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September 2, 2014
By Email for Electronic Filing

Honorable Kathleen H. Burgess
Secretary
State of New York Public Service Commission
Three Empire State Plaza
Albany, NY 12223-1350

Re: Cases 13-E-0030, *et al*: Con Edison's Electric, Gas, and Steam Rates
Con Edison's Storm Hardening and Resiliency Collaborative Phase Two Report

Dear Secretary Burgess:

In accordance with Ordering Clause 8 of the Public Service Commission's February 21, 2014 *Order Approving Electric, Gas and Steam Rate Plans in Accord with Joint Proposal*, Consolidated Edison Company of New York, Inc. is filing its *Storm Hardening and Resiliency Collaborative Phase Two Report*.

During May and June 2014, Con Edison, the Department of Public Service Staff, and a number of other parties met in a collaborative manner to review Con Edison's storm resiliency plans and to consider additional initiatives. This Report describes the resiliency work that Con Edison is currently performing, presents for the Commission's consideration Con Edison's proposed plans for resiliency work to commence during 2015 to 2016, and provides status reports regarding related collaborative initiatives including the methane emissions reduction initiative, the climate change vulnerability study, and risk assessment and cost benefit modeling.

Very truly yours,

Attachment

C: Active Parties: Cases 13-E-0030, 13-G-0031, 13-G-0032 (email)

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Storm Hardening and Resiliency Collaborative Phase Two Report

Consolidated Edison Company of New York Inc.

September 2, 2014

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I. Introduction

A. Storm Hardening and Resiliency Guiding Principles

On October 29, 2012, Superstorm Sandy (Sandy) struck our region, devastating communities and our energy systems. The storm brought historic flooding and sustained high-speed wind. The damage to the electric system caused service outages to over 1,115,000 customers – five times the number of outages caused by Hurricane Irene in 2011. One-third of our steam customers lost service, and another 4,200 customers experienced gas outages because of the storm. Sandy was an unprecedented storm, one that has changed the way our region and Consolidated Edison Company of New York ("Con Edison" or "the Company") plan for and respond to natural disasters. [1]

To protect our customers, the region, and energy systems from future natural disasters, Con Edison's electric, gas, and steam rate cases, filed on January 25, 2013 (Cases 13-E-0030, 13-G-0031, and 13-S-0032) ("rate cases") included proposals for a $1 billion investment in new capital initiatives for years 2013 through 2016 to mitigate impacts of future extreme weather.

The goal of Con Edison's storm hardening investments is to reduce total customer outages by reducing the impact of wind/flood damage and improving restoration. We plan to do this by making investments guided by the following four principles:

1. **Protect infrastructure** – Relocate and envelope equipment to minimize exposure to wind and water infiltration.

2. **Harden components** – Strengthen equipment to withstand water inundation and tree damage.

3. **Mitigate impact** – Improve flexibility to allow for advanced flow controls around damaged equipment.

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[1] As a result of Sandy, the Company incurred significant costs ($322 million) to repair and replace equipment and to restore service. Expenditures in Steam and Gas Operations were $9 million and $3 million, respectively. The remaining $310 million was incurred within Electric Operations; $81 million was associated with capital and removal costs. The balance of $229 million included $12 million of Company straight time labor and $217 million in incremental costs (overtime, mutual aid and other outside support).

4. **Facilitate restoration** – To identify location and description of damaged equipment, install remote monitoring and improve communications to expedite information flow.

These initiatives (resiliency plans) will improve the resiliency of Con Edison's electric, gas, steam distribution systems and steam and electric generation stations by making delivery and generation structures and equipment more resistant to weather-induced failure and by reducing the time for restoring service to customers.[2]

B. The Storm-Hardening and Resiliency Collaborative

In the rate cases, at the recommendation of the Department of Public Service Staff ("Staff"), Con Edison convened a collaborative of interested parties to consider:

- The Company's storm hardening proposals and related recommendations of the rate case parties,
- The storm hardening design standard for various aspects of the Company's system, and
- Whether and how climate change impacts should be incorporated into the storm hardening design standard.

The Collaborative Parties participated in a series of meetings beginning on July 8, 2013 to exchange and discuss information, ideas, and proposals on many of the resiliency-related issues that the parties presented in testimony filed in the rate cases. In addition to three areas mentioned above, workgroups of the Collaborative discussed and examined the following topics:

- Development of analytical models for risk assessment and cost/benefit analysis of proposed storm hardening projects,
- Examination of alternative resiliency strategies to hardening the grid, including microgrid projects, sited distributed generation, energy efficiency, demand response, and alternative meters; and
- Mitigation of the climate impacts of gas distribution system methane losses.

2 Throughout this report, the word "resiliency" refers to resistance of the Company's facilities to weather–induced failure or the ability to restore service following a weather-induced service outage.

1. Con Edison's Storm Hardening and Resiliency Collaborative Report

On December 5, 2013, following the completion of the Collaborative's deliberations, Con Edison filed with the Public Service Commission ("Commission"), its *Storm Hardening and Resiliency Collaborative Report* ("Phase One Report"). The Phase One Report summarized the work of the Collaborative, including the topics and issues examined by its several working groups.

With regard to storm hardening and resiliency, the Phase One Report described the work that Con Edison had performed to strengthen its energy systems during 2013 and presented for the Commission's consideration Con Edison's proposed plans for resiliency work to commence during the period of 2014 to 2016. The Phase One Report provided detailed scope and cost information about the Company's resiliency work plans for 2014, which had been reviewed in detail in the Collaborative, particularly by Staff.

The Phase One Report discussed Con Edison's adoption of a storm hardening design standard that reflects the most current flood plain maps issued by the Federal Emergency Management Agency ("FEMA") plus the addition of three feet. Con Edison will design flood protection projects to be commenced during 2014 through 2016 based on the 1% annual flood hazard elevation (100 year floodplain) established by FEMA's June 2013 Preliminary Work Maps 100-year floodplain plus three feet of freeboard ("FEMA plus three feet"). The Company committed in the Phase One Report to revisit this design standard at least every five years.

The Company will monitor for changes in base flood elevations and for updates in climate change forecasts and sea level rise projections made by organizations such as the NPCC.

Every five years, or sooner if warranted, the Company will consider revision of the flood protection design standard to reflect such changes.[3]

The Phase One Report also described Con Edison's redesign of its Risk Assessment and Project Prioritization Model which assesses and ranks storm hardening projects according to reduction in vulnerability of customers and critical infrastructure to an electric service outage due to flooding or wind damage. The redesigned model incorporates a storm surge inundation prediction model developed by the New York City Mayor's Office of Long Term Planning and Sustainability.

The Company committed in the Phase One Report to conduct a study to identify the long-term impacts of climate change on its energy systems and measures that the Company might undertake to address those long-term impacts.

The Phase One Report also included proposals to:

- Develop an economic cost/benefit model for assessing storm hardening projects,
- Conduct an initiative to reduce natural gas distribution system methane emissions by quantifying emissions from and reducing the backlog from Type 3 leaks, and
- Examine potential alternative strategies incorporating distributed energy resources to achieve resiliency or mitigation of the impact of future extreme weather, including heat and storms, on Con Edison's customers, including distributed generation, microgrids, energy efficiency, demand response, electric vehicles, energy storage, and time-differentiated pricing for rates.

Many of the Collaborative Parties filed comments on the Phase One Report.

[3] Based on 24 global climate model ("GCM") projections, the New York City Panel on Climate Change ("NYPCC") states that sea level at New York City is likely to rise over the next several decades. NYPCC states that relative to the 2000 to 2004 base period the middle range of GCM projections (25th to 75th percentile) projects sea level rise of 4 to 8 inches by the 2020s and 11 by the 2050s. NYPCC states that the "high estimate" of GCM projections (90th percentile) projects sea level rise of 11 to 24 inches by the 2020s and 31 inches by the 2050s. New York City Panel on Climate Change, *Climate Risk Information 2013: Observations, Climate Change Projections, and Maps*, June 11, 2013, http://www.nyc.gov/html/planyc2030/downloads/pdf/npcc_climate_risk_information_2013_report.pdf

C. Rate Case Joint Proposal

The Joint Proposal filed with the Commission in the rate cases recommended that the Commission accept the forecasted storm hardening expenditures reflected in the proposed Rate Year 1 (2014) electric, gas and steam delivery rates without change subject to electric, gas and steam net plant reconciliation mechanisms designed to address the rate impacts of any difference between forecasted and actual expenditures. The Joint Proposal further recommended second and third phases of the Collaborative to take place in 2014 and in 2015 to review and report to the Commission on the Company's storm hardening plans and projected expenditures for 2015 and 2016, respectively. Upon review of the Company's reports and party comments, the Commission would determine the extent to which, if any, the Company should modify its planned storm hardening projects and programs for the second and third years of the rate plans. The Joint Proposal also recognized that Con Edison may undertake other projects that are not reflected in the proposed rates and may be presented to the Commission as a result of ongoing collaborative discussions. The Joint Proposal recommended that the Commission approve the Company's recovery of the incremental costs of such projects that the Commission may encourage or direct.[4]

D. The Commission's 2014 Rate Order

The Commission's *Order Approving Electric, Gas and Steam Rate Plans in Accord with Joint Proposal,* issued February 21, 2014 in Cases 13-E-0030, *et al.* ("2014 Rate Order"),

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[4] The Joint Proposal also provides for Con Edison to implement a two-phase pilot program in 2014 to test the ability of a networked Automated Meter Reading ("AMR") and/or Advanced Metering Infrastructure ("AMI") system to assist in more timely identification of customer outages and improve overall outage response and efficiency and to address Phase Two of the pilot in the Company's September 2, 2014 storm hardening report. Phase one has begun but has been delayed. A propagation analysis has been completed to allow us to determine the site locations for data collectors and repeaters, and some of this communications equipment has been installed. Security requirements for communications and data have resulted in delays in the collection and evaluation of data. Given this delay in implementing phase one of this pilot, the Company is not in a position at this time to evaluate and determine whether to move forward with Phase Two of the pilot in either Westchester or the City of New York.

adopted, subjected to understandings and changes stated in the 2014 Rate Order, the terms of the Joint Proposal filed in that proceeding.[5] The 2014 Rate Order commended the Collaborative as "a unique process and a far-sighted approach" that "has provided a valuable focus for innovative approaches to the 21st Century challenges to the utility system."[6] The Commission adopted the Joint Proposal recommendations for phases two and three of the Collaborative. The 2014 Rate Order addressed the specific collaborative initiatives proposed in Phase One Report as follows:

- The Collaborative parties will review planned storm hardening projects and expenditures for the second and third rate years during collaborative discussions commencing in June 2014 (for second rate year projects) and in June 2015 (for third rate year projects), and Con Edison will file a report with the Commission on these discussions and Con Edison's recommended projects by September 2, 2014 ("September 2, 2014 filing") and September 1, 2015, respectively. Following the Commission's review of Con Edison's report and the parties' comments, the Commission will determine any modifications to the planned storm hardening projects for the rate years.[7]
- Con Edison will conduct a comprehensive climate change vulnerability study with participation of collaborative parties. The Commission stated that rapid developments in climate science forecasts require ongoing review of the Company's storm hardening design standard, and the Company's study of long-term climate impacts is expected to provide a longer-range basis for ongoing review and the data needed to revisit the standard if indicated. Recommendations related to this study or a progress report will be provided in the September 2, 2014 filing.[8]
- Con Edison will continue the development and expansion of its risk assessment model and will develop a cost/benefit model for future storm hardening and resiliency capital investment that assesses and compares the relative benefits and costs of resilience of utility infrastructure measures and alternative resilience measures. The model should consider risks and probabilities of future climate events, the expected useful life of assets, and social cost factors, such as, the impact of outages of varying duration on affected customers and the potential risk to critical facilities. Recommendations related to this initiative or a progress report will be provided in the September 2, 2014 filing.[9]

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[5] 2014 Rate Order, Ordering Clause 1, p. 73. The Joint Proposal is contained in Appendix C to the 2014 Rate Order.
[6] 2014 Rate Order, pp. 64 and 67.
[7] 2014 Rate Order, pp. 69, 74-75.
[8] 2014 Rate Order, pp. 67, 71, 75.
[9] 2014 Rate Order, pp. 67-68, 71, 75. The 2014 Rate Order states that the Commission expects to develop a single, consistent cost/benefit approach during the course of the "generic regulatory framework proceeding" that was subsequently established in Case 14-M-0101 (Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision).

- The Collaborative parties will continue to investigate technologies for quantifying methane emissions from Type 3 (non-hazardous) leaks and will propose a program to further reduce the backlog of such leaks. Recommendations related to this initiative or a progress report will be provided in the September 2, 2014 filing.[10]

With regard to the examination of alternative resiliency approaches incorporating distributed energy resources, the 2014 Rate Order stated that these issues would be considered in the upcoming REV proceeding rather than in the Collaborative.[11] However, the Joint Proposal had proposed that Con Edison undertake with collaborative input three projects involving alternative resiliency strategies, and the 2014 Rate Order directed Con Edison to undertake these projects and report to the Commission within six months of the date of the 2014 Rate Order:[12]

- Develop non-traditional programs to meet load growth in the Company's electric networks in Brooklyn,
- Consider elimination of the single customer limitation in the Con Edison's offset tariff to expand its availability for operators of microgrids, and
- Develop a time-sensitive rate pilot.

Con Edison submitted reports to the Commission on August 21, 2014 regarding non-traditional programs to meet load growth in the Company's electric networks in Brooklyn and a time-sensitive rate pilot project.[13]

[10] 2014 Rate Order, pp. 70-71.
[11] 2014 Rate Order, pp. 68-69. ("The broader issues of the role of alternative resilience strategies such as distributed generation and microgrids are encompassed in this anticipated generic enquiry.")
[12] 2014 Rate Order, pp. 69-70.
[13] The Joint Proposal provided that the Company would consider the elimination of the single customer limitation in the offset tariff as an element of an implementation plan addressing a report on the feasibility of microgrids for infrastructure that would be issued by NYSERDA in April 2014. Con Edison reported to the Commission, by letter dated August 20, 2014 to the Secretary, that NYSRDA has not yet issued its report and that the Company's consideration of the single customer limitation in its offset tariff has been held in abeyance pending issuance of the report.

E. Overview of Con Edison's Storm Hardening and Resiliency Collaborative Phase Two Report

Con Edison's *Storm Hardening and Resiliency Collaborative Phase Two Report* ("Phase Two Report") is filed in compliance with the 2014 Rate Order's requirement for the September 2, 2014 filing. This report addresses the following:

- A detailed presentation of Con Edison's planned storm hardening and resiliency projects to be conducted during 2015, including project scope, rationale and costs.
- A status report on Con Edison's ongoing Climate Change Vulnerability Study.
- A status report on Con Edison's update and expansion of its Storm-Hardening Risk Assessment Model and development of a Storm-hardening Cost/Benefit Model.
- A status report on Con Edison's ongoing project to develop technology to quantify methane emissions from Type3 gas leaks.

II. Organization of Phase Two Storm Hardening and Resiliency Collaborative

The 2014 Rate Order invited the Company, Staff and other participants to manage the collaborative process to most effectively and efficiently realize the scope of the Phase Two collaborative initiatives.[14] The Company and Staff established a Phase Two collaborative schedule with interested parties in early May, 2014. The parties decided to conduct collaborative activities in a series of weekly meetings of all interested parties during the months of May and June 2014. Each meeting focused primarily on Con Edison's 2015 storm hardening and resiliency infrastructure plan and an update on 2014 storm hardening activities in one or more operational area, e.g., gas infrastructure or electric overhead infrastructure. In addition, Con Edison reported on its organizational activities establishing and initiating its Climate Change Vulnerability Study and on its progress in refining its risk analysis model and in developing an economic cost benefit model for assessing storm hardening and resiliency projects. Con Edison prepared and circulated meeting agendas, including presentation slides, in advance of each

[14] 2014 Rate Order, p. 71.

meeting. Con Edison hosted each meeting and offered a WebEx presentation for the convenience of parties not attending in person.

The Collaborative parties held the following meetings:

Date	Topic
May 20, 2014	Substation Projects
May 27, 2014	Steam and Electric Generating Station Projects and Steam Distribution Projects
June 3, 2014	Gas System Projects and Tunnel Projects
June 10, 2014	Electric Distribution Projects and Risk Analysis and Cost Benefit Modeling
June 19, 2014	Climate Change Vulnerability Study[15]

The presentations provided by the Company at each of the above meetings are attached to this Phase Two Report as follows:

Appendix A: Substations Presentation

Appendix B: Generating Stations and Steam Distribution Presentation

Appendix C: Gas System and Tunnels Presentation

Appendix D: Electric Distribution Presentation

Appendix E: Risk Assessment and Cost Benefit Models Presentation

Appendix F: Climate Change Vulnerability Study Presentation

The methane emission reduction collaborative has been conducted in a series of separate meetings of interested parties on March 27, April 21, May 16, June 27, and August 8, 2014

III. Overview of Con Edison's Planned Storm-Hardening and Resiliency Projects to Be Implemented during 2014, 2015 and 2016

Con Edison initially presented its 2014 to 2016 electric, gas, and steam systems storm hardening projects in its January 25, 2013 rate case filings as updated on March 25, 2013.

[15] This meeting also included a presentation on Con Edison's Brownsville Load Area Relief Plan. Con Edison filed its Brownsville Load Relief Report on August 21, 2014 pursuant to the 2014 Rate Order (Ordering Clause 10, p. 75).

Throughout 2013 and 2014, the Company has performed engineering reviews that have refined project scopes and designs and have enabled the Company to develop more precise cost estimates for these projects. The Company also adjusted project designs to accommodate the FEMA plus three feet flood protection design standard that the Company adopted in July 2013. This Phase Two Report reflects updated storm hardening project scopes, designs, and costs resulting from Con Edison's ongoing work to plan, design and budget the deployment of these measures. As shown in the table below, the overall 2014 to 2016 cost of the electric, gas, and steam systems storm hardening projects have increased by about $22.7 million from $988.1 million currently reflected in the Company's electric, gas, and steam rate plans to $1,010.8 million.[16]

[16] The sum of $942.6 includes expenditures for electric storm hardening expenditures in 2016 as projected in the rate cases. Con Edison's Electric Rate Plan covers the period of 2014 through 2015. Con Edison's Gas and Steam Rate Plans cover the period of 2014 through 2016.

	2014-16 (Rate Plans) ($ millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014-16 Current Projection
Coastal Networks	185.0	40.0	42.5	48.7	131.2
Submersible Transformers	35.2	19	7.75	8.45	35.2
Overhead Distribution	242.0	39.4	127.0	124.0	290.4
Electric Transmission	8.9	5.2	4.9	2.0	12.1
Substations*	210.0	40.4	91.25	103.7	235.35
Electric Generation	55.5	5.6	21.0	28.9	55.5
Gas and Tunnels	143.8	16.2	51.45	75.6	143.3
Steam Generation	91.1	21.5	27.7	33.0	82.2
Steam Distribution	0	4.5	4.4	0	8.9
Facilities	10.0		5.0	5.0	10
Telecom System	6.6	1.3	2.7	2.6	6.6
Total	**988.1**	**193.1**	**385.7**	**432.0**	**1010.8**

* Portions of East 13 Street Substation work is dependent on feeder outages and will be performed at an estimated cost of $57.3 million from 2017 to 2020 as outages become available. This cost includes estimated $28 million for reliability improvements to comply with FERC's March 20, 2014 Order approving the revised definition of "bulk electric system." *Infra*.

This Phase Two Report describes and provides scope and cost information for each electric, gas, and steam project. Material changes from costs reflected in the electric, gas, and steam rate plans are identified and explained. Justification, scope and cost information for new projects are provided.

IV. Electric System Storm Hardening

This section will address projects to storm harden Con Edison's electric power system, including the network distribution system, the overhead distribution system, and substations. The costs of these projects are reflected in Con Edison's Electric Rate Plan.

A. Coastal Networks Storm Hardening

1. Coastal Networks Storm Hardening Objectives

Category 1 or 2 hurricane flooding caused by rain and coastal storm surges could cause major damage to Con Edison's underground electric infrastructure, particularly in low-lying areas, as was experienced in Sandy. The coastal networks in Brooklyn, Manhattan, and Queens could be submerged in several feet or more of salt-water. Severe flooding in underground networks and at substations causes customer outages. Outages also occur when specific flood-prone networks are preemptively de-energized when severe flooding is predicted, as was the case during Sandy, in order to prevent damage to Company equipment and customer equipment, and to protect the public from electric hazards.

The underground network cable system is submersible; all primary and secondary network cables are fully insulated, and waterproof splices are used to connect them in every manhole and service box on the system. Network switches, called Network Protectors (NWP), are not submersible; a NWP is used to take a 120/208 volt or 265/460 volt distribution transformer out of service for routine work or during an emergency (a fault on the distribution feeder that supplies the associated transformer). The customers' switchgear is also typically not submersible.

There are three types of services, 120 volt, 460 volt, and High Tension. Commonly referred to as High Tension Vaults (HTVs), the latter is used for large facilities that have their own transformers; they do not have NWPs and cannot be removed from service directly by the

Company. Extensive flooding of the networks, as experienced during Sandy, poses three threats: a safety concern (shock or electrocution) from submerged customer equipment at the 120 volt level; a fire concern due to cross phase arcing of submerged 460 volt equipment in the NWP vault room; and system sustainability issues from faulted HTV equipment causing network feeders to de-energize.

Con Edison began addressing this risk in 2005 based on lessons learned by electric utilities during Hurricane Katrina. The Company proactively began to require that interconnecting customers in flood-prone areas either install submersible electrical equipment, or raise critical equipment above the ground floor. By taking these steps, the Company not only mitigated the potential impact of a major flooding event on those customers' equipment, but also reduced the probability that the electric distribution system would be impacted by a fault current on the customers' side of the meter. Additionally, Con Edison began installing submersible transformers and network protectors as equipment in flood-prone areas was replaced or upgraded.

