STATE OF NEW YORK
DEPARTMENT OF PUBLIC SERVICE

Case 14-G-0201

Investigation of
Natural Gas Explosion and Collapse of the Buildings
1644 and 1646 Park Avenue, New York, NY
March 12, 2014
Consolidated Edison Company of New York, Inc.

REDACTION OF CERTAIN INFORMATION PURSUANT TO PUBLIC OFFICERS LAW SECTION 87(2)(b) AND (e).

Safety Section
Office of Electric, Gas & Water
Final Report November 12, 2015

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Abbreviations and Definitions

% Gas-in-air – a term used to express a percentage of gas in the mixture of gas and air. The flammable limit of natural gas is approximately 5% to 15% gas-in-air. 5% is the lower explosive limit (LEL) and 15% is the Upper Explosive Limit (UEL).

Butt Fusion – The joining of two pieces of plastic or metal pipes or sheets by heating the ends until they are molten and then pressing them together to form a homogeneous bond[1].

Covered employee - means a person who performs a covered function, including persons employed by operators, contractors engaged by operators, and persons employed by such contractors.

Covered function - means an operation, maintenance, or emergency-response function that is performed on a pipeline or LNG facility and the function is regulated by 49 CFR part 192, 193, or 195.

Electrofusion – A heat fusion joining process where the heat source is an integral part of the fitting, such that when electric current is applied, heat is produced that melts and joins the plastics[2].

Graphitization – A graphitized cast iron pipe[3] is one in which iron has been converted to corrosion products leaving graphite, with the pipe seemingly left intact. This is evidenced by the pipe being soft and able to be shaved away with a knife or other type of blade.

Head of Service Valve – (HOS) - Typically the first isolation valve after the building wall on the inside piping for natural gas of a house or a building.

Inches of water column - (inch W.C., "W.C., inches) is a non-SI unit for pressure. The units are by convention and due to the historical measurement of certain pressure differentials. It is used for measuring small pressure differences in a pipeline. Typical operating pressure of a low pressure natural gas distribution system ranges from 8 to 12 inches W.C. For conversion purposes, 1 PSI (pound per square inch) ≈ 27.7 Inches W.C.

Main – The larger gas piping in place to deliver natural gas to a

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[1] McGraw-Hill Dictionary of Scientific & Technical Terms, 6E, Copyright © 2003 by The McGraw-Hill Companies, Inc.
[2] ASTM Designation: F 1055 – 95a 07/23/97.
[3] Gas Piping Technology Committee (GPTC) Guidance Material Appendix G-192-18. Cast iron pipe 5.3(a).

number of customers in a service area. Typically runs parallel to the roadway.

MAOP - Maximum Allowable Operating Pressure pursuant to 16 NYCRR 255.619.

Code MuRRe[4] - A Multiple Resource Response Event is declared by Consolidated Edison Company of New York Gas Emergency Response Center for the following conditions:

- Probable combined commodity event
- Two or more calls on the same block, in the same vicinity
- Atmospheric readings in buildings of >=0.5% that cannot be vented quickly
- Atmospheric readings in two or more buildings
- Type 1 readings in two or more subsurface structures
- Type 1 reading in a single subsurface structure that does not quickly vent below a Type 1 condition
- Report of a strong odor from a Reliable Source
- Inside and outside damages (not secured by qualified gas personnel)
- Other situations requiring an escalated field response

RDL – Readily Detectable Level is a concentration of gas in air at which one identifies a readily detectable gas odor. RDL is another measurement used to monitor odorant levels in natural gas supplied as required by 16 NYCRR 255.625(b).

Saddle/Sidewall Fusion - The conventional technique to join a saddle (service tee) to the side of a pipe consists of simultaneously heating both the external surface of the pipe and the matching surface of the saddle type fitting with concave and convex shaped heating tools until both surfaces reach proper fusion temperature.[5]

Service – The piping that delivers natural gas to an individual premises. Typically runs perpendicular to the roadway.

Service Tee – As used in this report, refers to the entire fitting that connects the gas service to the gas main.

SSS - Subsurface structures – manholes (sewer, electric,

[4] CECONY procedure enhancement developed and implemented subsequent to 80-50 260th Street, Queens incident (Case 09-G-0380).
[5] Plastic Pipe Institute website.

telephone, etc.), catch basins, traffic control box, etc.

TDL – Threshold Detectable Level is the minimum concentration of a gas in air at which one can detect a change in odor. The odor cannot be readily identified at that concentration, but a change in odor is barely detectable. TDL is one of the measurements used to monitor odorant levels in natural gas supplied as required by 16 NYCRR 255.625(b).

"W.C. – inches of water column is a non-SI unit for pressure. The units are by convention and due to the historical measurement of certain pressure differentials. It is used for measuring small pressure differences in a pipeline. Typical operating pressure of a low pressure natural gas distribution system ranges from 8 to 12 inches W.C. For conversion purposes, 1 PSI (pound per square inch) ≈ 27.7 Inches W.C.

Acronyms

311 311 is New York City's main source of government information and non-emergency services. According to New York City 311 website, 311 services also provide insight into ways to improve City government through accurate, consistent measurement and analysis of service delivery Citywide. 311 accepts complaints from the residents and forwards them to appropriate agencies for follow-up. Based on 311 Protocol, all natural gas related emergencies or complaints are directly forwarded to the 911 system.

CECONY Consolidated Edison Company of New York (Con Edison), a regulated utility, provides natural gas service in Manhattan, the Bronx, and parts of Queens and Westchester.

CSR Customer Service Representative (CSR) - a CECONY employee

NYCDEP – Department of Environmental Protection is a New York City agency that manages and conserves the City's water supply; distributes more than one billion gallons of clean drinking water each day and collects wastewater through a vast underground network of pipes, regulators, and pumping stations.

NYCDOT – Department of Transportation is the New York City agency that maintains and improves the City's transportation infrastructure.

FDNY The Fire Department of the City of New York emergency response agency, providing fire protection, search and

rescue, pre-hospital care and other critical public safety services to New York City residents and visitors in the five boroughs.

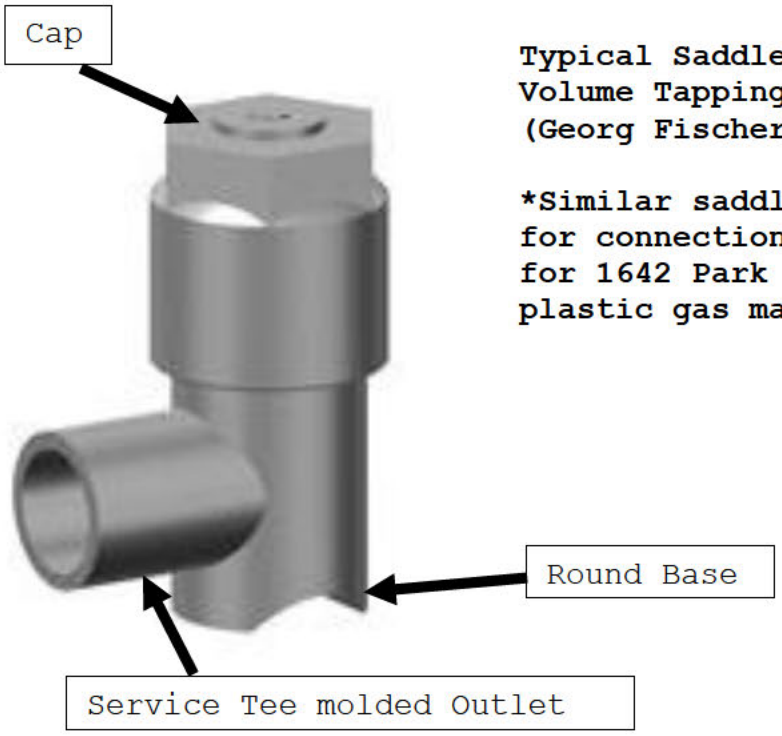
GERC CECONY Gas Emergency Response Center.

NTSB The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation – railroad, highway, marine and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents.

NYPD New York City Police Department.

OEM New York City (NYC) Office of Emergency Management is a coordinating agency for the City of New York. The agency plans and prepares for emergencies, educates the public about preparedness, coordinates emergency response and recovery, and collects and disseminates emergency information.

PHMSA Pipeline and Hazardous Materials Safety Administration. PHMSA is a U.S. Department of Transportation agency that develops and enforces regulations for the safe, reliable, and environmentally sound operation of the nation's 2.6 million mile pipeline transportation system and the nearly 1 million daily shipments of hazardous materials by land, sea, and air.



Typical Saddle Fusion Fitting: High Volume Tapping Tee with Large Round Base (Georg Fischer HVTT2LRB).

***Similar saddle fusion fitting was used for connection of the gas service line for 1642 Park Avenue onto the 8-inch plastic gas main.**

Typical McElroy Sidewinder equipment used to perform saddle fusion to install a service tee onto the plastic gas main.

Timeline

Chart of events leading to the incident and post-incident investigation.

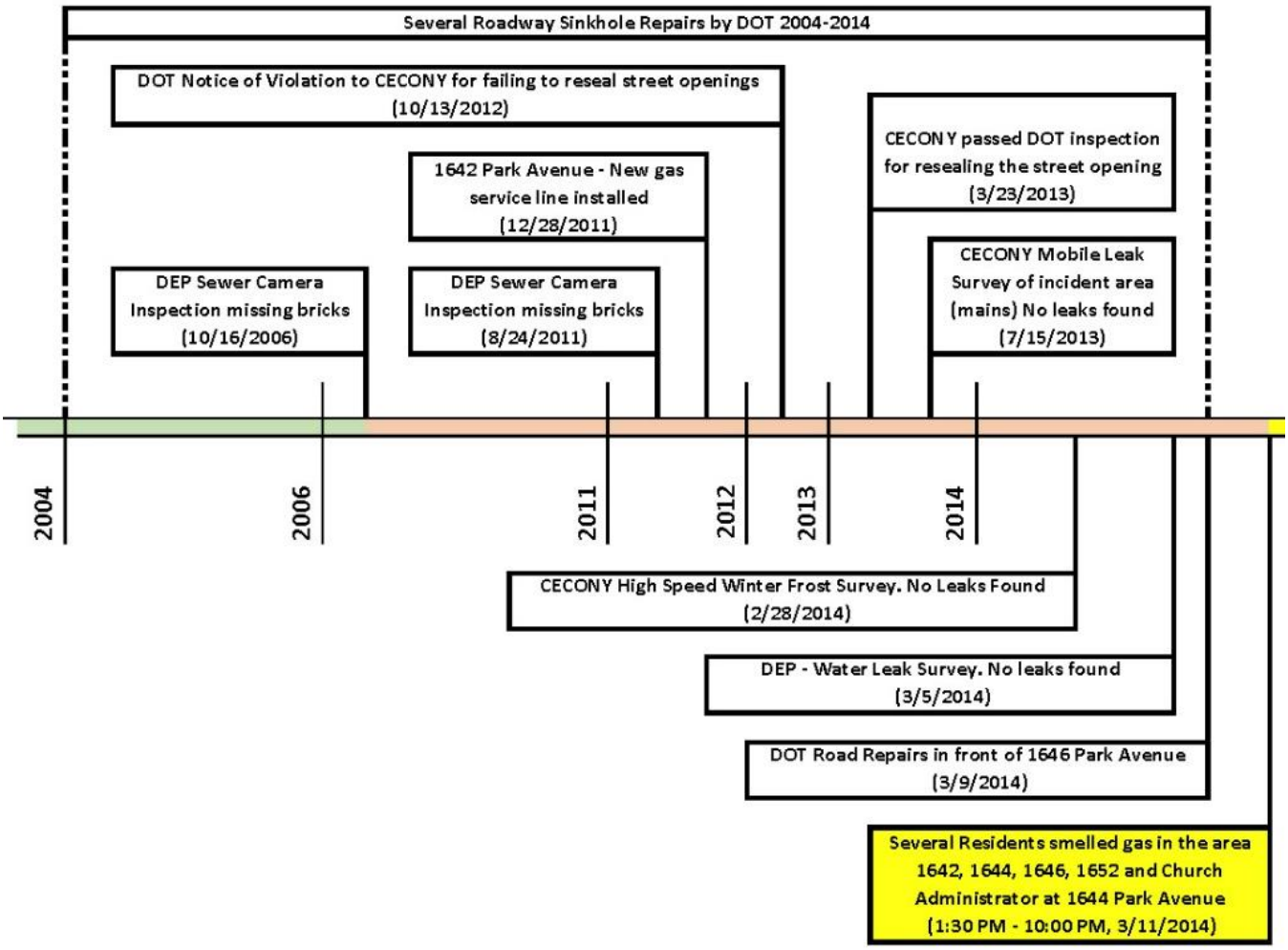
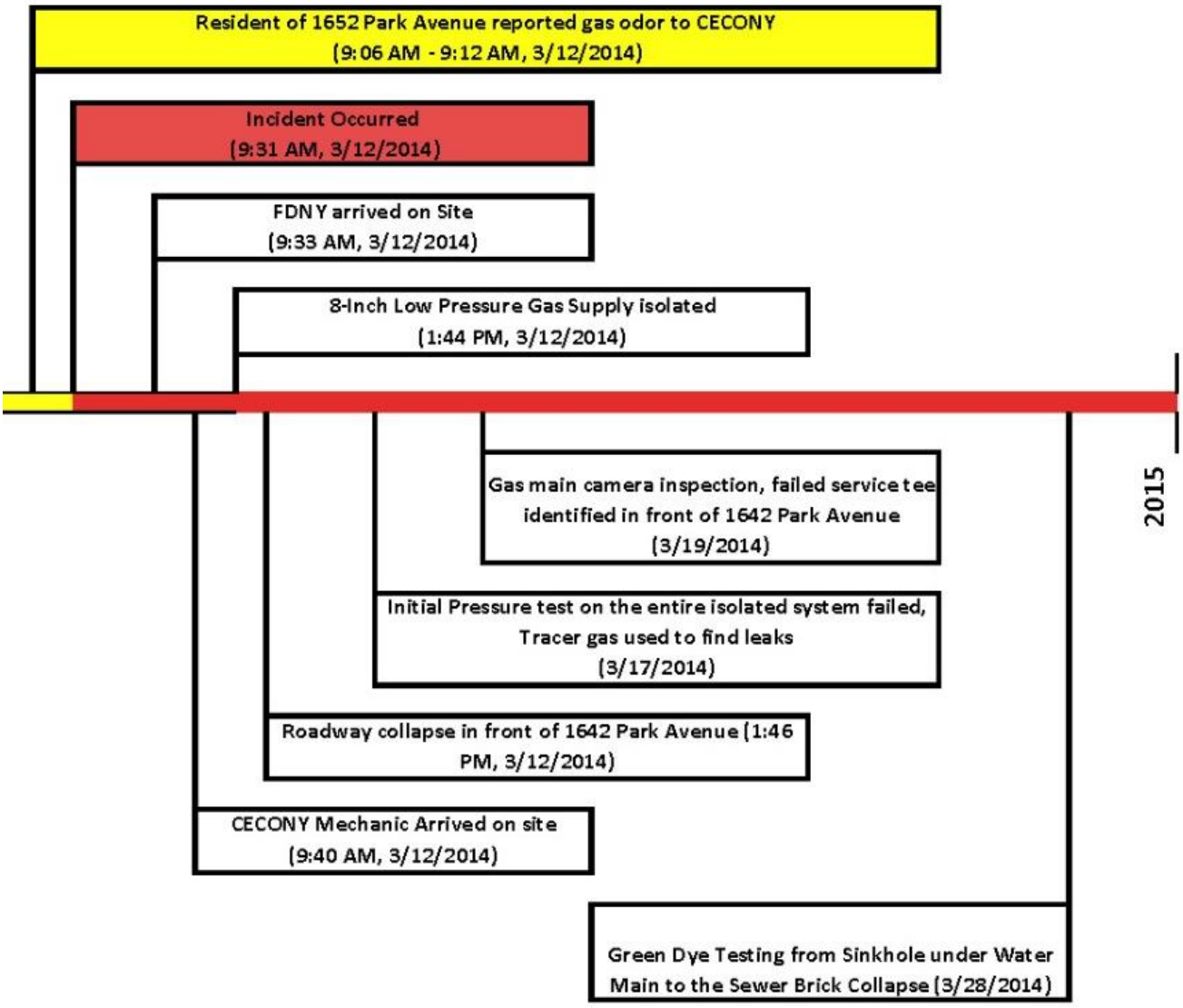


Chart of events leading to the incident and post-incident investigation (cont.)



Executive Summary

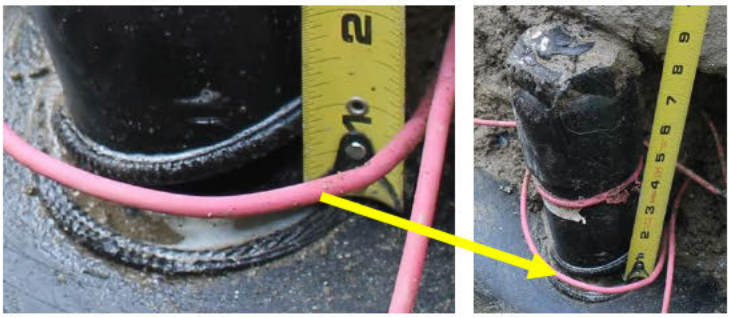
Accident

On March 12, 2014 at 9:31 AM Eastern standard time, a natural gas explosion and subsequent structural fire occurred at 1644 and 1646 Park Avenue, East Harlem, New York City within the natural gas service territory of Consolidated Edison Company of New York, Inc. (CECONY, the Company). This incident resulted in eight fatalities and approximately 48 reported injuries to nearby residents and pedestrians. Both of the 1644 and 1646 Park Avenue structures collapsed and all contents were destroyed; significant damage from an explosion wave, shrapnel, and fire occurred to adjacent buildings as well as structures across the street.

At the time of the explosion, a CECONY crew was en route to the location in response to a natural gas odor complaint received at 9:06 AM from a tenant at 1652 Park Avenue. The CECONY crew arrived at the site at 9:40 AM, approximately nine minutes after the explosion. The Fire Department of New York ("FDNY") had arrived to the location at 9:33 AM in response to the explosion.

Probable Causes

The Department of Public Service Staff (DPS Staff, DPS investigators) identified the source of the gas that ignited as coming from a failed plastic fusion joint of a gas service tee providing natural gas to 1642 Park Avenue. CECONY had installed the service tee on December 28, 2011.



Failed Plastic Fusion joint at the service tee at 1642 Park Avenue

A Crack on the bottom of the molded outlet of the gas service tee at 1642 Park Avenue

- The primary source of natural gas that caused this incident was the failed plastic fusion joint at the service tee to 1642 Park Avenue building installed in 2011. Among other reasons described below, based on Staff's estimated flow rate calculations and the extent of the natural gas odors sensed the night before the incident (based on personal interviews

DPS conducted), the crack on the bottom of the molded outlet of the same gas service tee could not have released sufficient gas to have caused an explosion of this magnitude.

- A long-standing, unrepaired, New York City (NYC) sewer collapse, identified in a 2006 NYC camera inspection, caused the undermining of the natural gas distribution main in front of 1644 and 1646 Park Avenue. That undermining caused sufficient removal of material supporting the gas pipeline and led to the fusion failure. The collapsed sewer served as the escape path for the soil underneath nearby gas and water utilities during natural groundwater movement and any pre-existing breaks on the City-owned water main in the same vicinity. Loading above the gas main due to repeated layers of roadway added since 2006 also added to overburden forces that pushed the gas main downward.

Although the failure of nearby municipal infrastructure contributed to this incident, because DPS is the jurisdictional entity that regulates and oversees CECONY and not the entities responsible for water or other municipal facilities, this investigation report focuses primarily on CECONY's actions and inactions under Public Service Commission (PSC) jurisdiction that contributed to the incident.

This DPS Incident Report is the culmination of independent fact-finding by DPS investigators. The conclusions drawn in this report may agree or disagree with the conclusions drawn in the National Transportation Safety Board (NTSB) Report, issued June 29, 2015. While the DPS relied upon facts discovered and testing performed by the NTSB, those facts are in addition to information and observations the DPS gathered during its own investigation. Further, the DPS conclusions were reached independent of all Party Submissions to the NTSB in its Docket No. NTSB/PAR 15/01, PB2015-104889, regardless of any apparent similarity to those Party Submissions.

DPS investigators remained on site at the incident throughout the investigation, including beyond the time when the NTSB left the scene. DPS investigators observed in real time the infrastructure excavated, the system shutdown, and pressure tests conducted to determine any potential leaks and failures. DPS took and shared with the NTSB thousands of photographs of the area; participated in all possible investigative team meetings with the FDNY, New York Police Department (NYPD), NYC Office of Emergency Management (OEM), NYC Department of Environmental Protection (NYCDEP), New York City Department of Transportation (NYCDOT), and CECONY; issued dozens of Interrogatory Requests to CECONY, the NYCDEP, FDNY, NYCDOT, and the NYPD; and reviewed all of the NTSB's testing

reports and records, which provided much of the documentation upon which the NTSB relied.

