STATE OF RHODE ISLAND
PUBLIC UTILTIES COMMISSION

IN RE:	**THE NARRAGANSETT ELECTRIC COMPANY, D/B/A NATIONAL GRID'S FY 2021 GAS INFRASTRUCTURE SAFETY, AND RELIABILITY PLAN**	**))))**	**DOCKET NO. 4996**

PREFILED DIRECT TESTIMONY OF

Rod Walker,
CEO & President
Rod Walker & Associates
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On Behalf of the Rhode Island Division of Public Utilities and Carriers

February 4, 2020

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND THE BUSINESS ADDRESS OF YOUR EMPLOYER.

A. My name is John Rodney (Rod) Walker. I am employed by Rod Walker & Associates Consultancy, Inc. ("RW&AC"). RW&AC is located at 1320 Mayes Road, Toccoa, Georgia 30577.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS MATTER?

A. I am testifying on behalf of the Rhode Island Division of Public Utilities and Carriers ("Division").

Q. WHAT DOES YOU POSITION WITH RW&AC ENTAIL?

A. RW&AC is a technical advisory and management consulting firm. As CEO and President of RW&AC, I am responsible for the overall development, direction, supervision, and preparation of technical advisory and management consulting projects for our clients, including involvement in capital replacement program reviews, system modeling and planning reviews, project engineering, planning and design reviews, construction management, organizational assessments, due diligence reviews, strategic planning, regulatory compliance and providing expert witness testimony.

Q. **WOULD YOU PLEASE OUTLINE YOUR EDUCATIONAL BACKGROUND?**

A. I graduated from Clemson University in Clemson, South Carolina in 1985 with a Bachelor of Science Degree in Civil Engineering.

Q. **ARE YOU A MEMBER OF ANY PROFESSIONAL SOCIETIES?**

A. I am active in the American Gas Association and the American Public Gas Association.

Q. **PLEASE BRIEFLY DESCRIBE YOUR EXPERIENCE WITH NATURAL GAS UTILITIES.**

A. I have worked in the natural gas industry since 1985. In the first seventeen years of my career, I worked in engineering, operations and management roles at the Atlanta Gas Light Company, and as Utilities Director for the City of Hartwell, Georgia and the City of Toccoa, Georgia. Through my work in the gas industry, I gained significant experience in the areas of natural gas utility operations, management, design engineering, system reliability analysis, as well as the design and construction of hundreds of natural gas infrastructure projects (pipelines, regulator stations, and tap stations). My industry work has also focused on system reliability and safety, system improvements for future expansion and replacement of aging infrastructure.

After my seventeen years of working in the gas industry, I have worked for several national energy consulting firms, R. W. Beck/SAIC, Halcrow, Black & Veatch as well as RW&AC, a gas industry consulting firm I started in 2015. In the role of a gas industry consultant, I have continued working with domestic and international utilities, state jurisdictions in the areas of capital planning, replacement programs evaluations, due diligence, organizational assessments, strategic planning, regulatory compliance, expert witness, and engineering the design and construction of various infrastructure projects.

Currently, I serve as an advisor to the State of Arkansas Attorney General's Office, DC-Office of People's Counsel, the Delaware Division of Public Advocate and the California Energy Commission in addition to the Rhode Island Division of Public Utilities and Carriers on natural gas industry issues. I have written numerous white papers and articles on subjects affecting the natural gas utility industry.

Q. HAVE YOU PREVIOUSLY TESTIFIED AS AN EXPERT BEFORE THE RHODE ISLAND PUBLIC UTILITIES COMMISSION?

A. Yes. I testified before the Rhode Island Public Utilities Commission ("Commission") in 2019 concerning Docket No. 4916, the FY 2020 Gas ISR Plan of The Narragansett Electric Company d/b/a National Grid ("National Grid" or the "Company").

II. PURPOSE OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to provide the Commission with my findings and recommendations on behalf of the Division regarding the Company's Gas Infrastructure, Safety, and Reliability Plan FY 2021 Proposal that was provided to the Division on September 27, 2019 and National Grid's Gas Infrastructure, Safety, and Reliability Plan

FY 2021 Proposal that the Company filed with the Commission on December 20, 2019. My testimony will discuss the following: i) the overall state of the Company's proactive main and service replacement programs, ii) the 2018 System Integrity Report, and iii) follow-up to last year's Division ISR plan recommendations as adopted in Order No. 23521 in Docket No. 4916.

III. REVIEW OF ANALYSIS

Q. PLEASE DESCRIBE THE OVERALL STATE OF THE COMPANY'S PROACTIVE MAIN AND SERVICE REPLACEMENT PROGRAMS?

A. The Rhode Island natural gas distribution system is one of the oldest in the United States and includes a large proportion of leak-prone and deteriorating infrastructure which in some instances was installed over 100 years ago. Categories of leak-prone pipe in the distribution system include cast iron, wrought iron, unprotected steel, copper and Aldyl-A and Polybutylene plastic pipe, which are more brittle and prone to leaks than today's modern plastic pipe. While the Company has done a reasonable job since acquiring the gas systems in Rhode Island in the 2000s in trying to eliminate its leak-prone and deteriorating infrastructure, it still has one of the largest collections of leak-prone infrastructure nationwide, with 1,086 miles of cast iron and unprotected bare steel mains and 41,982 unprotected bare steel and copper services. While the Company replaced 67.5 miles of leak-prone main in 2018, the overall leak rate, leak receipts, its inventory of Grade 1 leaks (most hazardous), leak backlog and cast iron break rates have increased according to the data provided by the Company in its 2018 System Integrity Report. More detailed analysis is found in the review of the 2018 System Integrity Report section of this testimony.

Overall, it is in the Company's, its customers' and in Rhode Island citizens' best interests to find the most cost effective, efficient, safe and reliable way to eliminate leak-prone infrastructure in the shortest time possible while continuing to plan and monitor the Company's natural gas system overall for reliability for *all* factors, not just for aging infrastructure alone. The Company needs to continuously re-evaluate the effectiveness of its proactive replacement programs to ensure the riskiest leak prone aging mains and services are being replaced so the metrics around leak rates, i.e., inventory of leaks to be repaired, continue to trend downward, especially around the most hazardous leaks (Grade 1). It is RWA&C and the Division's belief that the continued investment in replacing aging leak prone infrastructure will accelerate the elimination of Grade 1 and 2 leak prone pipes, so the remainder of the replacement program focuses more on the low risk pipe to be replaced.

RWA&C concerns are:

1) <u>Lack of a comprehensive inventory of aging leak prone mains.</u> As stated in our review of the 2020 Gas ISR, the Company does not have a comprehensive inventory of its aging leak prone gas system mains from which to assess which are the riskiest mains to be replaced. The continued lack of such an inventory is concerning since Rhode Island has one of the largest and oldest populations of aging leak prone pipe. While the Company expects to have such an inventory in 2020 with the implementation of new systems and

software which should address the inventory issue, the Division will need to monitor this issue to ensure the Company is focusing on removing and replacing its "worst offenders".

2) <u>Lack of proactive service replacement program.</u> While the Company has a reactive service replacement program and has agreed to begin replacing its isolated services (700 over 10 years) in the FY 2021 Gas ISR Plan, it does not have a proactive service replacement program to address other high-risk services, some as old as 75-100 years, most with inside meter sets. A proactive service replacement program to address the riskiest services similar to the main replacement program should be added to the FY 2022 ISR plan to ensure these services are being replaced in the most expeditious manner possible.

Q. PLEASE DISCUSS THE COMPANY'S 2018 SYSTEM INTEGRITY REPORT.

A. The Company's summary of the 2018 System Integrity Report states that the overall leak rate, leak receipts, its inventory of Grade 1 leaks (most hazardous), leak backlog and cast iron break rates have increased. The leak rate overall has been trending upward the last two years after reaching a low point in 2016 (p. 15) including the Grade 1 leaks which increased from 644 in 2016 to 724 in 2017 and 758 in 2018. Based on the Company's 2018 System Integrity Report (p. 21), the current replacement program has, as its timetable, the elimination of all leak-prone main within 20.9 years. This timetable is based on 1,086 miles of leak prone main/55 miles of actual annual main replacement. Cast iron pipe and un-protected bare steel continue to make up the largest population of leak-prone main at 714 miles and 386 miles, respectively (p. 20). The current replacement program pace for cast iron is 18.27 miles per year (p. 32) and 27.29 miles per year (p. 36) for bare steel. For services, un-protected bare steel services make up the majority of the leak-prone services at 41,793, with copper services at 189 (p. 40), some as old as 75-100 years, most with inside meter sets as reported in the Company's Distribution Integrity Management Program (DIMP) Report (attached hereto as Exhibit A, pp. RI-24, RI-25).

The assumption is leak-prone un-protected bare steel services are being replaced with adjacent leak-prone mains replacement programs. It is not clear how many leak-prone services are replaced as part of the Proactive Main Replacement program. While the Company has properly given much attention to main replacement, the risk factors and resulting priorities for main are different than services. From information on service replacement provided to the Division by the Company (attached hereto as Exhibit B - RI Service Replacement Program - March 2019 Presentation), the current replacement rate is ~420 services/year under the Reactive Service Replacement program. At this rate, the large population of aging leak prone unprotected bare steel services has not been significantly reduced and the Company has not identified when all of these services will be replaced. Given their proximity to homes and the public and the current rate of replacement, we believe the Company should develop a proactive service replacement program to replace the aging ~42,000 bare steel and copper services starting with highest risk services in a reasonable timeframe comparable to its main replacement program.[1]

[1] On December 11, 2019, the Division's Gas Pipeline Safety Section issued a Notice of Concern to the Company regarding Copper Services (attached hereto as Exhibit C). In the Notice, the Divsion expressed "serious concerns related to the remaining 189 copper services in Rhode Island". When viewed in its entirety, the risk data set forth in the Notice further supports the need for the recommended proactive service replacement program.

Q. PLEASE DISCUSS YOUR FOLLOW-UP REVIEW OF THE DIVISION'S RECOMMENDATIONS THAT THE COMMISSION ADOPTED IN ORDER NO. 23521 IN DOCKET NO. 4916.

A. The following reflects the status of the Division's assessment of the Company's compliance with the five (5) recommendations of the Division that the Commission adopted in Order No. 23521 in Docket No. 4916:

1) The Company shall develop, maintain and provide to the Division, the global list of all aging leak-prone infrastructure risks ranked in its overall replacement program. The Company has represented to the Division it will install new software in 2020 that will provide more robust tools to risk rank its natural gas infrastructure especially its leak-prone infrastructure. The greatest need in the Company's annual planning and risk evaluation activities are to: a) ensure it is removing the "worst offenders" of its leak-prone natural gas mains and services, and b) develop the most efficient program to accelerate its main and service replacement program to remove all leak-prone infrastructure in the shortest amount of time while maintaining the reliability and safety of the natural gas system for its customers and citizens in the areas that the Company serves. The Division's review of this requirement is ongoing.

2) The Company shall identify and develop a comprehensive risk-based list of its isolated services and commit to replacing all of these services within a seven (7) year period, starting in FY 2021. The Company has developed a list of 700 isolated services (metallic services attached to plastic or non-metallic mains) that details as specifically as

possible the material type, size, date of installation, condition, and risk of these isolated services in the Company's natural gas distribution system and has developed a plan to replace 100 isolated services each year for seven years, starting with the riskiest services first. The Company has satisfied this requirement.

3) The Company shall provide the Division with its Excel spreadsheets associated with this filing. The Company provided the Division with the Excel spreadsheets associated with its FY 2020 Gas ISR Plan. The Company produced unit costs by project for FY 2020 projects and included a set of standard unit cost tables in the FY 2021 Gas ISR proposal filed December 20, 2019 with sensitivity for projects in congested, rural areas, replacement versus. new construction, etc. The costs in both occasions have been reviewed for reasonableness and seem to be in order to that end. The Company has satisfied this requirement.

4) The Company shall provide the Division with its Excel spreadsheets associated with each future Gas ISR filing, as part of its annual requirement. The Company has reviewed with the Division, through on-site meetings and Webex presentations, the processes of its system planning, modeling, main replacement, operations, gas procurement and risk evaluation teams go through to ensure they are coordinated in their identification of and development of capital programs for infrastructure safety and reliability so that the elimination of leak-prone and deteriorating infrastructure is synced up with areas of the gas distribution system needing hardening and pressure improvement. As part of this review, Excel spreadsheets were provided of projects being discussed in the 2021 Gas ISR. The

Excel spreadsheets and cost estimates provided were helpful for the Division and RWAC to evaluate project level costs of the items in the FY 2021 Gas ISR Plan. The Company has satisfied this requirement.

5. The Company shall provide the Division with cost information and data of sufficient detail to satisfy the Division as to the reasonableness of the cost estimates of the various components of the Southern RI Gas Expansion Project and to update the Division on these costs on a regular basis throughout the project, at no less than ninety-day intervals. The Company provided, and continues to provide, the Division with the cost information mandated by this requirement. The Division's review of the Southern RI Gas Expansion in connection with the FY 2021 Gas ISR Plan is contained in the Direct Testimony of Mr. Mancini.

IV. CONCLUSION

Q. **DO YOU HAVE ANY RECOMMENDATIONS BASED ON YOUR REVIEW AND ANALYSIS?**

A. Yes, I do.

1) The Company should develop and maintain a comprehensive inventory of aging leak prone mains. The Company has represented to the Division that it expects to have a comprehensive inventory of its aging leak prone gas system of main in place with the implementation of new systems and software in 2020. The Division agrees with the Company that the development of such an inventory is in the best interests of ratepayers.

The Division will continue to monitor this issue to ensure that the inventory is developed and that the Company is focusing on removing and replacing its "worst offenders".

2) The Company should develop a proactive service replacement program in addition to its Isolated Service replacement program. The Company has developed a proactive service replacement program in its FY 2021 Gas ISR Plan to begin replacing its 700 isolated services over ten years. The Division recommends the Company should propose a proactive service replacement program in its FY 2022 Gas ISR Plan to accelerate replacement of the aging ~42,000 bare steel and copper services similar to its main replacement program. The Division and the Company will continue to discuss the content of such a program, including a timetable that will ensure the elimination of high-risk services within a reasonable period of time.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

EXHIBIT A

nationalgrid

National Grid Corporation

Gas Distribution Integrity Management Plan
2018

Preface

The development of this Distribution Integrity Management program was initiated in 2009 as a project involving the Northeast Gas Association, the Southern Gas Association, forty seven utilities (including National Grid), and Structural Integrity Associates. These parties collaborated to develop a best-in-class framework. Subsequent to the initial development, National Grid retained Structural Integrity to assist in the customization of the National Grid specific DIM Plan. Departments within National Grid that were directly involved in the Plan development included Operations Regulatory Compliance and Distribution Engineering. A team with representatives from these two groups was assigned the task of creating the National Grid DIM Plan by August 2011 for the U.S. gas operations.

REVISION CONTROL SHEET

Title: National Grid Corporation Distribution Integrity Management Plan

SECTION	PAGES	REVISION	DATE	COMMENTS
1-12	All	0	8/2/2011	INITIAL RELEASE
1-12	All	1	2/17/2012	REVISION 1
1-12 & All Appendices	All	2	8/29/2013	REVISION 2
1-12 & All Appendices	All	3	9/12/2014	REVISION 3
1-12 & All Appendices	All	4	9/1/2015	REVISION 4
1-12 & All Appendices	All	5	9/1/2016	REVISION 5 (Complete Re-evaluation)
1-12 & All Appendices	All	6	8/2/2017	REVISION 6
1-12 & All Appendices	All	7	8/2/2018	REVISION 7
1-12 & All Appendices	All	8	8/2/2019	REVISION 8

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1.0 COMPANY OVERVIEW

National Grid Corporation is one of the largest investor-owned utilities in the world and is the largest distributor of natural gas in the Northeastern US, serving approximately 3.5 million customers in Massachusetts, New York and Rhode Island (See Figure 1-1).

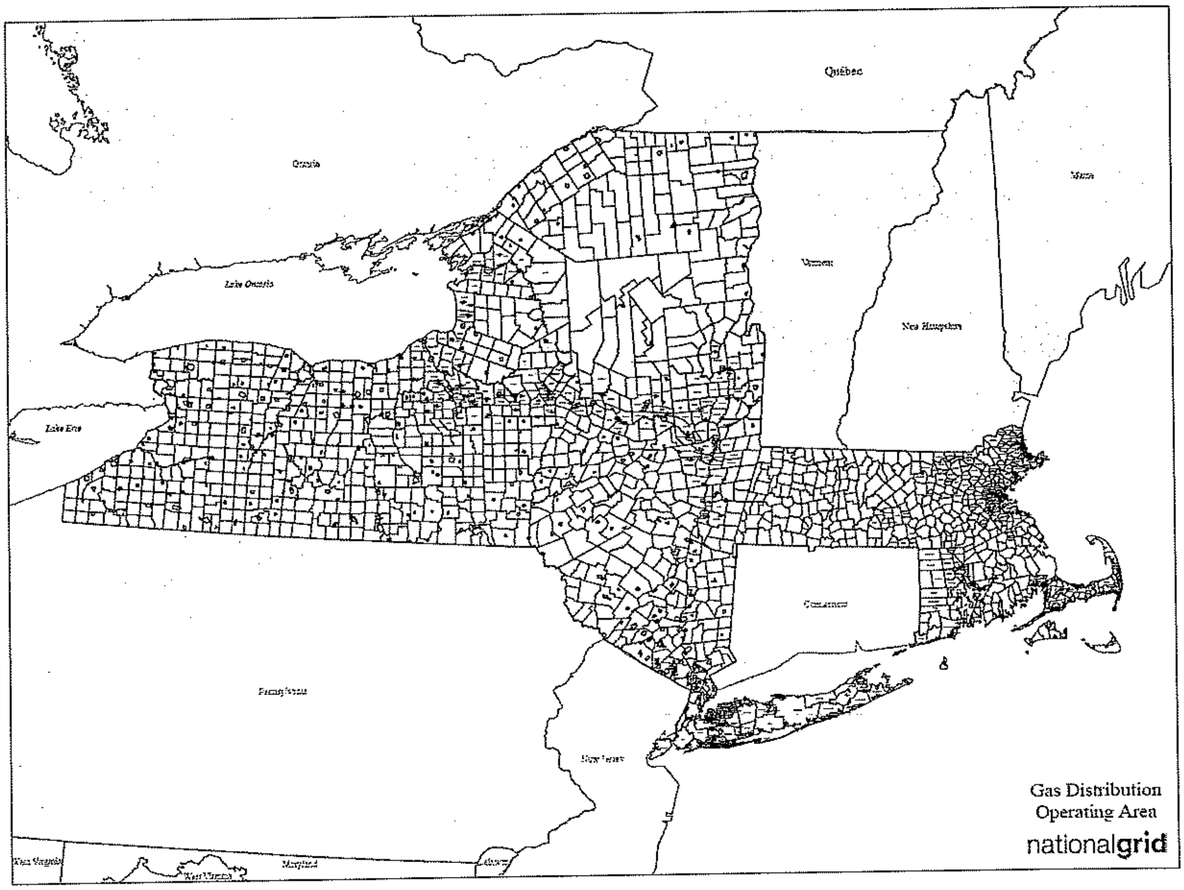

Figure 1-1

At this time, National Grid makes annual reports to The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) under the following Operator IDs:

Operator ID 4547 – Massachusetts (MA), Essex
Operator ID 11856 – Massachusetts (MA), Colonial Lowell
Operator ID 2066 – Massachusetts (MA), Colonial Cape
Operator ID 1640 – Massachusetts (MA), Boston
Operator ID 13480 – New York, Upstate (UNY)
Operator ID 1800 – New York City (NYC)

Operator ID 11713 – New York, Long Island (LI)
Operator ID 13480 – Rhode Island (RI)

2.0 COMPANY SAFETY

National Grid recognizes that its operations potentially give rise to risk, and believes that it can eliminate or minimize those risks to achieve zero injuries, and to safeguard members of the public. The communities that are served include all those who have a stake in or are affected by the company. By using the best designs, processes, tools, and training, National Grid aims to develop a process-focused approach to mitigating risk, therefore increasing the overall safety of our system and customers. The Distribution Integrity Management Program (DIMP) aims to ensure pipeline integrity by identifying, evaluating, and mitigating the risks within National Grid's system. The following are key elements within the program in order to achieve this goal:

- Knowledge
- Identify Threats
- Evaluate and Rank Risks
- Identify and Implement Measures to Address Risks
- Measure Performance, Monitor Results, and Evaluate Effectiveness
- Periodically Evaluate and Improve Program
- Report Results

3.0 SCOPE

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) amended the Federal Pipeline Safety Regulations on December 4, 2009 to require operators of gas distribution pipelines to develop and implement a Distribution Integrity Management Program (DIMP). National Grid's written integrity management plan also comply with Code of Massachusetts Regulations 220 CMR 99 (Dig Safe Rules), 220 CMR 100.00 through 113.00 (Gas Distribution Code), New York Code, Rules and Regulations 16 NYCRR§ 255 (Transmission and Distribution of Gas), and Rhode Island Division of Public Utilities Rules and Regulations Prescribing Standards for Gas Utilities, Master Meter Systems and Jurisdictional Propane Systems.

The purpose of the DIMP is to enhance safety by identifying and reducing gas distribution pipeline integrity risks. Operators must integrate reasonably available information about their pipelines to inform their risk decisions. The DIMP approach was designed to promote improvement in pipeline safety by identifying and implementing risk control measures beyond those previously established in PHMSA regulatory requirements, when warranted.

This written DIM Plan addresses the DIM Rule which requires operators to develop and implement a DIM program that addresses the following elements:

- Knowledge
- Identify Threats
- Evaluate and Rank Risks
- Identify and Implement Measures to Address Risks
- Measure Performance, Monitor Results, and Evaluate Effectiveness
- Periodic Evaluation and Improvement
- Report results

Because of the significant diversity among distribution pipeline operators and pipelines, the requirements in the DIM Rule are high-level and performance-based. The DIM Rule specifies the required program elements but does not prescribe specific methods of implementation.

This written Integrity Management Plan applies to gas distribution pipelines operated by National Grid Corporation. Gas distribution pipelines include the mains, services, service regulators, customer meters, valves, regulator stations, and other gas carrying appurtenance attached to the pipe. This Integrity Management Plan also applies to transmission pipelines that are not covered by the National Grid Transmission Integrity Management Program (IMP). Figure 3-1 below summarizes which National Grid piping systems (mains) are covered by the Transmission Integrity Management Program and which are covered by the DIM program.

Pipeline System	Approximate Miles of Mains as of 2018 PHMSA Report*	Asset Family	Integrity Program	Pipeline Attributes	National Grid Management Plans
Covered DOT Transmission	***300 miles	Transmission	IMP	= or >20% SMYS and in HCA	Assessment, Preventive & Mitigative Measures
Non-Covered DOT Transmission**	190 miles	Transmission	DIMP	= or >20% SMYS and NOT in HCA	Preventive, Mitigative & *Performance Measures*
Local Transmission (Distribution per §192.3)	498 miles	Transmission	DIMP	<20% SMYS >124 psi NYS > 200 psi NE	Preventive, Mitigative & *Performance Measures*
Distribution	About 35,561 miles	Distribution	DIMP	< or = 124 psi NYS < or = 200 psi NE	Preventive, Mitigative & *Performance Measures*

* *Provided for illustrative purposes, see Annual PHMSA Report for current mileage.*

** *Managed as Local Transmission under DIMP.*

****Total mileages went down due to data correction for NMPC*

Figure 3-1

This Plan also acknowledges National Grid's responsibilities relative to Oxbow Farm's master meter system in Middletown, RI in accordance with its Agreement with RI on Oxbow Farms Apartments (Docket# D-06-54). National Grid recognizes its ownership, operation and maintenance of the natural gas pipelines downstream of the Oxbow Farms master meter system. This includes performing walking leak survey on a 3-year cycle and the cathodic protection of steel facilities All piping was included in its respective asset category for threat identification, risk ranking, risk mitigation, and all other requirements as identified in 49CFR, Part 192.1015.

This plan does not cover:

Customer owned lines – piping downstream of the service line (as defined in Section 5.0).

Gathering lines –National Grid does not currently own or operate gas gathering lines.

Transmission lines covered under the National Grid IMP

Liquefied Natural Gas (LNG) Plant Facilities – the pipe, vessels, tanks, valves and appurtenances used in liquefied natural gas peak shaving facilities are designed, constructed, operated and maintained in accordance with the requirements established in 49CFR, Part 193.

4.0 PURPOSE AND OBJECTIVES

The purpose of the DIM program is to enhance safety by identifying and reducing gas distribution pipeline integrity risks. Managing the integrity and reliability of the gas distribution pipeline has always been a primary goal for National Grid; with design, construction, operations and maintenance activities performed in compliance with or exceeding the requirements of the Code of Federal Regulations (CFR) and as well as the following where applicable: Code of Massachusetts Regulations 220 CMR 99 and 100.00 through 113.00, New York Code, Rules and Regulations 16 NYCRR§ 255 (Transmission and Distribution of Gas), and Rhode Island Division of Public Utilities Rules and Regulations Prescribing Standards for Gas Utilities, Master Meter Systems and Jurisdictional Propane Systems.

The objective of this DIM Plan is to establish the requirements to comply with 49CFR § 192.1005, 192.1007, 192.1009, 192.1011, and 192.1013 (and 192.1015 for the master meter system in Middletown, RI) pertaining to integrity management for gas distribution pipelines. National Grid does not currently propose to reduce the frequency of periodic inspections and tests as allowed by 192.1013, but may submit such proposals for consideration and concurrence by regulators in the future.

The DIM Plan is comprised of seven elements depicted in Figure 4-1 (DIM Plan Section reference also provided).

