Peoples Gas and the SMP
History, Current State, and Alternatives

Prepared for the Illinois Commerce Commission in Docket No. 24-0081:

Illinois Commerce Commission
On Its Own Motion

-vs.-

The Peoples Gas Light and Coke Company

April 1, 2024
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1. Executive Summary

The Peoples Gas Light & Coke Company (“Peoples Gas,” “PGL,” or “the Company”) presents this report in compliance with the January 31, 2024 initiating order of the Illinois Commerce Commission (“Commission” or “ICC”) in Docket No. 24-0081, *Illinois Commerce Commission, On Its Own Motion, v. The Peoples Gas Light and Coke Company – Investigation of The Peoples Gas Light and Coke Company’s System Modernization Program*. That order directed Peoples Gas to provide thorough and complete responses to specific requests for information, using “lessons learned from the current replacement program to suggest improvements in pace, cost, and safety results.”

Peoples Gas appreciates the opportunity to provide additional information responsive to the Commission’s requests, to explain in greater detail why the major aspects of its System Modernization Program (“SMP”) previously reviewed and approved by the Commission continue to make sense for ratepayers, and to identify additional advances in SMP planning and execution that Peoples Gas is already implementing as part of its long tradition of continuous improvement.

As part of this discussion, Peoples Gas will explain why converting its natural gas distribution network to a medium pressure system eliminates the reliability and safety risks inherent in the current low-pressure system, and how its current approach to that conversion prioritizes the riskiest pipe requiring the most urgent repair. The Commission has already found that PGL’s “neighborhood approach” to SMP is the most efficient, cost-effective way to accomplish both goals simultaneously. That conclusion has even more support today. Pending federal rules will require such significant changes to distribution integrity management and leak detection and repair that compliance *without* a program like SMP would be significantly more costly, if not outright impossible.

While Illinois’ Climate and Equitable Jobs Act (“CEJA”) did not address the gas distribution system, the SMP also supports the goals of CEJA. Replacing old, leaking pipes on an accelerated basis reduces methane emissions—a goal shared by the Illinois General Assembly and the federal Pipeline and Hazardous Materials Safety Administration (“PHMSA”). A modern, medium-pressure distribution system is also essential to any initiative to use potential lower- and no-carbon energy sources like green hydrogen and renewable natural gas (“RNG”).

The importance of pipe modernization is underscored in New York City, where despite a policy that limits the future use of natural gas, regulators continue to support Con Edison’s program to replace aging pipes. And here in Illinois, the reason that other gas utilities (like Nicor and Ameren Illinois) no longer have cast iron main in their systems is because for decades, this Commission supported its replacement. Ameren eliminated the last of its cast iron pipe approximately a decade ago, and Nicor did so in 2018. These utilities’ rural and suburban customers are seeing

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the safety and reliability benefits from the Commission’s leadership in ensuring the deployment of modern natural gas distribution systems in Illinois; Peoples Gas is working diligently to deliver those same benefits to its customers in Chicago.

To enhance its Commission-approved neighborhood approach and remain on course for the Commission-approved target completion date of 2035 to 2040, Peoples Gas proposes—and the Commission may wish to consider—the following potential modifications to SMP based on “lessons learned” from studies of its distribution system since 1981:

✓ A scope reduction for the targeted, proactive pipe replacement program, removing medium-pressure pipe with a longer remaining average life (see Section 4, Bundle 3).

✓ A new step in the neighborhood prioritization process that would prioritize work in areas of the City that are most economically vulnerable (see Section 6.1).

✓ Alternative risk ranking attributes for work prioritization, with the goal of giving still greater weight to at-risk pipe within the Neighborhood Ranking Model (see Section 6.2).

✓ An alternative geographical approach to replacing risky pipe, referred to as the High Risk Zone Approach (HRZA), which would draw on improved asset-specific data to target prioritization at a geographic level not tied to City-defined neighborhoods (see Section 6.3).

✓ Alternative reporting options, including project-specific reports on an annual basis in lieu of quarterly program-level reporting and new, before-and-after maps for upgraded areas (see Section 6.4).

Peoples Gas looks forward to reviewing these proposals with stakeholders and the Commission—and to resuming the work that is so critical to maintaining a safe, reliable gas distribution system under Chicago’s streets.

Dated: April 1, 2024

Jon Czarnecki
Director – Engineering
The Peoples Gas Light and Coke Company
2. Overview of the PGL Gas System

For nearly 175 years, Chicagoans have relied on natural gas – first for lighting the streets of a growing metropolis and then for heating, cooking, drying clothes and powering industry. Peoples Gas, and the natural gas industry in general, have evolved as the needs and demands of society have changed.

Today, 891,000 customers in the City of Chicago count on Peoples Gas to deliver natural gas to their homes and businesses 24 hours a day, seven days a week. PGL connects and transfers more than 50,000 customers each year, and conducts more than 120,000 inside safety inspections annually for natural gas meters located inside customers’ homes and businesses. To ensure customers are safe, Peoples Gas has crews standing ready every day and night to respond to natural gas emergencies.

To help customers manage natural gas use, Peoples Gas offers high-efficiency natural gas appliance rebates, weatherization services, and free energy assessments for homes and businesses. Through these programs, since 2012, customers have saved over 122 million therms and reduced carbon emissions by 642,000 tons, equivalent to taking 138,000 cars off the road.

Looking to the future, natural gas will remain an abundant, reliable and efficient source of fuel, and will continue to be an integral part of the energy solution for Chicago’s homes and businesses – including as a complement to other emerging sources of energy.

Because PGL’s natural gas will continue to be needed to support a clean energy future, it is important to understand the state of the gas distribution infrastructure under Chicago’s streets, with a focus on a few key attributes: material type, age, pipe size, and predicted remaining life of the assets. As of March 2024, the PGL system included 4,717 miles of main:

![Chart showing material type, age, and diameter of main pipes]
As discussed in Section 3, which describes the history and current state of SMP, several studies dating back to the 1980s have reviewed these pipe attributes and other conditions to evaluate the remaining life of this main. Based on the results of the most recent independent study completed by Kiefner and Associates (2018-2020), this map shows that much of PGL’s main has a remaining life of less than ten years:

Even as the average remaining life of this infrastructure makes pipeline replacement an urgent necessity, the need for natural gas to supply energy needs long into the future means it is critical to upgrade that infrastructure in a way that provides the best value for customers in the long
term. For Peoples Gas, this means doing more than simply replacing old pipe with new. While replacing aging cast iron and ductile iron mains with modern plastic mains is essential to safety, another key consideration is system pressure. Currently, PGL’s distribution system is primarily supporting two different pressure systems—medium and low pressure—at the same time.²

Upgrading the remainder of PGL’s system from low to medium pressure has been another key priority of the SMP. The reasons for doing so are described in detail in Section 5.1.2. But one of the drivers for this approach is the significant overlap between the low pressure system and the leak-prone material, as reflected in the following figure:

The data Peoples Gas collects every day emphasizes the need to continue the SMP at its current pace. In 2023 alone, Peoples Gas crews responded to over 40,000 emergencies, including over 17,000 no-gas situations, and addressed over 1,800 Grade 1 and Grade 2 leaks. And these efforts to improve the safety of PGL’s system are working. By removing the at-risk pipe from PGL’s system, the number of Class 1 and Class 2 leaks has been declining steadily for several years, as shown in the following chart:

² Very small portions of PGL’s systems are at even higher (intermediate or high) pressure. These de minimis portions are not significant to the pressure upgrade analysis.
At the same time, PGL’s system across Chicago continues to experience hundreds of new Grade 3 leaks every year—those that are recognized as nonhazardous to persons or property at the time of detection and can be reasonably expected to remain nonhazardous. While Grade 3 leaks by definition do not pose the same risks as Grade 1 and Grade 2 leaks, they illustrate that PGL’s remaining vintage pipes continue to deteriorate more quickly than Peoples Gas can replace them, underscoring the urgency of the work. Moreover, Grade 3 leaks will soon be the subject of increased federal compliance requirements, requiring time-sensitive repair with or without the SMP, as discussed in Section 3.4.

In addition to the immediate safety concerns motivating the SMP, Peoples Gas shares the goals of the State of Illinois and the City of Chicago to reduce greenhouse emissions. The SMP is an important part of that solution: already between 2017 and 2022, the SMP reduced greenhouse gas emissions by over 33,000 metric tons, including 1,300 metric tons of methane emissions—the equivalent of 96 million miles driven by the average gasoline-powered passenger car. An upgraded natural gas delivery system will continue to reduce methane emissions.

“The workers were kind and explained what happened to the gas line outside the home. They fixed it and were respectful of my property and inside my home. (I was appreciative of them checking all gas appliances inside. I also like that one had on a mask). I never really thought about an emergency after-hours team, and it is a relief to know it's available. There were a lot of people out there, but they all worked together as a team. I was very impressed and kinda nervous at the same time. Thank you for the emergency team.” —PGL Customer
This report presents alternatives to PGL’s current approach to replacing its aging infrastructure. In identifying those alternatives, Peoples Gas has evaluated past and present recommendations from engineers, consultants, parties to regulatory proceedings, and Commission staff. But as the history of the SMP makes clear, there has never been one static approach to the SMP. Instead, through the regulatory process and PGL’s own tradition of continuous improvement, the SMP’s approach to planning, execution, and reporting has changed over time. Through that ongoing process, certain core aspects of the SMP have emerged with broad stakeholder consensus and regulatory approval—including the scope of SMP (comprising both at-risk and low pressure pipe), PGL’s neighborhood approach to risk assessment and implementation, and the target completion date of 2035 to 2040.

Peoples Gas has been part of Chicago almost since its inception. As Chicago has become a world-class city, Peoples Gas has grown and evolved with it. The next iteration of the SMP will be the latest chapter in that story.

_Gas Main Work in the 1930s_
3. The SMP: Then and Now

3.1 Origins of SMP

Peoples Gas was organized by a special act of the Illinois General Assembly passed February 12, 1855, as amended by a special act of February 7, 1865. By these enactments it received a right to use any or all of the streets of the City of Chicago for distribution of gas.

As of just a few years ago, some of the cast iron pipe laid in those early days was still carrying gas under Chicago’s streets. In June of 2019, Peoples Gas retired the oldest working natural gas pipe serving Chicago: a cast iron pipe installed in 1859, before the Civil War. The company marked the occasion by removing a 17-foot section of the 160-year-old, 20-inch-diameter pipe running under Orleans Street in the River North neighborhood. A portion of the pipe was donated for a safer and more fitting use: display in the Chicago History Museum.

That replacement was one small but meaningful part of a comprehensive overhaul of Peoples Gas’s aging natural gas distribution system—an effort that traces its roots to the 1980s, when Peoples Gas commissioned the first in what would become a series of engineering studies culminating in the 2011 initiation of its Accelerated Main Replacement Program (“AMRP”), which continues today as the SMP.

3.1.1 The Zinder Engineering Studies (1981-2002)

The first of those studies came in 1981, when Zinder Engineering, Inc. (later ZEI, Inc.) evaluated the overall condition of the gas mains in PGL’s distribution system. As summarized by a more recent study, ZEI’s 1981 study assessed the replacement of pipe segments using a predictive model based on the primary factors that affect the breaks and cracks of the pipe, such as corrosion, pipe age, soil type, frost effects, vehicle loadings, and frequency of those events.

Two subsequent studies completed by ZEI in 1994 and 2002 updated corrosion data, expanded the scope to include ductile iron, examined replacement of PGL’s low-pressure system, and implemented the use of the Main Ranking Index (“MRI”) for pipe segment replacement. The

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3 Priv. Laws 1855, at 514 (Feb. 12, 1855), as amended by Priv. Laws 1865, at 589 (Feb. 7, 1865).
9 PGL Ex. 2.02 (Second Kiefner Study), supra note 6, at 11–12.
MRI altered the model and data used to assess pipe segment replacement, changing it from a pure predictive model to one that incorporated PGL’s historical data.10

The ZEI Studies’ primary focus was on cast iron pipe, and explained why cast iron should be prioritized for replacement:

Cast iron is brittle and relatively weak. The cast iron pipe was installed bare and cannot be protected by cathodic protection because of lack of dependable electrical continuity across the mechanical joints. ZEI developed the rationale that explains why cast iron pipe fails. The individual pieces of pipe are supported at their ends on blocks. Flexural stress is created by the weight of the soil overburden, by the weight of the pipe itself, and by forces from frost heave. Corrosion reduces its wall thickness and thus reduces its flexural resistance. Eventually, the cast iron pipe installed will fail as it is in a relatively corrosive environment.11

The very earliest of these studies also supported accelerated replacement of cast and ductile iron mains. ZEI’s 1981 report emphasized: “Pipe age (vintage) is one of the major influences affecting cast iron pipe performance (others are corrosive characteristics of different soils, frost penetration and heavy truck traffic).”12 The same report concluded: “A stepped-up replacement program is necessary to control pipe breaks and other pipe failures.”13 And it recommended a completion date of 2030 for all replacement.14

3.1.2 The First Kiefner Study (2007)

Following ZEI’s initial work in the early 1980s, Peoples Gas began replacing cast iron pipe at a relatively modest pace. In 2007, at the Commission’s direction, Kiefner & Associates, Inc. ("Kiefner") completed a study called the “Review of The Peoples Gas Light & Coke Company Cast Iron Gas Main Replacement Program” (the “First Kiefner Study”).15 Like ZEI’s 1994 and 2002 studies, the First Kiefner Study observed that PGL’s replacement efforts were proceeding “reasonably well” based on data showing reduced breaks and cracks.16 But looking ahead, Kiefner concluded that “replacement of all segments of 4-inch, 6-inch, and 8-inch pipe should be completed by 2036.”17 That recommendation reflected increased urgency: whereas in 1981 ZEI

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10 Id. at 12.
11 PGL Ex. 2.01 (ZEI 1981), supra note 5, at ii.
12 Id. (emphasis added).
13 Id. (emphasis added).
14 Id. (emphasis added).
15 PGL Ex. 2.05 (First Kiefner Study), supra note 11. As Kiefner explained, “This effort was carried out in response to [a] mandate from the Illinois Commerce Commission as part of a merger order” in connection with the merger of WPS Resources Corp. and Peoples Energy Corp. Id. at 3.
16 Id.
17 Id. at 2 (emphasis added) (noting that these sizes of pipes accounted for over 90 percent of the instances of breakage and cracking).
had recommended full replacement within 50 years, Kiefner’s recommendation maintained approximately the same timeline – but now with 20 fewer years to complete the work.\textsuperscript{18}

### 3.1.3 San Bruno (2010) and PHMSA’s Call to Action (2011)

As these developments were playing out in Illinois, a tragic development in Pacific Gas & Electric Company’s natural gas transmission system made Kiefner’s 2007 recommendation appear all the more critical:

On September 9, 2010 at 6:11 pm, a 30 inch diameter natural gas transmission pipeline in San Bruno, CA ruptured and released vast quantities of natural gas. The escaping gas ignited and initiated structure fires in the community surrounding the pipeline. Local emergency responders utilized air drops of fire retardant and water to limit the spread of the fire. At 7:40 pm, PG&E completed the isolation of the ruptured pipeline from sources of gas supply by closing valves upstream and downstream of the rupture site. Approximately 5 hours after the rupture, PG&E reported the pipeline rupture to the National Response Center (NRC).

The consequences of the rupture and fire were devastating. Eight people lost their lives, 51 people required in-patient hospitalization, and 38 homes were destroyed. PG&E has estimated the property damage from the rupture to be over $220 million.\textsuperscript{19}

This incident spurred the U.S. Department of Transportation’s Pipeline and Hazardous Materials Safety Administration (“PHMSA”) to issue a Call to Action. PHMSA, which has federal oversight of gas pipeline safety, pointed to San Bruno and similar incidents as demonstrating “the terrible loss of life and property that can occur without adequate attention to the integrity of pipeline infrastructure.”\textsuperscript{20} And then-Secretary LaHood of the U.S. DOT called upon “all pipeline stakeholders, including the pipeline industry, the utility regulators, and our state and federal partners” to “ensure the safety of the American people and the integrity of the pipeline infrastructure for future generations.”\textsuperscript{21}

In issuing this Call to Action, PHMSA observed that “some century-old infrastructure continues to transport energy supplies to residential and commercial customers, particularly in the urban areas across our nation.”\textsuperscript{22} And it specifically called out “[o]lder pipeline facilities that are

\textsuperscript{18} Kiefner also recommended that 10-inch and 12-inch replacements be completed by 2050, and that 16-inch replacements be completed by 2080. \textit{id.} at 19.


\textsuperscript{21} U.S. Dep’t of Transp.: Call to Action to Improve the Safety of the Nation’s Energy Pipeline System, Nov. 2011, attached as PGL Ex. 2.06, at 1.

\textsuperscript{22} \textit{Id.}
constructed of obsolete materials (e.g., cast iron . . .)”.\footnote{Id.} PHMSA also pointed to its Distribution Integrity Management Final Rule, which became effective in August 2011 and extended “pipeline integrity management principles that were established for hazardous liquid and natural gas transmission pipelines, to the local natural gas distribution pipeline systems.”\footnote{Id.}

As explained by PHMSA, this new regulation:

requires operators of local gas distribution pipelines to evaluate the risks on their pipeline systems to determine their fitness for service and take action to address those risks. For older gas distribution systems, the appropriate mitigation measures could involve major pipe rehabilitation, repair, and replacement programs. At a minimum, these measures are needed to requalify those systems as being fit for service. While these measures may be costly, they are necessary to address the threat to human life, property, and the environment.\footnote{Id. at 1–2. The most recent iteration of this rule and its implications for SMP work are discussed in detail below.}

Against the backdrop of San Bruno and PHMSA’s Call to Action, it was clear that Peoples Gas could not prudently continue pipeline replacement at the then-current pace. PGL’s response, building on the work of the ZEI Studies and the First Kiefner Study, was the Accelerated Main Replacement Program, which it initiated in 2011 to accelerate the pace of replacing the aging, at-risk parts of its natural gas system. AMRP’s principal goal was—and SMP’s primary goal remains—to maintain the safety and reliability of PGL’s distribution system while systematically addressing risks attributable to aging main by removing that main from the system in a risk-ranked manner, starting generally with the riskiest pipe in the system and progressing over time until all aging, at-risk pipe is replaced. All aspects of the program, from how Peoples Gas prioritizes work, to scheduling, workforce composition, and so on are ultimately aimed to achieve that goal in a cost-effective manner. The remainder of the story concerns the details of AMRP’s (and later SMP’s) execution.

