STATE OF NEW YORK

PUBLIC SERVICE COMMISSION

Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Gas Service	CASE 16-G-0061

DIRECT TESTIMONY

OF

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ENVIRONMENTAL DEFENSE FUND

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New York, New York

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I. BACKGROUND

Q. Please state your name, title, and business address. By whom are you employed and in what capacity?

A. My name is Virginia Palacios. I am a Senior Research Analyst in the US Climate and Energy Program at the Environmental Defense Fund ("EDF"). My business address is 301 Congress Avenue, Austin, TX 78701.

Q. On whose behalf are you submitting testimony in this proceeding?

A. I am submitting this testimony on behalf of EDF.

Q. Please provide a summary of your education and experience.

A. I hold a Masters of Environmental Management from Duke University and a B.S. in Aeronautical Science from Embry-Riddle Aeronautical University. I have worked at EDF for four years, having joined the organization in 2012 as a Research Associate, later promoted to Research Analyst, and currently serve as Senior Research Analyst. In all, I have five years of experience working on issues relating to the natural gas sector.

In my current role, I provide technical expertise on scientific and regulatory concepts related to local distribution pipeline safety, lost and unaccounted for gas, and quantification of methane emissions from local distribution system pipelines. I also analyze quantitative and geospatial data related to methane leakage in the natural gas sector.

In my previous position as a Research Analyst at EDF I investigated local, state, and federal rules related to local distribution pipelines safety and lost and unaccounted for gas, and developed an understanding of how methane emissions from local distribution system pipelines can be quantified. Some of my work, which involved geospatial attribution of methane emission data, was published in two peer-reviewed articles. (Lyon, D., *et. al.* (2015). *Constructing a Spatially Resolved Methane Emission Inventory for the Barnett Shale Region.* Environmental Science and Technology. http://doi.org/10.1021/es506359c; Zavala-Araiza, D., *et. al.* (2015). *Towards a*

Functional Definition of Methane Super-Emitters: Application to Natural Gas Production Sites. Environmental Science and Technology. http://doi.org/10.1021/acs.est.5b00133.) Additionally, I reviewed reports on regulatory frameworks for controlling methane emissions in the natural gas sector, and a report on the costs of lost and unaccounted for gas. (Paranhos, E., *et. al.* (2015). *Controlling Methane Emissions in the Natural Gas Sector: A Review of Federal & State Regulatory Frameworks Governing Production, Gathering, Processing, Transmission, and Distribution*. Golden, CO; Webb, R. (2015). *Lost but not forgotten: The hidden environmental costs of compensating pipelines for natural gas losses*. Austin, Texas.)

When I began working for EDF as a Research Associate, I conducted regulatory comparisons and data analysis related to the oil and gas industry, with a particular focus on federal and state regulations on distribution system integrity management, Supervisory Control And Data Acquisition ("SCADA") leak detection systems, cost recovery mechanisms, lost and unaccounted for gas, and pipeline mileage and leakage data provided in Pipeline and Hazardous Materials Safety Administration ("PHMSA") Annual Distribution System reports.

In 2014, I presented at and participated in the PHMSA Research and Development Forum Working Group on Leak Detection and Fugitive Methane. The Forum Working Group provided recommendations on research priorities for leak detection and fugitive methane to PHMSA, for federal funding of potential research and development projects. After the Forum, PHMSA awarded nearly $3 million in grants for projects including an emissions quantification validation process, and a natural gas pipeline leak rate measurement system.

Prior to my time at Environmental Defense Fund, I was a Research and Campaign Associate at Rio Grande International Study Center in Laredo, Texas where I researched and presented information on potential environmental and community-level risks of oil and gas development to community members and elected officials. I also coordinated town halls, hosting panels with state agency representatives, industry representatives, and citizens.

At Duke University, I held a position as a Soil Nutrient Analysis Technician in the Jackson Laboratory. In this position I compiled data from peer-reviewed journal articles for a meta-analysis on the inorganic carbon content of grassland soils. I also collected and prepared soil samples for carbon-nitrogen analysis.

Q. Please provide a summary of your testimony.

A. EDF is proposing that the New York Public Service Commission ("Commission") require Consolidated Edison Company of New York, Inc. ("Con Edison" or the "Company") to incorporate spatially-attributed leak flow rate data in leak repair and pipeline replacement prioritization activities. Spatial attribution of leak flow rate data involves recording an observed leak flow rate with the geographic coordinates (e.g. latitude and longitude) of the leak.

EDF and the Company are currently collaborating on a pilot project aimed at demonstrating the benefits of using data on leak flow rate to prioritize leak repairs, and minimizing leaks from the Company's distribution system. As part of this project, a team that includes EDF staff and researchers from Colorado State University ("CSU") is managing and executing a survey of areas identified by the Company in its service territory where it is targeting the repair of its Type 3 leak backlog in order to quantify gas flow rate from those leaks, so that this data can be used by Con Edison to prioritize leaks for repair.

The new survey methodology being used in the pilot, will provide the Company, the Commission and other parties with quantitative information about the condition of Con Edison's subsurface mains, including spatially-attributed leak flow rate and leak density. The data will enhance the Company's ability to implement and manage such efforts and can potentially assist the Commission in rendering determinations regarding allocation of customer money for the Company's leak abatement activities.

