4. LONG ISLAND CITY RESPONSE

4.1. Response to Primary Feeder Outages

From Monday, July 17, through Friday, July 21, thirteen[1] of the twenty-two 27-kV primary network feeders in the LIC network were out of service at some point. These 13 feeders experienced a total of 37 outages during this time period.

Con Edison's primary goal was to restore these primary feeders and to fully restore the LIC network as quickly as possible. Con Edison follows a detailed, step-by-step process to accomplish this goal while ensuring the safety of the public and the company's workers. The process is coordinated by System Operations. Substation Operations and Electric Operations also perform functions associated with the process.

The feeder restoration process is broken down into six key steps: (1) isolate substation sources of electricity; (2) ground the feeder; (3) locate the fault; (4) prepare the feeder for work; (5) repair the feeder; and (6) prepare the feeder for service.

(1) Isolate substation sources of electricity: When a component fails on a feeder, large amounts of energy will flow to the damaged component. The system utilizes circuit breakers to de-energize the feeder at the substation and to isolate the feeder and faulted component from the system. This action limits the extent of the problem, and prevents additional damage to the equipment attached to the feeder.

(2) Ground the feeder: For safety, the feeder is grounded at the substation and any sources of electrical back feed are isolated. The feeder can energize if electric energy feeds back from

[1] The company's August 2, 2006, report, "Initial Report On The Power Outages In Northwest Queens In July 2006," stated that 14 feeders were involved; however, because one feeder provides service to an isolated customer, it is not a network feeder.

the secondary system through distribution transformers. The source of this back feed must be located and removed by opening the switch at the transformer. Once all sources of back feed are removed, the feeder is verified as de-energized at the substation, where it is then grounded. When possible, the grounding and isolation operations are done in parallel to expedite the process. Once the feeder is grounded and isolated, crews work to locate the fault. Subsequent steps in the process require removing the feeder ground when testing for faults and then reapplying the ground during repair. This process may be repeated several times.

(3) Locate the fault: The process of locating a fault involves applying high voltage on the feeder cables. This is referred to as high potential (hi-pot) testing. The high voltage creates a detectable signal at the fault location. Prior to applying high voltage on the feeder, voltage-sensitive equipment, such as shunt reactors, are disconnected from the feeder. The feeder ground is also removed during the test. Operating orders are issued to establish the high-voltage signal that is used to locate the fault on the feeder. The route of the cable is surveyed with equipment that senses the signal until the fault location is found.

Once the fault is located, the high-voltage is removed and operating orders are issued to once again, apply the ground to the feeder at the area substation.

(4) Preparing the feeder for work: After the feeder is regrounded at the station, the next step to restore a feeder involves preparing the feeder for work. Preparing the feeder for work involves positively identifying the cables at the work locations and applying protective grounds surrounding the repair locations. Protective grounds are required to protect the workers from any inadvertent energizing of the feeder. To positively identify the feeder,

operating orders are issued to apply tracing current on the feeder from the area substation. The tracing current is used to positively identify the faulted feeder in the structure.

Once field personnel report that the feeder has been identified and tagged, the company issues operating orders to remove the tracing current and reground the feeder at the area substation. Concurrently, field personnel apply several protective field grounds at manholes surrounding the work location. With the feeder grounded in the station and the field, the district operator reviews the job to verify that the feeder is properly isolated and protected, and then issues a work permit to initiate the repair work. Vehicles parked over a manhole, flooded underground structures, or environmental conditions can impede a crew's ability to access a structure and inspect the fault. Operations personnel determine the scope of the work, typically either making repairs or disconnecting the faulted equipment from the feeder.

(5) Repairing the feeder: The crew at the repair location then requests a work permit. The company tightly controls this process to verify that people are in the correct location and that they follow established procedures. Once the work permit is issued, the next step involves making repairs or separating the faulted equipment from the feeder. Once the repairs are made and the working group no longer requires the field grounds, the field personnel report this status to the control center. Operating orders are then issued to remove grounds.

(6) Preparing the feeder for service: After the ground switches used for protection are removed, the feeder is tested by applying low and, at times, high voltages to determine whether there are additional problems. The high-voltage application during the testing phase may identify incipient faults on the feeder. If additional problems are encountered during the

testing phase, these steps detailed above are repeated until the feeder passes the high voltage test.

4.1.1. Feeder Restoration Considerations

Depending on the cause of the feeder failure, emergency workers will expedite feeder restoration by separating a damaged piece of equipment from the feeder, allowing the feeder to be re-energized. A typical example involves separating a transformer and insulating the feeder section end. This technique is referred to as a "live end cap" and was used during the LIC network outage to reduce the repair time of a faulted feeder. The "open auto" feeders (feeders whose circuit breakers opened automatically to de-energize the feeder in response to a fault) in the LIC network were reviewed for possible live end caps and processed accordingly.

In addition, the company used a technique called the "known-point splice" during the LIC event as a means to disconnect a portion of a feeder. Since the location is documented and maintained as a "known point," conventional methods of identifying the cable are not required. This technique shortens feeder-processing times.

4.1.2. Alive on Back Feed

The condition of "alive on back feed" increases processing time of some feeders. This condition results when power from the secondary system flows back into the primary system because a network protector (switch) remains closed. When this condition occurs, field crews are dispatched to individual transformers to verify the position of the network protector (closed or open). If a network protector is found closed, the crew will open the network protector to clear the back feed. When more than one network protector is found closed, the process of clearing the back feed can take several hours. An additional means of clearing a

back feed condition would be to apply grounds at the substation in order to blow the fuses in the network protector and isolate the feeder from the secondary system. During the event, alive on back feed feeders were processed in different ways depending on the operational configuration of the network at the time of the back feed. The major categories of processing feeders were as follows:

1. If the open automatic (open auto) feeder was alive on back feed and there were no relay targets indicating a fault, the feeder was cut in. (Relay targets indicate the type of fault that caused the feeder's circuit breaker to open. The absence of relay targets can indicate that there is no fault on the feeder.)
2. If the open auto feeder was alive on back feed, and relay targets were indicating a fault, a three-phase ground was applied in attempt to clear the back feeding network protector.
3. If steps one and two were unsuccessful in clearing the back feed, field crews were dispatched to check individual network protector status.

4.1.3. Expedited Feeder Processing

During the Long Island City event, Con Edison followed a special set of operating rules for five feeder events based on operator judgment. This change in feeder processing approach reduced feeder processing time by eliminating the need to identify the cable at the fault location. While this approach expedited the restoration of certain feeders, it delayed feeder-processing work on other feeders due to safety considerations.

