National Transportation Safety Board

Washington, D.C. 20594

Office of Railroad, Pipeline and Hazardous Materials Investigations
Final Report Date: January 20, 2015

Natural Gas Distribution Pipeline Leak and Resulting Multi-Story Structures Explosion
Harlem, New York

Operations Group Factual Report DCA-14-MP-002

A. Accident

Operator: Consolidated Edison Company of New York, Inc. Location: East Harlem – Manhattan, New York
Date: March 12, 2014
Time: 9:30 a.m. (Eastern Standard Time)
Component: 2-inch High-Density Polyethylene (HDPE) pipe gas service line, 8-inch HDPE, 8-inch Cast Iron (CI) gas distribution main and 12-inch Cast Iron (CI) water main.

B. Operations Group Members:

Kalu Kelly Emeaba
Operations Group Chairman
National Transportation Safety Board
Washington, DC.

Michael S. Yazemboski
Group Member
Pipeline and Hazardous Materials Safety Administration
Eastern region

Christopher Stolicky
Group Member
State of New York
Public Service Commission

Leonard P. Singh
Group Member
Consolidated Edison Company of New York, Inc.

James J. Roberts, P.E
Group Member
New York City Department of Environmental Protection Bureau of Water and Sewer Operations

C. Accident Description:

On March 12, 2014, about 9:30 a.m., an explosion involving natural gas destroyed two adjacent buildings located near the intersection of Park Avenue and East 116th Street, in the East Harlem neighborhood of the Borough of Manhattan, in New York City, New York. The collapsed buildings were located on the west side of Park Avenue between East 116th Street and East 117th Street in the East Harlem district of the Borough of Manhattan, New York (See Figures 1 and 2). The collapsed buildings were mixed use, five story structures with apartments on the upper floors of each building. The recorded weather at the time of the accident was 49° F with clear skies. Eight people died and more than 48 people were injured as a result of this accident.[1]

Figure 1. Explosion damage to 1644 and 1646 Park Avenue.

[1] All times in this report are in eastern daylight time except otherwise stated.

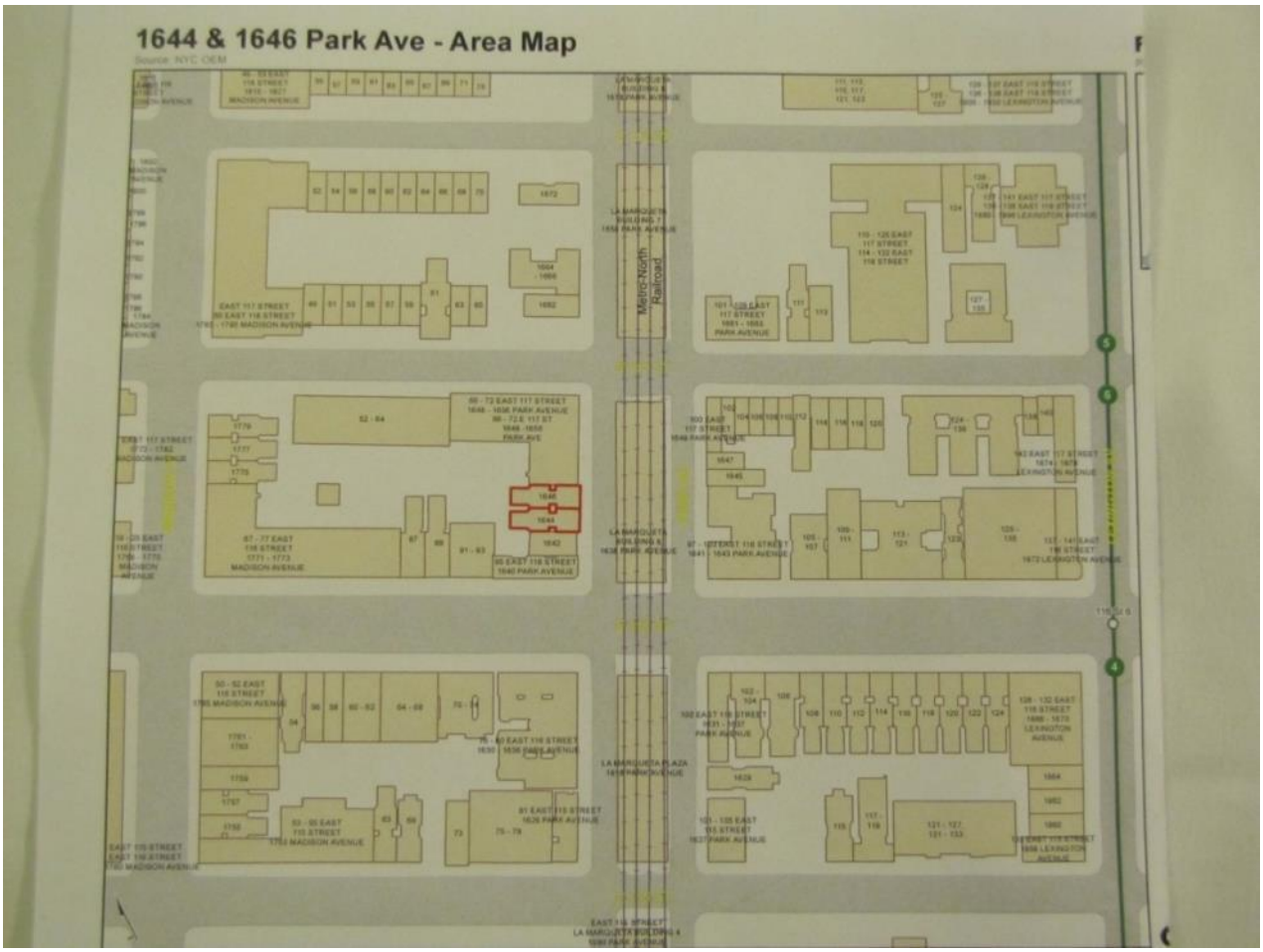

Figure 2. Area map (Source: New York Office of Emergency Management).

Consolidated Edison Company of New York, Inc. (Con Edison) owns and operates the natural gas distribution system in the area of the explosion. An 8-inch diameter low-pressure distribution main, comprised of original cast iron pipe coupled to a high-density polyethylene (HDPE) segment, extended north-south along Park Avenue between East 116th and East 117th Streets.[2,3,4] The buildings on that blocked were connected to the distribution main through HDPE or copper service lines.

About 9:06 a.m. an individual residing at 1652 Park Avenue reported a natural gas odor to the Con Edison Customer Service Department.[5] Con Edison dispatched a crew to investigate; however, the explosion occurred before the crew arrived at the scene.

Within minutes of the explosion the New York Police Department (NYPD) and the Fire Department of the City of New York (FDNY) responded to the explosion. The first FDNY unit arrived at the scene at 9:33 a.m. The gas flow to the 8-inch low pressure (about 1/3 pounds per square inch, gauge) pipeline that was supplying natural gas to the two structures through smaller diameter distribution pipeline was stopped by Con Edison at 1:44 p.m.

---

[2] Operating at 8-inches of water column (inwc) or 0.289 psig.

[3] The original cast iron distribution main was installed in 1887.

[4] About 69 feet of 8-inch diameter SDR-11 HDPE plastic pipe was installed in December 2011.

[5] See Survival Factor Factual Report for comprehensive timeline details.

Fire suppression and recovery activities continued for 6 more days. The violent explosion damaged adjacent buildings and buildings on the east side of Park Avenue and along East 116th Street and East 117th Street. The Metro-North Railroad suspended rail service shortly after the explosion for 7.5 hours on the elevated railway along Park Avenue due to debris that had fallen on the track.

D. Con Edison Operations:

Con Edison provides electric service to approximately 3.3 million customers and gas service to approximately 1.1 million customers in New York City and Westchester County. Con Edison also provides steam service to approximately 1,700 customers in Manhattan. In total, the Company serves approximately 9.3 million people in New York City and Westchester County in a geographic area encompassing 660 square miles.

Con Edison is the second largest gas distribution company in the northeast and the fifth largest nationally based on total throughput volumes. Con Edison's natural gas system consists of 4,300 miles of distribution mains and more than 367,000 gas service lines in Manhattan, the Bronx, Westchester, and parts of Queens. On an average day, Con Edison delivers to 947 million cubic feet of gas (equivalent to 975,779 dekatherms) to its customers.[6] In 2013, Con Edison's total natural gas system throughput, including gas used for power generation, was approximately 356 million dekatherms. On December 17, 2013, Con Edison set a new daily record by delivering 1.84 million dekatherms of gas.

Con Edison experienced an increase in new customers who had switched from using heating oil to natural gas as a source of energy, following changes in the City of New York regulations phasing out the use of numbers 6 and 4 heating oil. Con Edison plans to invest more than $2 billion in its gas infrastructure over the next three years to meet the increased demand and improve system reliability and growth.

E. Pipeline History and Constructions

Prior to 2011, the buildings at 1642, 1644, 1646, and 1652 Park Avenue were supplied with natural gas from an 8-inch cast iron gas main operated at 8-inch of water column that was installed in 1887. The construction of a new multi-unit building at 1642 Park Avenue in 2011 required a new gas service and the installation of other utilities.

Excavation at this location as a result of sewer lateral and water service installations by the plumber exposed and undermined[7] the 8-inch cast iron gas pipe. Con Edison considered the cast iron gas main exposure condition an encroachment according to the company Specification G-11839-9.[8] They decided to replace at the same time a segment of the 8-inch gas cast iron pipe with 8-inch HDPE gas main. The 8-inch HDPE main was joined at the north end of the cut cast iron pipe with transition 8-inch steel mechanical couplings,[9] (figure 3) and continued on the south end as 8-inch HDPE. The coupling is tightened and torqued in place with bolts that forms internal compressed rubber sealed joints. The new segment of 8-inch

---

[6] Dekatherm (DTH) is a unit of energy equal to 10 therms or one million British thermal units (MMBtu) or about 1 gigajoules (GJ).

[7] Undermined: This is Con Edison procedural language describing when a segment of the company's cast iron gas main has been exposed due to third party excavation. This exposure was seen as an "encroachment" and occurred due to the plumbers work at 1642 Park Avenue in 2011 during the sewer lateral installation and connection to the combined sewer main.

Attachment 3 - Specification G-11839-9 – Replacement and Maintenance of Cast Iron pipe located in construction areas. Reviewed: 1-24-2014

[9] Steel mechanical coupling – This coupling is manufactured by Dresser.

HDPE pipe ran from East116th Street south side going north and stopped in front of 1644 Park Avenue building. The gas service pipeline installation was completed on December 28, 2011.

Figure 3: North end of 8-inch HDPE gas main joined to 8-inch cast iron pipe to the left with 8-inch steel mechanical coupling in front of 1644 Park Avenue.

- **Pressure Test Requirement of Main and Service Installations:**

According to the Code of Federal Regulations (CFR), 49 CFR part 192.513 - Test requirements for plastic pipelines;

(a) Each segment of a plastic pipeline must be tested in accordance with this section.

(b) The test procedure must insure discovery of all potentially hazardous leaks in the segment being tested.

(c) The test pressure must be at least 150 percent of the maximum operating pressure or 50 psi (345 kPa) gage, whichever is greater. However, the maximum test pressure may not be more than three times the pressure determined under § 192.121, at a temperature not less than the pipe temperature during the test.

This section of the regulation requires all segments and length of plastic pipeline on both main and services lines to be pressure tested without exemption. But, the New York State pipeline safety regulation permits the operators to waive the pressure test requirement for main pipes installation up to 100 feet in length.

[Frank Diaz – page 15, line 23-25, and page 16 lines 1-9]

According to the fuser and installer (foreman), the installed segment of 8-inch HDPE main pipe that ran north to south in front of 1642 Park Avenue was not pneumatically pressure tested at the time of its installation because it was less than 100 feet long, approximately 69 feet.[10] The decision not to pressure test

[10] Attachment 5 – 2014 Harlem Incident pipeline History

the newly installed segment of pipe was in compliance with the New York State pipeline safety regulation,[11] as incorporated in the company's procedures. This segment of new main was only visually inspected and leak tested with soap solution under the line operating pressure of 8 inches of water column at the joints locations, according to Con Edison procedure.[12] Contrary to federal regulation, the new main PE segment was not tested to the 50 psi minimum test pressure.

The 2-inch HDPE service pipe installation to 1642 Park Avenue was tied in to the segment of the new 8-inch HDPE gas main with a fusion-tapped service saddle tee as shown in figure 4.