As described later in my testimony, incorporating leak flow rate data into leak repair and pipeline replacement prioritization provides enhanced efficiency and cost-effectiveness for capital investments, thereby benefitting ratepayers, and also presents environmental benefits. Spatially-attributed leak flow rate data can aid the Commission in tracking and verifying these benefits.

EDF has collaborated with other utilities to demonstrate the benefits of incorporating leak flow rate data into leak repair and pipeline replacement prioritization. For example, EDF recently collaborated with Public Service Gas & Electric ("PSE&G"), New Jersey's largest and oldest publicly owned utility, to incorporate leak flow rate data in prioritizing leak repair and pipeline replacement. The New Jersey Board of Public Utilities, PSE&G, and other parties recognized the safety, ratepayer and environmental benefits of using data on leak flow rate to prioritize large scale system modernization efforts. There are significant benefits to be gained from using a similar approach in designing and implementing Con Edison's leak repair and pipe replacement efforts.

The Company's proposal to test new and advanced leak detection technology that has higher sensitivity thresholds will enhance leak detection capabilities and leak survey datasets and is a step in the right direction. Several utilities across the country have already started integrating such new technological solutions into their regular operations. (*See, e.g.* PSE&G example above; *See, e.g.* case study in Wei, J., Menzie, M., & Jenkins, L. (2016). *A new view on pipeline risks -How spatial analytics can empower asset management for gas utility companies*. *Available at:* http://www.pwc.com/us/en/power-and-utilities/publications/assets/pwc_gas_pipeline_spatial_analytics_april_2016.pdf.)

The use of performance metrics for leak management, as described in Con Edison's testimony (Gas Policy Panel Testimony. P. 26, lines 8 – 19), is beneficial and can potentially play a significant role in advancing utility performance. However, to the extent that advanced leak detection technology is integrated into the Company's operations, any such metrics must be thoughtfully constructed.

As utilities transition to advanced leak detection technologies that are more sensitive than traditional leak detection equipment, they are likely to experience an overall surge in the number of leaks detected on their systems, all else being equal. Such an increase in leak backlogs may necessitate a new baseline or framework for measuring progress in pipeline integrity management.

Q. Are you sponsoring any exhibits to your testimony?

A. Yes. I offer Exhibit__ (VP-1), which is a compilation of the discovery responses from the Company that we relied upon in preparing our testimony, some of which we expressly reference. I also offer Exhibit__ (VP-2), which includes sample leak attribution maps developed by EDF in collaboration with PSE&G, New Jersey. I lastly offer Exhibit__ (VP-3), which is the Framework Agreement between Con Edison and EDF. This Framework Agreement, as discussed further below, sets forth the broad context and contours of a pilot project between EDF and the Company to address the repair of Con Edison's type 3 leak backlog.

II. PURPOSE AND SCOPE OF TESTIMONY

Q. What is the purpose and scope of your testimony?

A. The Company's request for funding to accelerate its pipe replacement and leak repair activities and to explore the use of advanced leak detection equipment is necessary and appropriate. The purpose of my testimony is to explain the nature and results of EDF's collaborative leak survey pilots, including with the Company, that demonstrate the benefits of using advanced leak detection and quantification methods to better prioritize leak repair and pipe replacement efforts. In addition to adopting advanced leak detection technology, the Company would optimize the benefits associated with its system maintenance and modernization efforts by using leak flow rate quantification methodologies with geospatial attribution of leaks to more efficiently prioritize leak repairs and the replacement of leak-prone gas infrastructure.

Q. Please summarize your understanding of Con Edison's proposed Distribution Supply Improvement Programs, and other initiatives proposed by the Company to minimize leaks and methane emissions from its pipes.

A. Con Edison is seeking approval of a surcharge mechanism to finance several projects falling under the umbrella of its Distribution System Improvement Program. Some of the goals of Con Edison's programs, as stated on page 38 of the Company's Gas Infrastructure and Operations Panel ("GIOP") Testimony, are to improve safety, reduce risk, and maintain or enhance operational excellence. The Company's GIOP Testimony additionally states on page 38 that it plans to "target replacement or rehabilitation of cast iron and unprotected steel mains that can potentially leak." According to the GIOP Testimony on page 39, "programs that directly achieve this goal include Supply Main Planned Reinforcement, Emerging Supply Mains Reliability, and Rehabilitation of Large Diameter Gas Mains."

Con Edison is partnering with EDF to quantify methane emissions from its non-hazardous gas leaks backlog (*see* Exhibit__ (VP-3)). The objective of this project, as provided in the Company's Gas Policy Panel ("GPP") Testimony on page 23, is to demonstrate the benefits of using leak flow rate data to prioritize the repair of non-hazardous leaks, thereby reducing the overall system-wide leak rate, which will advance ratepayer and environmental interests by reducing the rate of methane emissions from the Company's gas distribution system. In addition, the Company's GPP Testimony states on page 21 that the Company is seeking funding to purchase and test Picarro leak detection equipment in order to better understand the technology's leak detection capabilities and find better ways to survey leaks. On page 150 of the Company's GIOP Testimony, the Company also proposes an incentive performance metric, with respect to leak management and other aspects of its operations that would allow it to earn a positive revenue adjustment of two basis points for exceeding the 2016 established metric for leak management, with total positive revenue adjustments for this and other performance metrics capped at ten basis points.