4.1.4. Test Bus Overview

To facilitate feeder maintenance and repair, the North Queens substation is equipped with a test bus. The test bus applies various test voltages and identification signals to the outgoing distribution feeders. It also provides protective grounding for the safety of field crews.

The North Queens test bus consists of four test bus sections, one for each corresponding load bus. Each test-bus section has a stationary ground and test device (G&T), which allows a ground to be applied on an out-of-service feeder. Each test bus section can be connected for low-voltage or high-voltage testing. For low-voltage testing, the test bus is connected to a test panel, which provides the low-voltage test signals that identify a feeder for repairs. For high-voltage testing, which is more common, the test bus is connected to a single high-voltage test set, which allows high voltage to be applied to any one of the four test bus sections at one time.

The test-bus configuration, as originally installed at the North Queens substation, provided a method to repair and restore de-energized feeders during a single contingency event. In the 1990s, the test-bus capability at the North Queens substation was increased by the addition of high-voltage test connection boxes. This addition permitted the application of high voltage to feeders in more than one bus section at a time.

For safety reasons, when one feeder in a section is connected to the test bus, no other feeders in that same section can be connected to the test bus. A key interlock system prevents this from happening. However, even if the test bus is in use with one feeder, other feeders can be repaired and restored through a process that entails connecting the test voltage and ground leads directly to the outgoing feeder potheads. (A pothead is the point where the feeder transitions from solid copper bus in the substation to underground distribution cable.) This process requires additional coordination and incrementally increases the time needed to repair and restore de-energized feeders.

4.1.5. Grounding

Using the test-bus configuration (see figure 4-1), a feeder is grounded by moving the feeder disconnect to the test position and closing the stationary section G&T. Individual feeder ground switches can be operated to provide distribution feeder grounding. Once the feeder has been grounded, the section test bus is free to be used for other feeders within that same section.

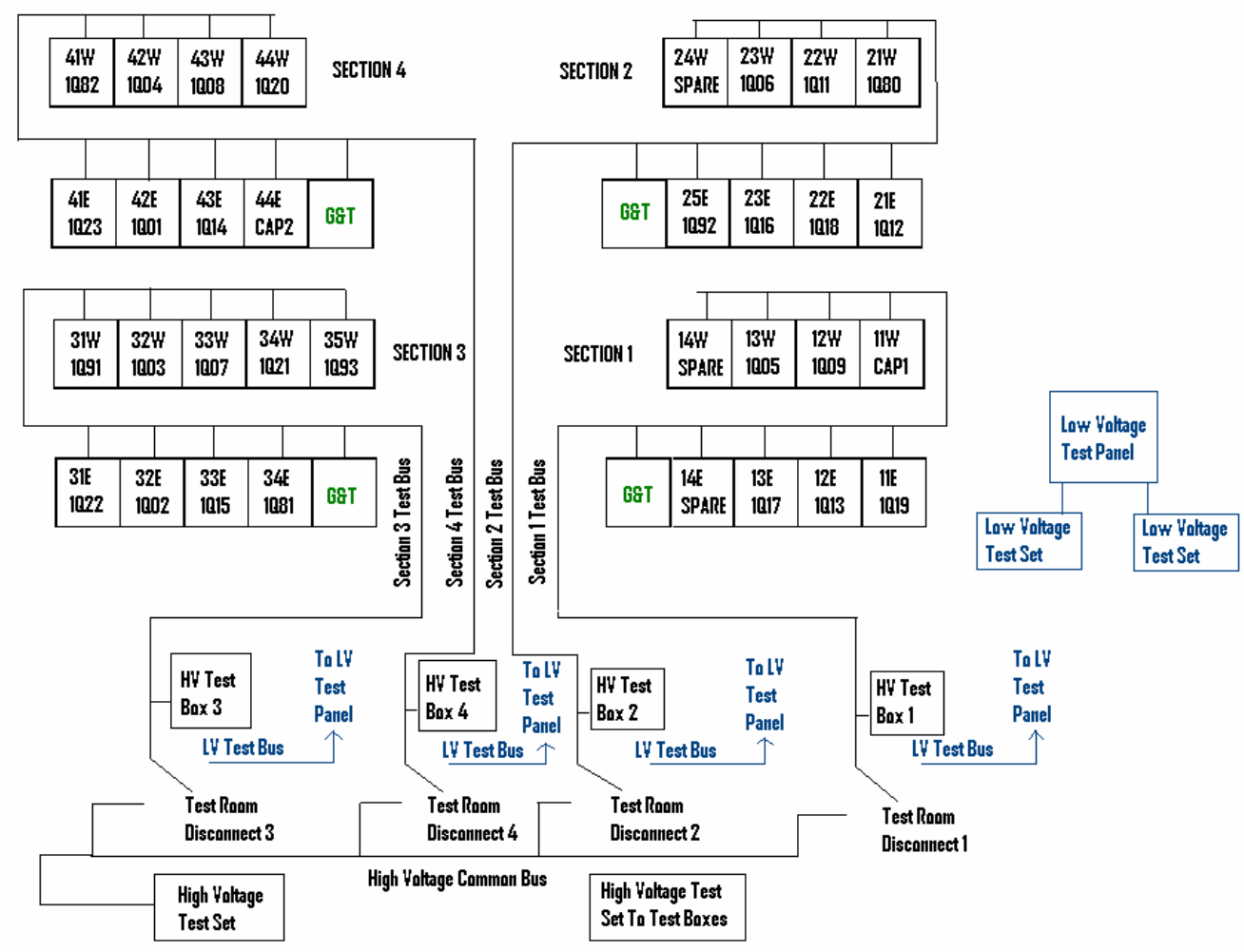

Figure 4-1: Diagram of Feeder Test Ground Configuration

4.1.6. Assessment of Feeder Restoration Response

During the LIC network outage, restoring the de-energized 27-kV network feeders and fully restoring the primary network were Con Edison's primary goals. Of the 37 total feeder outages during the event, 19 "opened auto" and an additional eight "failed on test" (Failed after the hi-pot process).

To expedite the restoration of particular feeders during the LIC network event, the company eliminated the use of tracing current to identify the cable at the fault location. This approach expedited the restoration of 11 feeder outages.

System Operations performed an analysis of feeder processing and determined that the affected LIC feeders were repaired and restored correctly and as quickly as possible, given the rapidly changing system conditions and safety considerations. The company also identified the following factors that contributed to the overall time it took to process feeders and restore them to service: (1) feeders remaining alive on back feed; (2) operational limitations due to other feeder work in the network; and (3) the design of the North Queens substation.