3.2 Enactment of Rider QIP (2013)

Peoples Gas was not alone in responding to PHMSA’s Call to Action. The Illinois General Assembly did, too. In July of 2013, it enacted Public Act 098-0057, providing a critical funding mechanism for natural gas pipeline replacement programs like PGL’s AMRP. The opening sentences of the new law clearly stated its rationale:

The General Assembly recognizes that for well over a century Illinois residents and businesses have relied on the natural gas utility system. The General Assembly finds that in order for a natural gas utility to provide safe, reliable, and affordable service to the
State’s current and future utility customers, a utility must refurbish, rebuild, modernize, and expand its infrastructure and adequately train its workforce on appropriate operations procedures and policies designed to effectively maintain its infrastructure.\textsuperscript{26}

To that end, the 2013 law authorized natural gas utilities serving more than 700,000 customers to file a tariff for a surcharge to recover costs associated with investments in “qualifying infrastructure plant, independent of any other matters related to the utility’s revenue requirement.”\textsuperscript{27} For purposes of the law, “qualifying infrastructure plant” (or “QIP”) and “costs associated with investments in [QIP]” were referred to as the “qualifying infrastructure investment” relating to seven categories of work, the first of which was:

(1) the installation of facilities to retire and replace underground natural gas facilities, including facilities appurtenant to facilities constructed of those materials such as meters, regulators, and services, and that are constructed of cast iron, wrought iron, ductile iron, unprotected coated steel, unprotected bare steel, mechanically coupled steel, copper, Cellulose Acetate Butyrate (CAB) plastic, pre-1973 DuPont Aldyl "A" polyethylene, PVC, or other types of materials identified by a State or federal governmental agency as being prone to leakage.\textsuperscript{28}

Other categories of QIP included (2) relocating meters from inside customers’ facilities to outside; (3) upgrading the gas distribution system from a low pressure to a medium pressure system, including installation of high-pressure facilities to support the upgrade; (4) certain modernization investments in advanced metering by a combination (electric and gas) utility; (5) replacing high-pressure transmission pipelines; (6) replacing difficult-to-locate mains and service pipes and associated facilities; and (7) replacing or installing transmission and distribution regulator stations, regulators, valves, and associated facilities to establish over-pressure protection.\textsuperscript{29}

The General Assembly’s approach was not the first attempt to jump-start funding for critical main replacement work to improve safety in Chicago. As early as its 2009 general rate case (Docket No. 09-0167), acting on the recommendation of the First Kiefner Study, Peoples Gas had proposed to undertake a more comprehensive main replacement program. To facilitate cost recovery for investments in this program, Peoples Gas proposed an Infrastructure Cost Recovery (“ICR”) rider, which would have allowed Peoples Gas to recover a surcharge for projected costs of system upgrades without filing for a general rate increase. The Commission’s Final Order in that docket approved the proposed Rider ICR and PGL’s proposal to recover main replacement costs

\textsuperscript{26} P.A. 098-0057, § 5-111(a).
\textsuperscript{27} Id., § 9-220.3(a)(1).
\textsuperscript{28} Id., § 9-220.3(b)(1) (emphasis added).
\textsuperscript{29} Id., § 9-220.3(b)(2)-(7) (emphasis added).
under that rider, requiring that the main replacement program be completed by 2030. But in September 2011, the Illinois Appellate Court reversed the Commission’s decision approving Rider ICR, leaving Peoples Gas unable to recover main replacement costs through that rider. With the 2013 QIP law, the General Assembly cut through this impasse.

Consistent with the General Assembly’s direction, PGL proposed a new tariff (“Rider QIP”) to recover its investments in QIP, and the ICC approved PGL’s Rider QIP on January 7, 2014 in Docket No. 13-0534. From January 1, 2014 through December 31, 2023, the costs of PGL’s AMRP (and later SMP) investments were recovered via Rider QIP, subject to an annual reconciliation process that remains ongoing for several years of this 10-year period.

The QIP law was enacted with a December 31, 2023 sunset date. While this date did not reflect a legislative decision that all work qualifying as QIP should be completed by then, the General Assembly’s deadline provided an additional incentive for natural gas utilities to accelerate their main replacement work, which Peoples Gas did.

As a point of clarification, Rider QIP also applied to work outside of the AMRP (or SMP). While all of the AMRP work qualified for recovery via Rider QIP, Peoples Gas was also undertaking non-AMRP transmission work that qualified for recovery via Rider QIP. The result was partial but not complete overlap between AMRP and Rider QIP.

This distinction can be seen in PGL’s annual Rider QIP reconciliation filings. To date, PGL has initiated reconciliation dockets for each year from 2014 through 2023, and its applications show that AMRP/SMP work made up most but not all of its QIP investments in most of those years:

<table>
<thead>
<tr>
<th>Rider QIP Reconciliation</th>
<th>2014-2023 Recoverable $s (in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMRP/SMP %</td>
<td>95.8%  84.2%  99.4%  88.4%  99.8%  98.3%  99.9%  100%  100%  100%</td>
</tr>
<tr>
<td>AMRP/SMP</td>
<td>$198.6 $268.1 $183.2 $266.2 $313.1 $296.9 $293.5 $282.5 $287.6 $255.7</td>
</tr>
<tr>
<td>Transmission</td>
<td>$8.6 $50.2 $1.1 $34.9 $0.5 $5.1 $0.3 $0.0 $0.0 $0.7</td>
</tr>
<tr>
<td>Total QIP Recoverable</td>
<td>$207.2 $318.3 $184.3 $301.1 $313.6 $302.0 $293.8 $282.5 $287.6 $256.4</td>
</tr>
</tbody>
</table>

Peoples Gas has also emphasized this distinction at the level of the categories established by the 2013 QIP law. For example, in PGL’s 2015 reconciliation period, it identified work in five of the seven QIP categories: (a)(1), (a)(2), (a)(3), (a)(5), and (a)(7), but not (a)(4) (because it is not a combination utility) or (a)(6) (replacing difficult-to-locate facilities). Peoples Gas then explained that its investments in these five QIP categories were divided into four programs: the

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31 People ex rel. Madigan v. Ill. Commerce Comm’n, 2011 IL App (1st) 100654, at ¶ 42.
33 P.A. 098-0057, § 9-220.3(j).
34 PGL Initial Brief, The Peoples Gas Light & Coke Co. – Petition Pursuant to Rider QIP of Schedule of Rates for Gas Service to Initiate a Proceeding to Determine the Accuracy and Prudence of Qualifying Infrastructure Investment, ICC Docket No. 16-0197, at 8 (Jan. 31, 2019) (citing PGL Ex. 2.02 at 85–91).
Neighborhood Replacement Program; the Public Improvement/System Improvement Program; the High Pressure Installation Program; and the Calumet 2/3 Program. Of these, only the first three programs were part of the AMRP/SMP; the Calumet 2/3 Program was not.  

With the sunset of Rider QIP at the end of 2023, the interrelationship between AMRP/SMP work and Rider QIP is no longer relevant. But PGL’s own program categories remain relevant because they demonstrate that its Neighborhood Replacement Program is (and has always been) only one component of its AMRP/SMP—a point that has become critically important on rehearing in PGL’s most recent rate case (Docket No. 23-069) and here, where the Commission’s Initiating Order specifically directs Peoples Gas to “justify the continuation of the neighborhood approach” while also identifying “[a]lternatives to the neighborhood approach.” This neighborhood component of AMRP/SMP has also been the subject of regulatory scrutiny since at least 2015.

3.3 Regulatory Oversight of SMP

As distinct from the accounting review provided by the annual QIP reconciliation dockets, the AMRP/SMP has been subject to regulatory scrutiny at the programmatic level almost since its inception, with an early and continuing focus on PGL’s neighborhood approach. From the beginning, the common theme of these proceedings has been repeated endorsement of the neighborhood approach by the Commission’s chosen auditors and the Commission itself.

3.3.1 2007 to 2017: The Liberty Audits

Commission scrutiny of PGL’s approach to infrastructure replacement began as early as 2007, with the completion of the First Kiefner Study as described in Section 3.1.2 and another Commission-mandated audit completed by The Liberty Consulting Group between May of 2007 and August of 2008. Like the First Kiefner Study, Liberty’s initial audit concluded that “[t]he cast iron replacement program appears to be on track and addressing the right diameter mains,” but recommended that within six months, “Peoples Gas should document a well-defined plan for the systematic replacement of vulnerable service lines.”

This was even before AMRP formally existed. In the years that followed, regulatory oversight of Chicago’s aging natural gas system intensified with the Commission’s own efforts to establish a cost recovery mechanism for main replacement work. After the courts rejected the Commission’s initial funding approach (Rider ICR), but before the General Assembly enacted the QIP legislation, Peoples Gas sought to recover its AMRP costs in general natural gas delivery rates. In its Final Order in PGL’s 2012 rate case (Docket No. 12-0512), the Commission granted this request, noting that PGL’s “distribution system . . . [was] approaching the point that further aging and

35 Id.
36 Initiating Order, supra note Error! Bookmark not defined., at 3.
38 Id. at 3, 16 (emphasis added).
deterioration will eventually cause replacement to maintain public safety to become an emergency matter.”

At the same time, the Commission expressed concern that, as described in PGL’s filings, AMRP lacked detail. Accordingly, the Commission ordered a two-phase investigation of the AMRP, selecting Liberty following an RFP process to complete the audit, which accordingly became known as the “Liberty Audit.”

That order of the Commission was dated June 18, 2013—just two years after Peoples Gas initiated its AMRP, and before any reliable cost recovery mechanism for AMRP investment had been established. The Liberty Audit would span the next four years, resulting in an exhaustive Phase I report in May of 2015, followed by eight quarterly Phase II reports ending in December 2017.

In Phase I, Liberty reviewed and audited Peoples Gas’s planning, implementation, and management of AMRP, ultimately issuing 95 recommendations for improving AMRP planning and execution. According to the Commission’s own historical narrative of PGL’s AMRP, Liberty’s 354-page report “was a comprehensive examination of the way that Peoples Gas had approached the SMP/AMRP, and resulted in recommended changes to essentially all of the processes and procedures underlying the work. Peoples Gas accepted and implemented the vast majority of these recommendations.”

As Liberty explained, through its AMRP, “Peoples Gas addresses cast and ductile iron replacement, system pressure increase, and the movement of meters from inside to outside customer buildings through a commonly managed program.” These three components coincided with the first three QIP categories, and “[t]he program focuses primarily on an approach that brings all three improvements simultaneously to those City of Chicago neighborhoods designated for work over the long course of the AMRP.” Liberty found that Peoples Gas had been applying this approach since 2013, and while it recognized “concern” over “the degree to which adding other considerations to the work prioritization process may produce an under-emphasis on the AMRP-specific risks of high-risk pipe,” it concluded that “[t]he introduction of the neighborhood approach created a sound overall means for combining AMRP work with the other two priorities created by the [QIP] Surcharge.”

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40 Id.
41 Id.
43 The Liberty Consulting Group: Phase Two of an Investigation of Peoples Gas Light & Coke Co.’s Accelerated Main Replacement Program, July 2017 (“Liberty Phase II Report”), attached as PGL Ex. 2.08.
45 PGL Ex. 2.07 (Liberty Phase I Report), supra note 42, at B-1.
46 P.A. 098-0057, § 9-220.3(b)(1)-(3)
47 PGL Ex. 2.07 (Liberty Phase I Report), supra note Error! Bookmark not defined., at B-1.
48 Id. at B-5, B-8.
Liberty repeated this finding in greater detail elsewhere in its Phase I report:

- “Conceptually, the Peoples Gas utilization of a ‘neighborhood’ approach with an overlay to address pipe in most critical need of replacement is sound. It promotes economy in serving a broader set of objectives, while focusing at the same time on reducing the safety threat risks posed by high-risk pipe.”

- “The neighborhood approach offers a sound construct for efficiently replacing high-risk pipe, while contemporaneously increasing the delivery pressure and moving meters outside.”

- “The neighborhood construct permits main installation and conversion to medium pressure without having lengthy interruptions in service. It allows build-out of medium-pressure infrastructure, while low-pressure mains remain in service until the Company can switch all customers served from a main to medium pressure. This approach may defer retirement of some old, low-pressure system components, but it ensures that all customers have gas service almost continuously. Short-duration outages may occur while Peoples Gas ties in a new outside meter, but these outages should be minimal in duration.”

Liberty’s Phase I report also highlighted the core problems with departing from the neighborhood approach, based in PGL’s experience between 2011 and 2013, when Peoples Gas had relied [solely] on the MRI approach:

- “Before moving to the neighborhood construct, Peoples Gas would find itself, when undertaking replacement of high-risk pipe, possibly extending medium-pressure feeds deep into areas without the ability to tie customers into them. Deferring the work necessary to make those connections not only forced customers to wait for medium-pressure service, it also substantially increased costs by requiring eventual tie-ins to occur under an entirely separate installation process.”

- “Past reliance solely on the Main Ranking Index to drive replacements also tended to produce widely scattered and more isolated work. That also increased costs, when compared with a program encouraging work that the Company could more economically perform through commonly marshalling resources and equipment to work more pipe in the concentrated area achievable under the neighborhood approach.”

To be sure, Liberty also identified recommendations for improving the neighborhood approach as it existed a decade ago, circa 2014. For instance, Liberty recommended that to the extent low pressure and single-contingency outage risks “prove material in any neighborhood, Peoples Gas should consider the benefits of addressing them more promptly by moving the

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49 Id. at C-13.
50 Id. at F-14.
51 Id.
52 Id.
53 Id. at F-15.
neighborhood involved up in priority order.”54 Similarly, Liberty found that under PGL’s 2014-vintage neighborhood approach, “Neighborhoods with the highest leak rates may fail selection for the first five-year window simply because they are physically small, do not contain a large percentage of pre-1920 cast iron mains, or do not have much small diameter main.”55 To address this, Liberty recommended that Peoples Gas “engage in a structured, comprehensive, and analytically-driven review” of the “weighting, parameters, and additional inputs” for its neighborhood rankings.56 But its focus was clearly on fine-tuning the risk-ranking model to better address high-risk pipe—not throwing the model out.

Phase II of Liberty’s work consisted of a structured, two-year program to monitor PGL’s effectiveness in implementing the Phase I recommendations, which included maintaining and improving the neighborhood approach. Phase II coincided almost exactly with new management of the program following WEC Energy Group’s acquisition of Integrys, which the Commission approved subject to conditions in June of 2015, one month after Liberty issued its Phase I report.57 One of those conditions was a requirement that Peoples Gas file a Cost Plan Model and Scheduling Master Plan for the AMRP.58 As a result, the Commission was now exercising oversight of AMRP via three separate regulatory avenues: (1) the annual Rider QIP reconciliation dockets, (2) the ongoing Liberty Audit, and (3) the cost and schedule planning conditions added in 2015.

Phase II of the Liberty Audit concluded in December 2017 with its eighth and final quarterly report, indicating that in the two years between 2015 and 2017, Peoples Gas management and Liberty had closed out 86 of Liberty’s original 95 recommendations. Seven more were deleted or merged with Liberty’s consent, and management considered the remaining two complete:

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54 Id. at C-15 (Conclusion C.5). Phase II addressed this recommendation as discussed below.
55 Id. at F-16.
56 Id. at F-23 (Recommendation F.3). Again, Phase II addressed this recommendation in more detail.
57 Final Order, Wisconsin Energy Corp., et al. – Application Pursuant to Section 7-204 of the Public Utilities Act for Authority to Engage in a Reorganization, to Enter into Agreements with Affiliated Interests Pursuant to Section 7-101, and for Such Other Approvals as may be Required Under the Public Utilities Act to Effectuate the Reorganization (hereinafter “Reorganization Docket”), ICC Docket No. 14-0496, at 100 (June 24, 2015).
58 Id. at 29–30 (Condition 5).
As to PGL’s neighborhood risk ranking methodology in particular, Liberty marked its recommendation (F.3) “complete,” “verified,” and “changed in 2016.” Liberty explained that under PGL’s new approach, “The neighborhoods that are at the highest risk should be prioritized for main replacement, regardless of size, because the new model normalizes the risk ranking for size.” To verify that this was the case, Liberty:

- Discussed the new methods with management and reviewed the specific changes proposed.
- Compared neighborhood scorings under the old and new methods.
- Confirmed that the new MRI uses normalized metrics, so that large neighborhoods are not over-weighted when compared with smaller, but higher risk neighborhoods.

Based on its observations, Liberty concluded: “Implementation is satisfactory and the original replacement plan for 2017 has been changed based on the new priorities from the model. Liberty considers this recommendation implemented.” In short, after Liberty recommended that PGL’s neighborhood ranking approach normalize risk rating inputs to make sure larger geographic areas were not weighted higher due to their size alone, Liberty worked with Peoples Gas to implement that modification and confirmed that it was working as recommended.

Both phases of the Liberty Audit also addressed PGL’s practice of “double decking,” which uses two mains, one on each side of a street, with each main serving customers on that side of the street. Liberty’s Phase I report found that as compared to a single main running down the middle of a street to serve customers on both sides of the street, PGL’s approach results in “significant

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59 PGL Ex. 2.08 (Liberty Phase II Report), supra note 43, at 2.
60 Id. at C-4.
61 Id. at C-59 (“Expected Post-Implementation Conditions and Factors” for this recommendation).
62 Id. at C-60.
63 Id.
addition of materials” (i.e., more pipe), “but avoids a significant portion of the substantial costs and restrictions imposed by the City on work involving street openings.”\textsuperscript{64} Thus, “despite the added cost of double decking, it too reflects an appropriate method, given City requirements.”\textsuperscript{65} The schematic below shows double decking in a typical residential setting:

As with PGL’s neighborhood approach, Liberty offered recommendations relating to double decking. Specifically, it emphasized that Peoples Gas “should not conclude that new, double decking makes more sense in all cases,”\textsuperscript{66} and recommended that Peoples Gas evaluate case-specific exceptions to double decking as an element of the neighborhood work planning

\textsuperscript{64} PGL Ex. 2.07 (Liberty Phase I Report), supra note 42, at B-1.
\textsuperscript{65} \textit{Id.}; see also \textit{id.} at C-9-10 (further explaining why double decking is, on net, economical).
\textsuperscript{66} \textit{Id.} at C-13 (Conclusion C.4).
process—while reiterating that “Double decking as a default option clearly makes sense for Peoples Gas.”

Again, Liberty’s final Phase II report marked this item (Recommendation C.1) “complete” and “verified.” It reviewed the percentages of single decking in 2015 and 2016, as well as 2017 proposed levels, and it found that “the model management developed and uses sufficient to establish a sound basis for determining where double decking proves advantageous.”

3.3.2 2016 to 2018: ICC Dockets – AMRP to SMP

By the time Liberty’s final Phase II report was released, the Commission had opened another avenue for oversight of AMRP: a series of workshops to address stakeholder input on the program at a holistic level. This initiative grew out of the Cost Plan Model and Scheduling Master Plan that Peoples Gas was required to submit and work with Staff to implement as a condition of the WEC-Integrys acquisition. A narrative history prepared by Staff in 2017 summarizes this as follows:

Between January 14, 2016 and March 22, 2016, ICC Staff held a series of six workshops, during which Peoples Gas provided information to Staff and other workshop participants about its goals for the SMP/AMRP and progress to date. Other stakeholders, including the Attorney General and Citizens Utility Board (CUB), also presented information concerning all aspects of the project.

In May 2016, ICC Staff submitted a report to the Commission that summarized the workshop participants’ positions on issues and recommended that the Commission initiate a formal proceeding to resolve the issues. To distinguish the Company’s revised approach from previous iterations of the modernization program, the parties began to call the program the System Modernization Program (“SMP”).

In July 2016, the Commission initiated Docket No. 16-0376 to investigate the SMP/AMRP’s cost, schedule, scope and other issues. Peoples Gas submitted a written plan for proceeding with system modernization through a neighborhood approach and pursuant to rolling, three-year plans. In March, 2017, following a contested proceeding, the Commission ordered the parties to undertake a second phase of the docket, in order to address additional questions in the interest of delivering a more complete record for Commission consideration.