III. <u>EXISTING UTILITY PRACTICE AND REGULATORY CONTEXT</u>

Q. Are utilities currently using leak flow rate to prioritize leak abatement and pipeline replacement activities?

A. Utilities do not routinely use leak flow rate to prioritize their leak abatement or pipeline replacement activities, although Con Edison currently considers operating pressure as a factor that accounts for the volume of gas leaking from pipeline segments in order to calculate a main replacement prioritization risk score (*See* Exhibit__ (VP-1), at page 3). Con Edison has indicated on page 23 of the GIOP Testimony that it sees merit to using leak quantification as part of its leak abatement activities in order to achieve environmental benefits and improve system safety. Several utilities, such as PSE&G, are beginning to explore the use of leak flow rate quantification methods. As a part of its 2013 rate case, Con Edison announced four collaborative projects with technical experts and other utilities, one of which is evaluating methods to quantify gas leaked from its system in order to maximize the benefits of efforts spent repairing and abating Type 3 leaks, some of which might otherwise indefinitely persist without repair. (Con Edison Media Relations. December 17, 2014. *Con Edison Steps Up Gas Safety Patrols, Studying New Ways To Quantify Methane Emissions, Accelerate Gas Main Replacement*. *Available at*: http://www.coned.com/newsroom/news/pr20141217.asp.) Similarly, in California, Pacific Gas & Electric Co. ("PG&E") is exploring how to integrate leak quantification technology into its leak management efforts. (*See generally:* PG&E. January 26, 2015. *PG&E Launches Next Phase of its Industry-Leading Gas Leak Management Strategy*. *Available at*: http://www.pge.com/en/about/newsroom/newsdetails/index.page?title=20150126_pge_launches_next_phase_of_its_industry-leading_gas_leak_management_strategy; *See generally* PG&E. November 1, 2012. *PG&E's Use Of Picarro Technology Enhances Natural Gas System Safety Throughout PG&E Service Area*. *Available at*: http://www.pge.com/about/newsroom/newsreleases/20121101/pgampes_use_of_picarro_technology_enhances_natural_gas_system_safety_throughout_pgampe_service_area.shtml.)

Q. Please explain any relevant aspects of the prevailing regulatory and policy context as it relates to the use of leak quantification technology by utilities.

A. The federal rules establishing integrity management requirements for gas distribution pipeline systems (the "Distribution Integrity Management Program for Natural Gas Distribution Sector" ("DIMP")) came into effect in 2011, and are codified at 49 C.F.R. 192 (2009). Under the rules, operators are required to develop and implement a distribution integrity management program. While the rules do not explicitly require utilities to quantify leaks, they state that (a) pipeline operators must consider all reasonably available information to identify threats to pipeline integrity and (b) the number and severity of leaks can be important information in evaluating the risk posed by a pipeline in a given location (49 C.F.R. §192.1007 (2009)). Under the rules, operators are required to consider the following categories of threats to each gas distribution pipeline: corrosion, natural forces, excavation damage, other outside force damage, material or welds, equipment failure, incorrect operations, and other concerns that could threaten the integrity of its pipeline (*Id.*). Sources of data may include, but importantly, are <u>not</u> limited to, incident and leak history, corrosion control records, continuing surveillance records, patrolling records, maintenance history, and excavation damage experience (*Id.*).

With technology evolving to make leak quantification methods commercially available and viable, and PHMSA rules requiring operators to consider all relevant data points in identifying threats to pipeline integrity, it is clear that the prevailing regulatory framework not only allows for leak flow rate to be considered in evaluating threats to pipeline integrity, but in fact, underscores the need to do so. Utilities are already making use of leak quantification technology, as reflected in the examples discussed above.

IV. <u>EDF'S ONGOING COLLABORATIONS WITH THE COMPANY AND OTHER UTILITIES ON THE USE OF LEAK QUANTIFICATION TO PRIORITIZE UTILITY LEAK REPAIR AND PIPE REPLACEMENT PROJECTS</u>

Q. Please provide a brief overview of the EDF-Google mobile methane leak survey project and EDF's engagement with utilities on the use of leak quantification methodology to prioritize pipe replacement and leak repair programs.

A. In collaboration with Google Earth Outreach, CSU, and a number of natural gas utilities, EDF is managing a project that uses Google Street View cars equipped with Picarro methane concentration analyzers to quantify methane leaks from distribution pipelines in cities. The data collected from this project is being used to create spatially-resolved analyses of the location and size of leaks in utilities' distribution systems. These maps have been referenced in several reports and presentations, including, for instance, the U.S. Department of Energy's ("DoE") Quadrennial Energy Review ("QER"), which was released in April, 2015. Further explanation of the methodological approach and scientific research underpinning this project is contained in the direct testimony of EDF expert witness Dr. Joe von Fischer.

The objectives of this project are (1) to enhance the efficiency of processes that utilities and other stakeholders use reduce the volumes of wasted natural gas and methane emissions from leaks, and (2) to demonstrate the means by which utilities can consider leak flow rate in prioritizing the replacement of leak-prone gas infrastructure and the repair of leaks on their systems. By allowing utilities to focus on abating the largest leaks first, all else being equal, leak quantification can enhance the cost effectiveness of leak repair and pipe replacement programs, thereby advancing ratepayer interests and benefitting the environment.

