesa Municipal System	0.00%

Source: 2007 US Census Bureau and 2007 US Office of Pipeline Safety

Q What is entailed in operating and maintaining a distribution system infrastructure like PGL's distribution system?

A Although the federal and state pipeline safety regulations establish minimum safety standards, operating and maintaining the integrity of legacy assets such as cast iron and ductile iron pipe in a large, urban environment necessitates the effective implementation of a robust Operating and Maintenance ("O&M") Plan of policies, processes and procedures. The breath and depth of PGL's plan is expansive because of the diversity of pipe materials (cast iron, ductile iron, steel, polyvinyl chloride, copper and polyethylene) and operating pressures (low-pressure and medium-pressure). The prevention and mitigation activities in the plan include, but are not limited to:

- Instrument surveys for leaks and corrosion;
- Patrolling for excavation activities;
- Inspection of exposed pipe and other facilities;
- Preventative maintenance;
- Repair, rehabilitation or replacement;
- Inside safety inspections;
- Damage prevention programs; and
- Emergency response.

The frequency of PGL's scheduled surveys, inspections, patrols and maintenance range from weekly to once every 10 years.

Exhibit SDM-1.6 – Frequency of Surveys and Inspections

	Description	Inspection Frequency
Safety Inspections	Residential Outside	5 yr
	Residential Inside	3 yr
	Exposed Pipe	3 yr
	Business Outside Business Inside -------------------- Navy Pier Filtration Plant Term 2 E-F Concourse (O'Hare Field) Term 3 H-K Concourse (O'Hare Field)	1 yr 3 yr -------------------- 4 times/yr
	Loop Outside	3 times/yr
	Bare Steel Services/ Non-Protected Metal	3 yr
	High Pressure >= 12"	4 times/yr
Services	Corrosion - Services (Initial)	As required
	Corrosion - Services (1 Year)	1 yr
	Corrosion - Services (10 Year)	10 yr
	Corrosion - Services (Corrective Action)	As required
Mains	Corrosion - Gas Main (1 Year) -------------------- Corrosion - Gas Main (odd/even year type of inspections with a reading frequency of 6 or 7)	1 yr -------------------- 2 yr
	Corrosion - Gas Main (10 Year)	10 yr
	Corrosion - Gas Main (Corrective Action)	As required
Valves	Distribution Frontage Valve	1 yr
	Gas Operation Network Valve	1 yr
	Follow-up Distribution Valve Inspection	As required
	Follow-up Network Valve Inspection	As required
Main Inspections	Business or Medium-pressure Cast or Ductile	1 yr
	O Hare	1 yr
	Loop	3 times/yr
	High Pressure	4 times/yr

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	Residential	5 yr
	Residential (Low-pressure Residential mains that are non-plastic or cathodically protected.)	1 yr
	System 30 Station Gas Line System 40 Regulator Piping System 50 Distribution Gas Main	4 times/yr
	Bridges & Tunnels	4 times/yr
	Kind of 03 (Bare Steel)	2yr
Leaks	Leak Recheck Inspection	As required
	Leak Recheck - 1st Audit	N/A
	Leak Recheck - 2nd Audit	N/A

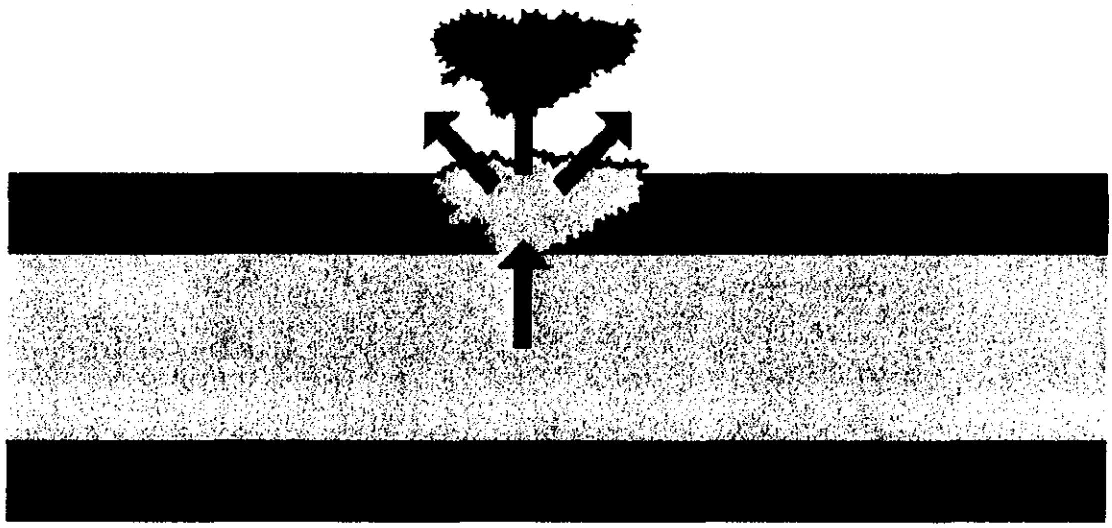
Q In your testimony, you frequently refer to risks and the potential failure of cast iron and ductile iron. What are the inherent risks associated with each of these materials and their failure mode?

A As the gas industry has evolved, so have the types of materials used in constructing gas distribution systems. The majority of pipe in PGL's gas distribution system is cast iron, ductile iron, steel, or plastic. It is evident in Exhibit SDM-1.4 that among its "peer" gas distribution utilities, PGL is the only entity with CI/DI service pipes in its system. This is largely due to PGL's long and unique history described above. The failure mode of these various pipe materials directly influences the principal risk associated with the integrity of the gas mains - the risk of injuries, fatalities and damage to property caused by gas releases and potential subsequent explosions.

For cast iron pipe, pipe fractures are the primary mode of failure resulting in the risk of an incident. Cast iron pipes fracture circumferentially (around the pipe) or axially (along the pipe) depending on the pipe diameter, extent of corrosion and external stresses. The operating pressure of cast iron pipes, which produces internal stress, is not a factor here because of the relatively low operating pressure of the cast iron distribution system. Circumferential fractures tend to result in catastrophic failure caused by ground movement that result in stress exceeding beam strength of the pipe causing the pipe to break in two pieces. While cast iron, like all materials, will eventually fail, cast iron failure is not time dependent, making it impossible to predict when a cast iron pipe will fail.

With respect to ductile iron pipe, plug failures are the primary mode of failure resulting in the risk of an incident. In ductile iron pipe, a hole or plug (typically the size of a dime or larger) will suddenly give way. This is illustrated in Exhibit SDM-1.7. The operating pressure of ductile iron pipes, which produces internal stress, combined with the corrosion of the pipe wall are factors in the likelihood of a plug failure. While ductile iron pipe failure is time dependent, failures are sudden and unpredictable. These failures can be similar to or worse than cast iron fractures. Ductile iron failures present a significant risk to personnel working on exposed ductile pipe, as the pipe can fail without warning. The use of cast iron risk models for ductile iron main is inappropriate due to the different mode of failure.

Exhibit SDM-1.7 - Plug Failure of Ductile Iron Pipe



Q What materials would PGL be using to replace the cast iron and ductile iron in its distribution system under the accelerated replacement program?

A Polyethylene pipe materials and coated cathodically protected steel, which currently represent the state-of-the-art in gas main and service materials, will be used.

Q Please discuss the approaches that gas distribution operators utilize to manage cast iron and ductile iron pipe systems.

A One method gas distributors use to manage failing CI/DI pipe is to repair leaks aggressively. This approach can be perceived as a "Band-Aid" approach that provides no proactive, systematic improvements by replacing the CI/DI with modern pipe materials.

The preferred method of managing CI and DI pipes is to replace these materials by using a combination of three approaches: condition, enforced and plan. This method provides for a long-term, proactive, systematic improvement of a company's distribution network.

The condition approach for identification and removal of CI/DI pipes is similar to the approach recommended by previous independent studies done for PGL (Zinder Engineering, Inc. 1981, 1994, 2002: Kiefner and Associates, Inc. 2007). Individual segments may be evaluated on such factors as maintenance history, soil conditions, and risks inherent in the pipe segment's location.

The enforced approach entails the removal or replacement of pipes in conjunction with the needs of the City of Chicago, or other applicable governmental agency, to accommodate public work projects such as road improvements and water infrastructure projects. It is beneficial to all parties involved if the removal and replacement of pipes can be done in conjunction with other projects, especially to minimize public inconvenience and to avoid the duplication of efforts. The plan approach, as I will more fully demonstrate in my testimony, involves systematic replacement of large contiguous areas of low-pressure and medium-pressure cast iron and ductile iron main while reducing the system risk, creating the best economic efficiencies for construction costs and also certain operation and maintenance economies.

In terms of program replacement strategies, some gas distribution operators have approached their state regulators and obtained funding approval to systematically replace all of the cast iron or bare steel in their system on an accelerated basis. For example, in 2006 the New Jersey Board of Public Utilities (NJBPU) approved Elizabethtown Gas' $37 million pipeline replacement program. This is approximately a four-year program to replace about 60 miles of cast iron gas mains, accelerating efforts over the previous 10 years that resulted in the replacement of approximately 144 miles of cast iron pipe.