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67 Id. at C-15 (Recommendation C.1).
68 PGL Ex. 2.08 (Liberty Phase II Report), supra note 43, at C-3.
69 Id. at C-13.
70 Supra note 57, at 29–30 (Condition 5).
71 Supra note 44, at 6–7.
As this description makes clear, PGL’s plan submitted in Docket No. 16-0376 continued to rely on a neighborhood approach—now with the benefit of the 2016 workshops, which had specifically examined the scope of SMP (specifically including the neighborhood approach and double decking), PGL’s management of SMP work, public safety considerations, SMP’s schedule and cost, rate impacts, ongoing monitoring, and engineering studies—a total of eight broad topics and forty individual issues.\(^{72}\)

As part of its March 2017 order requiring the parties to undertake a second phase of the docket, the Commission ordered further testimony and briefing on twelve issues in addition to the forty identified in Staff’s May 2016 report, specifically including “[t]he effect of, and how to balance, each of the risk-based factors and non-risk based factors in [PGL’s] Neighborhood Approach ranking.”\(^{73}\)

Nine months later, following four additional rounds of testimony, a two-day hearing, and three more rounds of briefing, the Commission issued a Final Order that once again specifically addressed PGL’s neighborhood approach.\(^{74}\) For 17 pages, the Final Order summarized party positions on this issue from Peoples Gas, Commission Staff, the Attorney General, and CUB over both phases of the docket.\(^{75}\) Peoples Gas, of course, supported the neighborhood approach, but so did Staff, noting that this approach “was recently evaluated by Liberty and was updated by the Company based upon Liberty’s recommendations,” and emphasizing that “Staff has been involved in reviewing accelerated main replacement issues at least since the onset of the Liberty investigation; indeed, the Liberty audit itself was based on a Staff recommendation.”\(^{76}\)

CUB, too, did not object to the neighborhood approach to planning, but asserted that “its proposal to require Peoples Gas to use advanced leak detection and leak quantification technologies to prioritize pipe replacement can be integrated into the neighborhood approach, to supplement the data on which Peoples Gas relies in developing prioritizations within the existing program.”\(^{77}\)

Only the AG opposed PGL’s neighborhood approach, arguing instead that Peoples Gas should “prioritize replacing the leakiest and most risky pipe no matter the location.”\(^{78}\) But Staff “recommend[ed] that the Commission reject the AG’s worst performing segments proposal, as the AG’s contention that [the SMP] does not address the ‘worst performing segments’ is wrong.”\(^{79}\) As Staff pointed out, “The AG fails to recognize that Peoples Gas will promptly replace any main segment that scores a six or higher on the UMRI. As a result, the Company replaces the worst

\(^{72}\) Bureau of Public Utilities: Staff Report to the Commission Regarding Workshops Held to Evaluate and Assess The Peoples Gas Light & Coke Co. Gas System Modernization Program, May 2016, attached as PGL Ex. 2.09.

\(^{73}\) Order Directing Additional Hearings, SMP Investigation, ICC Docket No. 16-0376, at 2 (Item 2.e) (March 1, 2017).

\(^{74}\) Final Order, SMP Investigation, ICC Docket No. 16-0376, at 66 (Jan. 10, 2018), attached as PGL Ex. 2.10.

\(^{75}\) Id. at 52–68.

\(^{76}\) Id. at 53; see also id. at 58 (Phase II position) (“Consistent with Staff’s position in Phase I of this proceeding, Staff found no reason to take issue with . . . the neighborhood approach”); id. at 63–64 (same).

\(^{77}\) Id. at 57 (emphasis added); see also id. at 64 (same position in Phase II).

\(^{78}\) Id. at 54-57; see also id. at 58–60 (same); id. at 66–67 (further summarizing AG’s “highest risk leak approach”).

\(^{79}\) Id. at 67.
performing segments *in addition to* the replacement work performed through the neighborhood approach.\textsuperscript{80}

In its January 2018 Final order, the Commission agreed with Peoples Gas and Staff on this point, and its rejection of the AG’s contrary position is worth quoting in full:

> The Commission finds that the record indicates that the AG’s leak rate analyses include leaks caused by third parties, and they do not take into consideration the effect of Chicago’s harsh winters on gas mains. Additionally, the record in this case reflects that the percentage of medium pressure CI/DI pipe is a proper factor to consider in the Company’s risk-ranking methodology. **The Commission holds that the neighborhood approach is efficient in addressing the high risk mains and pipes within the system, and it is approved.**

> [...]  

> The Commission approves Peoples Gas’ neighborhood approach. **As described above, the Commission finds that the Company’s neighborhood approach does target the worst performing and leak prone portions of the system.** Peoples Gas will replace any main segment that scores a six or higher on the UMRI on an expedited basis, thus the worst performing segments are replaced. Peoples Gas then prioritizes replacement activities for remaining high-risk pipe by neighborhood, using the UMRI and other factors to most effectively schedule program activities, as discussed in more detail below. **The Commission declines to adopt the AG’s worst performing segments proposal because it is more expensive to customers, ignores PHMSA’s Call to Action to eliminate at-risk piping on an expedited basis, is inconsistent when done in a piecemeal fashion, and would be disruptive to City residents.**\textsuperscript{81}

The AG petitioned for rehearing, specifically challenging the Commission’s endorsement of PGL’s neighborhood approach and emphasizing “the thousands of hours of case preparation and litigation, thousands of dollars in expert witness fees, and, in Peoples Gas’s case, attorney’s fees, expended” over “more than two years of investigation.”\textsuperscript{82} Following denial of its petition for rehearing,\textsuperscript{83} the AG appealed the Commission’s Final Order to the Illinois Appellate Court.\textsuperscript{84}

\textsuperscript{80} Id. at 54 (summarizing Staff’s position) (emphasis added, internal citations omitted); see also id. at 67–68 (providing additional detail from Staff on this point).
\textsuperscript{81} Id. at 66, 68 (Commission Analysis and Conclusions) (emphasis added).
\textsuperscript{82} Application for Rehearing of the People of the State of Illinois, *SMP Investigation*, ICC Docket No. 16-0376, at 2 (Feb. 9, 2018).
\textsuperscript{84} Notice of Appeal of the People of the State of Illinois, *SMP Investigation*, ICC Docket No. 16-0376 (Apr. 4, 2018).
Notably, however, the AG did not appeal from that portion of the Final Order endorsing the neighborhood approach; instead, it focused only on how the cost recovery provisions of the 2013 QIP law affected the Commission’s normal powers and duties of investigation and regulation under the Public Utilities Act. In August of 2019, the Illinois Appellate Court affirmed the Commission’s decision, and the question of the neighborhood approach appeared to be finally settled.

3.3.3 2018 to 2020: Additional Workshops and the Second Kiefner Study

The Commission’s January 2018 order in Docket No. 16-0376 ordered that a new engineering study be conducted for the project, and directed Staff to report on the criteria and timing for such a study within 90 days.

Staff’s resulting report summarized the four prior engineering studies completed by Peoples Gas since 1981: the three ZEI studies (1981, 1994, and 2002) and the 2007 Kiefner Study. Staff recommended that the Commission direct Peoples Gas to engage an engineering consultant to review its cast and ductile iron system during the 2019 construction season (“Study Period”) and prepare an engineering study and report detailing the findings of this review.

In May of 2018, the Commission opened another docket (Docket No. 18-1092) “in which the Commission may consider and resolve questions related to the Staff Report and the engineering study discussed therein.” In July of 2018, following additional submissions from the parties, the Commission ordered Peoples Gas to work with Commission Staff to procure a new engineering report by January 31, 2020, using 2019 as the Study Period and adopting Staff’s proposed criteria and content for the study.

Critically, however, the Commission did not order another reevaluation of the neighborhood approach. Instead, its order directed “[a]n assessment of date by which sound engineering practices dictate that [PGL’s] cast and ductile iron pipe system must be retired, assuming [PGL’s] current methods for replacement (neighborhood approach, UMRI, system improvement, and public improvements).” In other words, having just been approved in the Commission’s January 2018 order, the neighborhood approach was to be taken as a given.

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85 People ex rel. Raoul v. Ill. Commerce Comm’n, et al., 2019 IL App (1st) 180679-U, at ¶ 26; see also Notice of Mandate, SMP Investigation, ICC Docket No. 16-0376 (Aug. 21, 2019).
87 PGL Ex. 2.10, supra note 74, at 206.
89 Id. at 2.
92 Id. at 19.
Both the AG and the City of Chicago requested rehearing, arguing that the Commission’s latest order did not go far enough in reevaluating the neighborhood approach which by now had been reviewed three times.\(^{93}\) The AG and the City pointed out—correctly—that the Order “requires that the engineering consultant assume the validity of previous engineers’ conclusions regarding such factors as the current pace of the project and use of the neighborhood approach. In effect, the Commission is directing the engineering firm to conduct a study of the mains, but adhere to previous findings about the replacement approach, spending levels and timeline.”\(^{94}\)

The Commission evidently meant what it said about this, because it denied rehearing,\(^{95}\) and Peoples Gas and Commission Staff proceeded to work on the engineering study as directed by the Commission. The consultant selected to prepare the 2020 engineering report was Kiefner and Associates, the same consultant that had completed the First Kiefner Study thirteen years earlier. Its final report (the “Second Kiefner Study”) was filed on deadline: January 31, 2020.\(^{96}\)

The Second Kiefner Study opened by noting that this independent engineering study was “the fifth study in a series of ongoing engineering studies” dating back to ZEI’s original study in 1981.\(^{97}\) Kiefner confirmed that as of 2020, “most of PGL’s CI mains average over 90 years old and most of PGL’s DI mains average over 50 years old”—and that “83% of the remaining CI and DI pipes have an average remaining life of less than 15 years.”\(^{98}\) In light of this finding, Kiefner recommended even greater acceleration of the SMP:

[...] based on the analysis of the remaining life of PGL’s CI and DI inventory, and to hold paramount the public safety and welfare through the reduction of leaks and/failures, [Kiefner] recommends that all CI and DI pipes should be replaced by 2030, 10 years earlier than the current plan of completion by 2040. [...] [A] delay extending completion by more than five years (i.e. a completion date of 2045) would not be advised.\(^{99}\)

The 2030 completion date recommended by the Second Kiefner Study in 2020 was the same as what the first ZEI study recommended in 1981. It established one end of a 10-year range encompassing the recommendation of the First Kiefner Study (2036), and PGL’s current plan (2040)—all of which is consistent with the target timeframe directed by the Commission’s January 2018 order (2035-2040)\(^{100}\)—while urging that the date not be extended beyond 2045.

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\(^{94}\) Id. at 9.


\(^{96}\) PGL Ex. 2.02 (Second Kiefner Study), supra note 6.

\(^{97}\) Id. at i (emphasis added).

\(^{98}\) Id. “CI” refers to cast iron. “DI” refers to ductile iron.

\(^{99}\) Id. at ii (emphasis added).

\(^{100}\) PGL Ex. 2.10, supra note Error! Bookmark not defined., at 194–96 (“The Commission agrees with the need for flexibility on such a large scale project and approves [PGL’s] recommended target end date of 2035 to 2040 for the SMP.”).
Recognizing that compressing more work into less time presented financial and logistical hurdles, Kiefner emphasized that it had “primarily focused on safety and risk and did not evaluate logistical or financial constraints that could be necessary to support an acceleration of the SMP program,” which were beyond the scope of the work Kiefner had been asked to do. In short, Kiefner concluded that time was of the essence, subject to practical constraints.

As for PGL’s neighborhood approach, Kiefner found no contradiction between that approach and a focus on risk reduction: “The SMP’s objective is to prioritize replacement of the higher risk pipe, by neighborhood, based on observed historical pipe data that incorporates, among other things, the condition of the pipe. The SMP also addresses the riskiest mains where leaks were found and where pipe maintenance and repairs have occurred.”

Consistent with the Commission’s July 2018 order, the Second Kiefner Study did not revisit the Commission-approved neighborhood approach, but it did entail gaining a detailed understanding of PGL’s existing main replacement criteria and neighborhood approach and verifying assumptions used by Peoples Gas to place replacement activities under its neighborhood approach. Based on this study, Kiefner also developed a Neighborhood Ranking Model (NRM) to document the neighborhood approach.

As documented by Kiefner in 2019, the NRM “calculates a Neighborhood Score value considering the quantities of medium pressure CI/DI, small diameter CI main, mean MRI, quantities of unrepaired or pending leaks, and the presence of vulnerable services. The neighborhoods are primarily prioritized by Neighborhood Score and construction feasibility. Construction feasibility is primarily based on the availability of infrastructure to support the replacement.”

The Neighborhood Score attributes and weighting factors that went into the NRM were outside Kiefner’s scope and were not evaluated by the Second Kiefner Study. However, Kiefner recommended that they be reevaluated.

Specifically, the last of Kiefner’s twelve recommendations (R.12) was as follows:

**Neighborhood Ranking Model (NRM) Attributes.** PGL should re-examine the weighting coefficients used for its Ranking Model which have not been updated since 2015. Sensitivity of these coefficients should be studied. PGL could evaluate the use of the models developed as part of this study.
Kiefner’s reference to 2015 looks back to Liberty’s Phase I recommendation that Peoples Gas “engage in a structured, comprehensive, and analytically-driven review” of the “weighting, parameters, and additional inputs” for its neighborhood rankings— a recommendation that Liberty verified Peoples Gas had fully implemented by the end of 2017. Now Kiefner was proposing that Peoples Gas fine-tune the NRM again.

So Peoples Gas did. After Kiefner submitted its report, the Commission reopened the docket and directed Peoples Gas to submit a response to the report within 60 days. That response was to include an analysis of each specific recommendation made by Kiefner, an overview of PGL’s plan to implement each recommendation PGL agreed to implement, and, for any recommendation that PGL did not agree to implement, a detailed explanation for the rejection and the course of action, if any, that PGL would pursue as an alternative. Peoples Gas was also directed to address how these steps would affect the scope, schedule, and proposed cost of the SMP, and the corresponding short- and long-term effects on rates.

Peoples Gas submitted its response in May of 2020. Of Kiefner’s twelve recommendations, Peoples Gas supported all but one, and specifically agreed to undertake a re-examination of the NRM:

PGL agrees with this recommendation and in addition to reevaluating the weighting of the various model attributes, PGL is planning to evaluate the models developed by Kiefner as part of this study to determine if they can be used during the SMP’s design and planning stage. The predictive corrosion model developed by Kiefner is one that PGL feels can be used in alignment with the Neighborhood Ranking Model and Main Ranking Index.

In its second order on reopening closing its second stand-alone, comprehensive evaluation of the SMP, the Commission emphasized that “this proceeding was reopened for the limited purpose of considering what, if any, further action is called for by recommendations of the Final Kiefner Report”—“not [for] reconsideration of the determinations the Commission made regarding the SMP in its [January 2018] Final Order in Docket No. 16-0376.” In particular, the Commission found that “the most significant of Kiefner’s recommendations” was Recommendation 1 (accelerating SMP’s completion date from 2040 to 2030); the Commission explicitly rejected that

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108 PGL Ex. 2.07 (Liberty Phase I Report), supra note 42, at F-23 (Recommendation F.3).
109 PGL Ex. 2.08 (Liberty Phase II Report), supra note 43, at C-60.
111 Id. at 2.
112 Id.
114 Id. at 14. The “predictive corrosion model” referenced here reflected Kiefner’s recommended modifications to the Neighborhood Ranking Model as of May 2020. Over the past four years, Peoples Gas has continued to study the underlying recommendations, ultimately resulting in the more predictive approach discussed in Section 3.4.
recommendation, “agree[ing] with Peoples Gas that accelerating the SMP would lead to additional problems and costs for ratepayers.”\textsuperscript{116}

Otherwise, the Commission accepted PGL’s agreement to implement Kiefner’s remaining recommendations and directed it to begin providing several new periodic reports as recommended by Commission Staff, including continued quarterly reporting on SMP work and (as relevant to the Neighborhood Ranking Model) annual updates on the status of PGL’s incorporation of Kiefner’s Predictive Corrosion Model into its existing corrosion monitoring procedures, both in Docket No. 16-0376.\textsuperscript{117}

Peoples Gas continues its quarterly reporting on SMP to this day,\textsuperscript{118} and will discuss even more recent improvements to its planning and execution approaches in Section 3.6, leading to a more fulsome description of today’s SMP in Section 3.7.

3.4 New Federal Regulation: DIMP and LDAR Rules

In addition to all of this ongoing, overlapping scrutiny of the SMP since its inception, the ICC also regulates Peoples Gas through its Natural Gas Pipeline Safety section, which enforces federal gas pipeline safety mandates on behalf of (and subject to audit by) PHMSA. The SMP is a critical component of PGL’s compliance with those current and emerging mandates, and even pausing the neighborhood portion of the SMP has already hindered PGL’s ability to remain compliant.

As noted above, PHMSA’s 2011 Call to Action referenced its Distribution Integrity Management Final Rule, which became effective in August 2011 and extended pipeline integrity management principles that were originally established for hazardous liquid and natural gas transmission pipelines to local natural gas distribution pipeline systems. That rule remains in effect today as 49 CFR Part 192, Subpart P, and requires operators like Peoples Gas to maintain an “integrity management program” for distribution (or “DIMP”), defined as “an overall approach by an operator to ensure the integrity of its gas distribution system,” as well as an “integrity management plan,” i.e., “a written explanation of the mechanisms or procedures the operator will use to implement its [DIMP] to ensure compliance with this subpart.”\textsuperscript{119}

Among many other requirements, an operator’s DIMP must identify and implement measures to address risks and determine and implement measures designed to reduce the risks from failure of its gas distribution pipeline. These measures must include an effective leak management program, unless all leaks are repaired when found.\textsuperscript{120}

\textsuperscript{116} Id. at 15.
\textsuperscript{117} Id. at 13–14 (Staff-recommended reporting items), 16 (ordering same).
\textsuperscript{118} See 2023 Q4 SMP Report, SMP Investigation, ICC Docket No. 16-0376 (Feb. 14, 2024).
\textsuperscript{119} 49 C.F.R. § 192.1001.
\textsuperscript{120} 49 C.F.R. § 192.1007(d).
PGL’s DIMP plan, most recently updated in 2023, includes 50 identified threats to its gas distribution system.\(^{121}\) For many of these, the SMP is identified as an additional action to reduce risk.\(^{122}\)

More fundamentally, given that the objective of a DIMP is to manage the integrity of a gas distribution system and reduce risk, an essential part of a DIMP is a risk evaluation of the distribution system. Results from a risk evaluation allows proper attention to be focused on developing measures that address the greatest risks.

Thus, effective pipeline risk evaluation and risk management are federal imperatives for Peoples Gas regardless of the SMP; the SMP is simply one important way Peoples Gas complies with those imperatives specific to vintage cast iron and ductile iron pipe in its gas distribution system. Put another way, while the Commission and various parties in litigated dockets have given a great deal of scrutiny to the particular way in which the Neighborhood Ranking Model operates as an aspect of SMP, including suggestions by regulators and consultants for how to improve that model, PHMSA would require continuous improvement in that modeling even without that input or scrutiny—and the Commission’s own Natural Gas Pipeline Safety section is already overseeing those efforts.

To that end, independent of any condition imposed by any prior SMP order, Peoples Gas is in the process of transitioning from its historical risk model to a probabilistic risk model developed by JANA Corporation. JANA’s models take a data and spatial approach to modeling risks that will enable Peoples Gas to analyze interacting threats and track risk down to the individual asset level, with the option to bundle assets to consider overall risk at a sub-neighborhood level. Adoption of a probabilistic risk model like JANA is considered best practice by PHMSA, and through its participation in working groups, Peoples Gas understands that Ameren Illinois and Nicor Gas are likewise transitioning to JANA for distribution pipeline integrity modeling.

Even as Peoples Gas is working through this risk modeling transition that will, in turn, affect SMP planning and execution, changes are coming to PHMSA’s rules that will make the SMP all the more essential to PGL’s federal compliance efforts. These changes are largely driven by the federal Protecting Our Infrastructure of Pipelines and Enhancing Safety (PIPES) Act of 2020 and are being issued to implement provisions of that legislation.

One key future rule change is PHMSA’s Notice of Proposed Rulemaking (NPRM) titled “Pipeline Safety: Safety of Gas Distribution and Other Pipeline Safety Initiatives.”\(^{123}\) With this notice, PHMSA proposes revisions to the pipeline safety regulations to require operators of gas distribution pipelines to update their DIMP, emergency response plans, operations and maintenance manuals, and other safety practices.

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\(^{121}\) Peoples Gas Light & Coke Company: Distribution Integrity Management Plan, Dec. 31, 2023 (“DIMP”), attached as PGL Ex. 2.11.

\(^{122}\) Id. at Appx. A.

\(^{123}\) 88 FR 61746.
Among other changes, the rulemaking would establish a new regulation (§ 192.638) requiring operators of gas distribution pipelines to identify and maintain traceable, verifiable, and complete maps and records documenting the attributes of their pipeline systems that are critical to ensuring pressure control. The new rule would also include changes to Subpart P establishing additional criteria for operators of gas distribution pipelines to evaluate when identifying and implementing measures to address risks identified in DIMP plans. Specifically, operators would need to account for risks associated with the age of the pipe and pipeline system, the presence of known issues, and the potential for over-pressurizing the system. Operators would also be required to implement measures to address those risks.

