1. EXECUTIVE SUMMARY

1.1. Introduction

During the week of July 17, 2006, Con Edison's system was affected by an extraordinary series of events. Amid a heat wave that caused power outages throughout the region, 10 of the 22 primary feeders serving the Long Island City (LIC) network in northwest Queens were out of service simultaneously for two brief periods, on July 18 and July 19. By repairing and restoring these feeders and working closely with city agencies and customers to reduce energy usage in the area, Con Edison avoided a complete shutdown of the entire network, preserved electric service for the majority of the customers served by this network, and avoided a significant disruption to major transportation systems serving New York City and Long Island.

Despite our best efforts, however, approximately 25,000 customers went without power. The power outage created hardships for many – hardships that cause us great concern.

The employees of Con Edison pride themselves on the company's reliability, which exceeds that of other utilities in the state and the country by a wide margin. The company's unique system is designed, built, maintained, and tested so that it can provide energy to customers reliably and safely. The Long Island City network ranks in the top 25% of the company's system for reliability.

Con Edison personnel reacted quickly to identify and assess what happened. As part of one of the company's biggest emergency response efforts in many years, Con Edison deployed all available resources, including outside contractors and approximately 130 crews from other utilities. Emergency response plans – which employees had been trained to carry out – were activated. At the height of the restoration effort more than 600 Con Edison, contractor, and

mutual assistance crews were working around the clock to restore power safely. Since the network is underground, the effort required a block-by-block assessment and restoration plan aimed at preventing further damage to equipment and ensuring the safety of our customers, the general public, and our employees. By Sunday, July 23, power was restored to 80% of customers affected by the outage. The remaining customers were restored by midnight on Tuesday, July 25.

Con Edison has also responded by conducting a comprehensive investigation into the event. The investigation's goal was to precisely identify what went wrong and to develop a strategy and detailed plan of action that will further enhance reliability in the entire Con Edison system. A team has worked since July to conduct the investigation, to develop an action plan, part of which has already been implemented, and to prepare this comprehensive report. This far-reaching report demonstrates Con Edison's commitment to provide its customers with electric service at the highest possible level of reliability.

1.2. The Event

The service disruptions in the LIC network were precipitated by three unrelated events that combined to create an unprecedented set of circumstances and strain on the network system.

The first of these events occurred on Monday July 17, when a short-circuited, low-voltage cable caused a fire in an underground conduit running along 30th Avenue near 44th Street. The fire also damaged two of the network's 22 primary 27,000-volt (27 kV) supply feeders, causing both of those primary feeders to fail 32 minutes apart. Throughout the network, primary feeders deliver electricity to transformers, in which the voltage is reduced and from which electricity is sent out over the secondary distribution grid to customers' homes and businesses.

Although two adjacent primary feeders were out of service, the network system is designed so that other feeders supply the power, and service to customers is maintained. The ability to absorb the loss of two primary feeders and still provide customers with power is one reason Con Edison's underground network is known for its high reliability.

A second unrelated and unique event occurred approximately two hours later. A substation breaker malfunctioned when a third feeder failed, and this malfunction caused three network feeders to be isolated from the system. This single incident elevated the seriousness of the situation to a fifth contingency, meaning that five primary feeders serving the LIC network were out of service. The conditions were now well beyond the design criteria of the network.

The third unrelated event occurred when operators attempted to restore one of the five feeders to service. A phenomenon known as "inrush" current caused the feeder's circuit breaker to trip out upon restoration, even though the feeder had not sustained physical faults or damage. After a feeder is repaired, the circuit breaker needs to be closed to restore the feeder to service and allow electricity to flow through it. During the LIC network event, after closing the circuit breaker on a feeder, the system sometimes experienced an initial rush of transformer magnetizing current that was eight times the current normally supplied to customers. The inrush current was in excess of what is normally experienced. This excessive inrush of current, which lasts about one-tenth of a second, caused the circuit breaker to open again because the circuit breaker's sensors detected enough current to cause it to open as if there was a fault on the feeder.

Inrush current impeded the company's efforts to restore feeders and kept feeders out of service for longer periods of time. The longer it took to restore a feeder to service, the more the rest of the system experienced stress, overheating, and possible damage to equipment. Feeders were

being repaired and restored, but they weren't staying on. Con Edison had never before observed transformer magnetizing inrush current causing circuit breakers to open upon restoration of a feeder, so our operators did not recognize the phenomenon. Normally, feeders trip because of a failure or damaged equipment. When inrush current tripped feeders during the event, it appeared to the operators that the feeder equipment was damaged — but it wasn't.

The fifth contingency experienced by the LIC network was particularly serious because three of the five feeders out of service are adjacent, and provide energy to the same general geographic area of the network, in this case, the easternmost edge of the network. As a result, the network in that area was deprived of its primary source of supply, which meant that the power from other parts of the network was drawn from other transformers through the low-voltage secondary-cable grid to supply that area. When that happened, some of the transformers and cables on the secondary network were bearing much higher loads than usual, as were the remaining in-service primary feeders. As a result of the stresses of excessive current, some of the transformers and secondary cables began to fail.