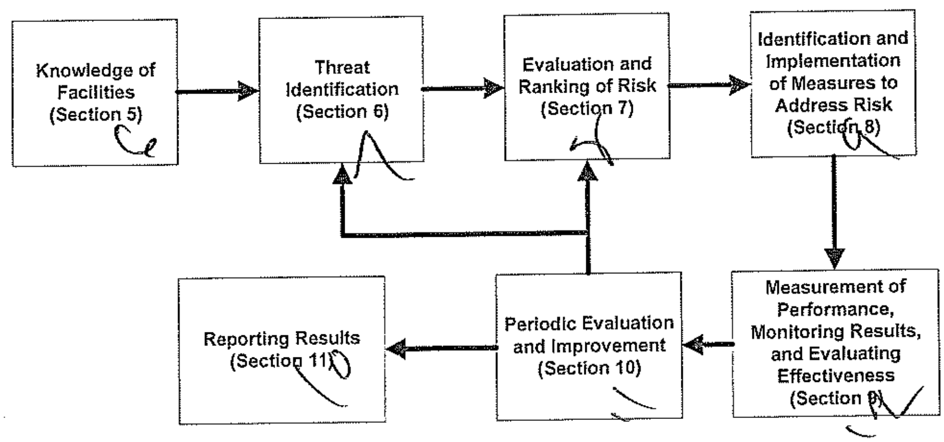

Figure 4-1 DIM Plan Elements

In addition to the key elements shown in Figure 4-1, the DIM Plan also establishes requirements for reporting of mechanical fitting failures (Section 12.1) and maintaining records (Section 13).

All elements of this DIM Plan shall be implemented by no later than August 2, 2011.

4.1 Company Roles

The purpose of this section is to describe key roles within the organization.

4.1.1 Vice President, Gas Asset Management

The Vice President of Gas Asset Management is responsible for oversight DIM Plan and assures that the program processes are implemented by the organization in accordance with this DIM Plan and associated regulatory requirements. The Vice President of Gas Asset Management may delegate, in writing, some or all of these responsibilities to Director Gas Distribution Engineering.

4.1.2 Director, Gas Distribution Engineering

The Director, Gas Distribution Engineering has overall responsibility to assure that the DIM Plan processes are implemented by the organization in accordance with this DIM Plan and associated regulatory requirements. The Director conducts a month to month review of the program with the Manager to make sure the DIM Plan aligns with the Company's operating procedures. The Director, Gas Distribution Engineering of DIMP may delegate some or all of these responsibilities.

4.1.3 Manager, DIMP

The Manager of DIMP has the responsibility for day-to-day program oversight, integrity policy, facility replacement priorities, and responsibility to assure that the plan is implemented effectively and is integrated with the Company's operating procedures. This Plan assigns authority to the Manager for approval of the DIM Plans.

4.2 DIM Program Administration

Table 4-1 provides an overview of the actions that may be necessary to administer the DIM Program.

Table 4-1: DIM Program Administration

Plan Section	Role / Responsibility	Responsible Position *
4.1	Overall Program Oversight	Vice President, Gas Asset Management
4.1	Overall Program Implementation	Director, Gas Distribution Engineering
6.1, 6.2, 6.3 Appendix A	Updates to Appendix A	Manager, DIMP
6.4	Update Action Plans for Gaining Additional Knowledge	Manager, DIMP
6.6, Appendix A Appendix B	Conduct and Record SME Interviews as necessary for input into Appendix A (Knowledge) and Appendix B (Threat Identification)	Manager, DIMP
7.0, 7.1, Appendix B	Update Threat Identification (Appendix B) as new or modified threats are known or recognized	Manager, DIMP
8.1	Update the Risk Assessment and Ranking process and/or algorithms	Manager, DIMP

Plan Section	Role / Responsibility	Responsible Position *
Appendix C	Perform and document updates to the Risk Assessment & Ranking Results.	Manager, DIMP
9.1, 9.2, Appendix D	Ongoing updates to Mitigation Measures to Address Risks	Manager, DIMP
10.1 thru 10.6, Appendix E	Maintain Performance Measures (updates to actual performance as well as the associated baselines)	Manager, DIMP
11.1, Appendix F	Periodic Updates to the Plan	Manager, DIMP
11.2, Appendix F	Conduct and document the Annual Effectiveness Review	Manager, DIMP
11.1, Appendix F	Conduct the Program Re-evaluation	Manager, DIMP
12.1	Prepare and submit the annual report to PHMSA and the State Pipeline Safety Authority	Manager, DIMP
13.0	Maintain DIM Program Records and Files as required by Retention Policy	Manager, DIMP

* or designee

4.2.1 Org. Chart

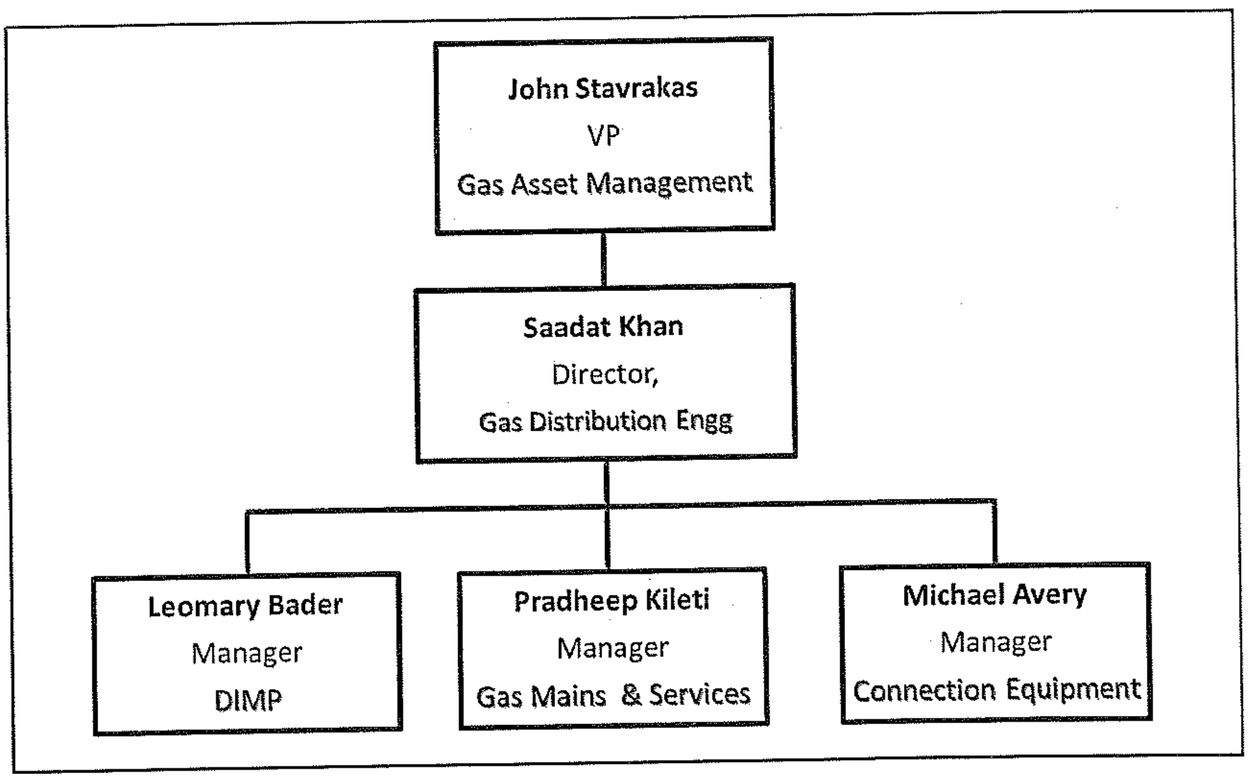

Figure 4-2 Organization Chart

4.3 How to Use this Plan

This DIM Plan is intended to be a resource and decision making guide for implementing the DIM Program at National Grid. The 12-section general Plan applies to all National Grid jurisdictions. There is also a state-specific Appendix for each of the three states in which National Grid operates. The general IMP and DIM Program workflow is outlined in Figure 4-3.

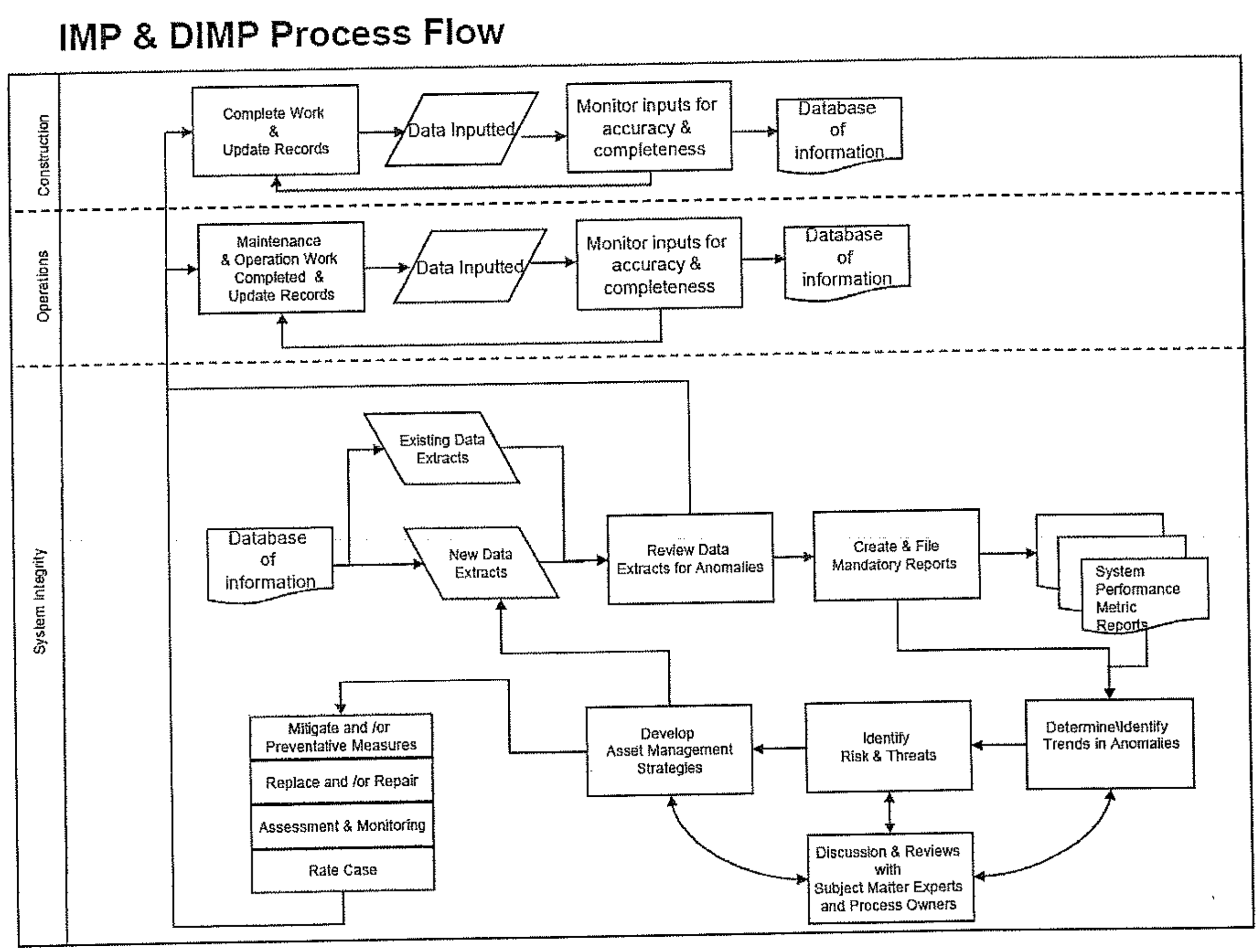

Figure 4-3 IMP & DIM Program Process Flow

5.0 DEFINITIONS AND ACRONYMS

The definitions provided in 49 CFR, §192.3 and §192.1001 shall apply to this DIM Plan. The following definitions and acronyms shall apply to this DIM Plan.

Baseline: A value established for the purposes of evaluating the ongoing results of a performance measure. Baselines are established as a matter of judgment and can change and evolve over time.

COF: Consequence of Failure

D.I.R.T.: Damage Information Reporting Tool – a secure, national web application for the collection, analysis and reporting of underground facility damage information for all stakeholders. More information on D.I.R.T. may be found at the Common Ground Alliance's (CGA's) website at www.cga-dirt.com.

Distribution Integrity Management Plan (DIM Plan): a written explanation of the mechanisms or procedures the operator will use to implement its integrity management program and to ensure compliance with subpart P of 49 CFR Part 192 (reference §192.1001)

Distribution Integrity Management Program (DIM Program): an overall approach used by an operator to ensure the integrity of its gas distribution system (reference §192.1001)

Distribution Integrity Management Program Files: Operator records, databases, and/or files that contain either material incorporated by reference in the Appendices of the DIM Plan or outdated material that was once contained in the DIM Plan Appendices but is being retained in order to comply with record keeping requirements.

DIM Rule: 49 CFR, Part 192, Subpart P

Distribution Line: a pipeline other than a gathering or transmission line (reference §192.3)

EFV: Excess Flow Valve. An Excess Flow Valve is a safety device that is designed to shut off flow of natural gas automatically if the service line breaks

Excavation damage: a physical impact that results in the need to repair or replace an underground facility due to a weakening, or the partial or complete destruction of the facility including, but not limited to, the protective coating, lateral support, cathodic protection, or the housing for the line device or facility (reference §192.1001)

Hazardous Leak: a leak that represents an existing or probable hazard to persons or property, and requires immediate repair or continuous action until the conditions are no longer hazardous (reference §192.1001)

HDPE: High Density Polyethylene

FOF: Frequency of Failure; synonymous with Likelihood of Failure

Integrity Management Program (IMP): A program used to manage gas transmission pipeline integrity in compliance with Subpart O of 49CFR, Part 192.

Main: a distribution line that serves as a common source of supply for more than one service line (reference §192.3)

MDPE: Medium Density Polyethylene

Mechanical fitting – As defined in the instructions for completing Form PHMSA F7100.1-1; includes Stab Type Mechanical Fittings, Nut Follower Type Mechanical Fittings, Bolted Type Mechanical Fittings and other types as may be specified by PHMSA.

NTSB: The National Transportation Safety Board

PHMSA: The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration

Pipeline: all parts of those physical facilities through which gas moves in transportation, including pipe, valves, and other appurtenances attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies (reference §192.3)

Region: areas within a distribution system consisting of mains, services, and other appurtenances with similar characteristics and reasonably consistent risk. The term Region may also apply to a geographic area within the operator's system.

Risk: a relative measure of the likelihood of a failure associated with a threat and the potential consequences of such a failure

Risk Model: the integration of facility data, operational data, SME input, and established algorithms to estimate the relative risk associated with a gas distribution system threat

Service Line: a distribution line that transports gas, or is designed to transport gas, from a common source of supply to an individual customer, to two adjacent or adjoining residential or small commercial customers, or to multiple residential or small commercial customers served through a meter header or manifold. A service line ends at the outlet of the customer meter or at the connection to a customer's piping, whichever is furthest downstream, or at the connection to customer piping if there is no meter. In New York State, under 16 NYCRR § 255.3, a service line ends at the first accessible fitting inside a wall of the customer's building where a meter is located within the building, or at the building wall if the meter is located outside the building.

SME: Subject Matter Expert. An SME is an individual who is judged by the operator to have specialized knowledge based on their expertise or training.

Sub-Threat: a threat type within one of the primary threat categories specified in §192.1007(b)

Ticket: a notification from the one-call notification center to the operator providing information of pending excavation activity for which the operator is to locate and mark its facilities

6.0 KNOWLEDGE OF FACILITIES

The objective of this section is to assemble and demonstrate as complete of an understanding of the company's infrastructure as possible using reasonably available information from past and ongoing design, operations and maintenance activities. In addition, this plan identifies what additional information is being sought for the program and provides a plan for gaining that information over time through normal activities.

National Grid has a long history of systematically managing its distribution systems. The Company actively participates in committees of the American Gas Association (AGA), the Northeast Gas Association (NGA), the American Society of Mechanical Engineers (ASME), and the National Association of Corrosion Engineers (NACE).

The National Grid Distribution Engineering Department is responsible for the development and implementation of Integrity Management Programs for Gas Distribution facilities and pipelines. The department compiles and analyzes system and operating data, files annual reports to the Department of Transportation (DOT) and State regulators, generates periodic bulletins, and prepares various Integrity Reports and Analyses. . Data analysis is an important component of Integrity Management. System performance, analysis, risk, threats, asset management, replacement strategies and rate case support are all performed. These engineering and operational activities require knowledge of the system inventory, age, and annual performance, as well as performance trends over time.

6.1 Policy & Procedures

National Grid has a number of existing policies and procedures that are related to integrity management and asset management of its gas distribution system. Table 6.1 below has been prepared to summarize which procedures exist to cover the elements as outlined in §192.1007. Procedures that are local to specific regions or are pending will be developed into enterprise wide documents over time.

For example: National Grid follows the nine (9) elements contained within the published PHMSA Damage Prevention Assistance Program (DPAP). The Company has been actively involved in mark outs and damage prevention for over 25 years and these processes are covered under numerous legacy operating procedures and test instructions. Mark out and damage prevention statistics are tracked and the company expects to develop a single enterprise wide policy document to include all the data elements required under the rule.

Section 10, Periodic Evaluation and Improvement, will identify any areas, policy or procedures that will require changes to comply with the rule or to improve the process over time.

Table 6-1: Policy Documents Related to Integrity Management for Distribution

Category	192.1007	Procedure	Revisions and Date	Regions	Procedure Title	Element
Asset Information	Elements A1	NA	NA	NA	Miscellaneous Legacy Records	Demonstrating Knowledge
Asset Information	Elements A1 & A5	NA	NA	NA	Miscellaneous Legacy Records	Demonstrating Knowledge
Annual SI Gas Distribution Report	Elements A1, A2, A4, B, C, & F	NA	NA	NA	Miscellaneous Legacy Records	Demonstrating Knowledge, Identified Threats & Periodic Evaluation
Improving Knowledge	Element A3	NA	NA	NA	IM Plan	Identify Additional information
Asset Information	Elements A1 & A5	GEN03002	Revision 9.0 07/15/18	All Regions	Preparation and Processing Gas Main and New Services Work Packages	Demonstrating Knowledge
Asset Information	Elements A1 & A5	CNST06020	Revision 2.0 11/15/17	All Regions	Completion and Processing of Gas Service Record Cards	Demonstrating Knowledge
Asset Information	Elements A1 & A5	CNST01005	Revision 1 09/15/13	All Regions	Preparation of Gas Facility Historical Records	Demonstrating Knowledge
Risk Scoring Policy	Element C	GEN01002	Revision 0 06/01/13	All Regions	Risk Scoring Policy	Ranking Risk
Annual DOT Reports	Element B & G	GEN01020	Revision 2.0 09/15/14	All Regions	Preparation and Filing of DOT Annual Report for the Gas Transmission and Distribution System	Identify Threats & Reporting Results
Problematic Materials	Elements A & B	GEN01009	Revision 2.0 06/01/13	All Regions	Reporting Nonconforming Material	Demonstrating Knowledge & Identifying Threats
Damage Prevention Policy	Element D	DAM01000	Revision 1.0 08/15/18	All Regions	Damage Prevention Policy	Mitigate Risk

Category	192.1007	Procedure	Revisions and Date	Regions	Procedure Title	Element
System Operation Procedures	Element D	GCON02001	Revision 6.0 05/15/17	All Regions	System Operating Procedure (SOP)	Mitigate Risk
Welding Policy	Element D	CNST05002	Revision 3 05/15/19	All Regions	Welding Policy	Mitigate Risk
Operator Qualification Plan	Element D	GEN01100	Revision 3.0 09/15/17	All Regions	Operator Qualification Plan	Mitigate Risk
Asset Information	Elements A1, A2, A3 & A5	ENG01002	Revision 3.0 05/15/17	All Regions	Design of Gas Regulator Stations	Mitigate Risk
Corrosion Design Criteria	Element D	COR01100	Revision 1 08/15/18	All Regions	Corrosion Design Criteria	Mitigate Risk
Leakage Survey	Element D	CNST02001	Revision 1.0 07/15/19	All Regions	Leakage Survey Policy	Mitigate Risk
Leakage Survey	Element D	CNST02002	Revision 2.0 07/15/19	NYC, LI	Leakage Surveys	Mitigate Risk
Leakage Survey	Element D	CNST02003	Revision 1.0 02/01/13	NYC, LI	Building of Public Assembly Inspections	Mitigate Risk
Leakage Survey	Element D	LSUR-5030	Revision 1.0 12/15/2011	MA	Building of Public Assembly	Mitigate Risk
Special Winter Operations	Element D	CNST02004	Revision 3.0 11/15/15	All Regions	Winter Leak Operations	Mitigate Risk
Corrosion Control	Element D	COR02100	Revision 2.0 08/15/18	All Regions	Requirements for Corrosion Inspection, Testing and Repair	Mitigate Risk
Atmospheric Corrosion Inspections	Element D	COR02010	Revision 4.0 07/15/19	NYC, LI RI, UNY	Atmospheric Corrosion Inspection of Services	Mitigate Risk

Category	192.1007	Procedure	Revisions and Date	Regions	Procedure Title	Element
Corrosion Control	Element D	COR03002	Revision 4 07/15/18	All Regions	Measuring Pipe-To-Soil Potential	Mitigate Risk
Valve Inspection Policy	Element D	CNST04009	Revision 4.5 07/15/18	All Regions	Valve Inspection Policy	Mitigate Risk
Classifying Gas Leaks	Element D	CNST02009	Revision 2.0 12/15/16	NYC, LI, UNY	Classifying Gas Leaks	Evaluating Risk
Eliminating Gas Leaks	Element D	CNST02010	Revision 1.0 02/01/13	NYC, LI, UNY	Leak Response and Repair	Mitigate Risk
Surveillance of Gas Leaks	Element D	CNST02011	Revision 2.0 08/15/18	NYC, LI, UNY	Surveillance of Classified Leaks	Mitigate Risk
First Responder	Element D	CNST02013 -MA	Revision 1.0 06/15/18	MA	First Responder – Massachusetts	Evaluating Risk
First Responder	Element D	CNST02013 -NY	Revision 2.0 05/15/14	NYC, LI, UNY	First Responder – New York	Evaluating Risk
First Responder	Element D	CNST02013 -RI	Revision 2.0 05/15/18	RI	First Responder – Rhode Island	Evaluating Risk
Odor Monitoring	Element D	INR06001	Revision 3.1 08/15/18	All Regions	Odor Monitoring	Mitigate Risk
Regulator Station Inspection	Element D	INR03001	Revision 4.1 02/15/17	All Regions	Regulator Station Monthly Inspection Policy	Mitigate Risk
Regulator Station Inspection	Element D	INR03003	Revision 1.0 04/15/17	MA, RI	Regulator Station Annual Inspection Policy: New England	Mitigate Risk
Asset Management Strategy	Element D	ENG04030	Revision 3 05/15/19	All Regions	Identification, Evaluation and Prioritization of Distribution Main Segments for Replacement	Mitigate Risk

Category	192.1007	Procedure	Revisions and Date	Regions	Procedure Title	Element
Survey & Inspection	Element D	CNST02005	Revision 1.0 03/15/17	All Regions	Patrolling Transmission Pipelines	Mitigate Risk
Asset Management Strategy	Element D	CNST06001	Revision 0.0 01/15/15	All Regions	National Grid's Policy for Inactive Services	Mitigate Risk
Asset Management Strategy	Element D	CNST06005	Revision 0.0 01/15/15	All Regions	Inspection and Abandonment of Inactive Services	Mitigate Risk
Regulators	Element D	ENG02001	Revision 2.2 4/15/17	All Regions	Design of Gas Services	Mitigate Risk
Purging Operations	Element D	CNST03006	Revision 1 1/15/17	All Regions	Purging Operations - Direct Displacement	Mitigate Risk
Purging Operations	Element D	CNST03007	Revision 1 01/15/17	All Regions	Purging Operations - Complete Inert Gas Fill	Mitigate Risk
Purging Operations	Element D	CNST03008	Revision 1 01/15/17	All Regions	Purging Operations - Slug Method	Mitigate Risk
Cast Iron Management	Element D	DAM01007/ DAM01009 effective 5/15/17	Revision 0 08/15/14	LI, UNY, NYC	Cast Iron Encroachment Policy for New York State	Mitigate Risk
Cast Iron Management	Element D	DAM01008	Revision 3.0 04/15/18	MA, RI	Cast Iron Encroachment Policy for Massachusetts and Rhode Island	Mitigate Risk
Leakage Survey	Element D	CNST02022	Revision 0 08/15/18	RI	Special Survey (Schools & Hospitals) for Rhode Island	Mitigate Risk

These documents are subject to revision or replacement at any time. It is not practical to issue DIM Plan revisions for every policy/procedure change or update. Table 6-1 will be updated whenever a full Plan revision occurs. See current documents available on the Standards and Policies Gas Procedures intranet site for the most current information. Some procedures may not have been in effect in all National Grid regions at the time of this publication. In those cases, the enterprise-wide procedure(s) should list any currently active state-specific policies and the date(s) that the enterprise-wide procedure(s) are expected to take effect. Also, during the transition to enterprise-wide procedures, some aspects of the Rhode Island Operations and

Maintenance Manual (including specifications and procedures for Construction and Maintenance (CM documents) and Customer Field Services (CFS documents)) will continue to be in effect.

6.2 Overview of Past Design, Operating, Maintenance and Environmental Factors

National Grid owns and operates approximately 35,561 miles of cast iron, steel (non IMP Transmission) and plastic distribution mains at various pressures from low to high throughout its service territory, as well as the associated services, connection equipment, instrumentation and regulation, and other appurtenances. The Company has sought and obtained regulatory approval to upgrade, replace and maintain the distribution systems needed to reduce risk and to address threats to its system and the customers it serves. Since annual system performance statistics can easily vary due to external conditions (e.g. weather), programs and plans must be based on the performance of the system over time. Identifying trends and evaluating data requires an understanding of the science of past designs, operating and maintenance histories. National Grid's knowledge of its gas distribution system is supported by the Company's gas industry experience and data.

National Grid separates its gas distribution system into two primary asset classes; Mains & Services which includes associated connection equipment, and Instrumentation & Regulation. National Grid also divides assets into sub-classes (regions) which include distinctions by factors such as material, size, vintage, pressure, construction method, and location.