PHMSA’s NPRM on DIMP was issued on September 7, 2023, so the proposed rule is not yet final and PGL’s risk modeling transition anticipates many of its new requirements for DIMPs. Further along in the rulemaking process is another major PHMSA rule relating to gas pipeline leak detection and repair (LDAR). The notice of proposed rulemaking for that proposed rule was issued in May 2023, with the final rule to be published in early September 2024 and (as currently proposed) will have an effective date in early March 2025. The new LDAR rule is onerous, and the current pause in the neighborhood portion of the SMP has already jeopardized Peoples Gas’s ability to comply with the new rule by the effective date.

As distinct from the new DIMP rule, which is focused on safety, the new LDAR rule is primarily environmental, focused on reducing methane from new and existing gas distribution pipelines and other gas-related facilities. As summarized by PHMSA, the new rule provisions include:

- Strengthened leakage survey and patrolling requirements;
- Performance standards for advanced leak detection programs;
- Leak grading and repair criteria with mandatory repair timelines;
- Requirements for mitigation of emissions from blowdowns;
- Pressure relief device design, configuration, and maintenance requirements;
- Clarified requirements for investigating failures; and
- Expanded reporting requirements for operators of all gas pipeline facilities within U.S. DOT’s jurisdiction.

Among other changes, the new LDAR rule will require more frequent leak surveys (annually for any susceptible material, including cast iron and ductile iron) using leak detection equipment eight times more sensitive than current equipment. Leak repair requirements will also increase, requiring that all Class 1 leaks be repaired immediately, all Class 2 leaks be repaired within 12 months, and all Class 3 leaks be repaired within three years—unless Class 3 leaks are being addressed as part of a broader replacement project like SMP, in which case the repair period is extended to seven years.

\[124 \text{ See id., § IV.F (Gas Distribution Recordkeeping Practices).}\]
\[125 \text{ See id., § IV.A (Distribution Integrity Management Programs).}\]
\[126 \text{ 88 FR 31890.}\]
\[127 \text{ See id. (Summary).}\]
The relationship between the new detection requirements and the new repair requirements is expected to result in a cycle where more leaks are detected on Peoples Gas’s system, which in turn will trigger additional repair requirements on a more compressed timeline. At the same time, as proposed, the new rule will not permit a downgrade of any below-ground leak; all leaks will need to be repaired on the original schedule, and all leaks will be deemed failures requiring detailed post-repair analysis. On top of this, leak rechecks of below-ground leaks will also be more frequent: 30 days for Class 2 leaks, 12 months for Class 3 leaks, and for repaired leaks, two weeks after repair.

To say that the cost of compliance with the new LDAR rule will be significant would be an understatement. While Peoples Gas is still developing its estimates, initial analysis based on the proposed ruling suggests that annual compliance costs will include significant operations and maintenance expenses and potentially significant capital expenditures. The critical point for purposes of this docket is that replacing leak-prone pipe through SMP will lower LDAR compliance costs, whereas leaving it in place will simply shift one-time replacement costs to ongoing repair or replacement costs over time, without the benefit of fully upgrading the system for safety, reliability, and future energy needs. Promptly resuming a proactive pipe replacement program is by far the best way to reduce the cost of LDAR compliance and provide the best value for customers.

3.5 New Technology: RNG and Hydrogen

Beyond these pending federal rule changes, Peoples Gas is positioning its gas distribution system to take advantage of advances in renewable energy technology, including developments in alternative fuels. These fuels are expected to take at least two principal forms: renewable natural gas (“RNG”) and hydrogen.

RNG is pipeline quality gas that has been upgraded from biogas generated through anaerobic digestion at landfill, agricultural, wastewater, or food waste facilities. RNG is the most prevalent renewable gaseous fuel in the US. There are currently hundreds of such facilities operating in the United States, many of which are used to generate electricity on-site to meet local requirements.

The most common source of biogas generation is associated with landfill gas collection systems, with an estimated 232 billion cubic feet of gas collected at 311 landfills in 2021. Agricultural digesters provide another common source of biogas generation, with 322 operational digesters in 2022, and another 85 under construction.

The figure below shows all agricultural and landfill biogas sites in the United States, many of which are producing compressed natural gas (“CNG”) due in large part to the availability of federal and state incentives for CNG production.

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129 Id.
RNG has strong potential to contribute to decarbonization of the gas sector. As reported by GTI:

Carbon intensities for the RNG pathways vary due to differences in utilized feedstocks, feedstock handling practices, selected biogas upgrading equipment efficiencies, and prevalence of flaring/venting which may result from operational disruptions. One of the key advantages of RNG is its ability to be seamlessly integrated into the existing natural gas infrastructure. By utilizing the existing gas pipelines, storage facilities, and distribution networks, the deployment of RNG can be rapidly scaled up and delivered to markets throughout the country, making it a viable solution for meeting decarbonization goals in the short to medium term. Even if some regions or states have minimal feedstocks for RNG, they can source RNG from other areas rich in RNG feedstocks, thereby decreasing energy costs for customers, just like they do today for fossil gas.

RNG can be stored and dispatched as needed, providing a reliable and flexible renewable energy option. This dispatchability addresses the intermittency challenges associated with certain renewable technologies, making RNG a valuable contributor to grid stability and energy reliability. Given the chemical compatibility and interchangeability between RNG and conventional natural gas, natural gas pipelines are well-suited for RNG transportation without significant modifications or alterations. RNG is especially valuable to sectors that are more difficult to abate emissions, such as the industrial, transportation, and power generation sectors. \[130\]

\[130\] Id. at 32–33.
Peoples Gas has also begun to evaluate hydrogen, another promising technology for the transportation, power generation, industrial, residential, and commercial sectors. Multiple technologies for producing hydrogen exist or are under development including electrolysis, natural gas reforming, partial oxidation, biomass gasification, and methane pyrolysis. Several gas utilities are currently exploring blending hydrogen into their existing pipeline infrastructure to reduce the carbon content of their gas supplies. These include Dominion Energy Utah, CenterPoint Energy, and New Jersey Resources. Other utilities – including Xcel Energy, SoCalGas, San Diego Gas & Electric, Pacific Gas & Electric, and Southwest Gas Corporation have announced similar pilots over the next few years. Peoples Gas’s parent company, WEC Energy Group, has completed a pilot program with EPRI and Wartsila to test running a power plant on up to 25% hydrogen, reducing overall carbon dioxide emissions by 10%.

Multiple federal programs are currently underway to encourage further development of hydrogen production, transport, storage, and use through research, development, and demonstrations. These include DOE’s H2@Scale initiative, launched in 2016, and the 2021 Bipartisan Infrastructure Law’s allocation of $8 billion to create six to ten regional clean hydrogen hubs in the U.S. One hub—the Midwest Hydrogen Hub, or MachH2—covers Illinois, Indiana, and Michigan, and will help decarbonize steel and glass production, power generation, refining, and heavy duty transportation. The hub will use renewables, natural gas, and nuclear power to produce hydrogen, with the goal of eliminating approximately 3.9 million metric tons of carbon dioxide emissions per year.

Peoples Gas is monitoring the emergence of electro-methane, often referred to as e-methane. E-methane is methane produced from carbon dioxide and hydrogen. Preferably the hydrogen would be green hydrogen that is produced using renewable energy and capturing CO₂ from exhaust gases. While research and development is still underway, e-methane is another potential pathway to decarbonization:

“Synthetic and fully renewable e-methane can be easily utilized in the green transition of industry, shipping and heavy road transport. It is technically interchangeable with biogas and natural gas, which means that there is already both an entire infrastructure as well as the technology for its transfer and use,” says Mikko Syrjänen, Gasum’s Director, Business Development.

The Appendix to this report provides additional resources on RNG and hydrogen technologies.

With all of these changes on the horizon, taking no action on upgrading PGL’s gas distribution infrastructure is not a viable option. Below, Peoples Gas explains its continuous improvement efforts in connection with SMP, including in anticipation of PHMSA’s new rules (Section 3.6), and how Peoples Gas was approaching key aspects of SMP (scope, risk ranking, coordination, and reporting) as of November 16, 2023, the day SMP was paused (Section 3.7).

131 Id. at 42.
132 Id. at 44.
3.6 Continuous Improvement: Key Changes in Planning and Execution

As the preceding discussion makes clear, today’s SMP reflects a decade of incremental changes and enhancements driven by regulatory oversight and PGL’s own culture of continuous improvement. These changes date back to ZEI’s 1994 and 2002 studies, which (as explained in Section 3.1.1) updated corrosion data, added ductile iron to AMRP’s scope, first examined replacement of PGL’s low-pressure system, and implemented the first use of the MRI, moving from a pure predictive model to one informed by PGL’s historical data for pipe segment replacement.

As described in Section 3.3.1, the Liberty Audits (2007-2017) further advanced AMRP’s development, affirming the current scope, PGL’s neighborhood approach, and double decking, but also recommending—and ultimately overseeing PGL’s implementation of—key changes in the MRI (leading to today’s UMRI) and over 80 other recommended improvements. Indeed, the Liberty Audits recognized that the neighborhood approach itself was an improvement on PGL’s prior, MRI-only approach, which had led to widely scattered, isolated work and increased costs.134

More recently, as described in Section 3.3.2 and Section 3.3.3, the Commission’s own workshop dockets (2016-2018) and the Second Kiefner Study (2019-2020) saw the transition from AMRP to SMP and exhaustively reviewed every aspect of the SMP, reaffirming the current scope, PGL’s neighborhood approach, and double decking, but also identifying modifications to the Neighborhood Ranking Model and numerous other opportunities to fine-tune SMP’s planning and execution. This period also saw Peoples Gas changing to a unit-price contracting strategy, updating and improving its schedule management structure, and reviewing CDOT rules and regulations to identify still other process improvements.

While it is not possible to succinctly summarize every change to the program over the years, these examples illustrate that Peoples Gas is committed to continuous improvement of its main replacement program. The result is the SMP of today, which remains coordinated around the core pillars reviewed and approved by the Commission while continuing to evolve daily.

3.7 SMP Today: Scope, Risk Ranking, Coordination, and Reporting

Against the backdrop of the significant engineering and regulatory reviews of Peoples Gas’s aging natural gas infrastructure and the SMP, and informed by the regulatory and technological changes on the horizon, this section examines the current state of the SMP. Certain aspects of the program were paused by the Commission in its decision in PGL’s test year 2024 rate case, and the scope and impact of that pause is currently under review in the rehearing in that docket. Therefore, this section discusses the SMP as it existed before the pause, as of the fall of 2023. In particular, this section discusses:

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134 PGL Ex. 2.07 (Liberty Phase I Report), supra note 42, at F-14-15.
• Scope of work under the SMP
• Prioritization of work under the SMP and design approach
• Field execution steps
• Metrics, reporting and coordination with third parties

3.7.1 Scope of Work Under the SMP

The SMP is improving the safety and reliability of Peoples Gas’s natural gas distribution system in three ways: (1) replacing cast iron and ductile iron mains and services, which is susceptible to leaks, cracks, and breaks; (2) increasing system pressure from low to medium pressure, which improves reliability, safety, and efficiency in the use of gas; and (3) relocating meters from inside to outside customers’ homes and businesses for safety and operational efficiency.

Each SMP project is categorized and reported on within one of five sub-programs: Neighborhood, Public Improvement, System Improvement, Emergency, or High Pressure.135

**Neighborhood** work is described in considerable detail above. This work takes a risk-ranked, neighborhood-by-neighborhood approach to retiring and replacing natural gas facilities that have been identified by PHMSA and the Commission as being prone to failure. For a typical neighborhood project, the scope of work includes all three pipeline asset components of work (replacing at-risk material, upgrading to medium pressure, and moving meters outside) as well as the associated restoration:

- **Two-inch plastic pipe** is most commonly used for main installation, which is considerably smaller than the pipe being replaced. This smaller diameter pipe is sufficiently sized to support customers’ gas load requirements with the upgrade to medium pressure.

- The scope of work includes running **service lines** with excess flow valves from mains under the parkway or sidewalk to each building. Each service line connects to one or more meters.

- Each customer typically has a **meter**, so in multi-tenant buildings in Chicago there are often multiple meters for each service line to each building. The scope includes moving each of these meters from inside buildings to outside, including piping work that may be required with the new location of the meter.

With the installation of the new mains, new services, and new meter locations, the old mains and services are retired. Restoration of the project site follows the Chicago Public Way Construction Regulations.136 The figure below is an overview of scope of work for a typical neighborhood project.137

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135 In PGL’s SMP Quarterly Reports, the System Improvement and Public Improvement, and Emergency projects are grouped together.
137 Note that the figure shows the retired gas main in the parkway, whereas the retired gas main for a typical neighborhood project would be in the street instead.
System improvement projects are pursued independent of the neighborhood program and are undertaken without respect to the neighborhood risk ranking model. These projects proactively address specific targeted problems wherever they are in the City and are focused on areas where there are active leaks, or where specific operational issues threaten to disrupt service to customers. In other words, system improvement work is critically necessary to prevent reliability problems from turning into emergencies. An example can be where water gets in main on the low-pressure system and on cold days causes a freeze up in the pipe, interrupting service to customers. The scope of work for system improvement projects is typically similar to Neighborhood projects but usually covers a smaller geographic scale.

One part of PGL's system improvement work is dictated by the UMRI, a tool that maintains historical information on individual pipe segments and creates an “index factor” for each segment based on past performance indicators on the pipe. Peoples Gas developed this methodology in response to Liberty's finding that the Company needed to re-evaluate the values assigned to the various factors in its main evaluation process, including assigning higher values to components with a higher probability and consequence of failure. As such, Peoples Gas addresses any emerging need to replace vulnerable pipe segments through the UMRI and a defined project.

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tracking approach.\textsuperscript{139} This requires the replacement of main segments that equal or exceed an UMRI score of 6.0, regardless of location or neighborhood, and main segments that equal or exceed an UMRI score of 5.0 that are adjacent to schools, hospitals, and nursing homes, within one year. In this way, the system improvement portfolio of projects work in tandem with the neighborhood projects to ensure that the riskiest segments of pipe are prioritized, as described previously in \textit{Section 3.3.2}.

Public improvement work is initiated through coordination and drawing reviews directed by the City of Chicago and is planned and completed separately from neighborhood work. Public improvement projects involve situations where the City or other underground users of the municipal right-of-way are performing work under the streets. In some cases, this work requires Peoples Gas to relocate its facilities, but even where relocation is not strictly required, the Company takes advantage of these situations to efficiently replace leak-prone pipe in the same area in a coordinated manner with the City and other underground users. So, for example, if the City has to open streets in an area to perform sewer work, Peoples Gas will coordinate with City crews to simultaneously replace leak-prone pipe in the area. This coordination helps Peoples Gas comply with the City’s street construction and resurfacing moratoria,\textsuperscript{140} which double permit fees and assess degradation fees, and to eliminate duplicative restoration costs. Coordinating in this way ultimately saves costs for customers, prevents multiple disruptions to City streets, and eliminates duplicative restoration costs. The scope of work for public improvement projects is typically limited to replacing the at-risk pipe that conflicts with third-party work.

Public improvement projects also move Peoples Gas’s facilities out of the way of other underground infrastructure to prevent emergencies that might arise when natural gas pipes are too close to other underground facilities, such as when a contractor excavating for an unrelated project strikes a gas pipe. Indeed, relocation is often required to comply with PHMSA’s rules to prevent system emergencies, as specifically noted for cast-iron systems:

\begin{quote}
When an operator has knowledge that the support for a segment of buried cast-iron pipeline is disturbed . . . That segment of the pipeline must be protected, as necessary against damage during the disturbance… . As soon as feasible, appropriate steps must be taken to provide permanent protection for the disturbed segment from damage that might result from external loads …
\end{quote}

49 CFR § 192.755(a), (b). In many cases the most prudent action is to replace an affected facility with modern material to stay in compliance with federal, state, and local codes or rules.

\textsuperscript{139} See Capital Construction – Engineering: UMRI Project Tracking Procedure, April 2022, attached as PGL Ex. 2.13.
\textsuperscript{140} The City, via ordinance, has established a street construction moratorium of 10 years for any street that has been constructed with a concrete surface/base and a street resurfacing moratorium of 5 years for any street that has been resurfaced with asphalt. See 2019 CDOT Rules and Regulations for Construction in the Public Way, Jan. 2019, at Sec. 3.4.3, available at: https://tinyurl.com/2p8y7hbd.
Emergency (or short-cycle) work includes responding to and addressing Grade 1 and 2 leaks on the Company’s system, which can and regularly do occur because of natural forces like frost heave or excessive corrosion, as well as manmade issues like excavation damage by contractors. These leaks pose immediate and near-term risks to people, property, and the environment and must be addressed quickly. Additionally, obstructions in gas mains caused by debris, calcification, or water and ice that interrupt the flow of gas to customers will at times require emergency work. In many cases, where the leak occurs on old, leak-prone pipe, Peoples Gas will replace that pipe with modern material to provide a more permanent repair. This approach is intended to avoid repeat failures, which create additional safety concerns, as well as being disruptive and costly. The typical process for emergency work is “replace-in-place,” which means to physically remove the existing main and to install the new main directly in its place.

Finally, high pressure work involves installation of the high pressure mains that support existing service throughout Peoples Gas’s service territory and provide the “backbone” for future upgrades to bring the entire gas network in Chicago up to medium pressure and to provide additional reliability for the existing medium pressure system. Failure to allow completion of the in progress high pressure project carries the same problems described above for unfinished system improvement work, plus the risk of abandoning critical infrastructure in a prime utility corridor space in the City of Chicago right of way.

3.7.2 Prioritization of Work and SMP Design to Address Riskiest Pipe

As the following chart shows, there are approximately 1,500 miles of pipe that remain to be addressed within the current scope of SMP. Of this, approximately 1,112 miles are cast and ductile iron, and 385 miles are low pressure main consisting of other materials. It is important to understand how work under the SMP is prioritized in order to ensure that the riskiest pipe is addressed as soon as practically feasible.
Before diving into the details of prioritization, it is helpful to review how the sub-programs work together by balancing immediate issues and ongoing system risks as shown in the following figure:

To illustrate how these pieces fit together, it can be helpful to analogize them to Bill’s car:

- **Emergency work**: One morning Bill finds a puddle of gasoline under his car. That is an emergency, as the car is unsafe to operate with a fuel leak and the leaked gas presents an immediate fire risk. This situation is disruptive and likely expensive to resolve. Bill will have to address the leak immediately, including coordinating with a towing service and finding a mechanic that can fix the leak promptly. Needless to say, this will change Bill’s plans for the day.

- **Public Improvement work**: Bill is pulled over by a police officer for having a headlight out. The officer issues Bill a warning that requires him to fix the headlight within 10 days. In compliance with the warning, Bill takes his car into the dealer for the repair. When the mechanic goes to start Bill’s car, he hears a clicking sound before the engine turns over. Since he has Bill’s car in the shop already, the mechanic runs diagnostics and discovers that the starter is failing and recommends replacement, which saves Bill two shop charges, and the inconvenience of two separate trips to the repair shop.

- **System Improvement work**: Over the last few weeks, when Bill pulls up to a stop sign, he has to push the brake pedal almost all the way to the floor to stop the car. Bill suspects the brakes are nearing the end of their useful life. His car still provides the necessary service, but based on Bill’s recent experience, there’s an increasing risk that his brakes will fail in the near future. Bill decides to make an appointment to have his brakes replaced, thus avoiding a potential emergency situation. Bill is able to schedule the work when it is less disruptive for his day-to-day business and shop around for the best price on a garage to do the work.