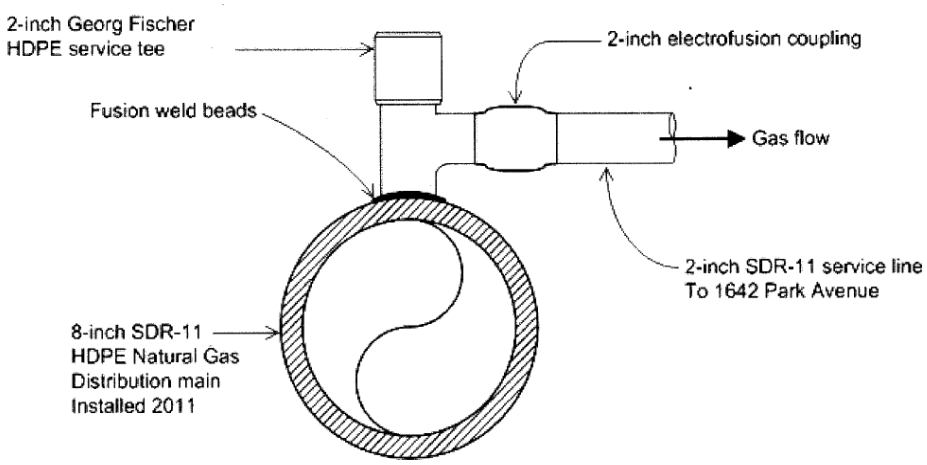

Figure 4: Drawing shows cross section of 2-inch service saddle tee assembly electrofused on top of the 8-inch HDPE gas main at 1642 Park Avenue.

The new service line was pressure tested at about 90 psig prior to cutting the plug through the 8-inch HDPE gas main. Compressed air was applied using an adapter fitting on the top of the fused saddle joint on the main to the service valve located inside the building, according to the contractor foreman.[13] The pressure used was also indicated on the completion construction work order. The service line pressure test was consistent with both Federal and State pipeline safety regulations.

The service saddle tee cap and the metal plastic cutter were removed from the installed service tee. An adapter cap with a pneumatic valve (test cap) is then used to pressurize the service line. This test cap is screwed down tight unto the service saddle tee. Air or inert gas is introduced with a supply line, and air flows into the service pipeline until required pressure is indicated on an attached pressure gauge, and then the air supply is cut-off. The air flows from the test cap, and continues to the closed service valve at the meter location. The air remains in the service pipeline for the duration of the pressure test.

At the end of the pressure test, the air is released through the service valve at the meter location by opening and reclosing the valve. The test cap is then unscrewed. The metal cutter is then screwed down into the 8-inch HDPE gas to cut a disc segment out of the 8-inch HDPE gas main. The plastic disc remains inside the hollow cutter, which is unscrewed until its top is flush with the top of the service saddle tee. The service

---

[11] 16 NYCRR 255.507(f)

[12] Attachment 6 – Interview of Frank Diaz - page 15 and 16 and Attachment 18 – Pressure Test Requirement - page 6 and 9 of G-8204-6, (section 5.0 Table 5.9 (c)).

[13] Attachment 17 - Constructed Pipe Length S10-84774-000M

saddle tee cap is then reinstalled. After the cut is completed, natural gas can flow through the service tee and into the service line to the meter.

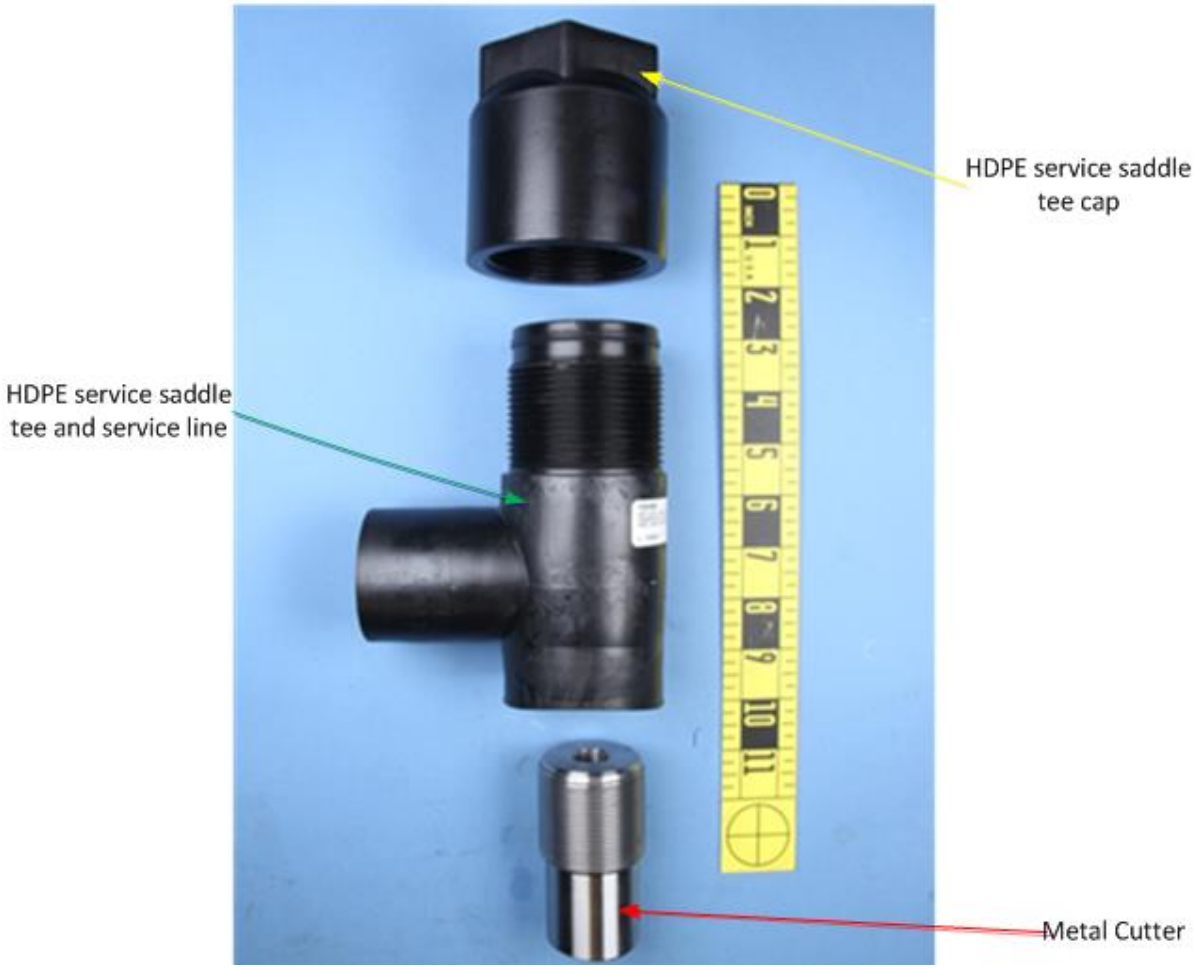

Figure 5: Gas service saddle tee components showing HDPE cap, saddle tee and metal cutter

The installer told investigators the work crew would go inside the property basement and shut the meter service valve. They would then remove the saddle cap and metal cutter and install an adapter on the service tee to attach the air supply line (figure 5). They would pressure test the service line to at least 90 psi, or more to the limit of the pressure gauge, then isolate the line from the pressure source and observe the line pressure for 15 to 20 minutes. If the pressure held, they would release the air from the service line, screw down the metal cutter to cut the hole in the 8-inch HDPE gas main, then retract the cutter and reinstall the cap.

[Frank Diaz page 17 lines 1-16, page 18 lines 1-25]

F. Distribution Integrity Management Program and Procedural Leak Survey of Gas Pipeline

The Senior Engineer in Gas Distribution Engineering[14] stated that Con Edison has developed and implemented its distribution integrity management program (DIMP) since August, 2011. Notwithstanding federal regulations requiring 5 years review of the plan, the Company conducted complete plan updates in

[14] Attachment 7 – Interview of John Ludwigsen

2011, and 2012, and annual update in 2013. The Company plans to have a complete evaluation of its DIMP program every three years by a team headed by the Senior Engineer and comprising representatives of all the company operating areas of Gas Operations and the Development Lab. [John Ludwigsen – page 7 lines 2-6, page 9 lines 5-6]

Con Edison states "the DIMP risk evaluation is a two-step process. The first step involves a high-level assessment of gas distribution mains that uses a risk scoring process to evaluate and rank the types of threats to the distribution system. Some of the threat types evaluated include corrosion, natural forces, and excavation damages. In determining the potential consequences of a failure in a particular area, the DIMP model considers four factors: loose fittings on high pressure facilities, cast iron breaks, population densities, and number of hazardous leaks. These factors, along with the frequency of failure, are used to develop the risk scores." [John Ludwigsen – page 17, lines 3-11]

Threats to the system identified in the DIMP prior to the accident on the gas pipeline, including plastic pipes were based on 6 years of repair history from the gas inspection system (GIS). The six years period was selected since it covers 2 complete cycles of the non-business district leak survey. The non-business district leak survey are performed every three years and used in actual development of the risk ranking, leak repairs and cause codes. The data are entered by the Mechanics or Supervisors into the GIS database. The GIS information on plastics failures are reviewed monthly. The DIMP uses the data to provide the total threat of the gas company system. Con Edison sends monthly reports of the plastic failures to the American Gas Association (AGA), and quarterly to the Public Service Commission of State of New York. [John Ludwigsen – page 10 lines 15-25, page 11 lines 13-21, page 12 lines 3-24, page 21 line 5-9]

The DIMP risk scores identified the cast iron main breaks (caused by natural forces, such as ground movement due to winter temperature fluctuations) and corrosion of bare/unprotected steel pipelines as the most significant threats to the Company system. The highest threats are the unprotected steel pipelines caused by corrosion and the second highest threats are the cast iron main breaks. Con Edison mitigates these threats through a main replacement program.[15]

Con Edison states

> The threats [are] identified in step one of the DIMP risk evaluation process, step two uses more detailed information to further evaluate, refine, and develop mitigation strategies. For the most significant threats referenced above, the second step involves ranking and prioritizing individual segments of main for replacement. This evaluation process uses a comprehensive decision support software tool the Main Replacement Prioritization Model (MRP)--to assess and prioritize risks associated with specific segments of gas mains. Con Edison has used the MRP model since 2006 for planning cast iron and bare steel replacements. [John Ludwigsen – page 17 lines 12-18, page 17 lines 21-25, page 18 line 1, page 21, lines 5-18]

Con Edison's DIMP that uses high level overview of the cast iron replacement program do not include the individual pipeline segments. The main replacement program is considered with the MRP model that is run each year and depends on updated system information and data that predicts the distribution pipeline segments, and could project or predict pipes that may fail. DIMP looks at overall mains and services of all threat categories and materials. [John Ludwigsen page 21, lines 22-24]

According to Con Edison Chief Engineer, the software programs for documenting the DIMP and MRP models currently do not communicate electronically with each other, but the managers discuss their

---

[15] Con Edison Distribution Integrity Management Plan (DIMP), page 122

issues and findings. DIMP program and the cast iron replacement program coordination occur between the two program managers because they are in the same department, and know the threats in both the DIMP and main replacement programs. According to the Senior Engineer for gas distribution engineering and DIMP, although they have discussions, there are no established procedures dictating what items should be communicated at those meetings [John Ludwigsen – page 17 lines 19-25, page 18 lines 1-21]

The main replacement program is part or sub-set of the DIMP program, and does have risk ranking score as DIMP does. However, main replacement program have individualized/segmented ranking system more than the DIMP, and the DIMP rely on the information from these rankings. [John Ludwigsen – page 18 lines 23-25, page 19 lines 1-7, page 20 line 1-2, page 20 lines 22-25, page 21 lines 5-18]

Since the inception of the DIMP, Con Edison states that the information gathered on plastic pipes has improved by adding more "cause codes" for threat categories (failures), such as environmental factors and materials components. Such additional plastic material types enable Con Edison to determine trends for each of the plastic materials instead of combining all plastic into one category.[16] [John Ludwigsen – page 32 lines 1-25, page 33 1-16]

Con Edison stated they have had very few leak failures due to the in service plastic pipeline materials and from the service tee fusions in particular. Majority of the leaks/failures they found on plastic pipes were on the Kerotest valves installed in the early 1990s. The problems on the Kerotest valves occur at locations between the valve coupling assembly and the pipes on the service lines, due to its loosed threaded assemblies. They temporarily re-tighten the valve and at a later time replace the valves. These types of failures are also known as mechanical fitting failures.