The three unrelated events put a significant burden on the network and made feeder restoration more difficult and time consuming. Operators, aware of the system's limitations, took a number of steps to reduce the resulting strain on the network. These steps included efforts that reduced the area's demand for electricity and accelerated feeder restoration.

Company operators then evaluated the potential solutions: either attempt to further reduce the amount of electricity being used to keep the remaining feeders and the network in service while repairing the damaged feeders as quickly as possible, or shut down power to the entire network, repair the damaged feeders, and then restore power to the network. The operators decided that

the network could be stabilized and fully restored without a shutdown, and they maintained the network in service while they repaired the feeders.

A network shutdown would have had an extreme impact. All 115,000 customers and major transportation systems serving Queens and Manhattan, including the 7, E, F, G, R, V, and W subway lines and the Long Island Rail Road would have been without power. All 115,000 customers in the network and members of the general public affected by the transportation outages would have experienced additional hardships.

Con Edison's experienced operators and field forces prevented the network from completely shutting down, despite having 10 of the network's 22 primary feeders out of service simultaneously — twice. But in the end, the strain on the system resulted in an unusually large number of customer outages. Several areas of the network were without electric service because the secondary network was damaged by the multiple primary-feeder outages.

Con Edison regrets the extended power outages to the approximately 25,000 affected customers, but the decision to maintain the network throughout the event succeeded in minimizing its impact for more than 90,000 customers within the LIC network and for the hundreds of thousands of people who travel through the LIC network each day. The situation was bad, but it could have been much worse.

1.3. The Short-Term Response

Continuing problems caused by the series of events complicated the task of restoring power to many Long Island City customers. In the six-day period of Monday, July 17, through Sunday, July 23, thirteen of the twenty-two 27-kV feeders in the LIC network were out of service at some point, and as many as 10 feeders were out of service simultaneously. The task faced by Con

Edison was to stabilize the primary network system and to restore the feeders to service while maintaining power for as many customers as possible. As the company was restoring feeders, other components of the network were operating beyond their design criteria, which caused additional feeder outages.

Despite our efforts to expedite the restoration of 27-kV feeders, some regions of the network were left without high-voltage feeder supply to local transformers. These areas were supplied through the network grid from more distant transformers, which strained the secondary network and the more distant transformers and their feeders. While only 13 of the network's nearly 1,200 transformers failed, eight of those were located in the network's east side, which increased the burden on the remaining transformers to the west.

When a transformer fails, the feeder to which it is connected comes out of service. Demand shifts from the out-of-service feeder to the remaining feeders, which increases their current flow and causes them to operate at higher temperatures. The higher operating temperatures, in turn, can cause failures on splices that are known to be heat sensitive. These splices, which the company has been programmatically replacing since 1999, caused four additional feeders to fail during the event.

As large amounts of power were drawn through the network from more distant transformers, demand on secondary cables increased, causing many network fuses to open to prevent damage to the cables. As a result, many customers lost power or experienced low voltage in their homes and businesses. Low-voltage conditions in parts of the secondary network delayed feeder restoration due to energy feeding back from the secondary network through a transformer and into the feeder. Some areas had insufficient energy in the secondary network to operate

distribution-transformer switches designed to prevent back feed. Inspecting multiple transformers to find the backfeed sources hampered operators in efforts to repair and return feeders to service.

Throughout the event, to reduce the strain on the primary and secondary systems, Con Edison implemented an organized effort to reduce network load. The company used a variety of measures to contact customers and work with them to reduce the use of electricity in the impacted areas. These measures included voltage reduction, demand reduction requests to large and small commercial customers, requests to some customers to switch to alternate supply sources, direct customer appeals to reduce usage made by employees in the field, appeals broadcast by the New York Police Department via mobile public address systems, and appeals made by the media. As a result of these efforts, and the cooperation of customers, the use of electricity in the network was reduced significantly.

Another priority was to restore primary feeders as quickly as possible. Through the diligence of the operators and the field crews working around the clock, the primary system was fully restored on Friday, July 21. Even before the primary system was fully restored, Con Edison began to assess the damage to the secondary network so that repairs could begin as quickly as possible. On Wednesday, July 19, engineering personnel in the Brooklyn/Queens region mapped the known secondary-network damage in order to create work plans for the restoration crews. Identifying damage on the secondary network is inherently more difficult and time-consuming in an underground system. In order to verify damage and make repairs, crews went block by block, going into manholes, and performing diagnostic tests in many of those manholes.

The repair and customer-restoration work began on Thursday, July 20. Company forces and contractors, supplemented by crews from other utilities from as far away as Ohio, were called upon to conduct inspections and make repairs in order to restore customers to service as quickly as possible. Approximately 130 mutual assistance crews and contractor crews with underground skills were deployed during this outage. By Sunday night, July 23, about 80 % of our customers were back in service. By midnight on Tuesday, July 25, all customers were restored.

1.4. Measuring Customer Outages

While Con Edison operators focused on restoring feeders and maintaining service to as many customers as possible, the information systems the company had in place to count the number of customers without power did not provide an accurate count. Generally, network systems are so reliable that few customers are out of service at any time, and the company's systems for counting customer outages have historically provided accurate estimates. The LIC network event, however, has revealed that the systems are not adequate to handle an event of this scale.