- **Neighborhood and High Pressure work**: The starter on Bill’s car is meant to last for about 150,000 miles. Bill’s car is currently at 149,000 miles. Bill’s tires are also losing treads and he recently learned about tires with silica-reinforced tread compounds which reduce rolling resistance and improve fuel efficiency. Bill makes an appointment to get the new tires with the latest material enhancements and replace the starter since it’s at the end of its useful life.
As these analogies illustrate, Emergency and Public Improvement work is reactive in nature. In the case of Emergency work, the Company is forced to react to issues within its system that can interrupt service to customers and pose dangers to Chicago residents and visitors in the short term. With Public Improvement work, the Company is reacting to other entities’ planned work that conflicts with existing gas infrastructure. System Improvement projects are both reactive and proactive – reactive to current system conditions and proactive to upgrade those areas before they result in an emergency. Neighborhood and High Pressure projects are proactive work, dependent upon prioritization based on system data used to calculate risks.

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<tr>
<th>Reactive</th>
<th>Proactive</th>
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<td>Emergency</td>
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<td>Public Improvement</td>
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<td>System Improvement</td>
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<td>High Pressure</td>
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<tr>
<td>Neighborhood</td>
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Based on the reactive versus proactive nature of the sub-programs, risk-ranking and prioritization are most relevant to the more proactive sub-programs, Neighborhood and High Pressure, followed by System Improvement.

The prioritization process for the Neighborhood and High Pressure programs includes these steps:

1. Risk Model Refresh
2. System Feasibility Analysis
3. Methane Emissions Review
4. Constructability Review

The prioritization review process starts with the annual refresh of the neighborhood risk model. Peoples Gas uses a rolling, three-year approach to SMP planning and implementation. The three-year plan is refreshed annually. Through this annual refresh process, project priority is re-evaluated and re-sequenced to minimize risk and coordinate work with the City and other stakeholders. The plan is also updated to incorporate work for an additional year. So, for example, at the end of 2022, Peoples Gas developed and finalized its 2023-2025 plan by re-sequencing work for 2023 and 2024 and adding work to be completed in 2025.

A rolling three-year plan with annual updates delivers several benefits over a longer-term plan.

*First*, a rolling three-year plan gives the Company flexibility to adapt to changes in the City’s and other stakeholders’ infrastructure plans and shifting work between years as appropriate. Projects that were originally scheduled for a given year might be moved forward or back to allow Peoples Gas to coordinate its work with other stakeholders, reduce disruption to City streets and to avoid the cost of having to restore streets multiple times.
Second, this approach allows the Company to adapt the SMP to future changes in federal, state and local regulatory requirements. Regulations and guidance relating to underground gas pipes are updated as new technology and construction methods allow utilities and operators to increase safety. A rolling three-year approach to planning allows Peoples Gas to adapt to these changes without significantly disrupting a longer-term plan.

Third, a rolling three-year SMP plan focuses Peoples Gas on near-term execution. A rolling three-year plan also focuses on nearer-term measurement of program cost, progress and performance and moves away from long-term plans that have historically proven to be unhelpful in managing programs such as the SMP that rely on dynamic risk ranking, and for which emergent public improvement and system improvement work can change the annual scope of work significantly. Decisions about how to deploy capital most efficiently can be made in nearly real time based on recent project experience and nearer-term project opportunities, rather than being locked into a longer planning and capital spending plan that allows little room for flexibility.

The first step in the Neighborhood re-prioritization process is to update the risk model, which incorporates five weighted factors, based on system data, shown in the table below:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Mean UMRI index</td>
<td>30%</td>
</tr>
<tr>
<td>2 Percentage of medium pressure cast and ductile iron pipe</td>
<td>30%</td>
</tr>
<tr>
<td>3 Percentage of small diameter cast iron pipe</td>
<td>15%</td>
</tr>
<tr>
<td>4 Percentage of services constructed of vulnerable materials</td>
<td>15%</td>
</tr>
<tr>
<td>5 Number of pending leaks per mile</td>
<td>10%</td>
</tr>
</tbody>
</table>

These factors and weightings are consistent with the results of the improvements incorporated through the Liberty Audit as described in Section 3.3.1. Each factor is described below.

The first factor, the mean UMRI, is the statistical mean of the Unified Main Replacement Index (UMRI). The UMRI is a calculation based on data on individual pipe segments that produces an “index factor” for each segment. The performance of the pipe is calculated by summing the break equivalent data based on cracks, visual inspections, pipe coupons,\textsuperscript{141} repairs, and actual breaks. An area with a higher mean UMRI for the individual pipe segments will have a higher overall risk score. The formula for calculating UMRI is as follows:

\textsuperscript{141} A pipe coupon, or corrosion coupon, is a piece of metal placed within a pipe to measure corrosion over time based on visual inspection of the coupon at the end of the test period.
The second factor is the percentage of medium pressure cast and ductile iron. Within the neighborhood boundary, the footage of medium pressure cast and ductile iron main is divided by the total footage of main, which normalizes for neighborhood size as recommended in Phase II of the Liberty Audit. An area with a greater amount of medium cast and ductile iron main will have higher overall risk score.

The third factor is the percentage of small diameter (less than or equal to 8”) cast iron pipe. Within the neighborhood boundary, the footage of small diameter cast iron pipe is divided by the total footage of main. An area with a greater amount of small diameter cast iron pipe will have a higher overall risk score.

The fourth factor is the percentage of services constructed of vulnerable material (such as cast and ductile iron as well as are copper, unprotected bare steel, and unprotected coated steel). This factor is similar to the second and third factors, but instead of looking at the quantity of vulnerable mains within a geographic area, it focuses on the services.

The fifth factor is a count of pending (unrepaired) class 2 and 3 leaks per mile. The count of leaks is based on the point in time when the risk ranking is refreshed.

Using these five factors with the weightings applied, a risk score is calculated for each neighborhood. The series of heat maps below shows the individual contributions of each of these factors to overall risk rankings based on the system data as of January 2024.
These factors provide a relative risk score for the geographic area, meaning how the overall risk for the existing main in that neighborhood compares to other neighborhoods.

The second step in the Neighborhood prioritization process is to perform feasibility analysis. The engineering team determines whether there is enough gas supply within the riskiest ranked neighborhoods to upgrade those neighborhoods to medium pressure. Through this analysis, the engineering team may determine that while neighborhood A is riskier based on the pipe attributes, neighborhood B may need to be upgraded first because neighborhood A is dependent on the flow of gas being available through neighborhood B.

The third step in the Neighborhood prioritization process is to review methane emissions data. In 2017, the company started using advanced methane leak detection (AMLD) vehicles to conduct mobile surveys of neighborhoods with the highest risk scores. The data collected in the surveys allows Peoples Gas to quantify the amount of methane being emitted within the neighborhood. If two neighborhoods have similar risk scores, a neighborhood with a higher amount of methane emissions based on the survey data collected will be prioritized for construction first.

The fourth step in the Neighborhood prioritization process is to review the work for constructability. This review looks at the geographic regions where the riskiest neighborhoods are located to ensure that the work does not overly burden one specific area of the City. If too many simultaneous projects are concentrated in one area, it is not possible to perform all of the necessary construction work while residents and visitors continue to live their lives. To avoid this problem and maintain the pace of the SMP, this step helps spread work across the North, Central, and South regions of the City, maintaining better regional balance within Chicago. This explains why certain neighborhoods may be scheduled before other neighborhoods with somewhat higher absolute risk scores.

High Pressure work prioritization derives from neighborhood prioritization. During the feasibility step for the neighborhood prioritization (step 2), engineering identifies areas where more gas supply is needed overall and next in priority to support the upgrade to medium pressure. The results of the risk-ranking and overall prioritization process for the Neighborhood and High Pressure sub-programs are documented annually in the Engineering Design White Paper and the rolling three-year plan.

The System Improvement sub-program also incorporates risk analysis and prioritization. Specifically, Peoples Gas prioritizes System Improvement work with its System Improvement Shop Requested Priority Risk Score Template, which is used to create a risk score and rank projects. This matrix, along with a presentation providing additional details of the system issues, proposed project remediation scope, and alternatives, is used to prioritize projects. The Template includes a total of ten overall priority factors; one of these is SMP neighborhood considerations, but others encompass historical issues, time sensitivity, over-pressurization risk factors, number of leak repairs performed, and future amount of annual O&M expenses forecasted if the current issue is

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142 See PGL SI Priority Ranking Matrix, attached as PGL Ex. 2.14.
not resolved. The System Improvement sub-program also includes the UMRI-driven projects. Again, the System Improvement sub-program seeks to proactively replace segments of main before the area becomes an emergency given observations of current field conditions. Because field conditions change, the SI risk analysis and prioritization is even more dynamic than the neighborhood ranking, allowing for the most at-risk pipe segments to be addressed.

The 2023-2025 plan targets an investment level of approximately $300 million per year. As shown below, the rolling three-year plan also lists the Chicago neighborhoods in which work is scheduled. For 2024, that work was to be focused on the neighborhoods shown.

Turning from project prioritization to how the Company designs and approaches individual projects, engineers consider multiple related items, including the amount of gas needed within an area, the diameter of the new main required, how much new main to install, and the location of the main.

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143 Id.
Each neighborhood and the standalone phases that comprise it have their own unique analysis and design requirements to ensure a safe and reliable distribution system is maintained. Project feasibility analysis is primarily completed utilizing the Synergi Gas hydraulic modeling and simulation software. This analysis takes into account a number of factors that are critical in ensuring a feasible design is produced. The forward and backward tracing analysis of existing MP/LP district regulators provides the load on the current low pressure distribution system and whether these district regulators can be retired from the system after conversion to medium pressure. The Long Range Plan (LRP) is utilized for the initial sizing of proposed medium pressure header mains and the loads obtained from the tracing are then added to these mains. Pressure and flow rates of these header mains are then analyzed to ensure they are properly sized. System pressure loss, gas velocities, isolations, fault scenarios and maintaining a two-pressure system are all analyzed to determine how the neighborhood will be phased. Customer loads are then distributed across the smaller distribution mains to ensure they are properly sized. A phasing and feasibility white paper along with a presentation recapping the analysis is then produced and stored for each neighborhood design.

PGL then utilizes an established design quality program to create and progress project plan sets for construction. The location of proposed gas mains are made based on a number of factors pertaining to the project, such as construction and restoration costs, third-party utility locations and CDOT rules and regulations (i.e., moratoriums). Field line of lay walks are performed in the plan set development stage for every project. Input from Field Operations, Project Management and other internal PGL stakeholders are obtained throughout the design process. The location of main is a driving factor in the installation method, and in the resulting restoration requirements as described in Section 3.7.3, which provides an overview of the field execution steps.

As was affirmed in both phases of the Liberty Audit and reviewed in Section 3.3.1, the double decking approach installs new main on both sides of the street to replace the existing run of main under the street. With this approach, more main is installed than retired. Intuitively, it would seem that installing more main would be less cost-effective. However, when service installation and restoration costs are taken into account, the double decking approach is more cost-effective. The following tables provide a summary cost comparison for one block of installation using a single decking approach and using a double decking approach:

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Single Decking</th>
<th>Double Decking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity</td>
<td>Cost Estimate</td>
</tr>
<tr>
<td>Main Installation</td>
<td>670 ft</td>
<td>$182,070</td>
</tr>
<tr>
<td>Main Retirement</td>
<td>670 ft</td>
<td>$8,437</td>
</tr>
<tr>
<td>Service Installation*</td>
<td>2,400 ft*</td>
<td>$117,866</td>
</tr>
<tr>
<td>Service Retirement*</td>
<td>2,400 ft*</td>
<td>$3,844</td>
</tr>
<tr>
<td>Restoration</td>
<td>26,120 sq ft</td>
<td>$113,707</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$425,923</strong></td>
<td><strong>$283,458</strong></td>
</tr>
</tbody>
</table>

* 30 total services  ** Service lengths are 75 and 85 ft. (single deck) vs. 50 ft. (double deck)
Engineering packages the design drawings and sends them to the Office of Underground Coordination (OUC) for existing facility protection (EFP) review. The OUC facilitates the review and approval process by distributing the design to all OUC utility members / agencies, who review the design drawings and, where applicable, require changes to be made to the design. In parallel and when applicable, the design drawings will also be submitted to CDOT for a deep shore review of the design drawings. In addition, for appropriate projects, a railroad review and approval will be conducted alongside the OUC review.

3.7.3 Field Execution Steps

This section describes the typical steps involved in executing a neighborhood project in the field from start to finish. Of course, conditions on and under the ground may dictate slight variations in these steps.

- **Letter to active customers:** Peoples Gas sends customers a letter notifying them of upcoming work and that a Peoples Gas representative (referred to as a “Marker”) will be reaching out to set up a time to gain access into the home or building to identify the location of the current gas meter. Typically this meter is located in the basement. PGL Exhibit 2.15, attached hereto, is a handout provided to our customers prior to starting construction for a neighborhood project. The handout describes the steps involved during construction, including key customer touch points.

- **Marker appointments:** The Marker meets with the customer at their home or business and discusses the recommended location for the new gas line service to be installed and where the new meter will be relocated - typically outside the home. The Marker will document this location with the owner on a sheet of paper called a “marking sheet” and give a copy to the owner. The Marker will also use a yellow construction crayon to mark on the building where the new service line will be run.
Field Execution: Marking sheet
• **Documenting exterior conditions:** Prior to beginning any work, the existing conditions of the street, sidewalk, parkway and home exteriors is documented using photos and/or videos. These records are kept and used to confirm all impacts created by the work are restored.

• **Locating and documenting existing sewer lines—street view:** Using the information on the marking sheets, sewer camera trucks inspect the sewers in the project area. The sewer is accessed by the manhole in the street and the sewer camera follows the route of the main sewer documenting all existing conditions of the sewer pipe and then the camera goes into each sewer lateral that runs to each home documenting all existing conditions of the pipe.

• **Locating and documenting existing sewer lines—home view:** If accessible, the contractor will also inspect the home's sewers from the home, typically using a drain clean-out to insert the camera. The contractor uses the information on the marking sheet to find the homeowner or building contact information and will call the contact listed or knock on the door to gain access. Gaining access into every home for sewer camera documentation is not required but is helpful in getting as much information as possible on the home's sewer lines to document and use for layout when installation of the gas service line begins.
• **Permits secured and crews mobilize to the site:** Once permits are issued by the City of Chicago our contractors can set up to begin work. No-parking signs are posted in areas where work is planned to provide space for equipment to be used. No-parking signs are posted 48 hours prior to the start of work per Chicago Department of Transportation (CDOT) requirements to allow for vehicle owners to have time to plan to park elsewhere. Typically parking is limited Monday - Friday during working hours usually 7 am - 4 pm. To allow for storage of equipment and material for the duration of a project, an Occupancy Permit will be requested. The Occupancy Permit allows for parking to be prohibited 24 hours per day, 7 days a week for an 80 to 100 linear foot section of curb lane and parkway for the storage of material and equipment.

• **Mapping out existing utilities:** Once permits are issued by the City of Chicago, DIG tickets are requested. This is a request for all utilities within the scope of the permit to be located in the field. These utilities are marked out using spray paint and/or flags that designate the existing electric, water, cable and gas lines.

• **Excavate and locate utilities:** To prepare for the installation of the new gas main any existing utility that is near to or crossing in the planned path of the new gas main must be visually verified. This work requires saw cutting the existing concrete or pavement and then excavating to find the utility line. These utility verification openings are called “potholes” and there are typically three potholes per address, one each for the water, sewer, and gas lines. During this initial phase of work it would be normal to see several openings down the block. Each opening is covered with a metal plate or plastic barricade.

*Photo from the field: Potholes covered with plastic barricade plates (locations of other utilities marked with paint and flags)*
• **Installation of new gas main in sidewalk or parkway (typically for double decking installation):** Upon completion of all the potholes, new gas main is installed in the sidewalk or parkway via one of two methods: directional drill or open cut. Whereas CDOT rules require open cutting for work in the street, work in sidewalk or parkway can use less disruptive directional drilling.

*Directional drilling* is the preferred method of install as it reduces disturbance and subsequent restoration as compared to the open cut method. The directional drill method is feasible when there is a clear path for the installation of main and no close existing utilities to work adjacent to or near. Generally, larger than 6” directional drill is not practical in the City of Chicago given the number of third-party utilities that need to be navigated around and protected.

The directional drill method uses a drilling machine to drill the path of the new main. The plates are removed from the pothole openings to visually confirm the drill auger does not impact existing utilities. The depth of the new main to be installed is monitored as it is drilled via a handheld sonar machine. A camera is pulled back through the bore path along with the new gas main pipe. The camera footage is confirmed to verify no other utilities were impacted during the installation. Once the new gas main is installed the potholes are temporarily backfilled and the temporary protection plates are removed.

*Open cutting* can be used to install any diameter pipe size. This method is typically used when the main pipe size is 8” diameter or larger or if there are existing utilities or obstructions in the path of the planned main installation. Again, pipe installation below City streets cannot be directionally drilled per CDOT regulations so any street crossings are open cut. The open cut method involves excavating a trench removing the existing sidewalk or parkway in the path of the new gas main installation. The new gas main is installed as the trench is dug and once installed the trench is temporarily backfilled.

*Photo from the field: Inside view of pothole showing auger for directional drill*
• **Installation of new gas main in the street (typically for single-decking installation):** Upon completion of the utility locates, new gas main in the street is installed via the open cut method. A trench is excavated removing the existing street in the path of the new gas main installation. Once the new gas main is installed it is covered by steel plates until it is backfilled with aggregate and then a concrete base is installed up to the existing street level. This is referred to as "concrete base to grade." The steel plates are removed once the trench concrete base to grade is fully cured.

• **Installation of new gas services:** Once the gas main is installed the layout of new gas services to each home or building begins. This process requires the excavation and visual verification of all existing utilities in the path or near to the path of the new gas service line. Once all potholes have been completed the services is installed via directional drill or open cut following the same procedure as used for the gas main installation. Once the new service line is installed and connected, the openings required are temporarily backfilled. Upon completion of the gas service line installation the gas service is visible typically at the front or side wall of the home at the location is that was designated on the marking sheet and the yellow construction crayon mark.
Photo from the field: Directional drill installation of new gas service line (boring rig drilling service line from new gas main in sidewalk to front of home)

Photo from the field: Temporary backfill of sidewalk openings needed for running new main, services and potholes
• **Transfer of meters from old gas service to new gas service**: This stage of work requires scheduling access into each home or building to complete the work needed to transfer the home or building from the old gas service line to the new gas service line. Typically this work will result in moving the gas meter to the outside of the building. Access to each home will be scheduled directly with the homeowner.

  *Photo from the field:*
  *Hanging a new meter outside a customer’s house*

• **Retire old gas main**: Once all customers in a project area are transferred to the new gas services the old gas main can be retired by cutting and capping the main and taking it out of service. This usually occurs in the street, requiring excavation to expose the old gas main. Once the old gas main has been retired the opening is filled concrete base to grade.

• **Restoration**: Restoration work is scheduled in phases to avoid damaging any newly restored work areas. This includes concrete restoration: once all main and services are installed, concrete is poured to restore sidewalks, parkway walks and curbs. In some cases, the concrete restoration is held until services are retired. This step also includes soft restoration – placing sod or seeding of grass and planting shrubs and trees, as necessary, after the concrete restoration in the area is completed. Asphalt paving restoration takes place after all retirement work is completed as the retirement openings are typically in the street.
3.7.4 Metrics, Reporting, and Coordination

Peoples Gas currently provides a wide range of metrics and reporting to internal departments and external stakeholders. Please see the table below for a summary of the information included in current reports:

<table>
<thead>
<tr>
<th>Report Title</th>
<th>Frequency</th>
<th>Regulator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHMSA Annual Report on Gas Distribution System</td>
<td>Annually</td>
<td>PHMSA</td>
<td>Provides current infrastructure quantity data for mains and services, broken out by material type and diameter size; also includes leak cause data and excavation damage information</td>
</tr>
<tr>
<td>Three Year Rolling Plan</td>
<td>Annually</td>
<td>ICC</td>
<td>Summary Gantt chart of upcoming construction projects</td>
</tr>
<tr>
<td>SB2266 Report</td>
<td>Annually</td>
<td>ICC</td>
<td>Reports on ten metrics including emergency response data, damage prevention incidents, several asset based metrics, and contract values for contracts with diverse suppliers</td>
</tr>
<tr>
<td>SMP Quarterly Report</td>
<td>Quarterly</td>
<td>ICC</td>
<td>Comprehensive report that includes dozens of metrics as ordered by ICC, including progress reporting (planned vs. actual quantity information), efficiency/productivity data (cost per unit), leak trending data, and status updates on items from Kiefner (2019)</td>
</tr>
<tr>
<td>Coordination Agreement Submittal Report</td>
<td>Monthly</td>
<td>CDOT</td>
<td>Includes summary and detailed project schedule information, permitting request duration data, and restoration quantity details</td>
</tr>
</tbody>
</table>

In addition to these reports, various processes and forums support effective coordination and communication regarding PGL’s construction projects. For example, as Section 3.7.2 describes, the OUC process enables coordination with nearly 30 other parties during the design phase of a project. As Section 3.7.3 highlights, communication and coordination with customers are essential for successfully completing the system upgrades and providing customers with the transparency and care that they deserve.