Summary of Regulatory Findings

As a result of its investigation, DPS Staff identified the following regulatory findings:

- The defective plastic fusion joint in front of 1642 Park Avenue, based on the joint's appearance, failed to conform to the manufacturer's or CECONY guidelines or acceptance criteria. Therefore, it should have been removed and replaced.
- CECONY failed to properly qualify the person who completed the failed plastic fusion in front of 1642 Park Avenue.
- CECONY provided no documentation to show that the person who had completed the failed plastic fusion in front of 1642 Park Avenue had visually inspected the fusion before placing it into service. Even if CECONY had visually inspected the plastic fusion before placing it into service, neither of the workers on site when the fusion was completed were properly qualified to perform such inspection.
- CECONY did not follow its written procedures to "ensure through evaluation that individuals performing covered tasks [plastic fusions] are qualified."
- CECONY'S written plastic fusion procedures for completing sidewall fusions used for installation of the failed plastic fusion in front of 1642 Park Avenue had not been properly qualified at the time the failed plastic fusion was completed.
- After receiving an Inside and Outside gas odor call from the resident at 1652 Park Avenue, CECONY should have requested Fire Department Assistance immediately in accordance with CECONY's gas emergencies dispatch guidelines and leak investigation procedures.
- CECONY should have performed Post-Incident Drug and Alcohol Testing of the GERC Dispatchers who handled CECONY's odor response before the incident.
- CECONY should have generated a record documenting the gas leak at the site of the incident.
- CECONY failed to perform a winter leak survey in 2013 and 2014 on a nearby segment of gas main in accordance with Company Procedures.
- CECONY had not maintained accurate maps in the area in that it failed to include a section of gas main and did not properly identify material for two gas service lines.
- The CECONY plastic fuser's 12-month requalification was lapsed when the worker completed the fusion on the service

tee to 1642 Park Avenue.

- CECONY did not follow plastic pipe installation requirements by installing a tracer wire wrapped around a gas service tee to 1642 Park Avenue in 2011, which is against Company procedures.
- CECONY did not install an isolation valve during the 2011 main replacement as required by Company procedures.

The following Area of Concern was noted:

CECONY's procedures do not require it to perform Post-Incident Drug and Alcohol Testing of the Customer Service Representatives (CSR), which CECONY believes are not "covered employees" within the meaning of gas safety regulations. CSRs, however, perform emergency response functions by answering and directing odor calls and should be subject to Drug and Alcohol Testing requirements.

Recommendations

1) NYCDOT road repairs had been ongoing for as many as nine years prior to the incident with layers of asphalt added to patch sinkholes, cave-ins, and road depression problems in front of 1644 and 1646 Park Avenue. Residents interviewed by DPS recalled multiple instances of such NYC road repairs. In addition, DPS Staff observed depressions in the road during the post-incident field investigation at the site and saw asphalt that was as much as 24 inches thick above the sewer break. NYCDOT notified NYCDEP on multiple occasions of this issue but NYCDEP took no remedial action. The loading from above and lack of foundation below as a result of the unrepaired, collapsed sewer, undermined the gas infrastructure in the area. NYCDEP should ensure that it performs necessary follow up on and investigations of reports of infrastructure problems, particularly from other governmental agencies. NYCDEP should also ensure that deficiencies identified during routine inspections are evaluated and necessary remedial actions are taken in a timely manner to improve the integrity of its own as well as nearby service infrastructure.

2) During mandated leak surveys or when otherwise patrolling over its gas distribution systems, CECONY should document any significant road depressions, sinkholes, and uneven road paving conditions which may potentially pose a threat to CECONY gas utilities.. CECONY should follow up such observations by notifying the municipal agencies responsible

so that potential threats to underground utilities can be addressed before they become a serious threat.

3) Inconsistencies exist between CECONY maps and its cast iron Risk Ranking model data. For instance, based on Company records, it appears that a segment of gas main segment originally identified as Cast Iron was determined, upon excavation, to be Wrought Iron. CECONY should identify and address any similar conflicts between its cast iron risk ranking data utilized and mapping information to avoid dilution of risk ranking within the model.

4) From multiple interviews conducted by DPS Staff as part of the investigation, it was learned that several members of the general public smelled natural gas odor before the incident but failed to notify CECONY or any NYC agencies. These individuals either disregarded the odor, failed to recognize the hazard, or were not sure who should be notified. In Case 11-G-0565, all gas utilities, including CECONY, are required to apply best practices to current public awareness programs by exploring additional measures to more efficiently and effectively increase consumer action upon smelling the odor of natural gas. Before this incident, however, public awareness outreach efforts involving natural gas obviously were not adequately reaching the general public. Some people have no access to the internet, and others do not read mail inserts in their bill. CECONY must continuously evaluate the effectiveness of its public awareness programs to explore additional measures to more efficiently and effectively reach the public, especially to those who are not reached via existing programs.

5) While ongoing research by NYSEARCH[6] and the Northeast Gas Association with several utilities (including CECONY) are developing residential methane detectors, this research should be expedited to the extent possible. CECONY should develop and implement a plan on the best use and application of such devices in residential single and multi-dwelling homes. Such plan should include the best location for installing methane detectors in buildings. This research should also address the ability of remote reporting capability for these detectors by which the detectors would send an alarm directly to utilities and/or emergency

[6] NYSEARCH is a collaborative Research, Development & Demonstration (RD & D) organization and works with New York's local distribution companies to target RD & D areas that directly address their unique challenges and opportunities.

responding agencies when a potentially hazardous level of natural gas is detected.

6) In a typical gas service line installation, CECONY pressure tests the service line from outside to the Head of Service Valve or building wall. It is unclear from CECONY's pressure test documentation that the service connections to mains are always included in CECONY's tests, which is allowed by 255.511(h) to have leakage test at operating pressure. In the case of typical high pressure gas service installations, if the connection to the main was not included in the test at 90 psig, a company is still required to test for leakage at operating line pressure which, in most cases, is 60 psig. In case of a typical low pressure gas service installation, if the connection to the main was not included in the test at 90 psig, it is only required to be tested for leakage at operating line pressure which is typically 8 inches of Water Column (W.C.) or approximately 0.25 psig.

   See 16 NYCRR §255.511 – Test requirements for service lines, requires all service lines except copper to be tested as follows: *"the test pressure shall be 90 PSIG (621 kPa) or 1.5 times the maximum operating pressure, whichever is greater;. . . . The service line connection to the main need not be included in these tests if it is not feasible to do so. However, it must be given a leakage test at operating pressure when placed in service."* 16 NYCRR §255.511(h).

   Staff recommends that CECONY test its low pressure service lines, including the connection to the plastic main in the test prior to tapping the main to 90 PSIG (360 times higher pressure than 0.25 psig). This will better expose any defects or major flaws, which may not be found using a leak test alone. Therefore, CECONY should amend its pressure testing procedures to ensure consistent application of the pressure testing methods and proper documentation of the actual piping involved in pressure tests consistent with this recommendation.

7) CECONY should develop a plan to ensure strict quality assurance compliance with its Operator Qualification Program, including on plastic fusion jobs. CECONY should follow that plan and increase the number of Quality Assurance/Quality Control (QA/QC) inspections of construction, operations, and maintenance activities.

8) CECONY should review the adequacy of all valve placements in its entire high pressure and low pressure distribution system, particularly in areas where significant customer

outages may occur if operations must continue during emergencies. CECONY should take the necessary steps to address any deficiencies, including reviewing construction records, to confirm that isolation valves were installed in compliance with established procedures for gas main replacements.

9) CECONY must explore and implement methods that will further reduce the amount of time it takes to perform emergency shutdown of high pressure and low pressure gas systems by valving or other methods in order to minimize hazards to life or property. The Company should review and revise its emergency response plans accordingly.

10) CECONY should establish a process to better manage its procured inventory of plastic pipe to monitor its period of ultraviolet exposure. The process should prevent the distribution and usage of any plastic pipe exceeding the current exposure limit specified in regulations.

11) CECONY should conduct a Root Cause Analysis including enterprise risk control for the 1644 and 1646 Park Avenue, New York, NY natural gas explosion and building collapse on March 12, 2014.

12) CECONY should adopt and follow American Petroleum Institute Recommended Practice (API RP) 1173 "Pipeline Safety Management System Requirements."

13) CECONY should fully investigate and remediate the reason why the computer screens froze on the Company's system during the March 12, 2014 transfer of the odor complaint information to the GERC from the Customer Service Representative who recorded the call.

Introduction

On March 12, 2014 at approximately 9:31 AM Eastern Standard time, an explosion and subsequent structural fire occurred at 1644 and 1646 Park Avenue, East Harlem, New York City within the natural gas service territory of Consolidated Edison Company of New York. The magnitude of the explosion and resulting damage was substantial and consistent with a natural gas explosion. This incident resulted in eight fatalities and approximately 48 reported injuries to

nearby residents and pedestrians.[7]

Figure 1 – 1644-1646 Park Avenue prior to explosion

Figure 2 – 1644-1646 Park Avenue after the explosion

The two buildings, numbered 1644 and 1646 Park Avenue, were located along the west side of Park Avenue between East 116th and East 117th Streets in East Harlem, New York City. Both buildings were mixed use (commercial and residential) five story brick structures. The first floor and basement of building 1644 was a Spanish Christian Church with its mezzanine extending up to the 2nd floor level; the third through fifth floors contained six residential apartments. The owner of building 1646 operated a piano store on the first floor, but lived in a different location. Building 1646 had eight residential apartments. Both the 1644 and 1646 Park Avenue structures collapsed and all contents were destroyed; significant damage from an explosion wave, shrapnel, and fire occurred to adjacent buildings as well as buildings across the street. Total property damage is estimated to be approximately $2,835,000.[8]

At the time of the explosion, a CECONY crew was en route to the

[7] Numbers of fatalities and injuries referenced in CECONY's 30-Day Incident Follow-up Report (ID: GCE-6529) to DPS required by 16 NYCRR 255.801(d).

[8] See CECONY's 30 day report – PHMSA F7100.1 dated 4/11/2014. Actual total damage estimates are significantly greater including insurance claims and litigation costs.

location in response to a natural gas odor complaint initiated at 9:06 AM from a tenant at 1652 Park Avenue, [redacted]. The CECONY crew was dispatched at 9:16 AM and arrived at the site at 9:40 AM, approximately nine minutes after the explosion. The Fire Department of New York ("FDNY") had responded to the location immediately after the explosion occurred.

At approximately 10:30 AM CECONY's investigation (of the odor complaint from 1652 Park Avenue) identified 10% and 20% "gas-in-air readings" inside and outside of the foundation wall of 1652 Park Avenue.[9] CECONY registered an inside atmospheric gas-in-air reading of 0.2% (4 LEL) in the apartment from which the odor was reported at 1652 Park Avenue. Higher concentrations of natural gas readings were also detected in multiple manholes near the incident location along Park Avenue between 116th and 117th Streets (See Figure 21). The FDNY assisted CECONY in evacuating nearby buildings and venting the gas safely.

Department of Public Service Staff arrived at the site at approximately 11:00 AM. The New York Police Department ("NYPD"), FDNY, NYC Office of Emergency Management ("OEM") and several media crews were on location when DPS Staff arrived. When DPS Staff arrived, the FDNY was actively engaged in rescue operations and putting out the fire. Electricity had been shut off to the incident area soon after the explosion.

The National Transportation Safety Board's (NTSB's) "Survival Factors Exhibits" state that at approximately 2:00 PM, a sinkhole/street collapse occurred due to an apparent water main break in the roadway in front of 1642 and 1644 Park Avenue. Also

[9] See definition of "gas-in-air readings" in "Abbreviations and Definitions" section.

about that time, (approximately 1:44 PM), CECONY crews completed the isolation of the low pressure (normally operating at 8 inches of W.C.[10]) natural gas supply feeding the incident area by performing "cut and cap"[11] operations at three excavation locations; this caused unscheduled interruptions to seven low pressure natural gas services to nearby buildings. At approximately 5:30 PM, NYCDEP crews shut off the water supply to the water main that runs parallel to the natural gas main on the west side of Park Avenue between East 116th and East 117th Streets. The National Transportation Safety Board ("NTSB") investigation team, and Pipeline and Hazardous Materials Safety Administration representatives arrived at the scene at approximately 6:00 PM.

The FDNY continued fire suppression activities and debris removal continued until the fire was completely extinguished on March 14, 2014. The rescue and recovery mission led by FDNY continued through March 18, 2014.

Description of Natural Gas Facilities at the Incident Site

The natural gas main along the west side of Park Avenue that served the buildings between East 116th and East 117th Streets was comprised of an 8-inch cast iron and 8-inch (SDR 11 Yellow stripe (Chevron Phillips) 8300 PE3408/4710 PE100 CEE ASTM D2513) high density polyethylene low pressure distribution main with a maximum allowable operating pressure (MAOP) of 12 inches of water column (W.C.). See Figure 3, below. The cast iron portion of the gas distribution main had been installed in 1887. In 2011, the building at 1642 Park Avenue was reconstructed and new water and sewer

[10] See definition in the "Abbreviations and Definitions" section.
[11] The process of isolating a natural gas main by cutting out a cylindrical piece of pipe and securing a cap at the ends of the pipe to make a gas tight seal.

laterals were installed. Excavation to install the new sewer lateral connection caused an undermining condition under the section of natural gas cast iron distribution main at the same location. As a result of the undermining conditions and in accordance with the replacement requirements specified in 16 NYCRR §255.756, CECONY replaced a section of gas distribution cast iron main with high density polyethylene pipe and installed a new 2-inch high density polyethylene gas service line to 1642 Park Avenue.

The gas service lines to the buildings at 1644 and 1646 Park Avenue, next door to 1642, were comprised of 1-1/4 inch copper tubing with short sections of plastic tubing at the connection to the 8 inch cast iron gas main (See Figure 2a below). At the time of the incident, the average operating pressure of those gas main and service lines was 7.7 inches of W.C., which is typical for Manhattan's low pressure distribution system.

Figure 2a: 1644 and 1646 Park Avenue gas services

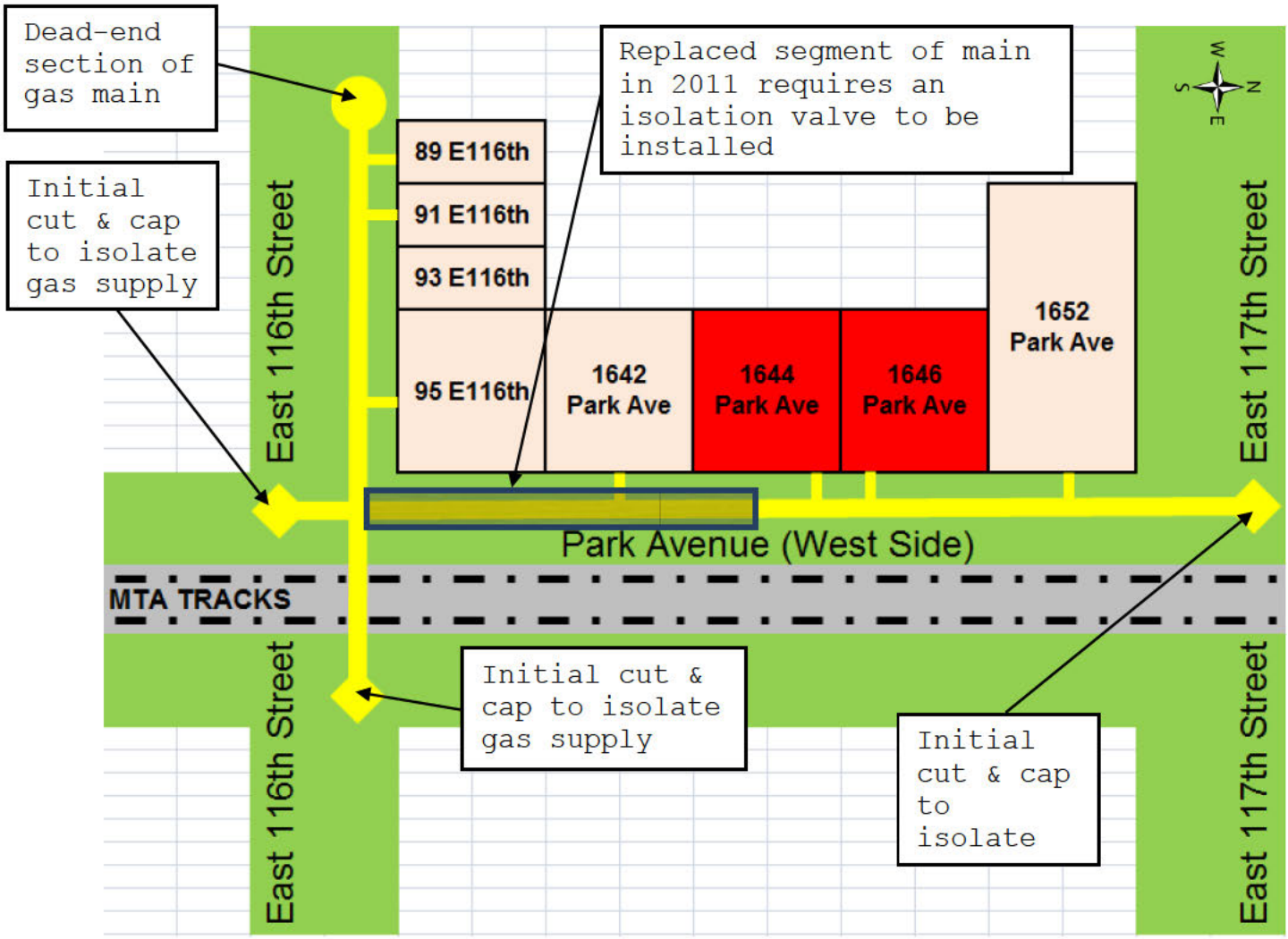


Figure 3 – Gas main isolation to the incident site[12]

[12] This diagram was generated by DPS Staff and, while it illustrates the locations of the cut and cap operations and the gas service at the site of the explosion, it is not drawn to scale.

Incident Investigation and Analysis

The below listed chronological sequence of events is based on DPS Staff's review of records, interviews conducted post-incident, information gathered at interagency meetings, and on-site inspections.

Timeline of events prior to the incident

Ongoing[13]	Reports of road sinkholes, cave-ins, and road depression problems in front of 1644 and 1646 Park Avenue buildings were noted by multiple residents interviewed by DPS Staff [redacted] See the interviewee information table in Appendix A.
March 9, 2014, 10:00PM-10:45PM	NYCDOT performed pothole and road depression repairs by adding asphalt to the pavement in front of 1646 Park Avenue between East 116th and East 117th Streets [redacted] Similar asphalt patches had been made at this location in the past.
3/11/14, Approx. between 1:00 PM & 4:00 PM	A resident of 1642 Park Avenue (Interviewee 1) smelled gas outside the apartment door, stairways, and basement while leaving for an appointment in the afternoon.
3/11/14, Approx. 4:00-5:00PM	A resident from 1646 Park Avenue (Interviewee 2), smelled gas in his apartment; windows were opened to allow venting and he did not smell gas anymore.
3/11/14, Approx. 7:00PM	A resident of 1642 Park Avenue (Interviewee 3) smelled gas in the hallway inside the building as he returned home from work.

[13] From interviews of the residents and NYC repair records, the road problems had been ongoing for as many as nine years prior to the incident.

3/11/14, Approx. 9:30PM	The financial secretary of the Church at 1644 Park Avenue(Interviewee 4) smelled gas in the street and by the manhole near the corner Deli located at 95 East 116th Street (NW corner of East 116th Street and Park Avenue) while coming out of the church. Notified the corner store owner of the gas smell and left.
3/11/14, Approx. 10:00PM	A resident from 1644 Park Avenue (Interviewee 5) smelled gas as he was coming up to his building from East 117th Street along Park Avenue. He mentioned it to Interviewee 6 from 1644 Park Avenue who was doing the church cleaning. Both checked inside and outside areas of the building, but could not confirm any gas odor.
3/11/14, Approx. 11:00PM	A resident of 1642 Park Avenue (Interviewee 1) noticed that there was no hot water in the apartment. Interviewee 1 also noted no prior issues with hot water in the apartment.
3/12/14, Approx. 6:30 AM	A resident of 1642 Park Avenue (Interviewee 3) noted there was no hot water in the apartment.
3/12/14, Approx. 7:00-7:30 AM	Interviewee 3 smelled gas in the hallway as he left for work. He noted that the gas odor was stronger than the night before.
3/12/14, 9:06-9:12 AM	Resident of 1652 Park Avenue, [redacted] reported a natural gas odor to CECONY call center. His partner smelled gas the night before (i.e. March 11, 2014) in the bedroom. They also smelled gas in the bedroom in the morning. The odor was reported to be coming from outside [redacted]
3/12/14, 9:16	CECONY dispatched a mechanic to 1652 Park Avenue,

AM	[redacted] to investigate the inside odor call [redacted]
3/12/14, 9:19 AM	CECONY issued an additional ticket for an outside leak investigation to the mechanic already en-route to 1652 Park Avenue [redacted]
3/12/14, approximately 9:31 AM	An explosion and fire occurred at 1644 and 1646 Park Avenue, East Harlem, New York [redacted]
3/12/14, 9:40 AM	CECONY's mechanic arrived at the location of the explosion and fire.