Another plastic pipe failure factors that Con Edison considers is the impacts of fill material on buried plastic pipe. Plastic pipeline failures in the Company's DIMP standard are examined to determine the prevalence of impingements on the pipes from buried materials. But "excavation damage to buried plastic pipe is not considered an inherent failure and, therefore, is not captured in the reporting of plastic failures. However, excavation damages, which are an external threat to Con Edison's gas distribution system, are included in the DIMP risk rankings." [John Ludwigsen –page 12 lines 24-25, page 13 lines, page 13 lines 1-25, page 14 lines line 1-10, page 14 lines 11-25, page 15 lines 1-2]

- **<u>Gas Leak Survey:</u>**

Prior to the accident, planned mobile leak surveys[17] were conducted on July 18, 2011, June 14, 2012, and July 5, 2013, over the distribution pipeline in the area of the incident. Walking survey of the gas service lines on Park Avenue between East 116th and East 117th was conducted on August 3, 2011. Con Edison, stated they perform mobile and walking surveys in the system covering more than 4,300 miles by mobile survey and 350,000 services by walking survey annually. Business district (area) leak surveys using both methods are done annually. For non-business district (area) the walking survey is done once every 3 years for the distribution services and the distribution main are leak surveyed by mobile survey annually.[18] [John Dimiceli – page 7 lines 7-8, page 12 lines 15-25, page 13 lines 1-4, page 13 line 9-13]

The segment of the gas pipeline on Park Avenue at the accident location is not classified as a business district (area) that receives an annual walking survey.[19] As a result, its survey occurs every 3 years

---

[16] See Interview of John Ludwigsen

[17] Definition: Leak Survey – According to Con Edison, is "a survey to detect gas leaks from gas pipelines, performed by trained and operator qualified personnel, using a gas detector, Detecto Pak-Infrared (DP-IR)"

[18] Section 8.5 of GS-11806-17 – Leak Survey Procedures

[19] Section 8.4 of GS-11806-17 – Leak Survey Procedures

under a planned survey.[20] The gas Company conducts an annual mobile leak survey over its entire system including this area, between East 116th Street and East 117th Street of Park Avenue over the gas mains. However, from East 116th Street going south, it is considered a business district because it has up to 50 percent of the buildings in the block used as businesses.[21] Since the Church assembly on 1644 Park Avenue was not considered business, this area did not qualify as a business district, although 1646 Park Avenue, which has a Piano shop, was a business.[22][John Dimiceli – page 12 line 20-25, page 13 lines 19-25, page 14 line 1-4, line 11-25, page 15 lines 1-7, lines 12-19, page 17 lines 6-11, lines 17-25, page 18 lines 1-4]

The mobile leak survey is conducted from a vehicle running over the main at 5 miles per hour down the streets, and on some streets similar to between East 116th and East 117th Streets it is offset about 6 feet (one car width) horizontally from being directly above the main distribution line due to vehicles parked on roadways. The technique involves four cones in front of the leak detection vehicle that pulls a continuous air sample into a single manifold holding detector equipment. The external pump draws the sample at about 10 liters per minute, and the sample is further drawn through another hose into the internal pump unit that has capacity of about 2 liters.

The gas detector is calibrated to detect natural gas down to 3 part per million. This detector could also detect methane gas at about 2 part per million, which occurs often in New York from other sources. The gas detector sensor device is located within the Detecto Pak Infrared device mounted in a cradle inside the vehicle. The leak survey technician monitor's the flow meter to make sure the pumps are working properly, and the detector unit checks itself where the sample is taken in, to determine if the detected gas is methane or not. This mobile detector is also self-calibrated whenever it is turned on. [John Dimiceli –page 18 line 16-25, page 19 lines 1-6, lines 8-25, page 20 lines 1-25, page 21 lines 1-18, page 22 lines 2-13]

According to the testimony of the Supervisor, mobile leak surveys through this segment of pipeline (East 116th Street and East 117th Street Park Avenue) were conducted two times in 2014, before the time of the accident. The two high speed mobile leak surveys were conducted in the area at the beginning and end of February 2014 (02-10-2014 and 02-28-2014)[23] at 15 miles per hour to capture any breaks in the main. Another mobile leak survey was performed after the accident in June 2014 consistent with the planned method of main pipeline annual mobile survey. Prior to these, the last annual mobile leak survey test, was done in about July 5, 2013. Both were run at 5 mile per hour. [John Dimiceli – page 23 line 23-25, page 23 lines 1-25, page 25 lines 1-5, lines 8-13]

The two high speed leak surveys in February were described by Con Edison to be precautionary operational decisions above requirements. This type of leak survey is initiated by the company because there were severe, adverse weather conditions as stipulated in the company procedures, section 11.1 of GS-11806.[24] This is performed with the intent to find cracked cast iron mains caused from frost or defrost conditions.

This high speed survey action was taken as a result of one of the following criteria that was met: freezing weather below 32 °F for 7 days that resulted in a frost depth of about 27 inches, 3 broken mains of any size in the entire system for 2 days in a row, and fluctuation of weather from freezing to about 40, and engineering judgment. The decision to initiate a high speed leak survey covers only cast iron, with diameters of 4-inch, 6-inch and 8-inch.[25] [John Dimiceli – page 26 line 4-12, page 41 lines 10-18, page 42 lines 7-13,

---

[20] Section 8.5 of GS-11806-17 – Leak Survey Procedures

[21] Section 5.2 of GS-11806-17 – Leak Survey Procedures

[22] Attachment 14 – Interview of John Dimiceli

[23] Attachment 19 – Response to DPS Interrogatories - DPS_1-f.12-Answer-DPS1_6. Dated 04-14-2014

[24] Attachment 21 – Leak Survey procedures –GS-11806-17

[25] See Interview of John DiMiceli

page 48 lines 14-25, page 49 line 1-5, page 51 line 11-19, page 62 lines 8-25, page 63 lines 1-8, page 65 lines 7-12]

Con Edison leak survey records thus shows that there were multiple leak surveys conducted between East 116th Street and East 117th Street on Park Avenue, using the mobile leak survey DP-IR vehicle at speeds of 5 miles per hour for planned leak survey and 15 miles per hour for the high speed, weather conditioned leak survey.[26] There was no natural gas leak detected in this area. [John Dimiceli – page 27 lines 13-18]

Limitations to the mobile survey equipment, detector pak infrared (DP-IR) arises where the road surfaces, paving, sidewalks, and building walls are 100 percent sealed because gas cannot leak to the surface into the atmosphere. However, it is believed there are no 100 percent sealed surfaces. Also the detector is set to detect natural gas leak at 3 parts per million (ppm) or greater, and detects naturally occurring methane gas down to 2 ppm.[John Dimiceli – page 31 lines 16-25, page 32 lines 1-16]

As a result of the gas leak detection machine operating at a default set of 3 ppm, any gas leak occurring below this range would not trigger the equipment to alarm and it would "not pick it up".[27] [John Dimiceli – page 58 lines 2-25]

The offset distance for the test vehicle from the main was based on prior experience and not a procedural requirement.[28] [John Dimiceli – page 42 line 23-25, page 19 lines 6, page 43 lines 18-21, page 44 lines 3]

Deviation exist from the written leak detection survey procedure because the vehicles run at 5 miles per hour for planned mobile leak detection survey, and 15 miles per hour for the weather conditioned high speed leak detection survey on cast iron mains of 4, 6, and 8 inches. The vehicle speeds used are discretionary, based on past experiences and not according to Con Edison gas leak detection survey specification.[29] The procedures require that the mobile leak detection survey be conducted at speed of 8-10 miles per hour for all leak detection survey conditions.[30]

Con Edison leak detection survey procedure under G-11806-17, section 8.5 require that a leak survey of distribution services in areas other than business districts, shall be done on a three-year cycle.

Con Edison performed distribution service walking leak detection survey for the non-business district survey area between East 116th Street and East 117th Street on Park Avenue in 2011. Records provided to document the walking leak detection surveys was the map used for the mobile leak detection survey for the business district and the non-business district.[31]

According to Con Edison leak detection survey procedure, section 7.2, the walking survey of services shall be conducted by Leak Survey Technicians with the most up-to-date maps; that indicate the locations of service lines. Technicians would walk the path of service lines from the curb valve or edge of the road to the building with DP-IR alarm level set between 3 and 5 parts per million. No scale adjustment is

---

[26] Leak Survey Procedures, GS-11806-17

[27] There is natural occuring methane gas in the New York areas that is detectable at 2 ppm, as a result, Con Edison set its leak detection equipment to detect natural gas at 1 ppm above the methane gas baseline in New York. At 3 ppm the gas detector can only give out an alarm when it detects natural gas leak.

[28] See Interview of John Dimiceli

[29] Specification G-11806-17 – Gas Leak Detection Survey Program.

[30] Specification G-11806-17 Gas Leak Detection Survey Program, section 7.1

[31] Leak Survey Map – This record was requested through information request as part of the investigation.

required. The map provided and used for the walking leak survey detection survey did not meet this procedural requirement because the map did not show the locations of service lines.

- **Post-Accident Pipeline Leak detection and Pressure Test:**

A pressure regulator was used to introduce air into the entire main to avoid over-pressurizing the pipelines above the operating pressure of 8 inches of water column.[32] The operating pressure of 8 inches of water column at the time of the incident was difficult to reach due to leak locations in the line. As soon as it reached 8 inches of water column, and then air supply was shut off, the pressure in the main immediately dropped confirming the leaks. The Company decided to employ a leak detection system requiring the use of PFT tracer.[33]

Segments of the 8-inch main comprising cast iron and polyethylene pipelines between East 116th Street and East 117th Street, and the 6-inch bare steel main on East 116th going west were mobile surveyed while leak detection perfluorocarbon (PFT) tracer gas was injected into the mains according to the company procedure after the accident and during the field investigation. Leak detection of the release of PFT tracer gas was conducted over the main pipeline.

The instruments for the leak detection were mounted in the vehicles for portability and quick sampling. Each uses two components; the concentrator and the gas chromatograph. The monitoring equipment detects high gas concentration areas over the pipeline, shown on the display screen which indicates there could be possible leaks at that location. The indicated locations are marked out and measured from a reference point, for a planned excavation and examination.

On March 17, 2014, the 8-inch HDPE gas main and cast iron pipe on Park Avenue between East 116th Street through East 117th Street going north, and the 6-inch bare steel pipe that ran along East 116th Street going west, were examined for leak detection. High PFT tracer gas concentrations were observed in front of 1642 Park Avenue on the segment of main with the polyethylene pipe. This high reading indicates where the tracer gas leaves/leaks from the pipeline unto the ground.

The segment of the entire main that showed high readings from the tracer gas egress, in front of 1642 Park Avenue was later excavated. This segment of pipe consist of the 8-inch HDPE main, and 2-inch HDPE separated fusion saddle tee installed in 2011, see figure 16 and 17. The separated service saddle tee and main segment was later cut out from the remaining 8-inch HDPE gas main on Park Avenue before another pressure test of the main was conducted.

The pressure test covered the two segments. Segment 1: Approximately 126.5 feet of 8-inch Cast Iron main tested from capped main in front of 1652 Park Avenue (south end of building) to capped main in fire bank at the intersection of East 117th Street & Park Avenue. Segment 2: Approximately 66.3 feet of 8-inch Cast Iron and Plastic main tested from north end of building to 1642 Park Avenue to south end of building to 1652 Park Avenue.

These segments of 8-inch main were pressure tested twice but failed to hold pressure during the tests due to small leaks on the pipeline. Because the segments could not hold pressure, calculations for flow test were performed to quantify the volume of lost gas from this pipeline. The flow rate of loss for the two

---

[32] Water Column is a measure of operating pressure

[33] Perfluorocarbon Tracer (PFT) – these are "a group of inert, highly volatile compounds used in tracing application." Note: Con Edison's "use of Perfluorocarbon Tracer began in the late 90's after a joint study with Electrical Power Research Institute (EPRI) proved the feasibility of using PTF to locate dielectric fluid leaks in High Pressure Fluid Filled (HPFF) Electrical Feeders."

calculations gave values of 1.7 cubic feet per hour (segment 1) and 0.6 cubic feet per hour (segment 2), respectively.

The service pipelines to 1644 and 1646 Park Avenue were tested with the entire main on March 17, 2014, in which the pressure test failed. They were retested and passed after they were disconnected from the gas main (see table 1). Both segments were later excavated and sent to the NTSB laboratory for further examinations. However, no further test was conducted on these service lines except visual examinations.

Table 1 - Pressure test at MAOP and Operating Pressure for service pipelines at 1642, 1644, and 1646 Park Avenue.

Address	Type of Pressure Test	Start Time	End Time	Duration (Minutes)	Start Pressure (inches of water column)	End Pressure (inches of water column)	Date	Result
1642 Park Avenue	Operating Pressure	2:23 p.m.	2:38 p.m.	15 minutes	8	8.05	March 21, 2014	Passed
	MAOP	2:40 p.m.	2:55 p.m.	15 minutes	12.0	12.2	March 21, 2014	Passed
1646 Park Avenue	Operating Pressure	10:09 a.m.	10:30 a.m.	21 minutes	8.17	8.89	March 25, 2014	Passed
	MAOP	10:45 a.m.	11:06 a.m.	21 minutes	12.22	12.68	March 25, 2014	Passed
1644 Park Avenue	Operating Pressure	11:36 a.m.	11.57 a.m.	21 minutes	8.13	9.19	March 25, 2014	Passed
	MAOP	12:12 p.m.	12:33 p.m.	21 minutes	12.08	13.82	March 25, 2014	Passed

The fact that the pressure held, confirms that the pipeline did not leak within the service lines segments that were tested. The pressure tests ended upstream of the service meters and do not include any building internal piping downstream from the meters. However, some pressure increases were observed during the pressure tests due to changes in temperature of pipes. These can be observed when there are no leaks in the system.[34]

Note: Pressure test for the 1644 and 1646 Park Avenue used test equipment similar to the equipment used in the mainline pressure test. This included charts recorders for pressure, temperature, ambient monitoring, and pressure gauge. Readings were recorded every 3 minutes.

G. Pre-Accident Activities:

- **<u>New York City Department of Transportation General Duties and Responsibilities</u>**

New York City states there are "nearly 6000 miles of street in the City." The New York City Department of Transportation (NYCDOT) is charged with maintenance and repair of the transportation surface of public streets. They inspect and respond to roadway defects and potholes conditions. The NYCDOT works with other agencies such as the New York City Department of Environmental Protection (NYCDEP) that is charged with maintenance of the sewer and water mains.