In addition to the coordination efforts already highlighted, PGL has two teams with significant focus on stakeholder communication and coordination:

- PGL’s City and Customer Coordination (CCC) department interacts with the Illinois Department of Transportation (IDOT), CDOT, and the Project Coordination Office (PCO), under CDOT, on a regular basis. This includes participating in CDOT’s conflict coordination process to identify potential timing conflicts or opportunities and coordinate the development of Memoranda of Understanding (MOUs) to agree on
restoration responsibilities. The CCC department participates in monthly PGL/CDOT leadership meetings, bi-weekly permitting coordination meetings, and Central Business District weekly project review meetings. In addition, CCC coordinates with IDOT on acquiring permits that impact IDOT’s right of way, and quarterly PGL/IDOT meetings highlight any updates or urgent permits needed on projects.

- PGL’s **Project Management** team is responsible for overseeing projects from initiation through closeout. Project managers facilitate regular status discussions with various internal departments as well as meeting with Alders to keep them informed of upcoming and in-progress work.

In coordinating and communicating with City officials, using established geographic boundaries, like the neighborhoods, has supported effective communication.
4. PGL’s Proposed SMP Scope and Approach

Peoples Gas’s preferred approach to the SMP is to continue to pursue a proactive pipe replacement program in Chicago that addresses the limited remaining life of portions of the Company’s infrastructure in a manner that “bundles” necessary work in a cost-effective manner, consistent with the Commission’s direction as recently as September 2020.

In accordance with the Initiating Order, Peoples Gas is providing in this section a list of disaggregated costs for specific scope items, including the Company’s preferred scope items, as well as alternatives. To be responsive, Peoples Gas is providing cost information on different types of work categories that are broken into “scopes,” as described below and in PGL Exhibit 2.16, attached hereto. The scopes are presented in the order discussed in the Initiating Order.

<table>
<thead>
<tr>
<th>Scope Item Number</th>
<th>Scope of Work</th>
<th>Install Qty.</th>
<th>Average Rate</th>
<th>$M</th>
<th>Avg. Rate x Quantity (in $M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope Item 1</td>
<td>Replace CI/DI Low pressure with modern material LP Main</td>
<td>983</td>
<td>$10,700,000</td>
<td>$10,518</td>
<td>$9.5B - $11.5B</td>
</tr>
<tr>
<td>Scope Item 2</td>
<td>Removing leak prone services</td>
<td>12,031</td>
<td>$5,615</td>
<td>$68</td>
<td>$68.0M</td>
</tr>
<tr>
<td>Scope Item 2A</td>
<td>Transfer other services connected to CI/DI Main</td>
<td>190,748</td>
<td>$7,240</td>
<td>$1,381</td>
<td>$1.4M</td>
</tr>
<tr>
<td>Scope Item 3</td>
<td>Replacing and Upgrading from LP to MP (Mains)</td>
<td>2,120</td>
<td>$1,950,000</td>
<td>$4,135</td>
<td>$3.1 - $6.6B</td>
</tr>
<tr>
<td>Scope Item 4</td>
<td>HP Main Installation</td>
<td>30</td>
<td>$14,000,000</td>
<td>$424</td>
<td>$363M - $478M</td>
</tr>
<tr>
<td>Scope Item 5</td>
<td>Replace CI/DI Medium pressure with modern material MP Main</td>
<td>129</td>
<td>$7,800,000</td>
<td>$1,006</td>
<td>$0.9B - $1.1B</td>
</tr>
<tr>
<td>Alternative Scope 5</td>
<td>Replace CI/DI Medium pressure with modern material, MP Main excludes 36in and above</td>
<td>80</td>
<td>$8,500,000</td>
<td>$677</td>
<td>$636M - $677M</td>
</tr>
<tr>
<td>Scope Item 6</td>
<td>Replacing all services associated with the main remaining to be upgraded</td>
<td>202,779</td>
<td>$5,615</td>
<td>$1,139</td>
<td>$1.1B - $1.3B</td>
</tr>
<tr>
<td>Scope Item 7</td>
<td>Moving meters to outside</td>
<td>346,912</td>
<td>$2,351</td>
<td>$816</td>
<td>$815 - $832M</td>
</tr>
</tbody>
</table>

**Scope item 1** are the costs associated with replacing the remaining cast iron and ductile iron main in the system, without upgrading any low pressure main to medium pressure. Currently, there are 983 miles of low pressure cast iron and ductile iron main in the system. Without upgrading to medium pressure, new plastic pipe will need to be the same diameter as the pipe it is replacing (most of the low pressure cast and ductile iron pipe is 6” diameter). The new pipe is installed in the same location as the old pipe, or “replaced in place.” Much of Peoples Gas’s old pipe is located under the street, so Scope item 1 principally relies on open cut installation and requires restoring the street to the standards set by CDOT. Open cut installation and associated restoration were described in Section 3.7.3.

**Scope items 2 and 2a** are the costs associated with reconnecting the services that are connected to the main installed in scope item 1. Specifically, scope item 2 replaces the vulnerable material services remaining in the system, which include cast and ductile iron as well as copper,
unprotected bare steel, and unprotected coated steel. Scope item 2a accounts for continuing to use the existing services, but cuts them from the old main and connects them to the new main. The customer’s gas service is disrupted as gas service will need to be stopped while the service pipe is cut from the old main and reconnected to the new main. After the service pipe is reconnected, the remaining turn-on tasks (like testing customers’ appliances) are completed.

Scope item 3 are the costs associated with replacing the remaining cast iron and ductile iron main and upgrades PGL’s system to medium pressure. In addition to the 983 miles of low pressure cast and ductile iron referenced above, there are currently 385 miles of low pressure plastic or steel main in the system. With the upgrade to medium pressure, the pipe diameter is reduced, the line of lay is moved to the parkway, double-decking methodology is used, and the directional drilling installation method is used more prevalently. With the widespread use of double decking, the scope item assumes installing 2,120 miles of main (approximately 55% more than the amount retired). Associated restoration work is included in this scope item.

Scope item 4 are the costs associated with installing new high pressure main to support the overall upgrade to medium pressure. Pipe size diameters will range from 12” to 36”. Open cut installation is predominantly used for this work. Associated restoration work is included in this scope item.

Scope item 5 are the costs associated with replacing the remaining cast iron and ductile iron main that is already on medium pressure with modern material. There are 129 miles of cast iron and ductile iron medium pressure main in the system that are replaced with this scope item, using the insertion and/or open cut installation methodology. Double decking methodology is not used as there are very few services connected to this main. Associated restoration work is included in this scope item.

Alternative scope item 5 are the costs associated with replacing only 80 of the 129 miles of medium pressure cast iron and ductile iron main with modern material. This alternative leaves 49 miles of medium pressure cast iron and ductile iron main that has a pipe size of 36” or greater, as the remaining asset life for pipe this size or greater is more than 50 years. The insertion and/or open cut installation methodology is used. Double deck methodology is not used as there are very few services connected to this main. Associated restoration work is included in this scope item.

Scope item 6 are the costs associated with installing new plastic service pipes off of the new main. With upgrading to medium pressure, the service pipe size is reduced (typically from 1.25” to 1.0”). When feasible, service pipes are installed using the directional drilling methodology. This scope item also includes retirement of the old service when a physical cut is required. Associated restoration work is included in this scope item.

Scope item 7 are the costs associated with relocating meters from inside customers’ homes and businesses to outside. Coordination with the customer is required to gain access to the meter, complete installation of piping inside, and remount the meter outside of the customer’s home.
This improves system safety by allowing easier access to customer meters in the event of an emergency.

For all scope items that involve installing new pipe (mains or services), the material of the new pipe is primarily plastic, with steel also being used in larger diameter and high pressure pipe settings. The useful life for plastic is at least 50 years, with some sources citing over 100 years. The useful life for steel is approximately 70 years.

In order to develop alternatives for the future scope of SMP, Peoples Gas has combined selected scope items into separate “program” options to arrive at an overall scope of work for the program. Because certain scope items are interdependent, it is not possible to select certain scope items without selecting others. As an example, Peoples Gas cannot replace mains and not reconnect services.

Taking these interrelationships into account, Peoples Gas has combined the disaggregated scope items into three different “programs,” alternative combinations of work that could function together to solve identified safety and reliability issues on Peoples Gas’s system. The cost of each program is calculated by multiplying unit costs by remaining quantities and assumes, hypothetically, that all work could be completed in 2024. The calculation is meant to provide a comparative framework to support informed decision-making amongst the various scopes and programs. The pace and assumed year for completion are discussed in Section 5.3.

When available at the necessary level of specificity, the costs presented here are based on SMP unit costs from 2019 to 2023 as reported to the Commission in the Company’s quarterly SMP reports. The indicative, high level cost information presented here does not include inflation, other escalation, or discount factors, and it is not meant to provide the Commission with a new cost estimate for the SMP. In particular, the disaggregated cost estimates provided here at the Commission’s request do not replace the comprehensive estimates contained in Burns & McDonnell’s cost and schedule models that Peoples Gas filed in Docket 14-0496.144

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144 Peoples Gas was ordered to prepare and file the Burns & McDonnell cost and schedule model as a condition of the Commission’s order in Docket 14-0496. The Company had 160 days between the Commission’s June 24, 2015 Order and filing the model on November 30, 2015. The indicative cost estimate and scope analyses prepared in response to the Commission’s initiating order were developed in significantly less time.
Program Option 1 includes scope items 1, 2, 2a, and 5. This program option can be thought of as “Addressing only leak-prone mains and services.”

Program Option 2 includes scope items 3, 4, 5, 6 and 7. This program option is consistent with PGL’s historical approach to upgrading its gas distribution system, as approved by the Commission following investigation in prior proceedings. It can be thought of as “Addressing leak-prone material and upgrading to medium pressure.”

Program Option 3 – PGL’s preferred alternative approach – is the same as program option 2, except that scope item 5 is replaced by Alternative scope item 5, which omits replacing large diameter cast iron mains (36” and 48” diameter) and addresses them on a more reactive basis. This program can be thought of as “Upgrading to medium pressure and addressing small and medium diameter leak-prone material.” Program 3 would be consistent with the recommendations of the Kiefner report (at page 39), which found that large diameter pipes had remaining useful lives of between 41 and 115 years (as of May 2019). This approach could reduce the overall scope and cost of the SMP.

As noted, the comparative cost estimates above hypothetically assume completion of all work in 2024. To address potential alternative target dates for SMP completion, the following charts show how spreading these costs over different assumed end dates, i.e., dividing the costs of each program over the remaining years from 2025 to 2030, 2035, 2040, and 2045, would tend to reduce annual spend for each program option. However, as stated above, these simple calculations do not factor in any assumptions about inflation or other escalation that would be expected to increase the overall aggregate nominal cost of the program the longer it is extended out in time.
To fully evaluate the scope items and program, Section 5 discusses in greater detail the benefits of three core infrastructure components: replacing leak-prone mains and services, upgrading to a medium pressure system, and moving meters outside.
5. Core SMP Elements: Benefits, Synergies, and Pace

5.1 Benefits of Key Scope Items

5.1.1 Replacing At-Risk Material

While various parties have challenged various aspects of the SMP over the years, from the earliest ZEI studies to today there has never been any serious dispute that it is essential to replace at-risk cast iron and ductile iron pipe in PGL’s distribution system and that it should be done on an accelerated basis in the interest of safety. Doing so is not just an obvious safety and reliability imperative, but also has environmental benefits and enhances compatibility with future fuels.

The safety and reliability benefits of replacing at-risk material in PGL’s system speak for themselves. Cast iron mains are disproportionately risky, making up 2% of distribution mains nationwide but accounting for 10% of all distribution accidents. Incidents on cast iron mains are twice as likely to result in injury or death, and 38% of all fatalities from gas distribution mains involved cast or wrought iron pipelines.145 And here in Chicago, as summarized above, the Second Kiefner Study—commissioned by the ICC and completed in 2020—found that 83% of the remaining cast iron and ductile iron pipes had an average remaining life of less than 15 years (now 10 years). Replacing this at-risk material holds paramount the public safety and welfare by reducing leaks and outright failure of these pipe materials.

As risk and safety are, generally, inversely proportional, reducing the risks posed by cast iron and ductile iron pipes by replacing them with new material will inherently increase the safety of the system. This is true even with no system pressure upgrade; even assuming straight size-for-size and pressure-for-pressure material replacement (i.e., replacing 6” cast iron low pressure pipe with 6” plastic low pressure pipe), safety would be enhanced as the risks of leaks and failure of existing vintage main due to graphitic corrosion, natural forces, and excavation damages are reduced. Specifically, fused plastic pipe greatly reduces leak points and the number of mechanical joints, is less impacted by ground movement and frost conditions (which also leads to fewer overall leaks), and is more locatable than legacy pipe, leading to reduced third party damage risk.146 With new pipe installation, tracer wires and marker balls can also be utilized to better identify main and service locations.

Because reducing leaks reduces emissions, replacing the at-risk material has direct environmental benefits, too. Prior Commission studies have established this link,147 and the American Gas Association (AGA) found a decade ago that replacing cast iron, unprotected steel, or other distribution lines with plastic pipe can yield significant emission reductions, particularly when combined with medium pressure upgrades.148

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147 Id.
This concept has been proven on PGL's own system: in areas where the system has been upgraded, methane emissions have decreased by at least 95% based on a before-and-after methane survey using AMLD vehicle technology.

Finally, to the extent hydrogen blending is to play any role in the future of gas for Chicago, replacing all leak-prone material on PGL's system is essential. While the permeability of hydrogen through plastic pipe is still being assessed for improved understanding, the early indications are promising. The AGA's review of known information could not identify operating or safety concerns with high-hydrogen blends in plastic distribution pipelines. And at lower blends, transporting hydrogen-enriched natural gas within medium pressure distribution systems of plastic and steel has been safely performed for decades; for example, Hawaii Gas has been doing this since 1974 with hydrogen blends of 10-15%.

Embracing the replacement of aging pipelines is a crucial step toward enhancing the efficiency of the existing natural gas infrastructure and mitigating emissions. This strategic move not only aligns with our environmental goals but also proves to be a wise investment. Modern pipelines, aside from being suitable for minimizing methane emissions, are more compatible with low carbon gases. By phasing out the legacy incompatible pipelines, we not only pave the way for emission reductions but also ensure that our investments are future-proof. These new pipes are not just conduits for natural gas; they are versatile infrastructural assets that can be easily repurposed, making our investment today a sustainable choice for tomorrow. Moreover, leveraging the existing rights-of-way and delivery networks of natural gas can facilitate the integration of decarbonization solutions, such as utilizing the infrastructure to transport domestically produced alternative fuels. However, additional policies, incentives, and addressing jurisdictional challenges are necessary to ensure a reliable and resilient energy system.

The key point here is that material matters: without a “leak-tight” system, introducing hydrogen is a non-starter.

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150 AGA: Impacts of Hydrogen Blending on Gas Piping Materials, June 2023, at 13 (included in Appendix as Ex. H) (“In fact, none of the studies reviewed for this white paper presented any concerns related to PE compatibility with hydrogen.”).
152 GTI Energy, supra note 128, at Error! Bookmark not defined.
5.1.2 Upgrading System from Low to Medium Pressure

Over and above the benefits achieved by replacing cast and ductile iron, upgrading PGL’s distribution system to medium pressure offers significant improvements in safety, operational efficiency, and—looking to the future of gas in Chicago—compatibility with future fuels.

First and foremost, upgrading to medium pressure enhances system safety through the use of key safety devices, which work together to regulate pressure on the system and minimize the impact of any failure:

- **Pressure reducing regulators (1 in graphic below):** Converting to a medium pressure system allows for installation of outside pressure reducing regulators at each building. These devices regulate and reduce the pressure of the gas coming into the customer’s home, which reduces the risk of over-pressurization and resulting accidents.\(^{153}\)

- **Shutoff valve (2 in graphic below):** These devices are installed on each customer service riser, allowing for access to shut off the flow of gas from outside of the building, providing accessibility 24/7 in case of emergency.

- **Excess flow valves (3 in graphic below):** These safety devices are installed on customer services and shut off the flow of gas in a service line if the flow exceeds a pre-determined rate, preventing leaks and resulting explosions. Excess flow valves are more compatible on medium pressure systems as there is a minimum flow rate necessary to activate this safety device.\(^{154}\)

- **In-line isolation valves (not pictured):** Isolation valves are used to minimize outage areas and limit customer disruptions in the event of a gas main break or other failure. Isolation valves also aid in performing maintenance on in-service gas mains. PGL’s legacy low pressure system does not possess these safety devices.

\(^{153}\) *Id.*  
\(^{154}\) *Supra note 146.*
After the tragic incident at Columbia Gas Merrimack Valley, Massachusetts, on September 13, 2018, which caused a series of explosions and fires to occur in as many as 40 homes, with over 80 individual fires, 30,000 evacuated, and one death, the National Transportation Safety Board (NTSB) recommended that PHMSA issue an alert to all low-pressure natural gas distribution system operations of the possibility of a failure of over-pressure protection and identify potential failures and take action to mitigate those identified failures.\(^{155}\)

Prior to the tragic incident at Columbia Gas Merrimack Valley, Chicago experienced its own tragedy caused by the existence of a low pressure, cast iron system. In 1992, an event similar to the Merrimack Valley incident occurred in Chicago. Due to undetermined causes, the low pressure system in River West overpressurized a 16-block area, damaging 18 buildings and killing four people. Both of these events could have been avoided, and similar events prevented in the future, with a modern medium pressure system, using modern materials, and the safety devices described.

Beyond these specific improvements, medium pressure systems have much larger pressure operating tolerances than low pressure systems. This results in a much wider margin of operating error before an under- or over-pressurization event occurs, leading to an overall safer system. A modern, medium pressure distribution system combined with more resilient material will deliver a safer future for Chicago’s communities.

Second, upgrading to medium pressure delivers greater operational efficiency, due in part to the safety enhancements just discussed. For example, the greater operating tolerance of the medium pressure system is not just about safety; it also reduces the frequency of customer outages (or perceived outages) that lead to service calls. In terms of pounds per square inch (psi), the normal operating limits for low pressure systems are extremely narrow: between 0.144 and 0.434 psi. Below this range, there is a high potential for a customer outage or a “no gas” call. Above this range, there is a safety risk for some customer appliances, and an increased probability of leaks on leak-prone low pressure mains.

<table>
<thead>
<tr>
<th>Operating Limits (PSI)</th>
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<tbody>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Low Pressure</td>
</tr>
<tr>
<td>Medium Pressure</td>
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<tr>
<td>Intermediate Pressure</td>
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<td>High Pressure</td>
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By contrast, the normal operating limits for medium pressure systems are much broader, between 10 and 25 psi. Even below that range, down to 2 psi, the majority of customers will not experience a gas outage. Similarly, above that range, up to 60 psi (the maximum allowable operating pressure for polyethylene mains), customers will not experience any disruption in

service due to pressure-reducing regulators at each premises. Fewer outages and disruptions mean fewer service calls and associated work, lowering costs for customers.