Post-incident Emergency Response

General Operations

The FDNY and several NYC emergency management officers responded to the location immediately after the explosion. DPS Staff arrived on site at approximately 11:00 AM. NYPD, NYC OEM and several news reporters were on location at that time. FDNY was actively engaged in rescue and recovery operations, as well as with putting out the fire at the 1644 and 1646 Park Avenue buildings.

The first CECONY mechanic arrived at the incident site at about 9:40 AM. CECONY mobilized additional CECONY emergency responders and resources to the location soon after responding to the explosion. CECONY established an on-site incident command center to manage utility operations.

Natural gas distribution mains in New York City streets are generally interconnected from multiple directions and, therefore,

[redacted]

require operation of several distribution system valves for proper isolation. The physical location of these valves would determine the number of service interruptions when the valves are closed. During the investigation, CECONY stated that the isolation of the incident site would require an operation of 62 valves. As an alternative to that time-consuming exercise, CECONY completed the isolation of the natural gas distribution main serving the incident site the same day by performing three cut and cap operations on the gas mains - as shown in Figure 3 above. Full isolation of the gas main was achieved 4 hours after the explosion at approximately 1:44 PM, causing an unscheduled interruption to seven services involving 119 customers (including the collapsed buildings).

At approximately 3:00 PM, DPS Staff became aware of the development of the sinkhole and spewing water in the roadway in front of 1642 Park Avenue.[15] At approximately 5:30 PM on the day of the incident, NYCDEP turned off the water at the main along Park Avenue between East 116th and East 117th Streets. The size of the sinkhole was approximately 10 feet wide by 15 feet long. In order to facilitate safe access to the incident site for cranes and other heavy equipment necessary to continue the rescue and recovery mission, a decision was made by FDNY/OEM to excavate the sinkhole area to assess the extent of the undermining condition and backfill as needed.

At this time, a circumferential crack on the 12-inch cast iron water main was exposed within the excavated area. This water main runs parallel to the natural gas main serving the buildings along

[15] PHMSA form F 7100.1 dated 04/11/2014 submitted by CECONY, on page 10 part H, states: *"At approximately 13:44, a street collapse and an apparent water main break were observed in the roadway in front of 1644 and 1646 Park Avenue. At the time of the street collapse, there was a strong odor of gas in the area".*

the west side of Park Avenue between East 116th and East 117th Streets. When DPS Staff initially viewed the gas main inside the excavated sinkhole, Staff did not see any visible breaks. The NTSB investigation team and a PHMSA representative arrived on-site at approximately 6:00 PM. At approximately 8:00 PM, the excavated sinkhole was backfilled with gravel so that rescue and recovery operations could continue.

The FDNY continued its fire suppression activities until the fire was completely extinguished on March 14, 2014; debris removal continued. The rescue and recovery mission led by FDNY continued through March 18, 2014.

CECONY Emergency Response & Dispatch

The below listed chronological sequence of CECONY's emergency response and dispatching operations on March 12, 2014 is based on the review of records and interviews conducted post-incident.

9:06 AM–9:12 AM	CECONY received an odor call from the resident of [redacted] at 1652 Park Avenue. The caller remained on the phone with CECONY's Customer Service Representative (CSR) until 9:12 AM on March 12, 2014. The caller stated there was a strong odor in his bedroom and that he believed the odor was coming from outside.
9:13 AM	CSR made a call to CECONY's Gas Emergency Response Center (GERC) and relayed the odor call information; the GERC representative advised to create an outside gas leak ticket in addition to the inside leak ticket CSR had already generated in the system.
9:15 AM	CSR made another call to GERC to confirm whether or not the outside leak ticket generated went through since the computerized system was freezing up. GERC

	representative responded that the ticket had not come through.
9:16 AM	GERC representative dispatched a mechanic in the field to the location to investigate an inside leak complaint and advised that the outside leak ticket is also coming for the same location. Mechanic confirmed receipt of the dispatch.
9:19 AM	A different GERC representative called the FDNY, stating that Fire Department assistance is needed at the location and provided the address. GERC also stated that they have an inside/outside leak at the location. It is not known why, but at that point the GERC representative apologized, asked FDNY to hold on, and then stated he would call right back. GERC did not call back the FDNY.
9:39 AM	Dispatched CECONY mechanic reported that he was a few blocks away from the location and there are flames and smoke visible.
9:40 AM	GERC representative made a call to FDNY asking if there were any reports near 114th Street and Park Avenue. FDNY stated that there was a building that exploded, collapsed, and currently on fire.

After the incident, the NTSB investigation team conducted interviews of the CECONY CSR and GERC representatives involved with emergency response actions related to the East Harlem Incident. From the interview transcript,[16] [redacted], a GERC representative, repeated a number of times that there are certain triggers that prompt a call to the Fire Department for assistance during the report of a gas leak. One such automatic trigger is an

[16] NTSB Docket ID DCA14MP002: "[redacted] August 7, 2014 Interview Con Edison Troubleshooter Dispatcher."

inside/outside leak like the odor complaint from the resident of 1652 Park Avenue, [redacted] on the morning of March 12. [redacted] stated that normally the same mechanic handles both inside and outside leaks for the same location. Later, when asked how one person can perform two different responses (inside and outside leak) at the same time, [redacted] stated that this is why the Fire Department is called immediately. Later [redacted] acknowledged during his interview that this particular odor complaint was a hazardous condition, which required Fire Department assistance, and hence the reason GERC called FDNY right away about this incident. The NTSB did not ask why the GERC representative hung up on the call before finishing the report to FDNY.

Based on the review of CECONY's procedures and guidelines, DPS Staff confirmed that a situation with an inside/outside gas leak reported triggers the requirement that the GERC dispatcher must request Fire Department assistance to the location:

- Both CECONY procedures for outside and inside leak investigation respectively G-11809-28b, Section 6.2 and G-11837-24a, Section 5.2 state:

  "All available resources should be considered when dispatching crews to respond to gas odor, gas leak and gas damage complaints. For inside and outside damages, GERC shall also request Fire Department assistance."

- CECONY procedure G-11876 – "Dispatching gas emergency and non-emergency work by the Gas Emergency Response Center" section 4.8 defines:

  "Emergency Work- reports of inside/outside gas leaks, carbon monoxide complaints involving reported/suspected CO illness and reports of building fires."

- During the course of the investigation, CECONY provided a document outlining a dispatcher's responsibilities related

to critical items pertaining to leaks and emergency work which stated:

> *"Know the Code MuRRE triggers and your responsibilities when dealing with a Code MuRRE event. Instances of "Broken/Hissing Pipe", "Electric Effect" and other unusual circumstances such as caller reporting gas odors inside/outside, boilers/water heaters/stoves not shutting off, rapid movement on a meter even without a gas odor reported, for examples, MUST have a fire department response as well as expedited company response. While these scenarios may not meet a specific MuRRE trigger, they indicate conditions other than usually encountered or reported and fire department response will help ensure an expedited response to the reported condition."*

Based on the documentation reviewed, Staff was not able to determine why the GERC Dispatcher did not complete the report to FDNY, nor why he did not call back the FDNY. Twenty (20) minutes elapsed between his initial call to FDNY and the report of the incident by the CECONY mechanic dispatched to the location back to GERC. In any event, CECONY failed to secure fire department assistance as its emergency procedures required CECONY to do.

Additionally, DPS Staff discovered that CECONY does not require Drug testing for its GERC dispatchers in accordance with 16 NYCRR 262.105(b). Nor did CECONY alcohol test both the CSR and GERC dispatchers after the incident in accordance with 16 NYCRR 262.225(a). These findings are listed in the Summary of Regulatory Findings section at the end of this report.

Post-Incident Gas Leak Investigation

Utilities investigate natural gas leaks by using a portable gas detector. This device takes air samples and yields gas-in-air readings which allow a first responder to identify hazardous conditions (such as explosive range readings), pinpoint the leak, and determine the extent of gas migration.

At about 09:40 AM on March 12, 2104, after the CECONY crew arrived at the scene, it conducted a leak investigation as part of its response to the odor complaint reported by the 1652 Park Avenue resident. A number of natural gas readings were identified at various locations as follows:

- A 10% and 20% gas-in-air reading, respectively, at the inside and outside foundation wall of 1652 Park Avenue, next door to the north of the collapsed buildings.
- A 0.2% gas-in-air reading in the atmosphere of [redacted] at 1652 Park Avenue.
- Further investigation in the surrounding area detected explosive range (5%-15%) readings in several subsurface structures ("SSS").
- A 10% gas-in-air reading was detected in a sewer manhole in front of 1640 Park Avenue (a.k.a 95 East 116th Street), two buildings down to the south of the collapsed buildings.
- A 7% gas-in-air reading was detected in CECONY's electric service box in front of 1652 Park Avenue.
- A reading of 40% gas-in-air was detected in CECONY's electric manhole on the NW corner of East 116th Street and Park Avenue. The road surface elevation runs uphill from East 117th to East 116th Street along Park Avenue, which is important to note because natural gas is lighter than air and typically travels in the upward direction or path of least resistance.

These high concentration readings of natural gas at the multiple locations on the block indicate that a significant portion of the natural gas was venting into the atmosphere across the entire block and was migrating underground throughout the block. Therefore, only a portion of the natural gas escaping from the failed plastic

fusion joint alone or combined with the crack on the bottom of the molded outlet of the gas service tee had migrated towards 1644 and 1646 Park Avenue before its ignition.

The FDNY assisted CECONY to evacuate the premises near the incident site and vent the gas remaining in areas where gas readings had been detected.

DPS Staff witnessed the odorant level testing conducted later in the day by CECONY's technician in the gas distribution system in the area surrounding the incident. The test was conducted at a nearby accessible location (106 East 116th Street, [redacted] at the stove at approximately 5:00 PM on March 12, 2014. The threshold detectable level ("TDL") was 0.10% gas-in-air, readily detectable level ("RDL") was 0.20% gas-in-air, and interpolated reading was 0.26% gas-in-air. All readings were found to be within the required range in compliance with 16 NYCRR 255.625(b) readily detectable at one tenth of the lower explosive limit and above, or 0.50% gas-in-air.[17]

Also, during the days of the onsite incident investigation, DPS Staff observed that the soil underneath the sidewalk in front of 1642 Park Avenue -- heading north towards 1644 Park Avenue - was very porous, with noticeable, continuous, voids. Additionally, there was visible evidence of charring underneath the sidewalk from the corner of 1644 Park Avenue, heading south, in the direction of what was later identified as the failure at the connection, or service tee, of a natural gas service to a gas distribution main in front of 1642 Park Avenue (See Figures 4 and 5 below for details). Because all inside piping to 1644 and 1646

[17] A qualified CECONY employee monitored the odorant levels near the incident site using a calibrated machine.

Park Avenue been was completely destroyed in the explosion, the possibility of an inside natural gas leak cannot be eliminated completely; however, the outside infrastructure, including the continuous voids in the soil at and around the service tee are the strongest evidence of the path that the natural gas traveled -- from the failed fusion joint on the service tee serving 1642 Park Avenue towards the collapsed buildings.

Figure 4 – Soil voids under sidewalk leading to 1644 Park Avenue building (Photo taken from inside basement of 1644 Park Avenue facing South-East direction).

Figure 5 – Charring and voids under sidewalk along the property line between 1642 and 1644 Park Avenue buildings.

Examination of gas mains, services and pressure testing

The natural gas main supplying the incident area is part of CECONY's low pressure distribution system, which typically operates at 8 inches of W.C. The MAOP of this low pressure gas main is 12 inches of W.C. The actual operating pressure of the system at the time of the incident was recorded at the nearest pressure regulator station as 7.7 inches of W.C.

DPS Staff witnessed several pressure tests that were performed on the gas mains and service lines during the post-incident investigation to determine the existence of any leaks. Tests were conducted at pre-incident operating pressure of 8 inches of W.C. first and again at the MAOP (12 inches of W.C.). CECONY, with other investigators, conducted the initial post-incident pressure test on March 17, 2014 on the entire isolated system in "as is" condition in an attempt to verify the integrity of the remaining

gas main and services supplying the incident area.[18] The pipeline system tested was limited to the main and services shown in yellow in Figure 3, with isolation points at initial cut and cap excavations and at the individual meter outlets or head of service connections. The initial test of the gas main in the incident area failed, meaning that it was unable to maintain pressure at 8 inches of W.C. After the failure, a tracer gas was introduced into the system in order to identify and locate any leaks. A few indications of tracer gas over the gas main were identified on Park Avenue between East 116th and East 117th Streets, indicating the presence of leaks. A collaboration of parties (NTSB, PHMSA, NYSDPS, FDNY, NYPD, OEM and CECONY) developed a plan to segment the system into smaller sections and conduct individual pressure tests of each section with priority given to sections of gas main that had tracer gas indications. A full list of pressure tests and test details are listed in Appendix B.

In addition, a series of integrity pressure tests were conducted on gas service lines and inside piping of the adjacent buildings near the incident area. Only minor leaks were detected during any of these pressure tests.

To check for other possible leaks, on March 19, 2014 at approximately 1:55 PM, CECONY hired a contractor, ULC Robotics, who attempted an internal camera inspection of the 8 inch gas main running along Park Avenue. The camera was inserted from the cut and cap excavation pit at the SW corner of East 116th Street and Park Avenue and pushed towards the incident site, as shown in Figure 3. At a distance of 110 feet from the starting position, the 2 inch plastic gas service tee to building 1642 Park Avenue appeared to be separated at the fused joint where it had been

[18] Described as the location parameters of "the entire isolated system."

attached to the 8 inch plastic main. At the 115 foot mark, the camera became submerged in water and could not proceed any further. ULC Robotics later made an attempt with a different kind of camera, which was able to travel further; the second camera confirmed that a water pocket in the gas main was located at approximately the 115 foot mark and extended north to the 123 foot mark. At the 134 foot mark, DPS investigators observed a transition coupling from plastic to cast iron.

Prior to the NTSB's removal of the service tee to 1642 Park Avenue with sections of main and service, DPS Staff observed tension loading on the service line. The gas main and the service tee were sagging slightly downward in relation to the rest of the service line to 1642 Park Avenue. See Figure 6.

Figure 6 – Plastic gas service line for 1642 Park Avenue bending down with gas main and service tee (Photo taken 3/20/14).

DPS investigators saw that the 8-inch plastic main and the service

tee were under stress loading from lumps of roadway above and was being undermined from below by erosion. The plastic fusion joint itself had partially failed on its northern side due, in part, to the stress loading applied on the plastic gas main (See Figure 7), which is consistent with this DPS conclusion.

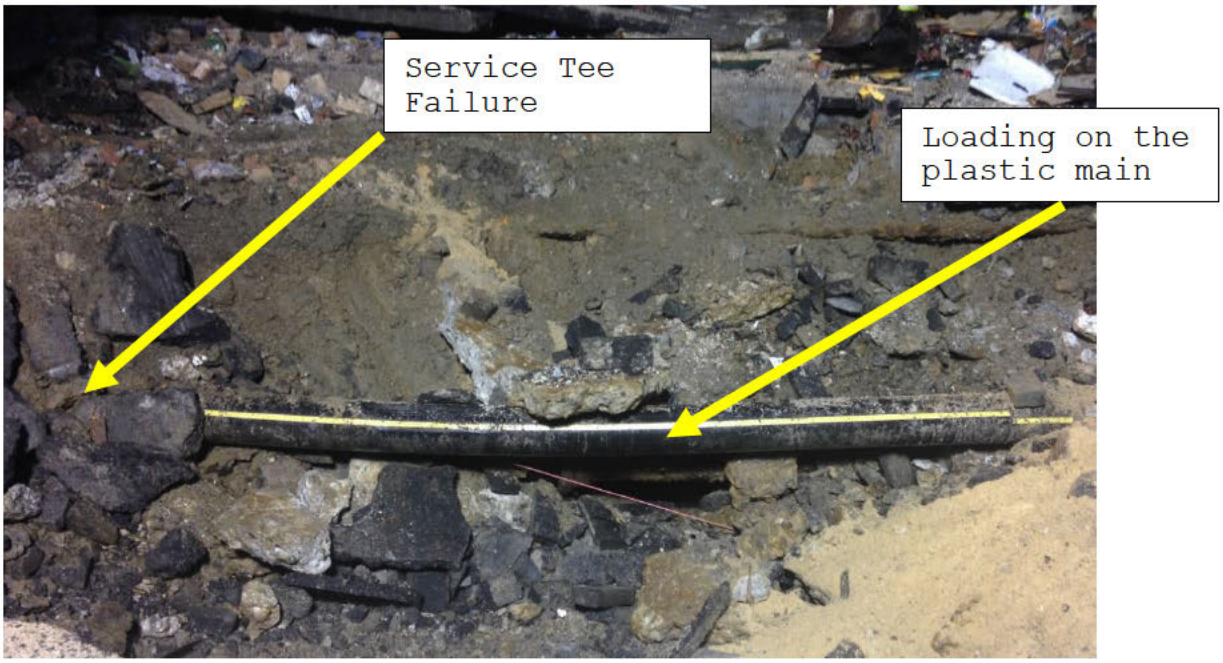


Figure 7 – Plastic gas main with stress loading and service tee for 1642 Park Avenue (Photo taken 3/12/14).

NTSB investigators removed the service tee assembly to 1642 Park Avenue, along with a section of the plastic main, on March 21, 2014. The NTSB took custody of these sections of pipe for additional testing. The details pertaining to the excavation and later inspection of the identified failures on the gas service tee to 1642 Park Avenue are explained below.

Because the segment of main spanning from the 1642 Park Avenue building service tee cut and cap location to the corner of East 117th Street (See Figure 8 below) failed the post-incident pressure test, investigators decided to excavate all of the services between East 116th and East 117th Streets, including the transition coupling between the 8-inch plastic and cast iron gas main (see Figure 22).

Therefore, the natural gas service lines to 1644 and 1646 Park Avenue were exposed on March 25, 2014 from their service tees on the 8-inch cast iron main towards the head of service valves.[19]

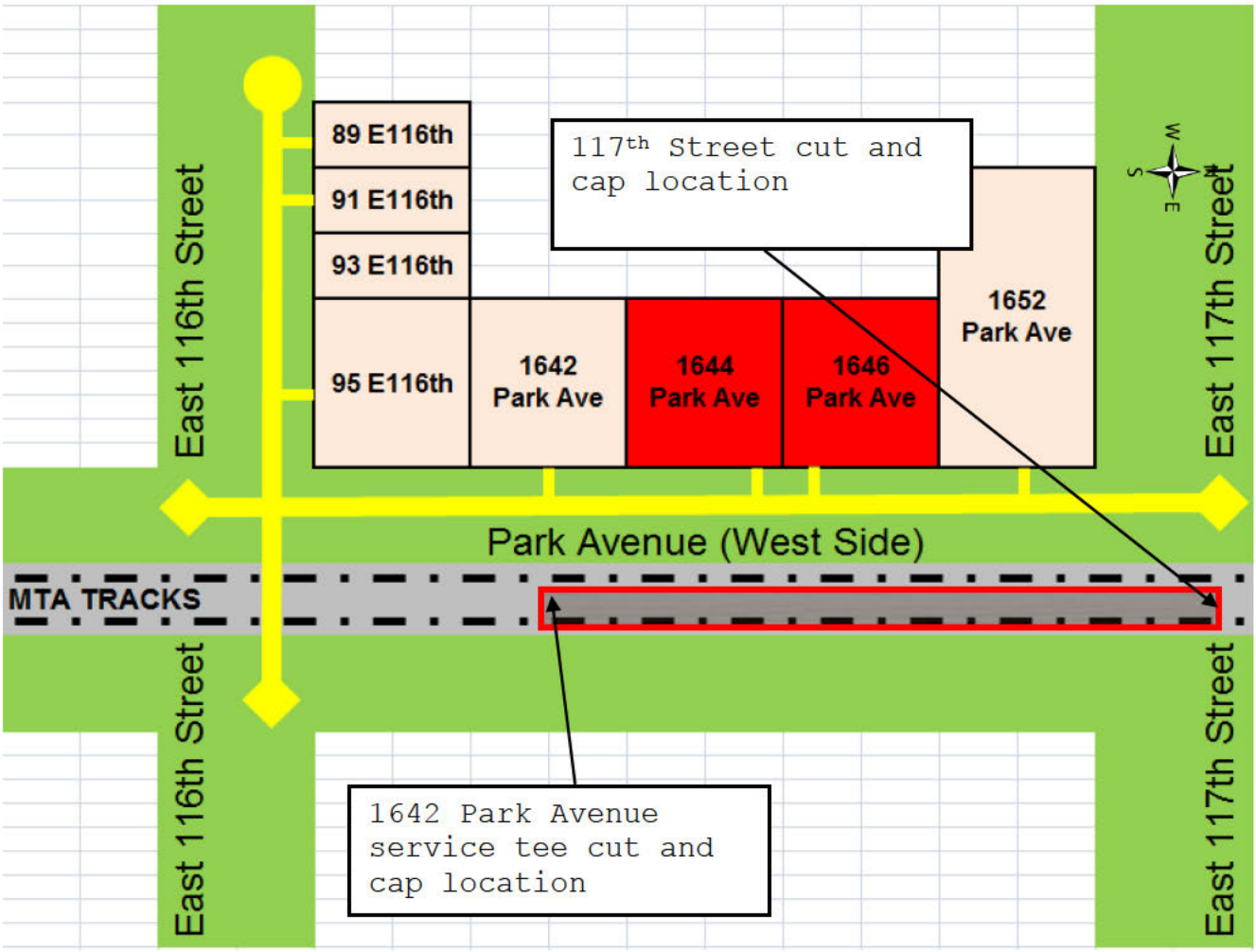


Figure 8 – Segment of main (red lined) pressure tested from 1642 Park Avenue service tee cut and cap location to the initial cut and cap location at 117th Street and Park Avenue.