As an example of spatially-referenced leak flow rates, Exhibit__ (VP-2) contains a sample leak map based on fictitious and randomly generated data, reflecting the type of spatially-attributed leak data and visual tool that can be produced using mobile methane surveys. This sample map illustrates a layer of data that can be used to optimize the economic and environmental outcomes of utilities' leak management efforts.

As part of a collaborative pilot project between EDF and PSE&G, similar data on leak flow rate relating to sections of PSE&G's service territory was collected by EDF using advanced leak detection and leak quantification methods. In November 2015, the New Jersey Board of Public Utilities ("BPU") approved a settlement agreement among PSE&G, EDF, and other parties relating to a proceeding in which PSE&G sought approval for an accelerated pipe replacement program. As part of this settlement, PSE&G has received BPU approval to implement a $905 million accelerated pipe replacement program over a three year time frame.

Under the collaborative arrangement between the two entities, PSE&G shared information with EDF on the location and type of its pipelines, enabling the collection of leak flow rate data that was spatially-attributed to specific pipes targeted for replacement by PSE&G. Under the terms of the settlement, PSE&G will, after taking safety considerations into account, use data gathered by EDF on the flow rate of methane emissions leaked from its pipes to help prioritize pipeline replacement. EDF is in the process of engaging with other utilities across the country in order to advance the integration of this methodological approach into utilities' regular leak operations.

Q. Please explain how the new survey methodology developed by EDF and its partners can assist the Commission and the Company in assessing the extent of need for and benefits from leak abatement and pipeline repair projects.

A. The scope of each of the Company's pipeline replacement projects has not yet been finalized. (*See* Exhibit__ (VP-1) at, page 28.) An opportunity is thus available to consider leak flow rate in main replacement prioritization.

Spatially-attributed leak data that are developed by connecting leak flow rates with information on the nature and location of utility infrastructure can aid in effective and transparent decision making, offering significant benefits to utilities and regulatory agencies. For instance, spatially-attributed leak flow rate data can help to characterize the condition of pipeline systems, and highlight where the needs for leak repair and pipeline replacement programs are greatest. Quantitative and spatially-referenced leak data can improve the design and implementation of such programs by allowing utilities to focus on the sections of their infrastructure with the largest leaks or the highest leak density, where appropriate.

Leak quantification and spatial attribution allows utilities and regulatory agencies to evaluate the progress, management, and implementation of leak repair and pipeline replacement programs. This is achieved first through the generation of a verifiable format that identifies known spatially-referenced leaks. Con Edison already plans to incorporate Picarro leak survey data, including geographic coordinates into its Gas Work and Asset management system, which will facilitate these objectives. (*See* Exhibit__ (VP-1) at page 7.)

Second, evaluation can include comparison of reductions in leaked gas volumes before and after the leak repair or pipeline replacement program is implemented. Currently, Con Edison uses emission factors associated with cast iron and unprotected steel mains to estimate methane emissions reductions from pipeline replacement activities, as reported under the U.S. Environmental Protection Agency's Subpart W of the Clean Air Act. (*See* Exhibit__ (VP-1) at page 4.) However, actual methane emission reductions would likely be different when measured, and this method does not take into account leak sizes that can arise on other pipeline materials. Leak quantification methodologies, and the leak maps and other visual tools that can be developed using these methods, allow regulatory agencies responsible for allocating ratepayer money to better assess the need for pipeline replacement or leak repair on different pipeline materials.

The evaluation of proposed pipeline replacement programs by state regulatory entities necessitates a robust cost-benefit analysis, requiring careful scrutiny of all available information, including negative external social costs of methane emissions. (Case 14-M-0101, *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, Order Establishing the Benefit Cost Analysis Framework (issued January 21, 2016).) Leak quantification will facilitate such cost-benefit analysis by providing new information on the size of methane leaks in utilities' distribution systems that was not previously available.

The Commission, as is the case with other state utility commissions around the country, is being asked by utilities to allocate significant amounts of customer money to fund expanded leak abatement programs, which include leak-prone pipe replacement and leak repair projects. The policy context for such programs is described at length in the DoE's 2015 Quadrennial Energy Review and stems from a 2011 "Call to Action" by then Secretary LaHood of the U.S.

Department of Transportation for gas distribution utilities to accelerate their activities to replace and remove leak prone pipe from their systems. (U.S. Department of Transportation. 2011. *Call to Action To Improve the Safety of the Nation's Energy Pipeline System*. *Available at*: http://www.phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/110404%20Action%20Plan%20Executive%20Version%20_2.pdf.) As the Commission is well aware, natural gas leaks pose a safety and environmental threat and squander customer money for gas purchased but then leaked. While the impetus for accelerated pipeline replacement programs is clear and is supported by federal regulations (49 C.F.R. 192 (2009)), this Commission and its counterparts around the country are required to balance customer costs and interests with the need for pipe replacement and leak abatement. However, the details relating to the specific subsurface conditions and the magnitude of underground main leaks are not available, which complicates the task of both assessing the extent of need for leak repair or pipeline replacement, and overseeing the implementation and progress of programs once approved. The leak detection and quantification methods that EDF helped to pioneer provide additional data and perspective around underground infrastructure condition, leak magnitude, and program need. These methods serve as tools that can help the Company and the Commission to better balance program need with cost. This is particularly relevant with respect to the additional leaks that the Company has found by increasing its leak survey frequency. From October 2014 through April 2016, the Company surveyed for leaks once per month, finding additional leaks – a total of 799 during that time period (*see* Exhibit__ (VP-1) at page 2). The Company has noted that repairing these additional leaks ultimately improves public safety. To the extent that some of these leaks are non-hazardous, but warrant repair as a means of improving system reliability and integrity, the Company can efficiently reduce lost gas through prioritizing the largest non-hazardous leaks for repair.