During Sandy, three coastal networks were taken out of service preemptively and 24 additional feeders in eight other coastal networks were shut down to de-energize 460 volt services. The three networks shut down (Bowling Green, Fulton, and Brighton Beach) have too many 460 volt services in the flood zones to simply remove the associated feeders from service; there would not be enough feeders remaining in service to supply the remaining network load. In addition, multiple network feeders de-energized due to faults on HTV equipment. It took five days to restore service, and 11 days to return to full contingency design (N-2), primarily because many NWP replacements were required. Our goal is to reduce these periods to 24 and 48 hours, respectively. To accomplish this, Con Edison is installing submersible units to eliminate the need for replacing these NWPs.

In the aftermath of Sandy, the Company further assessed the design basis for each underground electric network and developed strategies to further reduce the impact of flooding on underground equipment, including a plan to replace non-submersible equipment more proactively, rather than requiring such designs for only new installations and upgrades.

2. Coastal Network Storm Hardening Projects

a) 460V Submersible Network Protectors

A newly designed submersible network protector for the 460 volt services (which generally are used to supply larger buildings) will be installed to protect approximately 400 installations in flood zones from saltwater damage. All 265/460V units in the FEMA 100 Year plus 3 feet zone will receive new, submersible network protectors. During flood events, these units will be opened in order to de-energize customer's equipment that is not submersible so that our feeders supplying the network protectors will remain in service. We installed 11 units in 2013 and plan to install 100 units in 2014, 150 units in 2015, and 140 units in 2016.

b) 120/208V Submersible Transformers

We plan to replace all 120/208 volt transformers in FEMA 2013 plus three feet flood zones with off-the-shelf submersible equivalents. The Company has identified a total of 903 transformers for replacement and plans to replace 500 units at a cost of $150,000 per unit through 2016. We installed 106 units in 2013 and plan to install 150 units in 2014, 100 units in 2015, and 150 units in 2016. The remaining units will be replaced in 2017, 2018 and 2019. Transformers are being replaced on a prioritized basis that reflects the following factors:

- Damage from Sandy
- Critical/essential customers

- Association with a feeder that is critical to network reliability

c) Isolation Switches (Bowling Green / Fulton Networks)

Smart-grid technologies provide tools that make the grid more flexible and responsive during extreme weather to minimize power outages. Smart-grid measures such as sectionalizing switches allow system operators to identify and isolate problem areas and rapidly bring power back to the surrounding areas, keeping more customers in service. To protect underground coastal networks vulnerable to corrosive salt-water flooding, and minimize power outages, Con Edison is installing smart switches to reconfigure the most vulnerable underground networks to form separate flood areas. Three networks are being re-configured using smart-grid switches in order to limit the impact of flooding to isolated parts of the networks, protecting the rest of the networks. One reconfiguration is complete (Brighton Beach network in Brooklyn), and the reconfiguration of the Fulton and Bowling Green networks in lower Manhattan will be complete by the end of 2014. When the region is threatened by floods, operators will be able to preemptively isolate areas at risk, while keeping electricity flowing in the surrounding areas.

The Fulton and Bowling Green networks were preemptively shutdown during Sandy although over half of the customers in those networks are outside of the flood zone and experienced no flood damage, including the New York Downtown Hospital on Gold Street and the New York Stock Exchange on Wall Street. To avoid entirely shutting down the Fulton and Bowling Green networks during a future flood event, we are installing 21 isolation switches on network feeders in these two networks to allow the isolation of vulnerable flood zones while keeping the customers on higher ground in service. Opening the switches in advance of a flood event, will divide each network into an area that will remain energized and an area that will be de-energized. The net effect is that approximately half of the customers will remain in service, including the Stock Exchange and Downtown NY Hospital. This requires a new secondary boundary within the network and reinforcement of secondary and primary cable both to facilitate the de-energization plan and to expedite restoration as flood waters recede in the network and customers are ready to be restored.

d) Isolation Switches (13 Networks)

We will install similar isolation switches at an additional 69 locations in thirteen other networks in Manhattan to de-energize customer equipment associated with high tension (13,800 volt) installations. This equipment resides in the FEMA 100 Year plus 3 feet zone, and during Sandy, some of the network feeders that energized this equipment failed while in service because of customer issues related to flooding. Feeder failures due to flooding in customer equipment can jeopardize the sustainability of these networks during high demand periods because these networks would be at or beyond their design criteria. This could potentially affect over 100,000 customers residing in these networks. In order to minimize this exposure, these isolation switches will be installed to de-energize and isolate the customer equipment. We plan to install 10 switches in 2014, 23 switches in 2015, 23 switches in 2016, and 13 switches in 2017.

With the use of underground smart switches and submersible equipment, coastal networks will likely be restored in 24 hours after they are preemptively de-energized to protect equipment; these measures will provide substantially faster service restoration than occurred following Sandy.

A white paper describing the scope and cost for each of the four programs to storm harden coastal networks is provided in Appendix G – Coastal Networks.

3. Coastal Networks Storm Hardening Project Cost Estimates

a) Costs Reflected in Electric Rate Plan

In the rate case, Con Edison presented plans to conduct four programs to storm harden the coastal networks from 2014 through 2016 at a total estimated cost of $185 million. The estimated costs for these programs for the period 2014 – 2016, reflected in the rate plans and presented in the Phase One Report, are summarized in the following table:

Coastal Networks (Rate Plan)* ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
120/208V Submersible Transformers	15.0	10.0	15.0	40.0
460V Submersible Network Protectors	10.0	15.0	14.0	39.0
Isolation Switches (9 Networks)	19.0	23.0	23.0	65.0
Isolation Switches (Bowling Green / Fulton)	21.0	0	0	21.0
Subtotal	**65**	**48**	**52**	**165.0**
Submersible Transformers	12.5	11.3	11.4	35.2
Total	**77.5**	**59.3**	**63.4**	**200.2**

*Rate Plan period is 2014 and 2015

b) Updated Costs

During the Phase One Collaborative and in the Phase One Report, the Company presented updated costs for the coastal network storm hardening programs as shown in the following table:

Coastal Networks (Phase One Report) ($ millions)	**2014**	**2015**	**2016**	**2014-2016 Cost (Phase One Report)**
120/208V Submersible Transformers	22.5	15.0	22.5	60.0
460V Submersible Network Protectors	10.0	15.0	14.0	39.0
Isolation Switches (9 Networks)	19.0	23.0	23.0	65.0
Isolation Switches (Bowling Green / Fulton)	21.0	0	0	21.0
Subtotal	**72.5**	**53.0**	**59.5**	**185.0**
Submersible Transformers	12.5	11.3	11.4	35.2
Total	**85**	**64.3**	**70.9**	**220.2**

As a result of ongoing project development work, including incorporation of the new flood protection design standard, FEMA plus three feet, in late July 2013, Con Edison has refined the estimated costs of the coastal networks storm hardening projects.

The Company's current projection of cost for each coastal networks storm hardening project is shown in the following table:

Coastal Networks (Phase Two Report) ($ millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014-2016 Current Projection
120/208V Submersible Transformers	22.5	15.0	22.5	60.0
460V Submersible Network Protectors	10.0	15.0	14.0	39.0
Isolation Switches (13 Networks)	2.5	12	12	26.5
Isolation Switches (Bowling Green / Fulton)	5.0	0.5	0.2	5.7
Subtotal	**40.0**	**42.5**	**48.7**	**131.2**
Submersible Transformers	19	7.75	8.45	35.2
Total	**59**	**50.25**	**57.15**	**166.4**

Con Edison's current 2014 to 2016 expenditure projection of $166.4 is $33.8 million less than the sum of $200.2 million projected in the rate case mainly as a result of changes to the two isolation switch projects. The projected cost of the project to install isolation switches in networks is reduced by $38.5 million to reflect lower unit costs and installation efficiencies based on experience to date and the deferral of some installations to 2017. In addition, the project to install switches to reconfigure boundaries of the Fulton and Bowling Green networks was accelerated, and $14 million, originally planned for 2014, was spent in 2013. These reductions are partially offset by the $20 million increase in the 120/208V Submersible Transformers program that was explained in the Phase One Report. [17]

[17] See Phase One Report, p. 17, which explained that after more detailed review and analysis the unit cost for submersible 120/208 volt transformer installations was increased from $100,000 to $150,000 due to the higher percentage of larger capacity 1000 kVA units to be replaced vs. 500 kVA units.

B. Overhead Distribution System Storm Hardening

1. Overhead Distribution System Storm Hardening Objectives

Company's design basis for the overhead system is consistent with the National Electric Safety Code (NESC). The NESC section 250B requires power facility structures to be designed to withstand specific combinations of ice and wind depending on loading class. Con Edison follows the Grade B design basis, which is the highest design grade in the NESC. Nonetheless, the overhead system remains vulnerable to failure due to the impact of high winds on vegetation. During a typical storm event, the overhead distribution system's main vulnerability is to falling trees and tree limbs.

The Con Edison electric overhead distribution system has provided industry leading reliability on blue sky days due to the redundancy of its automatic loop and 4kV primary grid power delivery design. This redundancy and the ability for the system to automatically isolate faults and heal itself works extremely well to provide uninterrupted service to customers during events with one failure location. In storm events when widespread damage occurs, our system will automatically isolate damage, however, there are outage mitigation limitations such as when main supply feeds are unable to supply customers until field work and further isolation can be done.

In the past two years our overhead system experienced severe damage from Irene and Sandy. Several additional storms, though smaller in scale, were also destructive, including the February 2010 snowstorm, the March 2010 nor'easter and the October 2011 snowstorm. Prior to 2010, the last year with more than one major, destructive storm was 2006. While a majority of customers were restored over several days, complete restoration of the overhead electric system took a week or more for each of these storms, primarily due to extensive damage caused by downed trees and tree limbs, and the multiple impacts of those trees on single electric feeder routes.

To avoid lengthy outages after future major weather events, we plan to further harden the existing overhead system — both to reduce damage and to minimize the impact of any outages that do occur. The goal of Con Edison's overhead system storm hardening strategy is to make the grid stronger and also more flexible and responsive by mitigating each specific risk associated with the impact of high winds on vegetation. Our planned investments will reduce customer outage impacts on the overhead system. We will also reduce damage assessment time to improve recovery and response operations and thereby reduce outage duration. In addition to mitigating the impact of storm damage on customers, this work is expected to lower future restoration costs and increase the system's reliability on good weather days.

2. Overhead Distribution System Storm Hardening Projects

Con Edison's plan to storm harden overhead circuits involves three programs:

- reducing the number of customers served from each feeder segment
- installing isolation switches on small open wire spurs off the main circuit line
- improving resiliency on targeted supply circuits

a) Reducing Feeder Segment Size

Our overhead system upgrade plan will reduce storm impact to customers by reducing the number of customers served by a circuit segment to fewer than 500 customers wherever economically practical designs can be implemented. By making this change, we will reduce the number of customers that are impacted as a result of a single point of damage on the system. We have identified approximately 632 locations where we can deploy additional automatic devices to reduce circuit segment size, and thereby, the number of customers served by each.

Automatic isolation devices, such as fuses, reclosers, and Kyle switches, operate automatically to isolate the extent of an outage and rapidly restore service to customers on the upstream side of the isolation device without the need for operator intervention. A typical Con Edison circuit runs for several miles in total. A failure at a certain point of the circuit will impact other customers on the same circuit depending on the location of the closest upstream protective device. Increasing the number of automatic protective devices per circuit limits the number of customers affected by a single event, such as a falling tree. In addition to the benefit of the automatic operation, having additional devices also allows greater flexibility in isolation and restoration when a failure does occur.

The Company is installing additional reclosers and sectionalizing switches (both SCADA-ready and manual) that are designed to reduce the number of customers between circuit segments. In case of permanent faults occurring on the overhead system, the additional reclosers and sectionalizing switches are designed to reduce the number of customers impacted by a faulted cable section to a target of 500 or less. The Company's goal of approaching 500 customers per segment offers the best balance between reliability and expenditure given the current system configuration.

Specifically, we are taking the following actions:

- Deploy vacuum reclosers – intelligent switches that can automatically detect faults and isolate portions of feeders without operator intervention – at 581 locations. We installed 46 units in 2013. We plan to install 115 units in 2014, 208 units in 2015, and 212 units in 2016.
- Install Supervisory Control and Data Acquisition (SCADA) enabled switches in 51 locations where additional automatic switches cannot be added. These switches, called gang switches, are remotely controlled devices that allow operators to determine the location of a fault and isolate damaged sections from the control room, without having to dispatch a crew to the location. Having specific information on where the fault is located also allows our operators to narrow down where on our system a repair may be needed. We installed 0 units in 2013. We plan to install 51 units in 2014, 0 units in 2015, and 0 units in 2016.

b) Isolating Open Wire Spurs from Feeder Main Runs

Our overhead distribution system relies on a combination of main feeder lines and smaller spurs off of the main line to distribute power throughout a neighborhood. Usually the spurs – some of which have their own sub-spurs – are strung with open wire. Open wires are generally more vulnerable to damage from contact with trees and other debris than insulated wires. In some cases, damage or faults on an open wire spur can flow up to the main feeder line, potentially causing outages for many more customers down the main line. To reduce the risk that damage on spurs will affect main feeder lines, we are installing isolation devices (fuses, fuse bypass switches, and automatic sectionalizing switches) on open-wire spurs and sub-spurs that are more than two spans in length (i.e., the distance between three utility poles). These devices are designed to isolate faulted spur sections from the feeder main run.

We have identified approximately 3,500 locations where these isolation devices can be deployed. We installed 2,548 units in 2013 and plan to install 660 units in 2014 and 300 units in 2015. Once the devices are installed, customers in overhead areas will be less likely to experience power outages as a result of damage to lines in other parts of their neighborhood.

c) Improving Resiliency on Targeted Supply Circuits

In 2007, Con Edison commissioned a study to examine the costs and feasibility to underground our overhead facilities. The study developed an estimated cost to underground overhead feeders based on the characteristics of six typical feeders (three in Staten Island and three in Westchester) and an underground loop-type system design consisting of cable installed in a conduit and manhole system with underground vault transformers and with switching by a combination of vault-type automatic sectionalizing switches and manual single phase vacuum switches and disconnectable splices. At that time, the study estimated the cost of undergrounding our overhead facilities to be approximately $6.2 million/mile. The Company's 2013 update of the study estimated the cost to be $8.2 million/mile.[18]

In view of the high cost of undergrounding,[19] the Company believes that storm resiliency can be achieved more broadly and efficiently, and as effectively, by deploying a variety of measures that will a) improve circuit performance in overhead areas that have experienced relatively more storm damage and b) strengthen specific distribution facilities that supply municipal and commercial infrastructure and facilities that provide critical community needs following severe storms. These measures include: (1) improving auto-loop circuits, (2) installing circuit-specific measures to harden services to specific customers, and (3) selective undergrounding.

(1) Improving Auto-Loop Reliability

We are improving the reliability of our existing auto-loops – looped circuits that are fed power from both ends -- that have been susceptible to storm damage. The following measures are being implemented to improve auto-loop performance:

- Introduce additional supply feeders to allow for continued service during feeder outages
- Divide large auto-loops into several smaller loops
- Upgrade wire and pole sizes to improve storm resiliency. Require poles in storm-prone areas to be 15 percent stronger and able to withstand gusts up to 110 miles per hour.
- Use Hendrix Aerial Cable, which is more resilient than traditional open wire design

Auto-loops are selected for improvement based on the following criteria:

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[18] An expenditure of $100 million would underground about 12 miles of the overhead system. Undergrounding portions of the overhead system offers several benefits including reduced storm outages, improved roadway esthetics, reduced automobile-to-pole collisions, and reduced tree trimming costs. But undergrounding has a number of significant drawbacks including high cost, significant cost to residential and commercial customers to connect to the new underground service, exposure to corrosive conditions underground, longer service restoration time when outages do occur, and maintenance cost that is considerably higher than an overhead system

[19] Con Edison's two-year Electric Rate Plan (2014-2015) reflects an expenditure of $100 million in 2015 for undergrounding portions of the electric system for purposes of storm hardening. The Phase One Report proposed the expenditure of $100 million per year in 2015 and 2016 for undergrounding.

- Non-Network reliability Index (NNRI) ranking[20]
- Impact during Sandy and previous storms
- Availability of alternate supply
- Supply to critical infrastructure such as hospitals

Con Edison plans to invest approximately $33 million to improve the following auto-loops in 2015:

- Fleetwood Loop in Westchester
- Van Nest Loop in the Bronx
- Mt Vernon Loop in Westchester
- Banksville Loop in Westchester
- Laurel Hill Loop in Queens
- Dyker Loop in Brooklyn
- Gravesend Loop in Brooklyn
- Marine Park Loop in Brooklyn

(2) Installing Circuit-Specific Measures

Con Edison will develop circuit-specific solutions to harden services to critical customers such as hospitals, pumping stations, and community shopping centers that provide essential needs following a storm (gasoline station, supermarket, bank, etc.). These measures will include Aerial Cable systems and redundant feeds to Automatic Transfer Switch (ATS) supplied Transformer Systems, and Pad-Mounted Equipment (PME) switches. In addition, Kyle spurs, directional ties, and gang switches will be utilized.

An Aerial Cable System has a number of features that improve resiliency during storms. These include a durable, insulated underground-type cable that is suspended by a sturdy, non-

[20] The Company has developed a modeling technology known as NNRI (Non Network Reliability Index) to assist our engineers in evaluating the performance of feeders supplying auto-loops. This model takes into account past performance, current circuit conditions, and projected weather patterns to forecast predicted feeder reliability. These simulations result in circuit rankings that can be compared before and after a proposed improvement.

current carrying, steel messenger cable. This cable is less likely to fault on contact with tree limbs, less likely to be downed by tree contact, and more likely, compared to non-insulated open wire, to remain energized if dislodged.

An ATS-supplied transformer system creates two service supplies (a preferred and a redundant alternate) that provides a back-up service for a customer if one service supply fails.

PME switches provide operational flexibility to add generators or other back-up sources to maintain service in the event that distribution supply is interrupted. PME switches can support micro grid operation for further community flexibility.

We plan the following work to storm harden specific circuits to improve reliability:

Storm-Harden Supply Circuits to Critical Infrastructure (Westchester and Bronx)		
Installation Type	**Quantity**	**$ (millions)**
Extend Aerial Feeders and Install ATS	32	$20.0
Emergency Tie to Alternate Aerial Feeder	27	$11.0
Install UG Network Transformers	7	$8.0
Create Secondary Network Pocket	10	$9.0
Additional Feeder to Hospital	1	$3.0
Total		**$51.0**

(3) Selective Undergrounding

Undergrounding of distribution equipment will be used both selectively for extended runs of overhead circuits and as a component of a location-specific approach that develops the optimal mix of measures to improve storm resiliency on specific supply circuits, as discussed above.

Examples of undergrounding extended runs of overhead circuits are the conversion/relocation to underground of seven miles of open wire cable on feeders 33R04 and 33R06 in Staten Island during 2015. These two feeders were chosen because of their critical supply to our 4kV unit substations (Canterbury(06), Nassau(06), and Nelson(04)) and to critical customers (Staten Island University Hospital South (both 33R04 and 33R06), Tottenville High School (both 33R04 and 33R06), Seaview Hospital (33R04), and the College of Staten Island(33R06)). Our open wire circuits continue to be impacted by wind and lightning, and converting open wire 33kV feeders to underground and aerial cable will greatly improve their performance during weather events. The cost for undergrounding these circuits in 2015 is shown in the following table:

Staten Island: Install Aerial Cable and Underground Cable to Reduce Dependence on Open Wire ($ millions)		
Feeder 33R06		17.1
Feeder 33R04		7.9
Total		**25.0**

Examples of location-specific undergrounding will be the installation of underground cable sections to support ATS transformer systems providing redundant overhead and underground supplies to critical facilities such as a municipal town hall, fire station, and police station, or water works plant.[21]

The Targeted Supply Circuit Resiliency program will focus on feeders supplying areas that have experienced the highest storm damage impact and feeders supplying facilities that are critical to maintain community support following severe storms, such as police and fire stations, town halls, and pumping stations. We have enacted a comprehensive outreach to local governments in order to determine those facilities that are most critical to maintaining the basic necessities within their respective municipalities. In addition, we have analyzed our overhead

[21] Various examples of selective undergrounding are shown in Appendix H.

system to establish criteria to prioritize circuits and segments for hardening via the aforementioned measures.

This multidisciplinary, targeted approach to selectively harden the most critical portions of our overhead circuits will provide greater community benefits than a program focused on undergrounding 12 miles of existing circuits per year.

d) Breakaway Service Connectors

We are also conducting a pilot to evaluate the functionality and benefit of break-away service connectors. If struck by falling trees or heavy branches, break-away devices on overhead service cables (cable supplying individual customer premises) are designed to break away rather than pull down and damage the customer's equipment. The break-away device is designed to fully de-energize the service conductors to maintain public safety and can be quickly reconnected to restore service to a customer. Through the remainder of 2014 and throughout 2015, we will install approximately 1000 breakaway service connector devices in a pilot program area within various municipalities in southern Westchester (Greenburgh, Mamaroneck, Mt. Vernon, New Rochelle, Scarsdale, White Plains and Yonkers) where we analyzed historical outage data to identify specific areas with high concentrations of tree-related service cable outages and field verified that the targeted areas do in fact exhibit significant overhead tree exposure. The average unit cost is estimated to be $1,500 per device installation. Dependent upon weather conditions over at least the next 18 months, we will evaluate the functionality of the connectors -- specifically that the sacrificial component fails before damage to the associated pole or house connection can occur and that they do not fail under non-catastrophic impacts. The projected cost of this program is $500,000 in 2014 and $1 million in 2015.