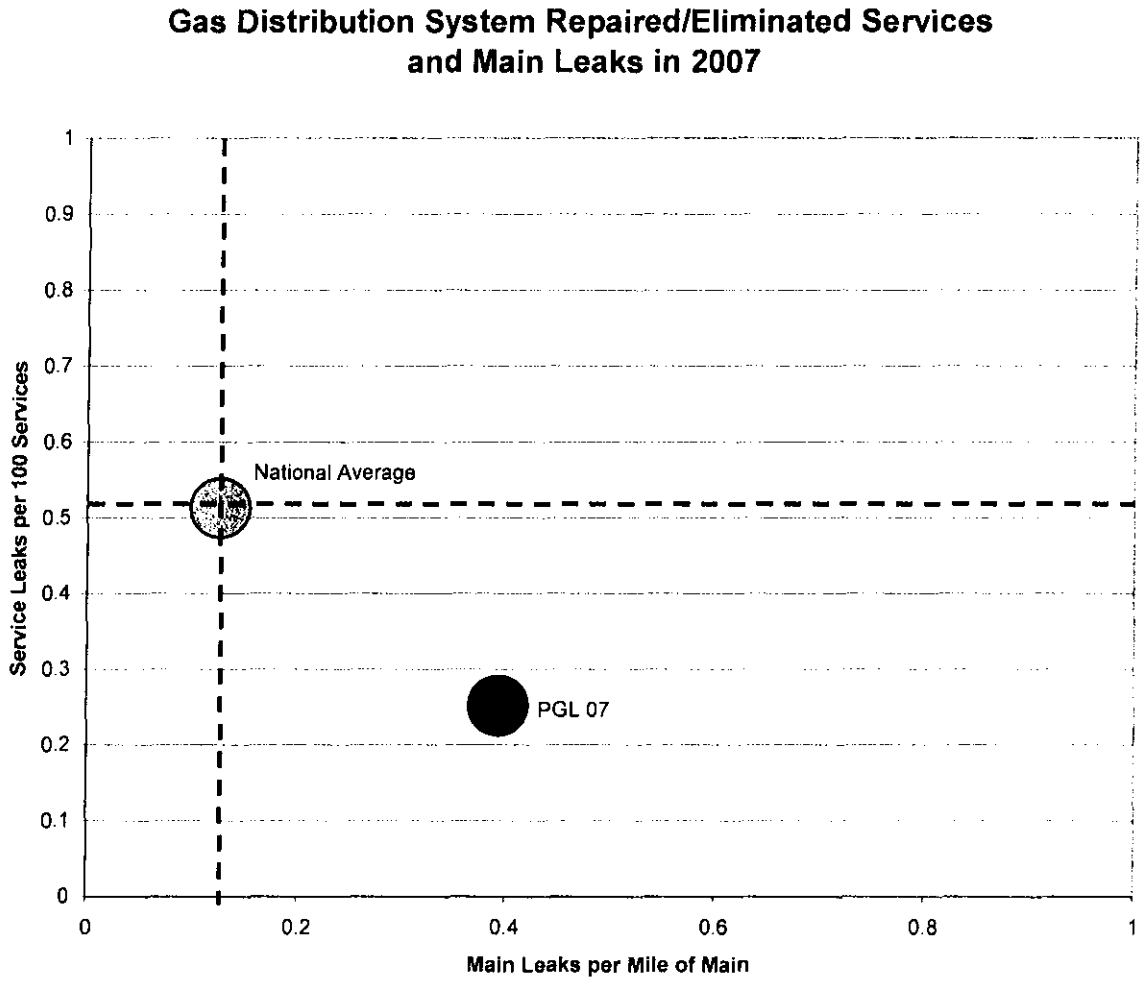
In my opinion, comparisons of PGL with the approaches undertaken by other utilities must be viewed in regard to the large amount of CI and DI pipe and medium-pressure DI in PGL's system. Also, by following the recommendations of other independent audits, PGL has not engaged in the systematic removal of CI/DI pipes on an accelerated basis. I have found that based on the 2008 U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration ("PHMSA") Office of Pipeline Safety ("OPS") Annual Reports filed by PGL and other gas utilities, PGL ranks second out of 1426 operators across the nation in terms of percentage of CI/DI as compared to total miles in its system. PGL also ranks first for miles of DI in its system and fourth in total miles of CI & DI combined. In terms of *service* lines with CI/DI, PGL ranks fifteenth for CI, first for DI and ninth for combined CI & DI in its system. These high rankings must be viewed in contrast to the fact that PGL ranks thirty-first in terms of total number of services.

Q In your opinion, does PGL currently operate and manage a system that is deemed safe by industry standards?

A In my opinion, within the constraints of not having an accelerated replacement program, PGL's operation and management of its distribution system currently provides a level of safety that compares well to industry standards, including other utilities with a large amount of CI/DI in their systems.

As shown in Exhibit SDM-1.8, PGL's leak rate for services per mile is below the national average, and above the national average for main leaks per mile.

Exhibit SDM -1.8 - Comparison of PGL to National Averages of Main and Service Leaks



Source: PHMSA Office of Pipeline Safety

A recent (2008) independent safety audit by the Liberty Consulting Group, which compared PGL to other utilities having a considerable amount of CI/DI mains in their system, determined that PGL ranked well below the median in terms of the number of leaks repaired, and PGL was well above the median in backlog of leaks to be repaired.

PGL's leak rates compare well with the other 10 systems in the industry with the most amounts of CI/DI pipes in their systems. (See Exhibit SDM-1.9) However, as is the case with all of these utilities having CI/DI pipes, PGL's leaks per mile of main is above the national average, as reported in OPS Annual Reports.

Exhibit SDM -1.9 - Leak Rates among 11 Utilities with Most CI/DI

Gas Distribution System Repaired and Eliminated Services and Main Leaks in 2007

	Total Main Leaks	Total Service Leaks	Total Miles of Main	Total # of Services	Main Leaks per Mile of Main	Service Leaks per 100 Service
PUBLIC SERVICE ELECTRIC & GAS CO	4,157	4,282	17,618	1,242,398	0.24	0.34
MICHIGAN CONSOLIDATED GAS CO (MICHCON)	4,224	3,771	18,520	1,193,333	0.23	0.32
BOSTON GAS CO	5,916	2,785	6,219	480,062	0.95	0.58
PEOPLES GAS LIGHT & COKE CO	1,587	1,280	4,029	508,475	0.39	0.25
KEYSPAN ENERGY DELIVERY - NY CITY	2,899	1,185	4,033	561,150	0.72	0.21
PHILADELPHIA GAS WORKS	2,440	5,545	3,023	460,989	0.81	1.20
CONSOLIDATED EDISON CO OF NEW YORK	5,562	3,988	4,264	382,286	1.30	1.04
BALTIMORE GAS & ELECTRIC CO	2,706	3,364	6,832	511,794	0.40	0.66
ALABAMA GAS CORPORATION	4,195	7,588	10,519	538,851	0.40	1.41
NIAGARA MOHAWK POWER CORP	2,273	669	3,102	186,291	0.73	0.36
PECO ENERGY CO	3,034	1,522	6,658	419,778	0.46	0.36
NATIONAL AVERAGE	**107**	**233**	**842**	**45,450**	**0.13**	**0.51**

With regard to other independent audits of PGL's safety relative to CI and DI mains (Zinder Engineering, Inc. 1981, 1994, 2002; Kiefner and Associates, Inc. 2007), it is my opinion that PGL has acted responsibly to meet CI/DI recommendations contained in the reports. I find that PGL has undertaken reasonable and innovative operations and management techniques to achieve compliance with all recommendations in undertaking the unique task of operating and managing such a relatively large amount of CI and DI pipe.

However, based on industry experience, the unpredictable nature of DI pipe and PGL's backlog of leak repairs in its system, it is my opinion that an accelerated replacement effort by PGL will be required to maintain or improve the safety of its system.

Q In your opinion does the current program main or service line replacement duration present any risks to PGL or its customers?

A Yes. While there is no immediate risk posed by PGL's current system and operating practices, the system is aging and, while PGL does a good job managing the risks posed by its antiquated system, all materials will eventually fail and require replacing. Moreover, the costs associated with the ongoing management of the risk posed by an aging system likely will increase as the system continues to age. For example, the rate of ductile iron failures in other gas distribution systems has been shown to increase with age. PGL has more ductile iron than any other gas distribution system in the U.S.

PGL's plan is one that is proactive and would allow it to stay ahead of any such potential failures or increased risk management expenses. If in the future, however, failures which could pose a risk to the general public manifest themselves, a reactive acceleration of the replacement program at that time could present costly and difficult management issues as opposed to a more proactive planned approach, such as the one proposed in this testimony.

Q In your opinion, will an accelerated program to replace the low-pressure main and service line infrastructure mitigate those risks and improve the safety aspects of PGL's distribution system?

A Yes. An accelerated program to replace the low-pressure system main and service line infrastructure would result in the replacement of 1,427 miles (86.3%) of CI pipe, and 238 miles (75.8%) of the DI pipe. Together with the removal of the remainder of the CI/DI pipe, which is in the medium-pressure system, these actions would, in my opinion, further mitigate future risks to PGL and its customers and avoid a potential reactive approach in the future. It is my opinion that a potential unpredictable failure or series of failures could precipitate a reactive approach to accelerating the replacement of these materials and would impact negatively all the benefits and advantages of pursuing a planned program like the accelerated replacement program being proposed in this testimony.

One example of a precautionary approach to accelerated replacement of low-pressure and medium-pressure higher-risk pipe is the actions taken by Transco (now National Grid) in the United Kingdom. Following a review of Transco's risk-based methodology, the UK Health and Safety Executive (HSE), which has national pipeline safety responsibility, no longer considered the risk-based program to be an acceptable course of action because it:

- Did not constitute adequate action to comply with the requirements of health and safety legislation; and
- Did not address the likelihood and severity of health and safety (and social and economic) consequences should a rapid deterioration of the network occur.

In 2001 the HSE and the Office of Gas and Electricity Markets (OFGEM), which has price control responsibilities, required Transco to complete replacement of 48,625 miles of cast iron and 8,125 miles of ductile iron within 30 years. At the previous replacement rate, it would have taken 51 years. The HSE keeps the replacement policy under review as program implementation proceeds.

Q **In addition to accelerating the replacement of higher-risk materials, are there any additional safety benefits that PGL's proposed system would provide?**

A Yes, there are many safety benefits that can be realized in addition to the elimination of the catastrophic fractures associated with cast iron pipe and the unpredictable plug failure of ductile iron pipe.

Replacing the low-pressure system will enable PGL to install excess flow valves on customer service lines. An excess flow valve is a device installed on the service line at the point where the service line is connected to the main. In the event that the service is cut, the sudden pressure drop and increased flow rate causes the device to be activated, stopping further escape of gas. Excess flow valves cannot be installed on low-pressure systems because the pressure difference between the pressure in the gas main and atmospheric pressure is insufficient for the devices to function.

The elimination of the low-pressure system will enable PGL to simplify its operating and maintenance plan. For example, medium- to low-pressure district pressure stations will be eliminated, increasing standardization of procedures and reducing the potential of operator error.

Unlike the low-pressure system, a medium-pressure meter set will have a pressure regulator with overpressure relief and a meter shutoff valve installed before the meter. The meters that are relocated from inside to outside will eliminate the need for inside safety inspections. However, PGL will still respond to inside gas odor calls from customers. Outside meters will also enable the City of Chicago Fire Department to quickly shut off gas to the property from the outside.

Eliminating the low-pressure system will reduce the size and duration of unplanned gas outages. Outages caused by water infiltration will be virtually eliminated. The use of polyethylene (PE) main will enable PGL crews to isolate gas leaks quickly for repair by either closing an existing valve or squeezing the pipe off upstream and downstream of the leak.

Other safety improvement associated with the replacement program is the opportunity to move gas facilities away from other utility infrastructure in the street, such as water and sewer lines, by moving gas lines into the parkway. This is expected to result in a reduction of excavation damage and an increase in worker safety.

Customers who currently require elevated pressure but are served from the low-pressure system must install and maintain gas boosters and safety back-check valves. Gas boosters and safety back-check valves present an operating risk to both the customer and PGL. If these devices should fail, it could result in damages to both the customer and PGL facilities. Switching these customers from a low-pressure to a medium-pressure source of gas supply will enable many of these customers to remove their gas boosters and safety back-check valves.

Q Does the need for infrastructure replacement reflect any unique and unpredictable circumstances?