6.2.1 Bare and Coated Steel Mains & Services

The modes and mechanisms of failure associated with bare-steel corrosion are well understood by corrosion experts and documented in a number of texts on the topic. It is a known fact that non-cathodically protected bare steel pipe, buried in the earth where there is moisture in the soil and without cathodic protection, will corrode over time. This corrosion may occur over the entire surface of the pipe and it may take many years before the first corrosion leak occurs. However, once the first leak on a pipeline segment occurs, there are other points on the pipe where the pipe is losing metal and where corrosion pits are becoming deeper. As the corrosion pitting continues and the pipes continue to lose metal, these pipes will increasingly experience additional leaks. Eventually many additional points of corrosion may result in an unmanageable leak rate.

The deterioration mentioned above is a function of time in the ground and is also influenced by the particular environment. This fact is evidenced by the fact that the USDOT has not allowed the installation of unprotected or bare steel for gas service since 1971. Furthermore, an early scientific reference regarding the failure rate of buried steel pipe was given in the book "Soil Corrosion and Pipe Line Protection" by Scott Ewing Ph.D., published in 1938. In the text, the performance of the service pipes in the Philadelphia Gas Works System was plotted and showed that corrosion leak occurrences over time on bare steel pipe increased at an exponential rate. This graph is shown below in Figure 6-1. When this text was written the natural gas industry was still in its infancy and high performance materials such as plastic and well-coated and cathodically protected steel were not available or well understood.

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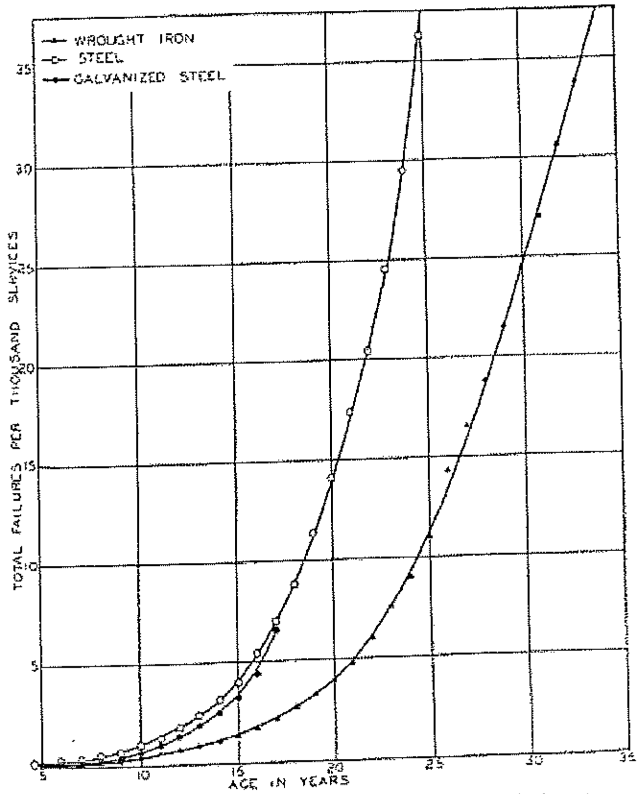


Fig. 7. Failure curves of house services in the Philadelphia Gas Works System

Figure 6-1 - Chart from 1938 text showing exponential leak rates for bare steel pipe in gas service

This very same finding is corroborated today in more modern texts. One such text that is considered by many to be a foundational book for the study of corrosion is: "Peabody's Control of Pipeline Corrosion" by A.W. Peabody, published by the National Association of Corrosion Engineers International, the Corrosion Society (Second Edition 2001). This text, published more than 60 years after the Ewing text, reaffirms the fact that leak incidents on unprotected bare pipe will occur at an exponentially increasing rate. In the Peabody text, this is shown as an example plotted on semi log paper. A copy of the graph used to describe this in the Peabody text (Figure 15.1 in Peabody) is shown in Figure 6-2 below.

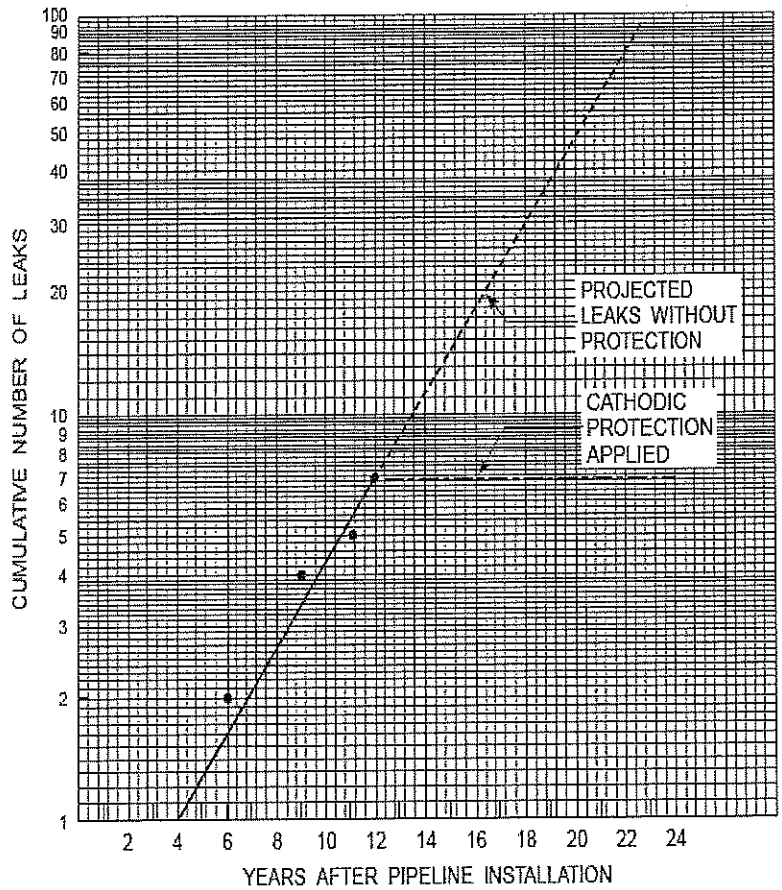


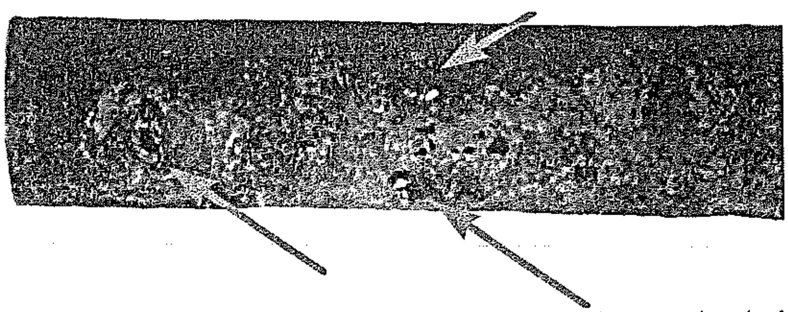
Figure 15.1 Cumulative number of leaks without CP.

Figure 6-2 - Chart from 2001 text showing exponential leak rates for bare-steel pipe in gas service.

As shown on this graph, no leakage occurs during the initial life of the pipe (first leak occurred 4 years after placing the piping in service). Then, in the next 4 years, 1.5 new leaks occurred. Then, in the next 4 years, 4.5 new leaks occurred. Then, in the next 4 years, 11 new leaks occurred. This accelerating occurrence of leaks continues at a rate that places the cumulative leak count off the scale, past the 23rd year, with more than 100 cumulative leaks occurring. What is important to note is not that the leaks are occurring, but that they are occurring at an ever increasing frequency as a function of time (once the corrosion process has reached the point to produce the initial leak). Although National Grid's inventory of main and services contains many pipes that have exceeded the 23 years noted, not all of these pipes have begun to leak at the same initial time.

This exponential growth of leak occurrences on bare-steel pipe is scientifically documented as indicated in the text above. This exponential growth of leak occurrences on bare steel pipe is also well known by experienced gas system operators who perform bare-steel repairs and find themselves installing multiple leak repair sleeves on sections of corroding pipe.

This ever increasing frequency of leak incidents is evident based on the corrosion mechanisms. Bare steel pipe is undergoing continuous deterioration by corrosion. In some locations, the deterioration is more aggressive than in other locations. In many cases, although the wall thickness is penetrated at only a single point, it can be seen that the entire pipe may have been degraded to the point where future leaks will occur at an ever increasing rate. This is visually obvious by viewing the piece of corroded pipe shown from the USDOT website in Figure 6-3. In this picture, there may be only a few points of actual leakage, but the pipe shows apparent signs of distress along the entire wall thickness.



An example of bare steel pipe installed for gas service. Note the deep corrosion pits that have formed. Operators should never install bare steel pipe underground. Operators should use either polyethylene pipe manufactured according to ASTM D2513 or coated steel pipe as new or replacement pipe. If steel pipe is installed, that pipe must be coated and cathodically protected.

Figure 6-3

Wrought iron pipes, while less brittle than cast-iron mains and service lines, are subject to corrosion. The corrosion of wrought iron is similar to bare steel in its exponential leak rate growth.

Coated steel mains and services, when cathodically protected against corrosion, are an excellent and well-performing gas distribution material. They resist corrosion and have significantly higher strength than plastic. All underground steel pipe installed after July 31, 1971 is required by federal code (per 49 CFR 192, Subpart I) to be coated and cathodically protected and is regularly tested to ensure an adequate level of protection and compliance. In many cases, steel pipe installed before 1971 is also coated, cathodically protected, and regularly tested. However, coated steel mains and services that are unprotected can undergo accelerated corrosion if the coating is breached – either by damage or disbonding. Such mains are currently viewed by National Grid as not protectable and are considered to be ineffectively coated and subject to the same risks as bare unprotected steel.

6.2.2 Cast Iron Mains

The natural gas industry considers cast-iron mains and non-cathodically protected steel mains and services to be higher risk materials. Cast Iron mains are among the oldest materials remaining in gas distribution systems, often pre-dating the 1900's. Gas facilities in most large older cities (particularly in the Northeast) account for the largest amounts of cast iron dating back before the turn of the 20th century. The cast iron system in National Grid's Boston Gas region is the second oldest in the United States (after Philadelphia Gas Works). The changeover from the use of cast iron to steel started slowly in the 1920s. During the 1940s, following the discovery of electric arc welding which provided a tight joint, steel pipe gradually replaced cast iron entirely. The industry has since replaced steel pipe with plastic pipe and cathodically protected coated steel pipe as the primary materials for distribution systems. Similar to unprotected or bare steel mains, the USDOT no longer permits installations of cast iron mains or service lines.

There are 22,895 miles of buried cast iron pipe still in service in the United States distributing natural gas as of 2017. Much of this pipe has provided excellent service over its life. However, aging cast-iron mains have experienced gradual deterioration and are susceptible[1] to breaks, cracks, and other failures such as joint leaks.

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[1] Other environmental effects, including methods used to support the pipe, frost, and vehicle loads that impose additional stress on the pipe, thus further reducing its useful life, exacerbate the deterioration caused by graphitization.

As the owner and operator of nearly 20 percent of all the cast iron distribution main in the United States, National Grid has unparalleled experience in dealing with cast iron mains in a safe and reliable manner. Extensive research has been done throughout the years by National Grid's legacy companies and National Grid's cast iron replacement programs have been carefully designed to continue cost-effective operation in the safest and most reliable way possible.

In 2013, National Grid also participated in the development of an AGA white paper to Congress entitled "Managing the Reduction of the Nation's Cast Iron Inventory", which is incorporated here by reference.

Experience from companies[2] that operate greater mileage of cast iron has identified certain parameters associated with higher leak and failure rates. Many of these parameters are useful to evaluate in identifying pipe segments more prone to failure. The predominant among these are:

- Pipe graphitization history
- Manufacture and original wall thicknesses, sometimes associated with vintage pipe diameter size and flexural resistance
- Loading and stresses associated with:
    - Operating pressures
    - Weather induced loads such as depth of winter frost penetration and frost action
    - Traffic loads
    - Construction impacts
    - Block supports
    - Settlement
    - Undermining
    - Washouts
    - Direct impact

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[2] A number of studies of cast-iron and factors affecting their service life have been made. A number of these studies and evaluations were made by ZEI, Inc. (formerly Zinder Eng Inc) Ann Arbor Michigan, including articles written; see Gas Industries, February 1986. The Department referred to this report in its February 28, 1991 Order concerning its investigation into proposed rules for cast iron.

Under research contracts with Cornell University that started in the early 1980's, the former Brooklyn Union (now part of National Grid) and other NY Gas Group companies sponsored research that has developed a library of technical papers on CI main condition, performance and evaluation. National Grid's Cast Iron related policies are informed by those studies, the most recent of which was prepared in 2008. National Grid's New York City Cast Iron system (the former Brooklyn Union Gas - which accounts for nearly 30% of all the Cast Iron in National Grid) dates from before 1895 through approximately 1950. After approximately 1930, centrifugally cast pipe predominates over pit-cast cast iron. Pit cast pipe was less uniform than later pipe, though out-of-spec wall thickness is rare. French cast iron piping of approximately WWI vintage has been reported to be overly brittle. Centrifugally cast pipe is theoretically more prone to stress crack corrosion according to UK studies, but that has not been recognized on the New York City system.

6.2.2.1 Cast Iron Graphitization

NACE[3], in its Introduction to Corrosion Basics, 1984, pg. 216, states that the corrosion rate of cast iron is comparable to that of steel in a soil. The iron is removed from the metal, leaving a network of carbon particles by the de-alloying phenomenon termed graphitization. The residual carbon retains the form of the pipe, and unless the weakened pipe is fractured, the graphitized pipe will continue to transport gas. Once the cast-iron is graphitized, the exterior becomes an extremely noble electrode in any galvanic couple. Thus uncoated or unprotected cast-iron or steel will act as the anode in contact with this "noble" pipe.

It should be noted that graphitization is still relatively infrequent within National Grid and only included here to demonstrate the Company's knowledge base. Experience shows that the soils in New York City and Long Island are the most benign with respect to graphitization. Upstate and New England soils appear to be somewhat more aggressive, though there does not appear to be much of a difference in the resulting frequency of graphitization.

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[3] National Association of Corrosion Engineers.

Graphitization occurs when cast iron is exposed to certain types of corrosive environments over time. The resultant graphitization causes the beam strength to weaken and the pipe to become brittle and contributes to rates of broken mains. In its 1971-72 study of cast iron, the New York Gas Operations Advisory Committee report stated that its experience indicated graphitization was limited to certain specific localized environments. These were areas where there were localized salt water exposures or extreme stray current discharges (such as at substations and electrified rail transit systems).

Cast iron contains carbon, in the form of graphite, in its molecular structure. It is composed of a crystalline structure as are all metals (i.e., it is a heterogeneous mass of crystals of its major elements iron, manganese, carbon, sulfur and silicon). In the presence of acid rain and/or seawater, the stable graphite crystals remain in place, but the less stable iron becomes converted to insoluble iron oxide (rust). The result is that the cast iron piece retains its shape and appearance but becomes weaker mechanically because of the loss of iron.

Graphitization is not a common problem. It generally will occur only after bare metal is left exposed for extended periods, or where joints allow the penetration of acidic rainwater to internal surfaces. Therefore there is a time dependency for graphitization to occur, and excluding other factors, the expectation would be that older pipes will have experienced deeper graphitic penetration and disintegration. Soil moisture is normally enough to provide a conducting solution. This corrosion process is galvanic, with the carbon present acting as the noblest (least corrosive) element and the iron acting as the least noble (most corrosive) element. The composition or microstructure of the iron affects the durability of the object because the rate of corrosion is dependent upon the amount and structure of the graphite present in the iron.

Graphitic corrosion or graphitization[4] is a form of de-alloying or parting caused by selective dissolution of iron from cast iron (usually gray cast iron). It precedes uniformly inward from the surface, leaving a porous matrix of the remaining alloying element, carbon. Graphitization

[4] NACE defines graphitic corrosion in its Introduction to Corrosion Basics 1984, at page 107.

occurs in salt water, acidic mine water, dilute acids, and soils, especially those containing sulfates and sulfate reducing bacteria. There is no outward appearance of damage, but the affected metal loses weight, and becomes porous and brittle. The porous residue may retain appreciable tensile strength and have moderate resistance to erosion. For example, a completely buried cast-iron pipe may hold gas under pressure until jarred by a worker's shovel. Sulfates and sulfate-reducing bacteria in soil stimulate this form of attack.

6.2.2.2 Cast Iron Pipe Support

A number of methods were used to install cast iron pipe sections. The most common method involved support of individual lengths of pipe with wooden or concrete blocks near each end. The blocks served to both support the main during construction and slope the pipe for proper drainage of manufactured gas liquids. Some installations included support near the center, placing pipe on mounds of earth instead of blocks, and still others directly on the trench bottom. Placing pipe on the trench bottom actually provides the greatest life expectancy as it minimized unsupported lengths of pipe, increased ability to withstand superimposed loads, and reduced beam action. Installation on wooden blocks has been seen to cause increased instances of graphitization at the point of contact between the cast iron and wood. There are no records indicating the method of installation; though at times, it can be inferred from the condition of the pipe. Block supports may also be detrimental when they cause pipe sections to behave as beams. All of these factors result in regionally higher break rates, which are used for identifying system replacement.

6.2.2.3 Cast Iron Pipe Size – Diameter and Flexural Resistance

Cast iron is more brittle and relatively weak as compared to steel. Sections of cast iron pipe supported at their ends on blocks experience loading and act as a beam. Flexural stress is created by the weight of the soil overburden, by the weight of the pipe itself, and by forces such as frost heave and other loads. Results of one study[5] to identify those main sizes that experience the

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[5] 2007 Final Report on Peoples Gas Light and Coke Cast Iron Main Replacement – Kiefner and Associates, Inc.

highest failure rates revealed that 4", 6" and 8" diameter pipe accounted for 90% of the incidences of breaking and cracking. Said another way, the beam strength is much less for smaller diameters of cast iron pipe than for larger diameter pipe. There is an increase in relative beam strength for cast iron pipe with diameters equal to or greater than 10", providing some higher relative safety. In its system integrity analyses, National Grid regularly tracks the cast iron breakage "rates" on all of its systems and has found similar results.

While National Grid has not experienced extensive cast iron graphitization, it should be noted that cast iron pipe was installed bare and cannot be adequately protected by cathodic protection. Graphitization reduces wall thickness and thus reduces flexural resistance. An evaluation of flexural resistance (which is directly related to the "section modulus"[6]) demonstrates that a wall loss of 0.2 inch will result in a change in the relative section modulus of 4" through 8" diameter cast iron of between 52% and 45%. This reduced flexural resistance demonstrates that the smaller size pipes are far more susceptible to breakage than the larger size pipes.

Research performed by Cornell University identified 2000 micro strain as a critical level for cast iron pipe. For the purposes of replacement decisions related to parallel trench construction, 600-800 micro strain (0.06-0.08%) was selected as the replacement criteria. The condition of the cast iron pipe tested supported those levels as a proper margin of safety, which has been proven out by field experience under New York State PSC waiver and Massachusetts regulation.

When cast-iron main was originally installed as low pressure piping, its bell and spigot joints were filled with compacted jute backing and sealed with molten lead and lead caulking or cement. After years of service and switching from wet manufactured gas to natural gas, the jute has dried out and reduced in volume, weakening the seal within the joint. Additionally, exterior loads impact and flex the pipe and disturbing the seal. Loads adversely impacting cast iron mains result from traffic, seasonal weather, vibration and soil movements due to nearby construction activities; causing these joints to leak. Cornell observed that depending upon the diameter of the pipe, the joint contributed more or less to the flexibility of the pipe. Lead and jute joints were

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[6] Section Modulus is a function of outside diameter, inside diameter, and wall thickness.

found to flex more than cement jointed pipe, which is common on Staten Island in New York City. Lead joints were also seen to leak when flexed, and later creep and seal again in low pressure applications.

6.2.2.4 Cast Iron Bell Joints

Cast Iron and Ductile Iron gas mains are constructed with bell and spigot joints. These joints were most often sealed with jute and lead, cement, or encased in concrete in order to make the joint leak free and rigid. In many cases, bell joints have been retrofitted with mechanical bell joint clamps or bell joint encapsulation as a means of addressing bell joint leaks. In the New York City operating area (formerly Brooklyn Union), all joints on cast iron pipe operating at a 15 psig MAOP have been sealed with mechanical clamps or elastomers. A majority of the low pressure joints are sealed as well.

National Grid has used a number of methods to seal cast iron joints in past years. These methods fall into five broad categories and are listed below:

- Metallic Joint Clamps – A two-part clamp secured by bolts and designed to force a steel ring over the bell and spigot joint. Pressure from a rubber gasket presses on the circumferential lead face of the bell joint. One problem caused by this method of repair is that the steel clamp can become anodic to the cast iron, resulting in corrosion.
- Shrink Sleeves – Rubber/plastic materials used have varied as have the shrinking methods (electrical or thermal). A sleeve is fitted over a cleaned bell and spigot joint as well as a short section of pipe beyond the joint. The material is then essentially shrink fit to seal the joint. Extensive cleaning of the joint area is required and if performed incorrectly it can cause these to fail over time.
- Anaerobic Seals - These have had the advantage of exposing only the top part of the joint. A hole is drilled into the bell and an anaerobic sealant injected into the jute backing. The sealant material wicks into the jute and joint surfaces sealing the joint.
- Encapsulants - Also commonly called boots or muffs, encapsulate the face of the joint. This method is more effective than shrink sleeves and not subject to corrosion or gasket failure as is common with metallic clamps, nor are they as susceptible to improper installation.

- Internal sealing methods - There have been a few approaches used over the years, including internal clamping of the joint, fogging of the main, spraying the inside of the joint with an atomized sealer, mechanically applying a sealant of the joint and the internal pipe surface from within the pipe as well as pipe lining with a type of "innertube".

Metallic Joint Clamps and Shrink Sleeves are no longer used, though metallic clamps that were properly coated are often found to be in good condition. Anaerobic seals are often selected when a large excavation is undesirable, exposing the entire joint is difficult or impossible, or in high water tables where it is difficult or disruptive to effectively encapsulate the joint. The current internal sealing method used is known as "CISBOT" and it has diameter, length and other limitations. Internal Lining is an expensive process, but adds other benefits. The best application for internal liners is on stretches of main without tie-ins or large numbers of services. Encapsulating bell joints is generally the most effective of the methods and the most commonly used. Many thousands of cast-iron joints are sealed every year in response to leaks. While this creates a high cost of operating and maintaining this class of asset material, leaking joints have rarely led to incidents.

6.2.2.5 Cast Iron Loading and Impact

Cast-iron is much more brittle than steel and is susceptible to cracks or breaks due to loading and impact. Main breaks are a major concern due to the large amount of gas that may be released in such instances. This is made worse when the driving force behind the cast-iron main leak is the operating pressure. Medium or high pressure cast iron aggravates the safety threat posed by cast-iron mains.

Cast iron breaks are often more severe than the typical corrosion leak. A cracked main may leak at a high rate, quickly saturating the area around the break with natural gas, migrating and entering conduits and following the path of other utilities to homes or other confined spaces such as utility vaults and sewers. Cast iron main breaks are of particular concern during periods of cold temperatures when frost actions may cause additional stresses on these mains and when frost caps create an impermeable barrier of the earth's surface, preventing leaking gas from safely venting to the atmosphere. Such leaks may be difficult to pinpoint as they can cause high gas readings at appreciable distances from the actual leak site. The difficulty of leak investigation is aggravated under frost conditions and with depth of frost penetration. The inability of the gas to safely escape increases the risk to near-by residents, as gas follows the path of least resistance, often to nearby habitable structures.

The inventory of small diameter cast iron in National Grid's service territory varies. Small diameter cast iron (8" and less) is most susceptible to bending stress and impact. National Grid policies define the replacement criteria for sound cast iron adjacent to parallel trenches or exposed due to crossing excavations. Additional consideration is given to conditions such as system performance and removal of pavement over shallow cast iron mains during road reconstruction.

6.2.3 Plastic Pipe

Plastic pipe has a more recent but yet almost 50 year history. Various plastic piping materials were developed and introduced into the gas industry in the late 1960's and early 1970's. The industry became more focused on the corrosion and performance concerns with unprotected piping following the 1968 "National Gas Pipeline Safety Act". This required Federal regulations on Gas Transmission & Distribution systems in the U.S. and placed them under the jurisdiction of the Department of Transportation. Table 6-2 below is a summary of the plastic pipe materials that have been manufactured and marketed to the gas industry with a notation as to whether or not they are known to exist on the National Grid system.

Table 6-2 Plastic Pipe Material Summary

Plastic Material Type	Known to Exist in the National Grid Gas System?
PVC – Polyvinyl Chloride	No
ABS – Acrylonitrile Butadiene Styrene	No
CAB – Cellulose Acetate Butyrate*	No
PB – Polybutylene**	Yes
PP – Polypropylene	No
PA – Polyamide	No
Century MDPE 2306	No
Aldyl-A (1972 and Prior) PE 2306	Yes
Aldyl-A (Post 1972) PE 2306	Yes
Aldyl-A (1973 and After) PE 2406	Yes
Aldyl 4A (green) PE 2306	Yes
MDPE 2406	Yes
MDPE 2708	Yes
HDPE 3306	Yes
HDPE 3406	Yes
HDPE 3308	No
HDPE 3408	Yes
HDPE 4710	Yes

* A limited number of 1-inch clear CAB services were installed in Upstate New York but have been reported to have been removed.
** Rhode Island only
NOTE: Fiberglass main was once used in MA, but has been completely removed to the best of our knowledge.

Table 6-3 below provides a summary of the currently approved plastic material types.