(1) Feeders remaining alive on back feed: As discussed in Section 4.1.2, the condition of alive on back feed occurs when electric energy from the secondary system feeds back through a closed network protector to the primary system. Crews must remove the backfeed condition before they can apply any protective grounds and start to repair the feeder. During the LIC event, 12 conditions of alive on back feed accounted for 64 hours and 12 minutes of feeder-processing time.

(2) Operational limitations due to other feeder work in the network: Operational limitations due to other feeder work in the network also can affect feeder-processing time. When the

company employs expedited feeder-processing methods that eliminate the use of tracer current to identify the faulted feeder, the company cannot apply any test voltages (high or low voltage) to any other feeder that is out of service in the network. As a result, while crews perform expedited feeder repairs on one feeder, the operator may have to suspend the use of high voltage to locate faults on other feeders. A similar limitation on applying high voltage on equipment occurs when crews are working in common manholes to repair separate feeders. During the LIC event, feeder-processing limitations resulting from 10 instances of parallel feeder work in the network accounted for 26 hours and 39 minutes of feeder-processing time.

(3) Design of the North Queens substation: As previously discussed, the North Queens substation test-bus configuration works well for single-feeder outage processing within a bus section. During the LIC event, where multiple feeders were out of service, a combination of test bus and direct cable pothead compartment processing was used. The use of direct-cable pothead-compartment processing reduced overall feeder processing by allowing simultaneous processing of multiple feeders. This method is not as efficient as test bus processing, however, because when applying grounds and test voltages to the cable potheads, certain feeder-processing activities had to be halted to provide access to the cable potheads.[2] Test bus design limitations on the simultaneous processing of multiple feeders accounted for 17 hours and 59 minutes of feeder-processing time.

[2] For those breakers that had been retrofitted, the station G&T devices would have provided a third method for feeder processing. These devices increase flexibility and would permit the processing of multiple feeders within a bus section. The G&T devices were not available during the LIC event, however, because they had not been commissioned yet. The commissioning process ensures the compatibility of the G&T with its associated breaker positions. This testing also ensures that the protective relay circuits will not malfunction during either the grounding or testing process.

Operators were actively engaged in making sure that feeders were repaired and restored efficiently. Placing liaisons from System Operations and Substation Operations in the Brooklyn/Queens Control Center was an especially effective means to address any uncertainties or questions about feeder processing. Additional management oversight at the Brooklyn/Queens Control Center, the Energy Control Center, and the North Queens substation also assisted in quickly responding to feeder-processing issues.

4.1.7. Operator Response to Feeder Open Autos

Over the course of the LIC network event, District Operations, in consultation with the Brooklyn/Queens Control Center, attempted to immediately restore seven different feeders after they had opened automatically (shown in Table 4-1). District Operations, located at the Energy Control Center, is responsible for the operation of the distribution system. Three of these feeders were successfully restored to service, while four feeders opened automatically again immediately after attempted restoration.[3] Analysis performed after the event showed that all seven of these feeders had power-quality fault data indicating a fault at the time the feeder initially opened auto.

District operators may attempt to restore underground feeders during emergency conditions. Because fault conditions on primary feeders create momentary overvoltages on the unfaulted phases throughout the network, which then results in additional stress on the grid, restoration attempts are carefully considered based on the circumstances.

[3] Four feeders in total experienced this issue over the course of the entire LIC network event. One of the four feeders (1Q18) is believed to have opened automatically on cut-in due to transformer inrush current. Inrush current is discussed below.

On the night of July 17, with high network loads and four feeders out of service, District Operations realized that feeder outages in the LIC network could cascade. Following the bus section 3S event (discussed in 4.4.2), feeder 1Q02 opened automatically with no relay targets, placing the network into a fifth contingency. Feeder 1Q02 remained alive on back feed. On July 17 at 20:08, District Operations, in consultation with the Brooklyn/Queens Control Center, successfully restored feeder 1Q02 to service, which reduced the contingency level to four. The feeder remained in service until July 18 at 08:23 when it opened automatically.

During the evening of July 17, two more feeders opened automatically—1Q20 at 21:42 and 1Q01 at 21:49—placing the network in a sixth contingency. Both feeders were de-energized with relay targets. District Operations, in consultation with the Brooklyn/Queens Control Center, attempted to restore both feeders. Both feeders were cut in, and they immediately opened automatically.

On July 18 at 20:04, feeder 1Q13 opened automatically. The feeder was alive on back feed with relay targets. Within an hour, three more feeders had de-energized, placing the LIC network in a tenth contingency. Since the previous evening, six feeders had been repaired and subsequently opened automatically upon attempted restoration.

The automatic opening of the feeders immediately after attempted restoration created doubt about the validity of the circuit breaker relay operations. In response, District Operations, in consultation with the Brooklyn/Queens Control Center, attempted to restore 1Q13 without completing feeder repair work. At 21:26 on July 18, feeder 1Q13 was restored successfully. This feeder remained in service for the rest of the LIC network event. Similar attempts were

made to restore feeder 1Q16 at 20:37 and feeder 1Q18 at 21:50, but both immediately opened automatically. Neither of these restoration attempts was successful.

On July 18 at 22:24, feeder 1Q19 opened automatically. This placed the network into a ninth contingency. Feeder 1Q19 was alive on back feed with relay targets. District Operations and the Brooklyn Control Center attempted to restore feeder 1Q19. At 23:57 on July 18, feeder 1Q19 was restored to service, but it opened automatically again on July 19 at 00:06.

Summary of Restoration Attempts on O/A Feeders With No Work Done						
Feeder	Open Auto Date & Time	Alive on Backfeed (Yes/No)	Relay Targets	Fault Detected by PQ Node(Yes/No)	Cut In Attempt Date & Time	Result of Cut in Attempt
1Q02	7/17/06 19:47	Yes	No	Yes	7/17/06 20:08	Stayed in service for 12 hrs 15 minutes
1Q20	7/17/06 21:42	No	Yes	Yes	7/17/06 21:55	Cut in open auto
1Q01	7/17/06 21:49	No	Yes	Yes	7/17/06 21:55	Cut in open auto
1Q13	7/18/06 20:04	Yes	Yes	Yes	7/18/06 21:26	Stayed in service for duration of event
1Q16	7/18/06 20:37	No	Yes	Yes	7/18/06 21:49	Cut in open auto
1Q18	7/18/06 21:50	Yes	Yes	Yes	7/18/06 23:57	Cut in open auto
1Q19	7/18/06 22:24	Yes	Yes	Yes	7/18/06 23:59	Stayed in service for 7 minutes

Table 4-1: Summary of Restoration Attempts on O/A Feeders with No Work Done

Overall, there was limited success with the rapid restoration on feeders that opened automatically. Of the four unsuccessful attempts, three created power quality fault data that showed overvoltages on the unfaulted phases indicating feeder faults. Given the escalating nature of the LIC network event, the unusually high number of relay operations on restoration attempts after feeder repairs, and the previous successful restoration attempts with no work done, District Operations and Brooklyn/Queens Control Center made reasonable and limited operational attempts to restore a select group of feeders that opened automatically.