A I previously described the unique and unpredictable circumstances of PGL's gas distribution system in various questions above. These circumstances are summarized below:

- Large urban operator in a large, world-class city
- Climatic conditions that pose challenges to infrastructure
- Large amount of DI medium-pressure pipe
- Large amount of low-pressure cast iron
- Failure modes of CI and DI material

The risk associated with cast and ductile iron failure increases with pressure. PGL has approximately 16% of its cast and ductile iron pipe operating at medium-pressure; this is more than Public Service Electric and Gas, which has the largest cast and ductile iron system in the U.S.

III. Modernization and Technology

Q What are the strengths and weaknesses of the type of materials used for mains and services in PGL's existing distribution infrastructure system that would be replaced under the proposed accelerated program?

A In my response earlier, I discussed the failure modes of the "at-risk" materials. The use of PE pipe will eliminate the threat to pipe integrity associated with corrosion of iron pipe and stress-related cracking of pre-1980 plastic pipe material. PE, which is also less expensive to install and maintain than coated cathodically protected steel pipe, has a longer life expectancy of 80 plus years.

However, there are situations where the material strength and gas capacity of coated, cathodically protected steel pipe will be necessary. The appropriate material will be determined when a project is designed.

Q In your opinion, what are the strengths and weaknesses inherent in a low-pressure gas distribution system such as the one that would be replaced under the proposed accelerated program?

A The low-pressure system is a legacy from the period when gas was manufactured from coal. When natural gas became available, the existing system was converted to a low-pressure natural gas distribution system. No new

(Greenfield) gas distribution system would consider constructing a low-pressure distribution system today.

In my opinion, a low-pressure system provides no compelling benefits.

Q What are the strengths and weaknesses inherent in a medium-pressure gas distribution system such as the one to which PGL plans to upgrade in the proposed accelerated replacement program? How do they compare to the existing system it would replace?

A A medium-pressure natural gas distribution system has many benefits. To begin with, it is less costly to construct because the operating pressure allows smaller diameter pipe to be installed. A medium-pressure system can be constructed of PE pipe, which is less expense than coated steel pipe.

From an operating and maintenance perspective, a medium-pressure system has fewer joint leaks because the PE pipe is fused and steel pipe is welded. The gas flow in a PE pipe can be shut-off as quick as or quicker than a low-pressure system by squeezing the PE pipe.

When a leak occurs on a medium-pressure system, all else being equal, additional gas will escape than from a low-pressure system. This does not necessarily mean that a leak on a medium-pressure system is more likely to result in a reportable incident. Often a leak on a medium-pressure system is reported sooner, and it is easier to locate the source of the leak. A medium-pressure system also generates fewer calls from customers with appliance problems caused by insufficient gas pressure.

Q Can you cite other systems which are undergoing modernization?

A The following is a list of companies that are undergoing modernization, based on the American Gas Association ("AGA") Rate Round-Up Newsletter of December 2007 and a Jacobs Consultancy telephone survey. This list was compiled by the participating AGA panel of companies and may not be a total list of U.S. companies undertaking modernization.

Exhibit SDM -1.10 - Gas Utilities with Regulatory Approved Asset Replacement Programs

Company Name	Type of Modernization
CenterPoint Energy Southern Operations	Replacement of Bare Steel Mains, Cast Iron Mains, and Associated Services
Atlanta Gas Light	Pipeline Replacement Program
Vectron South - SIGECO	Cast Iron Mains, Bare Steel Mains, & Services Replacement Program
Kansas Gas Service	New Infrastructure Replacement
Aquila	Replacing of Gas Main
Duke Energy - Cinergy	Accelerated Main Replacement
Laclede Gas	Infrastructure System Replacement
Missouri Gas Energy	New Infrastructure Replacement
Atmos Energy	Infrastructure System Replacement
Elizabethtown Gas	Pipeline Replacement Program
National Grid	Replacement of Leak-prone Mains
Duke Energy	Accelerated Main Replacement
NW Natural Gas Utilities	Gas Reliability Infrastructure Program
All Natural Gas Utilities	Gas Reliability Infrastructure Program
Atmos Energy	New pipes, Replacement Pipe, Pipeline Integrity Capital)
Texas Gas Service	New Infrastructure Replacement
Puget Sound Energy	Cast Iron Mains, Bare Steel Replacement Program
Vectren North - Indiana Gas	Infrastructure System Replacement
Columbia NiSource	Infrastructure Replacement Program
Oklahoma Natural Gas	Replacement of Mains and Service Lines

Q Will the new infrastructure system lead to synergies and efficiencies in system maintenance and operation?

A Yes.

Q How will those synergies and efficiencies translate into benefits for the customers?

A Customers will benefit from the synergies and efficiencies in system maintenance and operation in several ways:

- Simplify PGL's O&M plan, reducing the cost of maintaining the plan and associated employee training;
- Eliminate the inspection and maintenance of medium- to low-pressure regulator stations;
- Reduce and possibly eliminate some of the inconvenience and cost of inside safety inspections;
- Reduce the amount of pipe leak surveys each year;
- Reduce the number of emergency calls;
- Eliminate the freeze-up of low-pressure risers; and
- Reduce emergency and warehouse inventory.

Q Are there any additional reasons why this upgrade to a newer and more modern infrastructure system needs to be accelerated?

A Benefits of the medium-pressure system would include incremental services made possible by the medium-pressure system's ability to accommodate technologies and appliances not available through the current low-pressure system, including access to many high-efficiency appliances. In the relatively near future, the residential low-pressure system may not be able to serve standard residential appliances, if as expected; they require 6" of water column pressure at the burner tip. The lack of a medium-pressure system would cause customers in Chicago to forego consumer options or require more expensive special orders.

In addition, a medium-pressure system will allow Chicagoans to install higher efficiency appliances. The following higher efficiency appliances require inlet pressures that in many cases would require either a customer-installed booster or PGL's provision of a medium-pressure system:

- Tankless water heaters;
- Fan assisted heaters;
- Home generators; and
- Commercial-grade cooking appliances.

Exhibit SDM-1.11 shows the consumer benefits that could be achieved from the installation of a tankless water heater. These benefits will not be available to all customers, unless the system is upgraded to a medium-pressure system.

SDM -1.11 – Consumer Benefits of a Tankless Water Heater

Water Heater Type	Water Heater Life*	Minimum Gas Pressure	Estimated Annual Energy Cost**
Tankless Water Heater	20	4.5" - 7" WC	$265
Gas 40 Gallon Heater***	13	4.5"	$326
Electric 40 Gallon Tank***	15	NA	$453

* California Database for Energy Efficiency Results (DEER)
** Based Upon DOE average Energy Costs for 2006
*** Source: GAMA Consumers Directory of Certified Efficiency Ratings

The benefits for commercial applications would also increase. Current commercial kitchen equipment requires a minimum of about 6" of water column, as do current rooftop heating systems which are standard for commercial use. Therefore, in many areas, customers must install electric-driven gas boosters to raise the gas pressure, and back-up systems for the pressure boosters as a safeguard against electrical power outages. The cost of these booster systems and back-ups, based on information provided by PGL staff, are between $20,000 and $50,000, depending on commercial building size and back-up configuration. Currently, commercial boilers specifically made for low-pressure system installation are available from only one manufacturer. Another area of potential savings for customers is that a medium-pressure system would allow them the option of using corrugated steel piping, which is more economical and would allow customers to reduce their building construction costs.

Chicago code requires critical facilities such as schools, hospitals, and emergency services providers to have back-up generation installed. However, natural gas–fired generator equipment requires medium-pressure or additional booster and back-up expenses if connected to the low-pressure system in many locations.

In addition to the system safety advantages of replacing the low-pressure system that I have described above, there are other benefits relating specifically to natural gas-fired portable generators. Because natural gas-powered back-up generators require medium-pressure, the alternative is the more dangerous and less environmentally-friendly gasoline- or diesel-powered versions. The use of gasoline- or diesel-powered emergency generators is less safe than a permanently connected natural gas-fueled generator, primarily due to the risks involved in gasoline or diesel fuel storage and transfer, especially in residential situations.

Q Will the upgraded system provide any environmental benefits?

A Conversion of the current low-pressure system to a medium-pressure system would provide certain environmental benefits. In the upgrading of the system, the use of directional drilling and insertion construction techniques will reduce the amount of soil that will need to be removed and disposed. The use of double decking -- the process whereby the main in the street is replaced with a main installed in the parkway on both sides of the street -- will reduce future street excavation, as well as soil removal and disposal. In nearly all cases, the use of removed spoil is not eligible for use as fill and must be transported and disposed of in a landfill. Additionally, once the pipes are replaced, the carbon footprint of PGL's maintenance program would be reduced because much fewer maintenance trips by crew vehicles would be required.

PGL's proposed conversion from an low-pressure to medium-pressure system with replacement of CI/DI mains would also bring about a significant reduction in natural gas leaked to the atmosphere. According to a 1996 study by the U.S. Environmental Protection Agency, the largest contributors to the overall annual emissions from natural gas distribution systems were cast iron mains. Exhibit SDM-1.12 illustrates how the reduction in emissions was calculated.

Exhibit SDM -1.12 - Greenhouse Gas Emission Reductions

Material:	Emissions Factor:
Mains - Cast Iron	238.7 Mcf/mile/year
Mains - Unprotected Steel	110.5 Mcf/mile/year
Mains - Protected Steel	3.13 Mcf/mile/year
Mains - Plastic	9.91 Mcf/mile/year

Calculating of Emission Reduction (ER) for distribution systems replacement, using example of current replacing 45 miles of cast iron with 22.5 miles of steel and 22.5 miles of plastic is as follows:

ER = Emission Reduction

$ER = (Miles_{CI} \times EF_{CI}) - (Miles_{Steel} \times EF_{Steel}) - (Miles_{Plastic} \times EF_{Plastic})$

$ER = 45 \times 238.7 - 22.5 \times 3.13 - 22.5 \times 9.91$

ER = 10,448.1 Mcf/year

Therefore, applying the study to PGL's current replacement rate of 45 miles of CI pipe per year is resulting in reduced greenhouse gas emissions of 10,448 Mcf[1] per year. Doubling the rate of replacement of the 1,929 miles of CI/DI pipe in the low-pressure system would result in a reduction of nearly 21,000 Mcf per year.

Another environmental benefit of the conversion from a low-pressure to a medium-pressure system is the nearly complete reduction in the amount of water which would be collected from the distribution system. CI joints are prone to leaking and the water that enters the system pipes needs to be collected and removed. The locations where this water is collected are known as "drips". Drip

[1] "Mcf" is a unit of measure equaling a thousand cubic feet of natural gas.

collection on PGL's low-pressure system is done routinely and especially after rains. The water is collected and taken to PGL's Crawford facility where it is tested for contaminants. When contamination is found, it occurs in the form of PCB contamination that has been received from the interstate pipelines which provide gas to PGL's system.