Table 6-3 Currently Approved Plastic Pipe Material Summary

Current Approved Plastic Material Type	Region(s)
PE 2708/PE 2406	NYC/LI
PE 4710	LI
PE 4710	UNY
PE 4710	RI
PE 2708/PE 2406	MA
PE 4710	MA

Details for plastic pipe by Company, Material designation, description, and Region are provided below in Table 6-4.Table 6-4 Summary of Plastic Pipe by Region

Common Name	Company	Material Designation	Physical Description	Region(s)
Aldyl A*	Dupont Pipe	PE 2306 (pre-1973)	Pink, but can turn grey	LI, MA, NYC*, RI, UNY
Aldyl A*	Dupont Pipe	PE 2306 (1973 & later)	Pink, but can turn grey	LI, MA
Aldyl A*	Dupont Pipe	PE 2406 (1973 & later)	Pink, but can turn grey	LI, MA, NYC*, RI
Aldyl 4A	Dupont Pipe	PE 2306	Green	LI
CAB (Cellulose Acetate Butyrate)	Unknown	Unknown	Clear tubing	UNY***
Polybutylene	Clow Corp.	(1976 – 1979)	Tan	RI
Red Thread	Inner-tite	Epoxy-Fiberglass	Orange/red	NYC****, UNY
Inner-tite	Inner-tite	PE3306	Glossy Black	NYC,LI
Barrett	Barrett	PE3306	Glossy Black	NYC,LI
Orangeburgh	Orangeburgh	PE3306	Glossy Black	NYC,LI
Allied	Allied	PE3306	Glossy Black	NYC
Celanese Ultrablue	Celanese	PE 3306	Glossy Black	NYC
Crestline HD	Crestline	PE 3306	Glossy Black	UNY
Dupont HD	Dupont	PE 3406	Dull Solid Black	NYC**
Drisco 6500	Phillips Driscopipe	PE 2406	Orange	LI,MA,UNY
Drisco 6500	Phillips Driscopipe	PE 2406	Yellow	LI,MA,UNY
Driscoplex 6500	Performance Pipe	PE 2406/PE 2708	Yellow	LI,MA, RI
Drisco 7000	Driscopipe / Phillips	PE 3406	Solid Black	NYC, RI, UNY
Drisco 8000	Driscopipe / Phillips	PE3406/PE3408	Solid Black	NYC, MA,RI, UNY
Plexco	Plexco Pipe	PE2306	Orange	RI
Plexco	Plexco Pipe	PE2406	Orange	LI,MA
Plexco	Plexco Pipe	PE 2406	Yellow	LI,MA,RI
Plexco Yellowstripe	Plexco Pipe	PE 3406/3408	Black pipe with 4 yellow stripes	LI, MA, NYC,RI, UNY
Plexco Plexstripe II	Plexco Pipe	PE 3408	Black pipe with 2yellow stripes	UNY
CSR Polypipe 4810	CSR Poly	PE 3408	Black pipe with 6 yellow stripes	UNY
Extron TR 418	Extron	PE 2306	Orange	UNY
Drisco/Performance	Driscopipe /	PE 3408	Black with 3	LI, NYC, UNY, RI

Pipe 6800	Phillips		yellow stripes	
Drisco/Performance Pipe 8100	Driscopipe / Phillips	PE 3408/4710	Yellow exterior black pipe	NYC, RI, UNY
Performance Pipe 8300	Performance Pipe	PE 3408/4710	Black with 4 yellow stripes	LI, RI, UNY
US Poly UAC 3600 (formerly DuPont)	US Poly	PE 3408/ PE 3710	Black with 3 yellow stripes	LI, MA, NYC, RI, UNY,
US Poly UAC 3700 (formerly DuPont)	US Poly	PE 3408/4710	Black with 3 yellow stripes	LI, MA, NYC, RI, UNY,
JM Eagle UAC 3700 (formerly US Poly)	JM Eagle	PE3408/PE4710	Black with yellow stripes	LI, MA, NYC**, RI, UNY
UPONOR UAC 2000	DuPont	PE 2406	Yellow	LI, MA, NYC**, UNY
US Poly UAC 2000 -Formerly UPONOR	US Poly	PE 2406/PE 2708	Yellow	LI, MA, NYC, UNY
JM Eagle UAC 2000 (formerly US Poly)	JM Eagle	PE 2406/PE 2708	Yellow	LI, MA, NYC, UNY
Charter Plastics Inc	Charter Plastics Inc	PE 2406/PE 2708	Yellow	LI, MA, NYC
Charter Plastics Inc	Charter Plastics Inc	PE 3408/ PE 3608/ PE 4710	Black with 3 Yellow stripes	LI, MA, NYC, RI, UNY
Endot Bi-modal MDPE	Endot	PE 2406/PE 2708	Yellow	LI, MA, NYC,
Endot	Endot	PE 3408/ PE 4710	Black with 3 Yellow stripes	LI, MA, NYC, RI, UNY

* A very limited amount of Aldyl A exists due to a trial installation in New York City.
** limited to Staten Island
*** A limited number of 1-inch clear CAB services were installed in Upstate New York but have been reported to have been removed
**** Limited to Greenpoint Area Only - RETIRED

6.2.4 Copper Piping

Copper pipe was used for gas service lines in many service territories throughout the United States. Within National Grid's service territory, copper was predominantly used for service renewal by inserting copper inside of deteriorated steel services. In a much more limited manner, copper services were occasionally direct buried.

Copper services may be subject to leakage caused by corrosion. In particular, direct buried copper services may be subject to advanced rates of corrosion in the presence of dissolved salts in the soil (e.g., deicing salts to melt ice and snow on road surfaces).

Copper tubing is far less of a corrosion risk than steel. National Grid's corrosion experience with 130,846 copper services indicates that approximately 1% of all corrosion leaks are associated with copper. When inserted in older steel services, the steel provides corrosion protection since the steel is more anodic than the copper. The older steel also protects the copper pipe from excavation, natural forces, and other damage. Corrosion on National Grid's copper services has been limited to locations where it was connected to dissimilar metal without insulating joints to provide isolation between the two dissimilar metals. The dissimilar metal is anodic to the copper and corrodes. The most common situation for this exists where copper is joined to an iron or bronze service tee (the iron tees are the most susceptible). Records of where and when these dissimilar metals were installed do not exist.

6.2.5 Instrumentation & Regulating Facilities

The Instrumentation & regulating assets family includes regulating stations, transfer stations, heaters, control lines and all ancillary equipment. National Grid has over 1,800 instrumentation & regulating facilities within its service territory. Over the years there have been various designs, manufacturers and styles of stations. These include single stage with relief, double stage with either a working or open monitor. In addition, they may be above grade, below grade, in the same vault, or in separate vaults. Stations may have one single run or multiple runs. Each station is specifically designed for the upstream and downstream pressures and the intended capacity.

The regulating facilities have been designed for continuity of supply and peak performance during normal and critical gas demand periods. They have been designed for specific load and pressure requirements. The following design philosophy has been utilized:

- Stations are designed using corporate engineering guidelines for flow capacity and pressure control with consideration given to other factors such as the required footprint, security, noise, operation, maintenance, community impact and the potential for third-party damage.
- Stations are designed in accordance with applicable state and federal codes to help ensure safe and continuous supply of natural gas to our customers and the community we serve.

During the annual performance test, any minor maintenance issues are corrected. Any major repairs requiring parts replacement and calibrations are rescheduled. By the time all work is completed and the station is ready for the next season, the operating condition of that particular regulating station will be back to 100%.

A good asset management program consists of systematic and coordinated activities and practices through which National Grid optimally manages its assets, performance, risks and expenditure. The evaluation process will identify two key questions, what we expect the asset to do and what are we actually doing to maintain it.

National Grid is committed to managing and investing in our system to protect the future of our business. This is done through proactively managing existing and future risks as well as contributing to the economic growth of the region in which we operate through the provision of safe, high quality and dependable services.

National Grid achieved PAS-55 accreditation on February 11, 2009. The PAS-55 asset management certification program has been designed to enable organizations to demonstrate, by a certification process, that its asset management program is robust. It indicates to stakeholders and investors that the organization has a method of protecting and maximizing benefits from its assets and investment. National Grid's certification was valid through February 28, 2012 and may be refreshed in the future at the discretion of senior management.

6.2.6 *Construction Methods*

The existing National Grid system is one of the oldest in the country and various methods of construction may have been utilized from time to time. Table 6-5 summarizes the types of construction Practices that have been used or practiced within the company's service territory.

Table 6-5 Construction Practices Summary

Construction Practice	Comment
Open trench installation	Yes
Support and Blocking	Yes
Service Replacement via insertion of Copper	Yes
Replacement of mains and services via Insertion of Plastic	Yes
Main Replacement via insertion and pipe splitting via PIM (Pipe Insertion Method)	Yes
Main Replacement via insertion and pipe splitting (static pipe bursting)	Yes
Internal lining / swage-lining / roll-down	Yes
Joint Trench with other utilities	Yes
Unguided Bore (e.g. Hole Hog)	Yes
Guided Directional Bore / Drill	Yes
Blasting	Yes
Plow-in	Yes

6.2.7 *Excess Flow Valves*

National Grid has implemented the recent Pipeline and Hazardous Materials Safety Administration (PHMSA) requirement of 49 CFR 192.381 Service Lines: Excess Flow Valve Performance Standards, and 192.383 Excess Flow Valve Installations. National Grid has been installing excess flow valves for new and replacement high pressure residential service lines in all areas since the early 1990's and since the late 1970's in NYC.

Ball type EFVs installed in the 1970's has been found to be unreliable, but there have not been issues with the spring & plunger type. National Grid uses EFVs of various capacities, including branch service lines serving single family residence, multifamily residence, small businesses where they are compatible with load patterns and volumes. Refer to Table 6-7 for additional information.

Notifications to customers of their right to request installation of an EFV on service lines that are not being newly installed or replaced have been made through the Company's website[1].

National Grid is in the process of developing a tracking and maintenance program for new or replaced service valves as required by 49 CFR 192.385 Manual Service Line Shut-off Valve Installation requirements.

6.2.8 Mechanical Fittings

A summary of the known mechanical fittings currently in service is detailed below in Table 6-6.

Table 6-6 Mechanical Fittings

Mechanical Fitting Manufacturer	Type	Region
Perfection	Stab Fitting	All
Lyco	Stab Fitting	LI, RI
AMP Fittings	Stab Fitting	All
Reynolds	Nut-Follower	RI
ContinentalFittings	Stab Fitting	MA
Chicago Fittings	Nut-Follower	MA
ContinentalFittings	Nut-Follower	MA
Mueller w/ Dresser End	Nut-Follower	All
Normac	Nut-Follower	All
Dresser	Nut-Follower	All
Dresser	Bolted	All
Eastern	Bolted	All
Plidco	Bolted	LI, NYC, MA
Mueller	Bolted	All
Smith Blair	Bolted	All
CSI	Bolted	All
Dresser Posi-Hold	Hydraulic	All

6.3 Characteristics of Design, Operations and Environmental Factors

The characteristics of the pipeline's design, operations and environmental factors that are necessary to assess the applicable threats and risks are summarized in the following sections as well as Appendix A.

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[1] *https://www.nationalgridus.com/MA-Gas-Business/Natural-Gas-Safety/Pipeline-Safety*

6.3.1 Operating Pressures and Gas Quality

The National Grid gas distribution pipeline system operates at various pressures from low to high throughout its service territory. Sources of gas include LNG and gas produced from natural underground reservoirs. Gas Quality is monitored and managed via National Grid's Transmission Integrity Management Program.

6.3.2 Reportable/Significant Gas Incidents

Detailed summaries of recent DOT reportable gas incidents are provided in Appendix A, Section-1 and were given the highest influence in the risk evaluation and prioritization. Table A-1 summarizes incidents by year for the past 30 years – with consequences. Table A-2 summarizes incidents by year for the past 30 years – by cause. Additionally, details of last 10 years reportable incidents are provided in Table A-3 and the asset-threat combinations of all integrity-related incidents in that table were given a superseding influence in the risk ranking and prioritizations for that region.

6.3.3 Gas Distribution Inventory and Repair Data

National Grid's Distribution Engineering Department is responsible for the development and implementation of Integrity Management Programs for Gas Transmission & Distribution facilities pipelines. The department compiles and analyzes system and operating data, files annual reports to the Department of Transportation (DOT) and State regulators, generates periodic bulletins, and prepares various Integrity Reports and Analyses. System performance, analysis, risk, threats, asset management, replacement strategies and rate case support are all performed. The former Brooklyn Union committed to continuing to perform these sorts of analyses in an MOU issued to the New York State PSC in 1989 (although they were already a well-established routine by that time). These engineering and operational activities require knowledge of the system inventory, age, annual performance as well as performance trends over time.

A complete system inventory by material and size as well as leak repair data by cause is updated annually and submitted on the Annual DOT reports. Copies of the reports are available on the Distribution Engineering web page along with comparisons reports for each region over time.

Annual DOT reports are publicly available on PHMSA's website. National Grid Operator IDs are provided in Section 1.0.

6.3.4 *Environmental Factors*

National Grid operates gas distribution piping in some of the most populated regions of the country and where extremes of all four seasons are experienced. As such, all these factors are considered in the design, operation and maintenance of the gas system. As previously noted in this section (Knowledge of Facilities) there are many different policies, piping materials and construction methods utilized. National Grid utilizes, where appropriate, the characteristics of the distribution system, design, operating, environmental, performance and physical testing and inspections to assess the applicable threats and risk to its gas distribution assets. The actual performance, testing and observed condition of the asset is directly related to the environmental conditions encountered. Other attributes that are considered in the risk can include asset class (main, service or I&R facility), material, size, pressure, construction method, or meter location (sub-classes). Environmental factors that have been considered in threat identification (see Appendix B) include seismic activity, earth movement, frost heave, heat sources, and flooding. Population density and other location-specific conditions are considered in National Grid's secondary, more detailed, risk ranking efforts at the segment level via the estimate of potential human exposure (in the building types and usage), following the preliminary assessment by asset class and subclass (region). National Grid's leak survey and surveillance practices take into account environmental factors such as susceptibility to leak migration (wall-to-wall paving or seasonal frost cap) and proximity to buildings of public assembly. Valves are located in a variety of environments, including areas of paved streets. Valves are operated and maintained in accordance with Policy CNST04009.

6.3.5 *Gas Distribution Mains and Services Assets Analysis*

National Grid gas distribution system was constructed with the materials and methods described above over more than a century. The company reduces risk and threats by replacing the riskiest leak prone piping where appropriate and through prudent operating and maintenance that includes a number of Preventative and Mitigative policies as noted in Table 6-1.

The National Grid annual System Integrity Report is incorporated by reference into the DIM Plan and typically provides the following:

- Overall Regional Distribution Integrity Assessment Summary
- Total Leak Receipts – Current Year and Previous 5 Years
- Leak Receipts as a Function of Total System Pipe Mileage – Current Year
- Leak Receipts by Discovery Source (Excluding Damages) - Current Year and Previous 5 Years
- Leak Receipts by Original Classification (Excluding Damages) - Current Year and Previous 5 Years
- Year-End Workable (excludes Type 3) Leak Backlogs - Current Year and Previous 5 Years
- Year-End Open Type 3 Leak Inventories - Current Year and Previous 5 Years
- Performance Measure (Workable Backlog / Miles of System Pipe) - Current Year and Previous 5 Years
- Performance Measure (Type 3 Inventory / Mile of System Pipe) - Current Year and Previous 5 Years
- Main Inventory by regional Company- Current Year and Previous 5 Years
- Main age analysis by region - Current Year and Previous 5 Years
- Leak-prone pipe and Main replacement program - Current Year and Previous 5 Years
- Percentage of Leak-Prone Pipe - Current Year and Previous 5 Years
- Rate Case Supported Leak-Prone Main Replacement Levels
- Total Main Leak Repairs (Including Damages) - Current Year and Previous 5 Years
- Total Main Inventory by Material vs. Total Main Leak Repairs (incl. damages) by Material – Current Year
- All Main Leak Repairs by Material (Excluding Damages) - Current Year and Previous 5 Years
- All Main Leak Repairs (Including Damages) by Cause – Current Year
- Total Main Leak Rates (repairs per total mile of main) Including Damages - Current Year and Previous 5 Years
- Total Main Leak Rates (repairs per mile of total main) Including Damages - Current Year
- Main Leak Rates (Excluding Damages) by Material - Current Year and Previous 5 Years
- Current Year Main Leak Rates (Excluding Damages) – All Region Comparison by Material
- Main Leak Repairs – Material-Cause Matrix – Current Year
- 10-Year Cast Iron Main Inventory and Attrition Rate – All Region Comparison
- Total Cast Iron Main Breaks - Current Year and Previous 5 Years
- Cast Iron Main Break Rates – All Region Comparison by Diameter – Current Year
- 10-Year Bare/Unprotected Steel Main Inventory and Attrition Rate– All Region Comparison
- Main Corrosion Leak Rates - Current Year and Previous 5 Years
- Service Inventory by regional Company- Current Year and Previous 5 Years
- Total Service Leak Repairs (Including Damages) - Current Year and Previous 5 Years
- Total Service Inventory by Material vs. Total Service Leak Repairs by Material – Current Year
- All Service Leak Repairs (Excluding Damages) by Material - Current Year and Previous 5 Years

- All Service Leak Repairs (Including Damages) by Cause – Current Year
- Total Service Leak Rates (Including Damages) - Current Year and Previous 5 Years
- Total Service Leak Rates (Excluding Damages) by Material - Current Year and Previous 5 Years
- All Region Service Leak Rates (Excluding Damages) Comparison by Material – Current Year
- Service Leak Repairs Material-Cause Matrix – Current Year
- Distribution DOT Report data Comparisons – Current Year & Previous Year.
- System Integrity Report Analysis (Findings and Explanations)

The company has developed a procedure for selecting main segments for replacement. ENG04030: Identification, Evaluation, and Prioritization of Distribution Main Segments for Replacement. This procedure details the attributes that are considered and utilized and they include but are not limited to Design, Operations and Environmental factors.

National Grid Damage Prevention metrics are also incorporated by reference into the DIM Plan and provide the following:

- Total Damages per 1000 Tickets
- Excavator Error Damages per 1000 Tickets
- Damages due to No-Calls per 1000 Tickets
- Damages due to Mismarks per 1000 Tickets
- Damages due to Company & Company Contractors per 1000 Tickets

(Note that "tickets" refers to all "one-call" requests, and not actual mark outs performed)

6.3.6 Gas Distribution Instrumentation & Regulation (I&R) Facilities Asset Analysis

As previously noted above, I&R facilities are inspected annually and immediate or scheduled repairs are made to ensure continued operation. Observed conditions are noted and used to assess and risk rank the facilities. The risk ranking methodology is viewed as a high level assessment that goes beyond the annual PT to capture overall residual risks. The assessment process guides and validates the organization's activities.

The I&R risk ranking method consists of four primary factors: impact to the Company, effectiveness of technical controls, effectiveness of location specific controls, and the likelihood of an asset failure. These factors are weighted, averaged, and multiplied to make up the risk score. This risk score is utilized to risk rank and capture the overall condition of the station and compare it to the other stations.

The company has several programs related to integrity of I&R facilities:

- Reactive program – for operations to handle immediate parts & equipment changes
- Proactive Station Program - for planned station upgrades / replacements based on assessment, risk and threats
- Proactive Heater Program - for planned heater upgrades / replacements based on assessment, risk and threats
- Proactive Control Line Program - for planned control line upgrades / replacements based on assessment, risk and threats

Inspection data is collected and stored locally within operations and some regions have migrated to electronic data collection and storage. The risk ranking data is stored electronically and maintained by Pressure Regulating Engineering.

6.4 Additional Data Needed

Additional information needed that will be obtained over time through normal activities conducted on the pipeline is described in Table 6-7.

Table 6-7 Additional Information

Area of incomplete records or Knowledge	Can it be acquired over time through normal activities?	Does Action Plan Exist? Y/N	Scope	Schedule	Responsible Departments
Estimate number of EFVs • In system at CY end • Installed during the year on residential services only	Yes	Yes	• Interim - Estimate annual based on usage and totals calculations based on other available / reasonable data • Long term - through Electronic Reporting and GIS	• Interim for annual 2010 – 2018 DOT reporting estimates • Long term 3-5 years	• Distribution Engineering
Above grade hazardous leak repair data on services	Yes	Yes	Not previously included in DOT reporting. These leaks now need to be reported per latest OPS ruling	• Completed (2017 Annual DOT reporting)	• Distribution Engineering
Above grade leak repair data on I&R facilities	Yes	Yes	Not previously included in DOT reporting unless leak tickets and leak numbers are generated. These leaks now need to be reported per latest OPS ruling	• Completed (2017 Annual DOT reporting)	• Distribution Engineering
Leak repair data on Mechanical fittings	Yes	Yes	• Interim - Issued forms and bulletins • Long Term- Electronic Reporting	• Interim – Regulatory & Technical Bulletins issued 12/12/2010 • Long Term – 3-5 years	• Distribution Engineering
Incorrect or Incomplete Facilities Records – Maps and	Yes	Yes	• Employees may submit corrections to the AMMS system via Field Data Capture unit or the Maps &	• Continuous	• Maps and Records

Scanned Records – MA			Records Data Correction Form. • Appropriate changes are made in ArcFM & SPIPE. Sketches are added to the Scanned Records system		
Incorrect or Incomplete Facilities Records – Maps and Scanned Records – LI and NYC	Yes	Yes	• Employees may submit change requests through the Feedback tool in NRG. • Appropriate changes are made in NRG and Fortis. Sketches are added to the Fortis system.	• Continuous	• Maps and Records
Incorrect or Incomplete Facilities Records – Maps and Scanned Records – UPSTATE NY	Yes	Yes	• Employees may submit a corrected service card or GFDR. • Appropriate changes are made in Smallworld. Sketches are added to the GasCar system.	• Continuous	• Work Support • Asset Replacement
Incorrect or Incomplete Facilities Records – Maps and Scanned Records – RI	Yes	Yes	• Employees may submit corrections when inconsistencies are found. • Appropriate changes are made in Smallworld. Sketches are added to the Scanned Records system.	• Continuous	• Damage Prevention • Maps and Records

6.5 Data Capture for New Construction

The requirement for data capture for the location where any new pipeline is installed and the material of which it is constructed is contained in various standards as summarized in Table 6-8 below. The legacy procedures that exist are expected to be replaced by an updated enterprise wide procedure over time.

Table 6-8 Data Capture Requirements

STANDARD	NYC	UNY	LI	MA	RI
GEN03002 Processing Gas Main and New Service Work Packages	x	x	x	x	x
CNST06020 Completion and Processing of Gas Service Record Cards	x	x	x	x	x
CNST01005 Preparation of Gas Facility Historical Records	x	x	x	x	x
Construction Documentation Specifications					x

6.6 Knowledge Capture – Subject Matter Experts

In addition to existing enterprise wide data, information, and reporting, National Grid has conducted additional interviews and discussions with process owners and regional groups of Subject Matter Experts (SME's) to determine if there are undocumented risks that could impact system performance. SME's are individuals who have specialized knowledge based on their experience or training. SME's were used to supplement existing, incomplete, or missing records and may be the only or best source of information in subjects such as historical operations, maintenance, and construction practices. SME interviews were also utilized to ensure that all threats have been identified. All SME interviews have been documented and stored in the Distribution Integrity Management Program files.

It should be noted that, due to the extent of National Grid's gas delivery systems over eight (8) legacy companies, SME interviews needed to be limited in order to accomplish implementation of the Plan within the necessary time frame. SMEs were selected based on experience and knowledge of general regions. It was not possible to include operations personnel from all geographic locations in each legacy company. To ensure that all reasonable threats were identified and evaluated, the summary SME data was carefully reviewed after the first issuance of the Plan. If anything was believed to be incorrect by the engineering SME panel or any regulator, that information was corrected in the current revision. Furthermore, after the Plan is audited by regulators in all states, a more detailed rollout will be conducted with Operations and feedback will be solicited and incorporated into a future revision, as appropriate.

7.0 THREAT IDENTIFICATION

The objective of this section of the plan is to identify existing and potential threats to the gas distribution pipeline. *The following categories of threats shall be considered for each gas distribution pipeline:

- Corrosion
- Natural Forces
- Excavation Damage
- Other Outside Force
- Pipe, Weld or Joint Failure
- Equipment Failure
- Incorrect Operation
- Other concerns that could threaten the integrity of the pipeline.

In addition to the above categories established by §192.1007(b), National Grid may collect and assess threats by other additional categories to evaluate the system, trends and risk. National Grid Leak Cause categories and definitions are summarized below.

*Based on new PHMSA OMB No. 2137-0629 instructions, DIMP 2018 was completed for annual DOT reporting for Gas Distribution.

Corrosion

Only to be used when gas is leaking from a hole, crack or porosity in the pipe or other gas-carrying member AND that condition was caused by corrosion (or graphitization for cast iron). [NOTES: Corrosion of valves and couplings (not the pipe) or metallic risers are "Equipment" leaks. Corrosion of metallic CI joint clamps is "Other" leaks.]

Excavation

To be used when the leak is directly caused by current or previous physical damage (impact) that can be attributed to someone. It can be Company personnel, contractors working for the Company or a third party.

Equipment

To be used for leaks caused by malfunction of control/relief equipment (including valves, regulators or other instrumentation); stripped threads or broken pipe, couplings on nipples, valves or mechanical couplings; seal failures on gaskets; O-rings or seal/pump packing; etc. [Corrosion of valves and couplings (not the pipe) or metallic risers are "Equipment" leaks. Failures of previous cast iron joint sealing methods are "Other"leaks]

Pipe, Weld or Joint Failure (All Materials, Including Plastic)

To be used for leaks occurring on faulty material (such as faulty bends, joint due to faulty manufacturing (CI JOINTS ARE NOT PART OF THIS DEFINIATION), faulty field welds/fuses or material damaged in transportation or during installation); on originally sound material that was subjected to dents, gouges, excessive stress, etc.; or for leaks resulting from a defect in pipe material, component, fabrication or faulty weld seams. Do not use this for material that was fine but has deteriorated.

Other

To be used ONLY for leaks that are the result of deterioration (NOT corrosion) such as exceeding the normal service life or any other cause not covered above. USE THIS CAUSE FOR ALL CAST IRON JOINT LEAKS – Including those which re-occurred because a failed joint clamp or seal.

Natural Forces

To be used when the leak is directly caused by undermining, earth movement, lightning, floods, washouts, frost heave, frozen components, etc. It is a damage that was caused by nature rather than by a person. All broken mains that were not damaged by anyone and were not the direct result of corrosion/graphitization should be scored as Natural Forces.

Other Outside Force

To be used only when the leak is directly caused by fire, explosion, or a deliberate/willful act such as vandalism. Damage from vehicle or vessels not engaged in excavation. USE THIS CAUSE FOR ALL ELECTRIC BURN-THROUGHS.