Investigators measured the depth of cover over the gas service line serving to 1646 Park Avenue at 36 inches; it consisted of

[19] This is when DPS Staff first observed that both service lines for 1644 and 1646 Park Avenue consisted of approximately 4 feet of 1-1/4 -inch plastic pipe with a plastic tap to the main and a plastic curb valve which then transitions to 1-1/4 -inch copper service up to the head of service valves. This is inconsistent with CECONY's maps. See Figure 2a.

approximately 12 inches of concrete and 24 inches of asphalt above the service to 1646 Park Avenue.[20] Investigators compared the significantly greater thickness of asphalt at this location to the average of 6 to 8 inches at all other road locations on the block. The difference indicated a long-term pattern of sinkhole or cave-in repairs that had been made by patching with additional layers of asphalt. Additionally, during the field investigation, investigators discovered a collapse in the sewer wall (described later in this report) below this 36 inches of asphalt and concrete. The collapsed sewer wall, as revealed in dye tests, served as an escape path for soil and water, which caused or contributed to the sinkhole/cave-ins in front of 1646 Park Avenue. The location of the sewer collapse was directly below the gas services to 1644 and 1646 Park Avenue.

1642 Park Avenue Service Tee Investigation

Service Tee Inspection and Testing

When the 8-inch plastic gas main and the 2-inch plastic service tee to 1642 Park Avenue were exposed for inspection on March 20, 2014 and March 21, 2014, DPS investigators saw a large size rock or cluster of asphalt resting on top of the gas service tee. DPS Staff observed that the saddle plastic fusion joint of the service tee had failed; it was open on its north side, between the fusion beads (see Figure 9). The southern portion of the saddle fusion was not separated from the main at that time. Investigators on-site also saw a crack at the bottom of the molded outlet connection

[20] A typical road layer structure is made up of 12 inches of concrete for stability, with 6 inches of asphalt on top of the concrete, totaling 18 inches. Here, not only had the 12 inches of concrete been gradually sinking down, but 24 inches of asphalt as well. The 24 inches is an indication that NYCDOT continuously patched the spot with more and more asphalt, eventually increasing from 6 inches to 24 inches over the years.

to the service tee (see Figure 10).

Figure 9 – Failure of the service tee for 1642 Park Avenue at the fusion. (Photo taken 3/20/14). Top Photo, an overview shot. Bottom Photo, a close-up view of the fusion failure.

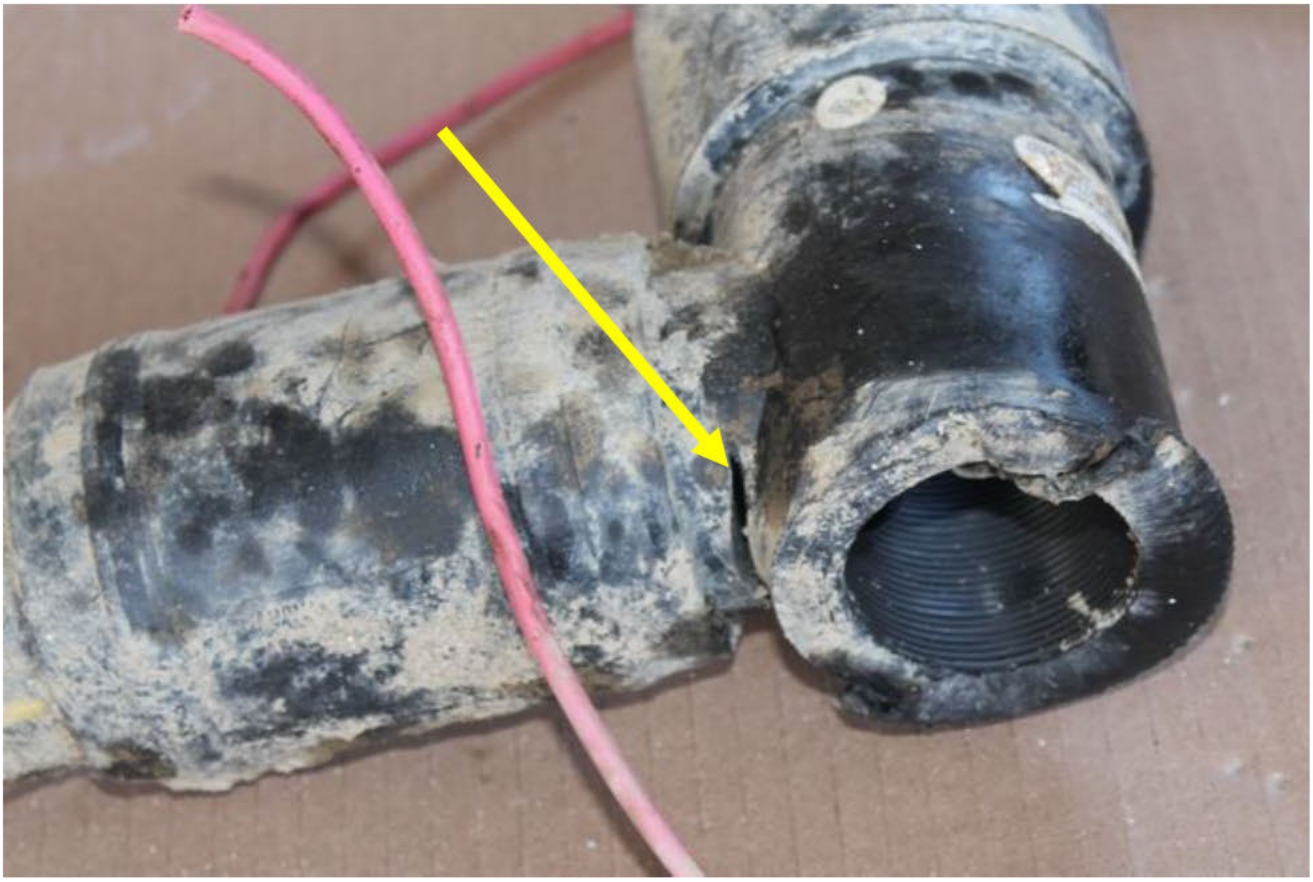


Figure 10 – Crack failure of the service tee for 1642 Park Avenue at the bottom of the molded outlet (Photo taken 3/21/14).

On March 19, 2014 ULC Robotics performed a camera inspection of the still in place 8-inch plastic gas main and identified a failed saddle fusion joint. DPS investigators noted visible mud deposits up inside the service tee (See Figure 11) as well as a pocket of water in the main at the same location. Staff estimates approximately 21 gallons of water was sitting inside the 8 inch plastic gas main on March 19. By 5:30 PM on March 12, 2014, however, the NYCDEP had shut off the water main, which had been operating at approximately 80 psi of water pressure prior to excavating the sinkhole and 8 hours after the explosion. The fusion joint failure was an opening on the north side of the fused joint, directly facing the break in the water main. Therefore, the mud found so far up inside the service tee and the large volume of water found

in the gas main indicate that the plastic fusion joint had failed before the water had been shut off and sinkhole was excavated. Further, the small crack running from north to south on the bottom of the molded outlet on the service tee to 1642 Park Avenue faced downward, unlike the failed plastic fusion joint that was parallel to the water main break; the crack did not have water or mud inside. Considering the law of gravity, the large volume of water in the gas main, and the amount of mud found far inside the service tee and the gas main, the plastic fusion joint failure would have had to have occurred before the sinkhole was excavated.

Figure 11 – Mud in the service tee to 1642 Park Avenue. Photo taken during the camera inspection of the 8 inch plastic gas main on 3/19/14.

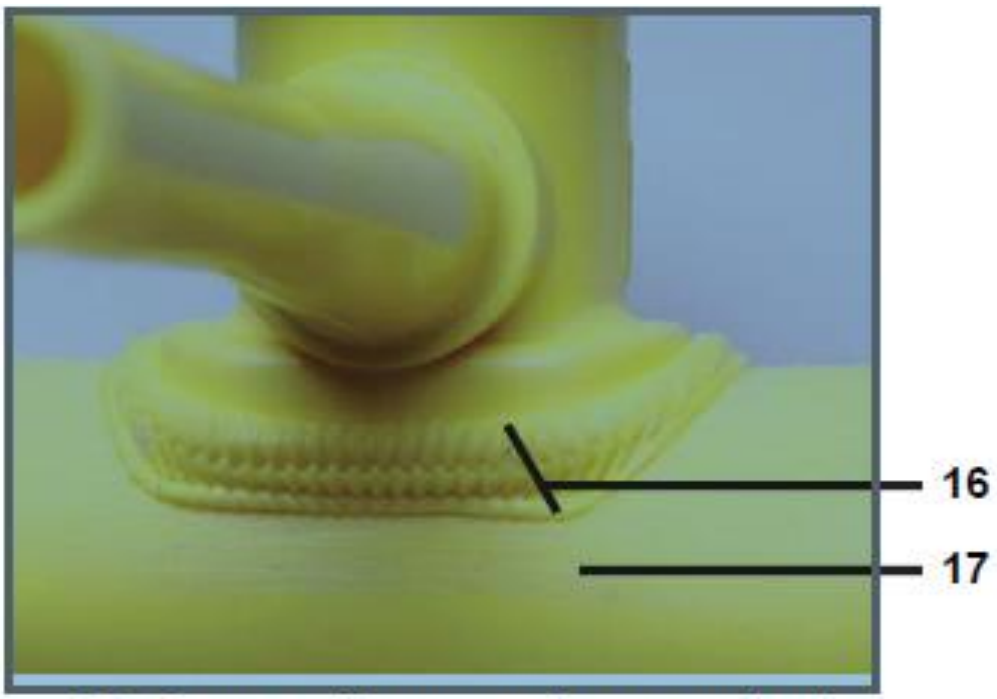
On March 21, 2014, the NTSB cut out and removed a T-shaped section of pipe, which included the 8-inch plastic main in front of 1642 Park Avenue, including 30 inches of length on either side of the service tee assembly, plus 29 inches of the service line to 1642 Park Avenue. NTSB took custody of the cut out section of pipe for further analysis at the NTSB laboratory.

ANALYSIS OF FUSION FAILURE

When an acceptable saddle fusion joint is made, a third bead is formed in the center between the melt bead on the fitting and the melt bead on the pipe by pressing the fitting against the pipe and applying the fusion pressure as per CECONY's procedure G-8123-12.

The manufacturer of this type of plastic tee assembly, Plastics Pipe Institute, provides guidelines for correct installation. The guidelines reference TR-41/2002 in G-8123-12 as the standard for evaluating acceptable saddle fusion joints during a visual inspection.[21] As shown in the photographic image of an acceptable saddle fusion, three uniform and distinct melting beads should be formed at the base of the service tee and around the entire joint (see Figure 12 below).

[21] CECONY procedure G-8123-12, Section 3.3(B)(2) states: "The heat fusion joint must closely resemble the manufacturer's recommended fusion joints as shown in the heat fusion qualification guide for the applicable Central Plastic (Fittings), U.S. Poly, and Performance Pipe polyethylene piping materials". On August 29, 2014, CECONY provided "TR-41 PPI Generic Saddle Fusion Joining Procedure 2002.pdf" as the reference document used by the Company for Georg Fischer products which contains photographs of proper fuses.



16. Proper alignment, force and melt
17. Proper pipe surface preparation

Figure 12 – Acceptable fusion criteria per Plastics Pipe Institute – TR-41/2002. Shown using MDPE example for visual effects.

DPS Staff visually inspected and reviewed the digital photographs of the failed joint of the gas service tee to 1642 Park Avenue, which revealed that the fusion of the 2-inch plastic service tee attached to the 8-inch plastic main presents non-uniform fusion beads around the entire joint. The beads appear to overlap and the top bead (the tee fusion bead) is significantly larger than the other two; the middle bead is barely visible (all beads should be uniform). CECONY Procedure G-8123-12 states that the manufacturer's acceptable fusions are shown in "Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping TR-41/2002" provided by Plastic Pipe Institute. The beading of the failed plastic fusion joint is consistent with an unacceptable fusion joint, one that was produced with excessive melt and/or force (See Figure 13).

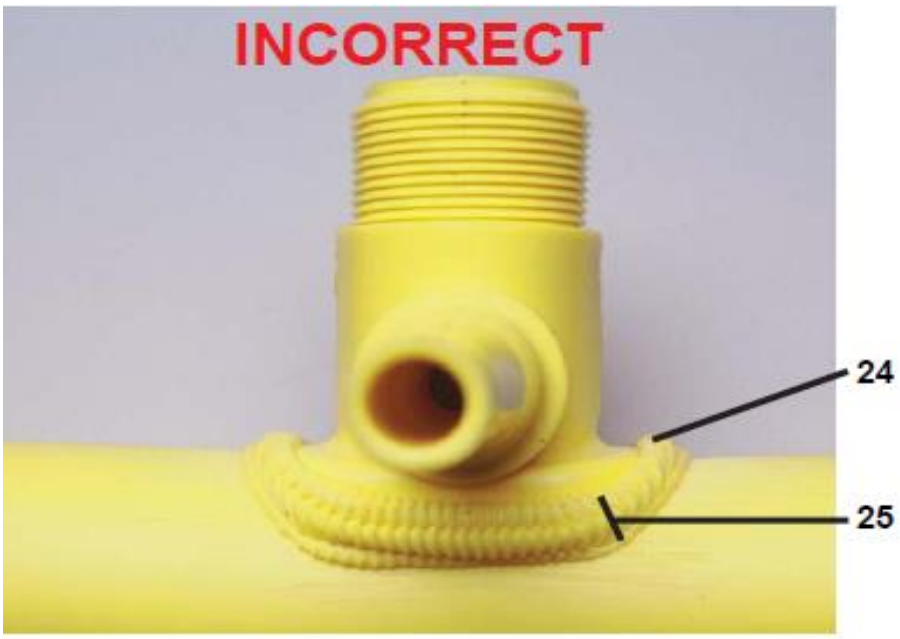


Figure 13 – Incorrect fusion per Plastics Pipe Institute – TR-41/2002.

DPS Staff observed a similarly unacceptable plastic fusion joint, in a February 2011 CECONY report, after CECONY conducted a gas lab failure analysis in response to a leak that occurred on a 1-1/4-inch IPS tapping tee that had been installed on a 6-inch IPS plastic pipe in Hawthorne, NY.[22] The CECONY lab determined that the probable cause of the Hawthorne incident was a cold fuse, which is the term used to describe poor preparation and poor installation of the fuse that attaches a service tee onto the main. Like the failed plastic fusion joint at 1642 Park Avenue, only two melt beads on the Hawthorne site were present at the edge of the fusion area instead of the correct three beads.

[22] NTSB Docket ID DCA14MP002: "Con Edison Gas Lab Failure Analysis Report GT-11-029 Hawthorne, NY 2011."

In addition to the unacceptable beading, the surface of the East Harlem failed fusion has radial flow marks on approximately one half of its circumference while the other half reveals a torn plastic surface (see Figure 14 below).

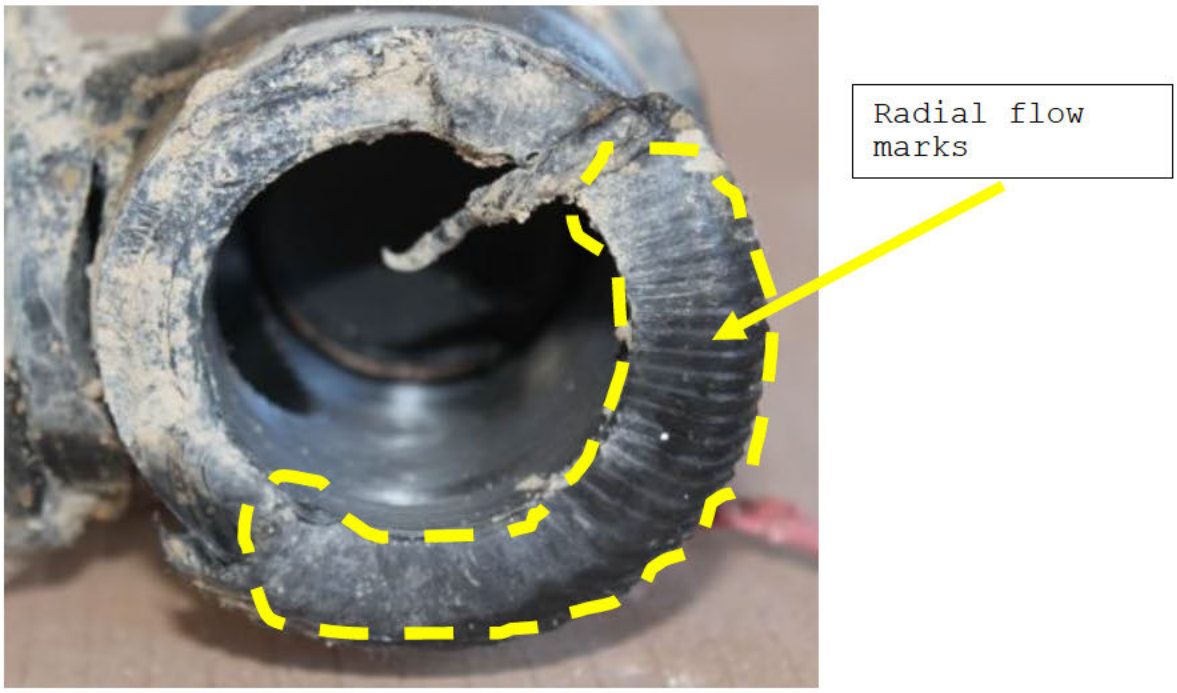


Figure 14 – Failure of the service tee for 1642 Park Avenue at the fuse.

During the NTSB Laboratory analysis, the manufacturer of the plastic service tee made a saddle fusion joint specimen (like the service tee to 1642 Park Avenue) with a plastic pipe and a service tee that had been intentionally sprayed with an organic soy bean oil mold release agent. It was sprayed on the surface of the fusion between the 2-inch service tee and the 8-inch main in order to simulate introduction of a foreign contaminant in the fusion process.[23]

[23] NTSB Docket ID DCA14MP002: "Material Lab Report 14-069 Polyethylene Gas Pipe."

The specimen was then subjected to a drop weight test per ASTM F905 standards.[24] The saddle fusion specimen failed the drop test in that it fractured at the fusion interface (between the tee fusion bead and pipe fusion bead). Once fractured, a radial flow mark pattern on the failed surface was revealed, which was similar to the radial pattern found on the failed saddle fusion joint from the East Harlem incident site. This similarity between the specimen's radial flow marks on the separated fusion joint and the one from the site indicates that the tapping tee joint in front of 1642 Park Avenue was not properly fused to the main when it was installed in December 2011 and the surface of polyethylene on both the tapping tee and the gas main had not bonded properly.

Based on review of CECONY records, the plastic fusion joint of the gas service tee to 1642 Park Avenue was made on December 28, 2011. According to weather history records, the mean temperature on December 28, 2011 in Manhattan was 41 degrees Fahrenheit with wind speeds of 12 miles per hour. Weather related or time dependent issues could cause the melt bead to cool too quickly before the fitting was pressed against the pipe, or significantly different temperatures between the fitting and the pipe at the time of fusion can lead to a poor quality fusion joint. Pursuant to the manufacturer's guidelines, the temperature the day the fusion at 1642 Park Avenue was installed in 2011 was well within the range of acceptable temperatures to complete the fusion. Based upon this, it is not likely that weather was a contributing factor in the fusion's failure.

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24 ASTM F905 is a standard practice for qualification of polyethylene saddle-fused joints. The tests described in this practice are intended to present a method of satisfying the requirements of U.S. Department of Transportation 49 CFR §§ 192.283 and 192.285 (equivalent to 16 NYCRR §§255.283 and 255.285).