A white paper describing the scope and cost for each of the four programs to storm harden the overhead electric system is provided in Appendix H – Overhead Distribution Projects.

3. Overhead Distribution System Storm Hardening Cost Estimates

a) Costs Reflected in Electric Rate Plan

In the rate case and in the Phase One Report, Con Edison presented plans to conduct four programs to storm harden the electric distribution overhead system from 2014 through 2016 at a total estimated cost of $242 million ($42 million without undergrounding projects), including $15 million in 2014, as follows:

1. Reduce Circuit Segment Size: $19.15 million from 2014 to 2016.
2. Isolation of Open Wire Spurs from Feeder Main Runs: $3.0 million from 2014 to 2016.
3. Improvement of Auto-loop Reliability: $19.8 million from 2014 to 2016.
4. Selective Undergrounding of Overhead Infrastructure: $200.0 million from 2015 to 2016.

The estimated costs for these projects for the period 2014 – 2016, reflected in the rate plans and presented in the Phase One Report, are summarized in the following table:

Overhead Distribution (Rate Plan)* ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
Reduce Circuit Segment Size	5.4	8.4	5.4	19.2
Isolate Open Wire Spurs	3.0	0	0	3.0
Improve Auto-loop Reliability	6.6	6.6	6.6	19.8
Selective Undergrounding	0	100.0	100.0	200.0
Total	**$15**	**$115**	**$112.0**	**$242.0**

*Rate Plan period is 2014 and 2015

b) Updated Costs

The Company's current projection of storm hardening cost for each program is as follows:

Overhead Distribution (Phase Two Report) ($ millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014-2016 Current Projection
Reduce Circuit Segment Size	8.0	14.0	14.0	36.0
Isolate Open Wire Spurs	5.7	3.0		8.7
Targeted Supply Circuit Resiliency	25.2	109.0	110.0	244.2
Breakaway Service Connectors	0.5	1.0	0	1.5
Total	**39.4**	**127.0**	**124.0**	**290.4**

The three-year increase of $50 million for overhead distribution reflects an enhanced focus on overhead areas that are more likely to be damaged by wind in a severe storm than coastal networks for which flood damage is a less likely occurrence. The increase for overhead distribution during the current two-year Electric Rate Plan is $35 million and is offset by a $17.5 million reduction for coastal network storm hardening during the Rate Plan.[22]

During the Collaborative, Con Edison's Chief Engineer for Overhead System planning met with representatives of the City of New York and Westchester County to explain the increased focus of the Company's storm hardening program on the overhead systems in New York City and Westchester County and particularly the Company's plan to focus on overhead feeders supplying areas that have experienced the highest storm damage impact and feeders supplying facilities that are critical to maintain community support following severe storms, such

[22] This $17 million reduction occurs in 2014, and $14 million of this reduction was spent in 2013 due to the acceleration of the Fulton and Bowling Green networks project to begin work in 2013.

as police and fire stations, town halls, and pumping stations. As discussed in this Phase Two Report, undergrounding of distribution equipment will be available as a component of a multidisciplinary approach that develops the optimal mix of measures to improve storm resiliency on specific supply circuits and auto-loops. During those meetings, the City and Westchester expressed support for the Company's plans.

C. Electric Substation Storm Hardening

1. Electric Substation Storm Hardening Objectives

Prior to Sandy, flood protection of substations was based on applicable codes, standards and historical storm data. As Sandy approached, initial predictions for the storm tide appeared to be approximately at the Company's existing flood protection level. As added protection, additional temporary protection measures were installed, including water barriers and sand bags to protect critical equipment as much as three feet above the predicted storm tide level. Nonetheless, the storm surge far exceeded predictions, and the additional flood control measures were overwhelmed. Critical stations were severely impacted leading to the loss of load at key locations that resulted in extensive customer outages followed by an extended system restoration period.[23]

Flooding during Sandy shut down six transmission substations and eleven area substations.[24] In total, 11 Manhattan networks and three Staten Island load areas were shut down as the result of flooding at these substations. These substations suffered a tremendous amount of

[23] The East 13th Street and the East River transmission substations, which supply seven area substations in lower Manhattan, shut down due to flooding. As a result, ten networks in lower Manhattan lost power for approximately four days until the transmission stations could be brought on line to energize the area substations. The Goethals and Fresh Kills transmission substations in Staten Island were shut down due to flooding and wind. As a result, three area stations in Staten Island and associated load areas lost power for up to 13.5 hours.

[24] The transmission substations are East 13th St.138 kV, East 13th St. 345 kV, and East River in Manhattan and Goethals, Fresh Kills 345 kV, and Fresh Kills 138 kV in Staten Island. The area substations are Avenue A, Cherry, East 29th St., East 36th St., West 19th St., Leonard St. No. 1, Leonard St., No. 2, and Seaport in lower Manhattan and Woodrow, and Fresh Kills 33kV in Staten Island.

salt-water flooding that damaged an extensive amount of equipment that is critical to feeder operation including the various components of the protective relaying and dielectric systems.[25] Salt water submergence caused extensive corrosion of controls and operating mechanisms. Transmission feeders and equipment could not be restored to service until minimal amounts of these auxiliary systems were in service. Restoration of these systems entailed a laborious and time-consuming process to clean, dry, or replace relay protection and station auxiliary equipment.

Post-Sandy assessments of damage at Con Edison's substations identified additional measures needed to protect the stations from storm flooding, including reinforcing station perimeter walls, installing gates and floodwalls, and raising critical equipment. The Company developed plans to protect the following 16 substations stations against future flood conditions and storm surge:

1. East 13th Street
2. East River
3. East 15th Street PURS
4. East 36th Street
5. Seaport
6. Trade Center
7. Gowanus
8. Goethals
9. Fresh Kills
10. Hellgate/Bruckner

[25] All major components of these transmission stations (feeders, power transformers, phase angle regulators and breakers) require protective relaying systems. These relay systems detect electrical faults and remove current carrying equipment from service to minimize damage and prevent cascading trip-outs from occurring. These relay systems, which require power to operate, are comprised of low voltage wires, control cabinets, relays, and telephone lines. Many of the feeders (transmission and sub-transmission) are comprised of current carrying conductors contained within a pipe. The conductors are surrounded by pressurized oil (pressurized to approximately 200 pounds per square inch), which is the insulating medium for the conductor. The dielectric system maintains this pressurized oil. It is comprised of Public Utility Regulating Stations (PURS), pumping plants and pressurization plants which contain many components such as pumps, valves, piping, etc. These plants require power to operate.

11. Sherman Creek
12. Farragut
13. Rainey
14. Vernon
15. Leonard Street
16. Avenue A

The installation of storm hardening measures is critical to maintaining the operational integrity of these facilities during extreme storm events. Overall, the substation storm hardening program is focused on of the following primary objectives:

- Maintain remote control and situational awareness
- Prevent de-energization of power supply equipment due to flood water intrusion;
- Maintain relay protection integrity;
- Minimize equipment damage from salt water; and
- Allow for rapid recovery.

The storm hardening program is designed to protect each station from the infiltration of flood waters could interfere with the operation of the station. This will allow the stations to maintain their configuration while minimizing salt water damage to critical electrical equipment and will prevent widespread customer outages due to a complete loss of a substation.

2. Storm Hardening Measures Installed by June 2013

Con Edison installed by June 1, 2013, the onset of the 2013 hurricane season, many of the following flood control measures in each of the operationally affected stations to mitigate the effects of a storm similar to Sandy:

- Installed reinforced-concrete protective moats around critical equipment and secondary flood pumps that provide additional protection against seepage into the moats;
- Sealed all electrical conduits and control wiring and cable troughs that could provide a water path between the outside environment and the protected interior;
- Installed valves on storm drains to prevent backflow of water into station

- New flood doors at egress points to protect against floodwaters;
- New gaskets on cabinets to protect against water infiltration;
- Expansive polymer foam in the conduits that enter each panel to ensure no floodwater is able to enter and damage equipment;
- Nitrogen-driven pumps that maintain pressure on critical feeders in the event of a loss of normal power to the pumping plants;
- Secured industrial shrinkable fabric material to protect non-operating equipment for deployment as part of coastal storm preparations (as outlined in the Corporate Costal Storm Plan) to enhance protection against moisture intrusion;
- Removed existing fencing and raised the concrete threshold level around the perimeter of some stations;
- New flood panels and new, higher, reinforced baffle plates behind louvers to protect against additional surge of floodwaters;
- New reinforced-concrete wall along the property line of certain stations to protect against floodwaters; and
- New watertight joint material to replace all existing caulking on the joints of precast panels at certain stations.

During 2013, Con Edison completed the following work at nine substations and three generating stations:[26]

- 54 new concrete moats (6100 LF)
- 210 flood doors and barriers
- 81 submersible pumps
- 21 high capacity diesel-powered pumps (1,000 gpm) with 16 hour fuel tanks
- Approx. 3000 conduit and trough seals

3. Storm Hardening Measures to Be Installed from 2014 to 2016

During 2014 to 2016, Con Edison plans to install the following additional measures that will allow the substations to maintain their normal electrical configuration, while minimizing saltwater damage to critical electrical equipment and preventing widespread customer outages due to a substation shutdown:

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[26] As discussed later in this report, the flood-control measures installed at generating stations were similar to those installed at substations.

- Install new, lifting relay cabinets distributed throughout the substations at the location of the equipment that they protect. The new cabinets will be able to be raised on their mountings above the flood zone when a storm is expected.[27] ;
- Install fiber-optic-based communications equipment to eliminate or significantly reduce copper cable, which is more vulnerable to salt-water infiltration;
- For future equipment purchases, such as transformers and phase-angle regulators, define the purchase specification to ensure that new equipment comes with critical flood-protection controls, including a tap-changer drive and control mechanism;
- Raise critical control cabinets in pressurization and cooling plants;
- Install new emergency diesel generators elevated above the flood-control level. Include design provisions to easily remove and reinstall the generator in case it has to be relocated during an emergency. Also, install quick-type emergency connection points that are accessible at the station; [28]
- Relocate the East 13th Street substation control room, which is located at grade level and was flooded during Sandy, to an available second floor space, which is 3.8 feet above the FEMA plus three feet design level. This shift will include the installation of new Human Machine Interface (HMI) automation equipment and relocation and installation of communication rooms. Relocation of major equipment such as the existing reactor breakers and a diesel generator is also included in the work scope at the complex;
- Install new high-capacity flood control pumps at certain stations;
- Relocate other critical station equipment above the flood-control elevation;
- Make submersible or protect critical equipment that remains in the flood zone;
- Install additional moat walls at other substations and raise existing walls to meet new flood-control elevations; and
- Install new sheet-pile surge walls around the perimeter of Goethals substation, and along sections of the perimeter at Fresh Kills and Gowanus stations. At Goethals, the wall will extend beyond the FEMA plus three feet flood control elevation.. This wall will protect the station from flooding as well as potential infiltration of ground water.

[27] The distributed, elevated relay cabinets replace centralized relay houses that in flooding conditions presented a single point-of-failure exposure and long runs of copper wiring susceptible to flood damage.

[28] The electric backup generators will have dual fuel (diesel and natural gas) capability, except at two locations where the weight of dual fuel units would exceed the structural capacity of the station roof. On-site diesel fuel storage will be sufficient to operate the generators continuously under full load for approximately 24 hours. In advance of major storms, provision will be made for availability of supplemental fuel to extend generator operation. We will evaluate the cost of gas supply to these units and other considerations and will address potential conversion to gas supply in our September 1, 2015 report of the third phase collaborative.

All critical substation equipment within the FEMA plus three feet elevation will be protected from flood water. The FEMA plus three feet design adds about three to four feet to the protection level achieved by the initial storm hardening measures completed by June 2013. All work requiring elevating equipment or constructing flood barriers will be designed to the FEMA plus three feet protection level. Con Edison plans to install flood control measures at 16 substations during 2014 to 2016.

The Company also plans to replace existing electromechanical type relays with microprocessor type relays at the six transmission substations 2014 and 2015. These substations are terminations for six overhead 345kV transmission feeders located in the same transmission corridor. The existing first and second line relays for these feeders are materially degraded and cannot be maintained adequately to Original Equipment Manufacturer (OEM) specifications, and OEM parts are unavailable to replace the failed components. The existing relays for these feeders have mis-operated multiple times in the last four years taking a feeder(s) out of service, which negatively impacts the reliability of the transmission system. The existing relays are susceptible to over-tripping which can be triggered by wind-blown debris, hail, and lightning strikes during storms or severe weather conditions.

During Sandy, 3,615 MW of base load units and 728 MW of gas turbines tripped out of service due to flooding at these facilities. Consequently, the performance of transmission lines to supply demand and maintain system stability was crucial during this period. However, 37 of 59 345kV transmission feeders (63%) and 21 of 68 138kV transmission feeders (35%) became unavailable during Sandy. Overall, there were 45 distinct outage events on 345kV feeders and 30 distinct outage event on 138kV feeders.[29] Hence, having a robust overhead transmission

[29] Of the thirty-seven 345 kV feeders that became unavailable, seven tripped twice and three tripped thrice. Of the twenty-one 138 kV feeders that became unavailable, two tripped four times each

system in periods of storm related high winds and rain etc., and not having them unnecessarily trip due to relay mis-operation, increases system security. The East 13th Street Substation supply to lower Manhattan networks was lost during Sandy due to a combination of the failure of Transformer (TR) 13 and the loss of the remaining seven 345kV supply feeders when salt water entered relay system and caused them to mis-operate and de-energize.

In our day-to-day operations, we experience approximately 85 transmission feeder trips in a year, and we implement our Rapid Restoration procedures using SCADA control from our Energy Control Center to immediately restore the feeders that tripped due to relay mis-operation. During Sandy, we experienced 72 transmission trips in approximately 18 hours, including 50 trips in just five hours. A large volume of trips in a short duration can overwhelm our capability to rapidly restore feeders using SCADA controls. This can lead to a cascading sequence of trips and loss of load because feeders that tripped due to relay mis-operations could not be restored quickly by operator action.

Because the potential for parallel mis-operation of these relays and the loss of transmission supply are enhanced during severe storm conditions, the Company will harden these six transmission feeders to the impacts of severe storm by upgrading the relays to microprocessor type relays which are not susceptible to over-tripping during severe weather conditions. The new relays will utilize Con Edison's Corporate Communications Transmission Network (CCTN) which will provide a more reliable platform for the transmission of relay signals than the current carrier platform.

White papers describing the scope and cost for each substation project are provided in Appendix I – Substations Storm Hardening Projects.

4. Substation Storm Hardening Project Cost Estimates

a) Costs Reflected in Electric Rate Plan

In the rate case, Con Edison presented plans to install storm hardening measures at 14 substations from 2014 through 2016 at a total estimated cost of $210.0 million, including $60.0 million in 2014, as shown in the following table:

Substations (Rate Plan)* ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
E 13th Street	32.0	34.0	39.1	105.1
East River Substation	1.35	2.8	3.15	7.3
Gowanus	2.5	6.25	4.25	13.0
Goethals	9.65	7.2	8.75	25.6
Fresh Kills	7.0	6.25	4.75	18.0
E 36th Street	1.0	1.5	1.0	3.5
E 15th Street	2.75	3.25	3.0	9.0
World Trade Center	1.2	0.7	1.0	2.9
Seaport	1.05	1.3	2.25	4.6
59th Pier	1.5	1.5	2.45	5.45
W 49th Street	0.0	1.15	1.0	2.15
Hellgate/Bruckner	0.0	1.9	4.45	6.35
Sherman Creek	0.0	1.7	4.35	6.05
Academy	0.0	0.5	0.5	1.0
All Substations	**60.0**	**70.0**	**80.0**	**210.0**

*Rate Plan period is 2014 and 2015

b) Updated Costs

As a result of ongoing project development work, including incorporation of the new flood protection design standard, FEMA plus three feet, in late July 2013, Con Edison has continued to refine the estimated costs of the substation storm hardening projects.

During the Phase One Collaborative and in the Phase One Report, the Company presented updated costs for storm hardening work at nine of these substations as shown in the following table:

Substation (Phase One Report) $ millions)	**Storm Hardening Project Cost (2014-2016) (March 2013 Update[30])**	**Total Storm Hardening Project Cost (2014-2016) (June 2013 FEMA + 3')**
East 13th Street	105.1	120.7
East River Substation	7.3	9.8
Gowanus	13.0	14.7
Goethals	25.6	25.7
Fresh Kills	18.0	17.5
East 36th Street	3.5	3.0
East 15th Street	9.0	9.2
Trade Center	2.9	1.5
Seaport	4.6	2.6
Totals	**189.0**	**204.7**

The total estimated cost of these nine projects, reflecting the then-current level of development of project designs and information, had increased by $15.7 million from $189 million to $204.7 million.[31]

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[30] The March 2013 Update refers to the additional detail that was provided in the Company's rate cases update filing on March 25, 2013 to support the projected storm hardening project costs.

As a result of adopting a new flood protection design standard in late July 2013, Con Edison identified five additional substations where flood protection measures will be installed from 2014 to 2016 and three substations where work originally planned for 2014 to 2016 will no longer be required. The five additional substations are:

1. Farragut
2. Rainey
3. Vernon
4. Leonard Street
5. Avenue A

The preliminary costs for Farragut, Rainey, and Vernon, provided in the Phase One Report, totaled $2.9 million. Preliminary costs for Leonard Street and Avenue A had not been developed.

The three substations that were removed from the 2014-2016 program are:[32]

1. 59th Pier
2. W 49th Street
3. Academy

The Phase One Report also stated that Con Edison continued to prepare detailed designs for each project and refine the costs for each project and would adjust estimated project costs accordingly. The Company's current projection of storm hardening cost at each substation is as shown in the following table:

[31] The projected costs of these nine projects have continued to be refined and adjusted and are currently projected to total $214.6 million, as shown in more detail in Appendix C.
[32] The Phase One Report stated that the funding of $8.6 million projected for these three substations will support the flood protection measures to be installed at the five added substations and increased costs for other substations.

Substation (Phase Two Report) (millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014-2016 Current Projection	2017-2020 Current Projection
East 13th Street	15.0	42.0	40.0	97.0	67.3***
East River Substation	1.6	2.8	2.9	7.3	
Gowanus	3.0	6.3	13.5	22.8	
Goethals	3.5	7.2	14.9	25.6	
Fresh Kills	3.6	6.3	12.0	21.9	
East 36th Street	1.9	4.5	1.0	7.4	
East 15th Street PURS	1.8	3.5	3.7	9.0	
Trade Center	0.7	1.3	0.9	2.9	
Seaport	2.4	4.3	2.25	8.95	
Hellgate/Bruckner	0	1.9	4.45	6.35	
Sherman Creek		1.7	4.35	6.05	
59th Pier*					
W 49th Street*					
Academy*					
Farragut	1.3	3.7	0	5.0	
Rainey		0.275	0.725	1.0	
Vernon		0.275	1.025	1.3	
Leonard Street		0.1	1.0	1.1	0.1
Avenue A		0.1	1.0	1.1	0.2
Overhead Feeders Relay Protection	5.6	5.0		10.6	
All Substations	**40.4**	**91.25**	**103.7**	**235.35**	**67.6**

* These projects are deferred beyond 2017.
** These projects were developed after the March 2013 rate case update filing to meet the FEMA plus three feet design standard adopted in July 2014.
*** Portions of East 13 Street Substation work is dependent on feeder outages and will be performed from 2017 to 2020 as outages become available.

Total projected expenditures for substation storm hardening from 2014 to 2016 have increased by $25.35 million from the rate case projection of $210 million to $235.35 million. A variety of factors contribute to the increased substation cost projections.

The Company has continued to refine its estimates as it prepares detailed engineering and designs for specific components of the projects and receives bids for the performance of construction and installation work. The rate case projection, filed less than three months after Sandy, reflected preliminary development of project designs and information. Con Edison had not previously constructed storm hardening projects of this nature and consequently developed its initial estimates on the basis of roughly analogous work from other historic jobs, for example, the cost to build a platform, but without any of details regarding the specific construction characteristics and equipment outages required for the particular storm hardening project. In addition, the rate case projection did not incorporate the higher flood protection design standard, FEMA plus three feet, which the Company adopted in late July 2013. Meeting the FEMA plus three feet design standard contributed substantially to the $120.7 million cost for the East 13th Street Substation projected in the Phase One Report – an increase from the $105.1 million rate case projection.

The current projected cost of the East 13th Street Substation is $164.3 million, an increase of $59.2 million from the original rate case projection of $105.1 million or an increase of $43.6 from the $120.7 projection in the Phase One Report.[33] As discussed below, additional storm hardening-related costs account for $15 million of this $43.6 million increase, and newly required bulk power station reliability design requirements account for $28 million. The $15 million increase in storm hardening related costs result from the following:

[33] The Phase One Report stated that the East 13th street Substation project would extend into 2017 at a cost of $120.7

- Upgrade and integrate the major transmission substations connected to East 13th St. in order to ensure communication among the stations and full functionality of the new East 13th Street Substation control room and automation system; also, integrate associated area substations and East River 69kV substation. In association with the relay system upgrades at East 13th Street, a substantial amount of upgrade, integration, and commissioning work will be performed at the transmission stations that are electrically tied to and fed from East 13th St. This work is essential to ensure that the new East 13th St control room, relay, and automation systems are properly integrated with these other stations and do not negatively impact the operations of the electric system. This work and the associated integration at East 13th St. will require a series of coordinated electrical system outages in order to perform the installations and upgrades while maintaining reliability. The additional projects associated with the integration of the other stations are outage-dependent and are projected to continue until 2020.

- Incorporate extensive subsurface interferences, located during detailed drawing and plate review, into the detailed project design, including extension and rerouting of the below grade trench and duct bank system.

- Full installation of the PASS breakers, including structural reinforcement and installation of new structures in order to effectively install the new breakers within the constraints of the existing station conditions.