The water collected from drips is treated and disposed of depending on whether it is contaminated. This process would be virtually eliminated in an medium-pressure system because newer pipe and joint materials would be much more impervious, and the medium-pressure of the gas would keep the water from entering the system.

The conversion to a medium-pressure system would also facilitate the use of higher-efficiency gas appliances such as those described previously in my testimony. The use of higher-efficiency appliances means that smaller volumes of gas are consumed to produce the same amount of therms when compared to standard appliances, providing for conservation of natural gas supplies. For example, according to the American Council for an Energy Efficient Economy's Consumer Guide to Home Energy Savings, a high efficiency gas water heater can perform at an annual fuel efficiency rating of 80%, compared to 60% ratings for conventional gas water heater.

IV. Identification and Description of New System's Functionalities

Q How will the operating and maintenance functionalities of the system differ following the system modernization?

A The gas pressure customers receive will be controlled more accurately and will enable PGL to accommodate customers that require elevated-pressure without the customer needing to install gas boosters. The medium-pressure will prevent water infiltration into the gas mains, eliminating the collection of liquids covered by environmental regulations governing the collection, transport and disposal of those liquids. There will be fewer district pressure regulators to monitor, inspect and maintain. The use of PE pipe will enable quicker and safer isolation and repair of mains.

In my opinion, there are no beneficial functionalities of the low-pressure system that will be foregone.

Q Please identify and describe the functionality of the new system beginning in 2009 from a system operation perspective.

A The system will be connected to two new city gate stations, six total, which will provide additional reliability and provide a more optimal design. Operating the system will be simplified. All 345 medium to low-pressure regulator stations will be eliminated. The 54 new high-pressure to medium-pressure regulator stations are expected to have a common design reducing construction costs and future maintenance costs. Outages caused by water infiltration will no longer occur.

This is especially important in winter months when conditions can lead to water main breaks at the same time that gas delivery for heating is crucial.

Additional capacity to existing customers could be accommodated by increasing the allowable operating pressure. Where possible, PE pipe in residential areas will be double decked – installed in the parkway on both sides of the street – reducing the amount of pipe beneath streets. This configuration also potentially may reduce excavation related damage and minimize maintenance costs. This will also result in benefits to the City of Chicago as PGL's pipes will be less likely to be encountered during street repairs or other utility activities. Additional valves will be available to isolate portions of the system, as well as create the ability to isolate smaller sections by use of squeeze off. Meter sets relocated outside provide greater access and improved safety. The volume of gas a customer uses will be metered more accurately because the gas volume will be temperature compensated and measured at a constant pressure. Company personnel will be able to shut-off gas to buildings in emergencies or for non-payment without the customer being present.

Q Please identify and describe the functionality of the new system from a system maintenance perspective.

A Where possible, the new regulator stations may be located in the parkway providing safe access and reduced impact on traffic. Elimination of a class of regulator stations - medium-pressure to low-pressure – will reduce the amount of training, inspection and maintenance, and therefore reduce the potential of human error. Overall, the City of Chicago will encounter far fewer regulator vaults that would impede in-street construction.

All steel pipes will be coated and cathodically protected. The increased proportion of PE to non-PE pipe will reduce the threat of leaks caused by corrosion and reduce the amount of pipe required to be leak surveyed annually. Outside meter sets will be readily accessible to both gas company personnel and City of Chicago emergency response personnel. Outside meters also can reduce the potentially unsafe theft of gas.

Q Please identify and describe the functionality of the new system from a system customer perspective.

A Operating a medium-pressure system will increase reliability over the low-pressure system. Customers currently on the low-pressure system requiring elevated pressures will no longer incur the cost of installing, operating and maintaining gas boosters and safety back-check valves. When practical, service lines will have excess flow valves, reducing the potential property damage caused by a damaged service line. Customers will be able to purchase gas utilization equipment, e.g. gas boilers, without paying equipment premiums due to the minimum gas pressure. Customers will be able to choose from new or more efficient gas appliances, e.g. tankless water heaters. The City of Chicago Fire Department will be able to shut off gas to a building from the outside meter sets, potentially reducing property damage.

Q In your opinion, will the new system involve any foregone functionality?

A In my opinion, eliminating the low-pressure system and high risk pipe will not result in any foregone functionality.

V. Benefit to Customer – Cost/Benefit Analysis

Q Please describe PGL's current distribution pipe replacement programs.

A PGL's pipe replacement program consists of three elements: condition replacement, block replacement and enforced replacement. For condition replacement, PGL utilizes its Main Ranking System to identify and prioritize gas main segments as candidates for replacement. Each individual segment is evaluated based on its maintenance history. Criteria taken into account include breaks, cracks at taps, pipe wall thickness based on pipe coupons (segments of pipe removed for testing), visual observation, incidence of leak and other repairs. Each of these criteria is assigned a factor based on "Break Equivalents" which is then multiplied by the number of occurrences.

The sum of the aforementioned numerical values is then multiplied by a factor based on pipe material, operating pressure, diameter, street type and pavement cover. The result of this calculation is a value that is assigned to each segment known as the Main Ranking Index (MRI). The MRI value is rounded to the nearest quarter point, (i.e. The Uniform Main Rank Index (UMRI)) and sorted in descending order in order to identify those segments with the highest incidence of UMRI points per block. In addition, a locational factor is also added. Segments with breaks in the low-pressure system are multiplied by 1 and those with breaks in the medium-pressure system are multiplied by 2.

All segments that have accumulated a UMRI rating greater than 6.0 are placed on a schedule to be retired. Segments with a UMRI value greater than 3.0 are viewed as possible replacement candidates when performing work on adjacent segments and when evaluating the extent of Public & System Improvement projects.

For block replacements, PGL recently developed a Cost Optimization Program (COP) in order to calculate and generate savings from future maintenance costs avoided by replacing pipe when needed. This program's goal is to create savings for customers and shareholders by reducing investment in repairs by replacing facilities on a timely basis. Using very detailed information on 80,000 pipe segments that is integrated with the representation of PGL's distribution system in its computerized geographic information system, the COP creates groupings where greatest future maintenance costs would be avoided by replacement.

PGL has inserted smaller-diameter plastic pipe in CI/DI pipes where feasible due to sufficient length of line without service connections being present. The remaining CI and DI mains would be in most cases abandoned in place, necessitating the reconnection and replacement of service lines. The existing service lines to be replaced are primarily plastic, cast iron, and copper. They are to be replaced by plastic service lines. If the low-pressure system were replaced by a medium-pressure system, low-pressure regulator vaults would no longer be needed and would be removed.

At the current rate, replacement of all segments of 10-inch and 12-inch diameter CI/DI pipe should be completed by 2050, and replacement of all segments of 16-inch and larger CI/DI pipe should be completed by 2080.

Q **What is the current approach utilized for determining pipe replacement goals by PGL?**

A As I stated in my answer to the previous question, PGL currently utilizes methods and systems to analyze and select potential distribution system capital improvement projects, based on a combination of pipe history and situational factors, as well as outcomes of the COP. The methodology for project selection ranges from the highest potential projects to improvement recommendations from PGL's general supervisors based on their knowledge of distribution system weaknesses in their territories to projects based on coordination with public improvement projects. The driver for determining the location and scope of these projects has been primarily based on the goal of retiring 45 miles of CI/DI pipe each year in the most effective manner possible.

Q **How was the basis for the proposed accelerated replacement period determined?**

A Scenario 3 of our cost benefit analysis model represents the proposed accelerated replacement period. To determine the accelerated replacement period, we ran Scenario 3 using three different replacement completion years: 2025, 2030, and 2035. The estimated construction costs and O&M savings that each completion year is expected to produce, as shown in Exhibit SDM-1.13 and Exhibit SDM-1.14, were analyzed. The replacement rate or miles of main abandoned per year and the average miles of main installed per year varied depending on the completion year as shown in Exhibit SDM-1.15. Although completing the replacement program in 2025 is estimated to produce the most savings, replacing 154 miles of main per year is more than three times the current replacement rate and deemed not practical in my opinion, which is corroborated by PGL operations management. Of the three completion years, 2035 is estimated to produce the least amount of cost savings. As a result, the completion year of 2030 was chosen based on the feasibility of its replacement rate and its overall cost benefits.

Exhibit SDM-1.13 – Estimated Construction Costs by Replacement Completion Year

Estimated Accelerated Program Construction Costs	2025			
	Scenario 1 Like & Kind	Scenario 2 Current	**Scenario 3 Proposed**	Capital Program Savings
Account 376, Distribution Mains	$ 1,284,928,525	$ 1,826,992,158	$ 1,662,662,951	$ 164,329,207
Account 380, Services	$ 801,924,071	$ 801,924,071	$ 506,279,857	$ 295,644,214
Account 381, Meters including Meter Installations	$ -	$ 163,152,673	$ 147,836,741	$ 15,315,932
Account 383, House Regulators	$ -	$ 81,576,336	$ 73,918,370	$ 7,657,966
Account 378 & 379, Abandon Regulator Stations	$ -	$ 10,061,764	$ 9,117,218	$ 944,547
Account 378 & 379, New Regulator Stations	$ -	$ 7,874,424	$ 7,135,214	$ 739,210
Account 378 & 379, New City Gate Stations	$ -	$ 7,895,678	$ 7,895,678	$ -
Total Construction Cost	**$ 2,086,852,596**	**$ 2,899,477,104**	**$ 2,414,846,028**	**$ 484,631,076**
Construction Cost/Mile	**$ 947,775**	**$ 1,316,840**	**$ 1,119,559**	**$ -**
Construction Cost/Year	**$ 42,588,828**	**$ 59,173,002**	**$ 172,489,002**	**$ -**

Estimated Accelerated Program Construction Costs	2030			
	Scenario 1 Like & Kind	Scenario 2 Current	**Scenario 3 Proposed**	Capital Program Savings
Account 376, Distribution Mains	$ 1,284,928,525	$ 1,826,992,158	$ 1,697,002,578	$ 129,989,579
Account 380, Services	$ 801,924,071	$ 801,924,071	$ 518,609,104	$ 283,314,967
Account 381, Meters including Meter Installations	$ -	$ 163,152,673	$ 151,546,216	$ 11,606,457
Account 383, House Regulators	$ -	$ 81,576,336	$ 75,773,108	$ 5,803,228
Account 378 & 379, Abandon Regulator Stations	$ -	$ 10,061,764	$ 9,345,984	$ 715,780
Account 378 & 379, New Regulator Stations	$ -	$ 7,874,424	$ 7,314,248	$ 560,176
Account 378 & 379, New City Gate Stations	$ -	$ 7,895,678	$ 7,895,678	$ -
Total Construction Cost	**$ 2,086,852,596**	**$ 2,899,477,104**	**$ 2,467,486,917**	**$ 431,990,187**
Construction Cost/Mile	**$ 947,775**	**$ 1,316,840**	**$ 1,143,964**	
Construction Cost/Year	**$ 42,588,828**	**$ 59,173,002**	**$ 129,867,732**	