DPS Staff reviewed frost depth and temperature data for approximately a month prior to the incident that CECONY provided. The frost depth measurements were taken in Westchester because it experiences the most frost in CECONY's service territory. DPS Staff accessed the Weather Channel as a source for gathering historical temperature data near the incident site. According to the data CECONY provided to DPS, the frost depth in Westchester did not exceed 14 inches in the 3 weeks preceding the incident.[25] DPS saw that the road layer composition of asphalt and concrete or asphalt alone where the service tee assembly had been installed was at least 14-18 inches deep. There is not enough evidence, therefore, to determine whether sufficient frost depth existed in the ground to contribute to the incident. Significant frost depth in the ground can cause a top layer of soil to freeze and serve as a barrier preventing the natural gas from venting into the atmosphere, forcing the natural gas to migrate further in distance horizontally.

DPS Staff's visual inspection of the service tee removed from 1642 Park Avenue in conjunction with NTSB Laboratory testing and analysis supports the conclusion that an inadequately fused plastic joint connected the 2 inch gas service line to the 8 inch plastic gas main. The surface of the failed plastic fusion joint is consistent with improper surface preparation in that it appears similar to the failed plastic fusion joint CECONY discovered after the 2011 Hawthorne, NY incident. Evidence of a poorly completed fusion joint supports the conclusion that CECONY had not properly adhered to the acceptable fusion process and the procedures established by the Company for completing plastic fusions. The

[25] Utilities maintain this data because they are required to conduct cast iron frost surveys once the trigger frost level is reached.

visible evidence that the beading around the fusion also did not meet industry standards warrants the conclusion that CECONY did not perform proper or sufficient inspection or oversight at this, and perhaps other, CECONY job sites. Currently there is an ongoing investigation by the New York State Public Service Commission requiring CECONY to perform random excavations and inspections of in-service tees throughout its system.

Because of the asphalt loading from above and the lack of soil support beneath the service tee and service line in front of 1642 Park Avenue, the NTSB performed tensile and impact tests in a laboratory environment on sample joints to determine failure and fracture characteristics on plastic joints under similar conditions. Based on the NTSB Laboratory testing, DPS concludes that a crack failure with fracture propagation similar to the crack on the bottom of the molded outlet on the service tee from the incident site would only be produced by an impact load. This is because both the crack on the molded outlet on the service tee and the lab specimen showed brittle failure characteristics on their surface.[26] Tensile tests, on the other hand, resulted in elongation deformations at the edges of the crack, which were not found on the crack at the bottom of the molded outlet on the service tee from the East Harlem incident site. This analysis indicates that the crack at the bottom of the molded outlet on the service tee resulted from an impact load in a very brief period of time.

Qualification of the Service Tee Installers

The CECONY qualification process for contractors is conducted at the CECONY Learning Center, however Company procedure G-8121-15, Section 5.1 states that: "all documentation for contractor

[26] NTSB Docket ID DCA14MP002: "Material Lab Report 14-069 Polyethylene Gas Pipe."

installers shall be the responsibility of the respective contractor," including the maintenance of the annual qualification.

The qualification of the contractor who performed the failed fusion had lapsed at the time he fused the plastic joint in front of 1642 Park Avenue. DPS later learned that the contractor, along with all CECONY workers performing plastic fusion, had not been qualified to perform plastic fusions in compliance with state regulations, which require that a destructive test be performed during qualification procedures.

As mentioned previously, building 1642 Park Avenue was reconstructed sometime before the end of calendar year 2011. As a result of the installation and excavation of the new sewer lateral to 1642 Park Avenue, the building's original 8-inch cast iron gas main (installed in 1887) was undermined. Subsequently, CECONY replaced a section of approximately 70 feet of 8-inch cast iron main with 8-inch plastic. CECONY records show that the new 2-inch plastic natural gas service to 1642 Park Avenue was installed on December 28, 2011. The plastic fusion joint connecting the service line to the gas main was completed by [redacted] as per the marking on the pipe, which DPS Staff observed during the field investigation. CECONY records related to this job folder identified the two employees who worked on this job as [redacted] and [redacted]. Joining of plastic pipes is Covered Task #50 in accordance with CECONY's Operator Qualification Plan and state regulations. Both regulations and CECONY procedures require individuals performing plastic fusions to be re-qualified on a three year cycle.

- In addition, CECONY's procedure, "G-8121-15 TITLED: Qualification of installers performing heat fusion or electrofusion of polyethylene plastic pipe/tubing and fittings for gas mains and services" paragraph 3.1 states:

> *"Only installers operator qualified and also in compliance with the 12 month requalification method in accordance with this specification shall perform the covered tasks of heat fusion or electrofusion joints."*

On December 28, 2011, as per CECONY records, the most recent requalifications to perform plastic fusion joints were November 23, 2010 for [redacted] and June 8, 2011 for [redacted]. Therefore, [redacted] annual re-qualification lapsed by over a month (was due on November 23, 2011) at the time he completed the fusion on the service tee to 1642 Park Avenue on December 28, 2011.

Moreover, 16 NYCRR §255.285 specifies the minimum testing requirements to be followed in order to qualify an individual to make plastic fusion joints. These requirements include visual inspections and other testing of the test joints made by persons being qualified to perform plastic fusions (including destructive testing, burst tests, or ultrasonic inspection). Staff's review of CECONY's plastic fusion procedures revealed that CECONY's tests listed as minimum requirements under New York gas safety regulations lacked some of the required tests beyond visual inspection for hydraulic butt fusion, electrofusion and saddle fusion. Therefore, CECONY's qualification testing method by which [redacted] and [redacted] were deemed qualified to make plastic joints did not comply with the minimum test requirements specified in 16 NYCRR §255.285(c) during initial qualifying of persons nor all subsequent re-qualifications. The importance of this finding specifically with respect to the East Harlem incident is that [redacted] lack of adequate qualifying in the completion of plastic fusions further supports the DPS conclusion that the fusion had been improperly completed, which made it more vulnerable to external loading, and that the gas released from that site is what ignited, causing the explosion.

Gas Flow Rate Estimations

DPS examination of the plastic service tee installed in December 2011 to serve 1642 Park Avenue revealed two failures: the failed plastic fusion joint had separated and the bottom of the molded outlet of the service tee had cracked. DPS Staff estimated the volume of gas that would have been released through these failure openings based upon their size, the existing pressure before the incident and over the same period of time. The dimensions DPS used in its calculations are based on the measurement of each opening made during the field investigation and standard fitting measurements from the manufacturer's reference guide. DPS used a formula for incompressible flow across an orifice plate to assess the volume of natural gas flow to calculate the approximate rate of natural gas escaping into the atmosphere from the failures.

Since the plastic fusion joint separated at the main only on its north side and the south side of the plastic fusion joint was still intact, Staff calculated that it had leaked from 50% of the 1-7/8-inch diameter of the opening to estimate the area from which natural gas would flow.

For the crack on the bottom of the molded outlet on the service tee, DPS estimated that the circumferential length of the crack was approximately 25% of the diameter of the outlet and that the opening was approximately 1/4 inch wide. These dimensions were used to estimate the area from which natural gas would flow. The two estimates showed that at the same constant pressure the flow rate through the failed plastic fusion joint would have released substantially more natural gas than the far smaller crack on the bottom of the molded outlet of the service tee over the same time period. Moreover, given the post-incident gas-in-air readings collected, which revealed significant volume of natural gas was migrating over a wide area, the smaller opening at the crack on

the bottom of the molded outlet on the service tee would not have released enough measurable gas over such a wide area. At the same time, given this broad migration of gas, enough gas would have to have been released from an opening to allow both enough gas to migrate across a block and to migrate inside the buildings sufficient to cause an explosion as large as the March 12, 2014 East Harlem incident.

The specific calculation details DPS Staff applied to estimate flow rates are contained in Appendix C of this document.

Water Main Break Investigation

NYCDEP owned and operated the 12-inch cast iron water main that runs along the west side of Park Avenue at a slightly greater depth than the 8-inch plastic gas main. Investigators discovered a circumferential crack on the water main with a wider opening at the top of the main. The NTSB cut out and removed the cracked section of the water main. The NTSB took custody of this section of the water main for further analysis and testing at the NTSB laboratory. The NTSB's test results revealed presence of graphitic flakes and tubercles (soil/silt deposit build-up) on the inner surface of the water main pipe which indicated graphitic corrosion (See Definitions).[27] The tubercles were 1 inch thick, compared to the thickness of the water main wall, which measured approximately 5/8 inch. Along the fracture surface of the water main, scale and tubercle-like features were identified.[28] Formation of tubercles and scale at the fracture surface takes place over a long period of time. Large sinkholes in the ground were also noted directly below the crack on the water main.

[27] NTSB Docket ID DCA14MP002: "Material Lab Report 14-071 Cast Iron Water Main."
[28] NTSB Docket ID DCA14MP002: "Material Lab Report 14-071 Cast Iron Water Main", p. 13, Figure 9.

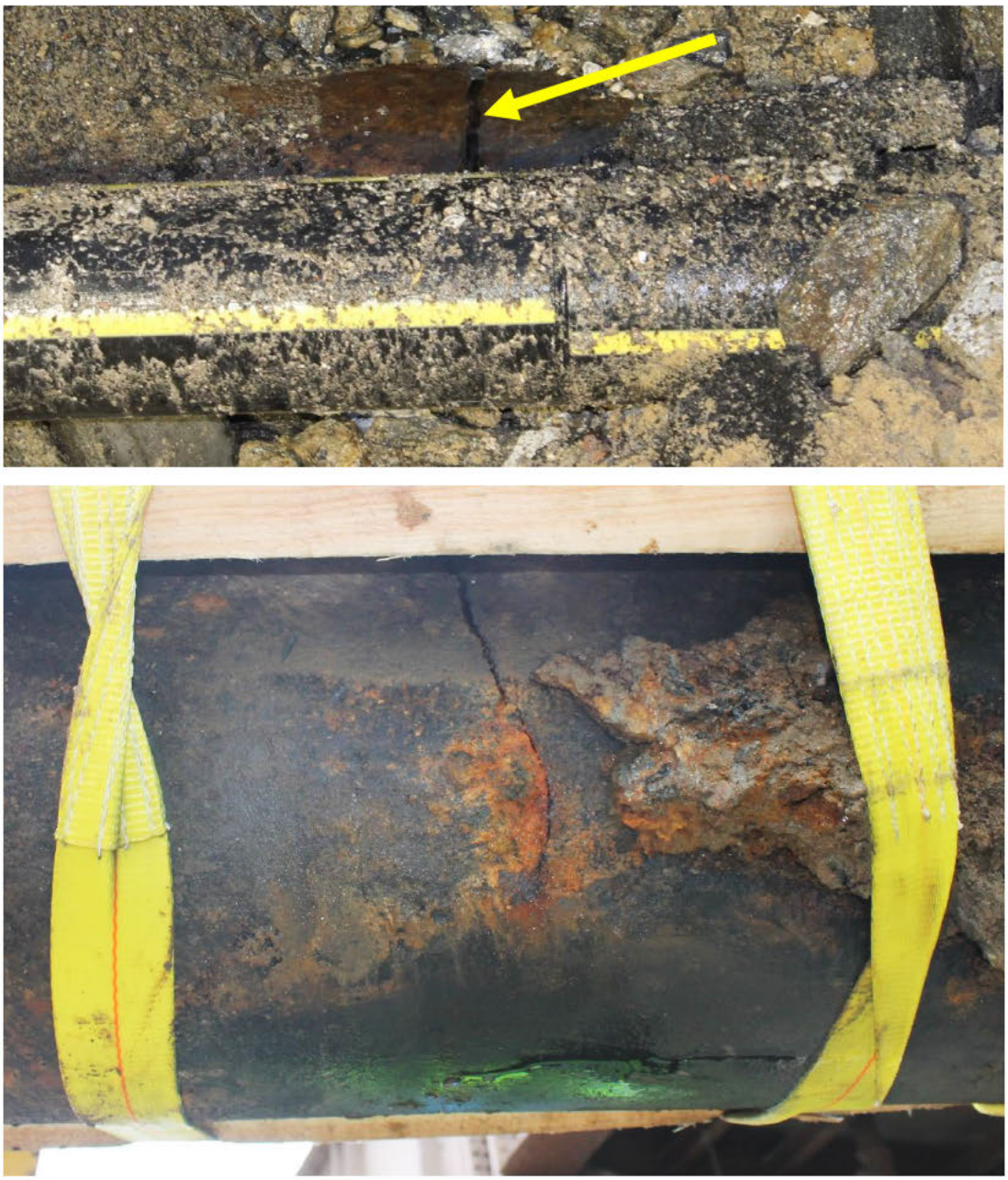

Figure 15 – A crack on the 12-inch water main running parallel to the 8-inch plastic gas main.

Collapsed Sewer Investigation

The sewer main along Park Avenue in front of the incident site runs approximately 20 feet beneath the surface roadway and parallel to the natural gas and cast iron water main. The dimensions of the sewer are 48 inches high and 32 inches wide made of brick joined with mortar. On March 19, 2014, the NYCDEP scoped the sewer with

a camera. A camera was inserted through a sewer manhole at the SW corner of East 117th Street and Park Avenue towards East 116th Street. This camera inspection revealed a collapsed brick sewer wall approximately 40 inches wide and 12 inches high at the nine o'clock position (east wall of the sewer) beneath and in line with the building wall between 1644 and 1646 Park Avenue. The City of New York provided photo and video documentation for inspections that NYCDEP had conducted in the area of the collapsed sewer. These records indicate that NYCDEP had previously identified the aforementioned sewer collapse during a NYCDEP inspection conducted on October 16, 2006. Sewer services from the two collapsed buildings were located at 116 feet and 118 feet from the camera insertion point. The camera could not advance beyond the 150 foot mark due to debris/obstruction in the sewer. The next attempt to scope the sewer main was through a manhole located at the NW corner of East 116th Street and Park Avenue. The camera was not able to travel north, but displayed the presence of loose debris in the sewer.

The area of extra thick asphalt investigators had found above the gas service to 1646 Park Avenue is located directly above the brick collapse in the sewer (See Figure 16). Excavation of the gas service tee serving 1642 Park Avenue revealed the gas main, the water main break, and multiple voids in the soil. To verify the depth of the sinkhole, investigators inserted a 5 foot crowbar into the sinkhole, confirming its depth was deeper than 5 feet. On March 28, 2014, once investigators removed the cracked section of water main in front of 1642 Park Avenue, investigators, at NTSB's request, tested the continuity of the sink holes. To do so, NYCDEP poured green colored dye mixed with water into the hole directly below the location of the water main crack (See Figures 17 and 18). Within minutes investigators saw the green dye entering the sewer through the brick collapse area (see Figures 19 and 20). The

water main break was located approximately 45 feet horizontally south of the brick sewer collapse. The green dye test confirmed a continuous void condition in the soil between the water main break and the sewer collapse.

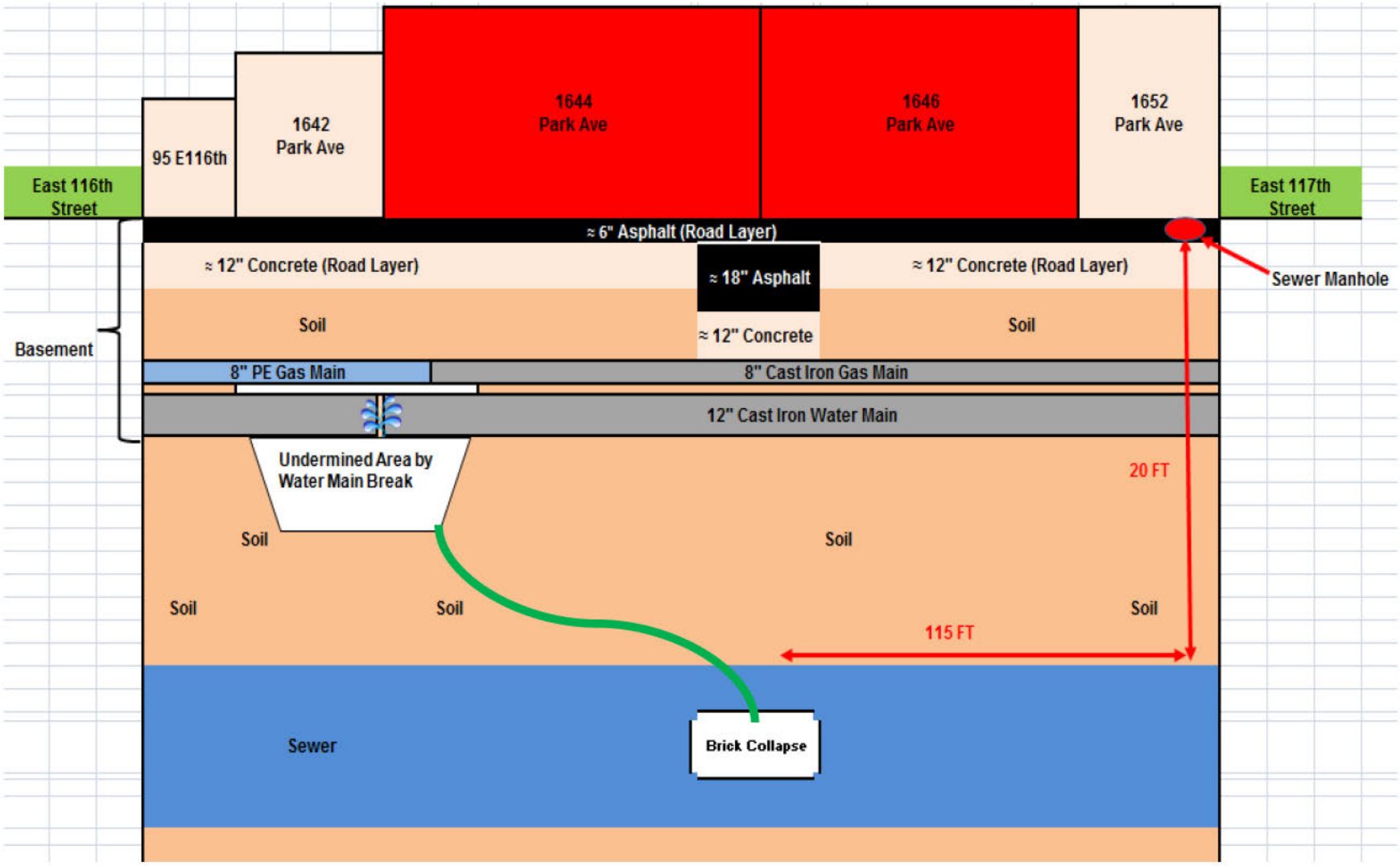

Figure 16: Elevation view of the road layers and utilities along Park Avenue between E 116th & E 117th Streets (not to scale).

Figure 17 – Prior to removing the section of water main with a crack.

Figure 18 – Sinkhole directly below the water main crack after removal, used for green dye tracing.

Figure 19 – Tracer Green dye observed in the sewer after pouring it through sinkhole approx., 45 feet south of the brick collapse.

Figure 20 – Tracer Green dye observed in the sewer after pouring it through sinkhole approx., 45 feet south of the brick collapse.

Based on DPS Staff's visual inspection of the road layer directly above the sewer brick collapse, the thickness of asphalt was 24 inches in comparison to an average of 6 inches on the rest of the block. This location is directly above the road sinkhole at which multiple repairs had been made over an extended period of time. Since as far back as 2006, the soil directly above the collapsed sewer had been gradually escaping as water flowed from either natural groundwater movement, the water main leak or a combination of both. A filled sewer above the height of collapsed brick wall would also contribute to additional washout of adjacent soil.

Post Incident Interviews

Between May 15, 2014 and June 19, 2014, DPS Gas Safety Section Staff, along with the DPS Office of Consumer Services Staff, conducted multiple interviews of residents and others who were in the area before the explosion. A total of 11 people were part of the eight interview sessions, including eight residents (from 1642, 1644 and 1646 Park Ave), 1646 Park Avenue building owners (2 people) and the financial secretary of the Spanish Christian Church located at 1644 Park Avenue. A Department interpreter was available for three interviews conducted in Spanish.

Based on the fact that many of those interviewed reported noticing a gas odor, DPS concludes that most of the interviewees were able to identify the odor of natural gas. Out of these 11 people, seven stated they were aware that they can call 911 for gas odors; one would have called CECONY. Some of the interviewees were reluctant to call either entity and others did not call once they sensed that the odor had dissipated. Several interviewees suggested that additional educational campaigns should be developed to emphasize the importance of reporting gas odors, in a manner that captures people's attention and changes their behavior. Overall,

information from the interviews suggests that natural gas odors were present intermittently from approximately noon of March 11, 2014 through the time of the explosion in the early morning of March 12, 2014. Figure 21, below, details the approximate areas where natural gas potentially was sensed by several of the interviewees.

Information from the interviews conducted indicates that natural gas odors were mainly noted outside at the sidewalk from 1644 Park Avenue towards the NW corner of East 116th Street and Park Avenue. In addition, natural gas odor was very prominent in the hallway and basement of 1642 Park Avenue the night before the explosion and became stronger during the morning of the explosion (March 12, 2014). A resident of 1646 Park Avenue smelled gas inside of his apartment at approximately 4:00-5:00 PM on March 11, 2014, but did not notify CECONY because the odor dissipated after he vented it through an open window.