Operations

To be used for a leak caused by operator error, inadequate safety practices/procedures or failure to follow procedures.

7.1 Means of Threat Identification

National Grid's legacy records and employees provide the basis of information regarding the system assets and material. The cause categories noted above are the threats for gas distribution pipelines. The 5 year summary of the annual DOT reports by operator identification is incorporated by reference into this DIM Plan.

In an effort to gain additional information about the gas system and to identify potential unknown threats, Subject Matter Expert (SME) interviews were conducted and are summarized in Appendix B. Subsequent threats shall be identified as they are discovered or identified and reviewed by Integrity Engineering for inclusion in the program.

A review of information gathered for Section 5 shall be conducted periodically to identify existing and potential threats. Threats (including material performance concerns) shall subsequently be identified by personnel who are knowledgeable of the National Grid system, operations and the Distribution Integrity Management Program. This is accomplished through the annual system integrity report that is prepared and issued by Distribution Engineering and is incorporated by reference into the DIM Plan. An annual review of the system performance combined with knowledge of the facilities, design, materials science, engineering, operation and maintenance histories, construction methods, environmental factors and an understanding of reportable/significant gas incidents provides National Grid with a sound indication of the threats to its system.

7.2 Monitoring Potential Threats

Potential Threats include those that are not currently evident based on National Grid gas distribution system failures, leak, or incident data. National Grid routinely monitors information from sources that may include:

- National Transportation and Safety Board (NTSB) Reports and Recommendations applicable to Pipeline Accidents.
    - Reports may be found at: http://www.ntsb.gov/investigations/reports_pipeline.html
    - Recommendation Letters may be found at: http://www.ntsb.gov/recsletters/
- Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) Advisory Bulletins: http://www.phmsa.dot.gov/pipeline/regs/advisory-bulletin
- Membership in a local, regional, or national gas association (e.g. American Gas Association, Northeast Gas Association, NACE, ASME, etc.) and involvement in Association workshops and forums that share knowledge regarding distribution pipeline threats
- Review of trade journals and magazines that publish material regarding gas distribution
- Incident Analysis (IA's) or Near Miss Reviews
- Leak Repair Data
- Mechanical Coupling / Fitting failure reports
- Process Safety Reporting
- All Failure Analysis Reports from the Materials, Standards and Testing Group (MS&T - which includes the Materials Testing Lab) are reviewed by Distribution Engineering and key failure data is entered into a Failure Analysis Database, which is used to identify any potential systemic integrity issues. Whenever an

issue is discovered, even if it is not attributable to any asset subclass in the risk ranking (eg – common substandard conditions, fittings, etc.), appropriate mitigative measures are developed and implemented regionally or organizationally (depending on the nature of the issue). To further enhance the accuracy of the Failure Analysis Database, details of plastic leak data from all regions are scanned quarterly to identify any failures that may not have been sent in for analysis.

For Mechanical Fitting Failures resulting in hazardous leaks, the following requirements have been incorporated into the gas operating procedure GEN01009, Reporting Nonconforming Material:

- Operations and Construction will complete the "Mechanical Fitting Field Failure – US DOT Report" and send it, with the fitting (if removed from service), to MS&T for evaluation.
- Operations and Construction will notify Distribution Engineering immediately if the failure is potentially systemic in nature, requiring immediate follow-up.
- MS&T will review the form, examine the material, perform any necessary testing, notify manufacturers and/or vendors when applicable, issue any necessary technical bulletins, product advisories or reports containing their findings, recommendations and required follow-up actions.
- MS&T will make all necessary filings with the AGA, PPDC and Public Service Commission.
- MS&T will forward the form and report to Distribution Engineering for appropriate filing with PHMSA and advise Distribution Engineering if the investigation deems that immediate or scheduled removal of in-service material is warranted.

- Also under "Reporting Nonconforming Material GEN01009 ", other potential threats (beyond mechanical fitting failures) are reported to and investigated by MS&T and the follow-up is similar.

8.0 EVALUATION AND RANKING OF RISK

8.1 Objective

Risk analysis is an ongoing process of understanding what factors affect the risk posed by threats to the gas distribution system and where they are relatively more important than others. The primary objectives of the evaluation and ranking of gas distribution risk are:

- Consider each applicable current and potential threat
- Consider the likelihood of failure associated with each threat
- Consider the potential consequences of such a failure
- Estimate and rank the risks (i.e. determine the relative importance) posed to the system
- Consider the differences in the relevance of threats in areas among the various regions

For the purposes of risk assessment, National Grid has separated its gas distribution system into two broad (and very different) asset categories; Mains & Services and Instrumentation & Regulation Facilities. Separate models have been developed to estimate and relatively rank the risks for each of the assets (by sub-category). The models are different and completely independent of one another. The models and the results of these models are maintained by Distribution Engineering and Pressure Regulation Engineering and are used to develop National Grid's Asset Management Strategies by State and by Operator ID.

8.2 Mains & Services

For mains and services (with service lines including all equipment upstream of customer-owned piping, with "service line" as defined in Section 5.0), because of their sheer volume and non-homogenous nature, National Grid has elected to divide these assets into "regions" (segments of the system with similar characteristics and reasonably consistent risk for which similar actions would be effective in reducing risk). For purposes of the mains and services model, the "regions" will be the asset subclasses. The asset is first broken into two general facilities – mains or services. Each facility is further broken down by such factors as material (including active/inactive status, pipe coating, and cathodic protection status), inside vs. outside meter set (for services), pressure and diameter (for mains).

Diameters for pipe are classified by the following diameter ranges: up to 4-inch (small fractional wall thickness), over 4-inch and up to 8-inch (nominally ¼-inch wall), and over 8-inch (0.375-inch wall). For iron pipe (cast and wrought), diameters are classified by the following diameter ranges: less than 4-inch (with a higher break rate), 4-inch to 8-inch, and greater than 8-inch (with a lower break rate).

All plastic pipe evaluated in the model is assumed to be Polyethylene. As covered in Section 6.2.3, there may be small quantities of CAB in Upstate NY and PB in RI. To address any potential risk associated with these materials, company policy requires that all integrity-related plastic pipe failures be reported to the MS&T lab for evaluation and monitoring for possible systemic issues.

A relative risk score is calculated for each asset subclass (with the main and service facilities ranked independently) for each of the eight defined threat categories. The risk ranking method for each asset subclass and threat consists of 4 parts: likelihood of failure and release of gas, likelihood of the release resulting in ignition, reduction controls and the potential consequences of such an event.

A separate score is calculated for each asset subclass and threat category. The highest scores (separately for mains and services) are identified for each region and then reviewed by an engineering SME panel in order to validate/adjust the model results. Some asset subclass/threat category scores were removed if the panel concluded that the high scores were the result of known data anomalies. Additionally, some asset subclass/threat categories with lower scores were added if the SME panel felt that the potential risk or exposure was not adequately represented by the calculations. Further, any asset subclass/threat category that experienced a reportable integrity-related incident within the prior ten (10) calendar years had its score changed in its respective region to "Known Incident". (If the asset subclass/threat was not among the top risks listed, it was added to the list with a score of "Known Incident".) All scores labeled "Known Incident" were then accelerated to the top of the risk rankings. The resulting final main and service lists of the highest risks for each region appear in Appendix C. The model and these lists will be updated annually based on the inventory and performance data for the previous calendar year.

It is not possible for National Grid to utilize operating environment factors such as known soil conditions, frost heave susceptibility, depth of cover, potential "other outside force damage" sources, potential "natural force damage" sources, geological conditions, paving, population density, building types, substandard conditions, etc. in its primary risk rankings (beyond the overall asset subclass general susceptibilities to "natural force" and "other outside force" damages); as these are very specific to geographic areas and can vary widely within even a small geographic region. As a result, National Grid's DIM Plan ranks risk by dividing it's mains and services into "regions" with similar characteristics (as previously described), These types of factors, when known, are all considered when evaluating and prioritizing assets for proactive replacement as a mitigative measure. National Grid utilizes a secondary methodology for replacement qualification and prioritization (ENG04030) (see Section 6.3.4) that is risk-based and applied on a segment-by-segment level. Wherever possible, this methodology allows for accounting of environmental and other location-specific factors in the qualification and prioritization algorithms. These algorithms also include a "DIMP Factor" (which is based on the highest risk scores for that region in the DIM Plan) to increase the scoring for those asset subclasses and subsequently accelerate their attrition.

The parts (or "factors") used for risk ranking have been carefully designed to take advantage of known differences in the asset subclasses, extensive experience in failure modes and subsequent events, actual current performance data for the asset subclasses and threat categories, subject matter expert opinion on assets and failures experienced throughout the history of the company, existing system operational procedures, and populations affected by each threat. Some of these factors are variable (and will be updated on an annual basis), while others are relatively fixed. The factors and their components are detailed as follows:

- Likelihood of Failure and Release of Gas – There are two components to this. The first is the actual failure frequency (or leak repair rate) for the most recent calendar year. This is a variable factor that will be updated annually. The second is a rating applied from the results of subject matter expert interviews. This strengthens the likelihood calculation because it accounts for infrequent failures that may not occur on a consistent basis. It also was derived from extensive questioning on not only each threat category, but of all the known sub-threats for each category. This is a comparatively fixed factor.
- Likelihood of the Release Resulting in an Ignition – There are 2 components to this factor as well. The first involves the hazardous nature of all failures. This will be determined by the percentage of all leak discoveries that are Type 1 (hazardous). This varies widely within National Grid's companies. This will be a variable factor and will be updated on an annual basis. The second component will be a failure mode factor, which will be a fixed score assigned based on the most common mode of asset failure.
- Separate failure mode factor scores were identified by an engineering SME panel and will be assigned based on the asset and threat category.
    - Additionally, reduction factors were included to this category for "controls" that are in place to reduce the likelihood of a release resulting in ignition. Extreme care was utilized not to include any controls that would have already been accounted for by the actual failure frequencies (leak rates). There was one control reduction factor applied to select services and one to select mains:
        - SERVICES – A reduction factor was applied to all non-LP services to account for the likelihood reduction due to the presence

of excess flow valves (EFVs). The factor was different for each region, based on the percentage of those services which had been equipped with an EFV.

- MAINS – A set of reduction factors was also applied to all Local Transmission mains. These factors are the same for each region, but vary by threat category. They were applied to account for the fact that these mains were designed and constructed as Transmission mains and are operated, maintained and monitored as Transmission mains as well; thereby reducing the likelihood.

- Potential Consequences – The Health & Safety consequence is given a weight of 60% of the total consequence score, while Customer Interruption is given a weight of 20% and Regulatory & Reputational Impact and Asset Impact consequences are weighted at 10% each.

The data used in the mains & services risk assessment is consistent with the data reported to PHMSA in National Grid's Annual Gas Distribution Reports.

8.3 Instrumentation & Regulation

National Grid utilizes a risk model to evaluate and risk rank the 1,892 Take and Regulating Stations across the service territory. Using data from the annual Performance Test, Cathodic Protection testing, and on-site inspections technical assessments are conducted for each station taking into account pipe and equipment condition, regulator performance, corrosion data, heater, and scrubber performance. This information, combined with the potential customer impact resulting from a station outage, is used to prioritize mitigation. Data to support the risk assessment and ranking was gathered throughout 2017 during routine testing and analysis of that data was used to prioritize the work for the 2018/2019 work plan.

Initial data analysis for each station asset has been completed and will be updated as necessary. An updated listing of the highest risk-ranked facilities is maintained by Pressure Regulation Engineering and is available at all times. This listing is not being physically incorporated into Appendix C of the Plan, as it is very dynamic – changing whenever retirements or replacements occur; but is incorporated by reference in its most updated form.

9.0 IDENTIFICATION AND IMPLEMENTATION OF MEASURES TO ADDRESS RISKS

The objective of this section of the DIM Plan is to describe existing and proposed measures to address the risks that have been evaluated and prioritized in section 7. National Grid has a number of Corporate and Gas Business programs and initiatives to minimize risk to the company, the customers and the public.

9.1 Corporate Culture Philosophy and Programs

National Grid recognizes that the energy it provides is essential to today's society, but that it has inherent risk which cannot be completely eliminated. The risk can however be managed and kept as low as reasonably possible. These programs and initiatives, in most cases, exceed existing gas safety regulations and position National Grid to be a premier energy company. These programs and initiatives include but are not limited to the following:

- *Asset Management* – National Grid has obtained independent asset management certification to Publicly Available Standard 55 (PAS 55). An Audit was conducted by Lloyds Register to certify National Grid's compliance with this standard for managing its gas assets.

- *Damage Prevention* - National Grid follows the nine (9) elements contained within the published PHMSA Damage Prevention Assistance Program (DPAP). The Company has been actively involved in mark outs and damage prevention for over 25 years. National Grid also participates in the Common Ground Alliance DIRT program.

- *Gas Emergency Procedure Manual – A* Gas US manual that includes plans specifically developed to provide for a rapid emergency response. The program is designed to minimize the extent of an emergency.

- *Incident Analysis* – this is the process necessary to ensure that injuries and serious incidents are analyzed thoroughly and promptly to avoid reoccurrence. This is a National Grid Safety Procedure J-1001.

- *Leak Management Program* – National Grid's leak management program (see Table 6-1 for specific procedures) adheres to the following principles:
    - *Locate the leaks (leak response and leak survey)*
    - *Evaluate the actual or potential hazards associated with these leaks*
    - *Act appropriately to mitigate these hazards (including leak surveillance)*
    - *Keep records; and*
    - *Self-assess to determine if additional actions are necessary to keep people and property safe*

- *Material Standards & Testing (MS&T)* - National Grid maintains its own materials lab that tests gas materials for compliance with standards and for suitability for its gas system. The lab also performs root cause analysis of materials failures and investigates issues with materials and tools. Findings often generate changes in manufacturers' products and QA/QC procedures. MS&T's role in investigating mechanical fitting failures and other non-conforming materials is described in Section 6.2.

- *Operator Qualifications (OQ)* – Representatives of The New England Gas Association, the regional trade association for 26 distribution companies operating in the 6 New England states, and the New York Gas Group, a regional trade association for 10 distribution companies operating in the state of New York, formed a consortium in 1999 to develop an operator qualification written plan. Those trade associations merged, and are now the Northeast Gas Association. The National Grid OQ committee has met monthly to ensure the effectiveness of the

OQ program. National Grid participates in meetings with all State Commission Staffs through the Northeast Gas Association's OQ Working Group (offspring of the two organizations mentioned previously).

- *Personnel and Job Site Safety* – This includes a core belief and commitment to Believe in Zero accidents, Employee Safety Handbooks, Trusted to Work Responsibly Documents, the Golden Rules of Safety, and Safe and Unsafe Acts (SUSA) Program.

- *Plastic Pipe Data Collection (PPDC) Initiative* – National Grid participates in the national effort to track plastic material failures and use that information to assess risk on plastic systems.

- *Proactive Main and Service Replacement Programs* – National Grid recognizes that over 29% of the mains and 23% of the services are made up of leak prone materials. Significant replacement plans are in place to reduce the inventory and thus the risk associated with leaks and cast iron breaks.

    - Additionally, ENG04030 has been revised (Revision 2, effective 12/15/2016) to better address systemic issues on vintage plastic pipe, and the extent of replacement under such conditions.

- *Process Safety* – This program is based upon practices of the chemical industry and the Baker Panel investigation of the BP Texas City incident. It seeks to understand and manage the risk of low frequency high consequence events (i.e. fires and explosions). In addition to internal measures and the review of incidents and near misses, events external to the company are also reviewed (e.g., sewer cross-bore incidents, compression coupling failures, etc.). Over 100 Process Safety Key Performance Indicators (KPIs) are tracked and reported to the Board of Directors, covering the following twelve Elements of Process Safety.

- Process Safety Leadership
- Plant design and modifications
- Operational procedures
- Workforce competence
- Human factors
- Emergency arrangements
- Protective devices, instrumentation and alarms
- Inspection and maintenance
- Permit to work
- Asset records and data quality
- Third party activities
- Audit, review and closeout

- *Flooding* – National Grid has begun identifying its vulnerable facilities in flood-prone regions on both 100-year and 500-year flood surge maps, and will consider any appropriate safety and reliability improvements to those facilities.

- *Storm Hardening* – National Grid is currently evaluating various potential storm hardening measures.

- *Process Ownership* - National Grid has established process owners for various safety and management tasks to reduce risk by ensuring that best practices are reviewed and there is consistent reporting and tracking across all territories.

- *QA/QC* – National Grid has a Quality Assurance and Quality Control (QA/QC) group which monitors compliance with all gas regulatory requirements, as well as applicable National Grid construction, maintenance, service and safety policies. This effort involves:

    - Field inspection and assessment of National Grid personnel and contractors who routinely perform gas construction, maintenance and service activities;

- Performing process audits involving Federal and State gas regulations;
- Conducting additional audits for gas related activities on a regional basis, as well as those identified by the PAS 55 Steering Committee for having potential adverse risk to the Company's gas assets;
- Utilize the Six Sigma process methodology to address companywide projects that require a detailed focus for inter related departmental issues;
- Re-Dig program - this program targets post inspection results of completed gas facility installation and repair activities across National Grid's U.S. Gas Operations.

- *System Integrity Reporting* – Distribution Engineering tracks and produces regulatory reports for compliance with annual DOT and State reporting requirements. In addition, various in-depth reports on the system's performance are created to provide trending data. These reports are also used to measure and monitor the performance of existing programs.

- *Corrosion Control* – National Grid has established enterprise wide corrosion control standards, test instructions and policies covering the design, installation, surveys inspections, testing and monitoring of the cathodic protection on its gas system. These provide the preventative and mitigative actions necessary to address the threat of corrosion.

- *Special Patrols* – The local and non-IMP transmission lines are covered under this DIM plan. National Grid has established enterprise wide patrol policy CNST02005, Patrolling Transmission Pipelines. The policy covers the DOT transmission system and local transmission lines.

- The Standards, Policies & Codes area of National Grid's Network Strategy organization has developed a Pipeline Public Awareness (PPA) program as a result of the Pipeline Safety Improvement Act of 2002. The program encompasses all of National Grid's gas transmission and distribution facilities across New York, Massachusetts and Rhode Island. The goal of the program is to educate the general public about pipeline safety, including topics such as:

- How to recognize possible leaks in gas pipelines and what to do if a leak is suspected
- How to contact the pipeline operator in an emergency
- The presence of buried gas pipelines in the communities served
- The necessity to call before excavation – Know What's Below; Call Before you Dig – Call 811
- The significant role the public/excavators can take in helping to prevent third-party damage accidents as well as how they should respond.
- The proper actions emergency response agencies and first responders should take in response to a pipeline emergency
- The means to assess the effectiveness of the communications used by the PPA Program, in order to improve the Program's effectiveness over time.

- The PPA program is managed within the Operations, Codes & Policies area of Network Strategy. There is a Committee that provides oversight to the program made up of:
    - Customer Communications
    - Community & Customer Management
    - Damage Prevention
    - Emergency Planning
    - Gas Work Methods
    - Learning & Development
    - Safety

- The PPA program has four key stakeholders:

    - Affected Public: Residents along a transmission pipeline right-of-way, places of congregation, near gas storage & operational facilities, along gas distribution lines as well as all National Grid customers should be educated on the appropriate actions and precautions to take while living in proximity of gas pipelines. This will in turn create a safer environment and allow for more reliable service.

    - Emergency Officials: Fire departments, police departments, Local Emergency Planning Management Agencies (EMA) and 911 call centers must be aware and educated on the safety measures and company plans while dealing directly with a gas pipeline emergency.

    - Local Public Officials: Mayors & administrators, zoning boards, public works officials, licensing & permitting departments, building code enforcement departments and public officials must be educated and work alongside National Grid to ensure the safety and cooperation of the public.

    - Excavators: Employees from construction, blasting, directional drilling and landscaping companies as well as farmers, sprinkler system installers and demolition teams all need to be aware of and educated on pipeline safety. This increased awareness and education will likely reduce the number of pipeline damages and accidental leaks.

National Grid's PPA Program communicates to these key stakeholder groups in a number of ways:

- Pipeline Public Awareness brochures included in customer bills
- Public service announcements
- Paid advertising

- Direct mailings with letters and safety brochures
- National Grid websites
- Links to other pipeline safety information sites
- Facebook
- Twitter
- On-line training programs for first responders and contractors dealing with natural gas and electric
- Education materials for elementary school teachers and students regarding natural gas and electric.
- Liaison meetings with emergency and local public officials
- Attendance at community events

- National Grid also participates in collaborative outreach to key stakeholders through the Northeast Gas Association using radio and cable television spots.

- The PPA program also communicates natural gas and pipeline safety information by direct mail outreach to excavators and in conjunction with the local Call Before You Dig call centers like Dig Safely, New York 811 and Dig Safe to provide natural gas safety and damage prevention information and training sessions.

9.2 Primary Threat Mitigation

National Grid worked with the American Gas Association (AGA) and the American Gas Foundation (AGF) on the development of an AGF Study on Distribution Integrity. This study was based on an analysis of gas distribution incidents in the DOT / OPS Database for the years 1990-2002. The study concluded that the top five (5) processes having the greatest impact on distribution integrity were:

- One Call / Mark Outs Systems to reduce third party damage
- Operator Qualifications to reduce operator error
- Cathodic Protection to reduce potential corrosion leaks or wall loss
- Leak Management to reduce the potential for leaks to cause an incident
- Proactive Replacement to reduce the inventory of problematic materials or components

National Grid also included construction activities in Operator Qualifications program early in its development. Additional or accelerated actions that have been taken or are being planned in order to reduce the risks from failure of the gas distribution pipeline are documented in Appendix D. These mitigation efforts address each of the primary threat types: corrosion, natural forces, excavation damage, other outside force, material or weld failure, equipment failure, incorrect operation, and other causes. National Grid's Distribution Engineering Department continuously monitors system performance in order to evaluate threats and also monitors gas industry best practices. As necessary, the Distribution Engineering Department will work with the Standards & Policy Department to update or issue new policies and procedures to mitigate threats.

10.0 MEASUREMENT OF PERFORMANCE, MONITORING RESULTS, AND EVALUATING EFFECTIVENESS

The objective of this section of the plan is to establish performance measures that shall be monitored from an established baseline in order to evaluate the effectiveness of the DIM program. The performance measures detailed in Sections 10.1 through 10.6 have been established in order to monitor performance and assist in the ongoing evaluation of threats. Distribution Engineering shall aggregate data from various legacy data sources (and successor data systems) as necessary to track each performance measure.

10.1 Number of Hazardous Leaks either Eliminated or Repaired, per §192.703(c), Categorized by Cause

National Grid has been tracking all leaks by material and cause since 2005, consistently monitoring trends. The baseline and ongoing performance of the number of hazardous leaks either eliminated or repaired, per §192.703(c), categorized by cause, shall be documented, or included by reference, in Appendix E, Section 1. The baseline for this performance measure shall be 2010 recorded performance. Recent improvements in data scrubbing and validation make 2010 performance the best baseline from which to monitor ongoing performance.

10.2 Number of Excavation Damages

Excavation Damage was defined in §192.1001 in December of 2009 with the publishing of the Final Distribution Integrity Management Rule. National Grid has been tracking and trending leaks associated with excavation damage since 2004; however the new definition of excavation damage goes beyond just leaks. Thus, the baseline for this performance measure will be 2010 performance. The baseline and ongoing performance of the number of excavation damages shall be documented, or included by reference, in Appendix E, Section 2.

10.3 Number of Excavation Tickets (received from the notification center)

The baseline and ongoing performance of the number of excavation tickets received from the notification center(s) shall be documented, or included by reference, in Appendix E, Section 3. The baseline for this performance metric will be 2010 performance.

10.4 Total Number of Leaks either Eliminated or Repaired, Categorized by Cause

National Grid has been tracking all leaks by material and cause since 2004, consistently monitoring trends. Recent improvements in data scrubbing and validation make 2010 performance the best baseline from which to monitor ongoing performance. The baseline and ongoing performance of the total number of leaks either eliminated or repaired, categorized by cause, shall be documented, or included by reference, in Appendix E, Section 4.

10.5 Number of Hazardous Leaks Either Eliminated or Repaired, per §192.703(c), Categorized by Material

National Grid has been tracking all leaks by material and cause since 2004, consistently monitoring trends. The baseline and ongoing performance of the number of hazardous leaks either eliminated or repaired, per §192.703(c), categorized by material, shall be documented, or included by reference, in Appendix E, Section 5. The baseline for this performance measure shall be 2010 recorded performance. Recent improvements in data scrubbing and validation make 2010 performance the best baseline from which to monitor ongoing performance.

10.6 Additional Performance Measures

As it is determined that additional performance measures are needed to evaluate the effectiveness of the DIM Program in controlling an identified threat, the performance measures shall be documented, or included by reference, in Appendix E, Section 6.

Additional performance measures initially established include:

- Workable Leak Backlog at the End of Year (known system leaks scheduled for repair)
- Total Excavation Damages per 1000 Tickets
- Main Leak Rates by Material Excluding Damages

- Service Repairs per 1000 Services by Material, Excluding Damages
- Total Leak Receipts
- Response Time Performance

National Grid monitors many other metrics in the course of conducting and monitoring operations and process safety. Extensive investigation/research, monitoring and improvement works are being performed on some special projects like Farm Tap investigation and design upgrade to new Process Safety Standards, Inner-Tite fitting Inspection etc. All the reports are incorporated by reference in its most updated form. Additional performance measures may be added to Section 9.6 when warranted to control threats.

11.0 PERIODIC EVALUATION AND IMPROVEMENT

The objective of this section of the plan is to periodically re-evaluate threats and risks on the entire pipeline and periodically evaluate the effectiveness of its program.