From Monday, July 17, through Thursday, July 20, based on calls received at the company's call center, the company believed that about 1,600 customers in the LIC network were without service. This estimate was reported on information systems throughout the company and communicated to the public. Sixteen hundred electrical outages is a lot for a network system. In the past 40 years, there have only been four incidents in which more than 1,000 customers were out in a network without a network shut down. But based upon reports and field observations, Con Edison became concerned that the company's information system was underestimating the extent of the outage. On Thursday evening, July 20, the company conducted a field survey of the affected area in order to estimate the number of customers affected. This effort resulted in a

higher estimate of the number of customers — 25,000 — who were out of service. Con Edison communicated the information widely as soon as it became available.

1.5. The Long-Term Response

Even as Con Edison was restoring power, the company began investigating the causes of the event and identifying the steps that need to be taken that will result in better service for customers in the future. This investigation has produced 16 recommendations that will strengthen the reliability of our electric system and improve our assessment of customer outages. Those recommendations appear in Section 6 of this report.

This section lists the major findings and actions resulting from our comprehensive analysis of the incident.

Substation Breakers

Poor contact on a relay-circuit connection prevented a 27-kV rack-out breaker from opening during a fault on feeder 1Q21. As a result, the bus backup-relay circuits operated and caused the loss of two additional 27-kV network feeders. The supervisory wiring did not alert the station operator to the condition.

Con Edison will improve the design of the contacts associated with rack-out breakers. Four substations, including North Queens, have contacts on rack-out breakers which need to be upgraded to an improved design. This work requires the equipment to be out of service (de-energized). North Queens is scheduled to be completed by June 1, 2007. Work at the remaining three stations will be completed by June 1, 2008.

In addition, we will modify the supervisory wiring so that the station operator can detect a problem in the trip circuit of a rack-out breaker. The supervisory wiring associated with feeder 1Q21 and the other 21 network feeders at North Queens substation have been modified. Three other substations may also have this condition and will be modified where required by December 31, 2006.

Relay Systems

Inrush current caused by the energization of network transformers resulted in the opening of four 27-kV circuit breakers at the North Queens substation.

As an interim step, the protective-relay settings for all North Queens feeders have been revised to further reduce the probability of inrush current causing trip outs. Prior to summer 2007, feeders with connected transformer capacity of more than 32 MVA at other stations will also have their relay settings reviewed and revised to reduce the probability of trip outs caused by inrush currents.

Furthermore, we will install microprocessor relays to the protective circuits of LIC feeders with more than 32 MVA of connected transformer capacity to further reduce the probability of an inrush current trip out. These microprocessor relays will differentiate between an actual fault and inrush current. This work is scheduled to be completed by December 31, 2007.

In addition, at other substations that have feeders with more than 32 MVA of connected transformer capacity, we will investigate the installation of microprocessor relays or other equipment, as appropriate, to further reduce the probability of an inrush current trip out.

Network Reliability

A review of potential reliability projects for the LIC network demonstrates that the addition of two new feeders in the LIC network will further improve the network reliability.

We will establish two new feeders in the LIC network by summer 2007.

Customer Outage Assessment

The initial estimate of the number of customers out of service was much lower than the actual number of customers out of service.

For the short term, we have developed a process and system to help provide better estimates of customers out of service. We have begun using a new computer-aided tool that analyzes data from existing network monitoring systems, as well as calls from customers and the public.

By summer 2007, we expect to develop and put in place a map-based graphics tool that will display the status of secondary network components and the locations of reported electrical problems.

By summer 2007, we will complete our review of the installation of electric meters that could alert the company when a customer is out of service.

Outage Reporting

Some customers received busy signals when attempting to report outages on Wednesday, July 19. In addition, some customers who attempted to report an outage through our interactive automated system experienced difficulties filing the report, in part because the process could take three minutes.

To reduce the possibility of customers receiving busy signals, we will increase the number of telephone lines into the Con Edison call system from approximately 400 to 650. This will be completed by the end of 2006.

We have improved the interactive automated system for customers to report electrical outages. The new system reduces the time to report an electrical outage by half.

1.6. Conclusion

Con Edison recognizes it is critically important to learn from the unique event that occurred in the LIC network and to take measures that will reduce the likelihood of such an event happening again.

Just as it takes time, careful planning, and patience to build and maintain a reliable, complex energy system, it takes time, careful planning, and patience to devise remedies when problems arise. The detailed, in-depth analysis Con Edison has conducted over the past several months has resulted in the identification of specific steps the company plans to take to strengthen the reliability of the LIC network and all other networks.

Each year, Con Edison invests in its infrastructure to provide its customers with the nation's most reliable electric service. Plans are in place to invest more than $1.2 billion in Con Edison's electric transmission and distribution infrastructure to prepare for the summer of 2007. As the company makes these investments, it will also continue to seek and develop tools and processes that strengthen the overall reliability of its system.

The company will take the steps needed to remain a reliable partner in the well-being and growth of metropolitan New York. This mission is one that Con Edison takes seriously.