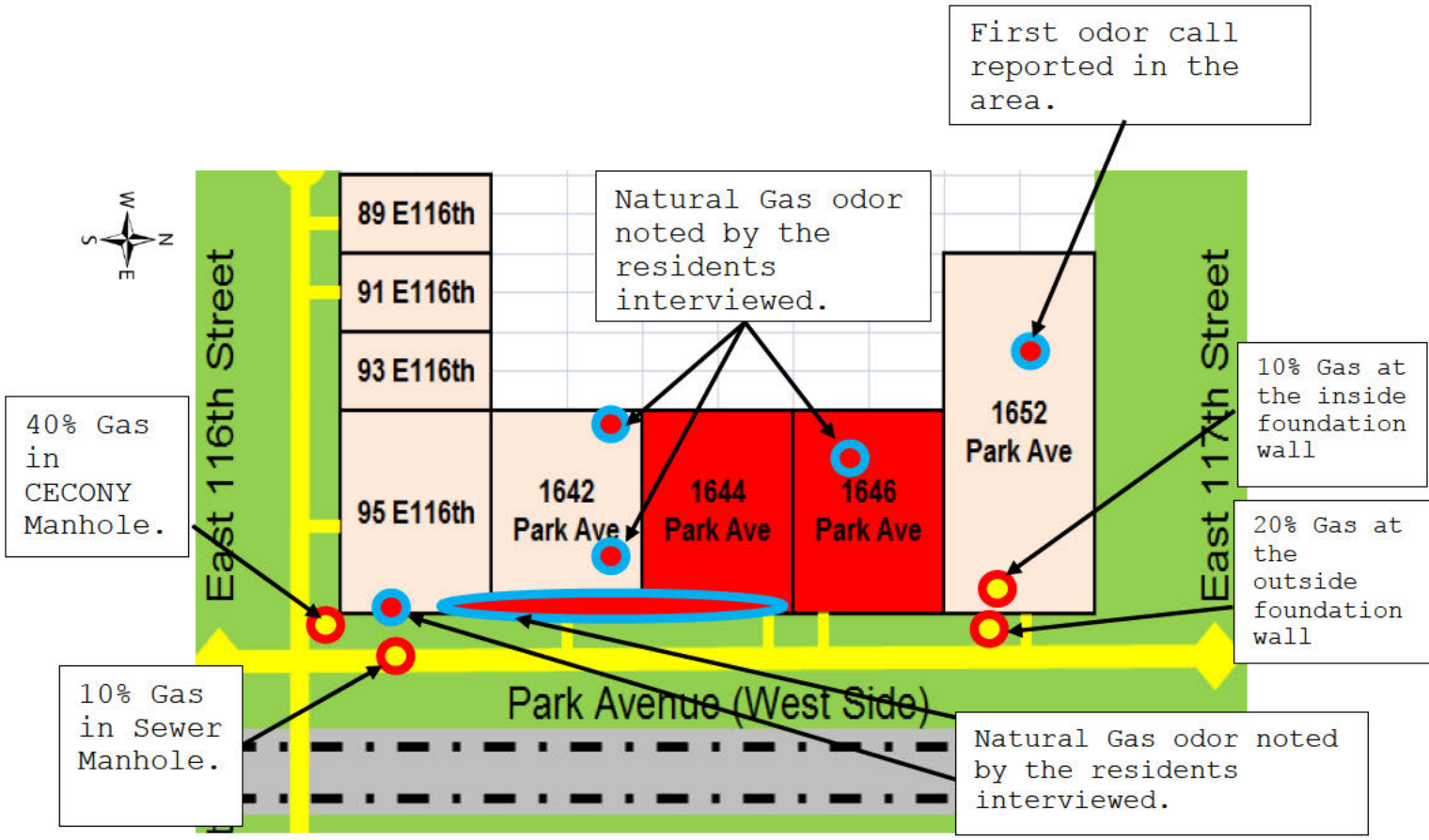

Figure 21 – Diagram with points of natural gas odor noted by the residents based on the interview conducted by NYSDPS (not to scale).

Some of the interviewees stated that they attempted to notify a building superintendent and attempted to self-investigate the gas leak. However, DPS investigators discovered no reliable evidence during this investigation to support the conclusion that anyone notified CECONY or any other emergency management agency nor services like 311 or 911 prior to the call CECONY received from the resident of building 1652 Park Ave just before the incident.

CECONY recordings of the odor call made by the resident of the Apartment at 1652 Park Avenue indicate that his wife smelled gas inside the apartment the night before the explosion (March 11, 2014), but after inspecting appliances and venting the air by

opening windows, they did not find any leaks, at which point they went to sleep. The next morning (March 12, 2014), his wife mentioned that the odor was still persistent and became stronger which prompted him to call CECONY at 9:06 AM. He is the first caller on record to report the natural gas odor in the area to CECONY.

Review of Applicable Records

As part of the investigation, DPS Staff reviewed several applicable CECONY records, which include, but are not limited to, recent outside and inside odor complaints for the incident area prior to the incident from July 2010 to March 2014, all post-incident gas leak investigation records, winter patrol and standard leak survey records from 2011 through March 2013, recent buildings of public assembly valve inspections, SCADA gas system pressure records from 2 days prior up to the time of the incident, related work orders performed by CECONY within the vicinity of the incident site from January 2009 to March 2014, risk ranking of the leak prone pipe gas mains within the incident area,[29] photo and video documentation available pre- and post-incident for the area, related procedures and operator qualification records for the jobs completed in the recent past, NYCDOT and NYCDEP records of any work history in the area, NYC 311 and 911 system records of any recent complaints for the incident area, and FDNY and NYPD media documentation for the incident.

Additionally, DPS Staff reviewed CECONY's Drug and Alcohol plan and requested drug & alcohol testing results for the CSR and GERC

[29] CECONY is required under Integrity Management program requirements specified in 16 NYCRR 255.1007 to evaluate and rank the risks associated with Cast Iron main segments in its distribution system; the utility is then required to implement measures to address the risks. One of such measures is main replacement.

dispatchers involved with emergency response actions related to the incident. All reportable findings from review of these records are listed in this report's Summary of Violations, which includes areas of concern.
A list of records reviewed is contained in Appendix A of this document.

Conclusion

Based on post-incident field investigations at which DPS investigators maintained a constant presence, NTSB testing, DPS investigator inquiries, and all available NYC and CECONY records and procedures, the cause of the explosion and subsequent fire can be attributed to a natural gas leak. The primary source of natural gas that caused this incident was the failed plastic fusion joint at the service tee to 1642 Park Avenue building. The crack on the bottom of the molded outlet of the gas service tee cannot be completely disregarded as an additional source of natural gas for this incident, but based on estimated flow rate calculations, it could not have been the sole source.

The fusion joint on the gas service tee to 1642 Park Avenue failed by fracturing through the fusion interface. DPS Staff reaches this conclusion based upon the following:

1. The fusion's surface was consistent with a specimen created in the NTSB lab that was contaminated with an organic soy bean oil mold release agent at the surface. This analysis demonstrated that the surface of the plastic service tee and/or gas main was not properly prepared at the time of installation and was, in some manner, similarly contaminated;

2. Based on Staff's visual inspection, the external beads on the

1642 Park Avenue failed plastic fusion joint were consistent with an unacceptable fusion joint that had been produced with excessive melt and force, as exhibited in the manufacturer's guide and similar to testing performed on another plastic fusion in a prior gas incident, in Hawthorne, New York;

3. Staff's review of CECONY records revealed that the initial and all subsequent re-qualifications of the fuser who installed the service tee to 1642 Park Avenue on December 28, 2011 did not meet the minimum test requirements specified in 16 NYCRR 255.285(c);

4. The crack on the bottom of the molded outlet identified on the 1642 Park Avenue service tee was determined in NTSB testing to be a result of an impact load, due to the brittle failure crack propagation characteristics. Brittle failure is an indication of an impact load which occurs over a short period of time. Had the crack on the bottom of the molded outlet on the service tee shown characteristics of a bending force, one might conclude that the crack occurred over a longer period of time prior to the incident and that it contributed to the incident;

5. The gas flow rate estimations DPS Staff performed demonstrated that the opening at the plastic fusion joint failure would have released a substantially greater amount of natural gas than the much smaller crack on the bottom of the molded outlet on the service tee opening over the same time period;

6. DPS interviews of people near the site revealed that they began smelling gas the day before the incident, not over a long period of time. Interviewees did, however, smell the gas odor along the entire block, which would occur only due

to a large gas leak;

7. Post-incident leak investigation indicated multiple high concentration gas-in-air readings across the block between 116th and 117th Streets. This demonstrates that a significant enough amount of the natural gas released had migrated over a wide area, venting into the atmosphere. Moreover, the odor call came from downhill of 1642 (the caller was at 1652). Natural gas, however, migrates upward. Therefore, only a portion of the natural gas escaping was migrating towards buildings 1644 and 1646 Park Avenue. Considering the volume of natural gas produced by the two estimated flow rates, the ratio of the flow rates and percentage of the gas venting to the atmosphere, and the size of the explosion, DPS concludes that the crack on the bottom of the molded outlet on the service tee alone released insufficient volume of gas to cause the incident within the time period established (starting with the first indication of a natural gas odor based on interviews (approximately afternoon of March 11, 2014));

8. Laboratory testing and inspection of the water main crack indicated scale and tubercle-like feature on the fracture surface of the water main. There is also evidence of a long standing (at least as far back as 2006) brick sewer wall collapse. The road layer directly above the sewer brick collapse contained an extraordinarily thick layer of asphalt near to which a road sinkhole had been paved over multiple times. The sewer brick collapse facilitated a path for soil directly above the sewer to gradually escape with flow of groundwater. Any preexisting water leaks on the City-owned cast iron water main could have also contributed. Clear pathways from the sink holes around the water main break area to the sewer collapse were demonstrated with green dye testing

during field investigation. This gradual washout of soil created an undermining condition for the gas main and road layers above it added downward pressure on the gas main. The undermining caused an unusual stress load on CECONY's natural gas main by the road surface and portions of the road along Park Avenue between East 116th and East 117th Streets. Undermining conditions caused by the sewer collapse and soil washout contributed to the tensile load characteristic failure of the plastic fusion joint.

For these reasons, DPS concludes the failed plastic fusion joint was the primary source of natural gas release.

Summary of Probable Regulatory Violations

In the course of DPS Staff's investigation, DPS identified a number of regulations CECONY appears to have violated as well as areas of concern.

1. **REQUALIFICATION LAPSE OF PERSON(S) PERFORMING PLASTIC FUSION AT SITE OF INCIDENT:**

16 NYCRR 255.285(d) – Plastic pipe: Qualifying persons to make joints
– Diaz performed the plastic fusion at 1642 with lapsed requalifications.

The natural gas service tee to building 1642 Park Avenue, Manhattan was installed on 12/28/2011. The plastic fusion joint connecting the service line to gas main was completed by [redacted] as per the marking on the pipe and additional documentation reviewed. Staff's review of the qualification records confirmed that [redacted] had been re-qualified last on 11/23/2010 and therefore exceeded 12 month qualification requirement as of 12/28/2011. CECONY complies with the requirements of 255.285(d) by requalifying all fusers every 12 months.

(d) A person must be requalified under an applicable procedure if during any 12-month period that person:
(1) Does not make any joints under that procedure; or
(2) has 3 joints or 3 percent of the joints made under that procedure, whichever, is greater, that are found unacceptable by testing under sections 255.507 or 255.511, by inspection by other than the joiner, or a combination of both.

2. **CON EDISON PRODUCED NO RECORDS TO SHOW THAT THE FUSE IN FRONT OF 1642 PARK AVENUE HAD PASSED VISUAL INSPECTION:**

16 NYCRR 255.273(c) & 255.281(c).

The plastic gas service tee to building 1642 Park Avenue was exposed during the field incident investigation. The service tee was found to be partially broken at the joint connecting to the main. Visual inspection and additional review of

digital photographs of the broken joint reveals that the fusion of the 2-inch plastic tee onto the 8-inch plastic main had non-uniform fusion beads around the entire joint; the beads appear to overlap and the top bead is significantly greater than the other two. According to manufacturer's acceptable fusions shown in "Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping TR-41/2002" provided by Plastic Pipe Institute, the appearance of the joint is consistent with an unacceptable fusion produced with excessive melt and force and should have been rejected, removed, or replaced.

255.273(c) Each joint must be inspected to ensure compliance with this Part.

255.281(c) The quality of the joints shall be checked visually. If there is any reason to believe the joint is defective, it shall be removed and replaced.

3. EVEN IF [redacted]Z HAD BEEN TIMELY REQUALIFIED, CECONY'S TESTING PROCEDURES WERE NOT IN COMPLIANCE WITH EXISTING REGULATIONS

16 NYCRR 255.285(a) (2) – Plastic pipe: Qualifying persons to make joints

The natural gas service tee to 1642 Park Avenue, Manhattan was installed on 12/28/2011. The plastic fusion joint connecting the service line to gas main was completed by [redacted] as per the marking on the pipe. CECONY records identified the two employees worked on this job as [redacted] and [redacted]. Their most recent qualifications to perform plastic fusion joints were completed on 11/23/2010 and 6/8/2011 by [redacted] and [redacted], respectively. The qualification testing of both these employees failed to include additional tests beyond visual examination in compliance with the following requirements:

(a) No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by:

(1) Appropriate training or experience in the use of the procedure; and

(2) making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth in subdivisions (b) and (c) of this section.

(b) The specimen joint must be visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure.
(c) Additionally, in the case of a heat fusion, solvent cement, or adhesive joint, the joint must be:
(1) tested under any one of the test methods listed under subdivision 255.283(a) applicable to the type of joint and material being tested; or
(2) examined by ultrasonic inspection and found not to contain flaws that would cause failure; or
(3) cut into at least three longitudinal straps, each of which is visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area and deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.

4. **THE PROCEDURES FOR SIDEWALL FUSIONS WERE NOT PROPERLY QUALIFIED AT THE TIME IT WAS ESTABLISHED AND DURING THE TIME IT WAS USED FOR FUSER QUALIFICATION. CECONY HAD NOT PROPERLY QUALIFY ITS WRITTEN JOINING PROCEDURE.**

16 NYCRR 255.283(a) (1) – Plastic pipe: Qualifying joining procedures

[redacted], the Company stated that the qualification testing for Company's specification G-8123-11 – "Heat Fusion Joining of Polyethylene Plastic Pipe/Tubing and Fittings for Gas Mains and Services" was conducted on 5/18/2006. As part of the sidewall fusion qualification testing, the lateral impact test method was used. However, burst test of the sidewall fusion specimen was not performed during 5/18/2006 qualification test.
Therefore, the Company failed to subject specimen joints to the tests required by 16 NYCRR 255.283(a)(1) prior to establishing a written joining procedure.

(a) Before any written procedure established under subdivision 255.273(b) is used for making plastic pipe joints by a heat fusion, solvent cement, or adhesive method, the procedure must be qualified by subjecting specimen joints, made according to the procedure, to the following tests.

(1) The burst test requirements of:

(i) in the case of thermoplastic pipe, paragraph 6.6 (Sustained Pressure Test) or paragraph 6.7 (Minimum Hydrostatic Burst Pressure) or paragraph 8.9 (Sustained Static Pressure Test) of ASTM Specification D2513 (as

described in Section 10.3 of this Title); or
(ii) in the case of thermosetting plastic pipe, paragraph 8.5 (Minimum Hydrostatic Burst Pressure) or paragraph 8.9 (Sustained Static Pressure Test) of ASTM Specification D2517 (as described in Section 10.3 of this Title).
(iii) in the case of electrofusion fittings for polyethylene pipe and tubing, paragraph 9.1 (Minimum Hydraulic Burst Pressure Test), paragraph 9.2 (Sustained Pressure Test), paragraph 9.3 (Tensile Strength Test), or paragraph 9.4 (Joint Integrity Tests) of ASTM Specification F1055 (as described in section 10.3 of this Title).

5. **CECONY DID NOT FOLLOW ITS OWN PROCEDURES, WHICH IS REQUIRED BY COMMISSION REGULATIONS.**

16 NYCRR 255.603(d) – General Provisions

1. [redacted] HAD NOT BEEN REQUALIFIED WITHIN SPECIFIED PERIOD IN ACCORDANCE WITH CON EDISON PROCEDURES.

   CECONY procedure, "G-8121-15 TITLE: Qualification of installers performing heat fusion or electrofusion of polyethylene plastic pipe/tubing and fittings for gas mains and services" paragraph 3.1 states:
   "Only installers operator qualified and also in compliance with the 12 month requalification method in accordance with this specification shall perform the covered tasks of heat fusion or electrofusion joints"

2. [redacted] AND [redacted] HAD NOT BEEN QUALIFIED IN ACCORDANCE WITH TESTING REQUIREMENTS SPECIFIED IN CECONY PROCEDURES.

   CECONY's company procedure G-8121-15: "Qualification of installers performing heat fusion or electrofusion of polyethylene plastic pipe/tubing and fittings for gas mains and services" section 3.6 states:
   "The specimen joint shall be cut into at least three longitudinal strips, each of which is visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area. The specimens shall be deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area."

   In addition, section 6.0 – "Disqualification" states:
   "(6.1) Reasons for failing either the initial operator qualification or requalification (12 month or three year) test shall include but not be limited to the following:
   B) Practical Test

Butt Fusion Joints

• A destructive test on three (3) strips cut from a single test joint reveals voids in the fusion area or failure at the fusion joint during either tensile or bend tests.

Electrofusion Joints

• A destructive test performed on the joint reveals that failure occurs in the fusion area when the tee is subjected to a bending force."

From Staff's review of documentation from [redacted] was qualified on 1/30/2002 initially and subsequently re-qualified on a three year cycle on 12/27/2004, 12/18/2007, 11/23/2010, and 11/19/2013.
(5 Occurrences: Initial and 3 Year Qualification did not meet required testing requirements).

Additionally, for the 12-month requalification requirement [redacted] was re-qualified on 5/18/2004, 5/17/2005, 5/12/2009, and 5/12/2010.
12 Month Requalification did not meet required testing requirements).

[redacted], was qualified on 6/11/2002 initially and subsequently re-qualified on a three year cycle on 6/6/2005, 6/16/2008 and 6/8/2011.

Additionally, for the 12-month requalification requirement Mr. Martello was requalified on 6/4/2003, 5/17/2005, 2/8/2006, 2/11/2009 and 1/21/2010.
12 Month Requalification did not meet required testing requirements).

None of the qualification tests listed above included additional evaluation testing for hydraulic butt fusion, electrofusion and saddle fusion specimen joints as required by 16 NYCRR 255.285(c).
Company failed to perform destructive testing as per sections 3.6 and 6.0 of Company's procedure G-8121-15 cited above.

3. [redacted]FAILED TO IDENTIFY AND REMOVE OR REPLACE DEFECTIVE FUSION JOINT IN ACCORDANCE WITH CECONY PROCEDURES.

CECONY' company procedure G-8123-12: "Heat Fusion Joining of Polyethylene Plastic Pipe/Tubing and Fittings for Gas Mains and Services", Section 3.3 states:

"All butt, sidewall, and branch saddle fusion joints shall be inspected as per the following procedure:

A) Verify that the proper fusion iron temperature has been maintained and verify the proper fusion pressure is being maintained during and after the fusion process.
B) The heat fusion joint shall be visually inspected by the qualified installer or by a qualified inspector using the following criteria:
1) The entire circumference of the joint must be visually inspected.
2) The heat fusion joint must closely resemble the manufacturer's recommended fusion joints as shown in the heat fusion qualification guide for the applicable Central Plastic (Fittings), U.S. Poly, and Performance Pipe polyethylene piping materials.
3) If there is any reason to believe the heat fusion joint is defective, it shall be removed and replaced."

The plastic gas service tee to 1642 Park Avenue was exposed during the field incident investigation. The service tee was found to be partially broken at the joint connecting to the main. Visual inspection and additional review of digital photographs of the broken joint fusion reveals that the fuse of the 2-inch plastic tee onto the 8-inch plastic main has non-uniform fusion beads around the entire joint; the beads appear to overlap and the top bead is significantly greater than the other two. According to manufacturer's acceptable fusions shown in "Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping TR-41/2002" provided by Plastic Pipe Institute, the joint appears to be consistent with unacceptable fusion produced with excessive melt and force.

By not rejecting the fusion joint based on visual inspection, CECONY failed to follow its Company procedure G-8123-12 which requires heat fusion joints to closely resemble the manufacturer's acceptable fusion joints as specified in "Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping TR-41/2002" provided by Plastic Pipe Institute.

CECONY did not identify the defective fusion joint in accordance with the visual inspection criteria in Company's procedure G-8123-12, Section 3.3(b)(3) and did not remove or replace the defective joint on the gas service line to 1642 Park Avenue.

4. CECONY DID NOT GENERATE A RECORD DOCUMENTING THE LEAK INVESTIGATION.

CECONY's procedure G-11834-8a, "Procedure for documenting an outside gas leak investigation and repair history", section 6 "Guidelines for completing the front of the leak history report" and Section 8 "Guidelines for completing the back of the leak history report" state the requirements for a leak record to have leak classification, the nature of the repair, adequate number of sample readings.