Estimated Accelerated Program Construction Costs	2035			
	Scenario 1 Like & Kind	Scenario 2 Current	**Scenario 3 Proposed**	Capital Program Savings
Account 376, Distribution Mains	$ 1,284,928,525	$ 1,826,992,158	$ 1,720,641,364	$ 106,350,794
Account 380, Services	$ 801,924,071	$ 801,924,071	$ 527,184,455	$ 274,739,616
Account 381, Meters including Meter Installations	$ -	$ 163,152,673	$ 154,116,941	$ 9,035,732
Account 383, House Regulators	$ -	$ 81,576,336	$ 77,058,470	$ 4,517,866
Account 378 & 379, Abandon Regulator Stations	$ -	$ 10,061,764	$ 9,504,523	$ 557,241
Account 378 & 379, New Regulator Stations	$ -	$ 7,874,424	$ 7,438,322	$ 436,102
Account 378 & 379, New City Gate Stations	$ -	$ 7,895,678	$ 7,895,678	$ -
Total Construction Cost	**$ 2,086,852,596**	**$ 2,899,477,104**	**$ 2,503,839,752**	**$ 395,637,351**
Construction Cost/Mile	**$ 947,775**	**$ 1,316,840**	**$ 1,160,818**	
Construction Cost/Year	**$ 42,588,828**	**$ 59,173,002**	**$ 104,326,656**	

Exhibit SDM-1.14 – Estimated O&M Savings by Replacement Completion Year

Estimated Accelerated Program O&M Costs/Savings			2025		
	Scenario 2 Current	Scenario 3 Proposed	O&M Total Savings	O&M Savings Per Mile of Main Abandoned per Year	O&M Savings Per Customer Per Year
Leak Repairs	$ 278,464,530	$ 95,802,738	$ 182,661,791	$ 6,048.91	$ 15.28
Leak Surveys	$ 10,636,741	$ 8,907,197	$ 1,729,544	$ 57.27	$ 0.14
Leak Rechecks	$ 17,771,669	$ 6,114,152	$ 11,657,517	$ 386.04	$ 0.97
Emergency Response to Make Safe	$ 16,097,868	$ 11,975,779	$ 4,122,089	$ 136.50	$ 0.34
Regulator Station Inspection and Maintenance	$ 6,042,415	$ 2,778,737	$ 3,263,678	$ 108.08	$ 0.27
Vault Survey and Maintenance	$ 914,221	$ 420,424	$ 493,796	$ 16.35	$ 0.04
Cathodic Protection Surveys and Maintenance	$ 67,390,478	$ 93,342,046	$ (25,951,568)	$ (859.40)	$ (2.17)
Valve Inspection	$ 27,179,168	$ 44,516,170	$ (17,337,002)	$ (574.12)	$ (1.45)
Cost of Lost Gas	$ 118,635,490	$ 44,292,062	$ 74,343,428	$ 2,461.91	$ 6.22
Inside Safety Inspections	$ 63,404,494	$ 15,312,709	$ 48,091,785	$ 1,592.58	$ 4.02
Total O&M Cost[1]	**$ 606,537,073**	**$ 323,462,015**			
O&M Cost/Mile	**$ 329,706**	**$ 179,473**			
O&M Cost/Year	**$ 12,378,308**	**$ 6,601,266**			
O&M Savings			**$ 283,075,058**		
Average Cost Savings per Mile of Main Abandoned per Year			**$ 2,678**		
Rider ICR - SV Factor			**$ 5,972**		

1 Labor costs do not include G&A.

Estimated Accelerated Program O&M Costs/Savings			2030		
	Scenario 2 Current	Scenario 3 Proposed	O&M Total Savings	O&M Savings Per Mile of Main Abandoned per Year	O&M Savings Per Customer Per Year
Leak Repairs	$ 278,464,530	$ 120,187,270	$ 158,277,260	$ 3,862.09	$ 9.75
Leak Surveys	$ 10,636,741	$ 9,159,567	$ 1,477,174	$ 36.04	$ 0.09
Leak Rechecks	$ 17,771,669	$ 7,670,379	$ 10,101,290	$ 246.48	$ 0.62
Emergency Response to Make Safe	$ 16,097,868	$ 12,525,163	$ 3,572,706	$ 87.18	$ 0.22
Regulator Station Inspection and Maintenance	$ 6,042,415	$ 3,213,886	$ 2,828,528	$ 69.02	$ 0.17
Vault Survey and Maintenance	$ 914,221	$ 486,263	$ 427,958	$ 10.44	$ 0.03
Cathodic Protection Surveys and Maintenance	$ 67,390,478	$ 90,039,218	$ (22,648,740)	$ (552.65)	$ (1.40)
Valve Inspection	$ 27,179,168	$ 42,258,718	$ (15,079,549)	$ (367.95)	$ (0.93)
Cost of Lost Gas	$ 118,635,490	$ 55,164,312	$ 63,471,178	$ 1,548.75	$ 3.91
Inside Safety Inspections	$ 63,404,494	$ 21,718,829	$ 41,685,665	$ 1,017.16	$ 2.57
Total O&M Cost[1]	**$ 606,537,073**	**$ 362,423,604**			
O&M Cost/Mile	**$ 329,706**	**$ 201,091**			
O&M Cost/Year	**$ 12,378,308**	**$ 7,396,400**			
O&M Savings			**$ 244,113,470**		
Average Cost Savings per Mile of Main Abandoned per Year			**$ 2,310**		
Rider ICR - SV Factor			**$ 5,911**		

1 Labor costs do not include G&A.

Estimated Accelerated Program O&M Costs/Savings			2035		
	Scenario 2 Current	Scenario 3 Proposed	O&M Total Savings	O&M Savings Per Mile of Main Abandoned per Year	O&M Savings Per Customer Per Year
Leak Repairs	$ 278,464,530	$ 142,927,679	$ 135,536,851	$ 2,618.21	$ 6.61
Leak Surveys	$ 10,636,741	$ 9,395,449	$ 1,241,292	$ 23.98	$ 0.06
Leak Rechecks	$ 17,771,669	$ 9,121,677	$ 8,649,992	$ 167.09	$ 0.42
Emergency Response to Make Safe	$ 16,097,868	$ 13,037,474	$ 3,060,394	$ 59.12	$ 0.15
Regulator Station Inspection and Maintenance	$ 6,042,415	$ 3,620,158	$ 2,422,257	$ 46.79	$ 0.12
Vault Survey and Maintenance	$ 914,221	$ 547,732	$ 366,489	$ 7.08	$ 0.02
Cathodic Protection Surveys and Maintenance	$ 67,390,478	$ 86,896,798	$ (19,506,320)	$ (376.81)	$ (0.95)
Valve Inspection	$ 27,179,168	$ 40,154,900	$ (12,975,732)	$ (250.66)	$ (0.63)
Cost of Lost Gas	$ 118,635,490	$ 64,886,839	$ 53,748,651	$ 1,038.28	$ 2.62
Inside Safety Inspections	$ 63,404,494	$ 27,698,461	$ 35,706,033	$ 689.74	$ 1.74
Total O&M Cost[1]	**$ 606,537,073**	**$ 398,287,167**			
O&M Cost/Mile	**$ 329,706**	**$ 220,990**			
O&M Cost/Year	**$ 12,378,308**	**$ 8,128,310**			
O&M Savings			**$ 208,249,906**		
Average Cost Savings per Mile of Main Abandoned per Year			**$ 1,970**		
Rider ICR - SV Factor			**$ 5,876**		

Exhibit SDM-1.15 – Cost Benefit Analysis Variables by Replacement Completion Year

			2025	2030	2035
	Scenario 1 Like & Kind	**Scenario 2 Current**	**Scenario 3 Proposed**	**Scenario 3 Proposed**	**Scenario 3 Proposed**
Replacement Strategy/Technology	No LP to MP	Double Decking, LP to MP	Double Decking, LP to MP	Double Decking, LP to MP	Double Decking, LP to MP
Approach to Replacement	Type & Age	Risk & Blocks	Zonal	Zonal	Zonal
Annual Inflation Rate	1.8%	1.8%	1.8%	1.8%	1.8%
Annual Labor Cost Escalation Rate	4.0%	4.0%	4.0%	4.0%	4.0%
Annual Materials Escalation Rate	3.0%	3.0%	3.0%	3.0%	3.0%
Years to Ramp Up	0	0	5	5	5
Years to Ramp Down	0	0	2	2	2
Number of Customers	840,000	840,000	840,000	840,000	840,000
Miles of CI/DI Main Abandoned	1,840	1,840	1,802	1,802	1,802
Miles of ST LP Main Abandoned	362	362	355	355	355
Total Miles of Main Abandoned	2,202	2,202	2,157	2,157	2,157
Miles of Main Installed	2,202	3,174	3,119	3,119	3,119
Total Services Replaced	302,566	302,566	296,392	296,392	296,392
Starting Year	2011	2011	2011	2011	2011
Completion Year	2060	2060	2025	2030	2035
Number of Years for Replacement Completion	49	49	14	19	24
Miles of Main Abandoned per Year	45	45	154	114	90
Miles of Main Installed per Year	45	65	223	164	130

Q Were you able to perform a cost-benefit analysis comparing the current replacement program to the proposed accelerated replacement program?

A Yes.

Q Can you summarize your cost-benefit analysis and its conclusions?

A The cost-benefit analysis compares the capital and O&M costs for the proposed accelerated program versus the current main replacement program to demonstrate that shortening the time frame for completing the main replacement program would decrease overall cost, because more current dollars will be used for capital. In addition, the cost benefit analysis estimates the benefits that PGL can accrue from enhanced investment to replace cast iron and ductile iron main in terms of the value of the savings in operating and maintenance expense that would be expected to occur as a result of such accelerated replacement. The model not only estimates the total capital cost and O&M cost for the entire accelerated program, but also presents schedules for capital investment and O&M expenditures on a yearly basis to show when certain capital investments are expected to occur and how the savings may vary during the replacement time period.

The cost benefit analysis concluded that there is a net benefit from the accelerated investment in cast iron and ductile iron main replacement for PGL, based on the assumptions in our analysis and the estimates of certain key parameters provided by PGL. According to the 2030 Case, the accelerated replacement program has economic value to PGL's customers because it is estimated that the proposed program will result in approximately $432 million in construction cost savings and $244 million in future O&M cost savings to implement the main replacement program in a shorter time frame. The results of the cost benefit analysis are summarized in Exhibit SDM-1.16 and Exhibit SDM-1.17. The cumulative savings resulting from the proposed accelerated program on a yearly basis are shown in Exhibit SDM-1.18.

As discussed later in my testimony, we have included additional costs associated with program management and additional labor for meter work, as well as training and professional development. These costs are referred to as Incremental O&M ("IOM"). The IOM for the 2030 Case is shown in Exhibit SDM-1.19.