The other major cost driver for the East 13th Street Substation is the revised definition of the Bulk Electric System (BES) approved by the Federal Energy Regulatory Commission (FERC) on March 20, 2014.[34] The new definition encompasses any facilities that are operated at or above 100kV and now captures many of Con Edison's 138kV transmission substation facilities, including the East 13th St. 138 kV substation. Compliance with this revision must commence no later than 2016, and will impact the East 13th St. storm hardening project due to the need to incorporate standard BES requirements into the 138kV components of this project. These requirements impact the station design basis, which is primarily established by the Northeast Power Coordinating Council's (NPCC) Directory No. 4: Bulk Power System Protection Criteria.

These design requirements must be incorporated into all 138kV transmission facilities on Con Edison's bulk power electric transmission system commencing when other modifications or

[34] 146 FERC ¶ 61, 199, Order Approving Revised Definition, issued March 20, 2014.

upgrades are made to the facilities. The East 13th St. storm hardening project impacts seven 138 kV (of a total of twelve) and one 69kV (of a total of nine) feeders and bus sections from the East 13th Street 345 kV substation (already designed to be in compliance with NPCC Directory No. 4) to the East 13th street 138 kV substation and East River 69kV substation, and these storm hardening modifications and upgrades trigger implementation of the NPCC Directory No. 4 criteria. The other five 138kV bus sections and eight 69kV bus sections do not require storm hardening modifications and upgrades and will not be redesigned to NPCC Directory No. 4 criteria during the storm hardening project.

Con Edison plans to implement the equipment modifications needed to meet the NPCC Directory No. 4 design criteria at the time that it removes individual feeders from service to implement storm hardening upgrades. If the modifications are not incorporated at that time, some of the upgrades performed for storm hardening would later have to be significantly modified to meet the requirements. In addition, the overall feeder outage duration will be reduced by incorporating the design modifications with storm hardening work and avoiding a second series of lengthy feeder outages. For East 13th St., the previously planned six to eight week storm hardening outage for each of the eight feeders supplying the substation will incorporate the necessary changes to meet the NPCC Directory No. 4 criteria. If this work is not done in conjunction with the storm hardening project, an additional 4 week outage for each of the 8 feeders will be required. The reduction in feeder outages mitigates the impact to electric system reliability.

The additional cost of work to incorporate the NPCC Directory #4 criteria is estimated to be $28 million.

With regard to the substation storm hardening projects generally, detailed engineering and design has been completed for 2014 work, and for some early 2015 work, and results in a more detailed cost projection for this component of the storm hardening projects. Additional engineering and design will be completed to support 2015 and 2016 work, particularly for the substations that have received no upgrades to date, as well as work in 2017 and beyond in the case of East 13th St. Engineering and design detail has not been developed for these outer years, and cost projections in this Phase Two Report reflect the previously proposed concept plans and order of magnitude estimates. As the program progresses, engineering and design detail for this later work will be further developed and will be reflected in updated cash flow projections. In addition, much of the 2014 work is currently in the construction contract procurement process. Due to market conditions and other factors, contractor bids could be at different values than what has been estimated, and cost projections for the future years of the program may be modified on this basis as well.

D. Transmission System Storm Hardening

1. Transmission System Storm Hardening Objectives

Generally, overhead transmission infrastructure will not be de-energized on a preemptive basis based on wind hazards. During Sandy, Con Edison lost 3,615 MW of base load units and 728 MW of gas turbines due to flooding at these facilities. Hence, the reliance on the overhead transmission lines to supply customer demand and maintain system stability was crucial during this period. However, overhead feeders and towers are vulnerable to high-velocity wind, wind-blown debris, hail, and lightning strikes during storms or severe weather conditions. The Company’s transmission system storm hardening program will reduce the risk of failures on transmission feeders by reinforcing or replacing compression fittings and splices (in-line and dead end assemblies) on feeders where fittings are near end of life and by reinforcing steel-lattice towers.

2. Transmission System Storm Hardening Projects

a) Replace Compression Fittings on Feeders 99941 and 99942

This project replaces the compression fittings on the overhead 138kV feeders 99941 and 99942 on the E-Line between Dunwoodie and Sprain Brook substations. These feeders were last reinforced in 1965, and significant problems with compression fittings related to advanced age have surfaced on these feeders. Failure to replace these fitting increases the likelihood that we will experience a connector failure during severe weather conditions. Compression fitting materials were purchased in 2013, and compression fitting replacement on feeder 99941 was completed in 2013 at a cost of $1.8 million. Compression fitting replacement on feeder 99942 will be completed in 2014 at a projected cost of $1.2 million.

b) Reinforce L-Line Compression Fittings

This project reinforces the in-line and dead end assemblies on feeder 398 on the L-Line between Pleasant Valley Substation and the Connecticut border. This feeder, which is about 17.8 miles in length, was constructed in 1964, and significant problems with compression fittings related to advanced age have surfaced. The reinforcement of these fitting will reduce the potential that severe weather conditions would cause a connector failure and feeder outage. Compression fittings and splice reinforcement materials were purchased in 2014, and we plan to complete approximately 50% of the compression fitting and splice reinforcements on feeder 398 in 2014 at a cost of $2 million. The remainder of the compression fitting and splice reinforcements will be completed in 2015 at a projected cost of $2.9 million.

c) Upgrade Overhead 345kV Transmission Structures

This project upgrades specific 345 kV steel lattice towers that are selected based on engineering analysis. The reinforcement of these towers decreases the likelihood of tower failure during weather events and decreases the likelihood and impact of multiple failures resulting from cascading since reinforced towers are better able to withstand the loads that would result from adjacent tower failure. Priority is given to towers with the highest risk on critical transmission corridors. This is an ongoing program at a cost of approximately $2 million annually.

White papers describing the scope and cost for each overhead transmission storm hardening project are provided in Appendix J – Overhead Storm Hardening Projects.

3. Transmission Structures Storm Hardening Project Cost Estimates

a) Costs Reflected in Electric Rate Plan

In the rate case, Con Edison presented plans to conduct three programs to storm harden the overhead transmission system from 2014 through 2016 at a total estimated cost of $8.9 million. The estimated costs for these programs for the period 2014 – 2016, reflected in the rate plans and presented in the Phase One Report, are summarized in the following table:

Transmission Structures (Rate Plan) ($ millions)	**2014**	**2015**	**2016**	**2014-2016 Cost (Rate Plan – March 2013 Update)**
Compression Fittings on Feeders 99941 and 99942	0	0	0	0
L-Line Compression Fittings	2.9	0	0	2.9
Overhead 345kV Transmission Structures	2.0	2.0	2.0	6.0
Total	**4.9**	**2.0**	**2.0**	**8.9**

b) Updated Costs

The Company's current projection of cost for each overhead transmission structure storm hardening project is as shown in the following table:

Transmission Structures (Phase Two Report) ($ millions)	2014	2015	2016	2014-2016 Cost
Compression Fittings on Feeders 99941 and 99942	1.2	0	0	1.2
L-Line Compression Fittings	2.0	2.9	0	4.9
Overhead 345kV Transmission Structures	2.0	2.0	2.0	6.0
Total	**5.2**	**4.9**	**2**	**12.1**

E. Electric System Storm Hardening Costs

Con Edison's Electric Rate Plan reflects storm hardening expenditures for coastal network, overhead system, substation, electric generating station and transmission storm hardening. This section discusses these expenditures on a combined basis.

1. Costs Reflected in Electric Rate Plan

The table below summarizes the electric system storm hardening expenditures reflected in Con Edison's current two-year Electric Rate Plan (2014 to 2015), as well as 2016 expenditures projected in the rate case in 2016.[35]

[35] Con Edison's two-year Electric Rate Plan (2014 to 2015) established in Cases 13-E-0030, reflects the Company's forecasted storm hardening expenditures subject to a net plant reconciliation mechanism designed to address the rate impacts of any difference between forecasted and actual expenditures and subject to the Commission's review of the Company's updated storm hardening plans and expenditure forecast as provided in this *Phase Two Collaborative Storm Hardening and Resiliency Report*.

Electric Rate Plan ($ Millions)	2014	2015	2016	2014-2016 Total
Coastal Networks	**65**	**48**	52.0	**165.0**
Submersible Transformers	12.5	11.3	11.4	35.2
Overhead Distribution	15.0	115.0	112.0	242.0
Electric Transmission	4.9	2.0	2.0	8.9
Substations	60.0	70.0	80.0	210
Electric Generation	14.0	21.0	20.5	55.5
Total	**171.4**	**267.3**	**277.9**	**716.6**

2. Updated Costs

The table below summarizes the electric system storm hardening expenditures projected in this Phase Two Report during the Company's current Electric Rate Plan, as well as 2016 expenditures.[36]

Phase Two Report ($ Millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014-2016 Current Projection
Coastal Networks	40	42.5	48.7	131.2
Submersible Transformers	19	7.75	8.45	35.2
Overhead Distribution	39.4	127.0	124.0	290.4
Electric Transmission	5.2	4.9	2.0	12.1
Substations	40.4	91.25	103.7	235.35
Electric Generation	5.6	21.0	28.9	55.5
Totals	**149.6**	**294.4**	**315.75**	**759.75**

* Portions of East 13 Street Substation work is dependent on feeder outages and will be performed at an estimated cost of $57.3 million from 2017 to 2020 as outages become available. Cost includes estimated $28 million for reliability improvements to comply with FERC's March 20, 2014 Order approving revised definition of "bulk electric system." *Supra*.

[36] As noted in the discussion of these expenditures in the sections above, the Company's Phase One Report updated some of the costs reflected in the Electric Rate Plan.

Projected electric system storm hardening expenditures have increased by about $5.3 million over the amount ($438.7) reflected in the Electric Rate Plan (2014 and 2015). Including work planned for 2016, overall storm hardening expenditures are projected to increase by $43.2 million above the amount projected in the rate case for the period of 2014 through 2016 ($716.6). The sections above have explained the cost drivers for the various projects.[37]

Consistent with the provisions of the Joint Proposal, Con Edison requests that the Commission approve the electric storm hardening projects presented in this Phase Two Report for 2015, the second rate year of the Electric Rate Plan. To the extent that the actual expenditures for these projects result in net plant balances above those reflected in the Storm Hardening category of the Average Electric Plant In Service Balances for the second rate year, the Joint Proposal provides that the Company may defer for later collection the carrying costs associated with such net plant exceedances upon the Commission's approval of such expenditures.[38]

Accordingly, Con Edison requests that the Commission approve the second rate year expenditures for the electric system storm hardening projects presented in this Phase Two Report. Upon such approval, and consistent with the Joint Proposal, the Company would defer

[37] For example, overhead distribution expenditures are projected to be about $35 million higher than reflected in the two-year Electric Rate Plan.
[38] The Joint Proposal (p. 36-37) states:

> With respect to the Storm Hardening category of the Average Steam Plant In Service Balances, the Commission's order regarding RY2 Storm Hardening programs in response to the Company's September 1, 2014 Storm Hardening report (see section D.4 below) may call for Storm Hardening capital expenditures in RY2 in an amount more or less than the amount reflected in the Storm Hardening category of the Average Electric Plant In Service Balances for RY2.
>
> If the Commission's order calls for RY2 Storm Hardening capital expenditures greater than the amount reflected in the Storm Hardening category of the Average Steam Plant In Service Balances for RY2, the net plant reconciliation mechanism will continue to apply as described herein and the Company will defer for future collection from customers the revenue requirement impact (i.e., carrying costs, including depreciation, as identified in Appendix 8) of the amount of average net plant resulting from the additional capital expenditures.

for later collection the carrying costs associated with actual expenditures above those reflected in the Company's Electric Rate Plan.

V. Gas System and Tunnel Storm Hardening

This section addresses storm hardening projects to improve the resiliency of Con Edison's gas distribution system, the Liquefied Natural Gas ("LNG") plant tunnels.

A. Gas System Storm Hardening

1. Gas System Storm Hardening Objectives

While Con Edison's gas system performed relatively well throughout Sandy, our post-storm assessments have identified the potential for significant damage if our region were to experience a significant coastal storm in the future. A critical threat to the gas system is the introduction of water into gas equipment, which can damage pipes, lead to over-pressurization, or result in service interruptions. By protecting our gas system from water infiltration, we will spare our customers the long and laborious process of restoring each and every gas service, which must be done one customer at a time. We have also identified flooding vulnerabilities at our Liquefied Natural Gas (LNG) plant and at gas regulator stations and remote operated valves in flood zones.

To harden our gas system in the near term, we are:

- accelerating plans to install vent line protection devices to prevent water from entering high-pressure regulators through the regulator vents
- replacing cast iron and bare steel pipe in flood-prone areas because these types of pipe could be more susceptible to water infiltration under flooding conditions
- installing measures to protect critical back-up systems at our LNG plant from inundation during a storm surge, and
- hardening gas regulator stations and remote operated valves against water intrusion

2. Gas Distribution System Storm Hardening Projects

a) Installing Vent Line Protection Devices to Prevent Water Infiltration

Water infiltration into the vent-line of high-pressure regulators could result in damage due to over-pressurization of downstream customer equipment, or loss of customer pilot lights. To mitigate these risks during future flooding events, Con Edison is installing vent-line protection devices ("VLPs") also known as "float-check valves." VLPs will prevent over-pressurization of the customer's internal gas equipment due to flooding by preventing water infiltration through the vent-line, and thus maintain gas service to customers during flood events. VLPs became commercially available in late 2012 after six years of research and development by Con Edison, the industry's national Gas Technology Institute, and several equipment vendors.

Following Sandy, the Company identified approximately 9,200 existing high-pressure services within 2003 SLOSH Category 1 through 4 hurricane flood zones that would benefit from this measure and projected the cost of installing vent line protectors to be $4.8 million. Based on the 2013 FEMA plus three feet standard for New York City locations and 2003 SLOSH Category 1 and 2 for Westchester County locations, approximately 3,700 high pressure services require vent-line protection devices. (Because FEMA has not published new flood maps for Westchester County, we have used 2003 SLOSH Category 1 and 2 to identify high pressure services in Westchester County).[39] We installed 950 valves in 2013 at a cost of $0.8 million and will install the remaining 2,750 in 2014 at a cost of $2.4 million.

b) Replacing Cast Iron and Bare Steel Pipes in Flood Zones

Leaking and/or weakened low-pressure cast iron and bare steel gas pipes can result in water infiltration into the distribution system during a coastal flood. Water infiltration, in turn,

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[39] Con Edison's Phase One Report updated the cost of installing VLPs from $4.8 million to $2.8 million. Phase One Report, pp. 154-55.

can result in poor system pressure, lengthy customer outages, and potentially hazardous interruptions of service.

As a result of Sandy, Con Edison's gas system had almost 400 service outages affecting over 4,200 customers in the Bronx, Manhattan, Queens, and Westchester. Customer outages resulted from water that infiltrated into the gas mains, mainly caused by shifting ground conditions that occurred during flooding and by long-term corrosion that occurs on bare steel pipe. To reduce the potential for similar or more significant damage in future storms, the Company is conducting a targeted low-pressure cast-iron and bare-steel replacement program in flood-prone areas. By replacing this pipe with plastic or protected steel pipe, we will reduce the likelihood of water infiltration. [40]

Con Edison's Gas Rate Plan provides that the Company will replace at least nine miles of leak-prone pipe in the FEMA 100-year flood plains during 2014 to 2016, including two miles in 2014, three miles in 2015, and four miles in 2016 with a minimum of six miles of such pipe to be replaced in Manhattan.

The Company's program prioritizes pipe replacement to mitigate the greatest risk. In 2013, the Company evaluated pilot areas throughout flood zones to identify key factors required to develop a program including factors for quantifying risk. As a result, the program quantifies risk according to factors such as elevation, Sandy flood area, and population density. The program targets small diameter (8" or less) leak-prone pipe for replacement. These pipes exhibit

[40] Another source of water infiltration is damage to customer equipment located in flooded basements, which then allows water infiltration into the low-pressure distribution system from the customer's side of the service. Currently, no commercially available device addresses this issue. Gas Operations is working with Con Edison's R&D Department on an initiative to develop an isolation device to prevent water infiltration into the low pressure system from flooded basements and damaged customer piping or equipment.

the highest risk for water intrusion. Where possible, low pressure pipe will be replaced by high pressure pipe.

Con Edison currently estimates a total cost of $79 million to meet the commitment in the Joint Proposal to replace 9 miles of pipe over three years (2014 to 2016), including six miles in Manhattan. The projected annual cost is:

- 2014 - $12 million for 2 miles of mains (one mile in Manhattan)
- 2015 - $26 million for 3 miles of mains (two miles in Manhattan)
- 2016 - $41 million for 4 miles of mains (three miles in Manhattan)

The Gas Rate Plan reflects $79 million for this targeted replacement program.

c) Remote Operated Valve Hardening

Remote operated valves (ROV) provide the capability to immediately isolate sections of the gas system to mitigate conditions such as over-pressurization or pipe rupture. Intrusion of water can cause the failure of ROV components including:

- Transducer and transducer cable failure resulting in loss of visibility/loss of pressure readings
- Actuator and actuator power and communication cable failure resulting in loss of control over remote operated valves
- Remote Terminal Unit (RTU) and actuator control box (located aboveground) failure resulting in loss of control and loss of visibility/pressure readings in the Gas Operations Supervisory System[41]

The Company plans to harden ROVs and associated underground vaults against flooding caused by coastal storms. The objective of this work is to allow the ROV to continue functioning during a storm event and/or minimize the restoration work that may be needed following the storm.

The scope of the project is as follows:

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[41] The Gas Operations Supervisory System monitors real-time pressure and flow information through remote terminal units located at various field locations, including interconnection points with interstate pipelines, electric and steam generating stations, and custody transfer metering stations with the National Grid gas system.

- Harden ROV Equipment
    - Replace wire in hollow conduit with solid cables and cable glands that are rated for wet/dry use eliminating water migration path
    - Replace analog actuators with digital actuators
- Harden ROV manhole vault
    - Remove existing casting and install storm hardened bolt-down inner pan and casting where feasible
    - Excavate as necessary to expose all vault penetrations and interface between vault wall and ceiling, then apply waterproof coating over these elements.
    - Apply waterproof coating inside of manhole
    - Install or replace penetration seals as needed
    - Rebuild vent post system if it appears to be a major source of water infiltration
    - Remediate manhole walls if deemed to be a major source of water infiltration

The Company plans to harden two ROV sights in 2015, at an estimated unit cost of $508,000 per ROV. Of 20 identified ROV sites in flood zones, two will be selected for hardening in 2015, using past history of flooding, likelihood of flooding, and proximity to critical facilities (such as gate stations, generating stations or tunnels) as prioritization criteria.[42] We plan to harden additional ROV sites in 2016; the work scope and volume will be informed by our experience with the two 2015 projects.

d) Regulator Station Hardening

As gas flows through the system, regulators control the flow from higher to lower pressures. If a regulator senses that the pressure has dropped below a set point, it will open accordingly to allow more gas to flow. Conversely, when pressure rises above a set point, the regulator will close to adjust. Water intrusion in a low-pressure regulator pilot vent line can cause the regulator set point to increase and could lead to over-pressurization. Intrusion of water

[42] The unit cost of $508,000 reflects replacement of the actuator. It is possible that the sites ultimately selected will not require replacement of the actuator, in which case the estimated unit cost is $337,000.

can also cause the failure of regulator above-ground electronics including failure of the RTU and the Smart Regulator/Transducer box.

The Company plans to harden pressure regulator stations against flooding during flood events.[43] The objective of this work is to allow the regulator to continue functioning during a flood event when operating conditions require continuous operation and/or minimize the restoration work that may be needed following the storm.[44]

The project will raise level of pilot regulator vent above FEMA 2013 plus three feet flood elevation. If the vent is not water tight, the vent will be rebuilt before extension. The project will also waterproof the existing regulator station manhole vault using the measures identified above for ROV manhole vaults.

The Company plans to harden one low-pressure regulator station in 2015, at an estimated cost of $688,000 per two-stage regulator station. We plan to harden additional regulator stations in 2016; the work scope and volume will be informed by our experience with the 2015 project.

3. Liquefied Natural Gas Plant Hardening

a) New Switchgear and Batteries and LNG Salt Water Pump House

The LNG plant provides peaking and contingency supply of natural gas to firm gas customers. The plant's automatic fire protection system utilizes an electric motor driven fire pump and a back-up diesel engine driven pump. The electric motor and the diesel engine and their associated fire pumps are located within a pump house ("pump house") that is sited alongside Luyster Creek, the salt water source for the fire pumps. The pump house also contains the electrical switchgear for the electric motor and the battery bank for the diesel engine. The

[43] Low pressure stations will be targeted first because high pressure regulators will not experience significant set point drift, even if water infiltrates pilot vent.
[44] The first measure of protection during a flood condition will be shutting down the regulator station, if possible, as there is an inherent risk to allowing a regulator station to continue to operate when it is inaccessible due to flood water.

transformers and high tension vaults (HTV) for the 27kV feeder supply to the electric motor are adjacent to the pump house. A storm surge similar to Sandy could flood both the electrical switchgear for the electric motor, the battery bank for the diesel engine, and the HTVs and transformers for the electric motor, and thereby render inoperable the electric motor driven fire pump and the diesel engine driven back-up pump.

This project will harden the pump house fire equipment by elevating equipment to the FEMA 2013 plus 5 feet level. FEMA 2013 plus 5 feet was chosen because the increase in cost from 3 feet to 5 feet was found to be incrementally small. The planned wok includes:

- Installing an immersible electric motor or elevating the electric fire pump motor in the west section of the pump house
- Installing the existing transformers and new outdoor electrical switch gear, electrical panels, batteries and fire pump controller on a new elevated exterior platform on the south side of the pump house
- Reconstructing the east section of the pump house to accommodate a new elevated interior platform where the diesel engine and its electrical panel and fuel day tank will be installed.