Q. Please explain the benefits of using leak quantification to prioritize pipeline replacement and leak repairs.

A. The benefits of using spatially-attributed leak flow rate to prioritize pipeline replacement and leak repairs include (1) efficient use of ratepayer funding for infrastructure improvements; (2) availability of data that enhances system condition assessments, risk assessments, and decision making capability; (3) transparency for utilities, regulators, and ratepayers; and (4) avoided social costs of climate change.

Spatially-attributed leak flow rate data has a valuable role to play in the management of non-hazardous leaks. Because utilities are required to repair hazardous leaks immediately, or otherwise schedule hazardous leaks for prompt repair, one of the most natural initial applications for spatially-attributed leak flow rate data is for non-hazardous leaks that could persist unrepaired for long periods of time.

In fact, data gathered through EDF's mobile methane surveys of various utilities' service territories suggests that the majority of methane emissions from natural gas distribution systems are attributable to a relatively small number of large, persistent leaks, as opposed to clusters of small leaks. This finding is supported by multiple independent sources. A 2014 Stanford University paper, which was based on a meta-analysis of methane leaks across the natural gas supply chain, noted that a small number of large leaks are responsible for a large proportion of the leakage across several sectors of the natural gas supply chain, including distribution systems. (A. R. Brandt *et. al*. (2014). *Methane Leaks from North American Natural Gas Systems*, Science, Vol. 343, *available at* http://www.novim.org/images/pdf/ScienceMethane.02.14.14.pdf.) These findings help to demonstrate how including leak flow rate as a parameter in prioritizing leak repair and pipeline replacement can more quickly reduce large leaks that would otherwise persist for long periods of time. Thus, leak flow rate data can improve cost-effectiveness by capturing the highest volumes of gas per dollar spent on leak repair. The larger reductions in lost gas improve the cost-effectiveness of infrastructure improvements for ratepayers, who generally pay the costs of gas lost on the pipeline system.

A recent report by researchers at Pricewaterhouse Coopers discusses the benefits of using spatial analytics to predict when and where pipeline leaks will occur. (Wei, J., Menzie, M., & Jenkins, L. (2016). *A new view on pipeline risks -How spatial analytics can empower asset management for gas utility companies*. p. 3 *Available at:* http://www.pwc.com/us/en/power-and-utilities/publications/assets/pwc_gas_pipeline_spatial_analytics_april_2016.pdf.) The report explains that using quantitative data on failure histories, customer calls, and condition-assessments can enable utilities to transparently manage their system, reduce human error, and cost-effectively improve decision making. (*Id.* at 2 and 6.) Traditional risk assessment has relied heavily on subject-matter experts who may use subjective data to make decisions about prioritizing risk mitigation actions. The solution to this problem, as the report proposes, is to integrate spatial analytics with condition assessment data to obtain a quantitatively rigorous snapshot of asset risks in near real-time to inform investment planning and pipeline replacement project prioritization. The report further indicates that a Picarro device can be used to provide data on leak density that can be integrated into a predictive model for leaks, further enabling capital prioritization. Such an approach can lead to efficiency and cost savings. For example, a case study presented in the report found that the client's quantitative spatial analytics model "delivered an estimated 3.9X more leaks avoided, 3.6X greater leaks/mile replaced, and 4.1X more O&M expense cost savings for the same capital investment." (*Id.* at 6.)

Improved leak detection using a Picarro device can provide useful information that aids in leak location prediction, while leak flow rate is an important parameter that can be used in the leak repair or pipeline replacement prioritization process. While leak density (i.e., leaks per mile) can be used in spatial analysis of pipeline condition, leak flow rates that are measured through the combined use of mobile leak detection devices and leak quantification methodologies can be incorporated at a later stage in the leak repair and pipeline replacement prioritization scheme. From a longer term perspective, there is value in considering the potential for leak flow rate to be incorporated as a distinct variable, with the appropriate weight, into the Company's hazard ranking algorithm. Many major utilities use proxy variables for leak flow rate (e.g. a combination of pipe diameter and pressure) in their hazard ranking models to get a broad understanding of the volume of leaking gas that could accumulate in an enclosed space, which is a necessary parameter to include in risk assessments. (Advantica and Philadelphia Gas Works. 2008. *Benchmarking Analysis, Risk Analysis and Model, Replacement Analysis and Computerized Main Prioritization and Ranking Program*. p. 91-92, *available at* http://media.philly.com/documents/Advantica_+PGW_BenchmarkingAnalysisReview_Final.pdf.) As mentioned earlier, Con Edison currently considers operating pressure as a factor that accounts for the volume of gas leaking from pipeline segments in order to calculate a main replacement prioritization risk score (*See* Exhibit__ (VP-1) at page 3).