[34] Investigation Operations Field Notes

As a norm, utilities and developers, as well as their subcontractors, must obtain a permit from the NYCDOT. In Fiscal Year 2014, the NYCDOT issued over 400,000 permits citywide, including approximately 181,000 street opening permits, 135,000 building operations/construction activity permits and 20,000 sidewalk construction permits.

According to City of New York, they generally do not own the subsurface infrastructure. Much of the infrastructure belongs to the utilities and companies that installed it and those entities remain responsible for the infrastructure's maintenance and repair.

New York City states that the block located at Park Avenue between East 116th and East 117th Streets is fairly typical other streets in Manhattan with respect to the number of permits issued and related street activity. Between 2004 and 2014, the NYCDOT issued about 309 permits on this block, including 116 street opening permits, 140 building operation/construction activity permits and 9 sidewalk construction permits. The NYCDOT issued these permits to different entities including Con Edison, Empire City Subway, Verizon, West Manor Construction Corp, and Plumbing Works, Inc. to work on this block.

- **Park Avenue Road Repairs between East 116th Street and East 117th Street:**

NYCDOT has carried-out a number of roadway repairs between East116th Street and East117th Street of Park Avenue before the accident. NYCDOT work orders, work descriptions, and employees' testimonies indicated a location with evidence of road depressions opposite 1644 and 1646 Park Avenue.

Most recently on March 9, 2014, a roadway depression[35] was identified in front of 1644 and 1646 Park Avenue according to the crew supervisor testimony. The condition was caught through a drive-by road inspection which was not among routine scheduled work assignment. The NYCDOT crew re-repaired and made safe a prior repaired about 12 feet x 12 feet condition that measured about 18 feet by 14 feet and 1-1/2 inches deep by applying hot asphalt on the road which was then compacted with hand roller constructed from steel with encased cement.[36]

On September 6, 2013, a NYCDOT crew identified a roadway depression[37] that measured about 15 feet x 9 feet, and 1 inch deep. They repaired the defect with asphalt, started at 8:45 p.m. and ended at 9:20 p.m.[38] The crew attributed the condition to the wearing of a prior restoration.

On June 3, 2010, on the southbound driving lane, west side of the roadway, the NYCDOT repaired a depression in front of 1644 Park Avenue, reported as cave-in with dimensions of 20 feet x 30 feet and 5 inches deep. The crew identified this location as a prior road repair with 10 feet x 20 feet asphalt patch. The NYCDOT record[39] indicates that this agency, requested that the New York City Department of Environmental Protection (NYCDEP) address the condition, and that the NYCDOT will re-inspect it within 60 days.[40] Additional NYCDOT reports to NYCDEP were made on August 10, 2004, and July 3, 2012, and another report from a private citizen to NYCDEP that was received by the agency on August 16, 2007.[41]

---

[35] Attachment 13 - NYC_DOT Road Repair Drivers Worksheet_03_09_14

[36] Attachment 11 – Interview of Rosario (Roy) Carluzzo

[37] A depression means a general settlement of an area in the roadway

[38] Attachment 12 - NYC_DOT Road Repair Drivers Worksheet_09_06_13

[39] NYCDOT completion report.

[40] See Attachment 13 - DOT Streets and Sidewalk report number SR#1-1-567468590

[41] Attachment 13 b - Appendix A1 - Consolidated Edison Factual Notes

On October 13, 2009, the NYCDOT received a complaint from an anonymous caller[42] from 311 Call Center reporting a sunken street patch at 1646 Park Avenue. The NYCDOT inspector noted that there was a 20 feet x 7 feet depression that was previously patched but sunken about 2 inches to 3 inches. The inspector's report also stated that the roadway was rough pitted or cracked, and should be resurfaced.[43]

On June 2, 2004, Borough of Manhattan reported[44] a large depression in the street on Park Avenue between East116th Street and East117th Street. However, this road defect was later restored on December 17, 2004.

- **Activities on Park Avenue between East 116th and East 117th Streets by Con Edison and Plumbing Contractors for 1642 Park Avenue**

In August 2011, the NYCDOT issued Con Edison about five permits pertaining to the installation of gas line on Park Avenue between East 116th and East 117th Street.

In December 2011, in relation with the construction of a new building at 1642 Park Avenue a plumbing contractor, Plumbing Works, Inc. conducted excavation to install a new connection for sewer and water service. The plumbing contractor restored the street surface. The plumber stated that Plumbing Works completed the road repairs before Con Edison performed any of the pipeline construction work. [Murdocca Page 33, lines 21-33, page 35, lines 14-25, page 36, lies 1-13]

Following the plumbing contractor's work, in December 2011, The NYCDOT issued Con Edison a permit to install the HDPE gas main in front of 1642 Park Avenue. The NYCDOT performed inspections of these work conducted by Con Edison based on the permit between December 2011 and September 2013. As a result of the inspections, the NYCDOT issued Con Edison a Corrective Action Request (CAR)[45] on October 13, 2012 for failure to reseal a street opening for an underlying permanent gas trench. On January 19, 2013, the NYCDOT re-inspected the work site and found Con Edison had not complied with the October 2012 CAR.[46] As a result the NYCDOT issued Con Edison a Notice of Violation (NOV) for failing to reseal the street opening joints around a permanent gas trench in the roadway. In March 23, 2013, Con Edison passed the NYCDOT re-inspection concerning the deficiencies in the CAR and NOV.[47]

According to Con Edison's records on reports of street and sidewalk openings - street segment, the company had performed six related works in front of 1642 Park Avenue. Some road paving and asphalts seal works were done by the gas company as listed in table 2.[48]

---

[42] Anonymous caller – The called individual did not want their name published.

[43] See attachment 13b - DOT Street and Sidewalks report number SR#1-1-515722689

[44] Attachment 13 b – Appendix A1 and History of defect; # DM2004154021

[45] Apprroval; #M012011362128

[46] Definition – HIQA; Highway Inspection and Quality Assurance

[47] Attachment 16 - NYCDOT Dynamic Access System for HIQA with NOV Number 181870857

[48] Attachment 26 - Con Edison Street Excavation and Paving

Table 2: Park Avenue road asphalt paving and seal

Date	Size of road repaired	Nature of work
September 2, 2010	27-foot by 2-foot	Plugging and restoring road shoulder
May 2, 2011	85-foot by 3-foot	Paving road
September 8, 2011	42-foot by 1.5-foot, and 15-foot by 5-foot	Paving road
December 29, 2011	15-foot by 5-foot	Paving road
November 12, 2012	25-foot by 12-foot	Asphalt sealing
January 29, 2013	150-foot by 4-foot	Asphalt sealing

Records reviewed of complaint on large street depression and repairs between East 116th Street and East 117th Street on Park Avenue, show that earlier report on this condition was dated June 2, 2004, and NYCDEP Park Avenue camera inspection of the combined sewer main before the accident was dated October 16, 2006, and August 24, 2011. The inspections record showed a point in the side-wall of the combined sewer main without bricks that were later determined to be located under the repeated depressed and repaired roadway location. Submissions to the NTSB identified an opening without bricks on the east side-wall of the 32-inch by 48-inch sewer main, more than 8 years before the accident.[49] This opened wall without bricks is shown located in the combined sewer main below the roadway at the numerous street depression repairs in front of 1644 and 1646 Park Avenue.

- **Sewer Lateral and Water Service Installations**

Construction of a commercial multi-dwelling property located at 1642 Park Avenue was in progress in 2011. During this construction, an 8-inch sewer lateral was connected to existing sewer main and a water service line was connected to a 12-inch existing cast iron water main. The cast iron water main was later observed cracked in a collapsed asphalt roadway during fire department of New York emergency response.

Both the sewer main, constructed in 1873, and the 12-inch water main, constructed before 1887, are managed by the New York City Department of Environmental Protection (NYCDEP).

According to the plumbing contractor,[50] they were contracted to install sewer lateral and water service lines in 2010 to 1642 Park Avenue, with a New York City Department of Transportation (NYCDOT) permit dated December 8, 2010. This permit extended until the 22nd day of the month. After starting the work, the contractor observed that the sewer main connection was very deep, about 19 feet below road grades, and with no sewer riser[51] indicated in the engineering (sewer) drawing. This sewer main condition resulted in the need to construct a sewer riser. Following this development, the engineers had to revise the drawings, secure a new permit from the NYCDEP, and restart the process. As a result, the work was restarted in 2011. After the construction of the sewer lateral, the water service line was installed to about 4 feet deep. [Rocco Murdocca – page 8 lines 12-22, page 9 line 2-21]

The sewer lateral construction was started from the street, through the riser, and worked back to the building wall. And according to the plumber, details of each sewer differ, it could be rectangular, or square shaped. Being a brick sewer main, the riser was constructed in form of a residential chimney and entered

[49] Attachment 23 – Interview of John Lobello - 08-06-2014

[50] Attachment 22 – Interview of Rocco Murdocca 8-8-14

[51] Sewer Riser; This is a vertical construction of sewer channel to off-set the depth from the sewer main and which the sewer lateral would be tied-in at a lesser depth.

through the side of the sewer with a concrete incased platform construction. They gained access to the sewer main by drilling into it. It was a brand new penetration to the building. [Rocco Murdocca - page 12 line23-25, page 14 lines 9-17, page 20, 20-25]

As a result of the sewer main depth and construction of the sewer riser, "a field condition"[52] according to the plumber was created due to "complete exposure" of a side of the sewer main. The contractor worked with NYCDEP specifications. According to the contractor, in accessing the sewer main, they broke through rocks, as a result; it required NYCDOT oversight during the work.

To avoid causing vibrations to nearby structures, according to New York City regulations, no mechanized equipment was used to break the rocks, but they had to drill and split the rocks using either a regular handheld rotary or air-powered drill. The contractor had hydraulic rock splitters. The start of the sewer excavation measured about 8-foot by 8-foot. He maintained that they had consistent texture of soil as they dug down the trench, and it was of stable nature. [Rocco Murdocca – page 15 line 10-19, page 19 line 6-12, line 14-24, page 24 lines 10-16, line 17-25, page 25 lines]

Throughout the sewer excavations, the contractor stated they did not encounter water and believed the water table in the areas was deep. After the sewer lateral installation was completed, the crew installed the water service. To do that, the 12-inch cast iron water main and 8-inch cast iron gas main were equally exposed. The NYCDEP came to tie in the service by connecting the sleeve. This was called a wet connection. [Rocco Murdocca – page 26 line 4-20, page 28 lines 1-13]

According to the NYCDEP, contrary to the plumber's statement, they require the plumber to "conduct the excavation and install the wet connection sleeve and valve to the main, after which the NYCDEP drills a hole in the water main using a bolting machine to prevent leakage or compromise to the integrity of the main."

- **Post-Accident Sewer Examination at 1642 Park Avenue by NYCDEP**

The NYCDEP records submitted to the NTSB on the agency's post-accident excavations and examination of the sewer lateral condition to 1642 Park Avenue revealed that some of the plumber interview testimonies were not consistent with the installation made about the 2011 Plumbing Works, Inc. work. The NYCDEP excavation from April 2014 activities shows that there was no "sewer riser" installed to connect the sewer lateral to the new building in 2011.

Neither the site connection proposal form for 1642 Park Avenue nor the approved plan for the housing connection required "sewer riser", but the later indicated "a drill-in" connection.

Based on the NYCDEP documents and photographic images (IMGs 3714, 3689, 1841, 1845, and 1846) submitted to the NTSB, it is evident that the plumber installed a drill-in connection, not a sewer riser, at 1642 Park Avenue.[53]

However, review of all the sewer lateral installation document shows that a prior proposal by the 1642 Park Avenue owner's engineer proposed a sewer riser, but subsequent communications from the owner's engineers to the NYCDEP indicated the plan changed from riser to drill-in connection.

---

[52] A field condition according the the plumber was explained as where the sewer location is deep, and there is no riser to tie-in the service sewer lateral, except to go in and cut new opening on the side of the sewer main. This would require the city's inspector presence when the sewer contractor would perform such activity. The NYCDEP cannot verify nor identify with this term as the industry language.

[53] Attachment 35: NYCDEP Exploratory excavations pictures at Park Avenue.

The post-accident sewer examination excavations at 1642 Park Avenue also revealed that after digging to a depth of about 6 feet into the 2011 plumbing works backfills of the sewer lateral, the crew encountered backfill that was comprised of large boulders throughout the trench until reaching the sewer connection. Reports and drawings from an NYCDEP exploratory excavation performed by Contract GE 351 in April 2014 to "ascertain the condition of, and connection detail for the sewer house connection as well as the situation of soil condition" are included in attachment 34.[54] Report of the combined sewer main's "exploratory excavation test pit over the defect 48-inch by 32-inch brick sewer to ascertain the condition was performed.[55]

- **Gas Main and Service installations**

A segment of 69 feet of 8-inch cast iron gas main was replaced with 8-inch HDPE pipe gas main in front of 1642 Park Avenue due to sewer lateral and water service installations in 2011. The 2-inch HDPE gas service to 1642 Park Avenue was installed in the same trench as the water service pipe. The gas service line was buried to a depth of about 3 feet and shallower to the water service line buried to about 4 feet. The gas and water services ran from the building wall to their respective main connections with about 18 inches of parallel separation and horizontally going from west to east.