During the East Harlem investigation, CECONY discovered a gas leak on a 16-inch Cast Iron gas main within an excavation at the SW Corner of East 116th Street and Park Avenue, Manhattan on 3/13/14. This excavation was made on 3/12/14 to perform cut & cap of the 8-inch PE gas main in order to isolate the gas supply towards the incident area of the East Harlem explosion. CECONY repaired the gas leak on 3/14/14 by encapsulating two hubs on the 16-inch Cast Iron main.

CECONY did not generate a record documenting the leak investigation, location, gas-in-air readings found, classification, type of repairs for this leak and follow-up results.

5. CECONY DID NOT PERFORM A WINTER LEAK SURVEY ON A SEGMENT OF GAS MAIN IN ACCORDANCE WITH CECONY PROCEDURES.

CECONY' company procedure G-11806: "Gas Leak Detection Survey Program", Section 11 states:

"A High-Speed Cast Iron Survey may be deployed when any one of the following criteria are met.
A) Significant variations in temperature oscillating above and below 32 degrees Fahrenheit. Example: Temperatures below 32 degrees rising to 40 degrees or more, then dropping below 32 degrees followed by a rise in temperature to 40 degrees or more and falling below 32 degrees or
B) When the ambient temperature is forecasted to remain at 32 degrees Fahrenheit or lower for 7 or more consecutive days and the system experiences three breaks or more per day over 2 successive days or
C) When the temperature falls below 20 degrees Fahrenheit and field verified frost depth conditions of 24 inches or greater exist.
11.2 When deployed, the High Speed Cast Iron survey will concentrate on: A) 4", 6", and 8" cast iron mains and B) Areas with historical cast iron breaks"

Staff reviewed CECONY's leak survey records/maps for Winter Patrol Leak Surveys conducted on 2/10/14 and 2/28/14

surrounding the 3/12/2014 East Harlem incident site. A dead-end section of 6-inch cast iron gas main running along the north side of East 116th Street to the West of Park Avenue was not included in both surveys.

[redacted] CECONY provided "cast iron risk ranking" as of June 2013 identifying this 6 - inch dead-end segment of gas main as Cast Iron and assigned a risk ranking number (#1303). In addition, during the on-site incident investigation, DPS Staff reviewed CECONY maps on a computer with a company representative and to DPS Staff's best recollection, the dead-end segment was identified as cast iron in the system.

Furthermore, [redacted] Company provided two screenshots of its map plate,[30] which states that the dead-end segment is a 6-inch wrought iron material; one screenshot was labeled as "Jan 18 2014", and the other "March 14 2014". These two screenshots do not have a date stamp and do not adequately demonstrate the date and time for the images provided.

CECONY's responses [redacted] are inconsistent in identifying the material of the gas main along the north side of East 116th Street and West of Park Avenue. Based on the identification of the gas main as cast iron in CECONY's risk ranking model, it should have been accurately documented in maps and included in all winter leak surveys all throughout (See Recommendations Section for addressing flaws in the current Risk Ranking Model).

6. CON EDISON SHOULD HAVE INSTALLED AN ISOLATION VALVE DURING DISTRIBUTION MAIN REPLACEMENT IN 2011

CECONY's Company procedure G-8141-4: "Installation of Valves on Gas Distribution Mains", Section 3.1 states:

"Valves shall be installed on new/replaced mains in accordance with the following guidelines:
A) Valves shall be installed at every street intersection or one per block, so that each block may be isolated.
B) Each intersection of main shall have installed three valves; two valves on the smaller mains and one valve on the larger main.

[30] Map plate is a section of a map with an identification number utilized for dividing the total area into smaller units for faster and easier reference.

C) Each consecutive pair of main intersections shall have the valves installed so that the isolating of the block between the intersections will require closing no more than four valves."

In December 2011, CECONY replaced approximately 70 feet of 8-inch cast iron distribution main with 8-inch plastic main due to undermining in front of 1642 Park Avenue. The section of main replaced spans from 1642 Park Avenue to the intersection of Park Avenue and East 116th Street where it is tied-in to the 6-inch plastic four way tee. CECONY failed to install a valve at the intersection of Park Avenue and East 116th Street as specified in Company's procedure G-8141-4, Section 3.1 to improve the efficiency of block isolation in case of an emergency.

From DPS Staff's review of Con Edison's post-incident emergency response, Con Edison isolated the incident area by a cut and cap operation due to the lack of isolation valves in the system. Because Con Edison had not installed valves at nearby intersections during its 2011 installation of the plastic services, the only alternative to a cut and cap operation would have been the closure of 62 valves, interrupting 93,255 gas accounts, which includes 2,204 services to critical customers involving several hospitals, schools, nursing homes, etc. Staff determined that the Con Edison had not installed a valve in 2011 as required and had not effectively implemented nor continuously evaluated it as part of the main replacement performed on Park Avenue in front of 1642 Park Avenue in December 2011.

7. CECONY SHOULD HAVE REQUESTED FIRE DEPARTMENT ASSISTANCE UPON RECEIVING AN INSIDE/OUTSIDE GAS ODOR CALL.

The dispatcher in CECONY's Gas Emergency Response Center (GERC) involved with this incident acknowledged that the odor complaint CECONY received at 9:06 AM on March 12, 2014 from a resident at 1652 Park Avenue was a hazardous condition that required Fire Department assistance as per CECONY's procedures G-11809-28b, Section 6.2 and G-11837-24a, Section 5.2 for outside and inside leak investigation respectively, as well as procedure G-11876 for dispatching gas emergency and non-emergency work by the Gas Emergency Response Center.

DPS Staff reviewed the call records and confirmed that a phone call to FDNY was made at 9:19 AM; however, the request for assistance was not completed, and the dispatcher said, "Hold up, no, sorry, hold on one second, hold on, hold on, I'll call you right back" and hung up the call. As a result,

the FDNY was not dispatched to the location. At 9:39 AM the CECONY mechanic from the field reported flames and smoke in the vicinity of the odor complaint location. At 9:40 AM CECONY GERC dispatcher contacted FDNY to inquire whether FDNY received any reports and FDNY confirmed there was a building collapse and an explosion. The CECONY dispatcher did not contact FDNY again within the 20 minutes between the initial call at 9:19 AM and the report from mechanic in the field regarding flames and smoke at 9:39 AM.

CECONY's GERC Dispatcher failed to follow Company procedures by failing to request Fire Department assistance for this incident.

8. CECONY FAILED TO FOLLOW PLASTIC PIPE INSTALLATION REQUIREMENTS IN 2011.

CECONY's Company procedure G-8005-23 "General Specification for the Installation of Gas Distribution Mains", Section 7.3 states:

"Tracer Wire may not be wrapped around the plastic pipe and contact with the plastic pipe must be minimized (i.e. just to the contacts for "taping intervals")."

During the excavation of the gas service tee to 1642 Park Avenue on 3/20/14, a tracer wire was found along the 8-inch HDPE gas main and wrapped around the 2-inch HDPE gas service tee to 1642 Park Avenue. The 8-inch gas main and the 2-inch plastic service were installed on 12/28/11.

6. 16 NYCRR 262.105(b) – Post Incident Drug Testing

16 NYCRR §262.105(b) states:

"Post-accident test. As soon as possible but no later than 32 hours after an accident, an operator shall drug test each employee whose performance either contributed to the accident or cannot be completely discounted as a contributing factor to the accident. An operator may decide not to test under this paragraph but such a decision must be based on the best information available immediately after the accident that the employee's performance could not have contributed to the accident or that, because of the time between that performance and the accident, it is not likely that a drug test would reveal whether the performance was affected by

drug use."

[redacted] CECONY stated that the Gas Emergency Response Center ("GERC") dispatchers involved with East Harlem Incident as well as any other incident are not covered employees performing a covered task and, therefore, do not require drug testing.

16 NYCRR 262.3(c) defines the following: *"Covered employee, employee, or individual to be tested means a person who performs a covered function, including persons employed by the operator, contractors engaged by the operator, and persons employed by such contractors." Furthermore, 16 NYCRR 262.3(d) states: "Covered function means an operation, maintenance, or emergency-response function that is performed on a pipeline or LNG facility and the function is regulated by 49 CFR part 192, 193, or 195."*

GERC Dispatchers are part of emergency-response function and, therefore, should be subjected to Drug Testing program as required by 16 NYCRR 262.105(b).

Further, in the 12 minutes between when CECONY's GERC hung up the call on the FDNY and the explosion, it cannot be completely discounted that fire fighters could have opened the front doors of 1642, 1644, and 1646, which may have avoided the incident.

6. 16 NYCRR 262.225(a) – Post Incident Alcohol Testing

16 NYCRR §262.225 Alcohol tests required.
Each operator shall conduct the following types of alcohol tests for the presence of alcohol:
(a) Post-accident
(1) As soon as practicable following an accident, each operator shall test each surviving covered employee for alcohol if that employee's performance of a covered function either contributed to the accident or cannot be completely discounted as a contributing factor to the accident. The decision not to administer a test under this section shall be based on the operator's determination, using the best available information at the time of the determination, that the covered employee's performance could not have contributed to the accident.

[redacted] CECONY stated that the Gas Emergency Response Center ("GERC") dispatchers involved with East Harlem Incident as well as any

other incident are not covered employees performing a covered task and, therefore, do not require alcohol testing.

16 NYCRR 262.3(c) defines the following: *"Covered employee, employee, or individual to be tested means a person who performs a covered function, including persons employed by the operator, contractors engaged by the operator, and persons employed by such contractors." Furthermore, 16 NYCRR 262.3(d) states: "Covered function means an operation, maintenance, or emergency-response function that is performed on a pipeline or LNG facility and the function is regulated by 49 CFR part 192, 193, or 195."*

GERC Dispatchers are part of emergency-response function and therefore should be subjected to Alcohol Testing program as required by 16 NYCRR 262.225(a).

Further, in the 12 minutes between when CECONY's GERC hung up the call on the FDNY and the explosion, it cannot be completely discounted that fire fighters could have opened the front doors of 1642, 1644, and 1646, which may have avoided the incident.

8. 16 NYCRR 255.615(a) (6) – Emergency Plans

Section 255.615 states *"(a) Each operator shall establish written procedures to minimize the hazard resulting from a gas pipeline emergency. At a minimum, the procedures must provide for the following: (6) Emergency shutdown and pressure reduction in any section of the operator's pipeline system necessary to minimize hazards to life or property . . ."*

In December 2011, CECONY replaced approximately 70 feet of 8-inch cast iron distribution main with 8-inch plastic main due to undermining in front of 1642 Park Avenue. The section of main replaced spans from 1642 Park Avenue to the intersection of Park Avenue and East 116th Street where it is tied in to the 6-inch plastic four-way tee. CECONY failed to install a valve at the intersection of Park Avenue and East 116th Street at the time of replacement to improve the efficiency of block isolation in case of an emergency.

From Staff's review of post-incident emergency response, the isolation of the incident area was performed by cut and cap operation which took over 4 hours due to the lack of required isolation valves in the system. CECONY stated the only alternative to a cut and cap operation would have been an operation of 62 valves and involve an interruption of 93,255

gas accounts which includes 2,204 services to critical customers involving several hospitals, schools, nursing homes, etc. CECONY's emergency response taking over 4 hours to isolate the incident area did not meet the expectations for emergency shutdown necessary to minimize hazards to life or property.

9. 16 NYCRR 255.321 (e) – Installation of Plastic Pipe – CECONY wrapped the tracer wire around the plastic service tee to 1642 Park Avenue.

During the excavation of the gas service tee to 1642 Park Avenue on 3/20/14, a tracer wire was found along the 8-inch HDPE gas main and wrapped around the 2-inch HDPE gas service tee to 1642 Park Avenue. The 8-inch gas main and the 2-inch plastic service were installed on 12/28/11.

(e) Plastic pipe that is not encased must have an electrically conductive wire or other approved means of locating the pipe. Tracer wire may not be wrapped around the pipe and contact with the pipe must be minimized but is not prohibited. Tracer wire or other metallic elements installed for pipe locating purposes must be resistant to corrosion damage, either by use of coated copper wire or by other means.

10. 16 NYCRR 255.807 (a) – Leaks: Records – CECONY did not generate a record documenting the leak investigation.

During the East Harlem investigation, CECONY discovered a gas leak on a 16-inch Cast Iron gas main within an excavation at the SW Corner of East 116th Street and Park Avenue, Manhattan on 3/13/14. This excavation was made on 3/12/14 to perform cut & cap of the 8-inch PE gas main in order to isolate the gas supply towards the incident area of the East Harlem explosion. CECONY repaired the gas leak on 3/14/14 by encapsulating two hubs on the 16-inch Cast Iron main.

CECONY failed to generate a record documenting the leak investigation, location, gas-in-air readings found, classification, type of repairs for this leak and follow-up results.

(a) A gas leak record, identified by number, shall be used to depict the entire history of a leak from the time of discovery through the follow-up inspection.
(b) The record shall contain information as to the nature of

the repair and follow-up results.
(c) Leaks shall only be classified or reclassified by a responsible and experienced individual whose name shall appear on the record.
(d) The gas leak record shall contain an adequate number of readings from the sample points tested during the leakage investigation to depict the extent of hazardous gas migration, expressed in percent gas-in-air or percent LEL found at the time of classification, reclassification if applicable, surveillance investigations, during leak repair activities, after completion of repairs, and at any follow-up inspections.

11. 16 NYCRR 255.603(c) – General Provisions

CECONY HAS NOT MAINTAINED ACCURATE MAPS TO INCLUDE 16-INCH CAST IRON STUB ON A GAS MAIN.

Within the excavation at the SW corner of East 116th Street and Park Avenue on 3/13/2014, CECONY discovered a 16-inch Cast Iron stub approximately eight feet in length running north from the 16-inch Cast Iron main which runs east to west along East 116th Street. This stub was determined to be not documented in any of CECONY maps maintained at that time.

CECONY DID NOT MAINTAIN ACCURATE MAPS TO PROPERLY IDENTIFY MATERIAL FOR TWO GAS SERVICE LINES.

Natural gas service lines to 1644 and 1646 Park Avenue were exposed on 3/25/2014 from the 8-inch Cast Iron main tapping tee towards the Head of Service valve. Upon excavation, it was noted that both service lines have approximately 4 feet of 1-1/4-inch plastic pipe with a plastic tap to the main and a plastic curb valve which then transitions to 1-1/4-inch copper tubing up to the Head of Service valves. CECONY's map records inaccurately identified both services as 1-1/4-inch copper gas service for its entire length (2 violations: two service lines misidentified).

(c) "Each operator shall establish and maintain the maps of its transmission lines and distribution mains and maps or records of its service lines as necessary to administer its operating and maintenance plan."

12. 16 NYCRR 255.603(b) – General Provisions

CECONY PROCEDURE FOR PLASTIC FUSION INITIAL AND 3 YEAR

REQUALIFICATION DOES NOT COMPLY WITH REGULATORY REQUIREMENTS.

CECONY procedure G-8121-15: "Qualification of installers performing heat fusion or electrofusion of polyethylene plastic pipe/tubing and fittings for gas mains and services" fails to comply with 16 NYCRR 255.285(a)(2). The procedure only requires visual inspection of the test specimens made with branch/sidewall fusion method. It fails to specify additional evaluation testing during the initial and any subsequent 3 year qualifications as an OQ task per requirements specified in 16 NYCRR 255.285(c).

CECONY PROCEDURE FOR PLASTIC FUSION 12-MONTH REQUALIFICATION DOES NOT COMPLY WITH REGULATORY REQUIREMENTS.

CECONY procedure G-8121-15: "Qualification of installers performing heat fusion or electrofusion of polyethylene plastic pipe/tubing and fittings for gas mains and services", section 3.4 states:
"Verification of an installer's skill, by the fusion of a plastic pipe joint under a qualified fusion joining procedure, is necessary for operator qualification and also the 12 month requalification method. The fusion joint must undergo visual (12 month) and/or physical examination (initial and 3 year) performed by a qualified supervisor or Learning Center Instructor to assure it's acceptable."

The Company's procedure fails to establish that each person making plastic fusion joints will be qualified in accordance with 16 NYCRR 255.285(a)(2); it fails to incorporate evaluation testing requirements specified in 16 NYCRR 255.285(c): in addition to the visual inspection during the 12-month (annual) requalification.

(b) "Each operator shall prepare and file a detailed written operating and maintenance plan for complying with all the provisions of this Part before operations of a pipeline system commence; it must be reviewed and updated by the operator at intervals not exceeding 15 months, but at least once each calendar year."

OTHER PLASTIC FUSION VIOLATIONS FOUND DURING INVESTIGATION.

13. 16 NYCRR 255.604(a)(2) – Operator Qualification.

CECONY's procedure G-8121-15: "Qualification of installers performing heat fusion or electrofusion of polyethylene plastic pipe/tubing and fittings for gas mains and services", section 5.1 states:

"12-month requalification method: all documentation for contractor (unit-price, turn-key, etc.) installers shall be the responsibility of the respective contractor (if the 12 month requalification method is done by the contractor)."

From comprehensive records review, documentation for annual plastic fusion qualification of contractor installers was the responsibility of the respective contractor. Numerous lapses in annual re-qualifications of contractors performing plastic fusion were noted over the past 5 years.

By assigning the responsibility to the contractor to maintain qualifications CECONY failed to ensure through evaluation that contractor individuals performing covered tasks are qualified (Number of violations for failure to timely requalify workers and ensure through evaluation that individuals performing covered tasks are qualified will be addressed in the Commission's proceeding, Case 14-G-0212).

"(a) Each operator shall have and follow a written qualification program. The program shall include provisions to: . . .
(2) Ensure through evaluation that individuals performing covered tasks are qualified . . ."

Areas of Concern

1. 16 NYCRR 255.59 – Plastic Pipe:

(a) New plastic pipe is qualified for use under this Part if:
(1) when the pipe is manufactured, it is manufactured in accordance with the latest listed edition of a listed specification;"

Section 255.321 - Installation of plastic pipe
(1) Uncased plastic pipe may be temporarily installed above ground level under the following conditions:
(1) The operator must be able to demonstrate that the cumulative above ground exposure of the pipe does not exceed the manufacturer's recommended maximum period of exposure or 2 years, whichever is less.

After the incident, on 3/14/14 CECONY was in the process of installing a new 4- inch plastic service from a 16 - inch

Cast Iron main on E 116th St in order to restore gas service to buildings 89 and 91 East 116th Street. A company contractor was in the process of fusing 4- inch HDPE segments of pipe for the new service. Staff verified pipe information and noted that 4- inch IPS DR11 PE3408/4710 being used was dated May 14, 2011, which exceeds the manufacturer's recommended maximum period of exposure for uncased plastic pipe of 2 years based on the latest (1999th version) specification adopted into regulations.

DPS Staff notified the Company supervisor on-site of the problem; the pipe was disposed of and later replaced with 6" IPS DR11 PE3408/4710, Nov 04, 2013 and 3" IPS DR11 PE3408/4710, Feb 08, 2014.

Additionally, in response to DPS IR #51, CECONY stated that the Company does not track sunlight exposure for pipe in outdoor storage as the latest specification published by manufacturers allows for longer periods of sunlight exposure for uncased plastic pipe.

2. 16 NYCRR 255.511(a)(c) – Test requirements for service lines

From the record review of CECONY's main replacement project, including the gas service line to 1642 Park Avenue, the record for the pressure test of the gas service indicates the stamp with pressure and time as required; however, the sketch on the form identifies a segment of the gas main only. CECONY's records are unclear whether the service or the main segment was tested as part of this test. Staff expects the pressure test documentation to be clear enough to specify the actual pipe and connections being tested.

(a) Except for steel service lines greater than two inches (51 millimeters) in nominal diameter that are to operate at 125 PSIG (862 kPa) or more, each segment of a service line must be leak tested in accordance with this section before being placed into service.

(c) Except for copper service lines, the test pressure shall be 90 PSIG (621 kPa) or 1.5 times the maximum operating pressure, whichever is greater; however, the maximum test pressure and material temperature during the test must be in accordance with section 255.507(b) of this Part.

3. 16 NYCRR 262.105(b) – Post Incident Drug Testing

[redacted] CECONY stated that the Customer Service Representatives ("CSRs")

involved with East Harlem Incident as well as any other incident are not covered employees performing a covered task and, therefore, do not require drug testing.

16 NYCRR 262.3(c) defines the following: *"Covered employee, employee, or individual to be tested means a person who performs a covered function, including persons employed by the operator, contractors engaged by the operator, and persons employed by such contractors." Furthermore, 16 NYCRR 262.3(d) states: "Covered function means an operation, maintenance, or emergency-response function that is performed on a pipeline or LNG facility and the function is regulated by 49 CFR part 192, 193, or 195."*
CSRs are part of emergency-response function while obtaining vital information from the caller and asking all essential questions to make proper determination for a hazard of a situation and therefore should be subjected to Drug Testing program as required by 16 NYCRR 262.105(b).