With leak quantification methodologies now becoming commercially available, there is reason to use actual, measured leak flow rate instead of estimates generated using a proxy variable. Measured leak flow rates that can be geographically attributed to infrastructure allow a more direct risk assessment to be made than would be possible with the use of proxy variables, and can therefore serve as a valuable parameter in main replacement prioritization.

Finally, there are societal benefits from reducing the amount of gas leaked. Methane makes up about 90% of pipeline quality natural gas (A. Demirbas. (2010). *Natural Gas. In Methane Gas Hydrate*, pp. 47, Springer, *available at:* http://doi.org/10.1007/978-1-84882-872-8), and is a greenhouse gas 84 times more potent than carbon dioxide over a 20-year time horizon. Considering impacts on climate, methane emissions therefore come with a cost to society. (IPCC. (2013). *Working Group I Contribution to the IPCC Fifth Assessment Report Climate Change 2013: The Physical Science Basis, available at:* http://www.ipcc.ch/report/ar5/wg1/#.Ut_4FxDna00.) The social cost of methane has been estimated at $140 - $1730/ton of methane, depending mainly on modeling assumptions and the types of damages included in the calculations. (This range is based on estimates culled from the following sources. All such estimates have been converted to 2011 dollars. *Hope, Chris W. The* *marginal impacts of CO2, CH4 and SF6 emissions*. Climate Policy 6.5 (2006): 537-544; Marten, Alex L., and Stephen C. Newbold. *Estimating the social cost of non-CO 2 GHG emissions: Methane and nitrous oxide*. Energy Policy 51 (2012): 957-972; Marten, Alex L., *et. al. Incremental CH4 and N2O mitigation benefits consistent with the US Government's SC-CO2 estimates*. Climate Policy 15.2 (2015): 272-298; Waldhoff, Stephanie, et al. *The Marginal Damage Costs of Different Greenhouse Gases: An Application of FUND*. Economics 8.31 (2014).) This Commission has previously considered costs of climate change, which are currently external to the costs of natural gas, in an order establishing the benefit cost analysis framework of Reforming the Energy Vision. (Case 14-M-0101, *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, Order Establishing the Benefit Cost Analysis Framework (issued January 21, 2016)). Therefore, some consideration of the social cost of methane has merit in this rate case.

Q. In your understanding, what methodology do utilities generally use to prioritize leak repairs and pipe replacement efforts? What methodology is Con Edison proposing to prioritize its accelerated pipe replacement efforts?

A. PHMSA offers non-binding guidance to operators on how to grade leaks based on safety risk (PHMSA. (2000). *Gas Leakage Control Guidelines for Petroleum Gas Systems*. *Available at:* http://phmsa.dot.gov/pv_obj_cache/pv_obj_id_7AECD83839CEA51DE56B663CCC0F5DD937FA0000/filename/smalllpgas-chapt10.pdf.) This guidance establishes leak repair priority and assists operators in complying with federal safety rules that require them to "evaluate and rank risk" posed by their distribution pipeline systems. (49 C.F.R. 192.1007 (2009)). Some states, including New York, have incorporated or adapted PHMSA's leak grading guidance into their rules and statutes (16 CRR-NY 255.811 through 16 CRR-NY 255.817.) The grading categories are based solely on an evaluation of the risk to persons or property, primarily considering proximity to building envelopes (PHMSA. (2000). *Gas Leakage Control Guidelines for Petroleum Gas Systems*, p. X-9. *Available at:*

http://phmsa.dot.gov/pv_obj_cache/pv_obj_id_7AECD83839CEA51DE56B663CCC0F5DD937FA0000/filename/smalllpgas-chapt10.pdf.) Under the existing regulatory framework, utilities are generally not required to repair non-hazardous leaks that do not pose immediate hazard to persons or property within a specific timeframe. As a result, some of these non-hazardous leaks (Type 3, in the case of New York's regulatory framework) may continue unabated for decades, thereby wasting a valuable resource and hurting the economic interests of ratepayers, who bear the costs of leaked gas. For example, in California, leak data made available by through California Public Utilities Commission ("CPUC") R. 15-01-008 – Natural Gas Leakage Abatement Rulemaking indicates that as of May 22, 2015, there were some leaks that were discovered in the 1990's that had still not been scheduled for repair.

Utilities, including Con Edison, are already characterizing leak history on their pipelines, including the leak history of non-hazardous leaks, for the purposes of prioritizing main replacement (Wei, J., Menzie, M., & Jenkins, L. (2016). *A new view on pipeline risks -How spatial analytics can empower asset management for gas utility companies*. *Available at:* http://www.pwc.com/us/en/power-and-utilities/publications/assets/pwc_gas_pipeline_spatial_analytics_april_2016.pdf.) For instance, Con Edison's main replacement prioritization model incorporates active leaks, leak hazard ranking, historical leak density, historical leak cause, and historical leak severity based on leak repair records (*See* Exhibit__ (VP-1) at page 4).

Q. Please describe the pilot project that EDF is conducting in collaboration with Con Edison in order to characterize the Company's Type 3 leak backlog.