On Park Avenue, the 8-inch HDPE gas main installed after the 8-inch pipe cast iron gas main was undermined by the plumber's work as defined in the Con Edison procedure. This 8-inch HDPE gas main was located with underground clearance of about 8.45 inches to the cast iron water main at the service tee location. The two main pipes also had about 7.5 inches clearance at the water main crack location through the excavations. The gas main pipe was further east. The gas main was buried at a depth of about 46 inches at the gas service tee location, 45 inches at the water main crack location and the water main was buried at about 58 inches at the gas service tee location, and 51 inches at the water main crack location at the 1642 Park Avenue excavations.[56]

H. Post-accident Activities; Site Inspection and Excavation

- **Sewer Main Inspection**

The sewer main running from north to south in direction of flow is located on the southbound lane of Park Avenue and is an oval or elliptical shaped construction. The combined sanitary and storm sewer main was 32 inches wide and 48 inches high, and the walls were made from bricks joined with mortar. Records submitted by the NYCDEP shows it was constructed in 1873.[57] The center of the combined sewer main buried to a depth of 19 feet was located at about 9 feet from the curb or baseline at front of 1642 Park Avenue.[58] The sewer main ran parallel at about 15 feet below the 8-inch HDPE gas main for several feet until the gas pipe ran directly over the sewer main construction along Park Avenue in the northern direction.

The NYCDEP used robotic camera equipment (robotic camera) to enter and inspect the sewer main on three different occasions on March 19 & 28, 2014. The sewer main was entered with the robotic camera, first from the upstream manhole[59] on March 19, 2014. With the robotic camera placed to the floor of the

---

[54] NYCDEP exploratory excavation performed by Contract GE 351 at 1642 Park Avenue.

[55] See Attchment 34: NYCDEP exploratory excavation performed by Contract GE 351 at 1642 Park Avenue

[56] Attachment 28 - Schematics of pipes facilities burial at 1642 Park Avenue – Relative Profiles

[57] Attachment 31 – Answers to Age Questions

[58] Attachment 28 –Schematics of pipes facilities burial at 1642 Park Avenue – Relative Profiles

[59] Upstream Manhole - # M101-1744 – near East 117th Street and 1652 Park Avenue

sewer main, it traveled and video recorded conditions in the sewer main until it encountered some bricks and debris blockage on the floor near the intersection of Park Avenue and East 116th Street, and could not move further.

To avoid getting the equipment stuck in debris, it was driven back and lifted out of the upstream manhole. After the combined sewer was cleaned from the downstream manhole,[60] the robotic camera was re-inserted and the inspection conducted from the downstream manhole. This inspection also went further south on Park Avenue with no significant abnormalities noticed. But the defects, such as missing bricks, observed with the robotic camera on both inspection runs in the sewer main coincided.

Another sewer main inspection conducted on March 28, 2014, was used to explore the relationship between holes or voids observed in front of 1642 Park Avenue excavation, where segments of 8-inch HDPE gas main and 2-inch HDPE gas service, saddle tee, and 12-inch pipe cast iron water main were excavated and extracted, and the 12-inch by 40-inch sewer main opening[61] observed in front of 1644 and 1646 Park Avenue. The robotic camera entered the sewer main from the upstream manhole, and was driven south on Park Avenue toward the downstream manhole. The inspection was completed with observation of several missing bricks in the sewer main wall that coincided with the previous inspections on March 19, 2014, figure 6.

Figure 6: Damaged east side of sewer main wall (12 inches by 40 inches) in front of 1644 and 1646 Park Avenue. Source: NYCDEP

The upstream manhole of the sewer main located near East 117th Street and 1652 Park Avenue was observed during the field investigation to have had the 8-inch cast iron believed to be gas main belonging to Con Edison travel through it at a depth of about 1.5 feet below the manhole lid and the roadway grade on Park Avenue as shown in figure 7. The cast iron pipe is indicated by the red arrow. However, this indicated 8-inch cast iron pipe inside the manhole was later discovered during post field investigation road

[60] Downstream Manhole - #M101-2264 - near East 116th Street and 1640 Park Avenue

[61] Sewer main opening describes the location where the combined sewer had missing bricks from its East side wall.

excavations and re-construction on May 5, 2014, to be an abandoned gas main while the cast iron gas main in service at the time of the accident was by-passed at the upstream manhole as shown in figure 8 with green arrow.

Figure 7: 8-inch cast iron pipe that travel through upstream manhole sewer main at 1652 Park Avenue, as indicated with red arrow at about 1.5 feet below manhole lid and roadway grade.

Figure 8: 8-inch cast iron gas main of Con Edison by-passed at upstream manhole of sewer main on Park Avenue, as indicated with green arrow. Source: NYPSC

The robotic camera, at 7.97 feet from entering the upstream manhole,[62] photographed a defective made tap at 02 o'clock about 6-inch tap within 8 inches of the joint, at 20.78 feet in the sewer there was mortar missing located from the 04 to 08 o'clock position, and defective made tap at 02 o'clock about 6-inch tap within 8 inches of the joint. At 35.30 feet there was a defective made tap at 02 o'clock, about 6-inch tap within 8 inches of the joint. At 116.38 feet there was tap break–in intrusion at 02 o'clock about 6-inch tap within 8 inches of the joint. At 118.30 feet there was tap break in at 02 o'clock, within 8 inches of the joint.[63]

At 118.50 feet from the upstream manhole, there was a hole on east side of Park Avenue opposite the lateral sewer service taps of 1644 and 1646 Park Avenue. The void was about 12 inches by 40 inches, and showed soil penetrations through this opening as shown in figure 6.

At 151.36 feet from upstream manhole, about at the frontage 1642 Park Avenue, looking south, there was continuous leak of water through the mortars shown in the inspection video from the 11 to 01 o'clock within 8-inches of joint. At 195.15 feet the defects in mortar joints from 04 to 08 o'clock ended on the west wall. Additional upstream sewer main inspection up to 153.90 feet was performed with nothing of interest in this accident.

- **Cast Iron Water Main**:

The buildings between East 116th Street and East 117th Street on Park Avenue have their water services supplied from the NYCDEP 12-inch cast iron water main constructed in 1887.[64]

On March 12, 2014, about 1:46 p.m. more than four hours after the explosion, responders observed water gushing out in a collapsed asphalt roadway in front of 1642 Park Avenue. The water main break created large void that was filled with water, and that also exposed the natural gas main.

The cast iron water main was first exposed (figure 9) during the fire department emergency response in an attempt to re-stabilize the street for the firefighting equipment and the heavy machinery brought on site to begin clearing the massive debris and excavation due to sink hole (figure 10 and 11) observed at the water main break location. The exposure of the cast iron water main equally exposed the segment of sagging 8-inch HDPE pipe gas main and the top of the service saddle tee to 1642 Park Avenue as shown in figure 12 with a red arrow and in figure 12 with a white arrow.

---

[62] Note: Locations of defects; the location of the defects observed are atimes approximates and varies in feet and inches depending on the movement of the Robotic Camera equipment's position capturing of an object. The Robotic Camera do have a zoom-in capability, and could capture the same object at different distances.

Note: The following paragraph was quaoted partially verbatim from the the report of the sewer scoping performed by National Water Main on March 19, 2014. This report reference to "defective made taps", "tap break in"all refers to housing sewer lateral connections that are not installed or maintained by NYCDEP.

[64] See Attachment 30 – NYCDEP Answers to Age Questions Utilities.

Figure 9: The exposed 8-inch HDPE gas main and 12-inch cast iron water main cracked location. Source: NYPSC

Figure 10: Sink-hole at the location of the 12-inch cast iron water main break. Source: FDNY

Figure 11: Sink-hole at 12-inch cast iron water main break location showing 8-inch HDPE gas main. Source: FDNY

Figure 12: The exposed 8-inch HDPE gas main and top of 2-inch HDPE service saddle tee indicated with a red arrow, in front of 1642 Park Avenue. Source: NYPSC.

Figure 13: Close view of exposed 8-inch HDPE main and top of 2-inch HDPE service saddle tee indicated with a white arrow, in front of 1642 Park Avenue. Source: NYPSC.

According to photographic evidence and testimony of an officer with the New York City Office of Emergency Management (OEM), a backhoe was used to expand a sinkhole over the cracked cast iron water

main pipe location exposed in figure 8 to excavate to sound surface.[65] This area was subsequently backfilled with small diameter gravel (crush and run)[66] and soil.

On March 28, 2014, after all Con Edison gas pipelines had been excavated and extracted, segment of the NYCDEP 12-inch cast iron water main pipe containing the crack was completely exposed. The crack on the 12-inch cast iron water main pipe was measured using both wooden measuring ruler and metal measuring tape (figure 14). The top of the crack on the water main pipe measured about three-quarter inch. The water main circumferential crack ran almost 360 degree and was wider on the top of the pipe as shown in figures 14 and 16. The cracked location was also observed to have been directly on top of rocks as shown in figure 15 and large holes in the surrounding fill, as shown in figure 17.

Two segments of the 12-inch water main pipe, about 6 feet and 8 feet long, were extracted from the excavation in front of 1642 Park Avenue for NTSB laboratory examinations. See the NTSB metallurgical factual report for additional information.

According to City of New York, they believe that after the two segments of the 12-inch water main were extracted from the excavation, the soil condition shown in figure 18 "remained undisturbed, without signs of subsidence except at the location where the water main experienced a nearly 360 degree" circumferential crack.

Figure 14: 12-inch cast iron water main pipe with circumferential crack top view. Source: NYCDEP

[65] See Attachment 31 - Interview of Frank McCarton and Attachment 32 –Party Photograghs on Sink Hole Excavations

[66] Crush and run – These were the backfill materials used in filling the exposed cast iron water main and gas pipelines location during the emergency operations.

Figure 15: 12-inch water main cracked location directly located on top of rock.

Figure 16: 12-inch water main pipe with circumferential crack bottom view.

Figure 17: Holes (hole-A) exposed in the rocky soil after water main pipe segment was removed.

- **Post Pipes Extraction and Large-Holes Examination:**

A test was devised to determine if water introduced into the holes exposed under the water main (figure 17) would flow down into the damaged sewer located about 15 feet below the water line.

To conduct the test, water from a water truck hose and florescent green colored dye were introduced into the holes under the water main. Within minutes the robotic video camera captured volume flow of the florescent green dyed water solution flowing into the sewer main through the 12-inch by 40-inch damaged wall (figure 18). The dyed water also penetrated through other sewer main wall cracks along 1642, 1644, and 1646 Park Avenue locations.

Figure 18: Florescent Green dyed water solution entering the sewer main at (hole-B) the damaged east sidewall. Source: NYCDEP

The water flow test established the fact that the holes in the ground under the water pipe in front of 1642 Park Avenue provided a direct, unimpeded water flow path into the sewer main.

- **Water Main and Service Lateral Leak Survey:**

According to the NYCDEP in charge of the water and sewer system, they had recently surveyed the water main system that included facilities between East 116th Street and East117th Street from January, 2012 to March, 2014. There were 6 leak surveys conducted (1-10-2012, 8-29-2012, 9-5-2012, 2-21-2013, 4-17-2013, and 3-5-2014). NYCDEP stated there was no leak revealed during the surveys and has provided worksheets specifying the streets covered during the surveys.[67]

[67] Attachment 33 - Park Avenue Water Main Leak Survey Records

NYCDEP's water main investigation method involves the use of a Correlator, Digicorr, and L-MIC[68] instruments to pinpoint the source of the water main leak by attaching sensors from this equipment to the water hydrants, and valves.

The leak survey crew targets an assigned area, then using the L-MIC instrument (also called SS20), a survey box to check and listen for sounds of water main break at the hydrants, and at valves locations. This survey box is made of sensor with an amplifiable sound and a headset for the ears. The probe for the instrument (a T-Bar) is set to make metal to metal contact with the valves. The operator places the sensor on top, then listen to it, and if there is sound, they make notation, but if there is no sound, they move on to the next location. [page 24 lines 7-23]

Manhattan is divided into three areas and had to be surveyed in a nine month cycle according to one of the supervisors in NYCDEP's Bureau of Water and Sewer Operations.[69] According to the supervisor, the inspection crew goes out after midnight (12:00 midnight – 08:00 a.m.) for surveys on daily basis. At this time there is minimal noise interference. They receive system map from the supervisor to walk the water main pipe with, and with note pads they indicate any location that require investigation. When there is noted location for suspected water leak, the supervisor then goes out with "a little more sophisticated" instrument to conduct a follow-up inspection. [John Lobello – page 8 line 18 – 25]

After the supervisor goes out and pinpoints a location, this is then marked out for repairs. If the repair group comes and dig the location, they repair the problem immediately. [John Lobello – page 9 line 10-17]

According to the supervisor, to verify a leak location when there is a sound on the water main, he attaches an instrument to part of the water main "Correlator"[70] that has two sensors, he moves it around where he perceive the problem exists, then the instrument narrows the distance between two points (for example, a mainline valve and a hydrant gate valve), which consequently pinpoints the source of the sound. [John Lobello page 9 lines 21-25, page 10 line 1-2]

This is achieved by measuring the distance between the two points, and then inputting the information of the distance, pipe material, and possible different segment of pipes; e.g. 6 inches, 12 inches, and 20 inches, into a computer that does the correlation. The computer system generates the footage from one point, and then estimates the leak point to that proximity. The supervisor further reconfirms the findings, checks nearby water services to ensure that no sound from them causes a false sound reading. When confirmed; it is passed over to be repaired. [John Lobello page 10 line 1-2, line 4-19, page 12 lines 1-8]

According to the Supervisor, the water main leak detector instrument use is calibrated about every two years as a matter of practice by the detection team personnel. This calibration interval was not set by the

---

[68] These are test instrument made by fluid conservation system (FCS).