4.1.8. Cut In Open Autos

Of the 37 automatic relay operations that occurred between July 17 and July 25, 15 operations were on feeders that were cut in and then opened auto. Cut in open auto (CIOA) is a particular type of automatic operation, where a circuit breaker is closed in an attempt to restore a feeder to service, but high currents trigger the operation of the protective relays, which then trip the circuit breaker. In most cases, a fault on the feeder causes the trip of the circuit breaker.

According to power quality analysis conducted after the LIC network event, four of the 15 CIOAs did not display any clear evidence of a fault. High currents approaching the pickup level of the instantaneous overcurrent relays were observed, however. The company has found that the LIC network may be susceptible to CIOAs because it has the highest connected load per feeder of all the networks in the Con Edison service area.

The four CIOAs that did not display clear evidence of a fault are:

1. July 17 at 19:09: Circuit breaker for feeder 1Q07 was closed. The feeder was cleared at North Queens, in high-speed, via phase-B instantaneous overcurrent (IOC) relay. Subsequently, a failed cable joint was found on the feeder.

2. July 18 at 23:55: Circuit breaker for feeder 1Q18 was closed. The feeder was cleared at North Queens, in high-speed, via phase-C IOC and ground time overcurrent (TOC) relay. Subsequently, a failed network transformer was found on the feeder. The failure was on phase C.

3. July 19 at 08:49: Circuit breaker for feeder 1Q17 was closed. The feeder was cleared at North Queens, in high-speed, via phase-B IOC. Subsequently, a failed cable joint was found on the feeder.

4. July 23 at 19:47: Circuit breaker for feeder 1Q14 was closed. The feeder was cleared at North Queens, in high-speed, via phase-A, B, and C relays. There was no indication as to whether instantaneous or time overcurrent units were involved. Subsequently, the feeder failed a full hi-pot test, but no fault was found. A failed joint found after the hi-pot test is believed to have failed because of the test.

4.1.9. Transformer Inrush Currents

Four CIOAs that did not have any clear indication of a fault were caused by a transformer inrush current resulting from all the network transformers being energized simultaneously when the circuit breaker at the substation closed. The electro-mechanical relays at the North Queens substation misinterpreted this inrush current as a fault and operated the circuit breaker.

The relays associated with the CIOAs were three instantaneous overcurrent relays and one ground overcurrent relay. The instantaneous relays were all set to operate at 4,000 amps, which is the setting for most of the LIC network feeders.

The high amplitude and shape of the observed current waveforms produced during the four CIOAs are indicative of transformer inrush currents. Therefore, the company has concluded that the four CIOAs without clear fault indication were the result of inrush current. However, it is difficult to characterize the waveforms definitively, since the power quality recorder is not connected to the distribution feeders. As a result, the captured waveforms include approximately a quarter of the combined load currents of the primary feeders, as well as any individual feeder inrush or fault current.

As of June 2006, the average amount of network transformer capacity connected to each LIC network feeder was 39 MVA. The highest average network-transformer capacity is 32 MVA for the remaining 27-kV networks. The number of CIOAs for the LIC network has grown considerably since 2000 and is comparatively higher than the other 27kV networks. Therefore, it can be concluded, based on empirical data, that an average value of 32 MVA per feeder could reduce the number of CIOAs.

To record transformer inrush currents when re-energizing feeders, Con Edison has been using temporary recording equipment for a number of LIC network feeders since July 25, 2006. These recordings have measured phase currents near the operating level of the instantaneous overcurrent relays (set for 4,000 amp pickup) and, in one instance, current high enough to operate the relay, which would automatically trip the feeder. In addition, there has been one instance of an unintended ground relay operation. This was due to feeder current transformer saturation (the current transformer was unable to accurately convert the primary current waveform due to its magnitude and DC component). This saturation produced an erroneous current in the ground relay circuit. Although ground current was produced very quickly after the feeder was energized, the preliminary analysis shows that the ground current is due to unequal saturation of the three-phase-current transformers. This produces, in effect, a false ground current, which causes the ground relay to operate.

The North Queens primary feeder relays were originally set properly for both the pickup and operating time. However, the addition of transformer capacity, particularly in recent years, has created conditions that were not part of the setting criteria.

The electro-mechanical feeder-protection relays in use at the North Queens substation are not capable of extracting the fundamental (60Hz) waveform from a raw AC (alternating current) waveform to open the feeder circuit breaker. A microprocessor relay has the ability to filter the harmonics and DC (direct current) offset to extract the fundamental waveform. This feature enables the microprocessor relay to better discriminate cable-equipment faults from other phenomena. The microprocessor relays instantly gather detailed relay targets data, capture waveforms to analyze faults, and possibly detect incipient faults. The installation of microprocessor relays will enhance reliability in the LIC network.

Con Edison reviewed the coordination between the bus-backup relays and the network-feeder relays and found that the minimum coordinating time interval is correct. In addition, the company discovered that the margin in this interval could be safely reduced by changing the feeder-relay settings to be less sensitive to transformer inrush currents.

4.2. Maintaining the Network in Service

During the LIC network event, the company was able to maintain the operability of the LIC network and maintain power to approximately 90,000 Con Edison customers. Had a network shutdown occurred, it is likely that there would have been an enormous impact on the people living, working, or commuting through the neighborhoods covered by the LIC network. This geographic area would have included major transportation systems (including LIRR and subways), industrial plants, high-rise buildings, schools, hospitals, and nursing homes. As discussed below, there were occasions when the company considered shutting down the network if additional feeders had come out of service or if conditions had otherwise worsened. The company's feeder-restoration and load-mitigation efforts, however, prevented the network from reaching the point when a network shutdown might have been required.