A. During its 2013 rate case, Con Edison and other rate case participants, including state and city agencies as well as non-governmental organizations such as EDF, formed a collaborative to consider methane leak reduction opportunities. This collaborative has since developed a project to test leak quantification methods, with the objective of identifying a method for the quantification of leaks on Con Edison's system to facilitate the prioritization of such leaks for repair using leak flow rate, in conjunction with other factors. NYSEARCH, a collaborative research, development and demonstration organization serving gas utility member companies, and other utilities, including National Grid, have since joined this effort.

In order to facilitate the development of a program to prioritize the repair of Type 3 leaks on Con Edison's system with the goal of minimizing the overall release of methane emissions from its pipes, Con Edison, EDF, and EDF's collaborators at CSU will commence a pilot program in 2016 (*see* Exhibit__ (VP-3), the Framework Agreement between Con Edison and EDF). Under this program, researchers from CSU will survey Con Edison's backlog of approximately 300 Type 3 leaks, and characterize these leaks into "small", "medium", and "large" emitters. In order to facilitate this survey exercise, the Company will provide EDF with location information for its Type 3 leak backlog, including information on underground infrastructure locations, under the terms of a non-disclosure agreement. The Company will prioritize the repair of a specified percentage of these Type 3 leaks classified based on emissions flow rate and/or leaks totaling a specified percentage of emissions; this specified percentage will be determined by the Company in consultation with relevant stakeholders in the broader Methane Collaborative with NYSEARCH. That is, the Company will consider leak size as a factor when selecting backlog leaks for rapid repair.

In the meantime, the Company's Research and Development team will continue its efforts to make technical progress to advance methane emissions quantification technology, and to integrate emissions measurement technology and methodology into its leak repair process.

Compared to other utilities serving New York, the Company's system has the second highest number of miles of mains that are considered "highly corrodible" based on the materials of which they are constructed (PHMSA 2014 Annual Distribution Report). Pipes which are made of these materials, namely cast iron and steel, make up the majority of the Company's system (52%). Forty percent of the non-hazardous leaks that the Company repaired in 2014 were caused by corrosion (*id.*). However, this leak data that is available through the federal Pipeline and

Hazardous Materials Safety Administration represents only those leaks that were scheduled for repair (*id.*, Form PHMSA F 7100.1-1 (rev 1-2011) instructions), whereas the EDF-CSU team will be surveying Type 3 leaks that are not required to be scheduled for repair within a specified time period (*see* 16 CRR-NY 255.817), and are therefore likely to persist for longer periods of time, emitting considerable amounts of methane into the atmosphere.

Q. What are the anticipated benefits of this pilot project?

A. Through participation in this pilot project, the Company has the opportunity to realize and ensure benefits including:

- Increased emission reductions through prioritizing repairs and replacements using leak flow rate, in addition to other relevant considerations;
- Potentially improved efficiency in lost gas reduced per unit of resources spent on leak repair or pipeline replacement;
- Characterization of typical Type 3 leak emissions by unique factors including leak type (e.g. corrosion, material or welds), leak repair history, pipeline material, operating pressure, depth of cover, or pavement characteristics;
- Ability to perform validation studies to evaluate technology;
- Experience with the operational aspects of using new and advanced leak detection equipment/technology, which is employed by EDF-CSU for the purposes of conducting the leak survey, including by identifying limits of deployment such as traffic, atmospheric conditions, GPS availability, etc.;
- A basis for development of an operational program to prioritize the repair of Type 3 leaks with the goal of minimizing the overall release of methane; and
- A baseline from which to measure any future greenhouse has reduction efforts.

These benefits are consistent with Con Edison's objectives as stated in its GPP Testimony on page 23 – that is, to accelerate reductions of methane leakage in Con Edison's distribution system.

Q. Please explain the current status of EDF's methane mapping in Con Edison's service territory in New York.

A. EDF has dispatched a Google Street View car specially-equipped with methane concentration analyzers to Con Edison's service territory. The vehicle is currently conducting test drives of the service area which began on May 10, 2016.

Q. Has EDF performed any scientific research on the quantification of methane leaks from natural gas distribution systems?

A. In 2012, EDF launched its largest scientific project to date to better understand and quantify methane emissions across the natural gas supply chain in the U.S. As part of this effort, EDF has managed 16 research projects involving collaboration with about 100 universities, research institutions and companies, and is employing a variety of sophisticated technology and scientific techniques. Four of these projects focused specifically on tracking methane emissions from local distribution systems. These projects have resulted in the publication of 27 papers in peer reviewed journals, two of which include observations of methane emissions from local distribution systems. (McKain, K., *et. al.* (2015). M*ethane emissions from natural gas infrastructure and use in the urban region of Boston, Massachusetts*. Proceedings of the National Academy of Sciences , 112 (7), 1941–1946. http://doi.org/10.1073/pnas.1416261112; Lamb, B., *et. al.* (2015). *Direct Measurements Show Decreasing Methane Emissions from Natural Gas Local Distribution Systems in the United States.* Environmental Science & Technology, 49(8), 5161–5169. http://doi.org/10.1021/es505116p.)

V. ENHANCED LEAK DETECTION AND IMPLICATIONS FOR LEAK MANAGEMENT PERFORMANCE METRICS

Q. What are the implications of utilities transitioning from the use of traditional leak detection equipment to new and advanced leak detection technologies?