11.1 Plan Updating and Documentation

This written integrity management plan shall be reviewed periodically and updated as required to reflect changes and improvements that have occurred in process, procedures and analysis for each element of the program. National Grid performs extensive trending and analysis annually and documents it in the System Integrity Report. Additionally, National Grid will update risk assessment and ranking by asset class on an annual basis. In addition to the annual efforts, a complete program re-evaluation shall be completed, at a minimum, every five years. The complete program re-evaluations shall address:

- Frequency of the next complete program re-evaluation based on the complexity of the system and changes in factors affecting the risk of failure
- Verification of general information
- Incorporation of new system information
- Re-evaluation of threats and risk
- Review the frequency of the measures to reduce risk
- Review the effectiveness of the measures to reduce risk
- Modification of the measures to reduce risk and refine/improve as needed

- Review performance measures, their effectiveness, and necessary improvements

Form F-1 in Appendix F may be used to document Periodic Review and Updating. All changes to the written plan, inclusive of material from the appendices, shall be recorded on the Revision Control Sheet on page ii. However, changes to material in the appendices that is included by reference need not be recorded on the Revision Control Sheet. This plan shall reside on the National Grid intranet with the accompanying change-management. Any significant update or major change to the plan will be informed to the appropriate regulatory agency.

11.2 Effectiveness Review

An assessment of the performance measures described in Sections 10.1 through 10.5 shall be performed periodically. The National Grid System Integrity Report shall be prepared annually. The evaluation of threats and risks shall be performed annually. Other discretionary measures (mitigation beyond minimum code requirements) may be necessary and shall be assessed at the discretion of management. An emerging threat in one or more location shall be evaluated for relevance to other areas. If the reviews described above demonstrate significant changes to threats or system performance, a complete program re-evaluation may be completed in a shorter timeframe than five years. Form F-1 in Appendix F may be used to document Effectiveness Reviews.

12.0 REPORTING RESULTS

12.1 State & Federal Annual Reporting Requirements

The following shall be reported annually, by March 15, to PHMSA as part of the annual report required by 49 CFR, § 191.11:

- Number of hazardous leaks either eliminated or repaired (or total number of leaks if all leaks are repaired when found), per § 192.703(c), categorized by cause
- Number of excavation damages
- Number of excavation tickets (receipt of information by the underground facility operator from the notification center)
- Total number of leaks either eliminated or repaired, categorized by cause

- Information related to failure of mechanical fittings, excluding those that result only in non-hazardous leaks, shall be reported to PHMSA on the Gas Distribution Mechanical Fitting Failure Form (PHMSA F-7100.1-2).

These measures, as well as any others that may be required by the State, shall also be reported to the appropriate State Agency as per GEN01020 (incorporated by reference). A copy of the reports shall be maintained in the Distribution Integrity Management Program files.

13.0 DOCUMENT AND RECORD RETENTION

The following records shall be retained in the Distribution Integrity Management Program files.

- The most current as well as prior versions of this written DIM Plan and its Appendices
- Documents supporting Knowledge of Facilities (material supporting Appendix A of the DIM Plan as well as the annual System Integrity Report)
- Documents supporting threat identification (material supporting Appendix B of the DIM Plan)
- Documents supporting the identification and implementation of measures to address risks (material supporting Appendix D of the DIM Plan)
- Annual Reports to PHMSA (as required by §191.11) and State pipeline safety authorities
- Mechanical fitting Failure Reports

Documentation demonstrating compliance with the requirements of 49 CFR, Part 192, Subpart P shall be retained for at least 10 years.

APPENDICES FOR RHODE ISLAND

RHODE ISLAND APPENDIX A – KNOWLEDGE OF FACILITIES

A summary of PHMSA Reportable Gas Incidents (reported on PHMSA F7100-1) as well as details of recent incidents are provided in Tables A-1, A-2 and A-3 below.

Table A-1: Reportable Gas Incidents by Year

Year	Number of Incidents	Fatalities	Injuries	Property Damage
2018	0	0	0	-
2017	3	0	0	$403,895
2016	0	0	0	-
2015	1	0	0	$58,140
2014	0	0	0	-
2013	1	0	0	$29,184
2012	1	0	0	$133,377
2011	0	0	0	-
2010	0	0	0	-
2009	1	0	2	$100,000
2008	0	0	0	-
2007	0	0	0	-
2006	0	0	0	-
2005	0	0	0	-
2004	2	0	2	$118,000
2003	1	0	0	$100,000
2002	0	0	0	-
2001	0	0	0	-
2000	2	0	0	$250,000
1999	0	0	0	-
1998	0	0	0	-
1997	0	0	0	-
1996	1	0	0	$250,000
1995	0	0	0	-
1994	1	0	1	$100,000
1993	1	0	0	$300,000
1992	2	0	1	$142,500
1991	0	0	0	-
1990	0	0	0	-
1989	0	0	0	-
Total	**17**	**0**	**6**	**$1,985,096**

Table A-2: Reportable Gas Incidents by Cause

Year	Corrosion	Natural Forces	Excavation Damage	Outside Force	Material or Weld Failure	Equipment Failure	Incorrect Operation	Other
2018	0	0	0	0	0	0	0	0
2017	0	0	1	1	0	0	0	1
2016	0	0	0	0	0	0	0	0
2015	0	1	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0
2013	0	0	1	0	0	0	0	0
2012	0	0	0	1	0	0	0	0
2011	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0
2009	0	0	0	1	0	0	0	0
2008	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0
2006	0	0	0	0	0	0	0	0
2005	0	0	0	0	0	0	0	0
2004	0	2	0	0	0	0	0	0
2003	0	1	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	2
1999	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0
1996	0	0	1	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1994	1	0	0	0	0	0	0	0
1993	0	0	1	0	0	0	0	0
1992	0	1	1	0	0	0	0	0
1991	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
30-Year Total	**1**	**5**	**5**	**3**	**0**	**0**	**0**	**3**

Table A-3: 10-Year Incident History Details (**Rhode Island**)

Company	Year	Facility	Asset Class/Subclass	Street	Town	Leak Cause
NIMO (RI)	2017	MAIN	Steel - 3"	Intersection Baker St and Water St	WARREN	Excavation Damage
Details:	The contractor while installing the water main hit a 3 inch gas main with a backhoe. During pipe repair process 310 customers were shut off and were all restored successfully after repair.					
NIMO (RI)	2017	SERVICE RISER	Plastic (PE) - 5/8"	110 Toll Gate Road	WARWICK	Other outside force damage
Details:	Vehicle driver crashed into a service riser and (3) meter assembly, causing the gas leak. This caused fire and one person was hospitalized. A 5/8" pe plastic end cap was installed and tested.					
NIMO (RI)	2017	MAIN	Steel - 12" - LP	30 Allens Avenue	Providence	Other Incident Cause
Details:	There was insufficient support of a live gas as the earth was removed during construction allowing vibration and pressure to pull the two 12 inch 99 psig pipe segments out from a 12inch dresser coupling					
NIMO (RI)	2015	MAIN	CI -6"- LP	130 Woodbury Street	Providence	Natural Force
Details:	Pipe in frozen ground caused disturbance and odor in area					
NIMO (RI)	2013	MAIN	Protected Coated Steel – 8" – HP(35#)	Rocky Hill Road & Rte-116	Providence	Excavation
Details:	Mechanical puncture on gas main by excavator					
NIMO (RI)	2012	I&R	Valve	Purgatory Road	Middletown	Other Outside Force
Details:	Vandalism, Contractor working for St. George's School hit an underground gas main, forcefully entered into NG's District Regulator building & closed a valve which caused 483 service outage.					
NIMO (RI)	2009	SERVICE (@ METER SET)	Protected Coated Steel - LP - Outside Set	Rugby St	Providence	Other Outside Force
Details:	Vehicular Damage					

RHODE ISLAND APPENDIX B
THREAT IDENTIFICATION

In February thru April of 2016, groups of Subject Matter Experts (SMEs) were brought together, each having knowledge of threats in the various communities served by National Grid. Details on SME qualifications as well as copies of their interview records are located in the Distribution Integrity Management Program files. A summary of the threats identified are presented below in Tables B-1 and B-2.

Table B-1: Summary of Applicable Threats

SME's to Consider the Following	YES / NO
Do you have the necessary knowledge and/or experience (skills sets) regarding the areas of expertise for which you provided knowledge or supplemental information for input into the DIMP plan? (PHMSA Q.)	Yes
Do operator personnel in the field understand their responsibilities under DIMP plan? (PHMSA Q.)	Yes
Have you received DIMP training? (PHMSA Q.)	Yes
Have you received instructions to address the discovery of pipe or components not documented in the company records? (PHMSA Q.)	Yes
Have you received instructions to address, if you find any possible issue? (ex: corrosion, dented pipe, poor fusion joints, missing coating, excavation damage, mechanical fitting failures). (PHMSA Q.)	Yes
Have you received instructions to address when you find situations where the facilities examined (e.g., Material, Diameter, Coating, etc.) are different than records indicate, what documentation do you prepare? (PHMSA Q.) • If yes, are the findings documented?	Yes
During any repairs, if you find an improperly installed fitting, do you remediate it? (PHMSA Q.) • If yes, are the findings documented?	Yes
1. Does CMS conduct atmospheric corrosion inspection when they have access to facilities? • If yes, are the findings documented?	Yes
2. Do you know the procedures to visually examine any plastic fusion that is uncovered as part of excavation? • If yes, are the findings documented?	Yes
3. Do you notify damage prevention if any municipal work is being performed near gas distribution facilities? • If yes, are the findings documented?	Yes

4. Does Cross Bore recognized as risk? • If yes, are the findings documented?	Yes

Primary Threat Category	SME's to Consider the Following	Rhode Island
Corrosion	Is there known evidence of Corrosion on the system?	Yes
	Is there a known history of leakage on the system due to Corrosion?	Yes
	Threat Applicable?	Yes
Natural Force	Is there known evidence of damage or failures on the system due to natural forces?	Yes
	Is there a known history of leakage on the system due to Natural forces?	Yes
	Threat Applicable?	Yes
Excavation Damage	Is there known evidence of damage or failures on the system due to Excavation Damage?	Yes
	Is there a known history of leakage on the system due to Excavation Damage?	Yes
	Threat Applicable?	Yes
Other Outside Forces	Is there known evidence of damage or failures on the system due to Other Outside Forces?	Yes
	Is there a known history of leakage on the system due to Other Outside Forces?	Yes
	Threat Applicable?	Yes
Material or Weld Failure	Is there known evidence of damage or failures on the system due to Material or Weld Failure?	Yes
	Is there a known history of leakage on the system due to Material or Weld Failure?	Yes
	Threat Applicable?	Yes
Equipment Failure	Is there known evidence of damage or failures on the system due to Equipment Failure?	Yes
	Is there a known history of leakage on the system due to Equipment Failure?	Yes
	Threat Applicable?	Yes
Incorrect Operations	Is there known evidence of damage or failures on the system due to Incorrect Operations?	Yes

	Is there a known history of leakage on the system due to Incorrect Operations?	Yes
	Threat Applicable?	Yes
Others	Is there known evidence of damage or failures on the system due to others reasons?	Yes
	Is there a known history of leakage on the system due to other reasons?	Yes
	Threat Applicable?	Yes

Table B-2: Summary of SME Interview Responses for Threat Identification

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
Corrosion	Cast Iron Pipe	Does Cast Iron pipe exist in the system?	**Yes**
		Is there a known history of body-of-pipe leaks, fractures, or graphitization?	**Yes**
	Bare Steel or Wrought Iron Pipe (with no CP other than Localized hot spotting with anodes)	Do bare (uncoated) steel main or services exist in the system that are not under CP?	**Yes**
		Is there known evidence of external corrosion on bare steel or wrought iron pipes not under CP?	**Yes**
		Is there a history of leakage on bare steel or wrought iron pipes not under CP?	**Yes**
	Bare Steel or Wrought Iron Pipe (with CP other than just localized hot spotting with anodes)	Do bare (uncoated) steel main or services exist in the system that are under CP?	**No**
		Is there known evidence of external corrosion on bare steel pipes under CP?	**No**
		Is there a known history of leakage on bare steel pipes under CP?	**No**
	Coated Steel with CP	Is there known evidence of external corrosion on coated steel pipe with CP?	**Yes**
		Is there a known history of leakage on coated steel pipe with CP?	**Yes**
		Are some CP systems frequently down (not achieving the required level of protection); more than 10% of the time?	**Yes**
	Coated Steel w/o CP	Is there known evidence of external corrosion on coated steel pipe without CP?	**Yes**
		Is there a known history of leakage on coated steel pipe without CP?	**Yes**
	Copper Services	Are direct buried or inserted copper services known to exist in the system?	**Yes**
		Is there a known history of leakage on copper services?	**Yes**
	Stray Current	Do distribution facilities exist near DC transit systems, high voltage DC transmission systems or other known sources of DC current?	**Yes**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
		Are any facilities known to be impacted by sources of stray DC current that has or may result in corrosion?	**No**
	Internal Corrosion	Are liquids known to exist within any portions of the distribution system?	**Yes**
		Is there known evidence of internal corrosion on steel pipe?	**No**
		Is there a known history of leakage caused by internal corrosion of steel pipe?	**No**
	Atmospheric Corrosion on above ground facilities	Do above ground distribution facilities exist in areas exposed to marine atmosphere, high humidity, atmospheric pollutants or agricultural chemicals?	**Yes**
		Is there known evidence of external atmospheric corrosion on exposed steel pipe, equipment or fittings?	**Yes**
		Is there a known history of leakage caused by atmospheric corrosion of steel pipe?	**Yes**
	Atmospheric Corrosion of facilities in Vaulted areas underground	Do gas distribution facilities exist underground in vaulted areas?	**Yes**
		Is there known evidence of external atmospheric corrosion on exposed steel pipe, equipment or fittings?	**Yes**
		Is there a known history of leakage caused by atmospheric corrosion of steel pipe in vaults?	**Yes**
	Corrosion of carrier pipe in Cased Crossing	Do steel carrier pipes exist within cased crossings?	**Yes**
		Are there any existing known contacts between carrier pipes and casings?	**Yes**
		Is there known evidence of past or active external corrosion on cased steel pipe?	**Yes**
		Is there a known history of leakage caused by corrosion on cased steel pipe?	**Yes**
	Other Corrosion	Are there other corrosion threats?	**wall piece, at dis-similar metals & isolated fittings**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
Natural Forces	Seismic Activity	Are there any seismically active zones or fault lines that exist in the area?	**Yes**
		Is there a history of leakage associated with Seismic activity?	**No**
	Earth Movement / Landslide (Unstable Soil)	Are there any areas susceptible to earth movement or landslide in the area?	**No**
		Is there a known history of leakage associated with landslide or earth movement?	**No**
	Frost Heave	Are there any areas susceptible to frost heave that exist in the area?	**Yes**
		Is there a known history of leakage resulting from frost heave?	**Yes**
	Flooding	Are there any areas within the gas system that are subject to flooding?	**Yes**
		Is there a known history of leakage or damage associated with flooding?	**Yes**
	Over-pressure due to snow/ice blockage	Are pressure control equipment vents subject to ice blockage during the winter?	**Yes**
		Is there a known history of over-pressure events as a result of snow/ice blockage?	**Yes**
	Tree Roots	Is there a known history of leakage to pipe or fittings as a result of tree root damage?	**Yes**
	Other Natural Forces	Is there a known history of leakage or damage due to other natural force causes; including but not limited to lightning, wild fire or high winds (tornados)?	**Lightning**
Excavation Damage	Improper Excavation Practice	Has damage requiring repair or replacement occurred on properly marked facilities due to the failure of the excavator to follow proper excavation rules and procedures?	**Yes**
	Facility not located or marked	Has damage requiring repair or replacement occurred due to failure to locate a valid and timely locate request?	**Yes**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
	One-call notification center error	Has damage requiring repair or replacement occurred due to an error made at the one-call notification center?	**Yes**
	Mis-Marked Facilities	Has damage requiring repair or replacement occurred due to the mis-marking of facilities?	**Yes**
		Threat Applicable?	**Yes**
	Incorrect Facility Records	Has damage requiring repair or replacement occurred due incorrect facility records?	**Yes**
	Other Excavation Damage	Has damage requiring repair or replacement occurred due other causes?	**Yes**
	Blow off Riser Damage	Has damage requiring repair or replacement occurred due mapping, marking and contractor communication issue?	**Yes**
Other Outside Force Damage	Vehicle Damage to Riser/Meter	Are existing risers and/or meters exposed to damage from vehicular damage that do not have barriers or other protection conforming to current design requirements?	**Yes**
		Has known leakage occurred due to vehicle damage to risers/meters.	**Yes**
	Vehicle Damage to above-ground equip/station	Are regulator stations or other above ground station equipment exposed to damage from vehicular damage that do not have barriers or other protection conforming to current design requirements?	**Yes**
		Has known leakage occurred due to vehicle damage to above ground stations or equipment?	**Yes**
	Vandalism	Are gas valves or station equipment susceptible to damage by vandalism that has the potential to pose a risk to employees or the public?	**Yes**
		Has leakage or other unsafe condition been created by vandalism?	**Yes**
	Structure Fire	Is there a history of damage to gas meters or other equipment due to structure fires?	**Yes**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
	Other Outside Force Damage	Has damage requiring repair or replacement occurred due other outside forces?	**Falling ice, Heat ground contamination, down electric lines**
Pipe, Weld or Joint Failure	Century Products (MDPE 2306)	Is Century Products (MDPE 2306) pipe (Tan) known to exist in the system?	**No**
		Is there a history of leakage of Century Products (MDPE 2306) pipe due to material failure?	**No**
	Aldyl A (MDPE 2306)	Is pre-1973 Aldyl A pipe (Tan, but can turn grey) known to exist in the system?	**Yes**
		Has pre-1973 Aldyl A pipe been known to leak due to brittle-like failure from rock impingement or other stresses?	**Yes**
		Is there a history of leakage of pre-1973 Aldyl A pipe due to material failure?	**Yes**
	Aldyl AAAA (MDPE 2306) Green Aldyl	Is Green Aldyl pipe known to exist in the system?	**Yes**
		Is there a history of brittle like failures of Green Aldyl pipe?	**Yes**
		Is there a history of leakage of Green Aldyl pipe due to material failure?	**Yes**
	PVC – Polyvinyl Chloride	Is PVC pipe known to exist in the system?	**No**
		Is there a history of leakage of PVC pipe due to material failure?	**No**
	ABS – Acrylonitrile Butadiene Styrene	Is ABS pipe known to exist in the system?	**No**
		Is there a history of leakage of ABS pipe due to material failure?	**No**
	CAB – Cellulose Acetate Butyrate	Is CAB pipe known to exist in the system?	**No**
		Is there a history of leakage of CAB pipe due to material failure?	**No**
	PB – Polybutylene	Is PB pipe known to exist in the system?	**Yes**
		Is there a history of leakage of PB pipe due to material failure?	**Yes**
	PP – Polypropylene	Is PP pipe known to exist in the system?	**No**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
		Is there a history of leakage of PP pipe due to material failure?	**No**
	Polyamide - PA	Is PA pipe known to exist in the distribution system?	**No**
		Is there a history of leakage of PA pipe due to material failure?	**No**
	PE Fusion failure	Is there a history of PE Fusion Failures or leakage in the system?	**Yes**
		Are any types of PE fusion (type, material, size, age, process, geographic area) more prone to leakage or failure?	**Yes**
	Pre-1940 Oxy-Acetylene Girth Weld	Do pre-1940 Oxy-Acetylene Girth Welds exist on pipe greater than 4 inch?	**Yes**
		Is there a history of pre-1940 Oxy-Acetylene Girth Weld failures or leakage in the system due to material failure?	**Yes**
	Other	Do other material failures occur that present a possible current or future risk?	**Yes**
Equipment Failure	Plexco Service Tee Celcon Caps	Are Plexco Service Tee Celcon Caps known to exist in the system?	**Yes**
		Is there a history of leakage of Plexco Service Tee Celcon Caps due to material failure?	**Yes**
	PP – Delrin Insert Tap Tees	Are Delrin Insert Tap Tees known to exist in the system?	**Yes**
		Is there a history of leakage of Delrin Insert Tap Tees?	**Yes**
	Stab Type Mechanical	Is there a history of Stab Type Mechanical Fitting failures or leakage in the system due to pullout?	**No**
		Is there a history of Stab Type Mechanical Fitting failures or leakage in the system due to seal leakage?	**Yes**
	Other Equipment Failure	What Types and Manufactures of Stab Type Mechanical Fittings have you seen used in the System?	**Perfection LYCO & AMP**
		Are any types of Stab Type Mechanical Fitting (type, material, size, age, manufacturer, geographic area) more prone to leakage or failure?	**LYCO**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
	Nut Follower Type Mechanical Fittings	Is there a history of Nut Follower Type Mechanical Fitting failures or leakage in the system due to pullout?	**No**
		Is there a history of Nut Follower Type Mechanical Fitting failures or leakage in the system due to seal leakage?	**Yes**
		What Types and Manufactures of Nut Follower Type Mechanical Fittings have you seen used in the System?	**Dresser, Normac, Innertite, Kerotest**
		Are any types of Nut Follower Type Mechanical Fitting (type, material, size, age, manufacturer, geographic area) more prone to leakage or failure?	**Kerotest**
	Bolted Type Mechanical Fittings	Is there a history of Bolted Type Mechanical Fitting failures or leakage in the system due to pullout?	**No**
		Is there a history of Bolted Type Mechanical Fitting failures or leakage in the system due to seal leakage?	**Early vintage**
		What Types and Manufactures of Bolted Type Mechanical Fittings have you seen used in the System?	**Dressers, Smith Blair, & CSI**
		Are any types of Bolted Type Mechanical Fitting (type, material, size, age, manufacturer, geographic area) more prone to leakage or failure?	**Early vintage smith Blair**
	Other Type Mechanical Fittings	Is there a history of other types of Mechanical Fitting failures or leakage in the system due to pullout?	**No**
		Is there a history of other types of Mechanical Fitting failures or leakage in the system due to seal leakage?	**Yes**
		What other types and manufactures of Mechanical Fittings have you seen used in the System (other than Stab, Nut-follower, or bolted type?)	**Dresser 700 posi lock**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
		Of the "other mechanical fittings" listed above, are any types of Mechanical Fitting (type, material, size, age, manufacturer, geographic area) more prone to leakage or failure?	**No**
	Valves	Are valves inoperable, inaccessible and or paved over without timely identification and repairs?	**Yes**
		Are certain types or makes of valves more likely to leak?	**Kerotest**
	Service Regulators	Is there a history of service regulator failures that present a threat to the public or employees?	**Yes**
		Are certain types or makes of service regulator more likely to create a risk?	**Farm Taps & Mercury**
	Meters	Is there a history of meter failures that present a threat to the public or employees?	**No**
		Are certain types or makes of meters more likely to create a risk?	**No**
	Control/Relief Station Equipment	Is there a history of control or relief station equipment failures that present a threat to the public or employees?	**No**
		Are certain types or makes of station equipment more likely to create a risk?	**No**
	Other Equipment Failure	Is there a history of other equipment failures that present a threat to the public or employees?	**Single Stage stations**
		Are certain types or makes of other equipment more likely to create a risk?	**No**
Incorrect Operations	General	Have inadequate procedures or safety practices, or failure to follow correct procedures, or other operator error resulted in an incident that created a risk to the gas distribution system?	**Yes**
	Gas lines bored through Sewers	Have pipes been installed via unguided or guided bore without proper procedures to ensure other facilities are not damaged?	**Yes**

Primary Threat Category	Material or Sub-Threat	SME's to Consider the Following	Rhode Island
		Have pipes unknowingly bored through sewer lines been damaged by sewer line cleaning operations?	**Yes**
Other	Bell Joint Leakage	Does Cast Iron pipe exist in the system?	**Yes**
		Is there a history of bell joint leaks?	**Yes**
		Are certain diameters or parts of the system known to be more prone to bell joint failure or leakage than others?	**Yes**
	Inserted Copper Puncture	Do copper services inserted in steel exist in the system?	**Yes**
		Is there a history of leakage of copper services due to puncture by a deteriorated steel outer casing?	**No**
	Copper Sulfide	Have any safety incidents occurred as a result of copper sulfide in copper services or service regulators?	**No**
	Construction over gas mains & services	Have others constructed over gas facilities or taken other action that prevents effective leak survey and other maintenance?	**Yes**
		When identified, is construction that impacts required maintenance corrected in a timely manner?	**Yes**
	Other	Are there any other known threats to the Gas Distribution system that we need to be aware of?	**gas mains in Catch basins, Vibration equipment, Anaerobic sealants**

RHODE ISLAND APPENDIX C
EVALUATION AND RANKING OF RISK

HIGHEST RANKED RISKS

STATE: RHODE ISLAND
REGION: ALL
FACILITY: MAINS

Mitigation Will Be As Per Appendix D, Except As Otherwise Indicated In Notes

Material	Pressure	Diameter	Mileage	Risk Score	Threat Category	Additional Mitigation Notes
582 – Cast Iron	LP	4" Thru 8"	582.80	2.06 Known Incident	NATURAL FORCE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
ProtectedCoated Steel	HP	Upto 4"	151.09	1.10 Known Incident	EXCAVATION	
ProtectedCoated Steel	HP	Over 4" Thru 8"	157.74	1.14 Known Incident	EXCAVATION	
UnprotectedCoated Steel	LP	Over 8"	3.86	0.22 Known Incident	OTHER	
Wrought Iron	HP	Under 4"	0.12	5.16	NATURAL FORCE/ OTHER	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
5 – Cast Iron	LP	Under 4"	4.65	4.08	NATURAL FORCE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Wrought Iron	LP	Under 4"	0.97	4.08	NATURAL FORCE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	> 60 PSI,Not T	Upto 4"	0.55	3.54	CORROSION/ NATURAL FORCE/ EXCAVATION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	> 60 PSI,Not T	Over 4" Thru 8"	1.82	3.54	CORROSION/ NATURAL FORCE/ EXCAVATION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	> 60 PSI,Not T	Over 8"	2.00	3.54	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking

582
25
607 Cast iron Total
15 Wrought Iron + D.I total
219 Unprotected Steel

RHODE ISLAND - MAINS (Cont.)