[69] Attachment 23 – Interview of John Lobello - 08-06-2014

[70] Correlator – This is a wireless transmitters.

manufacturer. There is no specific protocol or procedure governing the calibration.[71] He further stated that the instrument is very accurate and highly sensitive when a large leak occurs. He further stated that he had found locations where water main pipes had continued to leak for years using this process and equipment. [John Lobello page 12 lines 10 -25, page 13 lines 1-7]

The supervisor also stated that it is possible to have a large water main leak without water coming to the surface and that in the industry it is called "reading the street." And they had in the past found some depressions, where they have correlated with a water main break. He stated that sometimes the depression could be near the leak, or the water break could be washing away the soil as far as 10 feet away. In such cases, he stated he amplifies the sound and place another detector, L-Mic instrument over the main, then walk it, and where the water break leak is large, it would be heard. [John Lobello – page 13 lines 17-25, page 13 lines 1- 25, page 14 lines 12-25, page 15 lines 1-25, page 16 lines 1-5]

The supervisor also stated that the water main break detection may be affected by the pipe diameter and pressure. According to him, the extent of sounds detected is based on the vibration from the water main; the smaller the main is the louder sounds are picked up. If the diameter is larger; 20, 36, and 48 inches, it is more difficult to hear the sound, then you have to be closer to scan the pipes. Also pinhole leaks on service lines are hard to detect. Some other hindrances are interference coming from subway systems, traffic, skyscraper water pumps, and high pressure gas pipe main touching water main. There are no formal written guidelines that govern leak detection surveying. [John Lobello - page 20 lines 1- 19,]

The leak survey personnel acquire their skill through hands-on training only. They participate in field operations through listening to different sounds and are assisted by more experienced surveyors. [John Lobello – page 25 lines 220 -25, page 26 lines 1-25]

NTSB reviewed ten years of records (03-20-2004 to 03-20-2014) from the New York City Department of Transportation which indicated a total of 12 number 311 calls for locations between East 116th Street and East 117th Street on Park Avenue. None of these calls involved water leaks to the street surface or into any property basement was reported through this system.[72] NYCDEP records reviewed show no reports of water leak into the basement was ever received.

- **Gas Pipeline**:

There were several pipeline camera inspections by Con Edison as a result of the NTSB field investigation of the pipelines involved in this accident. Inspection of interest was camera inspection of the 8-inch main pipeline between East 116th and East 117th Street, on March 19, 2014, listed in table 3 that revealed the following:

[71] See Attachment 33 - Park Avenue Water Main Leak Survey Records

[72] Binder Park_Avenue-10 Year; from City of New York

Table 3: Camera inspection of the 8-inch gas main on Park Avenue, going south to north from Pit#2,

Distance (feet)	Observation
10, 22, 36, and 41 feet	Joints
43 and 44 feet	2-inch plugs (figure 11)
45 feet	Transition from cast iron to PE pipe (figure 12)
48 feet	Butt fusion on plastic main
50 feet	Cross weld
51.5 feet	6-inch tee at 3:00 O'clock
51 feet	Cross weld
52 feet	6-inch tee at 9:00 O'clock
52.5 feet	Butt weld
58.5 and 59 feet	2-inch tapping tees
59, 59.5, and 60.5 feet	Butt welds
62 feet	2-inch tapping tee
63, 83, and 102 feet	Butt welds
110.2 feet	2-inch service saddle tee possibly disconnected from the main and the tracer wire (figure 13)
115 feet	Start of pool of water in the main (figure 14)
118 feet	Debris in the pipe

Figure 19: Internal camera inspection of 8-inch gas main pipe shows two 2-inch plugs at about 43 feet and 44 feet. Source: Con Edison

Figure 20; shows the internal view of the cast iron to PE pipe transition in the 8-inch HDPE gas main. The joining material was by means of the steel mechanical compression coupling (manufactured by Dresser).

Figure 20: Internal camera inspection of 8-inch gas main pipe shows transition from cast iron to HDPE. Source: Con Edison

Figure 21; shows the internal view of the separated service saddle tee to 1642 Park Avenue. The inspection was conducted using a robotic camera inserted into the 8-inch gas main at Pit#2. The service tee was located at about 110.2 feet from Pit #2. Soil and other earth materials penetration were shown to have entered inside the 8-inch HDPE gas main and 2-inch service tee through the separation of the service saddle tee fusion from the main. The red colored tracer wire was observed in the gap between the service saddle tee fusion surface and the gas main. This condition was present on March 19, 2014, before the re-excavation of the gas main and service pipeline connection at this address on March 20, 2014.

Figure 21: 8-inch HDPE gas main disconnected 2-inch service tee on the main HDPE and red tracer wire. Source: Con Edison

Figure 22 of the internal view of the 8-inch HDPE gas main is shown filled with water[73] at about 114.5 feet from Pit #2. The water and debris contents prevented the robotic camera to move beyond that point during the gas main inspection. Relevant information about the gas main attributes before 1644 and 1646 Park Avenue service tees was however, gathered.

Figure 22: 8-inch gas main pipe with pool of water in the main PE pipe. Source: Con Edison

- **<u>Post Internal Inspection of Gas Pipeline Exposure:</u>**

Excavation at 1642 Park Avenue frontage over the 8-inch HDPE gas main revealed a separated 2-inch service tee from the polyethylene gas main at the saddle tee fusion as shown in figures 23-25. The gas

[73] Water in Con Edison pipeline resulted from the post accident activities at the site from water main break releases and emergency responders fire fighting activities.

main was colored black with yellow stripe and was indicated as high density polyethylene pipe. The surrounding ground was observed to be porous soil and contained holes around the 8-inch HDPE gas main and 12-inch cast iron water main pipe as shown in figure 26.

Figure 23 shows the 2-inch HDPE gas service saddle tee connection at 1642 Park Avenue that has been separated from the 8-inch HDPE gas main. On excavation, it was observed that a piece of asphalt from post-accident excavations on March 12, 2014 during re-stabilization of the roadway for fire department recovery activities had fallen and rested on top of the service saddle tee cap. This asphalt piece measured about 14 - 20 inches wide by 19 inches high and 6.5 inches thick. There was another piece of asphalt that lay against the gas main, and opposite the service tee. A red colored tracer wire was wrapped around the service saddle tee.

Figure 23: Separated gas service saddle tee at 1642 Park Avenue.

Figure 24 shows further excavations around the 2-inch HDPE gas service saddle and the 8-inch HDPE gas main. The 2-inch HDPE gas service line to 1642 was observed from west to east direction with the service saddle tee over the 8-inch HDPE gas main.

Figure 24: 2-inch separated HDPE service line at saddle tee.

The 2-inch HDPE gas service saddle tee curved from the service line over the 8-inch HDPE pipe gas main. There was a gap of about ¼-inch between the main and saddle tee. This ¼-inch gap continued to increase as the service line recovered from the downward curvature as the backfill was removed, and then lifted up as seen in figure 25. The 8-inch HDPE gas main was observed to have moved downward, going south to north from the service saddle tee location on the main.

Figure 25 shows the completely separated 2-inch HDPE service saddle tee from the 8-inch HDPE gas main. The service saddle tee contains dents and gouges. The photo also shows the tracer wire wrapped around the service line and service tee, down to the 8-inch HDPE gas main.

Figure 25: Separated 2-inch saddle tee from the HDPE main.

Figure 26 shows the surrounding excavated area to the 1642 Park Avenue near the 2-inch HDPE gas service line connection (covered with off-white colored nylon material). The 8-inch HDPE pipe gas main is seen as a black colored and yellow striped pipe. These areas were observed to be made of porous soil and small diameter gravel (crush and run) backfill materials[74], and had large holes below and near the gas main and water main.

Figure 26: Porous soil and large holes at 1642 Park Avenue near the gas main.

Figure 27 shows the underside of the service tee after it was removed from the excavation. A large crack at the junction between the main body of the service tee and the outlet fitting is indicated with a red arrow.

[74] This type of backfill materials were used for the emegency post-accident fill material.

Figure 27: Underside of the saddle tee showing the tee to gas main fusion surface and crack in the service line connection port (red arrow).

- **Incident Site Inspections**

Figure 28 is a photograph of excavations for the service tees to 1644 and 1646 Park Avenue that revealed a roadway with layers of concrete and asphalt overlays of over 24-inches thick by visual inspection. Con Edison's post-accident field investigations road cores sampling #4 and #6 in the service tees areas shows the layers, respectively, as shown in figure 29 and 30. Core #4 was collected nearest to the service tees, and core #6 was north of core #4 on Park Avenue.[75]

[75] Depth or thickness of concrete, alspalt layers measured varied and depend on the point of measurement.

Figure 28: Service tees to 1646 and 1644 Park Avenue below about 12 inches of concrete road underlay with about 18 inches thick asphalt paving.

Figure 29: Core #4 road pavement sample from front of 1646 Park Avenue near incident properties service tees. Source: Con Edison.

Figure 30: Core #6 road pavement sample from front of 1646 Park Avenue near incident properties service tees. Source: Con Edison.

Table 4 shows a comprehensive post NTSB accident site investigation core sampling of the Park Avenue roadway at the incident location by Con Edison that were obtained on March 29, 2014. These cores bore samples show the thickness and stratification of layers comprising the subsurface of the roadway. Multiple subsurface layers of paving material (i.e., asphalt, binder, and concrete) were observed beneath the

top layer of the roadway during excavation activities in the vicinity of 1644 and 1646 Park Avenue. These borings reveal that while the pavement depth of Park Avenue in general was 6 to 8 inches, it was between 12 and 18 inches in the travel lane in front of 1644 and 1646 Park Avenue, as described in the following table:"

Table 4: Core samples of roadway pavement at southbound travel lane in front of 1644 and 1646 Park Avenue.

Building	1646 Park Avenue					1644 Park Avenue									
Boring	10	9	8	7	6	4	2	11	3	1	12	5	13	14	15
Approx. pavement Depth (inches)	7.5	8.0	8.0	11.5	15	18	12	14.5	12	8.5	8.5	9.5	8.0	7.5	6.0

Figure 31 show an excavation to locate the gas service tees to1644 and 1646 Park Avenue. The trench revealed a large horizontal void under the concrete road under-lay. The surroundings also showed road depressions of misaligned concrete and asphalt layers of varying thickness from paving, and re-paving at this location.

Figure 31: Excavation showed layered roadway and large horizontal void in front of 1644 and 1646 Park Avenue.

Figure 32 shows openings under the front slab of 1644 Park Avenue sidewalk. Penetration of the carpenter ruler into this gap under the sidewalk was to a depth of about 35 inches before obstructions indicated in red arrow. The position of this opening was adjacent to the front brick building walls before the incident. A visual inspection into the large hole shows a clean opening without debris except coagulated soil and uneven concrete surfaces.

Figure 32: Underneath slab openings at 1642 and 1644 Park Avenue.

.

Also, figure 32 shows another gap, opening having more than 72 inches horizontal penetration indicated with a green arrow Camera examination of this opening showed it was greater than 85 inches horizontally.

Figure 33 shows direct view into the opening shown in figure 32, red arrow. The opening ran under the 1642 Park Avenue concrete sidewalk. Both openings as indicated in figures 32 and 33 ran toward the buried gas main and service tees with gaps of at least 4 inches high under the sidewalks as they reached the curb line and pavement.

Figure 33: Hole at 1644 Park Avenue frontage under sidewalk slab.

I. Training and Operator Qualification[76]

- **Program Requirements**

Con Edison reported to the New York Public Service Commission staff on May 29, 2014, that their processes for qualifying and requalifying individuals that perform plastic fusions on natural gas pipelines were not in compliance with the Commission's qualification and requalification requirements. According to State of New York Public Service Commission it investigated Con Edison practices and gathered information on plastic fusions on natural gas facilities in accordance with an Order dated June 26, 2014.