There are a number of variables that impact the operation of a network system during multiple contingencies and each of these variables, including the possibility of damaging equipment to maintain the majority of the network, must be evaluated in the context of current system conditions. During the LIC event, the operators understood that damage in the secondary grid was possible due to the high contingency levels, although they could not foresee the extent of the damage that actually occurred. To prevent an unnecessary shutdown of the entire network, the operators focused on restoring the full network supply through expedited restoration of

primary feeders, mitigating the impacts of the feeder outages by balancing loads, and working with large customers to reduce loads. These efforts permitted the company to maintain the network while keeping the primary network loads within their allowable operating parameters.

Consistent with the operating philosophy of restoring feeders as quickly as possible during high-load periods, the company employed all available tools and methods to expedite feeder restoration. One such method entails disconnecting defective equipment or faulted cable sections from the main run of the feeder by using live end cap splices. This permitted the unfaulted portion of the feeder to be restored to service. In addition, primary shunts were installed over the ground to bypass defective cable, eliminating the need to remove and replace primary cable in underground ducts. In some cases, the company employed emergency procedures that expedited the normal cable-identification process. These expedited processes gave operators the flexibility to safely bypass certain processing steps. Operators selected the appropriate expedited feeder process based on their experience and judgment as well as data provided by the company's various information systems. The relative advantage of each method was also considered. For example, if the identification process for a damaged feeder was bypassed, that feeder's restoration would be expedited. However, this could limit the processing of other defective feeders in the network due to required additional protective measures. During the LIC event, the operators used all of the available methods for expedited feeder restoration at appropriate times.

In addition to restoring faulted feeders, to the extent the company was able to monitor the condition of the secondary system, it was doing so by utilizing the Remote Monitoring System, Emergency Control System, and Outage Manager. The network demand continued

to be reduced through voltage reduction, demand-side management programs, large customer requests, customer appeals, and customer outreach efforts. As feeder restoration or repair efforts were in progress, network-transformer loadings as well as manhole events were reviewed and field crews were deployed to address and mitigate local overloads. This effort helped minimize the number of transformers that became overloaded. Described below are significant milestones that occurred during the LIC network event as they relate to the company's ability to maintain the network.

The B/Q Regional Control Center began preparing for the Monday, July 17, heat event several days before the anticipated high load period. Their immediate priority was to secure the distribution system by restoring all feeders to service by 07:00 Monday morning. In the LIC network, this restoration was achieved and the distribution system was operating normally with all 27-kV feeders in service. When the first feeder faulted and opened auto on Monday afternoon at 15:50 (1Q17), quickly followed by a second feeder (1Q16), the B/Q Regional Control Center directed the workforce to quickly locate and repair the faults on the feeders. Con Edison's experience in network operation has shown that restoring feeders to service as soon as possible after a fault is the best method to prevent cascading failures of other primary feeders. Operators took other actions appropriate for a distribution system under multiple-contingency conditions. These actions included reviewing feeder and transformer loading, prioritizing feeder-restoration efforts, checking and operating network-protector switches to ensure all sources of supply were available in load pockets of concern, checking and replacing network protector fuses to ensure all transformers were fully supporting the demand in the area, and cooling transformers.

On Monday evening, bus section 3S at the North Queens substation tripped, increasing the number of network feeders out of service from two to five. Operators immediately initiated an 8% voltage reduction, thereby reducing the demand on the network. Reducing network demand was essential to help prevent overloading of the remaining in-service feeders. Demand reduction appeals were also made to customers in an effort to ensure that feeders remained within operating margins.

Beginning Monday evening and continuing through early Tuesday morning, operators projected that feeders 1Q20, 1Q21 and 1Q16 would be restored in time for the Tuesday morning elevated demand period. This would return the network to its design state. Operators also planned to have feeders 1Q07 and 1Q01 restored to service in time for the evening high demand period. However, during Tuesday afternoon, the level of contingencies escalated as feeder restoration attempts failed and additional feeders came out of service. This escalation in contingency level continued and six feeders were out of service early on Tuesday evening. Operators anticipated having four feeders restored through the overnight period based upon the progress of field repairs. This would have brought the network to a second contingency for the start of the morning load period on Wednesday.

Between 20:00 and 20:40 on Tuesday evening, the network quickly escalated from a sixth to a tenth contingency when feeders 1Q13, 1Q12, 1Q15 and 1Q16 came out of service. As the network moved from a sixth to a tenth contingency, operators monitoring the secondary system received reports of one additional smoking manhole and 26 additional electric service interruption reports from customers. During this period, operators were preparing to restore feeders 1Q07 and 1Q01 to service.

In the tenth contingency, operators observed that a primary feeder was approaching its emergency loading limit and remote monitoring systems were reporting several transformer overloads that were of concern to the operators. Also, the following cumulative reports of network activity had been received (all numbers are cumulative from the first through the tenth contingency): 221 customer reports of low voltage, 44 customer reports of flickering lights, 306 customer reports of no power, one manhole explosion, two burning wires, and 17 smoking manholes. This activity was an indication that, although the tenth contingency was severe and causing high loads on some feeders and transformers, excessive damage to the electric distribution system was not occurring.

Due to concerns about feeder and transformer loading, a complete network shutdown was considered but deemed not necessary at the time. The operators concluded that if the network went into an eleventh contingency, or if they did not get at least one additional feeder restored to service, the network might be shutdown. An analysis was performed and it was determined that if the network was shut down the operators would need a minimum of 18 energized feeders to restore the network. However, the contingency level never exceeded ten, and one of the two feeders (1Q01) that was pending restoration was successfully restored to service thus reducing the loads on the in-service feeders and alleviating the concerns operators had during the tenth contingency. In addition, network demand was expected to continue falling through the evening. As the load decreased through the night, operators and engineers continued to closely monitor primary feeder and transformer loads. Their observations suggested that the combination of demand reduction strategies and the restoration of feeder 1Q01 had a beneficial impact on the loading of remaining feeders.

Based on the status of field repairs, operators anticipated restoring four additional feeders (1Q18, 1Q16, 1Q21, 1Q17) through the remainder of the overnight period into the morning. Thus, the network was projected to be in a fifth contingency as demand increased Wednesday morning. Feeder 1Q21 was successfully restored to service, and the restoration efforts on feeders 1Q16, 1Q17 and 1Q18 were unsuccessful. On Wednesday morning at 8:51, feeder 1Q14 faulted and de-energized, returning the network to a ninth contingency.