A. Several utilities across the country are adopting new and advanced leak detection equipment that is more sensitive than traditional leak detection equipment and is thus capable of finding more leaks. For instance, PG&E piloted the use of Picarro analyzers in 2013. PG&E notes that this technology is 1000 times more sensitive than any other commercially available instrument, with the pilot indicating that the Picarro technology finds many more leaks than traditional leak survey instruments (A.15-09-001, *2016 California PG&E General Rate Case*, Gas Operations Technology Panel at 9-24 (filed September 1, 2015)).

Along similar lines, a California Air Resources Board and CPUC Joint Staff Report (Mrowka, A., *et. al.* (2016) *Analysis of the Utilities' May 15th, 2015, Methane Leak and Emissions Reports Required by Senate Bill (SB) 1371 (Leno) and Rulemaking (R.) 15-01-008*) found that utilities experienced a 21% increase in the number of leaks detected from 2013 to 2014, due partly to the use of advanced leak detection technologies being employed. As utilities start adopting more sensitive surveying equipment, leak backlogs are likely to grow, increasing the need for, and benefits of, prioritizing leak abatement activities by considering leak flow rate. PG&E, for instance, plans to test this technology for the purposes of analyzing flow rate to identify and quantify the volume of fugitive emissions associated with PG&E's facilities, recognizing that this would improve site efficiency and safety, minimize losses and reduce greenhouse gas emissions (*see* CPUC Docket A.15-09-001, *2016 California PG&E General Rate Case*, Gas Operations Technology Panel at 9-24 (filed September 1, 2015)).

Q. Please comment on Con Edison's proposal to test new and advanced leak detection equipment.

A. Using advanced, highly sensitive leak detection technologies will likely result in an increased number of leaks discovered (*see* A.15-09-001, *2016 California PG&E General Rate Case*, Gas Operations Technology Panel at 9-24 (filed September 1, 2015); Centers, T. and Coppedge, B.

(2015). *Picarro Leak Surveyor – A Step Change in Leak Detectino Capability*. Centerpoint Energy. Slide 9, *available at*: https://southerngas.org/images/PSC_Tal_Centers.pdf). In fact, Con Edison has noted that using advanced leak detection technology "provided greater capability to detect leaks in the field trial areas," where it has conducted pilot tests thus far (*See* Exhibit__ (VP-1) at page 5). In these tests, the advanced technology was able to find 73 out of 79 gradeable leaks, whereas traditional survey technology was only able to find 36 out of 79 gradeable leaks. As leak inventories increase with the use of more sensitive leak detection equipment, it will become all the more important for the Company to consider ways to better prioritize its leak repair and pipe replacement efforts in order to balance the costs of leak repair and pipeline replacement.

To the extent that the Company is incentivized to meet or exceed performance metrics for leak management, the Commission should keep in mind that the current performance metrics based on comparisons to existing or historic leak backlogs may no longer be achievable. For example, the Company is proposing that leak management year-end total backlog thresholds remain the same as they were when established in 2014 (*See* Exhibit__ (VP-1) at page 8). That is, in order to earn a positive revenue adjustment of two basis points for leak management, the Company will have to reduce its leak backlog to at least 10 percent less than 750 leaks per year and maintain a leak backlog lower than what was achieved in the three prior annual measurement periods. (Case 13-E-0030 *et. al*., *Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service*, Order Approving Electric, Gas and Steam Rate Plans in Accord with Joint Proposal (issued February 21, 2014); Company GIOP Testimony, p. 150.)

The Company has a Type 3 leak backlog that consists of 13 leaks that were discovered between five and eleven years ago (*see* Exhibit__ (VP-1) at pages 10-26). The vast majority of the Company's Type 3 leak backlog, totaling 672 leaks, consists of leaks that were discovered after 2014 (*id.*). This indicates that Con Edison is generally keeping up with its leak backlog, and that the performance metric has been easily met. Nonetheless, the leak backlog is likely to change as Con Edison transitions to using advanced leak detection technology, such as Picarro.

VI. CONCLUSION

Q. Please summarize your recommendations and conclusions.

A. Based on my review of Con Edison's testimony, my conclusions and recommendations are as follows:

(1) Con Edison's proposed program to reduce methane emissions on its distribution system at an increased pace through accelerated pipe replacement efforts, use of advanced leak detection, is necessary and appropriate;

(2) Con Edison would enhance the cost-effectiveness of its leak repair and pipe replacement programs by using spatially-attributed data on leak flow rate, such as that being provided by EDF, as a factor in prioritizing pipeline replacement and leak repair. Focusing on the largest leaks first, after addressing those that pose a safety threat, will provide enhanced benefits to ratepayers by reducing the amount of lost gas, and will also provide environmental benefits. Additionally, the collection of spatially-attributed leak flow rate data can help provide unbiased, transparent information to both the Company and the Commission, helping to reduce human error and aiding in improved decision making;

(3) The Company's proposal to test, and ultimately integrate, new and advanced leak detection technology into its operations has the potential to improve the overall effectiveness of its leak abatement operations; and

(4) Any leak management performance metrics must be designed thoughtfully, keeping in mind that the Company is likely to experience a surge in the number of leaks detected on its system, as it transitions away from traditional leak detection equipment to more sensitive technologies.

Q. Does this conclude your testimony?

A. Yes.