This communication to the commission further stated that both the gas company and their contractors' employees "have not been satisfactorily" re-qualified for plastic pipes fusions. And some of both the gas company and the contractors employees were not initially qualified with the commission requirements. According to the Commission, they require local gas distribution companies (LDCs) whose employees and contractors employees install or repair plastic pipelines in natural gas system to demonstrate proficiency in a qualified procedure, and annually requalify persons that perform heated fusions on polyethylene pipes, except where a very specific quality control protocol are in place.[77] [Page 3, of Case 14-G-0212]

According to the Commission, they require LDCs to develop and follow procedures to test both their employees and contractors, whose plastic pipeline joints are to pass visual inspection and destructive testing in the classroom. The communication to the Commission stated that Con Edison Company of New York did not follow the state gas pipeline rules in 16 NYCRR parts 255. [Page 2-3, of Case 14-G-0212]

However, as part of the order, the NYPSC stated that "its normal field audit of the construction practices, Staff has found no evidence that Con Edison placed into service any pipe that had not been fused according to acceptable procedures and specifications." [page 2]

According to Con Edison Specification, section 3.0 of G-8121-15[78] for qualification of Installers Fusion for PE pipe, dated April 30, 2009, used in qualifying the installers and was in place at the time of the accident, it requires only qualified installers and also those in compliance with the 12-month requalification to perform covered tasks of heat fusion or electro-fusion joints, and the joint shall be done according to the company procedures.

Again an installer lacking the 3 year qualification[79] or 12 months qualified for covered tasks on fusion cannot perform fusion. [Jennifer Delaney - Page 7 line 7-12], page 32 lines 5-12

Assessment of capabilities of each installer's or operator's work on plastic pipe joint by heat fusion using a qualified fusion joining procedure is required for both initial and 3-year qualification by using physical examination, and visual inspection for the 12-month requalification.[80] These examinations shall be conducted by a qualified supervisor or Learning Center Instructor. [Jennifer Delaney page 25 line 1-17]

---

[76] Further detailed description of part I, and J of of this report, could be referenced in the Regulatory and Over-sight Factual report.

[77] Attachment 1 - Case 14-G-0212 Proceeding on Motion of Commission to Investigate the Practices of Qualifying Persons to Perform Plastic Fusions on National Gas Facilities. Dated: June 26, 2014.

[78] Attachment 2 – Specification G-8121-15

[79] Installer – This is an individual that had received an initial and 3 year qualification performed by a qualified supervisor or Learning Center Instructor to assure it acceptability with Con Edison procedures.

[80] Section 3.3 and 3.4 of G-8121-15 Construction Standards, Operation and Maintenance Manual.

According to Con Edison procedure G-8121-15 section 3.6 of the Construction Standards, Operation and Maintenance (O&M) Manual, the sampled joint shall be tested by cutting it to a minimum of three longitudinal strips, and are to be individually visually inspected, and found to contain no voids or discontinuities on the cut surfaces of the joint area. In addition, these sampled strips shall be deformed by bending, torque, or impact, and where it fails, the failure must not start in the joint area. [Jennifer Delaney - Page 45 line 10-25, page 46, line 1-25]

Moreover, section 5.1 of G-8121-15 states that the 12-month installer requalification is required to be documented as performed when due, showing that each installer has completed the annual requirement by fusing acceptable joint according to section 4.2 of this specification. This section requires the installers make test fusions for any size of the following;

- Butt fusion manually operated machine
- Butt fusion hydraulically operated machine
- Butt fusion on 12-inch and larger fusion machine (this is said to be optional)
- Sidewall fusion – manual or hydraulically operated
- Electrofusion equipment

The annual requalification consistent with the federal and state pipeline safety regulations also satisfies the requirement where the installer within 12-month period does not make any joints under the procedure, or when 3 joints or 3 percent of the joints made under the procedure, whichever is greater, did not pass a pressure test. This is also applicable when the joints do not pass visual inspection.[81]

- **<u>Documentation Requirements</u>**

According to the procedure, section 5.1 of G-8121-15 and the interview of the Section Manager – Gas training, customer operations, every documentation and monitoring for installers and operator qualification for the gas company employees are the responsibility of the gas company, whereas documentations and monitoring for contractors' employees are the responsibility of each contractor, when the annual requalification are performed by the contractor. The contractor employees' documentation shall be kept by The Learning Center (TLC), whenever the annual requalification is performed by the TLC.[82]

And it is the individual contractors' employee's responsibility to monitor and report the status of his or her current or expired covered tasks qualifications then seek re-qualification.[83] Con Edison had monitoring system for both the company employees and contractors' employees' operator qualification records, but could not identify that some of the installers performing fusion joints in their pipeline system were unqualified since July 1, 2009. But the Code of Federal Regulations requires operators to determine and monitor the qualification status of its entire employees.[84] [Jennifer Delaney - Page 56 line 15-25, page 58 line 2-12, page 16 line 8- 19]

Con Edison procedures allowed installers to make acceptable requalification joints as required in section 4.2 of G-8121-15 specification stated above within 12-month period either at an actual field installation, Con Edison Training Center or at the workout[85] location. But deviation from the stated 12-

---

[81] 49 CFR 192.285(c)(1)(2) or 16 NYCRR 255.285(d)(1)(2)

[82] Section 5.1 of G-8121-15 Construction Standards, Operation and Maintenance Manual

[83] Attachment 4 - Interview of Jennifer Delaney

[84] 49 CFR §192.285(d) - Each operator shall establish a method to determine that each person making joints in plastic pipelines in the operator's system is qualified in accordance with this section.

Workout location – This is one of Con Edison's local yards in their operating areas such as Bronx or Manhattan..

month requalification method according section 5.1 of G-8121-15 "shall immediately disqualify" the installer in doing any form of fusion joints, notwithstanding that the installer is operator qualified; meaning still current with the 3-year qualification. If the installer's requalification is not performed within the 12-month period, such individual cannot be re-qualified at an actual field installation but at a work out location or The Learning Center. Con Edison had not followed these requalification procedures for five years before the accident, and some of the plastic pipe installers/operators became unqualified. [Jennifer Delaney -Page 60 line 20-25, page 61 line 1-6, page 25 line 19-25, page 25 line 1-25]

All installers previously qualified for the initial 3-year period, are required to be re-qualified every 3 years by the Learning Center Instructors only; section 5.2 of G-8121-15. This requalification involves installers passing a written test in addition with making test samples of fusions according to section 4.2 of G-8121-15 specification. Every record from these operator re-qualifications shall be kept by The Learning Center. And deviation to follow the 3-year requalification method is ground for "immediate" disqualification of the installer from making any form of fusion joints. A disqualified installer can only be re-qualified at The Learning Center.[86]

According to the Section Manager, Gas training, Customer operations both company and contractors employees qualified following section 4.2 of G-8121-15 specification, should have their plastic pipe fusions destructively tested, however, Con Edison has only destructively tested 2-inch butt fusion joint strips, up until May 29, 2014. None of the other pipe sizes, and type's fusion performed by employees qualified in the company was tested. [Jennifer Delaney - Page 13 line 9-21, page 15 line 6-25, page 16 line 1- 6]

According to Con Edison contractor Foreman who installed the 69-foot long segment of 8-inch HDPE main that ran from East 116th Street going north and ended in front of 1644 Park Avenue, he has over 15 years' experience in plastic pipe fusion. This installer also installed the 2-inch HDPE service line that serviced 1642 Park Avenue. At the time of these installations, he was Foreman charged with responsibilities, such as main and service pipeline installations, hot, and cold tapping of natural gas pipelines, and other covered tasks. [Frank Diaz – page 7 line 22-25, page 8 lines 1-11]

Con Edison contractor Foreman stated that the 8-inch HDPE gas main was not pressure tested as allowed by the New York State pipeline safety regulation, because it was less than 100 feet long. But the 8-inch HDPE to cast iron joint was leak tested with soap solution after the line was re-pressurized with gas, based on the employees training. However, the New York State regulations (16 NYCRR 255.507(f)) require the entire length of pipe to be soap tested, not just the joints.

According to Con Edison contractor Foreman's testimony, the Con Edison Inspector called him before the start of the work, and indicated that the work at 1642 Park Avenue was assigned under his workload for inspection. The Inspector visited the site before the work ended, but being that the Inspector's responsibilities covers multiple sites, the Inspector did not stay throughout the entire work. Con Edison contractor Foreman believes the Inspector's functions are to make sure they are doing the work right and safely. Con Edison contractor Foreman could not remember the time the Inspector came on the site, or what he had observed him do, but remembered the Inspector did not ask him about his operator qualification card, for the covered tasks being performed, though he had it with him. Con Edison contractor Foreman called the Inspector by phone to inform him when the work was finished. [Frank Diaz - Page 20 lines 17-25, page 21 lines 1-14, page 22 lines 1-14, page 24 lines 14-25, page 25 lines 1-25, page 1-15]

When the plastic pipeline installations at 1642 Park Avenue were performed, Con Edison contractor Foreman had thought he was current on his plastic pipe joining operator qualification records according to

[86] Section 5.2 of G-8121-15 Construction Standards, Operation and Maintenance Manual

Con Edison procedures.[87] But he was not. For his 3-year qualification, he stated he was qualified, but only found out after the accident on March 12, 2014, that he was not qualified on his annual operator's qualifications. This annual requalification according to Con Edison contractor Foreman is for covered tasks on plastic pipe fusing, whereas the 3-year qualification covered other pipeline activities. [Frank Diaz – Page 26 lines 16-25, page 27 lines 1-25]

A review of Con Edison contractor Foreman's 3-year operator qualification training record submitted by Con Edison that included the plastic pipes fusion, shows he was qualified on November 23, 2010, and the qualifications expired on November 22, 2013. However, according to the federal and state pipeline safety regulations, consistent with the gas company written procedure, the plastic pipe joining was due for annual requalification, but was not performed for over 2 years and 5 months.[88]

According to Con Edison contractor Foreman, Con Edison's Foreman in the Bronx areas regularly checked their operator qualification records in the field, whereas in Manhattan district the company personnel did not often check these qualification records. Hence working in Manhattan, Con Edison contractor Foreman did not know he was no longer qualified to perform fusion on plastic pipes. After the accident, he found out about the unqualified status through his supervisor, and believes Con Edison informed the supervisor. [Frank Diaz – Page 28 lies 1-25]

Before the accident neither Con Edison contractor Foreman's employer, nor Con Edison Company notified him that he was no longer operator qualified to fuse pipes. He was 3-year re-qualified in about September 2013 but was actually due for requalification in November 2013.

However, Con Edison contractor Foreman later agreed he was responsible to know when he was no longer qualified to perform covered tasks. In addition he stated that Con Edison also has the responsibility to notify him when he was no longer operator qualified, and that both his 3 year and annual requalification are administered by Con Edison. He could not recollect whether in the past, if Con Edison ever informed him of being due for any requalification, since he had always initiated the need for his requalification but since 2011 he forgot, though the qualification card has an expiration date. [Frank Diaz – Page 33 lines 1-25, page 34 lines 1-5, and page 39 lines 13-16]

Con Edison contractor Foreman, was also qualified with National Grid,[89] and stated that the company's plastic pipe fusion qualification procedures are the same with Con Edison, except that National Grid performs destructive testing.[90] Though he had taken operator qualification trainings with National Grid, he do not work on their system. [Frank Diaz – page 34 lines 9-25, page 35 lines 1-25, page 36 lines 1-4]

Con Edison contractor Foreman acknowledged he had performed several plastic pipe fusions for Con Edison since he was unqualified but did not remember the total number. But after he knew he was unqualified after the accident, he had undergone requalification for a day, and has resumed fusing plastic pipes. Con Edison did not ask him about plastic fusions he had done while unqualified.[91] [Frank Diaz – page 40 lines 6-13, page 40 lines 23-25, page 41 lines 1-7]

As part of Con Edison contractor Foreman's interview, he stated that when his crew finished with pipe installations, they covered the trench with metal plates, as it was the responsibility of another company

---

[87] Attachment 24 – Operator Qualification Card of Contractor Foreman dated November 23, 2010

[88] See Attachment 24 – Operator Qualification Card of Contractor Foreman dated November 23, 2010

[89] National Grid – This is a company similar to Con Edison, another local gas distribution company.

[90] Con Edison before May 2014, only performed destructive tests during fusion qualifications on 2-inch plastic pipe fusion joints whereas the other entity performed destructive tests on all sizes of the plastic pipes they install.

[91] See Interview of Frank Diaz

crew to do the backfill. [Frank Diaz – page 25 lines 11-18, page 36 lines 21-25, page 37 lines 1-3, page 38 line 14-17]

According to Con Edison contractor Supervisor[92] to Con Edison contractor Foreman, he learned of the unqualified status of this employee from Con Edison after the accident, but could not recollect who told him exactly. Con Edison contractor Supervisor further stated that their company (Con Edison contractor) goes by notification from the employee stating the need to be re-qualified and then they schedule the individuals' requalification with the gas company, otherwise, they presume the employee is qualified. [Frank Yodice – page 15 lines 2-16, 21-25, page 16 lines 9-23]

Con Edison contractor Supervisor agreed to the fact that if their employees do not inform them of the need to get re-qualified, they may be working indefinitely while unqualified. He mentioned there were times when Con Edison offered the annual fusion requalification in the field, but the 3-year mechanical requalifications are performed at the company's Training Center. He stated that the Contractor make copies of the employees' operator qualification records after they have been qualified, keep them as to check their status, and they occasionally get email notifications from Con Edison about their employees' qualification status. But Con Edison contractor Supervisor could not recollect the last time in the past 5 years this Con Edison contractor received emails from the gas company on such issues.[93] [Frank Yodice – page 16 lines 24-25, page 17 lines 1-25, page 18 lines 1-7]

Con Edison contractor Supervisor re-stated that his company employees are similarly operator qualified under National Grid system. Compared to Con Edison qualification records, he mentioned that National Grid has assessable database where all plastic pipe fusers' qualifications could be viewed. He was unsure whether Con Edison has a database that holds all personnel operator qualification. "A far as I know, they don't." [Frank Yodice – page 19 lines 14-25, page 20 lines 1-2, page 20 lines 7-10]

- **<u>Operator Qualification Status</u>:**

In a Con Edison response to the NYPSC inquiries dated June 10, 2014, they stated that Con Edison contractor Foreman that fused the plastic pipe at the explosion site was involved in about 136 jobs; 120 low-pressure and 16 high-pressure, between November 2011 to November 2013 while not qualified. Also 13 of the contractor's employees were noted as plastic pipe installers, among this numbers, 12 of them, including the fuser of the pipe at the explosion location had times when these individuals' qualifications elapsed.