4. 16 NYCRR 262.225(a) – Post Incident Alcohol Testing

[redacted] CECONY stated that the Customer Service Representatives ("CSRs") involved with East Harlem Incident as well as any other incident are not covered employees performing a covered task and, therefore, do not require alcohol testing.

16 NYCRR 262.3(c) defines the following: *"Covered employee, employee, or individual to be tested means a person who performs a covered function, including persons employed by the operator, contractors engaged by the operator, and persons employed by such contractors." Furthermore, 16 NYCRR 262.3(d) states: "Covered function means an operation, maintenance, or emergency-response function that is performed on a pipeline or LNG facility and the function is regulated by 49 CFR part 192, 193, or 195."*

CSRs are part of emergency-response function while obtaining vital information from the caller and asking all essential questions to make proper determination for a hazard of a situation and therefore should be subjected to Alcohol Testing program as required by 16 NYCRR 262.225(a).

Appendix A

List of documents reviewed as part of investigation:

- Leak history for inside and outside natural gas odor complaints on Park Avenue, between 116th St and 117th Streets prior to the incident from July 2010 through March 12, 2014.
- Post-incident leak investigation records for the area surrounding Park Ave, between 116th Street and 117th Street.
- Annual leak survey maps for the block around incident site at Park Avenue for calendar years 2011, 2012 and 2013, as well as 2014 winter season patrol leak survey maps.
- History of gas distribution works performed along Park Avenue between 116th Street and 117th Street for the past 5 years from January 01, 2009 through March 11, 2014.
- Inspection records of the Building of Public Assembly located at 1644 Park Avenue for calendar years 2011, 2012 and 2013.
- Supervisory Control and Data Acquisition (SCADA) records for gas system pressures of all regulating stations feeding the incident area from 9:00 AM on March 10, 2014 through 11:00 AM on March 12, 2014.
- Records of cast iron encroachment on Park Avenue, between E 116th Street and E 117th Street from January 01, 2003 through April 2014.
- Records of gas main and service replacements for the incident area from January 01, 2003 through April 2014.
- CECONY's Control Room tape recordings from 09:00 AM through two hours following the explosion on March 12, 2014.
- GPS records with location and route for the crew that was dispatched to odor complaint at 9:13 AM on March 12, 2014 as well as GPS locations for all other on duty mechanics in Manhattan at the time the call was received.
- All customer meter and account records for 1644 and 1646 Park Avenue buildings including account numbers, names, meter numbers and meter readings from March 12, 2013 to March 12, 2014.
- Frost depth and temperature data records for the closest location to the incident site from February 1, 2014 through March 12, 2014.
- Cast Iron risk ranking records for all segments in CECONY's leak prone pipe replacement program on the square block bounded by Madison Avenue and Park Avenue between E 116th Street and E 117th Street.
- Records of meter readings for meters removed from 1644 and 1646 Park Avenue buildings post-incident.

Reviewed applicable procedures for:

- "Replacement and Maintenance of Cast Iron Pipe Located in Construction Areas."
- "Responsibility for Maintenance/Replacement of Gas Services and Also the Testing Requirements for Temporarily Disconnected Gas Services."
- "Pressure Testing Requirements for New and Replacement Gas Mains and Services."
- "Integrity Tests, Meter Turn-Ons and Turn-Offs, Meter Exchanges, and Restoration of Gas Service After Repairs."
- "Procedure for Purging Gas Piping in a Building with Natural Gas after an Outage, Repair, or a New Business Turn-On."
- "Heat Fusion Joining of Polyethylene Plastic Pipe/Tubing and Fittings for Gas Mains and Services."
- "Installation of Central Plastics and Frialen Electrofusion Molded Fittings on Plastic Pipe/Tubing and Molded Fittings Using Either the Central Plastics or Friatec Universal Control Unit."
- "Installation of Electrofusion Fittings on Plastic Pipe/Tubing and Molded Fittings Using a Universal Electrofusion Processor."
- "Qualification of Installers performing heat fusion or electrofusion of polyethylene plastic pipe/tubing and fittings for gas mains and services."
- "Qualification of contractors' maintenance engineers and field supervisors engaged in gas maintenance/installation of mains and/or services."
- "Outside Gas Leak Reporting, Classification, Surveillance, Repair and Follow-up Inspection."
- "Procedure for Documenting an Outside Gas Leak Investigation and Repair History."

- Electric maps showing primary and secondary cables to buildings on Park Avenue between E 116th Street and E 117th Street.
- Camera recordings of all natural gas main and services insertions on Park Avenue between E 116th Street and E 117th Street.
- Installation records for natural gas main and service replacement in 2011 along Park Avenue between E 116th Street and E 117th Street; all related operator qualification records
- Reviewed audio recording and transcripts for natural gas odor complaint from resident of 1652 Park Avenue on March 12, 2014.
- Records of CECONY's customers and residents receiving compensation post March 12, 2014 incident.

- NYC DOB records of violations, permits, inspection reports for 1644 and 1646 Park Avenue buildings for the past 5 years.
- One-Call System records for any recent mark out tickets in the surrounding incident area.
- CECONY's Drug and Alcohol Program Procedures for Post-incident testing.

Table of Interviewees referenced in the investigation report:

Identified as	Name	Resident of	Date of interview
Interviewee 1	[redacted]	[redacted] 1642 Park Avenue	[redacted]
Interviewee 2	[redacted]	[redacted] 1646 Park Avenue	[redacted]
Interviewee 3	[redacted]	[redacted] 1642 Park Avenue, [redacted] spouse	[redacted]
Interviewee 4	[redacted]	financial secretary of the Church at 1644 Park Avenue	[redacted]
Interviewee 5	[redacted]	[redacted] 1644 Park Avenue	[redacted]
Interviewee 6	[redacted]	[redacted] 1644 Park Avenue	[redacted]

Appendix B

Field investigation pressure tests and test details:

91 East 116th Street, New York, NY

Pressure test for 91 East 116th Street inside piping which includes header, two risers for meter (3) and (6), all meters except (1) and (2) (* numbering from left to right). Soap tested u-gauge, it was not leaking at 7.9 inches W.C.

Time	Pressure ("W.C.)	
1:09 PM, 3/14/14	7.80	testing u-gage, equip.
1:14 PM, 3/14/14	7.80	testing u-gage, equip.
1:16 PM, 3/14/14	7.80	start 15 min test
1:31 PM, 3/14/14	8.20	end, pressure released through HVAC roof unit
1:36 PM, 3/14/14	7.80	start 15 min verification test
1:51 PM, 3/14/14	8.05	End
2:02 PM, 3/14/14	8.20	addt. time, 0.3" WC increase

Pressure test for 91 East 116th Street header to curb valve on service line including HOS, four meters (3), (4), (5),(6) at 8 inches W.C. and at 12 inches W.C.). Equipment soap tested for 5 minutes.

Time	Pressure ("W.C.)	
11:19 AM, 3/15/14	8.00	testing u-gage, equip.
11:24 AM, 3/15/14	8.00	testing u-gage, equip.
11:32 AM, 3/15/14	8.00	start 15 min test
11:47 AM, 3/15/14	8.20	End
11:55 AM, 3/15/14	12.00	start 15 min test
12:10 PM, 3/15/14	12.00	End

89 East 116th Street, New York, NY

Multiple attempts for pressure testing of 89 East 116th Street (header up to meter inlet valves and up to HOS); all tests failed.

Time	Pressure ("W.C.)	
1:38 PM, 3/16/14	8.00	testing u-gage, equip. 5 min
1:43 PM, 3/16/14	failed	testing u-gage, equip. end
1:44 PM, 3/16/14	8.10	testing u-gage, equip. 5 min
1:49 PM, 3/16/14	8.10	testing u-gage, equip. end
1:56 PM, 3/16/14	7.80	start 15 min test
	failed	End
2:11 PM, 3/16/14	8.00	start 15 min test
	failed	End

Pressure tested 89 East 116th Street from cut and cap at the curb up to HOS at 8 and 12 inches W.C.)

Time	Pressure ("WC)	
1:14 PM, 3/17/14	8.00	testing u-gage, equip.
1:17 PM, 3/17/14	8.20	start 15 min test
1:32 PM, 3/17/14	9.00	End
1:55 PM, 3/17/14	12.00	start 15 min test
2:10 PM, 3/17/14	11.90	End
2:20 PM, 3/17/14	11.60	addt. time

DPS Staff witnessed additional testing on 3/18/14 of the inside piping at 89 East 116th Street to pinpoint the leaks with higher pressure. Tested header up to HOS at 3 psi, in approximately 15 min. pressure dropped to 2.7 psi. One fuzz leak was found on the union of the 1st meter (3152573) of the front 9 meters. One leak was found on the 90 degree angle connection going through a wall from HOS to front 9 meters. One leak was found in the back of the

basement on a reducer to the last meter (643009). One leak was found on the union of second to last meter (3060171) in the back of the basement. One leak was found on the meter valve immediately after HOS.

Total of 5 visible inside leaks were pinpointed at higher pressure.

1642 Park Avenue, New York, NY

Pressure tested 1642 Park Avenue from cut and cap up to caps on the meters. Tested from inside including HOS at 8 inches W.C. and at 12 inches W.C.

Time	Pressure ("W.C.)	
2:19 PM, 3/21/14	8.00	testing u-gage, equip.
2:23 PM, 3/21/14	8.00	start 15 min test
2:38 PM, 3/21/14	8.00	end
2:40 PM, 3/21/14	12.00	start 15 min test
2:55 PM, 3/21/14	12.00	end

1652 Park Avenue, New York, NY

Pressure test for 1652 Park Avenue from cut and cap section of service line up to HOS at 5 psi.

Time	Pressure (psi)	
10:26 AM, 3/21/14	5.39	testing u-gage, equip.
10:31 AM, 3/21/14	5.40	start 15 min test
10:48 AM, 3/21/14	5.40	End

Segments of main pressure tests:

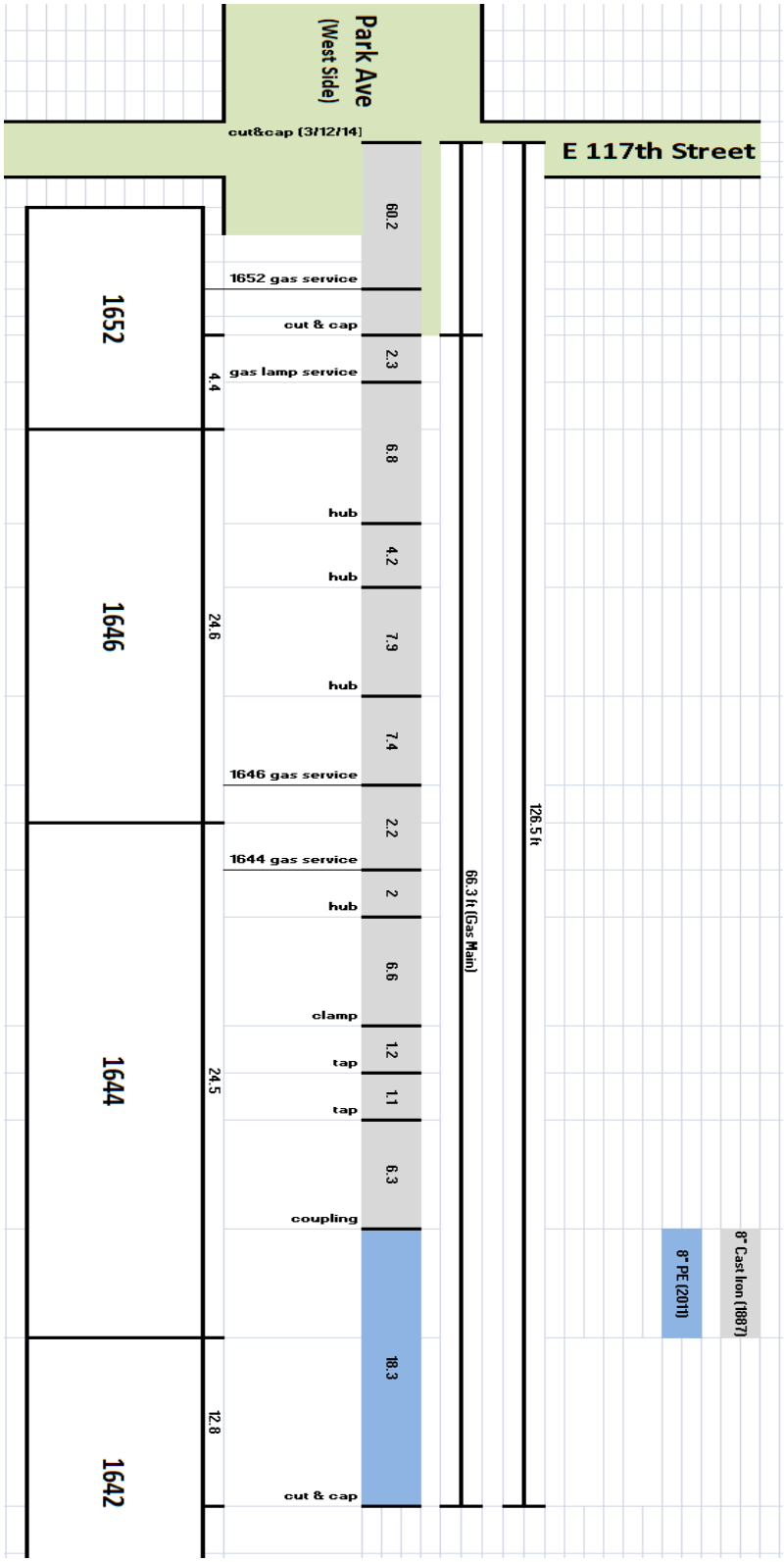

Figure 22 – Natural gas main pressure test layout (not to scale).

1) Pressure tested from East 117th Street and Park Avenue initial cut and cap to cut and cap in front 1642 Park Avenue, including both services for 1644 and 1646 Park Avenue, as well as cut and capped segment of service line for 1652 Park Ave.
Pressure was introduced from East 117th Street; pressure chart recorders were placed in front of 1642 Park Avenue.

Time (3/21/14)	Ambient Temp. (°F)	Pipe Temp. (°F)	Pressure ("W.C.)
4:15 PM	55	48	7.73
4:20 PM	55	48	6.70
4:25 PM	55	48	5.96
4:30 PM	55	48	5.31
4:35 PM	55	48	4.72
4:40 PM	54	48	4.06
4:45 PM	52	48	3.62
4:50 PM	52	48	3.21
4:55 PM	51	48	2.81
5:00 PM	51	48	2.48
5:05 PM	51	48	2.15
5:10 PM	50	48	1.83
5:15 PM	50	48	1.63
5:20 PM	50	48	1.36
5:25 PM	50	48	1.25
5:30 PM	50	48	1.11
5:35 PM	50	48	0.93
5:40 PM	50	48	0.76
5:45 PM	50	48	0.63
5:50 PM	50	48	0.51
5:55 PM	50	48	0.48
6:00 PM	49	48	0.35
6:05 PM	49	48	0.31
6:10 PM	49	48	0.22
6:15 PM	49	48	0.18
6:20 PM	49	48	0.15
6:25 PM	49	48	0.11
6:30 PM	49	48	0.03

As a result of the failed test it was decided to excavate two services for 1644 and 1646 Park Ave and over the coupling transitioning Plastic to Cast Iron.

2) Pressure tested an isolated section of 8 inch gas main from East 117th Street and Park Avenue cut and cap to cut off on Cast Iron in front of 1652 Park Ave at 8 inches W.C. Total footage from East 117th and Park Avenue is 126.5 ft.
(*cutout section of Cast Iron in front of 1652 Park Ave with a hub is 75 inches long).

Time (3/23/14)	Ambient Temp. (°F)	Pipe Temp. (°F)	Pressure ("W.C.)
9:15 AM	40	49	7.93
9:20 AM	40	48	7.23
9:25 AM	40	48	6.40
9:30 AM	40	48	5.55
9:35 AM	40	48	4.78
9:40 AM	40	48	4.22
9:45 AM	40	48	3.72
9:50 AM	40	48	3.26
9:55 AM	40	48	2.89
10:00 AM	40	48	2.54
10:05 AM	40	49	2.19
10:10 AM	40	49	1.88
10:15 AM	40	49	1.67
10:20 AM	40	49	1.49

3) Pressure tested from cutoff section in front of 1652 Park Avenue to cutoff in front of 1642 Park Avenue, including two services for 1644 and 1646 Park Avenue. Tested at 8 inches W.C.

Time (3/23/14)	Ambient Temp. (°F)	Pipe Temp. (°F)	Pressure ("W.C.)
1:40 PM	44	50	8.06
1:45 PM	44	50	7.36
1:50 PM	44	50	6.55
1:55 PM	45	50	5.73
2:00 PM	45	50	4.85
2:05 PM	45	50	4.50
2:10 PM	45	50	4.06
2:15 PM	45	50	3.58
2:20 PM	45	50	3.20
2:25 PM	45	50	2.84
2:30 PM	45	50	2.54
2:35 PM	45	50	2.22
2:40 PM	45	50	1.92

Leak rate determined from a setup with a meter and a regulator set at 8 inches W.C. was approximately 0.6 CFH.

Pressure Tests for Services:

1646 Park Avenue, New York, NY

Pressure tested 1-1/4" copper gas service from HOS up to cut and cap with plastic curb valve (approximately 4 feet of plastic from main to copper connection) for 1646 Park Ave at 8 inches W.C. and 12 inches W.C.:

Time (3/25/14)	Ambient Temp. (°F)	Pipe Temp. (°F)	Pressure ("W.C.)	
10:09 AM	32	42	8.17	start 15 min test
10:12 AM	33	42	8.42	
10:15 AM	33	42	8.35	
10:18 AM	33	42	8.44	
10:21 AM	33	42	8.6	
10:24 AM	33	42	8.79	
10:27 AM	33	42	9.02	
10:30 AM	35	42	8.82	end w/ extra time

Time (3/25/14)	Ambient Temp. (°F)	Pipe Temp. (°F)	Pressure ("W.C.)	
10:45 AM	38	44	12.22	start 15 min test
10:48 AM	39	44	12.27	
10:51 AM	40	44	12.45	
10:54 AM	40	45	12.1	
10:57 AM	40	45	12.13	
11:00 AM	40	44	12.38	
11:03 AM	40	44	12.64	
11:06 AM	40	44	12.68	end w/ extra time

1644 Park Avenue, New York, NY

Pressure tested 1-1/4" copper gas service from HOS up to cut and cap without plastic curb valve (approximately 4 feet of plastic from main to copper connection) for 1644 Park Ave at 8 inches W.C.

and 12 inches W.C.:

Pressure Test for cutout sections:

A leaking hub was identified immediately north of gas service connection to an 8 inch cast iron main for building 1646 Park Ave (NTSB red tag #9). A hub was part of 14 foot 3 inches section cutout.

The cutout section with 2 hubs, 1 of which was found to be leaking was pressure tested at 8 inches W.C. in order to determine the leak flow rate.

Time (3/26/14)	Ambient Temp. (°F)	Pipe Temp. (°F)	Pressure ("W.C.)	
10:30 AM	34	42	8.05	
10:35 AM	34	42	6.79	start 1 hour test
10:40 AM	34	42	5.68	
10:45 AM	34	43	4.73	
10:50 AM	34	43	4	
10:55 AM	33	43	3.35	
11:00 AM			2.81	
11:05 AM			2.25	
11:10 AM			1.89	
11:15 AM			1.52	
11:20 AM			1.28	
11:25 AM			1.02	
11:30 AM			0.92	
11:35 AM			0.84	end

Flow rate was tested with meter setup and regulator set at 8 inches W.C. In 20 min the revolution on the meter was less than 0.05 CFH. The dial reached 0.05 CFH at 22 min 40 sec. End time 12:48 PM. The leak rate was calculated to be approximately 0.15 CFH.

Estimated Gas Flow Scenarios

$$Q = 1658.5 \times A \times Cd \times \sqrt{h/g}$$

$$Q = C \times A \times \sqrt{2(\Delta P)/\rho}$$

A =	sq. in		A =	sq. m
Cd =	0.6		C =	0.6
H =	8 in H20		Δ P	1992.711 Pascals
g =	0.8		p	0.8 cu.m

Crack opening

A =	2.375 in	x	0.25 in	x	25%	Q =	467.1005 CFH	
=	0.1484375 in^2					=	**7.785009 CFM**	
						AVG =	**8.2 CFM**	
A =	0.0603 m	x	0.01 m	x	25%	Q =	0.004054 m^3/s	
=	9.57263E-05 m^2					=	**8.589756 CFM**	

Fuse Failure Opening (50% of Diameter)

A =	1.875 in	x	0.75 in	x	50%	Q =	2212.581 CFH	
=	0.703125 in^2					=	**36.87636 CFM**	
						AVG =	**38.8 CFM**	
A =	0.047625 m	x	0.02 m	x	50%	Q =	0.019211 m^3/s	
=	0.000453628 m^2					=	**40.70519 CFM**	