Material	Pressure	Diameter	Miles	Rel. Score	Threat Category	Additional Mitigation Notes
UnprotectedBare Steel	HP	Upto 4"	81.90	2.80	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	HP	Over 4" Thru 8"	33.36	2.80	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	HP	Over 8"	3.95	2.80	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Cast Iron	HP	4" Thru 8"	3.64	2.70	NATURAL FORCE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Plastic	> 60 PSI,Not T	Upto 4"	57.93	2.46	EXCAVATION/ O. O. FORCE/ MATERIAL-WELD	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Plastic	> 60 PSI,Not T	Over 4" Thru 8"	55.39	2.46	EXCAVATION/ O. O. FORCE/ MATERIAL-WELD	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Plastic	> 60 PSI,Not T	Over 8"	0.73	2.46	EXCAVATION/ O. O. FORCE/ MATERIAL-WELD	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedCoated Steel	> 60 PSI,Not T	Upto 4"	1.91	2.15	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedCoated Steel	> 60 PSI,Not T	Over 4" Thru 8"	4.37	2.15	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedCoated Steel	> 60 PSI,Not T	Over 8"	10.67	2.15	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Ductile Iron	HP	Over 4" Thru 8"	0.68	2.09	NATURAL FORCE/ CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Wrought Iron	LP	4" Thru 8"	0.14	2.06	NATURAL FORCE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking

RHODE ISLAND - MAINS (Cont.)

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Material	Pressure	Diameter	Mileage	Risk Score	Threat Category	Additional Mitigation Notes
Cast Iron	HP	Over 8"	16.32	2.03	NATURAL FORCE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	LP	Upto 4"	11.33	1.96	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	LP	Over 4" Thru 8"	60.41	1.96	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
UnprotectedBare Steel	LP	Over 8"	3.30	1.96	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Ductile Iron	LP	Over 4" Thru 8"	12.25	1.57	NATURAL FORCE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
ProtectedCoated Steel	HP	Over 8"	25.11	1.10	EXCAVATION	

HIGHEST RANKED RISKS

STATE: RHODE ISLAND
REGION: ALL
FACILITY: SERVICE (Active & Inactive)

Mitigation Will Be As Per Appendix D, Except As Otherwise Indicated In Notes

Material	Pressure	Meter Set	Quantity	Risk Score	Threat Category	Additional Mitigation Notes
Plastic	LP	Outside	27,382	1.81 Known Incident	O. O. FORCE	
Protected Coated Steel	LP	Outside	701	1.08 Known Incident	O. O. FORCE	
Copper	HP	Inside	48	7.46	CORROSION/ EQ. FAILURE/ EXCAVATION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Copper	LP	Inside	5	6.10	CORROSION/ EQ. FAILURE/ EXCAVATION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Copper	HP	Outside	138	5.97	CORROSION/ EXCAVATION/ EQ. FAILURE	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Unprotected Bare Steel	> 60 PSI,Not T	Inside	83	5.33	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Unprotected Bare Steel	> 60 PSI,Not T	Outside	249	5.33	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Unprotected Bare Steel	HP	Inside	917	5.16	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Unprotected Bare Steel	LP	Inside	39,504	4.53	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking

RHODE ISLAND – SERVICE (Cont.)

Material	Pressure	Meter Set	Quantity	Risk Score	Threat Category	Additional Mitigation Notes
Unprotected Bare Steel	HP	Outside	2,234	4.13	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Cast Iron	LP	Outside	6	3.64	NATURAL FORCE/ CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Unprotected Bare Steel	LP	Outside	2,571	3.39	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Unprotected Coated Steel	> 60 PSI,Not T	Inside	12	2.98	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Unprotected Coated Steel	> 60 PSI,Not T	Outside	110	2.98	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Plastic	HP	Inside	6,089	2.94	EXCAVATION/ O. O. FORCE	
Plastic	> 60 PSI,Not T	Inside	93	2.94	EXCAVATION/ O. O. FORCE	
Plastic	> 60 PSI,Not T	Outside	6,738	2.94	EXCAVATION/ O. O. FORCE	
Unprotected Coated Steel	HP	Inside	2,073	2.88	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Plastic	LP	Inside	21,531	2.80	EXCAVATION/ O. O. FORCE	
Unprotected Coated Steel	LP	Inside	1,701	2.70	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking
Plastic	HP	Outside	73,178	2.37	EXCAVATION	
Unprotected Coated Steel	HP	Outside	3,143	2.31	CORROSION	An additional factor will be applied to the replacement qualification and prioritization algorithm to account for this asset's DIMP risk ranking

RHODE ISLAND APPENDIX D
IDENTIFICATION AND IMPLEMENTATION OF MEASURES TO ADDRESS RISKS

Primary Threat Category	Sub-Threat	Existing Mitigation or Additional/Accelerated Actions Rhode Island
Corrosion	Cast Iron Pipe Graphitization (including risk of crack or break due to becoming brittle)	Proactive leak surveys, Proactive Leak Prone Pipe replacement program, reactive pipe replacement program and Leak management programs
	Bare Steel or Wrought Iron Pipe	Proactive leak surveys, Proactive Leak Prone Pipe replacement program, reactive pipe replacement program and Leak management programs
	Coated Steel w/o CP	Proactive leak surveys, Proactive Leak Prone Pipe replacement program, reactive pipe replacement program and Leak management programs
	Copper Services	Proactive leak surveys, service tees replaced with main replacements and leak management programs
	Stray Current	Design, Proactive leak surveys, Proactive Corrosion Control inspections
	Internal Corrosion	Proactive leak surveys, Proactive Leak Prone Pipe replacement program, reactive pipe replacement program and Leak management programs
	Atmospheric Corrosion on above ground facilities	Design, Proactive leak surveys, Proactive Corrosion Control inspections
	Atmospheric Corrosion of facilities in Vaulted areas underground	Design, Proactive leak surveys, Proactive I&R and Corrosion Control inspections
	Corrosion of Buried Farm Tap Equipment	Proactive leak surveys, Proactive Corrosion Control inspections, Pressure Tests
	Corrosion of Service Fittings on cast iron mains that are not cathodically protected.	Proactive leak surveys, services associated with main replacement programs are replaced, proactive high pressure service replacement program and leak management program

Primary Threat Category	Sub-Threat	Existing Mitigation or Additional/Accelerated Actions Rhode Island
	Grounds installed on risers making CP ineffective	Cathodic Protection Monitoring
	Corrosion of carrier pipe in Cased Crossing	Cathodic Protection Monitoring
Natural Forces	Earth Movement / Landslide(Unstable Soil)	Proactive Leak Survey Programs
	Frost Heave	Proactive Leak Survey Programs / Winter Operations
	Flooding (including Coastal)	Proactive Leak Survey Programs
	Tree Roots	Proactive Leak Survey Programs
	Over-pressure due to snow/ice blockage or freeze up.	Design, Proactive Leak Survey Programs
	Other Natural Forces (Lightning, High winds)	Design, Proactive Leak Survey Programs
Excavation Damage	Improper Excavation Practice (including mitigation for high-risk tickets)	Damage Prevention Monitoring, Design, EFV's, training and emergency response
	Facility not located or marked	Damage Prevention Monitoring, Design, EFV's, training and emergency response
	One-call notification center error	Damage Prevention Monitoring, Design, EFV's, training and emergency response
	Mis-Marked Facilities	Damage Prevention Monitoring, Design, EFV's, training and emergency response

Primary Threat Category	Sub-Threat	Existing Mitigation or Additional/Accelerated Actions Rhode Island
	Incorrect Facility Records	Damage Prevention Monitoring, Design, EFV's, training and emergency response (see Table 5-7)
	Shallow Mains - reduced cover	Damage Prevention Monitoring, Design, training and emergency response
	Plastic without tracer wire that cannot be located	Damage Prevention Monitoring, Design, EFV's, training and emergency response
Other Outside Force Damage	Vehicle Damage to Riser/Meter	Design, Proactive Leak Survey Programs
	Vehicle Damage to above-ground equip/station	Design, Proactive Leak Survey Programs
	Vandalism	Design, EFV's Proactive Leak Survey Programs
	Structure Fire	Design, EFV's, training and emergency response
Pipe, Weld or Joint Failure	Pre-1973 Aldyl A (Tan MDPE 2306)	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	1973 and later Aldyl A (Tan MDPE 2406)	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Aldyl 4A (Green MDPE 2306)	Not Applicable.
	PE other than Aldyl A & 4A	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Delrin Insert Tap Tees	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Plexco Service Tee Celcon Caps	Not Applicable
	PE Fusion failure	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.

Primary Threat Category	Sub-Threat	Existing Mitigation or Additional/Accelerated Actions Rhode Island
	Pre-1940 Oxy-Acetylene Girth Weld	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
Equipment Failure	Stab Type Mechanical	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Nut Follower Type Mechanical Fittings	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Bolted Type Mechanical Fittings	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Other Type Mechanical Fittings	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Valves	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Service Regulators	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Meters (including Tin Meters)	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Control/Relief Station Equipment	Design, I&R Inspections, Operator Qualifications, training and emergency response
Incorrect Operations	General	Operator Qualifications, training and emergency response
	Gas lines bored through Sewers	Operator Qualifications, training and emergency response
Other	Bell Joint Leakage, Cast Iron and Ductile Iron	Proactive Leak Survey Continue to monitor leak rates. Not currently an increased threat.
	Construction over gas mains & services	Operator Qualifications, training and emergency response

Extensive investigation/research, monitoring and improvement works are being performed on some special projects listed below and all the reports are incorporated by reference in its most updated form.

MITIGATION OF OIL/LIQUIDS

Natural gas pipeline liquids have been identified as recurring at some existing distribution collection points as well as some commercial customer locations within a portion of the natural gas distribution system. These liquids can be a problem in and of themselves, but they can also cause trace contaminants such as PBS to become mobile and accumulate at different points, possibly even travelling all the way to a customer's meter set. National Grid is actively monitoring collection points, removing liquids from the system and employing mitigation measures to help limit movement of liquids and ensure customer protection.

ATMOSPHERIC CORROSION

In Rhode Island, National Grid visits all services with inside meter sets to inspect the service for atmospheric corrosion. Due to the timing of these inspections, National Grid cannot always gain access to all buildings to inspect the pipe. National Grid attempts two more times to contact the customer and schedule an appointment. However, a large number of service inspections attempted are never completed and have a result of "Can't Get In" (CGI).

In order to address any safety concerns with these services, National Grid conducted a review to see if any other inspection programs or service work were conducted at the address in the last 6 years. National Grid determined that if the service was replaced in the last 6 years or if an atmospheric corrosion inspection was completed as a "tag-a-long" inspection to other work being completed, the service was at a lower risk to be severely corroded.

For the remaining services that have had no access to the premises in the last 6 years, National Grid prioritized the risk by year of installation and will begin to turn the customer's gas off in the summer in order to schedule an appointment for an atmospheric corrosion inspection.

INSIDE METER SETS

The National Grid Inside Meter Sets program is dedicated to upgrading the natural gas infrastructure by relocating inside gas meter set. Natural gas meters are moved from inside to outside locations so that National Grid can continue to provide safe, high-quality customer service by replacing older leak prone pipe made of cast iron or unprotected steel. Service lines may also be replaced with modern materials if they have not previously been replaced during routine maintenance. Some of the benefits of this program are the replacement of LPP with more modern materials in order to reduce the risk of gas leaks. This program also contributes to customer and company convenience by eliminating the need to enter the home for atmospheric corrosion inspections and leak surveys. The inside meter sets program increases customer satisfaction by facilitating more frequent and comprehensive inspections and maintenance work on meters and service piping that has been placed outside. Lastly, the inside meter sets relocation program eliminates the risk of shut-off due to access issues, and provides easy access to relocated outside meters in the event of an emergency.

INNERTITE FITTINGS

National Grid had 2 incidents involving InnerTite fittings in 2008 and 2011 on Long Island, with the 2008 incident resulting in property damage. History has shown the InnerTite fitting has corroded at a faster rate than the rest of the service. Because of this, National Grid has identified all plastic and plastic tube inside meter services installed in 1974 and prior for the Rhode Island Service territory to be inspected, as services meeting these conditions involve the possibility of having the InnerTite equipment installed as part of the fitting assembly.

From 2012 – 2014, National Grid visited every site and completed inspections when able to get access inside the building. However, despite multiple lettering and communication attempts, National Grid was not able to get access inside the house to complete the inspection. In 2015, National Grid reviewed other work done from other programs and reduced the list of services needing inspection in Rhode Island. In 2016, National Grid is attempting these inspections again. If access is still not possible, we will work to turn off the gas for the customer in the summer.

WATER INTRUSION/WASHOUT PROJECTS

The National Grid Water Intrusion/Washouts Program is in place to remediate situations where water has infiltrated the gas distribution system. This situation is known to cause poor pressure, resulting in repeated customer supply disruptions and decreased system reliability. The program addresses outstanding water intrusion issues in addition to allowing in-year projects to be walked-in as locations meeting criteria for inclusion in the program are identified. This program also addresses unanticipated infrastructure washouts and main exposures that can occur due to storms, heavy rains and/or seasonal snow melt. Main exposure/undermining can result in damage to facilities, emergency response and potential loss of service to customers. Distribution washouts/exposures can create potential for further damages and risks to assets if not addresses efficiently and appropriately. National Grid is required to ensure proper integrity for safe operation of its assets and to maintain proper cover and protection of its facilities.

PROACTIVE MAIN REPLACEMENT PROGRAM – LPP

This program supports the replacement of Leak Prone Pipe (LPP) inventory, defined as mains less than 16" in diameter that are non-cathodically protected steel, whether bare or coated (collectively termed "unprotected steel") or cast/ wrought iron or pre 1985 Aldyl-A plastic. The goal of this program is to reduce the risk associated with leak prone pipe in the distribution system.

CI FROST PATROL

Cast Iron (CI) is a brittle material and has tendency to break when extended periods of cold temperature allow frost to form in the ground. The downward pressure of the expanding frost line can exert such great force that it can crack smaller diameter cast iron mains. In a natural process of graphitization, iron degrades to softer elements, making iron pipelines more susceptible to cracking. Gas may leak from the joints or through cracks in the pipe if graphitization has occurred. National Grid performs periodic survey to identify CI breaks and joint leaks.

PLASTIC FAILURES

National Grid policy requires that failed plastic parts (either leaking or visually identified as not exhibiting properties of a properly fused or assembled part) be returned to the Laboratory for analysis and testing. When possible, parts are destructively tested to assess cause of leak/failure. A log of analyzed failures is maintained and periodically reviewed in order to recognize system wide failure trends. Local analysis (frequently a leak survey) is conducted to check contemporary and contiguous installation work for similar failures. The paperwork associated with nearby failures from other years may also be examined in order to further complete the review. Certain failures, such as the identification of slow crack growth on pre-1985 Aldyl-A plastic, may lead to proactive replacement of similar pipe.

CROSS BORE

National Grid has installed several plastic gas mains through Horizontal Directional Drilling (HDD) technology where the pipe can bore through an unverified sewer lateral and cause blockage. If a mechanical cleaning tool is used to remove the blockage, it may lead to damaging the gas line, causing the gas to migrate into the building that can lead to an explosion. National Grid cross bore inspection program address all previous HDD installations to review if a cross bore incident has occurred and if so, take proactive steps to remediate the situation.

PROACTIVE SERVICE REPLACEMENT

RI proactive service replacement program lead to the review of steel services and a risk prioritization based upon recent leak history statistics. Targeted for replacement will be the services at greatest risk for leakage and those that are an inside set. All targeted services should be outside the bounds of planned main replacements.

METHANE EMISSIONS:

The leak migration is based on the volume of the gas leaking from a facility i.e. a high emitting leak will have a greater extent of leak plume than that of the low emitting leak. The Company will be using this principle in evaluating and prioritizing the type-3 leaks for repair to reduce the methane emissions.

For every individual leak, adding all the bar hole readings will result in the relative size of the plume. Greater the sum of bar hole readings, larger the plume and hence larger the methane emissions. By analyzing the sum of bar-hole readings per leak across all open type-3 leaks, will relatively prioritize them based on emissions. Figure1 below shows how a typical leak from a gas pipe plume up in the soil and how a leak is evaluated in the field. Highest gas reading has to be zeroed out in all directions.

Every leak has a different migration pattern and the bar-hole readings will be relative to the size of the leak. For e.g., a small leak will have migrated only to limited distance and the leak investigation will get 0% readings in relatively smaller area when compared to a larger leak where the leak investigation will lead to more readings and farther migration patterns.

Material, diameter and pressure normally do not impact the size of leak plume or emission volume since the gas leaks are identified based on the gas in the air. High pressure main will have a much smaller opening in the in the pipe to have similar methane emissions as a low pressure main with larger opening. Furthermore, we should repairs any type 3 which may be 5-7 year old and not on a pipe which is scheduled to be replaced in next two years.

RHODE ISLAND APPENDIX E
MEASUREMENT OF PERFORMANCE, MONITORING RESULTS, AND EVALUATION EFFECTIVENESS

Appendix E. Section 1 – Number of Hazardous Leaks Either Eliminated or Repaired, Categorized by Cause

The baseline and ongoing performance of the number of Hazardous (***Type 1***) Leaks for Main and Service combined Either Eliminated or Repaired, Categorized by Cause is provided below (Including Excavation Damage Leaks):

INCLUDING Damage

Rhode Island

Cause		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Corrosion	Actual	644	705	310	504	458	376	545	350	292	368	251
	Baseline	Rolling average since 2008 + 0.5 standard deviation (526 for 2008-2017)										
[1] Natural Forces	Actual	3	4	17	72	22	59	123	102	33	26	93
	Baseline	Rolling average since 2008 + 0.5 standard deviation (67 for 2008-2017)										
Excavation Damage	Actual	139	27	140	107	130	114	92	134	106	116	97
	Baseline	Rolling average since 2008 + 0.5 standard deviation (127 for 2008-2017)										
Other Outside Force	Actual	2	0	0	1	0	2	9	6	10	11 [2]	6
	Baseline	Rolling average since 2008 + 0.5 standard deviation (6 for 2008-2017)										
Material or Welds	Actual	2	1	2	0	1	15	25	5	2	2	4
	Baseline	Rolling average since 2008 + 0.5 standard deviation (10 for 2008-2017)										
[3] Equipment Failure	Actual	64	32	34	83	76	72	107	127	98	74	135
	Baseline	Rolling average since 2008 + 0.5 standard deviation (92 for 2008-2017)										
Incorrect Operations	Actual	3	0	1	0	0	0	0	0	0	0	0
	Baseline	Rolling average since 2008 + 0.5 standard deviation (1 for 2008-2017)										
Other	Actual	425	737	736	346	234	449	308	267	211	215	340
	Baseline	Rolling average since 2008 + 0.5 standard deviation (492 for 2008-2017)										
Total	Actual	1,282	1,506	1,240	1,113	921	1,087	1,209	991	752	812	812
	Baseline	Rolling average since 2008 + 0.5 standard deviation (1,206 for 2008-2017)										

Above Baseline Comments:

1 - We are monitoring the Natural Force and will take appropriate action if the number keeps increasing.

2 - We are monitoring the Other Outside Force and will take appropriate action if the number keeps increasing.

3 - If we have any leak on a service, we normally insert-retube/relay the service. Currently we are in a process to investigate equipment leaks.

Appendix E, Section 2 – Number of Excavation Damages

The baseline and ongoing performance of the number of excavation damages is provided below (Including Excavation Damage Leaks):

INCLUDING Damage

Rhode Island		2010	2011	2012	2013	2014	2015	2016	2017	2018
Excavation Damages	Actual	158	80	88	76	80	135	106	116	95
	Baseline	Rolling average since 2010 + 0.5 standard deviation (120 for 2010-2017)								

Appendix E, Section 3 – Number of Excavation Tickets

The baseline and ongoing performance of the number of excavation tickets is provided below (Including Excavation Damage Leaks):

INCLUDING Damage

Rhode Island		2010	2011	2012	2013	2014	2015	2016	2017	2018
Excavation Tickets	Actual	46,808	50,463	51,461	54,714	61,384	60,509	63,541	53,550	43,022
	Baseline	Rolling average since 2010 + 0.5 standard deviation (58,266 for 2010-2017)								

Appendix E, Section 4 – Total Number of Leaks Either Eliminated or Repaired, Categorized by Cause

The baseline and ongoing performance of the number of Leaks Either Eliminated or Repaired, Categorized by Cause is provided below (Including Excavation Damage Leaks):

INCLUDING Damage

Rhode Island

	Cause		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Corrosion	Actual	1,265	1,318	707	630	653	588	819	461	480	562	435
		Baseline	Rolling average since 2008 + 0.5 standard deviation (901 for 2008-2017)										
1	Natural Forces	Actual	60	5	22	77	26	59	137	106	41	28	97
		Baseline	Rolling average since 2008 + 0.5 standard deviation (77 for 2008-2017)										
	Excavation Damage	Actual	141	28	140	107	133	115	92	135	107	117	100
		Baseline	Rolling average since 2008 + 0.5 standard deviation (128 for 2008-2017)										
	Other Outside Force	Actual	7	0	0	2	1	2	9	7	10	11	6
		Baseline	Rolling average since 2008 + 0.5 standard deviation (7 for 2008-2017)										
	Material or Welds	Actual	3	2	11	0	2	18	30	6	4	2	7
		Baseline	Rolling average since 2008 + 0.5 standard deviation (13 for 2008-2017)										
2	Equipment Failure	Actual	216	70	50	96	154	128	159	169	142	132	193
		Baseline	Rolling average since 2008 + 0.5 standard deviation (156 for 2008-2017)										
	Incorrect Operations	Actual	2	0	3	2	0	0	0	0	0	0	0
		Baseline	Rolling average since 2008 + 0.5 standard deviation (1 for 2008-2017)										
	Other	Actual	1,503	2,252	1,646	1,479	1,261	914	807	424	568	671	776
		Baseline	Rolling average since 2008 + 0.5 standard deviation (1,440 for 2008-2017)										
	Total	Actual	3,197	3,675	2,579	2,393	2,230	1,824	2,053	1,308	1,352	1,523	1,614
		Baseline	Rolling average since 2008 + 0.5 standard deviation (2,604 for 2008-2017)										

Above Baseline Comments:

1 - We are monitoring the Natural Force and will take appropriate action if the number keeps increasing.

2 - Currently we are in a process to investigate equipment leaks.

Appendix E, Section 5 – Number of Hazardous Leaks Either Eliminated or Repaired, Categorized by Material

The baseline and ongoing performance of the number of Hazardous (***Type 1***) Leaks for Main and Service combined Either Eliminated or Repaired, Categorized by Material is provided below (Excluding Excavation Damage Leaks):

EXCLUDING Damages

Rhode Island

	Cause		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	Cast Iron / Wrought Iron	Actual	373	388	322	324	303	393	481	365	251	247	437
		Baseline	Rolling average since 2008 + 0.5 standard deviation (380 for 2008-2017)										
	Unprotected Bare	Actual	420	624	470	404	389	477	515	372	299	351	276
		Baseline	Rolling average since 2008 + 0.5 standard deviation (479 for 2008-2017)										
	Unprotected Coated	Actual	75	88	71	54	41	49	40	36	29	33	31
		Baseline	Rolling average since 2008 + 0.5 standard deviation (62 for 2008-2017)										
	Protected Bare	Actual	0	0	0	0	0	0	0	0	0	0	0
		Baseline	Rolling average since 2008 + 0.5 standard deviation (0 for 2008-2017)										
2	Protected Coated	Actual	0	0	0	0	0	0	0	0	2	0	2
		Baseline	Rolling average since 2008 + 0.5 standard deviation (1 for 2008-2017)										
	Plastic	Actual	247	364	223	208	40	51	78	73	68	57	76
		Baseline	Rolling average since 2008 + 0.5 standard deviation (197 for 2008-2017)										
2	Copper	Actual	2	0	1	0	1	1	0	0	0	2	6
		Baseline	Rolling average since 2008 + 0.5 standard deviation (1 for 2008-2017)										
	Other	Actual	11	15	13	16	17	2	3	11	3	6	1
		Baseline	Rolling average since 2008 + 0.5 standard deviation (13 for 2008-2017)										
	Total	Actual	1,128	1,479	1,110	1,006	791	973	1,117	857	652	696	829
		Baseline	Rolling average since 2008 + 0.5 standard deviation (1,104 for 2008-2017)										

Above Baseline Comments:

1 - Increased in CI Joint leaks are directly propositional to the colder temperature in the winter.

2 - We are monitoring the cause and will take appropriate action if the number keeps increasing.

Appendix E, Section 6 – Number of Excavation Damages

The baseline and ongoing performance of the number of known system leaks at the end of the year scheduled for repair is provided below:

	Workable Leak Backlog		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	Rhode Island	Actual	264	77	15	33	54	26	38	49	68	74	169
		Baseline	Rolling average since 2008 + 0.5 standard deviation (105 for 2008-2017)										

The baseline and ongoing performance of total damages per 1000 tickets is provided below (**INCLUDING** Excavation Damage Leaks):

Total Excavation Damages per 1000 Tickets		2010	2011	2012	2013	2014	2015	2016	2017	2018
Rhode Island	Actual	3.38	1.59	1.71	1.39	1.30	2.31	1.67	2.17	2.21
	Baseline	Rolling average since 2008 + 0.5 standard deviation (2 for 2008-2017)								

The baseline and ongoing performance of Total Leak Receipts is provided below (**EXCLUDING** Excavation Damage Leaks):

Total Leak Receipts		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Rhode Island	Actual	3,134	3,652	2,624	2,502	2,417	2,252	2,753	2,407	1,964	1,924	1,989
	Baseline	Rolling average since 2008 + 0.5 standard deviation (2,825 for 2008-2017)										

Above Baseline Comments:

1 - It should be noted that implementation of the 2018 Work Continuation Plan had a significant impact to work in this region.