At 11:33 on Wednesday morning, the network went into a tenth contingency with the loss of feeder 1Q01. A complete network shutdown was again considered but not initiated based on satisfactory equipment loading, the reduced demand for the network, and the projected restoration of four feeders (1Q02, 1Q07, 1Q17, 1Q20) within the next several hours. Operators continued to monitor the secondary system as reports of additional customer outages and manhole events were received. Cumulatively, through Wednesday afternoon, there were 356 customer reports of low voltage, 56 reports of flickering lights, 1,450 customer outage reports, one manhole explosion, 11 manhole fires, 11 burning wire events, and 86 smoking manholes. These reports indicated to operators that some secondary system damage was occurring but the majority of the secondary system was not impacted and the network could be maintained. Through Wednesday afternoon, a number of feeders that had been repaired were restored to service. Operators reviewing and analyzing the company's information systems as well as feeder restoration progress continued focusing on reducing demand through additional appeals to major customers and restoring feeders quickly to rebalance the current flow in the network. Direct appeals continued to be made to large customers. Through Wednesday afternoon, it appeared that demand reduction efforts had a significant beneficial impact on equipment loading.

By late Wednesday evening, the network was restored to a sixth contingency. Based on progress of field repairs it was projected that three feeders (1Q19, 1Q14, 1Q17) would be restored by Thursday morning. The network contingency level continued to be reduced through Thursday into Friday as primary feeders were repaired and restored and the network was fully restored.

Conclusion

Based on information available to operators, including equipment loading, projected demand for electricity, projected feeder restoration, and events in the secondary system, the operator's judgment was that the network could be maintained during the course of the event. While a complete network shutdown was considered during this event, operators were successful in managing the system to avoid the large-scale outage associated with a network shutdown.

If the operators had been unsuccessful in maintaining the network and the LIC network had been shut down, there would have been an enormous impact on the people living, working, and commuting through the LIC network. Shutting down the LIC network would have interrupted electric supply for an undetermined amount of time to all of the 115,000 customers served by the network including the majority of the customers in the network that were previously unaffected by the event. A network shutdown would have also impacted the entire city and metropolitan area by interrupting electric supply to the LIRR and MTA subways lines that run into and through the network.

Due to the extraordinary number of feeder failures that occurred during the course of the event, the duration of an outage after a full network shutdown cannot be determined. There would have been significant complexities involved with re-energizing the network, and many

of the same feeder processing challenges addressed during the LIC event would have existed even after a network shutdown. There would have been additional challenges posed by trying to operate and restore equipment in a significantly larger area impacted by the service interruption.

The company's guidance documents have been reviewed to incorporate lessons learned from this event and these updated documents will be available for operating personnel as a reference. Additional efforts will involve the development of systems to integrate field reports of manhole events, area outages, individual outages, and other information into a format that can alert operators to the possible presence of widespread outages. In addition, a review will be conducted to determine methods to incorporate information from various existing systems into integrated visual models for operators. The annual heat drills conducted by the operating and engineering personnel prior to summer 2007 will involve a cascading scenario that requires the organization to mobilize and consider a network-shutdown decision.

4.3. Transformer Response

When the Con Edison electric distribution network experiences feeder contingencies, the regional engineering department, supplemented by field forces and the regional control center, monitor the network transformer status (loading, voltage, temperature, and alarms). When the transformer's loading exceeds design levels, an analysis of nearby transformers is performed to identify opportunities to shift the loads to nearby transformers. Locations are identified and crews are dispatched on a prioritized basis. These priorities can shift as feeder outages change. Locations are also checked to determine whether a network protector switch can be closed to balance the load from other nearby transformers.

When the analysis or field inspection determines that there is no opportunity to reduce the load by addressing nearby transformers with open switches or blown fuses, crews are then directed to cool the overloaded units.

Water is sprayed onto the units or, in some instances, the vault is flooded, then pumped out and the process is repeated until the temperature is reduced. Another method of cooling utilizes special air conditioning units that circulate chilled air over the units to reduce the oil temperature.

As the contingency level increased in the LIC network, Con Edison crews from outside the Brooklyn/Queens area were used to check switches and blown fuses. The use of supplemental crews to cool transformers during the LIC event was an added resource to the response team, allowing them to dedicate the majority of network crews to switch checks.

From Monday, July 17, to Friday, July 21, field crews cooled 59 transformers and an additional 24 transformers were addressed through the closing of switches or replacing blown fuses. Seven transformers that were overloaded during the incident eventually short-circuited.

Starting on Friday, July 21, Con Edison began removing failed transformers in the LIC network in preparation for replacement. In addition, transformer crews were provided by Manhattan and the Bronx to support transformer replacements. With the assistance of the Bronx and Manhattan crews, the Brooklyn/Queens Equipment group changed out 24 defective transformers during the following week.

4.4. Substation Response

4.4.1. Emergency Response to the Incident

As the incident progressed, additional operating crews were deployed to the North Queens substation to address the increased volume of operating orders issued. The staffing in the station was ramped up in anticipation of subsequent feeder outages. This allowed the senior station operators to process the increasing rate of operating orders and minimized feeder processing delays. Two additional operating crews (for a total number of four crews) were called to the station upon occurrence of the second feeder outage on Monday, July 17. At the height of the LIC network outage, between five and eight senior operators were on duty with enough assistant operators and maintenance mechanics at the North Queens substation to provide between five and eight operating crews to process distribution feeders.

Management personnel, including a station supervisor and a field operations planner, were also in the station serving as on-site operational coordinators to communicate with the Brooklyn/Queens Control Center and the feeder boss position at the Energy Control Center to avoid feeder processing delays. In addition, they coordinated job activities on-site to avoid delays. Throughout the event, there was an area manager, general manager, and/or vice president at the station to provide support and monitor performance. A senior operator was assigned the specific task of communicating with the district operator to facilitate the issuance of operating orders. This provided a constant open line of communication between the station and the Energy Control Center and ensured that operating orders issued by the district operator were immediately acted upon by a station operator.

Personnel from other groups within substation operations also staffed the North Queens substation during the incident. This included mechanics from Auxiliary Systems Maintenance (ASM) and the Transformer Group as well as electrical technicians from Protective Systems Testing (PST). Representatives from these groups were either on hand or on call in anticipation of any service that might be required. For example, PST technicians would be assigned to investigate relay targets. ASM mechanics worked to check availability of the spare low voltage test sets and determine whether they were ready for operation.

Additional steps were also taken to facilitate feeder processing in the North Queens substation during the incident. Two mobile test trucks were set up to facilitate processing feeders from the feeder pothead compartments in the instances when the station test bus was occupied. Additional high-voltage test leads from surrounding stations were also brought to North Queens as back up. Numerous leads were run from the station high-voltage test set to every aisle in the station. This minimized the time required to prepare for high voltage testing. The response to the event in the LIC network (the increased staffing and the additional test equipment brought to the station) was conducted in conjunction with maintaining the required heat contingency staffing at the other area distribution stations throughout the Con Edison service territory.