The project will be designed in 2014 at an estimated cost of $350,000, and construction will be commenced and completed in 2015 at an estimated cost of $5.1 million.

b) Elevate Diesel Blackstart Generator

The LNG plant's blackstart, diesel-driven generator ("blackstart generator") provides back-up power to maintain 100% operational capability during an electric contingency upon the loss of the three 27 kV feeders supplying light and power to the plant. The blackstart generator is currently installed at an elevation that leaves it vulnerable to a high storm surge.

This project raises the generator to the FEMA plus three and one-half feet flood elevation level by elevating the unit on a newly installed steel corrosion resistant platform. The project will be designed in 2014 at an estimated cost of $60,000, and construction will be commenced and completed in 2015 at an estimated cost of $550,000.

c) Install Dockside Auxiliary Fire Pumps

The LNG plant's automatic fire protection system utilizes an electric motor driven fire pump. The back-up fire pump is a diesel engine driven pump. The FDNY Bureau of Fire Protection issues a permit to operate the plant predicated on the continuous availability of both of these fire pumps. To meet this requirement during the year-long construction phase for elevating the electrical and mechanical systems for the primary and back-up pumps, an auxiliary set of permitted pumps will be installed to serve as primary pumps. Thereafter, the auxiliary pumps will be maintained on site and placed in service when either the primary or back-up pump is out of service for maintenance.

This project installs two new standby auxiliary pumps with piping to tie into the existing fire protection loop. The project will be designed in 2014 at an estimated cost of $60,000, and construction will be commenced and completed in 2015 at an estimated cost of $1.7 million.

White papers describing the scope and cost for each of the gas system storm hardening projects are provided in Appendix K – Gas System.

4. Gas System Storm Hardening Costs

a) Costs Reflected in Gas Rate Plan

In the rate case and in the Phase One Report, Con Edison presented plans for storm hardening the gas distribution system as follows:

- Complete installation of vent line protection valves to prevent water infiltration on high pressure services in 2014 at a cost of $4.8 million and

- Replace cast iron and bare steel in flood zones in 2015 and in 2016 at a total cost of $33.3 million.

In the rate case, the Company stated that the need for storm hardening at the LNG plant was being studied, but proposals and costs had not yet been developed and reflected in the revenue requirement. Con Edison's three-year Gas Rate Plan (2014 to 2016) established in Case 13-G-0031 reflects the forecasted expenditures shown in the following table:

Gas System Projects (Rate Plan) ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)*
Main Replacement in Flood Zones	18.0	26.0	35.0	79.0
Vent Line Protector Installation	4.8	0	0	4.8
Regulator Stations and ROVs Hardening	0	0	0	0
LNG Hardening	0	0	0	0
Total	22.8	26	35	83.8

* Main Replacement in Flood Zones program reflects cost established in the Joint Proposal, Appendix 23.

During the Phase One Collaborative meetings and in the Phase One Report, Con Edison presented plans to storm harden critical back-up facilities at the LNG plant in 2014 at an estimated cost of $2 million.[45] In addition, the City of New York urged Con Edison during the Phase One meetings to establish plans for storm hardening regulator stations and remote operating valves. Following discussions with the City and Staff, the Company developed its plan for storm hardening these facilities and presented it to the parties during the Second Phase Collaborative.[46]

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45 Phase One Report, pp. 158-160.
46 See Appendix C.

b) Updated Costs

Con Edison's current projected expenditures for gas system storm hardening projects during 2014, 2015, and 2016 is $147.3 million, itemized by project, are as shown in the following table:

Gas System Projects (Phase Two Report) ($ millions)	2014	2015	2016	2014-2016
Main Replacement in Flood Zones	12.0	26.0	41.0	79
Vent Line Protector Installation	2.4	0	0	2.4
Regulator Stations and ROVs	0	1.7	10.7	12.4
LNG Hardening (Black Start, Auxiliary Pumps and Salt Water Pump House)	0.5	7.35	0	7.8
Total	**14.9**	**35.05**	**51.7**	**101.6**

Projected expenditures for gas system storm hardening have increased by $17.8 million from the level reflected in the Gas Rate Plan. This increase results from the new costs for the LNG storm hardening projects ($7.8 million) and regulator and ROV hardening projects ($12.4 million) as offset by decreased costs for vent line protection (-$2.4 million). As discussed below the increase of $21.9 million is also offset by a projected decrease in $18.4 million in tunnel hardening costs.

B. Tunnel Storm Hardening

1. Tunnel Storm Hardening Objectives

During Sandy, water entered the First Avenue, Ravenswood, Astoria, Hudson Avenue, Flushing, and 11th Street tunnels. These tunnels contain steam mains, gas mains, and/or high voltage electric feeders that may need to be de-energized for safety if the tunnels are significantly flooded.

With the exception of the First Avenue Tunnel, all of our tunnels have "head-house" entrances that are in close proximity to bodies of water.[47] Currently, these head houses are either sheet metal or masonry structures that are not designed to withstand coastal flooding.[48] The objective of this project is to harden these head house structures to protect against flooding and wind damage; to protect their equipment from salt water damage, flotation, and destruction due to wave action and flood hydraulic head pressure; and to provide alternate access in emergency. Storm-hardening projects for Astoria, Ravenswood, Hudson Ave, 11th Street, and Flushing Tunnels are projected to be completed in 2015 and 2016. The design basis for all storm hardening work will meet the FEMA plus three feet flood elevation and applicable New York City Building Code requirements for wind.

As part of the entrance-hardening plans, certain head houses will be rebuilt to acceptable standards, while others will be hardened with flood doors and floodgates, and the roofing structures will be reinforced to weather rain and wind events associated with anticipated high magnitude storms. Other control measures to prevent water from infiltrating the tunnels will include the construction of barrier walls and the sealing of cracks and other penetrations in the interior tunnel walls. The project will improve pumping operations to pump out water that

[47] During Sandy, significant flooding and a power outage forced the First Avenue Tunnel out of service. The entrances to this tunnel consist of street-level vent gratings that allowed water to enter the tunnel. Tunnel de-watering pumps could not be operated due to the power outage; as a result, the tunnel was flooded by over 500,000 gallons of water. The resulting damage required a lengthy restoration process of pumping out the water, replacing steam pipe insulation, as well as other repairs, and restoring service.

To prevent future flooding of the First Avenue Tunnel, Con Edison designed and fabricated at a cost of $300,000 in 2013 vent cover plates that can be installed prior to a storm. These plates will prevent floodwater from entering the tunnel through the open street-level vent gratings and damaging electrical circuits, controls, piping and tunnel structures. The design incorporates a vent stack to bleed ambient heat and steam from the tunnel, and a new closure plate at the 36-inch steam-main point of entry. These measures also allow faster restoration of steam service and may allow the steam main to remain in service, depending on the nature of the weather event. Backup power generation, which will keep the pumps operational during a power outage, is in the regulatory permitting process. The permitting process is taking longer than anticipated. Our goal is to complete the installation of the generator in advance of the 2015 hurricane season at an estimated cost of $500,000.

[48] Pictures of these head houses are provided in Appendix C.

infiltrates the tunnels. The project includes, where necessary, raising above flood levels the equipment in the yards surrounding the head houses, protecting equipment such as oil-water separators by raising it above the design flood elevation, anchoring, or constructing flood-barrier walls, and providing emergency back-up power. Cameras and lighting for remote monitoring will be installed.

2. Tunnel Hardening Projects

a) 2015 Projects

Con Edison plans to implement and complete three tunnel storm hardening projects in 2015 – the Hudson Avenue Tunnel ($8.4 million), the 11th Street Conduit ($2.2 million), and the Flushing Tunnel ($5.2 million).

(1) Hudson Avenue Tunnel

The following measures will be implemented for the head house on the Brooklyn side of the tunnel:

- reinforce existing walls
- new roof membrane and hatches
- new wind resistant louvers
- emergency egress
- secure oil water separator

The following measures will be implemented for the head house on the Manhattan side of the tunnel:

- replace existing structure
- rebuild south foundation wall
- install flood proof hatch doors
- investigate integrity of seawall

(2) 11th Street Conduit

The following measures will be implemented for the head house on the Queens side of the tunnel:

- relocate entry door above DFE
- new roof membrane
- new wind resistant louvers
- emergency roof egress

The following measures will be implemented for the head house on the Brooklyn side of the tunnel:

- reinforce existing structure
- new roof membrane
- new wind resistant louvers
- install bulkhead doors
- install new emergency generator
- install flood proof hatch door
- emergency roof egress
- secure oil water separator

(3) Flushing Tunnel

The following measures will be implemented for the head house on the College Point side of the tunnel:

- build new structure on caissons
- new vent fans and louvers
- raise existing shaft
- install back-up generator
- relocate electrical panels and cabinets to interior or above DFE

The following measures will be implemented for the head house on the Corona side of the tunnel:

- build new structure on caissons
- install wind resistant louvers

b) 2016 Projects

Con Edison plans to implement and complete two tunnel storm hardening projects in 2016 – the Astoria Tunnel ($10.7 million) and the Ravenswood Tunnel ($13.7 million).

(1) Astoria Tunnel

The following measures will be implemented for the head house on the Queens side of the tunnel:

- reinforce existing perimeter walls of structure
- install flood barrier doors
- install new roof
- raise vent fans above DFE
- install flood wall around oil water separator/coke filter

The following measures will be implemented for the head house on the Bronx side of the tunnel:

- install floodwall around existing structure
- new flood gates
- new roof membrane
- new louvers

(2) Ravenswood Tunnel

The following measures will be implemented for the head house on the Queens side of the tunnel:

- replace existing structure
- install new vent fan and louvers
- relocate electrical to interior of building
- install flood wall and flood gates around oil water separator

The following measures will be implemented for the head house on the Manhattan side of the tunnel:

- strengthen supports for louvers
- protect base louver from flooding
- install new flood door
- emergency egress

White papers describing the scope and cost for the 2015 tunnel storm hardening projects are provided in Appendix L - Tunnels.

3. Tunnel Storm Hardening Costs

a) Costs Reflected in Gas Rate Plan

In the rate case and in the Phase One Report, Con Edison presented the following costs for tunnel storm hardening projects: $25 million in 2015 and $35 million in 2016.

Con Edison's three-year Gas Rate Plan (2014 to 2016) established in Case 13-G-0031 reflects the forecasted expenditures for tunnel hardening projects shown in the following table:

Tunnel Hardening Projects (Rate Plan) ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
Tunnel Hardening	0	25.0	35.0	60.0
Total	0	25.0	35.0	60.0

The forecasted expenditures for Tunnel Projects are reflected in the "Storm Hardening" gas net plant category.

b) Updated Costs

Con Edison's current projected expenditures for tunnel storm hardening projects during 2014, 2015, and 2016 is $41.6 million as shown in the following table:

Tunnel Hardening Projects (Phase Two Report) ($ millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014-2016 Current Projection
Tunnels Hardening	1.3	16.4	23.9	41.6
Total	**1.3**	**16.4**	**23.9**	**41.6**

Projected expenditures for tunnel storm hardening projects have decreased by $18.4 million from the level reflected in the Gas Rate Plan. This decrease results from cost estimates resulting from conceptual studies for the projects. The Company will continue to refine its estimates as it prepares detailed engineering and designs for specific components of the projects and receives bids for the performance of construction and installation work.

C. Gas System and Tunnel Projects Storm Hardening Costs

Con Edison's Gas Rate Plan reflects storm hardening expenditures for both the gas system and the tunnels. This section discusses these expenditures on a combined basis.

1. Costs Reflected in Gas Rate Plan

In the rate case and in the Phase One Report, Con Edison presented the following storm hardening plans:

- Complete installation of vent line protection valves to prevent water infiltration on high pressure services in 2014 at a cost of $4.8 million
- Replace cast iron and bare steel in flood zones in 2015 and in 2016 at a total cost of $33.3 million, and
- Storm harden tunnels in 2015 and in 2016 at a total cost of $60 million.

In the rate case, the Company stated that the need for storm hardening at the LNG plant was being studied, but proposals and costs had not yet been developed and reflected in the revenue requirement. During the Phase One Collaborative meetings and in the Phase One Report, Con Edison presented plans to harden critical back-up facilities at the LNG plant in 2014 at an estimated cost of $2 million.

Con Edison's three-year Gas Rate Plan (2014 to 2016) established in Case 13-G-0031 reflects the following forecasted expenditures:[49]

Gas Project (Rate Plan) ($ millions)	2014	2015	2016	2014-2016
Main Replacement in Flood Zones	18.0	26.0	35.0	79.0
Vent Line Protector Installation	4.8	0	0	4.8
LNG Hardening	0	0	0	0
Regulator Stations and ROVs	0	0	0	0
Tunnel Hardening	0	25.0	35.0	60.0
Total ($000)	22.8	51	70	143.8

The forecasted expenditures for the Vent Line Protector Project and the Tunnel Projects are reflected in the "Storm Hardening" net plant category. The forecasted expenditures for the Main Replacement in Flood Zones project are reflected partially in the "Storm Hardening" net plant category ($33.3 million) and partially in the "Delivery" net plant category ($45.7).[50]

2. Updated Gas System and Tunnel Hardening Costs

Con Edison's current projected expenditures for Gas System and Tunnel storm hardening projects during 2014, 2015, and 2016 is $147.3 million, itemized by project as follows:[51]

Gas Project (Phase Two Report)	2014 Current	2015 Current	2016 Current	2014-2016 Current

[49] Con Edison's Gas Rate Plan reflects the Company's storm hardening expenditures forecast in its rate case update filing, as adjusted for the cost of the Main Replacement in Flood Zones program in the Joint Proposal (see Joint Proposal, Appendix 23), subject to a storm hardening net plant reconciliation mechanism designed to address the rate impacts of any difference between forecasted and actual expenditures and subject to the Commission's review of the Company's updated storm hardening plans and expenditure forecast as provided in this Phase Two Report.

[50] The Company believes that the forecasted expenditures for the Main Replacement in Flood Zones program should be reflected entirely in the "Storm Hardening" net plant category. The Company will confer with DPS Staff to discuss whether and how this matter should be addressed.

[51] As noted in the discussion of these expenditures in the sections above, the Company's Phase One Report updated some of the costs reflected in the Gas Rate Plan.

($ millions)	Projection	Projection	Projection	Projection
Main Replacement in Flood Zones	12.0	26.0	41.0	79.0
Vent Line Protector Installation	2.4	0	0	2.4
LNG Hardening (Black Start, Auxiliary Pumps and Salt Water Pump House)	0.5	7.35	0	7.8
Regulator Stations and ROVs	0	1.7	10.7	12.4
Tunnels Hardening	1.3	16.4	23.9	41.6
Total	**16.2**	**51.45**	**75.6**	**143.3**

Projected expenditures for gas system and tunnel storm hardening have decreased slightly (-$0.5) from the level reflected in the Gas Rate Plan. The new costs for the LNG storm hardening projects ($7.8 million) and regulator and ROV hardening projects ($12.4 million) are fully offset by decreased costs for tunnel hardening (-$18.4 million) and vent line protection (-$2.4 million).

Consistent with the provisions of the Joint Proposal, Con Edison requests that the Commission approve the gas system and tunnel storm hardening projects presented in this Phase Two Report for 2015 and 2016, the second and third years of the Gas Rate Plan. To the extent that the actual expenditures for these projects result in net plant balances above those reflected in the Storm Hardening category of the Average Gas Plant In Service Balances for the second and/or the third rate year, the Joint Proposal provides that the Company may defer for later collection the carrying costs associated with such net plant exceedances upon the Commission's approval of such expenditures. [52]

[52] The Joint Proposal states (p. 43):

> With respect to the Storm Hardening category of the Average Gas Plant In Service Balances, the Commission's order regarding RY2 and RY3 Storm Hardening programs in response to the Company's September 1, 2014 Storm Hardening report (see section D.4 below) may call for Storm Hardening capital

Accordingly, Con Edison requests that the Commission approve the expenditures for the gas system and tunnel storm hardening projects presented in this Phase Two Report. Upon such approval, and consistent with the Joint Proposal, the Company would defer for later collection any carrying costs associated with actual expenditures above those reflected in the Company's Gas Rate Plan.

VI. Steam System Storm Hardening

This section addresses storm hardening projects that improve the resiliency of Con Edison's steam system. These include projects related to the operation of the Company's steam and electric generating stations (collectively "generating stations") and the steam distribution system.[53]

A. Generating Stations Storm Hardening

1. Generating Stations Storm Hardening Objectives

Prior to Sandy, generating station storm hardening objectives were based on the impact of previous storms. The Company's generating stations were designed to withstand a storm surge corresponding to a peak tidal water level of 12.1' at the Battery. During Sandy, flooding from the unprecedented storm tide levels exceeding 14 feet at the Battery overcame restraint barriers protecting critical generating station equipment. The storm surge levels resulted in station shut-downs and steam service impacts as follows:

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expenditures in RY2 and/or RY3 in an amount more or less than the amount reflected in the Storm Hardening category of the Average Gas Plant In Service Balances for RY2 and/or RY3.

If the Commission's order calls for RY2 and/or RY3 Storm Hardening capital expenditures greater than the amount reflected in the Storm Hardening category of the Average Gas Plant In Service Balances for RY2 and/or RY3, the net plant reconciliation mechanism will continue to apply as described herein and the Company will defer for future collection from customers the revenue requirement impact (i.e., carrying costs, including depreciation, as identified in Appendix 9) of the amount of average net plant resulting from the additional capital expenditures.

[53] Con Edison's several steam generating stations and its one electric generating station are operated by the Steam Operations department within the Company's Central Operations organization. The East River Generating Station produces both electricity and steam.

- Preemptive shutdown of the East River Generating Station to protect the station's steam distribution outlet mains from contact with flood water;
- Shut down of 59th and 74th Street Steam Generating Stations (nearly 90% of total steam generating capacity being unavailable);
- Shut down of the First Avenue Tunnel;
- Operation of the steam system at pressures lower than normal due to shut-down of steam generating stations; and
- Isolation of steam service to 53 large commercial customers due to forecasted loads in excess of available steam generation capacity.

The East River, 59th Street, and 74th Street Complex generating facilities incurred significant damage during the storm.

Post-Sandy assessments of damage at Con Edison's generating stations, identified additional measures needed to protect the stations from storm flooding, including reinforcing station perimeter walls, installing gates and floodwalls, and raising critical equipment. Con Edison is conducting storm hardening projects to protect the following five generating stations against future flood conditions and storm surge:

- East River Generating Station and South Steam Station
- 59th Street
- 74th Street
- 60th Street
- Ravenswood A House

Overall, the storm hardening program is focused on of the following primary objectives:

- Employ defense in depth measures
- Minimize equipment damage from salt water
- Mitigate major water entry into steam stations
- Maintain continuous operation during a coastal storm event
- Allow for rapid recovery

2. Generating Stations Storm Hardening Measures Installed by June 2013

The first-phase, immediate storm hardening projects listed below were completed as of June 2013 in advance of the hurricane season. The measures were designed to prevent damage to critical equipment from a storm similar to Sandy that would otherwise significantly delay the start-up of the station. The objective of the following measures was to mitigate the infiltration of water in the generating stations from three primary sources: tunnels, the station perimeter (including doorways and roll-up doors), and pipes and conduits entering the station from the exterior:

- Install new reinforced concrete flood walls to isolate tunnel openings from other areas of the station;
- Install new reinforced concrete flood walls and moats around critical station equipment to protect the equipment against floodwaters that enter the station;
- Install new floodgates and doors in new walls and moats to access isolation zones;
- Install new flood pumps on mobile skids to remove any excess water that enters new isolation zones and moats;
- Seal selected tunnel openings in the station with new plates;
- Install new sealed plate covers with gaskets for manhole covers that link the tunnels and the station floor;
- Intercept all known open drain-piping connections entering the station from the exterior by installing new isolation valves inside the station boundary;
- Install new expansive RTV foam seals at any trench and conduit penetrations into the critical areas of the station to minimize the infiltration of water. These new seals were installed at all conduits and trenches to ensure that the enclosed critical areas of the station are watertight;
- Install new expansive RTV foam seals in conduits entering all critical panels and cabinets. The expansive foam seals were installed in all conduits entering the piece of equipment in order to ensure the cabinet or panel is watertight and protected against floodwaters;
- Secure industrial shrinkable fabric material to protect selected non-operating equipment within the postulated flood plain. This protective fabric will be deployed during the Company’s 120-hour Corporate Costal Storm Plan to enhance protection from water damage;

- Install new sliding or hinged steel flood control gates, doors and barriers at all station openings, including doorways and roll-up doors; and
- Construct new barriers and walls to close all non-required openings, such as doors, roll-up doors, or windows, that are no longer in service.

3. Generating Stations Storm Hardening Measures to Be Installed from 2014 to 2016

In addition to the immediate measures described above, the Company has developed a longer-term storm hardening plan for these five generating stations. The following summarizes the installation work to be performed at the generating stations under this longer-term hardening plan:

- Install sluice gates or reinforced concrete walls in the intake and discharge tunnels to control the inundation of floodwaters from those routes (this will require de-silting of some tunnels);
- Relocate critical mechanical and electrical equipment above the defined flood-control elevation;
- Install submersible equipment within the flood-control elevation;
- Reinforce station perimeter walls to withstand higher flood levels;
- Install pressure resistant/submarine type doors to protect deep basements or structures;
- Install permanent, high-capacity flood-control pumps in additional areas of the stations;
- Install new emergency generators to power flood pumps and to provide additional support to the stations during an emergency; and
- Raise existing moats and walls to meet the flood-control elevation.

All critical equipment within generating stations located within the FEMA plus three feet flood zone will be protected to at least the FEMA plus three feet elevation. The FEMA plus three feet design adds about three to four feet to the protection level achieved by the initial storm hardening measures completed by June 2013.