Exhibit SDM -1.16 - Estimated Accelerated Program Capital Costs

Estimated Accelerated Program Construction Costs	2030		
	Scenario 2 Current	**Scenario 3 Proposed**	Capital Program Savings
Account 376, Distribution Mains	$ 1,826,992,158	$ 1,697,002,578	$ 129,989,579
Account 380, Services	$ 801,924,071	$ 518,609,104	$ 283,314,967
Account 381, Meters including Meter Installations	$ 163,152,673	$ 151,546,216	$ 11,606,457
Account 383, House Regulators	$ 81,576,336	$ 75,773,108	$ 5,803,228
Account 378 & 379, Abandon Regulator Stations	$ 10,061,764	$ 9,345,984	$ 715,780
Account 378 & 379, New Regulator Stations	$ 7,874,424	$ 7,314,248	$ 560,176
Account 378 & 379, New City Gate Stations	$ 7,895,678	$ 7,895,678	$ -
Total Construction Cost	**$ 2,899,477,104**	**$ 2,467,486,917**	**$ 431,990,187**
Construction Cost/Mile	**$ 1,316,840**	**$ 1,143,964**	
Construction Cost/Year	**$ 59,173,002**	**$ 129,867,732**	

Exhibit SDM -1.17 - Estimated Accelerated Program O&M Costs

Estimated Accelerated Program O&M Costs/Savings	2030				
	Scenario 2 Current	**Scenario 3 Proposed**	**O&M Total Savings**	**O&M Savings Per Mile of Main Abandoned per Year**	**O&M Savings Per Customer Per Year**
Leak Repairs	$ 278,464,530	$ 120,187,270	$ 158,277,260	$ 3,862.09	$ 9.75
Leak Surveys	$ 10,636,741	$ 9,159,567	$ 1,477,174	$ 36.04	$ 0.09
Leak Rechecks	$ 17,771,669	$ 7,670,379	$ 10,101,290	$ 246.48	$ 0.62
Emergency Response to Make Safe	$ 16,097,868	$ 12,525,163	$ 3,572,706	$ 87.18	$ 0.22
Regulator Station Inspection and Maintenance	$ 6,042,415	$ 3,213,886	$ 2,828,528	$ 69.02	$ 0.17
Vault Survey and Maintenance	$ 914,221	$ 486,263	$ 427,958	$ 10.44	$ 0.03
Cathodic Protection Surveys and Maintenance	$ 67,390,478	$ 90,039,218	$ (22,648,740)	$ (552.65)	$ (1.40)
Valve Inspection	$ 27,179,168	$ 42,258,718	$ (15,079,549)	$ (367.95)	$ (0.93)
Cost of Lost Gas	$ 118,635,490	$ 55,164,312	$ 63,471,178	$ 1,548.75	$ 3.91
Inside Safety Inspections	$ 63,404,494	$ 21,718,829	$ 41,685,665	$ 1,017.16	$ 2.57
Total O&M Cost[1]	**$ 606,537,073**	**$ 362,423,604**			
O&M Cost/Mile	**$ 329,706**	**$ 201,091**			
O&M Cost/Year	**$ 12,378,308**	**$ 7,396,400**			
O&M Savings			**$ 244,113,470**		
Average Cost Savings per Mile of Main Abandoned per Year			**$ 2,310**		
Rider ICR - SV Factor			**$ 5,911**		

[1] Labor costs do not include G&A.

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Exhibit SDM -1.18 – Estimated Cumulative Savings

Year	Scenario 2 Construction	Scenario 2 O&M	Scenario 3 Construction	Scenario 3 O&M	Net Benefit	Cumulative Benefit
2011	$ 44,475,156	$ 17,815,107	$ 172,048,836	$ 17,153,936	$ (126,912,509)	$ (126,912,509)
2012	$ 45,328,663	$ 17,746,427	$ 93,489,144	$ 16,655,845	$ (47,069,899)	$ (173,982,408)
2013	$ 46,138,083	$ 17,654,134	$ 100,445,136	$ 16,081,247	$ (52,734,166)	$ (226,716,574)
2014	$ 46,904,707	$ 17,746,708	$ 107,488,546	$ 15,857,284	$ (58,694,415)	$ (285,410,989)
2015	$ 142,930,044	$ 17,687,629	$ 209,907,944	$ 15,270,032	$ (64,560,303)	$ (349,971,292)
2016	$ 48,314,579	$ 17,571,516	$ 116,255,433	$ 14,616,759	$ (64,986,097)	$ (414,957,389)
2017	$ 48,960,254	$ 17,437,176	$ 117,809,069	$ 13,937,252	$ (65,348,891)	$ (480,306,280)
2018	$ 49,567,991	$ 17,285,586	$ 119,271,417	$ 13,233,432	$ (65,651,272)	$ (545,957,552)
2019	$ 50,138,929	$ 17,117,691	$ 120,645,218	$ 12,507,146	$ (65,895,744)	$ (611,853,296)
2020	$ 54,744,280	$ 16,934,402	$ 223,324,762	$ 11,800,940	$ (163,447,020)	$ (775,300,317)
2021	$ 51,174,826	$ 16,736,596	$ 123,137,813	$ 11,035,370	$ (66,261,761)	$ (841,562,078)
2022	$ 51,641,925	$ 16,525,121	$ 124,261,756	$ 10,252,426	$ (66,347,135)	$ (907,909,214)
2023	$ 52,076,507	$ 16,300,795	$ 125,307,454	$ 9,453,682	$ (66,383,834)	$ (974,293,048)
2024	$ 52,479,574	$ 16,064,404	$ 126,277,322	$ 8,640,649	$ (66,373,994)	$ (1,040,667,042)
2025	$ 154,356,405	$ 15,859,194	$ 127,173,717	$ 7,814,779	$ 35,227,104	$ (1,005,439,938)
2026	$ 53,195,058	$ 15,601,193	$ 127,998,931	$ 6,977,462	$ (66,180,142)	$ (1,071,620,080)
2027	$ 53,509,357	$ 15,333,300	$ 128,755,204	$ 6,130,031	$ (66,042,578)	$ (1,137,662,658)
2028	$ 53,795,910	$ 15,056,193	$ 104,788,578	$ 5,442,197	$ (41,378,671)	$ (1,179,041,330)
2029	$ 54,055,600	$ 14,770,527	$ 99,100,637	$ 4,789,869	$ (35,064,378)	$ (1,214,105,708)
2030	$ 54,289,288	$ 14,476,930		$ 4,809,013	$ 63,957,206	$ (1,150,148,502)
2031	$ 54,497,812	$ 14,176,008		$ 4,825,982	$ 63,847,838	$ (1,086,300,664)
2032	$ 54,681,989	$ 13,868,344		$ 4,840,848	$ 63,709,484	$ (1,022,591,180)
2033	$ 54,842,614	$ 13,554,496		$ 4,853,680	$ 63,543,430	$ (959,047,750)
2034	$ 54,980,462	$ 13,235,004		$ 4,864,544	$ 63,350,922	$ (895,696,828)
2035	$ 55,096,290	$ 12,910,384		$ 4,873,507	$ 63,133,168	$ (832,563,660)
2036	$ 55,190,833	$ 12,581,134		$ 4,880,631	$ 62,891,335	$ (769,672,326)
2037	$ 55,264,806	$ 12,247,729		$ 4,885,980	$ 62,626,555	$ (707,045,771)
2038	$ 55,318,909	$ 11,910,628		$ 4,889,614	$ 62,339,923	$ (644,705,848)
2039	$ 55,353,820	$ 11,570,271		$ 4,891,592	$ 62,032,498	$ (582,673,350)
2040	$ 55,370,201	$ 11,227,078		$ 4,891,972	$ 61,705,307	$ (520,968,043)
2041	$ 55,368,697	$ 10,881,453		$ 4,890,808	$ 61,359,342	$ (459,608,702)
2042	$ 55,349,935	$ 10,533,783		$ 4,888,158	$ 60,995,561	$ (398,613,140)
2043	$ 55,314,526	$ 10,184,438		$ 4,884,069	$ 60,614,895	$ (337,998,245)
2044	$ 55,263,065	$ 9,833,774		$ 4,878,599	$ 60,218,240	$ (277,780,005)
2045	$ 161,202,203	$ 9,526,410		$ 4,871,794	$ 165,856,818	$ (111,923,186)
2046	$ 55,114,283	$ 9,174,041		$ 4,863,705	$ 59,424,619	$ (52,498,567)
2047	$ 55,018,075	$ 8,821,316		$ 4,854,380	$ 58,985,011	$ 6,486,444
2048	$ 54,908,037	$ 8,468,531		$ 4,843,863	$ 58,532,706	$ 65,019,150
2049	$ 54,784,690	$ 8,115,970		$ 4,832,200	$ 58,068,460	$ 123,087,610
2050	$ 54,648,539	$ 7,763,901		$ 4,819,436	$ 57,593,004	$ 180,680,614
2051	$ 54,500,074	$ 7,412,584		$ 4,805,612	$ 57,107,046	$ 237,787,660
2052	$ 54,339,773	$ 7,062,264		$ 4,790,770	$ 56,611,268	$ 294,398,928
2053	$ 54,168,103	$ 6,713,175		$ 4,774,950	$ 56,106,327	$ 350,505,255
2054	$ 53,985,514	$ 6,365,538		$ 4,758,193	$ 55,592,859	$ 406,098,114
2055	$ 53,792,447	$ 6,019,565		$ 4,740,535	$ 55,071,477	$ 461,169,591
2056	$ 53,589,329	$ 5,675,457		$ 4,722,013	$ 54,542,773	$ 515,712,364
2057	$ 53,376,577	$ 5,333,404		$ 4,702,665	$ 54,007,316	$ 569,719,679
2058	$ 53,154,593	$ 4,993,587		$ 4,682,525	$ 53,465,655	$ 623,185,335
2059	$ 52,923,772	$ 4,656,176		$ 4,661,626	$ 52,918,322	$ 676,103,657
2060						
TOTAL 2011-2060	$ 2,899,477,104	$ 606,537,073	$ 2,467,486,917	$ 362,423,604	$ 676,103,657	
				IRR	1.81%	

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Exhibit SDM -1.19 – Incremental O&M

Estimated Accelerated Program Incremental O&M	2030	
	Scenario 3 Proposed	
Program Management[1]	$	123,374,346
Additional Labor	$	36,371,092
Total Incremental O&M Cost[2] (IOM)	**$**	**159,745,438**
Incremental O&M Cost/Mile	**$**	**74,060**
Incremental O&M Cost/Year	**$**	**8,407,655**

[1] Program management includes project delivery strategies; management of design, and construction phase activities; cost control; schedule management; document control; and quality assurance.

[2] These costs are not included in the Construction and O&M Costs.