4.4.2. North Queens Bus Section 3S Event

The North Queens substation bus section 3S opened automatically on July 17, moving the LIC network from a second to a fifth contingency. None of the network feeders associated with this event had any relay targets indicating a fault. The only feeder that should have opened due to a fault was feeder 1Q21. Due to problems with the feeder circuit breaker open/close control

circuit, breaker 34W (1Q21) did not open. As per design, the feeder fault was cleared via bus backup relaying isolating all feeders fed from bus section 3S (1Q21, 1Q07, 1Q81, and 1Q15). Also, during this event, breaker 34E (1Q81) failed to open when called upon by the backup relay protection.

Both 34W and 34E are retrofitted Merlin Gerin Model SF2 rack-out breakers. A rack-out breaker can be removed from a breaker cubicle. Rack-out breakers require control-wiring contacts to provide, for example, breaker position indication, and close and trip coil connections. Stationary contacts in the breaker cubicle mate with contacts on the moveable breaker making up the control and indicating circuits and allowing for proper breaker operation.

Breakers 34W and 34E did not operate properly because, for each breaker, one of the 24 contacts was not making contact between the fixed and movable control wiring contacts. See Figure 4-2. The failure of 34W to open when feeder 1Q21 faulted, resulted in the backup overcurrent relay tripping the entire bus section 3S.

Figure 4-2: Photograph of sliding contacts

During the restoration of bus section 3S, one feeder (1Q15) was successfully restored, reducing the network contingency level to four (feeder 1Q07 opened auto on the cut in due to a feeder fault). At this time, crews tested the trip circuit ladder and found that on both 1Q21 and 1Q81, the relay-protection trip path was open while the supervisory trip path and its associated indicating light were fully functional. Upon further investigation, technicians found that for each of these breakers, the movable contact (Terminal 24) was not making contact between the fixed and movable control wiring contacts. This resulted in the relay protection trip path becoming inoperable, causing both 34W and 34E not to open on a relay operation. A temporary jumper was immediately installed between the relay protection path (terminal 24) and the supervisory trip path (terminal 3) to allow the relay and supervisory trip signals to reach the breaker trip coil via parallel paths. See Figure 4-3. After applying the temporary jumper, a modified trip check was performed to verify that if there were a future event, breakers 34W and 34E would trip via protective relays. Circuit breakers are normally provided with a trip circuit monitoring scheme that provides both a visible and audible indication of a lack of continuity in its associated trip circuit. The original breakers installed in the North Queens substation had a trip circuit monitoring indication light without an audible alarm. This monitoring light is located in the substation control room and serves two purposes: visual indication that the breaker is closed, and visual indication that the relay and remote supervisory paths are being monitored. The loss of this indication light would mean that either the relay trip path or the remote supervisory path was interrupted.

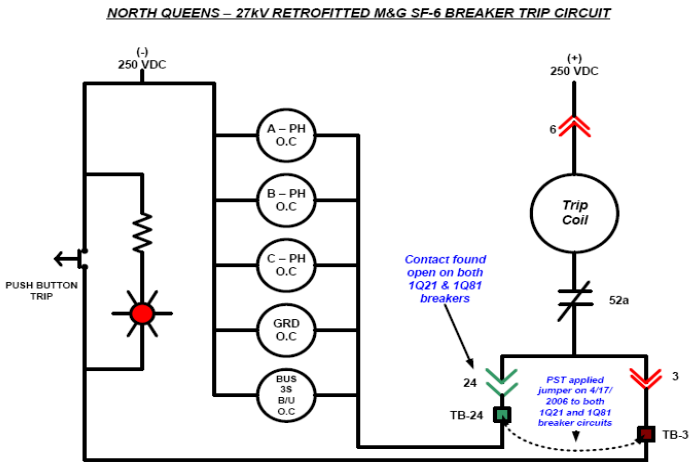

Figure 4-3: Simplified Schematic of 27kV Retrofitted M&G SF-6 Breaker Trip Circuit

The North Queens retrofitted breakers have the control room indication light discussed above and an additional indication light attached to each breaker cubicle. The loss of this additional breaker indication light would mean that either the trip coil or the breaker push button trip circuit is defective (i.e., local supervisory trip circuit). Therefore, the retrofitted breakers have an indication light in the control room as well as at the breaker control box.

In the case of breakers 34W and 34E, during the retrofit process, the trip circuit monitoring scheme was inadvertently wired to serve a single function to eliminate confusion for the substation operator. The control room indication light, the remote supervisory trip circuit, and the local supervisory trip circuit were all wired to the same terminal on the control block. This resulted in the operator not being visually alerted that the breakers' trip paths were not being monitored. Breaker 34W had last operated correctly to clear a feeder fault on April 18, 2006 and was subsequently restored to service on April 20, 2006. This places the loss of the trip path continuity between April 20, 2006 and July 17, 2006.

4.4.3. Trip Tests

Trip tests are standard tests performed to verify the integrity of the breaker trip circuit. As part of its investigation after the LIC network event, the company reviewed the data for all trip tests performed after each installation of a North Queens rack out breaker.

With the exception of a single, spare, breaker position, all of the breakers were successfully trip tested after their installation. The two breakers that failed to operate during the July 17 bus section 3S event were successfully trip tested four months before the event. Table 4-2 lists all of these breakers, along with their last trip-test dates and installation dates.

Table 4-2: North Queens Trip Tests of Rack-Out Merlin Gerin (M&G) Breakers

BUS SECTION	BREAKER POSITION	LAST TEST DATE	INSTALLATION DATE	COMMENTS
1N	14E	11/01	11/13/01	Spare Position
	14W	11/01	11/13/01	Spare Position
1S	BT-110	9/27/05	11/15/01	
	TR1	9/27/05	10/25/99	
2N	24W	Not tested.	11/13/01	Spare Position
	24E (C3)	4/12/05	Prior to 1995	To be replaced with a new higher rated breaker
2S	BT-220	9/6/99	11/16/97	
	22E	9/6/99	11/16/97	"
	22W	9/6/99	11/16/97	"
	TR2	9/6/99	12/18/00	"
3N	BT-330	3/22/06	3/19/06	
	31E	3/22/06	12/13/04	
	31W	3/22/06	12/13/04	
	32E	3/22/06	4/25/04	
	32W	3/22/06	4/25/04	
	TR3	3/22/06	11/25/00	

BUS SECTION	BREAKER POSITION	LAST TEST DATE	INSTALLATION DATE	COMMENTS
3S	33E	3/7/06	1/13/02	
	33W	3/7/06	1/13/02	
	34E	3/7/06	3/10/02	
	34W	3/7/06	3/10/02	Feeder 1Q21 opened auto successfully on 4/18/2006 and was put back in on 4/20/2006.
4N	41E	1/4/05	2/15/99	
	41W	1/4/05	2/15/99	
	42E	1/4/05	2/15/99	
	42W	1/4/05	2/4/02	
	BT440	1/4/05	2/4/02	
	TR4	1/4/05	10/21/00	
4S	None	–	–	
Sect 1	25E	12/5/05	12/5/05	
Sect 2	TR5	5/27/06	2002	Last Bus Sect 2 trip test done on 11/27/01. TR5 breaker installation was subsequent to this.