The primary sources of water intrusion into the stations are flood water ingress through perimeter openings and river water ingress through the station water intake and discharge tunnels. Water entering the station from the perimeter via doorways, rollup doors, louvers, etc. will be addressed by flood doors, barriers, isolation valves, sealants, and gaskets installed to the FEMA plus three feet elevation. If necessary, station perimeter walls will be reinforced to withstand hydraulic pressure based on the FEMA plus three feet elevation. Sluice gates will be installed at the 59th Street, 74th Street, and East River Generating Stations to prevent tunnel water ingress into the stations. The installation of sluice gates will prevent the ingress of tunnel water at any storm surge height, including FEMA plus three feet and above. These measures provide the primary protection against flooding to the FEMA plus three feet elevation.

Secondary measures are being established to address any water that may enter the stations from the perimeter or the river despite these primary measures. High-capacity pumps, supported by emergency generators, will remove water from station interiors. Moats and compartmentalizing walls protect critical station equipment from any pooling water before it is pumped out. Compartmentalizing wall and moats are backup measures to the primary perimeter and sluice gate barriers and the secondary flood pumps.

Flood-control measures at the generating stations are designed to maintain four of our five steam station online throughout a storm surge. These measures will significantly reduce the number of customers for whom steam service is impacted following the storm and will reduce the number of days that service must be restricted while the full system is restored. The fifth steam plant, the East River Station, will be preemptively shut down ahead of large coastal storms to protect the heated steam distribution pipes exiting the station from contact with cool floodwater, but with the measures listed above, the station will return to service faster following a flood event.

Con Edison plans to install flood control measures at five generating stations during 2014 to 2016. White papers describing the scope and cost for each generating station project are provided in Appendix M – Generation Stations.

4. Generating Stations Storm Hardening Project Cost Estimates (2014 to 2016)

a) Costs Reflected in Steam and Electric Rate Plans

In the rate case and during the Phase One Collaborative, Con Edison presented plans to install storm hardening measures at the five generating stations from 2014 through 2016 at a total estimated cost of $146.6 million, including $42.8 million in 2014. The Company estimated $55.5 million for electric generation facilities and $91.1 million for steam generation facilities. The estimated costs for these projects for the period 2014 – 2016, reflected in the rate plans and presented in the Phase One Report, are summarized in the following table.

Generating Station Rate Plan* ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
East River EP**	14.0	21.0	20.5	55.5
East River SP	4.8	4.5	7.0	16.3
59th Street	10.0	12.0	11.9	33.9
74th Street	10.0	12.0	12.9	34.9
60th Street	2.0	1.0	0.0	3.0
Ravenswood A House	2.0	1.0	0.0	3.0
All Steam Stations	**28.8**	**30.5**	**31.8**	**91.1**
All Generating Stations	**42.8**	**51.5**	**52.3**	**146.6**

* Steam Rate Plan period is 2014, 2015, and 2016. Electric Rate Plan period is 2014 and 2015.
** East River EP is electric plant. All other stations are steam plant.

b) Updated Costs

As a result of ongoing project development work, including incorporation of the new flood protection design standard, FEMA plus three feet, in late July 2013, Con Edison has refined the estimated costs of the generating station storm hardening projects. In addition, as was presented during the Phase Two collaborative and discussed below, $8.9 million is being reallocated from steam generating station funding to the steam distribution system due to the benefits that can be realized by hardening distribution infrastructure.

The Company's current projection of storm hardening cost at each generating station is as follows:

Generating Station (Phase Two Report) ($ millions)	**2014 Current Projection**	**2015 Current Projection**	**2016 Current Projection**	**2014-2016 Current Projection**
East River EP	5.6	21.0	28.9	55.5
East River SP	2.8	1.7	2.9	7.4
59th Street	8.0	12.0	13.9	33.9
74th Street	6.7	12.0	16.2	34.9
60th Street	2.0	1.0	0	3.0
Ravenswood A House	2.0	1.0	0	3.0
All Steam Stations	**21.5**	**27.7**	**33.0**	**82.2**
All Generating Stations	**27.1**	**48.7**	**61.9**	**137.7**

Projected steam generating station storm hardening expenditures during the Steam Rate Plan have decreased by $8.9 million, all of which results from lower projected expenditures at the East River Steam Generating Station.

With regard to the generating station storm hardening projects generally, detailed engineering and design has been completed for 2014 work, and for some early 2015 work, and results in a more detailed cost projection for this component of the storm hardening projects. Additional engineering and design will be completed to support 2015 and 2016 work. Engineering and design detail has not been developed for these outer years, and cost projections in this Phase Two Report reflect the previously proposed concept plans and order of magnitude estimates. As the program progresses, engineering and design detail for this later work will be further developed and will be reflected in updated cash flow projections. In addition, much of the 2014 work is currently in the construction contract procurement process. Due to market conditions and other factors, contractor bids could be at different values than what has been estimated, and cost projections for the future years of the program may be modified on this basis as well.

B. Steam Distribution System Storm Hardening

The Phase One Report noted that Con Edison is developing several projects to improve steam distribution system resiliency and proposed that the Phase Two Collaborative "examine Con Edison's storm hardening project plans under development for initiation in 2015, including … steam distribution projects."[54] Con Edison presented to the Phase Two Collaborative five steam distribution storm hardening projects that the Company is implementing to comply with the FEMA plus three feet flood design elevation. This Phase Two Report describes these projects, as well as the Company's implementation plan for each.

1. Steam Distribution System Storm Hardening Objectives

After Con Edison adopted the FEMA plus three feet flood standard in July 2013, Con Edison's Steam Operations organization applied that standard in planning protective measures to mitigate the impacts of flooding on Con Edison's steam system.

Con Edison's Corporate Coastal Storm Plan establishes protective measures to mitigate the impacts of flooding on Con Edison's steam system. The Coastal Storm Plan calls for preemptive shut down of flood-prone areas of the steam distribution system in case of a severe storm. Isolation and de-energization of steam main and services are necessary to prevent

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[54] Phase One Report, pp. 9, 23, 83

damage to the mains from contact with flood water and the creation of condensation conditions that could lead to water hammer.

The FEMA plus three feet floodtide boundary encompasses approximately 14 miles of steam mains and steam services to about 216 customers in lower Manhattan.[55] Con Edison will pre-emptively isolate these steam mains and services when warranted by forecasted storm conditions. The steam distribution system storm hardening projects discussed below are being implemented to efficiently and effectively implement Con Edison's plan for preemptively isolating customers in flood areas and restoring their steam service without delay when flood water recedes, while maintaining steam service for all customers outside of flood areas during severe storms.

2. Steam Distribution System Storm Hardening Projects

a) Install tie between the 15th Street Distribution Main and the 1st Avenue Transmission Main

Portions of three major steam mains supplying lower Manhattan, the Avenue D main, the 7th Avenue main, and the First Avenue main, lie within the FEMA plus three feet flood zone. These mains will be isolated depending on the severity of flood conditions. When these three mains are isolated from the system, approximately 13 miles of steam mains and 137 customers in lower Manhattan outside of the FEMA plus three feet flood zone will be isolated as well.[56] The installation of a tie between the 15th Street distribution main and the 1st Avenue transmission main will re-route steam from the 15th Street main to the First Avenue main in order to maintain steam supply through the First Avenue transmission main south of 10th Street to Trinity Place north of Cedar Street, which are portions of the First Avenue main that are not in the flood zone.

[55] The steam distribution system contains 105 miles of steam pipe supplying service to 1,704 customers.
[56] The main isolation configuration, as well as graphics depicting the other steam distribution storm hardening projects discussed in this section, can be seen in the "Generating Stations and Steam Distribution Presentation" presentation given to the Collaborative parties on May 27, 2014 and provided in Appendix B.

The tie, which includes a 24" diameter 120 foot cross tie main and an isolation valve, will allow continued steam supply for approximately 110 of these 137 customers in lower Manhattan, which include three hospitals, one university, one high school, Police Headquarters, and City Hall. This project commences in 2014 and will be completed in 2015 at a total projected cost of $1.8 million.

b) Install additional isolation valves outside of flood zone

This project will extend steam service to the remaining 27 customers who would otherwise lose steam service when the Avenue D main, the 7th Avenue main, and the 1st Avenue main are shut down as described above. These customers include the New York Stock Exchange/Amex Equities (former American Stock Exchange), Trinity Church, New York Bank of Mellon, Deutche Bank, and Chase Manhattan Bank. This project will install isolation valves at Reactor Street west of Trinity Place, Cedar Street west of Trinity Place, and W15th Street west of Eighth Avenue. This project commences and will be completed in 2015 at a total projected cost of $1.8 million.

c) Install remote operated valves to facilitate isolation of mains in lower Manhattan flood zone

The Avenue D Main, the First Avenue Main, and the Seventh Avenue Main supply steam to Lower Manhattan and will be isolated depending of the severity of flooding.

The Avenue D Main is located in the flood zone, and this main will be preemptively isolated prior to anticipated flooding conditions.

The First Avenue Main is supplied from the East River Generating Station which is in the flood zone. All steam mains emanating from the East River Generating Station will be shut down to preclude flood water from contacting live steam mains. However, as discussed in project

“1” above, steam will be rerouted to the First Avenue Main via a tie from the 15th Street Main so that steam supply in Lower Manhattan can be maintained.

Portions of the Seventh Avenue Main in the lower Manhattan area are in the flood zone. During flooding conditions, this main will be kept in service as long as possible along with other mains outside of the FEMA plus three feet flood area in lower Manhattan.

Steam Distribution will convert the existing control valve on the First Avenue main south of 10th Street to a control/isolation valve, and change the manual valve on the Seventh Avenue main south of 12th street to a control/isolation valve. These installations will provide capability to keep the mains and adjoining customers in lower Manhattan in service as long as possible during a severe storm and will avoid shutting down the entire steam system if supply to lower Manhattan must be isolated.

When steam is supplied through the First Avenue main to lower Manhattan via the tie from the 15th Street main, the Company must be able to control the steam flow and completely isolate it if necessary depending on the extend of flooding in lower Manhattan. For this purpose, Con Edison will convert the existing control valve (CV3) on the First Avenue main south of 10th Street to a control/isolation valve. CV3 currently provides remote operation to divert flow between upper and lower Manhattan. This control valve has a hole in its rotating disc which maintains flow through the valve. It has a “stop” installed to prevent full closure of the valve, and no seat is present in the valve to allow for completely sealing. In addition, the electronics do not allow precise control that would be required for isolation use. Therefore, the existing valve and its controls will be replaced to provide remote throttling and a tight shut-off for isolation.

On Seventh Avenue south of 12th Street, the existing valve is a manually operated valve that is used only for isolation purposes. This valve will be replaced with a new control/isolation valve which can be remotely throttled to control the flow, and remotely operated.

With these two remotely operated valves, the steam dispatcher will be able to remotely sectionalize the steam system to isolate lower Manhattan if warranted by flood conditions while maintaining steam service to the remainder of the steam system. The remote operated valves will avoid shutting down the entire system due to lower Manhattan flooding and will maintain steam service for approximately 1,424 customers that are outside of lower Manhattan. As flood levels rise during a storm, steam dispatchers will use these remotely operated valves to throttle steam to lower Manhattan. If flooding becomes severe and threatens lower Manhattan mains and customer services, or upon sudden loss of an electric network in lower Manhattan, steam dispatchers will be able to remotely operate these two control/isolation valves to immediately isolate lower Manhattan without risking the safety of the employees in the field for manual valve operation during severe storm conditions. Immediate isolation will also minimize the risk of a water hammer event, which can endanger the public.

This project commences in 2014 and will be completed in 2015 at a total projected cost of $1.6 million.

d) Improve debris capture and removal in the York Steam Main located on Hudson Avenue Property

This project will reconfigure the main and drip pot arrangement located immediately downstream of main valve YMS-1 on Marshall Street in the Hudson Avenue Property to facilitate draining of condensate in the York steam main from Brooklyn Navy Yard Cogeneration Partners (BNYCP) and purging of the pipe to prevent transport of debris to the steam traps further downstream in the system.

Currently, BNYCP will preemptively isolate in anticipation of a coastal storm. This includes preemptive isolation of the adjoining York steam main which is below grade in the FEMA plus three feet flood zone and is usually submerged during storm conditions. Although the York main and the mains in BNYCP will be preemptively isolated, flood water inundation rapidly cools the mains causing the protective magnetite layer on the inside wall of the pipe to scale off. After start up and when flow conditions create enough velocity, the scales are transported in the flow. The reconfiguration of the pipe and drip pot arrangement is on the above-ground section of the York main and provides a suitable flow condition and a mechanism to capture the transported debris. The new arrangement utilizes a tee fitting in place of an elbow, provides a horizontal run of several feet of straight pipe beyond a vertical riser and relocates the drip pot to facilitate the transport of pipe scales/debris to the drip pot for capture and removal before it goes further downstream into the steam system. This project also helps to expedite the restoration of the main. The projected was commenced and completed in 2014 at a cost of $200,000.

e) Storm Hardened Remote Monitoring System (RMS)

The RMS provides information regarding the operation of steam facilities at particular locations on the steam system. This information includes the presence of water, i.e., flooding, in steam manholes. This project will waterproof approximately 300 underground Remote Telemetry Unit (RTU) boxes within the FEMA plus three feet flood zone to avoid RTU failures due to flooding. In addition, this project will install the RMS at approximately 45 new locations that have been identified to provide system status information during storm tide conditions. The information from these RTUs will assist Steam Operations in determining the need and scope of steam main isolation during flooding conditions. This project commences in 2014 and will be completed in 2015 at a total projected cost of $2 million.

f) Expedited restoration

Steam mains that have been isolated and removed from service rapidly loose warmth and must be re-warmed gradually in order to safely restore steam supply. Typically, this process has entailed introduction of steam at low and gradually increasing pressures.[57] This project will study the feasibility of using high temperature air to expedite restoration of preemptively isolated steam mains in the flood zone.[58]

The project will

- Build engineering models of simulated mains using Finite Element Analysis (FEA) software to determine the feasibility of using high temperature air for heating up the pipe and drying out the saturated insulation and the parameters of the high temperature air supply.
- Build a piping assembly, simulate the conditions analyzed, and use the field measured values and test results to validate and refine the model.
- Model actual steam mains in the FEMA plus 3 feet flood area surrounding the East River Station and determine flow parameters and specifications for the source of the high temperature air.

The cost estimate of $1.5 million does not include the purchase of equipment and making appropriate connections to the steam system. The study will specify the air source(s) necessary to achieve the project if feasible. In anticipation, the Company has researched potential air sources and has found two possible vendors. Direct cost estimates for potential high temperature air sources currently available in the market are:

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[57] When a hot steam main becomes inundated with flood waters, it is quenched and any steam inside the main will rapidly condense and can potentially generate a water hammer. To avoid water hammer conditions, the mains in the FEMA plus 3 feet area of Manhattan will be preemptively isolated prior to a forecasted storm based on forecasted intensity. Once a steam main is inundated, the pipe becomes cold and the insulation becomes saturated. Restoring steam to a main after flooding will generate a significant amount of condensate, and there is no practical way to quickly remove the condensate to avoid conditions that can create a water hammer. As a result, the restoration process requires the gradual introduction of steam over an extended period of time to dry the insulation, remove condensate, and avoid conditions that can generate a water hammer.

[58] High-temperature air has no moisture and will not generate condensate while heating up the steam mains. If the high temperature air can be utilized to heat up the mains above 212 °F, it will boil off the water present in the saturated insulation wrapped around the outside of the mains. In addition, the air will help to eliminate any condensate present inside the mains by forcing it out through traps or open valves. If utilizing high temperature air to warm the steam mains is feasible, it will help to produce conditions (hot mains with dry insulation) experienced regularly during normal steam main outages and would facilitate rapid restoration of the steam system.

- TurboPHASE Unit $2,000,000 for 3.2 MMBTU/hr
- Ingersoll Rand Unit C950 $4,470,800 for 4.0 MMBTU/hr

The study commences in 2014 and the projected costs in 2014 and 2015 are $1.5 million.

In order to protect the steam distribution system to the FEMA plus three feet flood protection standard as rapidly as possible, the Company has initiated or expects to initiate each of the projects in 2014 and to complete the projects no later than 2015. A white paper describing the scope and cost for each project is provided in Appendix N – Steam Distribution.

3. Steam Distribution System Storm Hardening Project Costs

The projected costs of the steam distribution storm hardening projects are as shown in the following table:

Steam Distribution Project (Phase Two Report) ($ millions)	2014 Current Projection	2015 Current Projection	2014 – 2015 Current Projection
Tie Main	0.8	1.0	1.8
Isolations Valves	1.8	0	1.8
Remote Operated Valves	0.3	1.3	1.6
Debris Removal	0.2	0	0.2
Hardening REMS	1.1	0.9	2.0
Expedited Restoration	0.3	1.2	1.5
Total	**4.5**	**4.4**	**8.9**

C. Steam System Storm Hardening Costs

1. Costs Reflected in Steam Rate Plan

The Steam Rate Plan reflects $91.1 million for storm hardening expenditures at the steam generating stations and no expenditures for storm hardening of the steam distribution system as shown in the following table:

Steam Generating Stations Rate Plan ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
All Steam Stations	28.8	30.5	31.8	91.1
Steam Distribution System	0	0	0	0
Total	**28.8**	**30.5**	**31.8**	**91.1**

In the steam rate case, Con Edison did not propose steam distribution storm hardening projects to meet the FEMA plus three feet flood design standard because that standard is based on FEMA flood maps that were issued after the Company filed its steam rate case on January 25, 2013. The Company adopted the FEMA plus three feet standard in July 2013. Accordingly, the Company's three-year Steam Rate Plan does not reflect the projected expenditure of $8.9 million for the steam distribution storm hardening projects that were examined during the Phase Two Collaborative and are proposed in this Phase Two Report.

2. Updated Costs

Con Edison's current projected expenditures for Steam Generating Stations and Steam Distribution System storm hardening projects during 2014, 2015, and 2016 is $91.1 million, as follows:

Steam Generating Stations Phase Two Report ($ millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014 – 2016 Current Projection
All Steam Stations	21.5	27.7	33.0	82.2
Steam Distribution System	4.5	4.4	0	8.9
Total	**26**	**32.1**	**33**	**91.1**

Consistent with the provisions of the Joint Proposal adopted the 2014 Rate Order, Con Edison requests that the Commission approve the expenditures for the steam storm hardening projects, including steam distribution storm hardening projects, presented in this Phase Two Report. To the extent that the actual expenditures for these projects result in net plant balances above those reflected in the Storm Hardening category of the Average Steam Plant In Service Balances for the second and/or the third rate years, the Joint Proposal provides that the

Company may defer for later collection the carrying costs associated with such net plant exceedances upon the Commission's approval of such expenditures.[59]

At this time, due to the projected lower amount of storm hardening expenditures for steam generating stations, the Company expects that its total expenditures for steam plant storming hardening (steam generating stations and steam distribution) will not exceed the amount ($91.1 million) reflected in the Company's Steam Rate Plan. Accordingly, Con Edison requests that the Commission approve the expenditures for the steam storm hardening projects, including steam distribution storm hardening projects, presented in this Phase Two Report. Upon such approval, and consistent with the Joint Proposal, the Company would reserve the right to defer for later collection the carrying costs associated with actual steam distribution storm hardening expenditures above those reflected in the Company's Steam Rate Plan. However, as explained above, the Company expects to implement its steam generating station and steam distribution storm hardening projects within the steam storm hardening net plant target, and the Company currently believes that deferral of the carrying costs for the steam distribution projects will not be needed.

[59] The Joint Proposal (p. 47) states:

> With respect to the Storm Hardening category of the Average Steam Plant In Service Balances, the Commission's order regarding RY2 and RY3 Storm Hardening programs in response to the Company's September 1, 2014 Storm Hardening report (see section D.4 below) may call for Storm Hardening capital expenditures in RY2 and/or RY3 in an amount more or less than the amount reflected in the Storm Hardening category of the Average Gas Plant In Service Balances for RY2 and/or RY3.
>
> If the Commission's order calls for RY2 and/or RY3 Storm Hardening capital expenditures greater than the amount reflected in the Storm Hardening category of the Average Steam Plant In Service Balances for RY2 and/or RY3, the net plant reconciliation mechanism will continue to apply as described herein and the Company will defer for future collection from customers the revenue requirement impact (i.e., carrying costs, including depreciation, as identified in Appendix 10) of the amount of average net plant resulting from the additional capital expenditures.

VII. Facilities Storm Hardening

This section addresses storm hardening projects that are conducted and funded by Con Edison's Facilities organization and for which capital costs are allocated among the Company's Electric and Gas Departments and reflected accordingly in Con Edison's Electric and Gas Rate Plans.[60] These projects support the storm and flood integrity of buildings and yards used in common for electric, gas, and steam operations.

A. Facilities Storm Hardening Objectives

Con Edison's Facilities organization is responsible for the day-to-day operation and maintenance of the Company's buildings and yards (generally service centers). In the wake of Sandy, a number of Con Edison's buildings and service centers were flooded resulting in substantial damage and creating significant disruption to electric, gas and steam operations that the properties support. For example, the two main buildings at the 16th Street Service Center near the East River were flooded to depths of four (at Building 750) and five to six feet (at Building 700) and incurred significant damage to key operational equipment. The Facilities organization has developed a storm hardening plan that seeks to minimize flood and wind damage to building structures, minimize damage to critical building equipment, and mitigate interruption to operations. The overall program incorporates a combination of three different types of measures – permanent, deployable and administrative – depending on the circumstances presented by each location. Permanent or passive measures involve physical modification to a building or site with the intent of making it a permanent feature of the facility. A primary example is structural strengthening of building/room enclosures to sustain high hydrostatic forces and prevent storm surge water from damaging critical building infrastructure necessary to keep the facilities habitable and functional, *e.g.* chillers, boilers, sewage pumps, emergency

[60] Interdepartmental rent is charged to the Steam Department for these facilities.

generators, air compressors, electrical equipment, etc. Deployable measures are implemented immediately in advance of a potential flood condition to provide protection for the duration of the storm event and are then removed. Administrative measures provide for the temporary relocation of equipment and supplies from flood prone locations to minimize damage and allow faster deployment.