Q **Please describe the factors considered in the cost analysis.**

A The factors considered in the cost analysis are summarized in Exhibit SDM-1.15

Q **What asset replacement strategies (maintenance, reactive, proactive) were considered?**

A Maintenance-based replacement strategies have been recommended by past studies, including Zinder Engineering, Inc. and Kiefner and Associates, Inc., which are primarily focused on maintaining or modifying current rates of pipe replacement. The replacement strategies these studies propose include completion dates as late as 2080 for certain pipe diameters. Such strategies often lead to reactive replacement when segments that have not been replaced pursuant to the planned schedule become problematic. However, as described in the Liberty Consulting Group audit and my previous testimony, PGL's adherence to the recommendations of Zinder Engineering, Inc. and Kiefner and Associates, Inc. has resulted in an unacceptable backlog of leaks carried over to the next year. Most of these leaks are related to CI pipes. As I stated previously, the uniqueness of PGL's system and the unpredictability of CI and especially DI pipe in regard to potential failure, points to a proactive pipe replacement program as the best replacement strategy.

In the Cost Benefit analysis, we have applied three scenarios: "Like and Kind", "Current", and "Proposed". Like and Kind involves the replacement of pipes with similar diameters and pressure, and may be considered as a reactive strategy. As I stated above, PGL's current approach is an example of a maintenance-based strategy. In my opinion, the continuance of a maintenance-based approach could result in eventual failures that would necessitate a reactive strategy that would preclude the application of better proactive strategies. As I will demonstrate further in my testimony, a proactive approach that replaces mains on an accelerated basis is best suited to serve PGL's future needs, and is considered as the "Proposed" strategy in the analysis.

Q What technology options or alternatives were identified and evaluated?

A PGL is always looking for new efficient technologies. The model, however, assumes that PGL continues using its existing technology, such as directional drilling, dead insertion (installing new pipe in abandoned pipe) and double decking in the current and proposed scenarios. Any benefits from future alternative technology options which emerge will increase efficient operation and possibly provide additional savings on top of the O&M cost reductions currently estimated by the model.

Q What are the benefits for each technology considered?

A The benefits of directional drilling include reduced surface restoration costs which can represent up to 50% of installation costs compared to open trenching. Similar savings are achieved by moling, auguring and dead insertion. However, the use of double decking has the potential for reducing future O&M cost.

By using these technologies PGL has focused not only on reducing current construction costs, but on future O&M expenditures as well.

Q What proposed technology approach was utilized for the cost analysis?

A The cost benefit analysis assumes PGL continues with its existing technology approach, as described above.

Q What approaches to pipe replacement did you consider?

A There are a number of approaches to pipe replacement selection: individual pipe segments based on risk, pipe by type and age, individual blocks determined on engineering grounds, and zone replacement. The replacement of individual pipe segments based on either risk, or on type of pipe and age was considered. Essentially in a maintenance-type strategy, these selection criteria are equivalent to identifying and replacing individual pipe segments based on UMRI ratings, or in the latter case, by the individual factors of pipe type and age which could contribute to the UMRI ratings. An approach involving somewhat larger scale would include the identification of individual blocks based on engineering criteria. Zone replacement was considered to convert the low-pressure system to medium-pressure, while reducing the risk of CI/DI pipe and creating the best economic efficiencies for construction costs. There are also certain operation and maintenance economies of scale inherent in zonal replacement. For example, if all pipes within a zone have been replaced with plastic, the less frequent leak survey requirements of plastic pipe can be applied to labor-intensive leak survey scheduling, all within a designated geographic area. Also, replacement of steel pipes with plastic would result in the reduction of corrosion inspections that would be needed.

In the cost benefit analysis model, Scenario 3 assumes that replacement projects will be based on both risk and zonal means. In my opinion this approach ensures that high-risk segments will continue to be replaced, while potentially gaining the efficiencies and benefits of larger zone replacements, such as economic opportunities in material and labor negotiations.

Q Why was the zone replacement approach chosen?

A Perhaps the most visually compelling reason for choosing a zone replacement approach can be seen in the attached Exhibits SDM-1.20 (Low-pressure System CI/DI Map) and SDM-1.21 (Medium-pressure System CI/DI Map). The ubiquitous distribution of CI/DI pipe in PGL's system does not lend itself to isolated replacement strategies that would ignore synergies of coordinated removal within pre-planned zones.

Zonal replacement would allow PGL to move from the piecemeal approach of removing individual pipes based on a maintenance history and cost reduction basis, to a comprehensive basis that would maximize the opportunity of low-pressure to medium-pressure conversion and removal of CI/DI pipes. Zonal replacement would also potentially result in greater cost reductions per mile of pipe replaced. CI/DI pipes within the existing medium-pressure system in the replacement zone would also be replaced.

I have not included the construction cost savings due to economies of scale related to larger replacement zones and benefits accrued as a result of this approach to contractor pricing and PGL efficiencies. It is my opinion that there are additional savings opportunities related to providing contractors with a guaranteed volume of continuous work around which they can plan their resources and minimize overhead management cost. Further, there are additional savings opportunities from the economies of scale for PGL meter setting crews, in-the-field inspectors, and the use of value engineering. While these savings cannot be quantified at this time, based on my experience, I would expect such savings to occur.

Zonal replacement would provide cost savings to the City of Chicago and projects of other utilities by facilitating the coordinated movement of equipment, traffic, and street restoration. Also, zonal replacement could potentially reduce the cost associated with multiple independent projects.

Another non-cost related benefit of zonal replacement is that it would allow for a planned approach that minimizes unexpected third-party incidents, service interruptions and traffic disruptions on an ongoing basis. This will be of particular importance during the likely Chicago 2016 Olympic events, or other large construction venues.

Q What are the parts that would you expect to make up a main replacement program?

A The zones suggested for replacement would be determined by the optimization of three components: enforcement, condition, and plan. Enforcement components would be determined by coordination with the City of Chicago, which is already responsible for issuing permits for and scheduling utility and public works projects. The condition of pipes, based on their UMRI score, would weigh into the selection of candidate zones. Finally, zone boundaries and selection would depend on technical and non-technical factors.

Q What technical and non-technical factors need to be considered in determining the quantity and timing of replacement zones?

A Under the accelerated replacement plan, we estimate that PGL could have upwards of 12 zones being worked on per year. Each zone could be comprised of a number of projects. The size and composition of mains, services and meters within a given zone will depend on a number of factors:

- UMRI segment scores;
- Available pressure and capacity;

- Type of streets;
- Condition of mains and services;
- Consequence of an adverse event; and
- Other planned infrastructure projects by the City of Chicago.

Regardless of whether a zone approach or some other approach is implemented, PGL may need to install additional infrastructure before the low-pressure areas can be replaced.

Q Please summarize the system modernization cost scenarios considered.

A Three main scenarios were considered in the cost benefit analysis:

- Scenario 1 - Like and Kind Replacement
- Scenario 2 - Current Replacement Program (Zinder Engineering, Inc. and Kiefner and Associates, Inc.)
- Scenario 3 - Proposed Replacement Program

In both Scenarios 1 and 2, we assume a 45-mile per year replacement program of cast iron, ductile iron and steel pipe (in the low-pressure system) continuing from 2011, which would lead to complete retirement by 2060 or a 49-year replacement. However, in Scenario 2 we assume that the low-pressure system is replaced by a medium-pressure system, and double decking is used for 70% of the new 2" plastic pipe installed. As a result, more pipe is installed than replaced in Scenario 2, and the estimated total capital cost for Scenario 2 is slightly more than Scenario 1 due to the cost of moving inside meters outside and additional regulator stations and city gate stations.

The proposed accelerated replacement program is modeled in Scenario 3, assuming a 114-mile per year program that would lead to complete retirement by 2030. The replacement strategy and technology are the same for Scenarios 2 and 3 but the replacement period is 49 years in Scenario 2 versus 19 years in Scenario 3. Cost savings (reductions) are obtained from the difference between Scenario 2 and Scenario 3. Cost Savings per customer are based on PGL's total customer count.

Q How were the estimates of capital cost developed?

A The estimates of capital cost were developed using actual cost information provided by PGL's Operations group. The contractor construction costs for various activities, such as main pipe installation, plastic service pipe installation, and meter installation on a per unit basis, were provided. Using the 30-year plan being developed by PGL that outlines the amount, type and size of pipe to be abandoned and new pipe to be installed, we projected the pipe installation cost assuming that new main would be installed at a constant rate for each pipe size. In Scenario 3, however, we included 5-year ramp up and 2-year ramp down periods in construction to allow time for the additional labor required to be trained.

All cost projections are in 2010 dollars and include adjustments for inflation using 90% of the labor and 10% of the material cost escalation rates projected for the pipeline construction industry in the Chicago area. The capital costs are segregated by the plant accounts used in the Rider ICR and the categories are as follows:

- Account 376, Distribution Mains
- Account 380, Services
- Account 381, Meters, including Meter Installations
- Account 383, House Regulators
- Account 378 & 379, Abandon Regulator Stations
- Account 378 & 379, City Gate Stations
- Account 378 & 379, New Regulator Stations

Q **What are the most significant cost drivers?**

A The most significant cost drivers for capital are the main and service installation costs and the meter replacement costs. Most of the savings in overall capital costs are a result of the shorter replacement time period due to the time value of money.

For O&M, the significant savings drivers are related to the savings from leak repairs, lost gas, and inside safety inspections. These savings are a result of the expected lower leak rate on the new main system and reduced cost in inspecting outside meters versus inside meters. These figures have been provided in Exhibit SDM - 1.16 and SDM – 1.17

The capital cost and O&M savings are also sensitive to labor, material and inflation escalation factors. As we have seen in recent years, construction costs and materials have seen unprecedented escalation due to demand for domestically produced energy.

Q If the zone approach is used, will low risk pipe be replaced before high risk pipe?

A Under a zone replacement approach the higher-risk infrastructure will continue to be replaced for reasons of condition (e.g., main segments exceeding a UMRI threshold score of 6) or enforcement (e.g., sewer improvement). The risk associated with mains and services is one consideration in establishing and prioritizing a zone project, but not the only factor. The prioritization of zones considers replacement impact on customers and businesses, availability of capacity and pressure, higher-risk infrastructure and program costs.

Q Why is it necessary to put some medium-pressure infrastructure in place prior to replacing cast iron and ductile iron pipe?

A In order to increase the operating pressure using pipe of smaller diameter, there must be adequate capacity and pressure in the mains feeding the segment or zone. When either adequate capacity or pressure is not available, additional incremental investments must be made in advance of infrastructure improvements. Although it is possible to replace the existing pipe with the same size pipe and up-rate or increase the pressure at a later date, this increases the program cost. These incremental investments may include new city gate stations, new or redesigned high-pressure to medium-pressure regulator stations or additional medium-pressure pipe.

Q Why does the Accelerated Infrastructure Replacement Program show more pipes being installed than pipe replaced?