This greater resilience, in turn, reduces the scope of customer outages when work is performed on the system. When a pipeline segment is de-energized so that work can be performed, it reduces pressure on the surrounding system. Because of the narrow operating tolerance of a low pressure system, this can result in broad outages in the area of work. But because medium pressure systems have a broader operating tolerance, segment de-energization has a much more localized effect, significantly reducing customer outage areas and frequency. This is true not just of planned, isolated shutdowns for segments of the system, but also in the event of third party damage.

Increasing to medium operating pressure also eliminates water infiltration and associated customer outages, particularly when paired with less leak-prone material. Water infiltration is a common cause of customer outages on low pressure systems.\(^{156}\)

A medium pressure system provides greater operating flexibility in other ways, too, ultimately resulting in savings for customers. Converting to medium pressure allows for smaller mains to be installed when replacing at-risk low pressure lines. Smaller mains are less expensive to install and take up less space in the City of Chicago’s public right-of-way, minimizing installation costs and reducing the risk of third party damage. And because most new medium pressure mains are 2” or 4” in diameter, they can be directionally drilled in parkways or sidewalks, leading to additional cost savings over replacing low pressure mains via open cutting under the street.\(^{157}\) At the same time, medium pressure pipelines provide greater load capacity than low pressure pipelines. This better positions Peoples Gas to expand service to future customers and accommodate load increases for existing customers without the need to install additional pipeline at a future date—again, reducing future costs.

Third, upgrading to medium pressure enables potential use of future fuels, opening pathways to hydrogen blending and RNG. Modern medium pressure distribution systems are compatible with RNG, a net carbon negative process that can help the industry reach target net zero goals. Provided the RNG is processed and purified to traditional pipeline gas standards, it is 100% compatible with a modernized medium pressure gas distribution system as well as end-user equipment.\(^{158}\)

Looking to the future, hydrogen blended with natural gas could be compatible with PGL’s modernized distribution network, assuming reasonable system adjustments and modified maintenance practices to ensure safe and reliable service. Peoples Gas remains closely involved with numerous industry research projects and field test cases that are validating the successful

\(^{156}\) Supra note 146.

\(^{157}\) Id.

\(^{158}\) Univ. of California: Renewable Natural Gas – Challenges & Opportunities, Nov. 2016, at 1 [RNG “is fully interchangeable with fossil natural gas [...] and can be used as a 100% substitute for, or blended with, conventional natural gas streams.”], available at: https://tinyurl.com/y55fu69w.
delivery and end-use of hydrogen blended natural gas, including those discussed in greater detail in Section 3.5 above.

Finally, it is possible that a modern, medium pressure system could be used for more than transporting fuel. Geothermal networks utilize plastic pipelines filled with water buried underground. There is potential that medium pressure plastic gas mains could be utilized or repurposed into geothermal networks in the future. Industry research on this topic is ongoing.159

5.1.3 Moving Meters Outside

In addition to replacing leak-prone material and upgrading from low to medium pressure, transitioning meters from inside customers’ homes and businesses to outside was identified as a priority under the former QIP statute and has been an important component of SMP’s scope.

Moving meters outside has numerous benefits. It reduces tampering and provides easy access for emergency customer shut-offs when needed.160 It significantly reduces the need for day-to-day customer coordination because meters can be inspected and maintained without entering the customer’s home.161 Outside meters also free up the space taken up by meters within the home.

PGL’s current approach to meter relocation is not merely good practice; it is also the approach directed by the Commission following study by Commission Staff. Specifically, in connection with WEC’s 2015 acquisition of Integrys, the Commission ordered Peoples Gas to work with Commission Staff to agree on a process for meter relocation:

With respect to indoor meters that are associated with pipe to be replaced as part of AMRP, the Joint Applicants agree that the decision process for leaving meters inside, or not centrally located, needs to be based on a common set of expectations that are uniformly applied. Within six months after the close of the Reorganization, the Joint Applicants will develop a new process for Staff review, with standard criteria and approvals, describing when Peoples Gas will allow a meter to stay inside or in a de-centralized location.

If Staff and Peoples Gas are unable to reach agreement on a process for leaving some meters inside or not relocating all meters to an accessible inside location, then Peoples Gas shall file a petition no later than eight months after the close of the transaction for the initiation of a new docket seeking approval of its proposed process.

159 See, e.g., ICC: Thermal Energy Network Report, Feb. 2024, at 67–68 (recommendations for provision of thermal energy networks by current regulated utilities), included in Appendix as Ex. K.
160 Supra note 146.
161 Id.
In that new proceeding, Staff and Peoples Gas will have the opportunity to provide testimony and argument supporting its proposed process for Commission consideration. Regardless of whether Staff and Peoples Gas reach complete agreement on the process or the Commission ultimately decide on the process to be implemented, Peoples Gas will implement the new process and, as part of its discussions with Staff, work on developing and implementing refinements to the process.162

Consistent with this directive, Peoples Gas developed a process that makes outside meters the default installation alternative, with approval required to leave the meter inside if necessary due to space constraints, known safety hazards, code violations, or other operational reasons. PGL’s proposed scope for meter relocation reflects that policy.

5.2 Efficiency and Cost-Effectiveness of Bundling Key Scope Items

While the three core SMP components discussed above—replacing leak-prone mains and services, upgrading to a medium pressure system, and moving meters outside—each have independent benefits, bundling these components together results in synergies that could not be achieved by pursuing them in isolation, while also eliminating certain drawbacks of performing only portions of this work.

First, there are inherent drawbacks to pursuing only material replacement without also pursuing a system pressure upgrade. Replacing PGL’s remaining low pressure system with another low pressure system of different material would mean that Peoples Gas would still need to maintain two primary systems of varying pressure: a medium pressure system and a low pressure system. This, in turn, would require maintaining various system regulators at each point where pressure is stepped up or down from one system to another,163 different MAOP-rated mains for each system, and different shutdown and maintenance operations for each level of pressure.

Over-pressurization would also remain an elevated risk in this hybrid system because without a systematic medium pressure upgrade, there would be far fewer of the failsafe devices discussed above to prevent an increase in pressure from reaching the customer’s home. And locating leaks on the low pressure portions of the system would remain a problem, as the reduced gas pressure makes it more difficult to locate the origin of the leak. If a low pressure line is damaged by a third party, the leak is silent and may not be immediately noticed or addressed for some time. In addition to the risks for customers, this would make it significantly more difficult for Peoples Gas to comply with PHMSA’s new LDAR rule.

Then there is the relationship between the approach to pressure and where facilities are installed. In general, a material-only approach would require size-for-size and pressure-for-pressure replacement, meaning replacement pipe of 6” or larger diameter, for which the

163 Currently, the MP/LP district regulators include some of the oldest and most at risk regulators in PGL’s system.
directional boring primarily used for sidewalk and parkway installations is not effective. This would reduce the efficiencies that both Liberty and the Commission have confirmed are gained from the “double decking” enabled by a medium pressure upgrade. Instead, existing main would be replaced by open cutting in the street and open cutting services, half of which will be long-sided, requiring significant additional installation time: whereas eight short-sided services can be installed in one day, it takes two days to install one long-sided service. During this time, each street is impacted from curb to curb, requiring residents to park their vehicles elsewhere with limited access to their street during construction.

The single decking associated with a material-only approach also unnecessarily embeds problems for the future. As shown in the figure on the following page, the street of a city block is the typical corridor for other utilities: sewer, water, electric, telecommunications, and other utilities all primarily install in the street. When the single deck methodology is utilized, half of the gas services are installed as long-sided and thus cross this utility corridor perpendicularly, meaning that every time a third-party utility is installed in the street, it will need to cross over or under each long-sided service. PGL’s newly installed gas main would also be in the street, as opposed to out of the way in the parkway, and all of this increases the risk of third-party damage to PGL’s facilities, PGL’s operational costs to address leaks caused by such hits, and the additional costs associated with cutting services out of the way to allow other utilities to cross and then reconnecting once the pass is complete.

On top of this, PGL’s footprint in the typical city street increases, as single decking leaves two 6” pipes in the street (one active and one retired). This reduces the location options for other utilities to install and, again, will increase third party costs if retired facilities later need to be removed for installation of other utilities.
For these reasons, Peoples Gas has pursued material replacement and a system pressure upgrade together as interrelated aspects of SMP, consistent with Liberty’s recommended approach and the Commission’s prior approvals. The resulting cost efficiencies are reflected in the bundling alternatives presented in Section 4, and they are significant: whereas program option 1 (addressing only leak-prone mains and services) entails costs approaching $13 billion, program options 2 and 3 (upgrading to medium pressure and addressing some or all remaining leak-prone material) offer relative customer savings of $5.45 and $5.78 billion, respectively.
As the visual above highlights, successful overall completion of the next iteration of SMP will involve completing the scope items that provide the best value for customers in the most cost-effective manner.

### 5.3 Program Pace

In addition to alternatives relating to SMP scope, Peoples Gas has developed alternatives relating to the target completion date of the program. As summarized in Section 3, the Commission previously approved a target completion date of 2035 to 2040 for SMP, and the Second Kiefner Study urged the Commission to treat 2045 as the outside date for completion of the work.

In planning and executing the SMP, Peoples Gas has relied on these recommendations and prior regulatory approvals. However, it recognizes that risk and affordability each play a role in the Commission’s assessment of the SMP, and that prioritizing the riskiest pipes within the context of the neighborhood approach – as Peoples Gas was doing until November 2023 and proposes to continue – should result in significantly reduced risk in the out years of the program. Therefore, while Peoples Gas does not believe the evidence supporting a target completion date of 2035 to 2040 has changed, a target completion date of 2045 would not be unreasonable if the Commission concludes that annual affordability should play a greater role in the analysis. To assist
the Commission in understanding how the pace of the program (program end date) affects the annual cost, Peoples Gas developed the “annual spend” bar chart presented in Section 4, albeit without accounting for how extending the program end date could (and likely would) inherently increase overall cost.

6. Additional Alternatives for Commission Consideration

Section 4 and Section 5 described disaggregated scope items for SMP, provided options for bundling scope items, and calculated costs for different pace options associated with each program option. In addition to the options and alternatives presented within those sections, this section discusses additional aspects of the program and alternatives for those aspects: modifications to prioritization, an alternative geographical approach, and options related to reporting.

6.1 New Fifth Step for Neighborhood Prioritization Process

As described in Section 3.7.2, PGL’s current neighborhood prioritization process includes four steps: (1) risk ranking, (2) feasibility analysis, (3) methane emissions review, and (4) constructability evaluation. The Commission may wish to consider a fifth step that would prioritize work in areas of the City that are most economically vulnerable, given that customers in these areas are least likely to be able to afford alternate energy options. While it remains critical to focus on the areas of the system with the most risk before they develop into emergency situations, for regions otherwise similar in risk, the affordability factor could be applied to help prioritize the area with the greater economic need.

6.2 Alternative Risk Ranking Attributes for Prioritization

Peoples Gas has provided evidence that the neighborhood approach and the associated risk attributes are working. This methodology has reduced the overall average leak rate year over year.¹⁶⁴

Within the framework of PGL’s Commission-approved neighborhood ranking model (NRM), the current risk ranking attributes and their associated risks were last updated in 2015. Continued evaluation of these attributes and their rankings, consistent with the Commission’s request in this docket and the recommendation of the Second Kiefner Study, ensures that Peoples Gas will continue to take the most prudent and effective approaches to prioritizing replacement of the riskiest of its aging infrastructure.

In the spirit of continuous improvement and based on further analysis and considerations, Peoples Gas has identified two alternatives for modifying its neighborhood ranking model. The current attributes and two alternatives are summarized in the table below:

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¹⁶⁴ See supra note 121, at 3, Appendix B.
Option #1: Maintain Neighborhood Approach with Adjusted Attributes & Weightings

This option reflects four adjustments to the NRM. First, the current attribute Medium Pressure (MP) Cast Iron & Ductile Iron Main is adjusted to MP Cast Iron Main with the weighting reduced from 30% to 15%. This adjustment is based on the following reasoning:

Since 2015, PGL has reduced the total mileage of MP Cast Iron & Ductile Iron Main remaining in its distribution system by 31% (from 188 miles down to 129 miles) by executing the SMP and the neighborhood approach. Of this remaining amount, MP cast iron main accounts for 91% (118 of 129 miles). By contrast, only 1% of PGL’s total remaining low pressure (LP) and MP cast iron and ductile iron distribution system is MP ductile iron main (11 of 1112 miles). This means ductile iron main is no longer a significant component of this ranking attribute.

Moreover, 42% of remaining MP Cast Iron Main (50 of 118 miles) is 36” and larger. Based on the Second Kiefner Study, 36” main has the longest average remaining lifespan currently in PGL’s system (54 years and 107 years respectively).\textsuperscript{165} As a result, it may be reasonable to reduce the weighting of this attribute by approximately half.

Second, in this option, the current attribute 8” or smaller CI Main is also adjusted to LP 12” or smaller Cast Iron & Ductile Iron Main with the weighting increasing from 15% to 25%. This adjustment is based on the following reasoning:

Since 2015, PGL has reduced the total mileage of 8” or smaller CI Main by 35% (from 994 miles down to 650) by executing the SMP and the neighborhood approach. With this improvement, this attribute can now be expanded to account for other sensitive pipe sizes in alignment with the results of the Second Kiefner Study, which states that 12” and smaller cast iron and ductile iron main has the lowest average remaining life span (5 years or less).\textsuperscript{166}

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\textsuperscript{165} PGL Ex. 2.02 (Second Kiefner Study), supra note 6, at (i).

\textsuperscript{166} Id.
because the remaining **LP 12” or smaller Cast and Ductile Main** accounts for 77% of PGL’s total remaining LP and MP cast iron and ductile iron distribution system (859 out of 1112 miles), or 87% of PGL’s total remaining LP cast iron and ductile iron distribution system (859 out of 983 miles), it may be reasonable to increase the weighting of this attribute.

Third, in this option, the weighting of the *unrepaired leaks* attribute is increased from **10%** to **20%**. This reflects increased focus on the parts of the system experiencing the highest rate of leaks, and aligns with PHMSA’s forthcoming LDAR rule, which requires more sensitive leak detection equipment to be used and more stringent leak reporting methodology. Increasing this attribute would reduce operations and maintenance dollars spent to remediate leaks.

Fourth, in this option, the weighting of the **vulnerable services** attribute is decreased from **15%** down to **10%**. This reflects the fact that there are varying initiatives outside of SMP to replace vulnerable services.

### Option #2: Maintain Neighborhood Approach with Adjusted Attributes & Weightings

<table>
<thead>
<tr>
<th>Ranking Attribute</th>
<th>Weighting</th>
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<tbody>
<tr>
<td>MP Cast Iron &amp; Ductile Iron Main</td>
<td>0%</td>
</tr>
<tr>
<td>LP 12” &amp; Smaller Cast Iron &amp; Ductile Iron Main</td>
<td>35%</td>
</tr>
<tr>
<td>Mean MRI</td>
<td>30%</td>
</tr>
<tr>
<td>Unrepaired Leaks</td>
<td>25%</td>
</tr>
<tr>
<td>Vulnerable Services</td>
<td>10%</td>
</tr>
</tbody>
</table>

This option reflects four adjustments to the NRM. First, it implements a **new project driver to replace 12” & 24” Cast Iron & Ductile Iron gas main**. This is based on the following reasoning:

12” and 24” MP Cast Iron & Ductile Iron Main accounts for 28% of PGL’s remaining **MP Cast Iron & Ductile Iron Main** (36 out of 129 miles), and 45% of all remaining cast iron and ductile iron main smaller than 36” (36 out of 79 miles). Again, only 1% of PGL’s total remaining LP and MP cast iron and ductile iron distribution system is MP Ductile Iron main (11 of 1112 miles), so the vast majority of the 12” and 24” main in this category is cast iron. And the Second Kiefner Study states that 12” and 24” cast iron and ductile iron main has some of the lowest average remaining life span (5 years and 1 year respectively).167

By contrast, 38% of remaining **MP Cast Iron & Ductile Iron Main** (50 of 129 miles) and 42% of remaining MP Cast Iron Main (50 of 118 miles) is 36” and larger. Again, based on the Second Kiefner Study, 36” main has the longest average remaining lifespan currently in PGL’s system (54 years and 107 years respectively).

Accordingly, it may be reasonable to take the **MP Cast Iron & Ductile Iron Main** attribute out of the NRM, give replacement of the 12” and 24” main in this category first priority (independent of the NRM), and deprioritize 36” and larger main in this category (again, independent of the

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167 *Id.*
NRM), while leaving the remainder of PGL’s system subject to an adjusted NRM where the weighting for MP Cast Iron & Ductile Iron Main is reduced to 0%.168

Second, in this option, the current attribute 8" or smaller CI Main is adjusted to LP 12" & Smaller Cast Iron & Ductile Iron Main, with the weighting increasing from 15% to 35%. This is based on the same reasoning presented for the second change in Option #1, except that here this attribute is given even greater weight in light of the proposed treatment of 12” & 24” Cast Iron & Ductile Iron gas main as a separate project driver.

Third, in this option, the weighting of the unrepaired leaks attribute is increased from 10% to 25%. This is based on the same reasoning presented for the third change in Option #1, except that here this attribute is given even greater weight in light of the proposed treatment of 12” & 24” Cast Iron & Ductile Iron gas main as a separate project driver.

Fourth, in this option, the weighting of the vulnerable services attribute is decreased from 15% down to 10%, based on the same reasoning presented for the fourth change in Option #1.

As noted in Section 4, Peoples Gas’s preferred alternative is to remove the remaining largest diameter cast and ductile iron main from the scope of the proactive main replacement program (i.e., program option 3). Program 3 would pair well with this risk-ranking model adjustment described in option 2.

### 6.3 Alternative Geographical Approach to Replacing Risky Pipe

As described above, upgrading to a medium pressure system is very valuable from a safety and reliability perspective and in terms of “future-proofing” PGL’s gas distribution system. The need to upgrade to medium pressure is a significant consideration in evaluating how best to approach system upgrades from a geographical perspective. As natural gas infrastructure is one connected network of pipes, upgrading a section to medium pressure requires a path to move an adequate supply of gas into the area being upgraded (refer to Section 3.7.2 for a description of this analysis). Over the years, various alternatives to a geographical approach have been discussed (see Section 3) and consensus has generally been reached that a geographical approach is the most cost-effective way to implement the upgrade to medium pressure.

Currently, the geographical approach has focused on neighborhoods as defined by the City of Chicago.169 Previous evaluations considered using a community-based approach, which would divide the system into 77 areas, but those evaluations concluded that the neighborhood-based approach, which divides the system into 228 areas, would be better sized for prioritization and managing the work.

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168 In this option, the remaining 11 miles of DIMP main may be able to be retired via larger project scopes that include CIMP main.

In preparing this report, the Company has begun the process of considering another alternative for the geographical approach: the High Risk Zone Approach (HRZA). Under the HRZA, Peoples Gas would apply the Commission-approved risk ranking attributes to its distribution system at the asset level to create a system heat map. With this information, PGL could more specifically analyze the areas within the City of Chicago that are identified as most critical. Project boundaries would be identified based on system feasibility and reliability, not the neighborhood geographical approach, although they may still encompass portions of neighborhoods or even whole neighborhoods if warranted in specific cases based on these criteria.