B. Facilities Storm Hardening Projects

Facilities' storm hardening plan includes a capital program to storm harden service centers and other buildings that are most vulnerable to flooding. In conjunction with a consultant's hardening study, which provided evaluation and recommendations for the properties within the FEMA plus three feet flood zone, Facilities has identified 14 vulnerable service centers and buildings. Facilities plans to harden the seven most vulnerable of these sites during 2015, 2016, and 2017 at a cost of $5 million per year, as follows:

- 2015 Projects
  - 16th St. and 28th St. Service Centers and portions of The Learning Center
- 2016 Projects
  - 110th St., College Point and Neptune Ave Service Centers
- 2017 Projects
  - Eastview Service Center and the remaining portions of The Learning Center

For each of the properties, Facilities will issue a request for proposal (RFP) to generate detailed design packages based on concept study design criteria specified in the RFP. Detailed design engineering is in progress for the 16th S.t and 28th St. Service Centers and will be completed in 2014. Detailed design engineering will begin for The Learning Center by October 2014. Construction at these properties will begin and be completed in 2015. A similar process will follow for the 2016 and 2017 projects.

The design for each project will incorporate primary measures to prevent water from entering the building and secondary measures that provide "defense-in-depth" protection for key locations and equipment within the building. The primary measures consist of the following:

- Relocate vents/louvers
- Seal electrical penetrations
- Seal concrete slabs
- Deploy drain plugs
- Install storm sewer backflow valves
- Install sanitary sewer backflow prevention devices
- Protect lobby entrances and loading bays - flood defense blocks

The secondary measures consist of the following:

- Harden and seal existing interior and exterior CMU walls surrounding equipment rooms
- Replace existing doors
- Replace or remove existing windows
- Replace elevator sensors and switches with submersible cable and equipment
- Provide for emergency power to critical equipment
- Provide submersible sump pumps/leak detection

A white paper describing the scope and cost for the 2015 to 2017 Facilities storm hardening projects is provided in Appendix O - Facilities.

C. Facilities Storm Hardening Project Costs

1. Costs Reflected in Electric, Gas, and Steam Rate Plans

In the rate cases, Con Edison presented preliminary plans to establish projects to storm harden its Facilities properties that sustained flood damage during Sandy and estimated the cost at $5 million per year in 2015 and 2016 as shown in the table:[61]

Facilities Projects (Rate Plan ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
	0	5.0	5.0	10.0

2. Updated Costs

Following the consultant's hardening study, conceptual design and detailed design work for the 2015 projects, the Company continues to project expenditure of $5 million annually in 2015 and 2016 consistent with the expenditures reflected in the Company's Electric, Gas, and Steam Rate Plans. The Company expects that this program will extend at least through 2017 at a similar annual cost.

Facilities Projects (Phase Two Report) ($ millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection		2014-2016 Current Projection
	0	5.0	5.0		10.0

[61] The Phase One Report also identified this cost. See, Phase One Report, pp. 10, 25, and 83. These expenditures are allocated among the Company's Electric and Gas Departments, and the Steam Department is charged interdepartmental rent for use of the properties. The project costs are reflected accordingly in the Company's Electric, Gas, and Steam Rate Plans.

VIII. Telecommunications System Storm Hardening

A. Telecommunications System Storm Hardening Objectives

Con Edison owns and operates a private communications network called the Corporate Communications Transmission Network (CCTN). This network provides secure communications circuits for SCADANet, voice, video, protection, and the computing and storage environment. The CCTN supports consolidation of computing resources and reduces public carrier costs. Communications rooms, communications huts, and enclosures at over 100 Company locations host CCTN equipment, and over 400 miles of fiber optic cable in underground structures and on utility poles and electric transmission towers provide CCTN communications services. The CCTN provides multiple radio systems that support voice-to-field crews, such as from control centers to field crews, and machine-to-machine smart grid applications, such as the distribution automation system. These systems share an infrastructure of antenna sites throughout the service territory which enable wireless communication to occur on the CCTN.

Con Edison has established three projects to address the impacts of Sandy. The first initiative is to harden radio sites by improving backup generator power and reinforcing antennas and radio frequency cables at radio sites. The second is to extend the CCTN fiber optic network to critical transmission substations in lower Manhattan. The third is to mitigate the impact of flooding on communications infrastructure.

B. Telecommunications System Storm Hardening Projects

1. Harden Radio Sites

During Sandy, high winds detached antennas and cable at two of our 35 radio facilities, and several radio sites experienced prolonged power outages that interrupted radio service in pockets of Westchester County. The unavailability of these radio facilities had an adverse effect on the overhead distribution restoration efforts in the areas served by the affected radio sites. Typically, radio sites have 8 to 16 hours of battery backup time compared to the several days it took to restore utility power. To harden these sites, our Antennae Hardening Project inspects, evaluates, redesigns, reinforces and replaces antenna and line systems at all radio sites and dispatch centers – more than 50 locations. The project reinforces supports, fastenings and anchoring systems used to secure various antennas, including pole, panel and dish antennas and radio frequency cabling and waveguides. The projected cost of this project is $200,000.

We will also deploy a backup generator at the Buchanan complex radio hut, increase generator gas tank capacity at the Graymoor radio site, and install a gas-fired generator at the North Castle 1 radio site. These enhancements to the backup power facilities will maintain wireless communications during an extended power outage in Westchester County. The projected cost of this project is $350,000.

The two radio systems initiatives are projected to cost approximately $550,000 over three years from 2014 to 2016.

2. Extension of CCTN in Lower Manhattan

During Sandy, the local exchange public carriers sustained (i) severe damage to their telecommunications facilities, which included central offices and copper outside plant directly affected by the flood waters, and (ii) power outages that resulted in prolonged service outages to their customers. These outages adversely affected voice and data services and feeder protection circuits at lower Manhattan substations. Therefore, to provide carrier diversity for critical communication circuits, Con Edison is extending the CCTN fiber optic network to the Leonard Street, World Trade Center, and Seaport substations in lower Manhattan.

CCTN will provide these substations with a high-speed, redundant and diverse complement to public carriers. The work entails installing CCTN telecommunications facilities at each substation and building underground fiber spans linking 4 Irving Place, Leonard Street, World Trade Center, Seaport, and Cherry Street Substations in a self-healing ring topology. The new telecommunications equipment will be housed in pre-fabricated huts and existing communications rooms and will possess diverse points of entry to the substations and redundant electronic components, including power sources, to eliminate any single point of failure and provide redundancy and diversity. The estimated cost for this project is approximately $5 million. The projected completion date is December 2016.

3. Elevation of Communication Huts

Telecommunications equipment is housed in communications rooms and pre-fabricated huts located at generator stations, substations, and other operations and office facilities. During Sandy, CCTN circuits remained operational at all locations except the telecom room at East 13th Street substation and the communications hut at Goethals substation, which were severely impacted by flood waters. Replacement equipment at Goethals was reinstalled higher on the equipment rack. The planned construction of flood walls around the Goethals substation will further protect the equipment to the FEMA plus three feet flood elevation, and the Company is evaluating elevating the equipment above that elevation as a defense-in-depth measure. A communications room will be established in the new control center at the East 13th Street substation, which will be above the FEMA plus three feet elevation.

All new huts in flood-prone areas will be installed on a concrete pad at least three feet above the FEMA 100-year flood elevation. The Company is currently evaluating solutions that range from enhanced sealing techniques to prevent water ingress to hut replacements at existing flood-prone locations. The communications huts at Fresh Kills substation and 1 Davis Avenue in Staten Island are in flood prone areas. The planned construction of flood walls around the Fresh Kills substation will protect the communication equipment to the FEMA plus three feet flood elevation, and the Company is evaluating elevating the equipment above that elevation as a defense-in-depth measure. In 2016, the hut at 1 Davis Avenue will be elevated to at least the FEMA plus three feet level. The estimated cost for this program during 2015 and 2016 is approximately $1.0 million.

A white paper describing the scope and cost for the Telecommunications System storm hardening projects is provided in Appendix P – Telecommunications System.

C. Telecommunications System Storm Hardening Project Costs

1. Costs Reflected in Electric, Gas, and Steam Rate Plans

In the rate case, Con Edison presented the CCTN storm hardening projects described above and estimated expenditures for the project $1.3 million in 2014, $2.7 million in 2015, and $2.6 million in 2016 as follows: [62]

Telecommunications System Projects (Rate Plan) ($ millions)	2014	2015	2016	2014-2016 Cost (Rate Plan – March 2013 Update)
Total	**1.3**	**2.7**	**2.6**	**6.6**

[62] The Phase One Report also identified this cost. See, Phase One Report, pp. 10, 25, and 83. These expenditures are allocated among the Company's Electric and Gas Departments, and the Steam Department is charged interdepartmental rent for use of the CCTN. The project costs are reflected accordingly in the Company's Electric, Gas, and Steam Rate Plans.

2. Updated Costs

The Company continues to project expenditure of these sums in 2014, 2015, and 2016, as follows:

Telecommunications System Projects (Phase Two Report ($ millions)	2014 Current Projection	2015 Current Projection	2016 Current Projection	2014-2016 Current Projection
Radio Site Hardening	0.04	0.06	0.1	0.2
Generators	0.14	0.16	0.05	0.35
CCTN Extension	1.12	2.23	1.7	5.0
Communication Huts	0	0.25	0.75	1.0
Total	**1.3**	**2.7**	**2.6**	**6.6**

IX. Risk Assessment and Cost Benefit Modeling

A. Background

Con Edison's portfolio of storm hardening projects is designed to mitigate the impact of severe weather events on Con Edison's customers and systems. Con Edison, in conjunction with the Collaborative parties, is tasked with developing analytical tools for assessing the merits of the Company's storm hardening projects. The goal of these projects is to lessen the impact of severe events on Con Edison's customers and systems.

In satisfying this aim, there are two related deliverables: (1) risk assessment and prioritization and (2) economic cost value analysis.

1. Risk Assessment and Prioritization Model

During the Phase One Collaborative, Con Edison and the Collaborative parties developed a risk assessment and prioritization model to gauge, in terms of risk reduction to customers and critical infrastructure, both the collective impact of Con Edison's programs and their relative merits across different components of the Company's system. The output of this model quantifies and ranks the reduction in risk associated with each of the storm hardening projects related to the Company's transmission, substation, coastal network, and overhead distribution systems.

The model establishes the value of each of Con Edison's storm hardening initiatives in terms of the magnitude of the reduction in risk at each targeted asset. This metric helps to demonstrate a cost causality linkage between capital funding allocated for storm hardening and the reduction in risk obtained via that investment. Key components of the model are:

- Location-specific information regarding high-rise residential buildings and municipal critical infrastructure, e.g., hospitals and water treatment facilities;
- Location-based flood probabilities provided through proprietary New York City inundation models;
- Wind damage probabilities derived from historical wind gust frequency distributions;
- Costs to storm harden Con Edison's facilities; and
- Projected outage durations in absence of and after implementation of effective storm mitigation.

The Phase One Report provided a detailed explanation of the development and function of the risk assessment and prioritization model, including inputs and outputs.[63] That explanation is also provided in Appendix Q – Risk Assessment Model Development and Function.

The intention of the model is a prioritization of risk reduction under the assumption that all of the proposed storm hardening programs will be undertaken. This risk reduction ranking

[63] See Phase One Report, Section VI B, pp. 66-73.

illustrates that the proposed capital funding for the storm hardening programs are being appropriately allocated to maximize risk reduction to the most critical assets. The model is not intended to establish a threshold below which particular projects would be deemed as not viable and eliminated from consideration. The risk prioritization ranking is not a standalone litmus test of project value. If overall funding for storm hardening were to be reduced, the Company would not necessarily eliminate the programs displaying the lowest degree of risk reduction. The Company would apply engineering judgment reflecting system design and operating characteristics and experience in the selection of eliminated programs while considering the prioritization ranking.

2. Phase II Refinement of Risk Assessment and Prioritization

The Risk Assessment and Prioritization model developed and vetted during Phase One of the Collaborative provides the fundamental data assemblage structure carried forward into the Phase II risk modeling effort. Maintained in the Phase I to Phase II evolution are the asset specific targeting, 20 year asset life horizon, pre and post hardening base year and asset life probabilities, pre and post hardening outage durations, asset specific populations, asset specific infrastructure counts, and the computational methodologies detailed in the Phase One Report.[64]

Where necessary, the Phase I risk model has been augmented via enhancements to the targeted scope of work for existing resiliency programs and direct additions to the targeted list of assets reflecting a maturation of the resiliency planning process. The cost of resiliency projects has been updated. Additionally, using the company's Network Reliability Index (NRI) model, reliability based programs for the eight highest risk networks have been blended into the model to capture the impact of heat and the offsetting effects of heat related risk mitigation strategies on those networks.

[64] Appendix Q.

Advancements in the modeling of the Infrastructure Equivalents have been incorporated into the initial risk model to better reflect the contribution of targeted critical infrastructure on risks.

The updated risk model now includes preliminary heat wave related events in the mix of current system impacts (wind and flood). This inclusion links the company's NRI model and the resiliency initiatives and allows for a simultaneous assessment of network capital expenditures on both a reliability and storm resiliency basis. Traditionally, heat waves and resulting high system loads have been addressed through targeted reliability programs and have not been viewed from the perspective of storm resiliency. As evidenced by consistent improvements in network system summer performance over the past years, these reliability enhancement programs provide a viable means of strengthening the networks against high heat conditions. A comprehensive extension of heat event effects beyond network distribution system assets to overhead distribution and transmission systems will require further effort.[65]

Visual summaries of the Phase II Risk Assessment and Prioritization model analogous to Charts I through IV contained within Section VI of the Phase One Report have been provided as part of the model package supplied to the Collaborative. As evident from the numerical model results and graphical depictions, the results of the Phase II risk analysis continue to support the consistent prioritized allocation of capital funding for risk reduction across assets both with and without the presence of the original five major "too big to fail" assets. These visual summaries appear in Phase II Risk Assessment and Prioritization Model Simulation provided in Appendix R – Phase II Risk Assessment and Prioritization Model Simulation.

Additionally, enhancements to the Phase II Risk Assessment and Prioritization model incorporating dynamic probability simulations of flood, wind damage, and durations in place of

[65] In addition, any simple data errors identified in the Phase One assembly have been corrected.

the fixed estimates of those parameters have been completed and are also reflected in the Phase II Risk Assessment and Prioritization Model Simulation attached in Appendix R.

Through the application of established Monte Carlo methods to empirical probability distributions of flood potential, wind damage, and storm durations, a simulated quantification of risk reduction within stated percentile levels was obtained. These percentiles allow for a broader perspective of the risk reduction coverage provided by each of the asset specific storm resiliency initiatives.

In all cases, the risk reduction levels for area and transmission substation level assets satisfied the 90th percentile tier. This effectively indicates that the storm resiliency measures taken for these assets cover up to 90% of the anticipated flood likelihoods. In similar fashion, the majority of risk reduction levels realized for distribution underground (coastal networks) and overhead assets fell within the 70th to 80th percentile levels thereby establishing an upper level of resiliency coverage against flooding and wind damage, respectively.

It should be noted that in gauging the significance of these results the limitations inherent in any simulation of long horizon, *i.e.*, 20 year, weather effects are acknowledged and the risk reduction levels indicated are derived and restricted to currently available sources. These sources include flood probabilities provided through the extensive NYC inundation modeling, historical Con Edison regional wind gust and derivative damage probability distributions, and historical Con Edison storm duration distributions. As more refined local climate studies become available, these simulations can be updated as needed using any revised weather information as the foundation.

Of particular note, simulations of the risk reduction percentiles associated with heat events were not carried out due to the uncertainty regarding an acceptable characterization of a "warmer summer period" and the lack of required viable temperature distributions. Essentially, an overall increase in summer temperature can take a myriad of definable but not easily predictable forms. Temperature rise could be uniform but moderate. It could represent an increase in the number of heat waves, an increase in their individual severity, *i.e.*, higher daily temperatures, or an increase in their individual durations. Ultimately any combination of these four potential temperature pattern changes could manifest themselves as an increase in summer temperatures. Because the impact of each of these conditions on system reliability differs greatly in the absence of specific knowledge regarding the likelihood of each form of temperature increase, any simulation of weather effects becomes problematic.

3. Cost/Benefit Analysis Model

Discussed at length during Phase I of the Collaborative, but only partially addressed due to time constraints, was the development of a model that considers the relative value of each storm hardening program from an avoided economic-cost point of view.

This view considers not only the reduction in risk associated with resiliency efforts but also quantifies that risk in monetary terms. By quantifying the benefits of a project in monetary terms, it becomes possible to directly compare the benefits to the cost, in equivalent dollar terms. This approach can provide additional insight into the value of resiliency programs.

The Cost/Benefit model has been developed within the overarching analytic structure established previously through the Phase I Risk Assessment and Prioritization model ("risk model") and refined via the current Phase II evolution of that effort. The risk model provides an effective and convenient starting point from which the Cost/Benefit analysis can evolve.

Fundamental asset-specific characteristics utilized in the risk model have been expanded upon via the inclusion of service class customer information, commodity data (kWh), and a range of potential commodity-to-cost conversion factors, to develop preliminary estimates of the monetary benefits anticipated from the storm resiliency work being carried out.

In developing this form of analysis, the asset targeting and associated storm resiliency mitigation costs used in the Phase II Risk Assessment and Prioritization approach can be brought forward directly. Since the same storm resiliency initiatives are being carried out at the same capital costs no changes are required. Similarly, the 20 year asset life horizon, pre and post hardening base year and asset life probabilities, and pre and post hardening outage durations can be directly incorporated as model parameters as they represent fundamental asset resiliency (pre and post) measures. What will require reevaluation is the manner in which each asset is characterized in order to allow for a cost estimate of an outage. Essentially, a means is required to convert inherent asset features into an outage cost.

Due to the innovative nature of the Cost/Benefit model as a potential utility planning tool, the Company has engaged the expertise of an industry recognized Economic/Engineering consultant, “O’Neill Management Consulting, LLC”, to lend broader support and direction to the computation of the outage cost estimates. They have assembled and provided a primer on factors and specific values that affect the monetary value of avoiding a power outage. Outage cost information referenced in this primer has been used in the development of the Cost/Benefit analysis. An extrapolation of those values and associated outage cost estimates have been incorporated into the initial cost/benefit model and are discussed in more detail below.

In the primer provided to Con Edison by O’Neill Management Consulting, a study published by The Ernest Orlando Lawrence Berkeley National Laboratory, June 2009, titled “Estimated Value of Service Reliability for Electric Utility Customers in the United States” and authored by Freeman, Sullivan & Co.[66] provided what is considered to be the most comprehensive and analytically supportable meta-data base of the cost of various outage durations by customer class. From the abstract on page xii:

> This paper summarizes research designed to provide estimates of the value of service reliability for electricity customers in the US. These estimates were obtained by analyzing the results from 28 customer value of service reliability studies conducted by 10 major US electric utilities over the 16 year period from 1989 to 2005. Because these studies used nearly identical interruption cost estimation or willingness-to-pay/accept methods it was possible to integrate their results into a single meta-database describing the value of electric service reliability observed in all of them.
>
> Estimated interruption costs for different types of customers and of different duration are provided.

The relevant conclusions of this paper are contained within Table ES-1 on page xxi of the report. The information appearing there allows for the conversion of an electric commodity measure (kWh or kW) into a related outage cost. The derivative cost is provided as a function of five distinct outage durations and three major customer class groupings (Residential, Small Commercial, and Large Commercial). Accepting for the moment these commodity conversion factors as representative of the Con Edison service territory, outage costs by commodity measure within customer class groupings were interpolated/extrapolated to capture the wider range of outage durations manifest in the Phase II risk model parameters used. The details of this interpolation/extrapolation are provided in Appendix T - Interpolated-Extrapolated Outage Costs by Customer Type for Cost-Benefit.

For the purposes of the Cost/Benefit model, annual kWh by customer class was selected as the constructive variable to which the cost conversion factors described above were applied. Annual kWh is a commodity measure directly available on the company's billing system and

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[66] http://certs.lbl.gov/pdf/lbnl-2132e.pdf

common to all three customer types. Annual kWh data was assembled by asset by customer type and converted via the associated commodity conversion factors into estimates of outage costs based upon the pre and post outage durations and pre and post asset life event probabilities appearing in the risk model.

The direct impact of critical assets above and beyond their kWh captured within their parent asset was accomplished through a conversion of asset counts into equivalent annual kWh. This conversion was derived from empirical relationships appearing in the data assembly.

The final component of outages costs were provided by again applying the commodity conversion factors by customer type to these estimated kWh based on pre and post outage durations and pre and post asset life event probabilities. These costs were combined on an asset by asset basis with the customer type outage costs computed previously to yield a total asset level estimate (Monetary Impact) of pre and post hardening outage costs.

Computing the simple difference on an asset by asset basis between the pre and post resiliency monetary impact costs results in an estimate of the monetary impact reduction that can be expected from the storm hardening initiative. Prior to comparing this monetary impact reduction to the total project cost, the stated capital cost was grossed up by a 20% carrying charge factor. The intent of this factor’s inclusion was to capture additional project related costs such as maintenance associated with capital work, periodic project inspection costs, and any potential short term cost increases that might manifest themselves over the construction life of the project. The use of a 20% value was not derived via any finely tuned analyses but rather arrived at as a reasonable rule-of-thumb to acknowledge the existence of additional costs and provide more conservative (i.e., lower) benefit to cost ratios.