A One previously described technique that will be employed in replacing existing higher-risk pipe is double decking. Double decking has several benefits:

- Removes the main from the congestion of utilities already under the street;
- Reduces future maintenance costs;
- Reduces the potential of excavation damage to gas facilities;
- Reduces the average length of service lines;
- Reduces the number of long side services (i.e., services running from one side of the street where the main is installed to the opposite side of the street where the building being served is located); and
- Reduces program installation costs.

Q How were O&M costs and savings incorporated into the cost analysis?

A The operating costs and savings included in the analysis were:

- Reduced leak survey expense;
- Reduced leak repairs;
- Reduced regulator inspection and maintenance expense;
- Reduced lost gas; and

- Reduced number of emergency responses.

Records of reported operation and maintenance work units and costs were reviewed. Using this information for PGL's current replacement program (Scenario 2) and the accelerated replacement program (Scenario 3), the operation and maintenance expenses for the remaining pipe (including related facilities such as regulator stations) to be replaced/abandoned and the new pipe (including related facilities such as valves and regulator stations) to be installed were estimated. These operation and maintenance costs were estimated for the period from 2011 to 2060. The savings is the difference between the Scenario 2 and Scenario 3 costs in 2010 dollars.

Q **What are the non-O&M benefits associated with the Accelerated Infrastructure Replacement Program?**

A There are a number of additional qualitative benefits associated with an Accelerated Infrastructure Replacement Program that are not associated with operations and maintenance, which have been described throughout my testimony:

- Greater appliance choice by customers;
- Reduced greenhouse gas emissions;
- Increased availability of higher-efficiency appliances;
- Reduced cost of gas utilization equipment;
- Improved customer safety;

- Fewer inside safety inspections which inconvenience customers by requiring them to be at home;
- Outside access to service shut-off valves at meter sets; and
- Greater application of service line excess flow valves.

As an integral part of a conversion from low-pressure to medium-pressure, PGL would relocate meters from inside to the outside of buildings. Currently, according to PGL, there are 540,678 inside meters in PGL's distribution system. Moving meters to the outside of buildings would facilitate maintenance of automated meter reading equipment, would reduce bad debt (unpaid gas bills) and its corresponding share of burden on all customers, and most importantly, would enhance safety by providing outside access to service shut-off valves at meter sets.

An additional safety benefit would be the installation of temperature-compensated meters and excess flow valves that operate at pressure ranges within the medium-pressure system, but above those available in the current low-pressure system.

VI. Implementation of the Accelerated Infrastructure Replacement Program

Q In your opinion is PGL capable of efficiently and effectively managing the Accelerated Infrastructure Replacement Program?

A Yes.

Q Please describe what is entailed in Program Management.

A Program Management is the disciplined, systematic orchestration of manpower, time, dollars, materials, equipment and information to plan, design, construct and deliver large, complex capital investment programs. From our experience, effectively executing an accelerated infrastructure program requires identifying what systems, processes, skills and resources are necessary to "ramp up" to the expected level necessary to meet the program's commitments. Therefore, pre-planning and the identification of any gaps that may hinder executing the program effectively and efficiently are needed to insure the proper costs and needs are understood in the implementation plan.

Q Please describe what is entailed in Quality Assurance.

A Quality Assurance (QA) ensures that PGL plans its work to achieve a quality product and that its work is carried out in a manner that produces the expected quality. This includes assuring that whatever procedures are established for the planning, design, and construction phases to meet requirements established by PGL, the Commission, the Occupational Safety and Health Administration, the City of Chicago or any other authority having jurisdiction are followed and documented.

Q How will PGL monitor the costs of and savings from the accelerated program?

A Ms. Grace (PGL Ex. VG-1.0) describes Rider ICR and the proposed reporting and audit provisions of that rider.

Q What program and management processes will be needed to efficiently and effectively implement the Accelerated Infrastructure Replacement Program?

A One of the lessons learned in the cast iron replacement program in the City of London, UK, was the need to create a dedicated team to manage the zonal replacement program. We would expect that PGL's program implementation plan would address the following at minimum:

- Organizational Structure;
- Staffing Levels and Skills Assessment;
- Adequacy of Business Process and Systems;
- Roles and Responsibilities of PGL Staff and Service Providers;
- Program Budget;
- Cost Estimating;
- Buildability/Constructability/ Maintainability Review;
- Program Schedule;
- Cost Management, Control and Reporting;
- Contract Administration;
- Project Records, Document and Drawing Controls;

- Quality Control/Assurance; and
- Performance Measurement.

Q How will PGL address the efficiency of its management programs?

A To date PGL has been managing its current main replacement program through business processes that include planning, scheduling and monitoring replacement projects. However, the proposed accelerated replacement program will require the current replacement rate to more than double. From my experience, when a company significantly increases its capital budget, a gap review of existing tools, processes, practices and resources must be undertaken. Such reviews often result in changes that are necessary to improve program management and execution. These improvements are developed and phased in during a program ramp up period.

PGL recognizes the need to review its replacement program management process as part of the pre-planning effort.

Q Are there any barriers to efficiently and effectively implementing the Accelerated Infrastructure Replacement Program?

A Yes. PGL is expected to hire additional union personnel to perform meter installation and relights. To efficiently implement the accelerated program it may seek to change some work rules. Additional personnel, equipment and vehicles will be necessary. Limited space at existing operating shops may need to be addressed.

Although stakeholder communication and coordination will be a challenge, we do not see it being a barrier.

Q **How will the issue of resourcing qualified and skilled people be addressed?**

A This program will involve a need to hire both union and management company personnel and outside contractors. This was considered in selecting the replacement period. To effectively address the resourcing issues, we would expect that a program resource and skills assessment and staffing plan be developed prior to 2011. The accelerated replacement program will need to be ramped up. In our cost benefit analysis we have included a five-year ramp up period and two-year ramp down period. As stated previously in this testimony, incremental investment will be necessary. A portion of the incremental investment will take place during the initial two years, which should enable the transition to the peak main replacement level. PGL has recognized the need to address this issue.

Q **Will additional training and professional development be required in order to ramp up the program?**

A While a significant portion of the program will be outsourced to contractors, additional internal training and professional development will be necessary for PGL staff, including engineers, project managers, and inspectors. To manage this additional training and professional development, the program is expected to be ramped up over five years. These incremental costs for training and professional development are included as IOM in the cost benefit analysis.

Contractor personnel will receive skills training in compliance with existing operator qualification program.

Q How might restoration costs be controlled?

A In my experience with the industry, excavation and restoration costs can account for up to 75% of maintenance expenditures. PGL reports that street restoration costs have more than tripled in the last five years. In 2008, PGL spent $7,284,133 on restoration costs related to installing 86.5 miles of main. This cost stems from a variety of factors including more stringent requirements of the City of Chicago and the Chicago Department of Transportation, spoil disposal, labor, and street restoration materials. In nearly all cases, removed spoil is not eligible for use as fill and must be transported and disposed of in a landfill. The City of Chicago is stringent in its resurfacing requirements in an effort to assure that all entities leave the city streets in a high quality and lasting condition.

As stated earlier, one of the advantages of an accelerated infrastructure replacement program, if it incorporates a zonal work plan, is the congregation of work forces and the advantageous use of economies of scale in the employment and coordination of excavation and restoration workforce, equipment and transportation. For example, spoil material is currently sent to landfills after collection at PGL's facilities and testing. As a result, PGL's shops must now secure permits to operate as transfer stations. An accelerated program with zonal strategy would create large enough loads in near proximity to facilitate the cost-effective use of contractors who would haul, test, and take materials to landfills without use of PGL's shops.

In addition, coordination with the City of Chicago would reduce the likelihood that a particular site would undergo repeated restoration for multiple projects by the City and other utilities, resulting in restoration cost controls to both PGL and the City's public works projects.

Q Are there any additional technologies that can be utilized to significantly reduce restoration costs and public inconvenience and improve public and employee safety?

A Yes, in my experience the use of "small hole" technologies is one potential technology that has been proven to significantly reduce restoration costs and public inconvenience, and improve public and employee safety. Other utilities that have implemented these technologies experienced savings as great as 50% in the performance of routine work associated with maintaining a gas distribution network. The savings primarily result from a reduction in excavation and restoration costs associated with openings to conduct repair and capital activities. It is my opinion that PGL may be able to use this technology to reduce its restoration costs and improve productivity. See Exhibit SDM - 1.22 for detail.

Q **Because these technologies provide so many benefits, why are they not included in your cost analysis?**

A I did not include small hole technology in the cost analysis because although the technology has been proven for use in other cities with similar conditions, the City of Chicago's construction code, like that of several other cities, has not been updated to accommodate the technology. Small hole technology involves techniques that are not applicable to the proscribed specifications in the current code. For example, one of the cost advantages of small hole technology is in the use of vacuum excavation units which collect the minimal amount of spoil from excavation and later replace the material as fill. This can be accomplished by sifting the spoil material to remove unacceptable debris. However, the City of Chicago at this time does not allow self-sifting of spoil to meet its fill requirements. Another example is in the requiring of additional cut back and resurfacing, which is illustrated in the City of Chicago's construction code for more conventional trenching and excavation, but not for the extraction of small holes which require much less filling and restoration.

Obtaining City of Chicago approval and implementing vacuum excavation/keyhole and coring technologies would help PGL reduce expenditures on repair and replacement activities, improve quality of street restoration, and provide several other benefits in reduced traffic disruption. In addition, this technology would minimize environmental impact and improve public and worker safety.

VII. Compliance and Transparency

Q How will the Commission be able to monitor PGL's accelerated replacement program, the recovery of costs for this program and the flow of reduced system cost back to the customers?

A PGL's intent and goal is to provide transparency of this program for the Commission. The goal is to provide the people of the City of Chicago the modern infrastructure and improved safety they deserve, as well as to flow the reduced system costs back to them when those benefits are achieved.

If approval for Rider ICR is granted, allowing the accelerated main replacement program to proceed, PGL will commit to providing Commission Staff annually with a detailed report showing the progress and plans for its accelerated replacement program. The flow of reduced system operations and maintenance costs to customers, when achieved, will be apparent in the annual reconciliation process.

VIII. Conclusions

Q In summary, in your opinion, does the cost-benefit analysis, technologies to be applied by PGL, functionalities of the proposed system and other items addressed in your testimony support PGL's Accelerated Infrastructure Replacement Program and its requested Rider ICR?

A Yes. In my opinion, the cost analysis clearly demonstrates that accelerating the replacement program will significantly reduce the customer's total cost of modernizing the gas distribution system. Rider ICR enables customers to almost immediately realize the benefits of reduced operating and maintenance costs. Most importantly the customers benefit from a safer and more reliable medium-pressure gas distribution system, which will allow customers to purchase the latest and most fuel efficient, environmentally friendly gas utilization equipment.

Q Does this conclude your testimony?

A Yes