Qualification records reviewed for the installer that performed the service saddle tee joint at the explosion site shows that he was last qualified on November 23, 2010, for his 3-year qualifications and the qualification expired on November 22, 2013. This 3-year qualification included the annual requalification of covered tasks on plastic joining. However, his annual requalification that was due on November 23, 2011, for plastic pipeline joining was not done until after the accident. He was unqualified for more than 2 years.

Records reviewed from Con Edison indicates that for a covered period May 1, 2011, to April 30, 2014, shows about 700 plastic fusion works had been performed by the pipe fusers.[94] And between July 1, 2009, to June 30, 2014, 186 Con Edison employees and 115 contractors' employees had lapses in their operator qualifications at different intervals.

---

[92] Attachment 8 –Interview of Frank Yodice

[93] See interview of Frank Yodice

Attachment 20 - Consolidated Edison Letter – Fopiano Response – Supplemental OQ Issues - Date: June 10, 2014

J. State Regulatory Oversight: Jurisdictional Service Pipeline and Pressure Test

According to the interview of the Chief, Gas Safety Section with the New York State Public Service Commission, the State regulations have been in place since 1952, but in 1980's the agency made changes in its regulation to make it more consistent with the CFR. [Kevin Speicher – page 12 lines 15-25]

He further stated that the State agency, and PHMSA, follow the same numbering system, except for regulations such as operator qualification, distribution integrity management program, control room management, and the integrity management program (transmission), "which have been adopted verbatim from the federal regulations, but have different numbering." However, the remaining State regulations are stated to be at least as stringent as the federal requirements, but in some cases are more stringent for example, the New York State's pipeline regulatory requirements to odorize both gathering and transmission lines. In addition, "distribution pipelines in New York are odorized to twice the requirements found in the federal regulations." [Kevin Speicher – page 11 lines 1-7, page 12 lines 1-25

NYPSC also stated that its leak requirements are more stringent than the CFR. This is because PHMSA does not define the leak classification under its regulations, but the NYPSC clearly "requires specific grading of all leaks, and defines the frequency at which each leak classification should be surveyed or repaired."[95] [Kevin Speicher – page 12 line 12-13]

The lack of maintenance of segments of federally regulated customers' service lines by the New York State gas pipeline operators in routine operations was identified as another area of concern, and was noted by the NTSB during the on-site investigation. Such condition results due to the differences between the federal and state regulation as stated below.

> **49 CFR 192.3** Service line means a distribution line that transports gas from a common source of supply to an individual customer, to two adjacent or adjoining residential or small commercial customers, or to multiple residential or small commercial customers served through a meter header or manifold. A service line ends at the outlet of the customer meter or at the connection to a customer's piping, whichever is further downstream, or at the connection to customer piping if there is no meter.

> **16 NYCRR[96] parts 255.3 –** (a) As used in this Part: (29) Service line means the piping, including associated metering and pressure reducing appurtenances, that transports gas below grade from a main or transmission line to the first accessible fitting inside a wall of the customer's building where a meter is located within the building; if a meter is located outside the building, the service line will be deemed to terminate at the outside of the building foundation wall.

During the on-site investigation comprising party representatives, pressure tests for integrity of both the mains between East 117th Street and East 116th Street, and East 116th Street going west were tested. These pressure tests included seven residential services at 1652, 1646, 1644, 1642 Park Avenue. Also pressure tested was 95 East 116th/1640 Park Avenue, 91 East 116th Street, and 89 East 116th Street service pipelines.

Pressure tests of the 1652 Park Avenue, and 89 East 116th Street service lines showed slow leakage that occurred before the outlet of the customers' meter sets that are covered under the federal regulations as

---

[95] Attachment 9 – Interview of Kevin Speicher

[96] Official Compilation of Codes, Rules and Regulations of State of New York (NYCRR) Public Service Part 255 – Transmission and Distribution of Gas

regulated pipes. The pressure tests were done for the service lines integrity verifications of the adjacent properties to the incident location.

The state regulations as defined above[97] enforced by New York State Public Service Commission staff deviates from CFR.[98] This difference in regulation permits local gas distribution companies (LDCs) in State of New York to end their regulated service pipeline responsibilities for an inside gas meter, at the building walls and locations before the first service valve after the foundation walls of a property. The service valves or header valves in this context are upstream of the customer's service meter(s).

In a further discussion on the issue of the limits to, and definition of the service lines, the Chief, Safety Section of the NYPSC explained that the State commission had thought they were more stringent but later realized they were less stringent on this part of the regulation.[99] [Kevin Speicher –page 13 lines 9-25, page 14 lies 1-14, 15 lines 1-9, lines 13-25, page 16 lines 1-7, lines 8-20]

According to NYPSC "since discovering the extent of the discrepancy, they had some dialog with PHMSA over the matter and have begun the process of revising the regulation with a notice of proposed rulemaking being issued on September 11, 2014, and published in the State Register on September 24, 2014."

The Chief, Safety Section of the NYPSC was asked by the investigators, what hinders them from enforcing the federal regulations now as stated above, and whether the State agency is not obligated by contract with PHMSA to enforce it. An NYPSC legal agent with the interviewee responded that, with respect to their PHMSA relationship, from her understanding, what the NYPSC does is to audit, and they give it to PHMSA to enforce. According to the NYPSC, the legal agent's response during the interview is only applicable to interstate pipelines.
[Kevin Speicher page 63 lines 16-25, page 64 lines 1-8]

Also the Chief, Safety Section, stated that his understanding after their preliminary discussions with PHMSA is to consider what the State regulatory agency would be doing at the moment, until the regulations are changed. And that is currently what they are studying to learn.[100] The investigators concern on the less stringent regulation of the service pipeline was the fact that majority of the services are inside gas meters. But the regulators stated that the situation is more prevalent in Downstate, NY but different Upstate, NY. [Kevin Speicher – page 64 lines 10-19]

NYPSC inspection method comprises that of risk ranking metrics, involving audits of issue areas in operators' system. They "ranks each code section by risk – high, medium, low – and devised an inspection plan based upon this risk, where the higher risk audit functions are audited at a greater frequency than lower risk items, but all items are audited at frequencies not exceeding 5 years."[Kevin Speicher –page 9 line 14-22, page 10 lines 1-9, page 53 lines 12-25]

The field audits performed by NYPSC pipeline inspectors are less compared to inspection of records done per year.[101] The few field inspections are chosen by random spot checks, and does not witness all pipeline works. [Kevin Speicher – page 45 lines 7-25, page 46 lines 1-3]

---

[97] 16 NYCRR parts 255.3

[98] 49 CFR §192.3

[99] See interview of Kevin Speicher

[100] Interview of Kevin Speicher

[101] According to NYPSC "NYS DPS spends approximately 50% of the year focused on record audits and approximately 50% of the year focused on field audits. However, witnessing a single field inspection is more time consuming than reviewing the record for the same task. Many records can be reviewed in a single day, whereas, a single field inspection could take an entire day to complete."

Additional deviation exist between the CFR and the New York State regulation enforced by the Public Service Commission on pressures test of segment of pipeline up to 100-foot long.

49 CFR part 192.513 requires that;

> (a) Each segment of a plastic pipeline must be tested in accordance with this section.
> (b) The test procedure must insure discovery of all potentially hazardous leaks in the segment being tested.
> (c) Plastic pipelines must be tested to 150 percent of maximum operating pressure or 50 psig, whichever is greater;

16 NYCRR§ 255.507 Test requirements for pipelines to operate at less than 125 psig

> (f) For tests on short sections (100 feet or less) of pipe, and tie-in sections, where all joints, uncoated portions of longitudinal seams, and/or fittings are exposed, a soap test is acceptable at line pressure. For short sections of plastic pipe, the entire pipe length must be soap tested. Gas may be used as the test medium at the maximum pressure available in the distribution system at the time of the test.

Considering the contrast, in pressure test requirement as stated in 16 NYC RR part 205.507 (f) which the NYPSC enforces, and does not implement the CFR, the state operators' including Cons Edison wrote and followed a procedure that is less stringent than the federal pipeline safety codes. New York State has taken steps to start a rulemaking that addressed this deviation.[102]

K. Pipeline and Hazardous Materials Safety Administration (PHMSA);

PHMSA is a federal agency that has oversight over the state offices of pipeline safety, and the state programs. Each state pipeline safety program has a liaison from PHMSA that regularly audits the performance of their program and consequently rate them.

The ratings of each state program affect how much funding they get from the federal agency over the enforcement of the federal pipeline safety regulations they have been delegated. The NYPSC has consistently received rating above the enforcement activities and implementation of the federal pipeline regulations. Recent rating assigned to the state pipeline safety program in the past years has been above 90 percent, according to The Chief, Safety Section of the NYPSC.[103]

Some state pipeline safety programs has jurisdiction to enforce regulations over intrastate pipelines only, while others have jurisdiction over both intrastate and interstate. NYPSC has jurisdiction of intrastate and interstate pipelines within the New York State boundaries. However, it has enforcement authority over intrastate pipelines only. As an "interstate agent," NY audits interstate pipelines, but PHMSA retains enforcement authority over all interstate pipelines in New York.

The investigation in this accident and Con Edison Company of New York, Inc. records reviewed have shown several areas of deviations from 49 CFR 192 on gas pipeline safety requirements. Some of these deviations stated earlier, results from direct incorporation, implementations of the state regulations by the operators that should have been enforced. However, none of these deviations played any role in this incident.

---

[102] See Regulatory Oversight factual report for descriptive information on part I and J.

[103] See interview of Kevin Speicher

Attachments:

Attachment 1 - CASE 14-G-0212 Proceeding on Practices of Qualifying Personnel

Attachment 2 - Con Edison Specification G-8121-15 Qualification of Installers Fusion PE Pipe

Attachment 3 - Cast Iron Replacement Procedure Letter

Attachment 4 - Interview of Jennifer Delaney

Attachment 5 -2014 Harlem Incident Schematics

Attachment 6 – Interview of Frank Diaz

Attachment 7 – Interview of John Ludwigsen

Attachment 8 –Interview of Frank Yodice

Attachment 9 – Interview of Kevin Speicher

Attachment 10 – Interview of Anthony Mancino

Attachment 11 – Interview of Rosario (Roy) Carlusso

Attachment 12 - NYC_DOT Road Repair Drivers Worksheet_09_06_13

Attachment 13 - NYC_DOT Road Repair Drivers Worksheet_03_09_14

Attachment 13 b - Appendix A1 – Consolidated Edison Factual Notes

Attachment 14 – Interview of John Dimiceli

Attachment 15 - NYDEP 2006 sewer main inspection and documents

Attachment 16 - NYDOT Dynamic Access System for HIQA with NOV Number 181870857

Attachment 17 - Constructed Pipe Length S10-84774-000M

Attachment 18 - Pressure Test requirement G-8204

Attachment 19 – Response to DPS Interrogatories - DPS_1-f.12-Answer-DPS1_6 - Dated 04-14-2014

Attachment 20 - Consolidated Edison Letter – Fopiano Response - supplemental OQ Issues

Attachment 21 – Leak Survey Procedures – GS-11806-17

Attachment 22 - Interview of Rocco Murdocca 8-8-14

Attachment 23 – Interview of John Lobello - 08-06-2014

Attachment 24 – Operator Qualification Card of Contractor Foreman dated November 23, 2010

Attachment -25 - 8 Inch Gas Main Inspection 03-19-2014 Report (1)

Attachment 26 - Con Edison Street Excavation and Paving

Attachment 27 - Road Work Repair Calls Binder Park Avenue-10 Year

Attachment 28 - Schematics of pipes facilities burial at 1642 Park Avenue - Relative Profiles (2)

Attachment 29 - NTSB IR 10162014 (CE 103014)

Attachment 30 – NYCDEP Answers to Age Questions Utilities

Attachment 31 - Interview of Frank McCarton

Attachment 32 –Party Photographs on Sink Hole Excavations

Attachment 33 - Park Avenue Water Main Leak Survey Records

Attachment 34 - NYCDEP exploratory excavation performed by Contract GE 351 at 1642 Park Avenue-1

Attachment 35 - NYCDEP Exploratory excavations pictures at Park Avenue