In other words, instead of using established boundaries and ranking geographical areas based on the assets within those boundaries, Peoples Gas would rank the individual assets (segments of pipe) and then define appropriate geographical boundaries based on the results of the ranking. The following table summarizes the pros and cons of both methodologies:

<table>
<thead>
<tr>
<th>Neighborhood Approach</th>
<th>High Risk Zone Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pros</td>
<td>• Further optimizes geographic boundaries to further focus on the riskiest pipe segments</td>
</tr>
<tr>
<td></td>
<td>• Established and documented process with proven effectiveness</td>
</tr>
<tr>
<td></td>
<td>• Geographic boundaries are clearly established and easily understood by various stakeholders involved with the project work</td>
</tr>
<tr>
<td>Cons</td>
<td>• Further development and testing are required in order to determine feasibility</td>
</tr>
<tr>
<td></td>
<td>• Stakeholder communication may be more complex as the HRZA regions will be defined solely for purposes of SMP work</td>
</tr>
<tr>
<td></td>
<td>• May not be as optimized as possible for addressing the riskiest pipe segments</td>
</tr>
</tbody>
</table>

To be implemented successfully, the HRZA will require a more sophisticated risk model built on the most up-to-date information regarding the condition of PGL’s distribution system at the asset level. This is precisely the work Peoples Gas is doing with JANA to prepare for compliance with PHMSA’s forthcoming DIMP rule, as described in Section 3.4.

6.4 Alternative Reporting Options

As described in Section 3.7.4, Peoples Gas currently provides a variety of information through multiple reports to various stakeholders, including the Commission. While PGL’s primary objective in this docket is to confirm alignment on the scope, bundling, pace, prioritization, and geographic approach for SMP, the Company is proposing two additional reporting options for the Commission’s consideration.

First, to further support progress and efficiency evaluation of project work, an alternative to current, program-level reporting would be for Peoples Gas to provide project-specific reports, which would provide greater transparency concerning SMP. PGL Exhibit 2.18, attached hereto, is an example of a project-specific report. If this project-level reporting is desired, Peoples Gas would recommend discontinuing current quarterly reporting and instead providing a bundled report annually for any projects that achieved field completion during the year.
Second, to further demonstrate the effectiveness of the prioritization and replacement of pipe, as part of its annual reporting, Peoples Gas could provide before-and-after maps for geographic areas that have been upgraded. This would allow the Commission and other stakeholders to visualize SMP’s progress year over year.
7. Conclusion

In this report, Peoples Gas has explained the long history of its System Modernization Program, including extensive regulatory oversight for the entirety of the program’s existence, and the continuum of improvement that has led, over many iterative changes, to the SMP of today. Peoples Gas has also identified its proposed scope and approach to the program moving forward, including core alternatives relating to scope items, bundling of those items, program pace, and more detailed options relating to neighborhood prioritization, risk ranking, geographical approach, and reporting. As always, Peoples Gas remains committed to doing the work necessary to maintain safety and reliability for its customers and all who live and work in the City of Chicago.

Peoples Gas recognizes that the Commission is also in the process of considering the “future of gas” more generally, and that some would prefer to discontinue investment in a natural gas distribution system that they believe will soon be obsolete. This would be a mistake. It is cast iron pipe—not all natural gas infrastructure—that is obsolete, and Peoples Gas has some of the last cast iron pipe left in the nation. Notably, whereas cast iron main accounts for just 2% of distribution mains nationwide, it makes up 23.6% of PGL’s distribution system—and, since 2017, 100% of the cast iron distribution main left in Illinois.170

As referenced in the introduction, other Illinois gas utilities like Nicor and Ameren Illinois no longer have significant amounts of cast iron main in their systems because for decades, this Commission supported its replacement. In other states where gas utilities still have significant amounts of cast iron mains, the same is true. Even in New York, where state-wide restrictions have been placed on the future use of natural gas, Consolidated Edison has reduced its cast iron mains from 1,406 miles in 2005 to 811 miles in 2023, and is still working to replace the rest.171 And the City of Berkeley’s recent, prominent repeal of its own natural gas ban confirms that deeming natural gas obsolete anytime soon would be premature.

On March 22, 2024, as Peoples Gas was concluding its preparations to submit this report, Moody’s Ratings announced that it had completed a periodic review of PGL’s rating.172 Moody’s warned that future ratings decisions would depend on additional developments in two of PGL’s regulatory proceedings. First, Moody’s emphasized that “[t]he outcome of the company’s 2023 rate case proceeding has increased regulatory risk because it evidences the deterioration in the predictability of the regulatory environment in Illinois.”173 Second, Moody’s pointed to “[t]he November 2023 Illinois Commerce Commission decision to pause PGL’s system modernization program (SMP) until the completion of a 12-month investigation.”174 Moody’s continued:

The [continued A2] rating is premised on our expectation that there will be credit supportive outcomes of the two key pending

170 Supra n. 144.
171 Id.
173 Id. at 1.
174 Id.
regulatory proceedings. These proceedings include: (i) a limited scope rehearing for possible reconsideration of certain aspects of the November 2023 order based on test year 2024, which relates to disallowed investments totaling approximately $144 million. These investments are associated with emergency work and certain work related to the SMP; (ii) the SMP investigation itself, and whether it will allow the utility to continue making certain investments to enhance system safety and reliability. The latter proceeding is particularly important because PGL’s low or medium pressure mains still include around 1,112 miles of higher risk cast and ductile iron pipe or around 28% of the total.175

Ordinarily this level of scrutiny from a major ratings agency would be a subject of significant concern for both a regulated utility and its regulator. In this case, that concern is outweighed by even more serious risks. Past Commissions have studied the SMP and its prior iterations exhaustively, for far longer than 12 months. Relying on the work of independent outside experts and auditors, they have concluded that delaying the critical work of replacing deteriorating gas mains under Chicago’s streets cannot be justified.

Based on the most recent evidence presented in this docket, this Commission should reach the same conclusion. While Peoples Gas can and will continue to improve the SMP, experience demonstrates that it can do so as work continues, and forty years of warnings confirm that there is no more time to wait.

175 Id. at 2.
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<td>PGL Ex. 2.08</td>
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<td>Bureau of Public Utilities: Staff Report to the Commission Regarding Workshops Held to Evaluate and Assess The Peoples Gas Light &amp; Coke Co. Gas System Modernization Program, May 2016</td>
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ENGINEERING REPORT NO. ER-048

CAST IRON PIPE REPLACEMENT STUDY

FOR

PEOPLES GAS LIGHT AND COKE COMPANY

CHICAGO, ILLINOIS

VOLUME I
May 22, 1981

Mr. Louis C. Baldacci, Jr.
Vice President
The Peoples Gas Light and Coke
Company
122 South Michigan Avenue
Chicago, Illinois 60603

Dear Mr. Baldacci:

Zinder Engineering, Inc., is pleased to transmit herewith eight (8) copies of Engineering Report ER-048, entitled "Cast Iron Pipe Replacement Study for PEOPLES Gas Light and Coke Company," Volumes I and II.

As part of the report, we included an executive summary to provide you with a synopsis of our investigation and major findings.

You will find the resumes of the principal contributors to this report in the Appendices (Volume II). Because of the education and broad experience of the participants in the study, ZEI was able to address what are believed to be the major influences contributing to cast iron pipe failures and to develop the analytical models necessary to quantify these influences.

The outcome of our study is a proposed 50-year replacement program, which schedules the replacement of 4" and 6" pipe buried in clay soil, as the various vintages attain their critical ages.

While the approach we have taken is somewhat different from that outlined in PEOPLES 1978 Long-Range Operating Plan, we have, nonetheless, arrived at similar conclusions. Moreover, we believe our report answers some of the questions raised by the 1979 Institute of Gas Technology Report, including the quantification of the soil and frost conditions that are believed to be major contributors to pipe failure.

Some of our more significant findings are:

- The age of pipe, type of soil, frost penetration and frequency, and vehicular traffic, are the major factors that affect cast iron pipe performance.
The life expectancies (critical ages) for 12-foot lengths of cast iron pipe buried in clay soil are from 51 to 76 years for the 4" pipe size, and from 92 to 108 years for the 6" pipe size.

The life expectancy (critical age) for 16-foot lengths of 6" cast iron pipe buried in clay soil is from 49 to 86 years.

A stepped-up replacement program is necessary for controlling pipe breaks.

The existing Gas Main Information System database contains valuable information that would aid in making the repair/replacement tradeoff decisions. But, further software must be developed to better utilize the data for maintenance system planning.

We wish to express our thanks to Mr. P. J. Doyle and Mr. R. C. Peters and the other members of PEOPLES' study task group for their cooperation and responsive assistance during the course of our work on this report.

In summation, ZEI believes that this report provides the necessary information to make the initial management decisions relative to cast iron pipe replacement. Moreover, we believe that the computer and rational models contained in this report, along with additional development and use of the Gas Main Information System, will further improve future replacement decisions.

We are pleased to have been of service on this important and challenging assignment, and we look forward to working with PEOPLES at some time in the future.

Sincerely,

ZINDER ENGINEERING, INC.

[Signature]

Robert W. Potts, P.E.
Senior Vice President

RWP/jk
ENGINEERING REPORT NO. ER-048

CAST IRON PIPE REPLACEMENT PROGRAM
FOR
PEOPLES GAS LIGHT AND COKE COMPANY
CHICAGO, ILLINOIS

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ZINDER ENGINEERING, INC.
2621 Carpenter Road
Ann Arbor, Michigan 48104

May 22, 1981
EXECUTIVE SUMMARY

Peoples Gas Light and Coke Company (PEOPLES) has approximately 18,600,000 feet of cast iron pipe in its gas distribution system. This pipe ranges in size from 4" to 48", has an average age of approximately 58 years, and is subject to graphitic corrosion.

Because of an increasing incidence of cast iron pipe failures, PEOPLES formed a task group to evaluate the performance of their cast iron pipe system and to recommend a course of action. The results of the study were published in a report entitled, "Long-Range Operating Plan for the Distribution Department" dated January, 1978. As part of this study, PEOPLES' task group investigated the relevant parameters affecting the behavior and service life of the cast iron pipe and concluded that certain pipe sizes and quantities should ultimately be replaced and that a replacement program should be structured to allow continued control of pipe breaks and joint maintenance activities, safety of operation and integrity of service considering financial and other related resource constraints.

Zinder Engineering, Inc. (ZEI) was retained to independently review and evaluate the PEOPLES cast iron pipe distribution system and submit a report of its findings and recommendations for controlling the cast iron pipe failure problem.

ZEI designed its investigation to:

- Determine the major failure mechanisms.
- Develop Statistical, Theoretical, and Rational Models to quantify the effects of the failure mechanisms on the life expectancies of the pipe.
- Determine the amount of cast iron pipe to be replaced in the City of Chicago over discrete periods considering pipe age, soil type, and weather.
- Develop a cost-effective repair/replacement program and strategy consistent with PEOPLES objectives.

While the approach taken by ZEI was somewhat different from that taken by the task group, the results, nevertheless, confirmed and therefore supported the major findings of the task force; namely,
Pipe age (vintage) is one of the major influences affecting cast iron pipe performance (others are corrosive characteristics of different soils, frost penetration and heavy truck traffic).

A stepped-up replacement program is necessary to control pipe breaks and other pipe failures.

Modify cast iron pipe replacement program.

The outcome of ZEI's study is a proposed 50-year replacement program for the City of Chicago which schedules the replacement of 4" and 6" pipe buried in clay soil as it reaches its life expectancy (critical age). The replacement schedule over the next twenty years is considered to be most critical for effectively controlling pipe breaks and minimizing joint leaks.

Major conclusions and recommendations resulting from this study are set out below. Other conclusions pertinent to an overall understanding of ZEI's study appear in the summary at the end of Sections III, IV, V, VI, VII, VIII, IX, and X.

CONCLUSIONS

1. ZEI's assessment of the PEOPLE'S existing cast iron pipe system, based on a review of studies and other resource data provided by PEOPLE'S, is that past repair and replacement programs have adequately controlled pipe breaks and joint leaks, such that a high level of system integrity has been maintained. However, substantial additional quantities of cast iron pipe are currently reaching an age where their behavior is expected to increase the incidence of joint leaks and pipe failures.

2. The five soil types found to exist in the City of Chicago are alkaline in nature (attributed to their high calcium content and geologic makeup). All display poor drainage characteristics; three are clayey soils, which are more highly corrosive and susceptible to frost action; two are sandy soils (with some silt) which are less corrosive and have medium potential for frost action.
3. Although the literature on corrosion of cast iron in soils is extensive, the most carefully conducted and most completely documented study is that reported in the National Bureau of Standards (NBS) Circular 579, "Underground Corrosion," published in April, 1957. The corrosion data on plain cast irons reported in the Circular are based on 6" cast iron pipe buried in 1922 and 1928 at a number of locations around the country representing a variety of soil types. The corrosion data are documented in terms of loss in weight and depth of maximum pit penetration.

4. On the basis of meeting both the chemical and mechanical test criteria, the following soil match-ups were selected as representative of the five soil types (three chemical groups) existing in the City of Chicago:

<table>
<thead>
<tr>
<th>Chemical Group No.</th>
<th>Soil Survey No.</th>
<th>Soil Name</th>
<th>Matching Soil No.</th>
<th>Soil Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>5</td>
<td>Frankfort-Bryce</td>
<td>15</td>
<td>Houston Black Clay</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>Markham, Ashkum</td>
<td>8</td>
<td>Fargo Clay Loam</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>Milford</td>
<td>8</td>
<td>Fargo Clay Loam</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>Selma, Oakville</td>
<td>18</td>
<td>Knox Silt Loam</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>Faxon, Kankakee, Rockton</td>
<td>8</td>
<td>Fargo Clay Loam</td>
</tr>
</tbody>
</table>

While the soils selected from NBS Circular 579 are not indigenous to the Chicago area, their mechanical and chemical characteristics compare favorably as do climatic and geologic features such as rainfall, temperature and glacial origin.

5. The corrosive characteristics of a soil will determine the rate of loss of pipe wall thickness over time and the load-carrying capacity of buried cast iron pipe will, therefore, decrease with time because of the progressive loss of wall thickness due to graphitic corrosion.
6. Due to the manner in which the cast iron pipe was supported when placed, the pipe now behaves like a simple beam and thereby is subjected to bending stress caused by soil and other superimposed loads.

7. Because cast iron is brittle and weak in bending (beam), the 4" and 6" pipe sizes are most vulnerable to breaking and leaking at joints; moreover, breaks and joint leaks can be expected to increase during the coldest winter months because of the added load caused by frost penetration.

8. Large diameter pipe will not normally fail in bending as a beam, but is more likely to fail in ring bending which causes longitudinal cracks in the pipe. Moreover, such cracks would be expected to be more prevalent at the end of the pipe segment near the block supports.

9. Cast iron pipe buried under roadways will have a higher incidence of failures than pipe installed in the parkways because truck traffic imposes loads which are similar in behavior to loads imposed by frost; also, frost penetration is generally greater under roadways than in parkways.

10. ZEI's Theoretical, Statistical and Rational Models incorporating the major break failure mechanisms that include pipe vintage, soil type, frost depth and vehicular traffic to forecast failure rates, detects those pipe sizes and their geographic locations most sensitive to failure.

11. Statistical analysis of the PEOPLE'S Gas Main Information System (GMIS) break data over the period 1954-1980 clearly shows that soil type (clay versus non-clay) and weather (frost depth), in addition to age, are significant parameters in explaining pipe breaks.

12. The best statistical formula for forecasting future levels of break rates is best described by the following equation:

\[ PB_{t,k} = A + B \cdot AGE_{t,k} + C \cdot (AGE_{t,k} \cdot DFROST^2_t) + D \cdot (AGE_{t-1,k} \cdot DFROST^2_{t-1}) + e_{t,k} \]
Where:

PB = 6" cast iron pipe breaks at month (t) in soil type (j), from vintage (k)

AGE = Average age at time (t) of pipe in soil type (j), from vintage (k)

DFROST = Depth of frost in inches, in month (t)

A, B, C, D = Parameters to be estimated

et, k = Equation error term

t-1 = One month lag between breaks and frost depth

13. The Rational Model quantifies the major factors affecting pipe breaks and joint leaks, as well as provides the tools to detect those pipe sizes most sensitive to failure and to predict their behavior under load.

14. The Rational Model is more appropriate for generating a replacement program since the Statistical Model is believed to have underestimated future breaks because:

a. The Statistical Model's failure rate results are biased because break history data relating to abandoned mains had been deleted from the data base used to forecast future pipe breaks.

b. Statistical projections based on a regression analysis can only project pipe break behavior based on past experience. This can lead to an under- or over-estimation of future break behavior. In this instance, it is ZEI's opinion that the Statistical Model's break projections understate future expectations because of the early state of maturation of the system and the fact that the preponderance of the critical size pipe is in the more corrosive clay soil.

15. The life expectancies of PEOPLE's cast iron pipe population determined from the Rational Model analysis based on break criterion, suggest that all 4", 6" and 8" pipe and some 12" pipe
buried in clay soil (NBS Soil No. 8), totaling 8,867,000 feet, be replaced over the next 50 years, in the following order:

a. All 4" pipe (519,000 feet) should be replaced over the next ten years.

b. All 6" pipe (5,857,000 feet) with 12-foot lengths, should be replaced over the next 50 years beginning in 1980.

c. All 6" pipe (2,371,000 feet) with 16-foot lengths, placed before 1970, should be replaced over a 40-year period beginning in 1990.

d. All 8" pipe (119,000 feet) with 12-foot lengths, installed before 1900, should be replaced over a 30-year period beginning in 2000.

e. All 12" pipe (1,000 feet) with 12-foot lengths, installed before 1870, should be replaced over a ten-year period beginning in 2020.

16. Calculations indicate that pipe break repairs extend the life of the repaired pipe about 15 to 20 years, depending on the length of the sleeve used to make the repair, after which failure would be expected to occur again - probably a break just beyond the repair sleeve.

17. Replacement versus repair economic analyses of the 1981-2000 period indicate that it is better to replace pipe than to repair it once it reaches its life expectancy (critical age). The existing GMIS data base contains valuable information that would aid in making the repair/replacement tradeoff decisions, but further software must be developed to better utilize the data for system maintenance planning. ZEI's "Hot Spot" contour map identifies geographic areas within the system where high rates of pipe failure have occurred and where replacement rather than repair is most likely justified. Using the GMIS data base and the "Hot Spot" map, pipe vintages can be compiled by square mile areas and past break histories to form the basis for planning maintenance replacement activities.
18. The recommended replacement program in PEOPLES' Long-Range Operating Plan Report, dated January, 1978, calls for more pipe to be replaced during the 1981-1990 period and less pipe during the 1991-2000 period than recommended by ZEI as summarized below:

<table>
<thead>
<tr>
<th>Period</th>
<th>ZEI Replacement Plan (Feet/Yr.)</th>
<th>PEOPLES 1978 Long-Range Operating Plan (Feet/Yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-1990</td>
<td>217,000</td>
<td>308,000</td>
</tr>
<tr>
<td>1991-2000</td>
<td>332,000</td>
<td>308,000</td>
</tr>
</tbody>
</table>

19. Based on Net Present Value Analysis, the ZEI replacement program offers an average annual savings over the 1978 Long-Range Operating Plan recommendation of about two million dollars per year over the twenty-year period.

RECOMMENDATIONS

Based on the foregoing conclusions, ZEI recommends that:

1. PEOPLES implement the following replacement program for cast iron pipe, consisting mostly of the 4" and 6" sizes buried in Class No. 8 soil (clay), commencing in 1981:

<table>
<thead>
<tr>
<th>Time Period</th>
<th>ZEI Recommended Pipe Replacement (Feet/Yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981-1990</td>
<td>63,000 12 mile/year</td>
</tr>
<tr>
<td>1991-2000</td>
<td>178,000 34 mile/year</td>
</tr>
<tr>
<td>2001-2010</td>
<td>216,000 41 mile/year</td>
</tr>
<tr>
<td>2011-2020</td>
<td>230,000 44 mile/year</td>
</tr>
<tr>
<td>2021-2030</td>
<td>199,000 38 mile/year</td>
</tr>
</tbody>
</table>

1Adjusted to include system expansion, system improvement and public improvement categories.
2. Since pipe breaks are more critical than joint leaks, PEO-PLES should continue to concentrate on controlling breaks through replacement, which will also partially eliminate future joint leaks.

3. Continue to use GMIS data base and expand it to facilitate compilation of special reports relating to system status and maintenance planning.

4. Modify the recommended replacement program as more complete GMIS and other decision-making data develop.

*  *  *  *  *  *
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