The baseline and ongoing performance of the Response Time Performance are provided below:

Regular Day												
Response Time		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
30 Minutes	Actual	95.60%	95.30%	96.10%	96.10%	95.40%	95.60%	95.00%	95.26%	95.05%	95.48%	94.94%
	Baseline	94.38% as established by NGrid										

Nights & Weekends												
Response Time		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
45 Minutes	Actual	96.30%	95.80%	95.80%	96.50%	97.00%	96.40%	96.30%	95.96%	96.10%	95.69%	96.17%
	Baseline	95.27% as established by NGrid										

The baseline and ongoing performance of the Main Leak Rates (LEAK REPAIRS BY MILE OF MAIN) by Material are provided below (Excluding Excavation Damage Leaks):

EXCLUDING Damages

Main Leak Rates (LEAK REPAIRS BY MILE OF MAIN) by Material												
Rhode Island		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Cast Iron	Actual	1.54	1.65	1.1	1.09	1.13	0.93	1.19	1.25	0.83	0.98	1.25
	Baseline	Rolling average since 2008 + 0.5 standard deviation (1 for 2008-2017)										
All Steel	Actual	0.63	0.75	0.51	0.42	0.53	0.25	0.21	0.14	0.11	0.12	0.14
	Baseline	Rolling average since 2008 + 0.5 standard deviation (0 for 2008-2017)										
Plastic	Actual	0.28	0.25	0.19	0.18	0.01	0.01	0	0.01	0.01	0.01	0.01
	Baseline	Rolling average since 2008 + 0.5 standard deviation (0 for 2008-2017)										

The baseline and ongoing performance of the Service Leak Rates (LEAK REPAIRS BY 1000 SERVICES) by Material are provided below (Excluding Excavation Damage Leaks):

EXCLUDING Damages

Service Leak Rates (leak repairs per 1000 services) by Material Excluding Damages												
Rhode Island		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Copper	Actual	11.24	0	5.85	0	4.81	4.83	0	0	0	26.04	37.04
	Baseline	Rolling average since 2008 + 0.5 standard deviation (9 for 2008-2017)										
All Steel	Actual	5.08	8.98	6.35	6.41	6.72	9.33	11.39	6.57	7.94	9.81	7.71
	Baseline	Rolling average since 2008 + 0.5 standard deviation (9 for 2008-2017)										
Plastic	Actual	1.81	2.88	1.61	1.58	0.36	0.42	0.69	0.57	0.54	0.45	0.65
	Baseline	Rolling average since 2008 + 0.5 standard deviation (2 for 2008-2017)										

RHODE ISLAND APPENDIX F
PERIODIC EVALUATION AND IMPROVEMENT

2018 REGIONAL DISTRIBUTION INTEGRITY ASSESSMENT

Distribution Engineering has reviewed all of the findings in the annual Trend-Based Distribution System Integrity Analysis (*System Integrity Report*) in accordance with our Distribution Integrity Management Plan, and found leak receipts and repairs went up in 2017. There are no immediate causes for concern that would warrant changes to DIMP.

Below is a summary of the individual key integrity measure results for the following federal (PHMSA) filing entity that constitutes National Grid-US.

NATIONAL GRID 2018 System Integrity Report Summary REGIONS ITEMS	RI
• Leak Receipts	↑
• Workable Leak Backlog	↑
• LPP Main and Service Inventories	↓
• Overall Main Leak Rate	↑
• Cast Iron Main Break Rate	↑
• Steel Main Corrosion Leak Rate	▬
• Service Leak Rate	↓

Rhode Island (RI)

- Leak receipts increased slightly.
- Workable leak backlog decreased.
- Leak prone main and service inventories continue to decline steadily.
- Overall main leak rate increased. Steel main corrosion rate decreased and Cast Iron main break rate increased.
- Service leak rate decreased.

Form F-1: Periodic Updating and Review

Annual Evaluation of Performance Measures that Exceeded Baseline				
Performance Measure	Actual Performance for Year 2018	Established Baseline	Are additional measures beyond minimum code requirement necessary?	Has an engineering evaluation been completed and documented?
Leak Receipts	1,989	2,825	NO	Annual System Integrity Report
1 Workable leak Backlog	169	107	NO	Annual System Integrity Report
LPP Main Inventory	1,100 miles	1,140 miles (2017)	NO	Annual System Integrity Report
Overall Main Leak Rate	0.29	0.58	NO	Annual System Integrity Report
2 Cast Iron Main Break Rate	0.13	0.11	NO	Annual System Integrity Report
Steel main Corrosion Leak Rate	0.08	0.41	NO	Annual System Integrity Report
Service Leak Rate	2.32	3.74	NO	Annual System Integrity Report

Existing Date for Complete Program re-evaluation: 09/2021 Is a shorter timeframe for complete program re-evaluation warranted? : NO

Complete Re-evaluation was performed on 9/1/2016 - DIMP REV 5

Saadat Khan (Director) and Leomary Bader (DIMP Manager) Gas Distribution Engineering

Required frequency	Program Re-evaluation Element	Date Completed
Required Annually	Evaluate Performance Measures	8/2019
As needed	Update Knowledge of System Characteristics, Environmental Factors and Threats	8/2019
As needed	Update General Information	8/2019
As needed	Update Threat Identification	8/2019
As needed	Update Risk Evaluation and Ranking Process	8/2019
Required Annually	Update Risk Evaluation and Ranking of Risks	8/2019
As needed	Update Risk Evaluation and Ranking Validation	8/2019
As needed	Update Risk Evaluation and Ranking Process Improvement Action Plans	8/2019
As needed*	Update Action Plans	

Above Baseline Comments:

1 - It should be noted that implementation of the 2018 Work Continuation Plan had a significant impact to work in this region.

2 - Remediation projects: Main & Service Replacement – LPP and DIMP factor to prioritize segments.

RHODE ISLAND APPENDIX G
CROSS REFERENCE OF 49 CFR PART 192, SUBPART P REQUIREMENTS TO THE DIM PLAN

The table below provides a cross reference between 49 CFR Part 192, Subpart P (Gas Distribution Pipeline Integrity Management) and this Gas Distribution Integrity Management Plan.

49 CFR Part 192, Subpart P	DIM Plan Reference
§192.1005 No later than August 2, 2011 a gas distribution operator must develop and implement an integrity management program that includes a written integrity management plan as specified in § 192.1007.	3.0
§192.1007 A written integrity management plan must contain procedures for developing and implementing the following elements:	
§192.1007 (a) *Knowledge.* An operator must demonstrate an understanding of its gas distribution system developed from reasonably available information.	5.0, 5.1, 5.2, 5.3, 5.4, 5.5
§192.1007 (a) (1) Identify the characteristics of the pipeline's design and operations and the environmental factors that are necessary to assess the applicable threats and risks to its gas distribution pipeline.	5.3
§192.1007 (a) (2) Consider the information gained from past design, operations, and maintenance.	5.2
§192.1007 (a) (3) Identify additional information needed and provide a plan for gaining that information over time through normal activities conducted on the pipeline (for example, design, construction, operations or maintenance activities).	5.4
§192.1007 (a) (4) Develop and implement a process by which the IM program will be reviewed periodically and refined and improved as needed.	10.1, 10.2
§192.1007 (a) (5) Provide for the capture and retention of data on any new pipeline installed. The data must include, at a minimum, the location where the new pipeline is installed and the material of which it is constructed.	5.5
§192.1007 (b) *Identify threats.* The operator must consider the following categories of threats to each gas distribution pipeline: corrosion, natural forces, excavation damage, other outside force damage, material, weld or joint failure, equipment failure, incorrect operation, and other concerns that could threaten the integrity of the pipeline.	6.0
§192.1007 (b) An operator must consider reasonably available information to identify existing and potential threats. Sources of data may include, but are not limited to, incident and leak history, corrosion control records, continuing surveillance records, patrolling records, maintenance history, and excavation damage experience.	5.1, 6.0,
§192.1007 (c) *Evaluate and rank risk.* An operator must evaluate the risks associated with its distribution pipeline. In this evaluation, the operator must determine the relative importance of each threat and estimate and rank the risks posed to its pipeline. This evaluation must consider each applicable current and potential threat, the likelihood of failure associated with each threat, and the potential consequences of such a failure.	7.1, 7.2, 7.3
§192.1007 (c) An operator may subdivide its pipeline into regions with similar characteristics (e.g., contiguous areas within a distribution pipeline consisting of mains, services and other appurtenances; areas with common materials or environmental factors), and for which similar actions likely would be effective in reducing risk.	Non-Mandatory

49 CFR Part 192, Subpart P	DIM Plan Reference
§192.1007 (d) *Identify and implement measures to address risks.* 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).	8.1, 8.2
§192.1007 (e) (1) *Measure performance, monitor results, and evaluate effectiveness.* Develop and monitor performance measures from an established baseline to evaluate the effectiveness of its IM program. …… These performance measures must include the following: (i) Number of hazardous leaks either eliminated or repaired, per § 192.703(c), categorized by cause; (ii) Number of excavation damages; (iii) Number of excavation tickets (receipt of information by the underground facility operator from the notification center); (iv) Total number of leaks either eliminated or repaired, categorized by cause; (v) Number of hazardous leaks either eliminated or repaired per § 192.703(c), categorized by material; and (vi) Any additional measures the operator determines are needed to evaluate the effectiveness of the operator's IM program in controlling each identified threat.	9.1 – 9.6
§192.1007 (e) (1) *Measure performance, monitor results, and evaluate effectiveness.* …. An operator must consider the results of its performance monitoring in periodically re-evaluating the threats and risks.	10.2
§192.1007 (f) *Periodic Evaluation and Improvement.* An operator must re-evaluate threats and risks on its entire pipeline and consider the relevance of threats in one location to other areas.	7.1, 10.1
§192.1007 (f) Each operator must determine the appropriate period for conducting complete program evaluations based on the complexity of its system and changes in factors affecting the risk of failure. The operator must conduct a complete program reevaluation at least every five years. The operator must consider the results of the performance monitoring in these evaluations.	10.2
§192.1007 (g) *Report results.* Report, on an annual basis, the four measures listed in paragraphs (e)(1)(i) through (e)(1)(iv) of this section, as part of the annual report required by § 191.11. An operator also must report the four measures to the state pipeline safety authority if a state exercises jurisdiction over the operator's pipeline.	11.1
§192.1009 Each operator must report, on an annual basis, information related to failure of mechanical fittings, excluding those that result only in nonhazardous leaks, as part of the annual report required by §191.11 beginning with the report submitted March 15, 2011. This information must include, at a minimum, location of the failure in the system, nominal pipe size, material type, nature of failure including any contribution of local pipeline environment, coupling manufacturer, lot number and date of manufacture, and other information that can be found in markings on the failed coupling. An operator also must report this information to the state pipeline safety authority if a state exercises jurisdiction over the operator's pipeline.	11.1
§192.1011 An operator must maintain records demonstrating compliance with the requirements of this subpart for at least 10 years. The records must include copies of superseded integrity management plans developed under this subpart.	12.0

49 CFR Part 192, Subpart P	DIM Plan Reference
§192.1013 (a) An operator may propose to reduce the frequency of periodic inspections and tests required in this part on the basis of the engineering analysis and risk assessment required by this subpart. (b) An operator must submit its proposal to the PHMSA Associate Administrator for Pipeline Safety or, in the case of an intrastate pipeline facility regulated by the State, the appropriate State agency. The applicable oversight agency may accept the proposal on its own authority, with or without conditions and limitations, on a showing that the operator's proposal, which includes the adjusted interval, will provide an equal or greater overall level of safety. (c) An operator may implement an approved reduction in the frequency of a periodic inspection or test only where the operator has developed and implemented an integrity management program that provides an equal or improved overall level of safety despite the reduced frequency of periodic inspections.	Not covered by DIM Plan
§192.1015 (a) (a) General. No later than August 2, 2011 the operator of a master meter system or a small LPG operator must develop and implement an IM program that includes a written IM plan as specified in paragraph (b) of this section. The IM program for these pipelines should reflect the relative simplicity of these types of pipelines. (b) Elements. A written integrity management plan must address, at a minimum, the following elements: (1) Knowledge. The operator must demonstrate knowledge of its pipeline, which, to the extent known, should include the approximate location and material of its pipe-line. The operator must identify additional information needed and provide a plan for gaining knowledge over time through nor-mal activities conducted on the pipeline (for example, design, construction, operations or maintenance activities). (2) Identify threats. The operator must consider, at minimum, the following categories of threats (existing and potential): Corrosion, natural forces, excavation damage, other outside force damage, material or weld failure, equipment failure, and incorrect operation.(3) Rank risks. The operator must evaluate the risks to its pipeline and estimate the relative importance of each identified threat. (4) Identify and implement measures to mitigate risks. The operator must determine and implement measures designed to reduce the risks from failure of its pipeline. (5) Measure performance, monitor results, and evaluate effectiveness. The operator must monitor, as a performance measure, the number of leaks eliminated or repaired on its pipe-line and their causes. (6) Periodic evaluation and improvement. The operator must determine the appropriate period for conducting IM program evaluations based on the complexity of its pipeline and changes in factors affecting the risk of failure. An operator must re-evaluate its entire pro-gram at least every five years. The operator must consider the results of the performance monitoring in these evaluations. (c) Records. The operator must maintain, for a period of at least 10 years, the following records: (1) A written IM plan in accordance with this section, including superseded IM plans; (2) Documents supporting threat identification; and (3) Documents showing the location and material of all piping and appurtenances that are installed after the effective date of the operator's IM program and, to the extent known, the location and material of all pipe and appurtenances that were existing on the effective date of the operator's program.	2.0

EXHIBIT B

nationalgrid

RI Service Replacement Program

Gas Distribution Engineering
Leomary Bader, Manager
Saadat Khan, *Director*

March 2019

Background

nationalgrid

- In last 5 years 2,098 services were replaced due to corrosion leaks*
- Corrosion leaks are slightly down in 2018 due to milder temperatures.

Year	Corrosion
2018	314
2017	460
2016	395
2015	332
2014	597
TOTAL	2098

**2,098 leaks is assumed to correlate to 2,098 relays*
The 2018 Leak repair data may vary slightly from the 2018 DOT report

Methodology

nationalgrid

- Data analysis is based on service corrosion leaks during last 5 years (2011-2015)

- Identified services most susceptible to corrosion leaks based on:
  - Age
  - Size
  - Material
  - Meter Location (Inside/Outside)
  - Pressure (HP/LP)

Risk Score Calculation

nationalgrid

Size Summary:					
Diameter	w/previous leaks	All srvcs	%	Comments	1-10 Scale
1	160	7087	2.26%	--	10.0
1.25	340	16457	2.07%	--	9.2
2.5	1	20	5.00%	Use 1.25	9.2
1.125	5	205	2.44%	Use 1.25	9.2
unknown	23	2098	1.10%	Use 1.25	9.2
1.5	549	37263	1.47%	--	6.5
2	62	4930	1.26%	--	5.6
3	3	618	0.49%	Use 2	5.6
0.625	1	389	0.26%	Use 0.75	2.0
0.75	98	22065	0.44%	--	2.0
4	2	494	0.40%	--	1.8
8	1	21	4.76%	Use 4	1.8
6	2	137	1.46%	Use 4	1.8

Age Summary:						
Install Decade	w/previous leaks	All srvcs	%	Comments	Adjusted %	1-10 Scale
1890s	2	9	22.22%	Use 1910s	3.17%	10.0
1900s	4	121	3.31%	Use 1910s	3.17%	10.0
1910s	163	5148	3.17%	--	3.17%	10.0
Unknown	256	10354	2.47%	Use 1920s	2.14%	6.8
1920s	277	12958	2.14%	--	2.14%	6.8
1930s	111	7266	1.53%	--	1.53%	4.8
1940s	103	7289	1.41%	--	1.41%	4.5
1950s	121	11685	1.04%	--	1.04%	3.3
1960s	101	20473	0.49%	--	0.49%	1.6
1980s	6	1664	0.36%	Don't Use	N/A	0.0
1970s	10	12499	0.08%	Don't Use	N/A	0.0
1990s	1	1670	0.06%	Don't Use	N/A	0.0

Material Summary:						
Material	w/previous leaks	All srvcs	%	Comments	Adjusted %	1-10 Scale
Cast Iron	1	89	1.12%	Use 2.5x weight	3%	10.0
Bare Steel	1152	66003	1.75%	--	1.75%	6.2
Unknown	14	1511	0.93%	Use BS	1.75%	6.2
Copper	2	389	0.51%	Use BS	1.75%	6.2
Wrapped Steel	78	23793	0.33%	--	0.33%	1.2

Adjusted some of the ratios due to small data sets.

- Illustrates the types of services that are more prone to corrosion leaks

Risk Score Calculation

nationalgrid

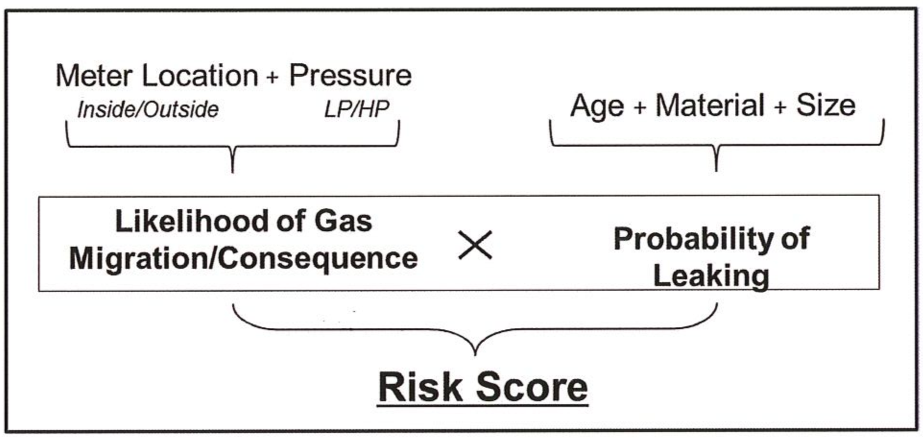
Meter Location Summary:					
Location	**w/previous leaks**	**all srvcs**	**%**	**Comments**	**1-10 Scale**
Inside Set	631	59,895	1.05%	Use 3x weight	10.00
Outside Set	545	19,468	2.80%	Use 1x weight	8.86

Pressure Summary:					
Pressure	**w/previous leaks**	**All srvcs**	**%**	**Comments**	**1-10 Scale**
LP	1,017	62,048	1.64%	Use 1x weight	8.8
HP	138	29,716	0.46%	Use 4x weight	10.0

- Created individual risk scores based on the historical service corrosion data

Risk Ranking Algorithm

nationalgrid



- Risk scores were calculated on all steel, CI, copper and unknown services

- Top highest scored services that are not on scheduled for upcoming projects (main replacement, public works, etc.) will be selected for FY18 replacement

Geographical Location

nationalgrid

- Mainly Providence area
- Scattered “pockets”

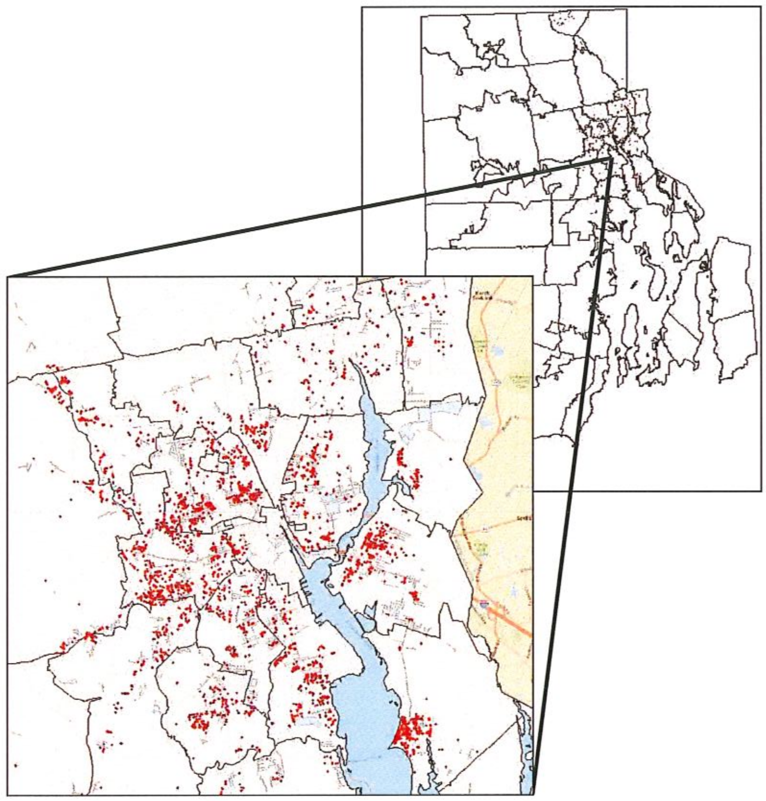


EXHIBIT C

State of Rhode Island
Division of Public
Utilities & Carriers

DIVISION OF PUBLIC UTILITIES AND CARRIERS
89 Jefferson Blvd. FAX (401) 941-4885
Warwick, R.I. 02888
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Terry Sobolewski, President
National Grid - Gas
280 Melrose Street
Providence, RI 02907

December 11, 2019

Notice of Concern: Copper Services

The Rhode Island Division of Public Utilities and Carriers (Division), through an agreement with the U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA), is charged with enforcement of the **Pipeline Safety Code of Federal Regulations CFR Chapter 49 Parts §190-§199 and Part §40**, inclusive. These regulations pertain to the safe operation and maintenance of underground natural gas pipelines within Rhode Island. The above-mentioned regulations give the Division the authority to observe and review construction and maintenance procedures and records of all utilities operating natural gas pipelines.

The Division inspected National Grids (Company) Distribution and Integrity Management Plan (DIMP), dated 8/2/2019 Rev 8, on November 13, 2019 for compliance with the **Federal Pipeline Safety Regulations CFR 49 Part §192.1007(d) What are the required elements of an integrity management plan?** Per **Part §192.1007(d)** *Identify and implement measures to address risks.* Each operator shall, "Determine and implement measures designed to reduce the risks from failure of its gas distribution pipeline."

Page 33, Section 6.2.4 **Copper Piping** states that "Copper services may be subject to leakage caused by corrosion. In particular, direct buried copper services may be subject to advanced rates of corrosion in the presence of dissolved salts in the soil. (e.g., deicing salts to melt ice and snow on road surfaces). Corrosion on National Grid's copper services has been limited to locations where it was connected to dissimilar metal without insulating joints to provide isolation between two dissimilar metals. Records of where and when these dissimilar metals were installed do not exist."

Page 39 of the **2018 System Integrity Report, Service Inventory,** incorporated by reference in the DIMP Plan, states that Rhode Island had 189 known copper services.

Per page RI-24 (see Exhibit "A") copper services have the highest risk scoring for gas services in your DIMP Plan with risk scores rated at 7.46, 6.10, and 5.97.

Page 43 of the **2018 System Integrity Report, 2009-2018 Service Leak Repairs,** Rhode Island reported 29 leaking copper gas services. On page RI-43, Appendix E, in the DIMP Plan the Company reported, of the 29 leaks, 6 were classified as grade 1 leaks, the Company classifies a grade 1 leak as <u>any</u> readings of natural gas within 5 feet of a foundation of a house or building. The 6 grade 1 leaks are determined to be well above the standard deviation of "1" as shown on the chart. (see Exhibit "B"). The chart states, "Baseline Rolling average since 2008 + 0.5 standard deviation (1 for 2008-2017)". A comment at the bottom of the page RI-43 the Company states, "*We are monitoring the cause and will take appropriate action if the number keeps increasing.*"

On page RI-48, **2018 Regional Distribution Integrity Assessment**, the Company in conclusion states, "There are no immediate causes for concern that would warrant changes to DIMP".

The Division, based on this information has serious concerns related to the remaining 189 copper services in Rhode Island. The Division, on the day of the inspection, requested the Company provide the actual gas leak survey records related to the 6 grade 1 leaks referenced in the 2018 DIMP Plan, with the associated percentages of gas found, the addresses where they occurred, the operating pressures of the copper services, and the dates when the gas services were installed. After reviewing the 6 grade 1 leak records that occurred in one year, the Company corrected the report to 5 grade 1 leaks, one leak was actually graded as a grade 2, and should not of been reported as a grade 1. Of the 5 grade 1 copper service leaks, 4 were located with-in a small cluster of houses found on Water Street in Warren, RI, at addresses #101, #139, #194, and #211. All the gas services operated at high pressure 60 psi, 3 services were installed in 1939, and 1 service was installed in 1976.

The corrosion leak found at #194 Water Street has readings of 32% gas at the foundation, realize 1% gas at the foundation is considered hazardous, there also was a reading of 67% gas at the curb located only about six (6) feet from the foundation of the building, and there was a reading of 4% gas found in a nearby manhole.

The equipment leak found on the fitting at #211 Water Street read 7% gas at the foundation and the corrosion leak found on a fitting at #139 Water Street read 5 LEL at the inside wall. These were very serious gas leak situations that fortunately were repaired before further gas was allowed to migrate into the buildings. Looking further into data provided by the Company related to copper gas services, the Division reports that there are still twenty-seven (27) more copper services operating at 60 psi with the same installation dates of 1940 on Water Street in Warren, RI. The addresses of this cluster of homes ranges from #49 - #376.

As background, Water Street in Warren, Rhode Island is a historic town where most of the houses are located at the curb with very little set back and many may still have their original fieldstone foundations. A gas leak in the street is trapped under wall to wall paving and cement sidewalks in many cases, the gas has little areas to vent out and will follow the paths of least resistance. The Company that originally installed these gas lines belonged to a legacy Company called The Bristol-Warren Gas Company. This is not the first time the Division has addressed the gas lines located on Water Street. This same high-risk situation, high pressure gas, houses with fieldstone foundations, located at curbside, was addressed in 2017 when the Division witnessed several gas service line location mismarks on Water Street due to the poor record keeping associated with the former legacy company, the Division brought this safety concern to the Company's attention and the Company agreed to spend more time monitoring a major water replacement project that was on-going. The Division was concerned if a high-pressure gas line was struck by a backhoe the high pressure could release into the basement of homes located just off the curb.

On page RI-34 of the DIMP Plan, section PROACTIVE SERVICE REPLACEMENT, the Company references an older risk-based high-pressure steel service replacement program that was focused on inside meter sets that penetrated the foundations of homes and businesses. Since this program apparently is no longer in operation the Division requests the Company reevaluate your DIMP Plan conclusion stated on page RI-48, **2018 Regional Distribution Integrity Assessment**, the Company in conclusion states, "There are no immediate causes for concern that would warrant changes to DIMP". The above risk data when reviewed in its entirety paints a similar picture from a risk standpoint as did the former steel service replacement program. The Division requests in writing a response to this Notice of Concern with-in thirty (30) days from receipt.

* * * * * *

If you have any further questions please feel free to contact me.

Robert Bailey, P.E.
Supervising Civil Engineer
RIDPUC

cc: Linda George, Acting Administrator, RIDPUC
Don Ledversis, RIDPUC Consultant
Alberico Mancini, RIDPUC Accounting
Regina Maddox, National Grid Gas Regulatory Compliance