Comparing the monetary impact reductions to the 20% escalated capital project costs results in either a benefit cost ratio or a benefit cost difference which can be utilized in gauging the merits of individual programs. A prioritized summary of these ratios and differences based on the initial Cost-Benefit model has been provided to the Collaborative and an updated version is contained within the Phase II Cost Benefit Model Rev 1 Simulation provided in Appendix S – Phase II Cost Benefit Model Rev 1 Simulation.[67]

Similar to the dynamic simulation enhancements being reflected in the Phase II Risk Assessment and Prioritization Model Simulation, the Cost-Benefit analytic effort has been expanded to more adequately capture the uncertainty surrounding the parameters driving asset storm impacts and the associated efforts toward the reduction of those risks. This analytically revised Cost-Benefit construct has been completed and is also contained within the Phase II Cost Benefit Model Rev 1 Simulation provided in Appendix S.

Paralleling the use of a Monte Carlo approach to the empirical probability distributions of flood potential, wind damage, and storm durations carried out in the risk assessment simulation, monetary impact reductions within stated percentile levels were developed and provide comparable interpretations.

Area and transmission substation level assets again satisfied the 90th percentile tier for monetary impact reduction indicating that the storm resiliency measures taken for these assets again cover up to 90% of the anticipated flood likelihoods. The majority of monetary impact reduction levels realized for distribution underground assets are within the 70th to 80th percentile levels against flooding events. For distribution overhead assets about two-thirds of the monetary impact reductions are within the 70th to 80th percentile groups while the remaining third fell within the 80th to 90th percentile level for wind damage events.

[67] Any simple data errors identified in the initial Cost-Benefit assembly have been corrected.

Regarding the interpretation of these simulated monetary impact levels, the same caveat as stated for the risk reduction simulations applies. As the results of more refined local climate studies become available, their inclusion in these simulations can be easily carried out.

It should be pointed out that all of the escalated project costs, estimated monetary impact reductions, and resulting Benefit/Cost ratios and differences discussed previously have been stated in current dollar terms omitting the inclusion of any discount factor in the calculations. This decision was made to focus on the fundamental computational structure of both the risk assessment and cost-benefit models. Restatement of the final project costs or monetary impact reductions in present values terms has also been completed and appears within "NPV Calculations" tab within the Phase II Cost Benefit Model Rev 1 Simulation provided in Appendix S.

The discounted Benefit/Cost ratios and Net Present Values calculations were computed upon a basic set of assumptions. For both costs and monetary impact reductions, it was assumed that project costs would be incurred and monetary impact reductions realized at the end of each year. The annualized project costs included in the present value calculations were based on total project cost uniformly distributed over a five year construction period. Although individual projects may be completed in anywhere from one to five years, the choice of the five-year upper bound guaranteed a construction horizon within which all of the stated costs would be expended. For the annualized monetary impact reductions, a twenty-year benefit horizon was selected providing consistency with the asset life time frame of twenty years adopted previously as a modeling parameter. In this case, the total estimated monetary impact reduction for a project was uniformly distributed across a twenty-year period for inclusion as annualized values in the associated present value computations.

Finally, the discount factor used throughout all of the present value calculations was 9.94%. This value represents the rate year one pre-tax rate of return on rate base stated in the Joint Proposal. It was selected as being representative of the cost of capital investment on the Con Edison system. Derivative benefit to cost ratios were computed as the quotient of the present value of discounted annual monetary impact reductions over twenty years to the present value of discounted annual costs over five years. The numerical difference of those two calculations respectively results in an estimate of NPV for each project. Prioritized listings of projects based on project Benefit/Cost ratios and NPVs appear on the "NPV Calculations" tab within the Phase II Cost Benefit Model Rev 1 Simulation provided in Appendix S.

X. Climate Change Vulnerability Study

A. Climate Change and Impact on Infrastructure

Con Edison's equipment and systems are exposed to various weather conditions including storm surge, wind, rain, snow, ice, temperature variations, humidity, and heat waves. These conditions influence our system design and equipment procurement standards as well as required capital investments to continually deliver reliable energy to our customers. A key element of the Company's approach to improving resiliency going forward is to understand how weather and climate may be changing and how those changes will impact the Company's infrastructure.

In the rate cases, Con Edison, New York City, and other interested parties agreed on a flood protection design standard for projects that Con Edison commence in 2014, and the Company has adopted that standard for future flood protection projects and will review this standard at least every five years. However, a number of other key system and equipment design standards (as reflected in the table below) require additional analysis related to the effects of climate change.

	Prior Con Edison design standard	**Current Con Edison design standard**
Flood	• FEMA 2007 100-yr floodplain plus two feet	• FEMA 2013 100-yr floodplain plus three feet
Wind	• 98 mph wind • 45 mph plus 0.5 inch of ice	• (Under review)
Temperature & Temperature Variable	• 86°F	• (Under review)
Heat waves	• Two per year • Four days long	• (Under review)

An understanding of these key climate and weather factors, as well as those applicable to flooding, is an essential building block in determining the system and equipment design standards and consequent infrastructure investments necessary to improve system resilience to the effects of future climate change

Five of Con Edison's top-10 storms from a customer outage perspective have occurred in the three years from 2010 to 2012. All were coastal type storms.

Historical Storm Comparison		
Date	**Type of Storm**	**Customers Interrupted**
29-Oct-12	Superstorm Sandy	1,115,00028
28-Aug-11	Tropical Storm Irene	203,821
13-Mar-10	Nor'easter	174,800
29-Oct-11	Nor'easter	135,913
9-Sep-85	Hurricane Gloria	110,515
2-Sep-06	Tropical Storm Ernesto	78,300
25-Feb-10	Snow	65,200
18-Jan-06	Wind / Rain	61,486
31-Mar-97	Nor'easter	45,180
19-Oct-96	Nor'easter	41,830

In summer 2013, a seven day heat wave gripped our service area with 90°F and greater temperatures from July 14 to 20. A seven-day heat wave is rare and has occurred only seven times since 1869.

Temperature and precipitation data shows that the climate of our region is changing. The Phase One Report examined weather trends in New York City based upon recorded weather history since 1869 and concluded that the general trends for various temperature and precipitation related metrics show an increase above climatological normals.

The science of forecasting future climate conditions is based on both climate model-based percentile outcomes, and qualitative projections of peer-reviewed scientific literature. The Phase One Report synthesized a sample of authoritative climate reports and found that the reports are aligned on the direction and magnitude of their quantitative projections.[68] Specifically, for our region, those directions appear to be:

- Increased average surface air temperatures by 2050;
- Increasing number of extreme heat days (including consecutive days);
- Decreasing number days below freezing;
- Increasing precipitation; and
- Increasing sea level rise.

[68] The Phase One Report summarized climate projections in the following reports:

- The New York City Panel on Climate Change: Climate Risk Information 2013: Observations, Climate Change Projections, and Maps. The City of New York,
- The U.S. Department of Energy: U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather, July, 2013,
- U.S. National Oceanographic and Atmospheric Administration: 2013 Regional Climate Trends and Scenarios for the U.S. National Climate Assessment, and
- Working Group 1 to the International Panel on Climate Change: Summary for Policymakers, September 27, 2013.

These trends may manifest themselves as greater electric demand on the distribution system, larger storm surges impacting and damaging coastal infrastructure, and soil more commonly saturated – resulting in increased damage from wind/rain events.

B. Goals of Climate Change Vulnerability Study

The New York City Panel on Climate Change ("NPCC") climate projections released in June 2013 project that our climate will continue to change to one that by mid-century will include higher temperatures, increased precipitation, and higher sea levels. In addition, extreme weather events such as heat waves, heavy downpour, and coastal flooding will be more frequent and severe. However, neither the NPCC report, nor reports or forecasts on climate change issued by other agencies, including the US Department of Energy, National Oceanic and Atmospheric Administration, and Federal Emergency Management Agency, address all the key weather and climate inputs that are required for Con Edison to review its design standards, such as:

- Daily and Hourly Temperatures - NPCC has published temperature projections as changes in average yearly temperature for the 2020s and 2050s; however, Con Edison's design standards require a more detailed understanding of summer temperature and humidity projections, both of which are currently not addressed.
- Wind – NPCC does not include projections of wind speed and duration.
- Precipitation – NPCC does not include forecasts of types of precipitation (e.g., rain, snow, and ice) and the frequency of such events.

Con Edison is committed to understanding the impact of climate change and has undertaken a Climate Change Vulnerability Study (Study) with the following goals:

- Develop a shared understanding on the impact of climate change to Con Edison's infrastructure,

- Quantify climate change risks and uncertainties,
- Consider revisions to system and equipment design standards, and
- Develop a risk mitigation plan.

The Study will synthesize current scientifically credible views on predicted climate change, the output of the most up-to-date climate model, input from Collaborative participants.

C. Progress Report on Climate Change Vulnerability Study

The Phase One Report provided a Scope of Work Outline for the Study, which is provided in Appendix U – Climate Change Study Scope of Work.[69] The Commission's Order provides that the Company's Phase Two Report "incorporate recommendations or progress reports on the Study.[70] A progress report on 2014 activities in the Study is provided below.

Con Edison appointed two persons to project managers for the Study. One person has represented the company on climate-adaptation matters for the past 8 years, including the New York City Climate Adaptation Task Force and Governor Paterson's Climate Action Plan and has undergraduate and post-graduate degrees in earth science, environmental science, and Public Administration. The other person is a degreed meteorologist with over 10 years of experience and is a Certified Consulting Meteorologist through American Meteorological Society.

The Project Managers met with representatives of the Columbia Center for Climate Law (CCCL) and the Office of the New York Attorney General (NYOAG) – two Collaborative Parties that have been primary proponents of the Study -- to prepare the following three-phase action plan to guide the work of the Study:

[69] Phase One Report, pp. 111-113.
[70] Order, Ordering Clause 8, pp. 74-75.

1. Climate Change Vulnerability Study Action Plan

Step 1. Utilize outside expertise to develop a shared understanding of climate science gaps.

a. Identify climate factors and associated parameters that are relevant to our utility territory and impact infrastructure design specifications

b. Work with a reputable party or institution to develop projected climate data from existing climate models, identify projected climate data that cannot be projected from current modelling and research ("gap analysis data"), and establish parameters for longer term modelling and research necessary to develop gap analysis data.

c. CCCL representative and NYOAG representative to assist with personal and institutional expertise.

d. Present gap analysis data to Collaborative in late 2014, with options for continuation of research and collaboration with national climate experts into 2015 and beyond.

Step 2. Work with Company and New York City engineering teams to develop future design considerations

a. Work with Con Edison electrical and civil engineering organizations to evaluate weather-sensitive components of current equipment (e.g. wind specs, margins for overloading), and develop design and asset utilization solutions to adapt to future climate conditions

    i. Consider effect of New York City initiatives pursuant to A Stronger, More Resilient New York Plan

    ii. For climate variables important to existing design specifications, but for which there currently is inadequate information, assess opportunities for additional research and evaluate alternative decision-making models.

b. Develop shared understanding of design impacts with the Collaborative

<u>Step 3</u>. Develop Options for future design considerations

a. Assign value propositions and costs to design options for climate change risk mitigation

    i. Incorporate technology advances and customer perspective into solutions (e.g. distributed energy resources)

b. Utilize cost/benefit model as available for analysis

c. Identify solutions; propose recommendations

2. Action Plan Implementation Activities

To address step 1, the project managers and CCCL and NYOAG representatives met with Columbia University Center for Climate Systems Research (CUCCSR) researchers on April 21, 2014. The parties:

- Discussed information on weather and climate variables that are important to Con Edison for engineering specifications and long term planning,[71]
- Determined what projected climate variable information is readily available from current climate models and research community to inform Con Edison specifications and planning, and
- Discussed scope, deliverables, time to complete, and long term research needs.

The parties determined that Columbia can perform an analysis to determine probability of occurrence for temperature extremes with existing data. However, other climate factors Con Edison requires are either not available for long-term projection or in a format that is not useful for analysis by Con Edison engineering teams. This will require the research team to examine the climate models and data outputs in novel ways to fit Con Edison specifications.[72] As such, the

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[71] For example Con Edison's substations and associated equipment are designed to operate in a temperature range of Minimum (-30°C) to Maximum (40°C).

[72] CUCCSR informed the Con Edison managers that other climate change impacts, such as changes in wind speed, return frequency and intensity of coastal storms, and extreme inland precipitation events were not readily available

project team determined that it should focus on temperature extremes and heat events in the short term (2014-2015), and revisit the scientific underpinning of extreme non-temperature related events in later years (2016-2018). Additionally, the entire Collaborative will receive a briefing on the climate science temperature extremes and gap-analysis in late 2014.

In June, CUCCSR provided a project proposal that is focused on developing projections for extreme temperatures. This deliverable will utilize existing results from various global climate models to project long-term temperature extremes in the New York City area.

CUCCSR has started work on this task. Internally, the project managers are working with Con Edison's electric, gas, and steam engineers to develop the resources and potential outside consultation required to evaluate the impact of the new temperature paradigms being developed by CUCCSR. Con Edison is expecting proposals from two consultant firms that specialize in weather and climate risk analysis and mitigation to oversee the facilitation of steps 2 and 3 (engineering analysis and risk-based options for future designs) and prepare a final report addressing long-term temperature impacts.

The Company expects that the engineering analysis will be complex and extend into 2015. Engineering teams will consider design and value-based asset utilization solutions to adapt to future climate conditions. Solutions will consider dynamic effects of governmental initiatives, such as the City of New York's adaptation planning. Future research and additional evaluation of alternative decision-making models may be required for uncertain climate variables; however, we anticipate this to be of greater importance in future years when studies to evaluate wind, storm surge, and precipitation variables are looked at more specifically.

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for analysis. However, these topics continue to be of interest within the scientific community, and there is a growing body of research that may be available within the next 2-3 years to evaluate in the context of Con Edison's storm hardening.

D. Costs of Climate Change Vulnerability Study

The parties to the Joint Proposal recommended that the Commission permit the Company to recover costs associated with storm hardening initiatives approved by the Commission, though not reflected in rates, as follows:[73]

> In addition to further evaluation of the Company's current forecasted expenditures to storm harden its electric, gas and steam systems in RY1, RY2 and RY3 as described above, the Signatory Parties recognize that the Company may undertake other projects and programs that may be presented to the Commission as a result of ongoing collaborative discussions by Working Groups 1 through 4 of the Storm Hardening and Resiliency Collaborative. Since the electric, gas and steam delivery rates recommended by this Proposal do not (and could not reasonably) reflect any incremental costs associated with new or additional initiatives that the Commission may encourage or otherwise direct, the Signatory Parties recommend that the Commission authorize the Company to recover the incremental costs associated with any such initiative(s), whether by surcharge, deferral, and/or such other means as the Commission may determine.

Con Edison does not have sufficient information at this time to project an overall cost for the temperature phase of the Study. At such time as the Company can estimate such costs, the Company will propose that the Commission authorize cost recovery.

XI. Methane Emissions Reduction Collaborative Project

The methane emissions reduction collaborative is engaged in a project to investigate technologies for quantifying methane emissions from Type 3 (non-hazardous) leaks on Con Edison's gas distribution system and develop a program to further reduce the backlog of such leaks ("methane emission project" or "the project"). The 2014 Rate Order stated:[74]

> [T]he Collaborative should continue the work reflected in the Joint Proposal on reducing natural gas leaks and therefore methane emissions, by investigating

[73] Joint Proposal, p. 52.
[74] 2014 Rate Order, pp. 70-71.

> technologies for quantifying emissions and proposing a program to further reduce the backlog of Type 3 (non-hazardous) leaks.
>
> * * *
>
> [W]e anticipate recommendations or progress reports on these Collaborative efforts as part of Con Edison's September 1, 2014 filing concerning RY2 storm hardening projects and programs.

The methane emissions reduction collaborative parties have met in a series of meetings from March to August 2014 to establish and commence action on a work plan for the methane emissions project.[75] To that end, the parties have adopted a "Scope of Work for Project to Quantify and Reduce Type 3 Leak Methane Emissions" ("Scope of Work") establishing a governance structure and a project framework for the methane emissions project. The Scope of Work is provided in Appendix "V - Scope of Work for Project to Quantify and Reduce Type 3 Leak Methane."

The governance structure charges the collaborative parties with identifying the project strategy, monitoring project implementation, and developing project modification, if necessary. Major project decisions will be discussed by the parties. Individual parties at their own expense may offer scientific advice of outside experts for consideration by the collaborative parties.[76]

The Scope of Work and sets out five work phases for the project. Con Edison has retained the services of NYSEARCH, a product research and development organization, that has begun implementation of the project. NYSEARCH, an organization within the Northeast Gas Association, has conducted research and product development and demonstration projects on behalf of the natural gas industry since the mid-1980s focused mainly on the needs of local

[75] During the Phase Two Collaborative, the collaborative parties met to discuss the methane emission reduction project on March 27, April 21, May 16, June 27, August 8, and August 25, 2014.

[76] The Environmental Defense Fund ("EDF") has been an active participant in the methane emissions reduction collaborative. Drawing upon its experience in an ongoing series of research projects designed to better understand from where and how much methane is lost across today's U.S. natural gas supply chain, EDF has provided to the collaborative its experience with some of the sophisticated scientific techniques that are being deployed in these projects and insights born of its experience in these research projects.

distribution companies. NYSEARCH has been active in the leak detection area since the early 1990s and has investigated many approaches for leak survey and leak pinpointing. NYSEARCH Staff have performed real time sensing technology scans for leak detection, damage prevention, pipeline inspection and chemical sensing for constituents that may also be part of the pipeline gas.[77]

NYSEARCH has completed Phase I of the Scope of Work, which has been a search for and assessment of current technologies that could be applied for quantifying methane emissions rates for non-hazardous Type 3 leaks that are part of an urban environment in CECONY's service territory. NYSEARCH is currently engaged in Phase II of the Scope of Work, which is the preparation and issuance of a request for proposal soliciting owners of those technologies found potentially suitable in the Phase I assessment to participate in technology field testing and potential adaptation to LDC operational requirements. To implement Phase III of the Scope of Work, NYSEARCH will develop field testing protocols and will conduct the field testing consistent with Scope of Work guidelines. In Phase IV, NYSEARCH will analyze and summarize test results, recommend technology best suited for the project goal, and identify work required for commercial development of equipment utilizing the technology.

NYSEARCH's design of the main study and technology intercomparison field testing protocols will be based on consensus recommendations of the collaborative parties with Con Edison retaining the option for directing NYSEARCH's activities in the absence of or upon its

[77] The NYSEARCH R&D managers assigned to the methane emissions project have over 25 years of natural gas industry experience both within the R&D arena as well as with gas company utility operations and engineering. NYSEARCH Staff have are experienced in methane survey and detection, having conducted projects concerning handheld tools, mobile platforms and work evaluating possible technologies in aerial leak detection. NYSEARCH Staff have knowledge and experience in the practical application of technology to LDCs, programmatic knowledge of technology assessments, extensive and experience in R&D project development including a myriad of controlled and live field test program developments. NYSEARCH's most well-known success in the area of leak detection is the design, development and testing of the Remote Methane Leak Detector, which is sold in over 40 states and 30 countries worldwide by Heath Consultants, Inc. More information about the NYSEARCH program is available at www.nysearch.org.

disagreement with such recommendations. NYSEARCH will participate in collaborative meetings to provide updates on its activities and consult with collaborative parties. Con Edison will provide to the collaborative parties a quarterly report detailing all expenditures made on the project.[78] The Scope of Work recognizes that the methane emissions project is in all aspects subject to the Commission's oversight, and to that end, the Department of Public Service Staff has been an active participant in all collaborative discussions.

XII. Conclusion

Sandy was the most harmful and destructive storm our region has ever seen. Over 8.5 million customers in eight states, including 1.15 million of Con Edison's customers, lost power as a result of the storm. The National Hurricane Center estimates that the storm caused over $50 billion in damage to homes and businesses up and down the eastern seaboard.

Con Edison continues to strive to keep the power flowing and our vibrant region energized in all circumstances. Con Edison has developed a comprehensive resiliency plan to storm harden its energy system infrastructure to better enable the Company to provide safe, reliable, reasonably-priced energy services to our customers in an era of changing weather patterns and more frequent and increasingly destructive storms. To fortify our Electric, Gas, and Steam systems against future storms, we are strengthening our infrastructure so it can better withstand harsher conditions, particularly coastal flooding and high winds. In the aftermath of Sandy, this involved installing measures in advance of the 2013 hurricane season so that substations and generating stations that were operationally affected by Sandy can withstand a storm similar to Sandy. Longer term, we are preparing for more intense storms, which involves

[78] The cost for NYSEARCH's work in implementing the methane emission's projects is being funded through and within Con Edison's gas research and development program. The Company does not at this time contemplate seeking deferral of the costs of the project.

measures such as further increasing the height and strength of perimeter and interior walls and barriers, installing emergency diesel generators to keep critical equipment online, relocating a major substation control room to a higher elevation, hardening overhead networks to withstand stronger winds and contact with tree branches, replacing cast-iron and bare steel pipe in flood zones and segmenting our steam system to maintain the highest possible number of customers in service during coastal floods.

Con Edison presented its resiliency plans in electric, gas and steam rate cases and has reviewed these plans with the parties during Phases One and Two of the Storm Hardening and Resiliency Collaborative. The Company continues to look for ways to improve its resiliency initiatives through input from our customers, stakeholders and regulators. The Collaborative has provided Con Edison a valuable forum for obtaining such input and examining an array of solutions to better protect our region, and to prepare for our future.

Con Edison is presenting this Phase Two Report to the Public Service Commission to summarize the work of the Phase Two Collaborative and to present for the Commission's consideration Con Edison's plans for resiliency work during the period of 2014 to 2016.

Dated: September 2, 2014

Consolidated Edison Company of New York, Inc.