The feeder 1Q21 relays were tested to verify their operability. The phase relay, phase and instantaneous units, and the ground relay 51N, all have electric targets. These targets require a complete DC circuit for the target to operate. The open breaker trip circuit also would preclude the relay targets from operating. Without relay targets, no visual indication will alert an operator as to why a feeder circuit breaker has opened automatically.

4.4.4. Relay Settings

Con Edison reviewed the North Queens 27 kV primary relay settings and determined that they conform to the setting criteria:

- The minimum margins of 150% for detecting three-phase faults were met.
- The minimum margins of 200% to 300% for detecting single-phase to ground faults were met.

- The minimum margins of 150% above short-time emergency ratings for phase overcurrent relay pickups were met.
- The minimum coordinating time interval of 0.3 seconds was met.

The company analyzed all automatic relay operations associated with the LIC network event and found that, with the exception of the four CIOA operations discussed previously, all relays operated according to design. Most of the faults cleared in high speed, which is consistent with the combined operating times of an instantaneous overcurrent unit and a circuit breaker.

4.4.5. Load Bus Backup Relay Analysis

The time-current curves for all of the bus backup overcurrent relays were reviewed. The conditions that produce maximum fault currents, that is, all four 138/27 kV North Queens transformers in service and all three Astoria gas turbine (GT) generators (#5, #7, and #8) in service, were considered. For a bolted three-phase fault and a single-phase-to-ground fault, occurring at the North Queens 27 kV bus, the minimum coordinating time interval of 0.3 seconds was met.

The company also reviewed the relay coordination data associated with bus section 3S event and the feeder 1Q21 fault. Using the fault currents observed on the power quality record, combined with the additional contribution from the Astoria GTs (which were in service at the time), the backup overcurrent relays should operate in approximately 1.5 seconds. This time, combined with the bus breakers' nominal interrupting time, should produce a bus tripping time of 1.63 seconds after the initial feeder 1Q21 fault. This calculated time matches the actual bus section 3S fault time observed on the power quality record.

Similarly, the company reviewed the case of the subsequent bus breaker MBSB302 cut-in shortly after the bus section 3S opened auto. This would produce less fault current because one of the main sources, 138/27 transformer #3, was out of service as a result of the event, and thus did not contribute fault current. Due to the inverse time characteristic of the bus backup overcurrent relay, the lower current would result in a longer operating time. The calculated fault clearing of 1.73 seconds, matches the actual fault time observed on the power quality record.

The coordination between the bus backup relays and the network feeder relays was found to be proper, in that the minimum coordinating time interval was observed. In addition, it was also found that the margin in this interval could be safely reduced if feeder relay settings are changed to be less sensitive to transformer inrush.

4.5. Response to Secondary Outages

Unlike an overhead system where damage can be assessed visually by observing downed wires, transformers, and poles, identifying the locations of service outages, the nature and extend of damaged equipment, is more difficult because there is no simple way to know the status of the components.

Customer calls are important in a network area in order to determine the locations of service outages for the dispatch of crews to assess damage and make repairs. Customers and others (such as municipal agencies and public safety offices) relay service-related problems to Con Edison by contacting the Con Edison Customer Service Call Center (Call Center) at 1-800-75-CONED. Service related problems include no lights (NL), no light area (NLA), side off or partial service (SO), manhole fire or a smoking manhole, a wire down in the street, a service

wire down, and any number of other trouble types. The Call Center representative records the customer's problem and creates a service request (trouble ticket or B ticket) that is managed by Con Edison's Emergency Control System (ECS). Trouble tickets are sent to the appropriate Control Center where they are dispatched in priority order based on various factors such as safety, customer impact, and system condition.

Under normal conditions, the Control Center emergency operating general supervisor (EOGS) and the troubleshooter dispatcher (Emergency Desk) will review the trouble ticket and dispatch the appropriate troubleshooter (overhead or underground crew) to correct the problem. Under storm or emergency conditions, the EOGS has the primary responsibility to oversee the prioritization process. If the volume of trouble tickets becomes too large, skilled crews from other areas within the region, or outside the region, are utilized to manage the excess trouble jobs.

During the initial stages of the LIC event, the Control Center EOGS was prioritizing and dispatching the work. As the primary network contingency worsened, the control center did not dispatch crews to every trouble job. Field resources were prioritized for response to public safety calls (e.g., smoking and burning manholes) and support for primary feeder restoration.

4.5.1. Restoration Prioritization

During the evening hours on Wednesday, as feeders were being restored, Brooklyn/Queens engineering reviewed all trouble tickets to map the locations of the trouble calls to assist the effort to locate, identify, and repair equipment and restore customers after the primary system was fully restored. The customer counts listed for Long Island City on Outage Manager indicated approximately 2,000 customer outages. This information was notated on the zone

map with the number of secondary manhole events for the most apparent impacted areas. Upon review of the visual plot, it became apparent that the locations of most of the trouble tickets were concentrated in three areas of the network that were then designated zones 1, 2, and 3. The northern section of the network was designated zone 2, the central section of the network was designated zone 1, and the southern section of the network was designated zone 3.

The area of the Long Island City network where the secondary system was damaged initially comprised an area described by 62 Mains and Service (M&S) plates (or geographic maps of sections of the network). The restoration progress within zones was further divided by M&S plates. The plates were categorized by customer outages into lead and adjacent plates. Initially, the three zones were comprised as follows: zone 1 included 17 M&S plates; zone 2 included 27 M&S plates, and zone 3 included 18 M&S plates. Figure 4-4 illustrates the outage area in the LIC network based on the initial 62 M&S plates. In addition, secondary repair work identified on nearby plates was linked to one of the 62 original M&S plates in order to more effectively manage the restoration work.

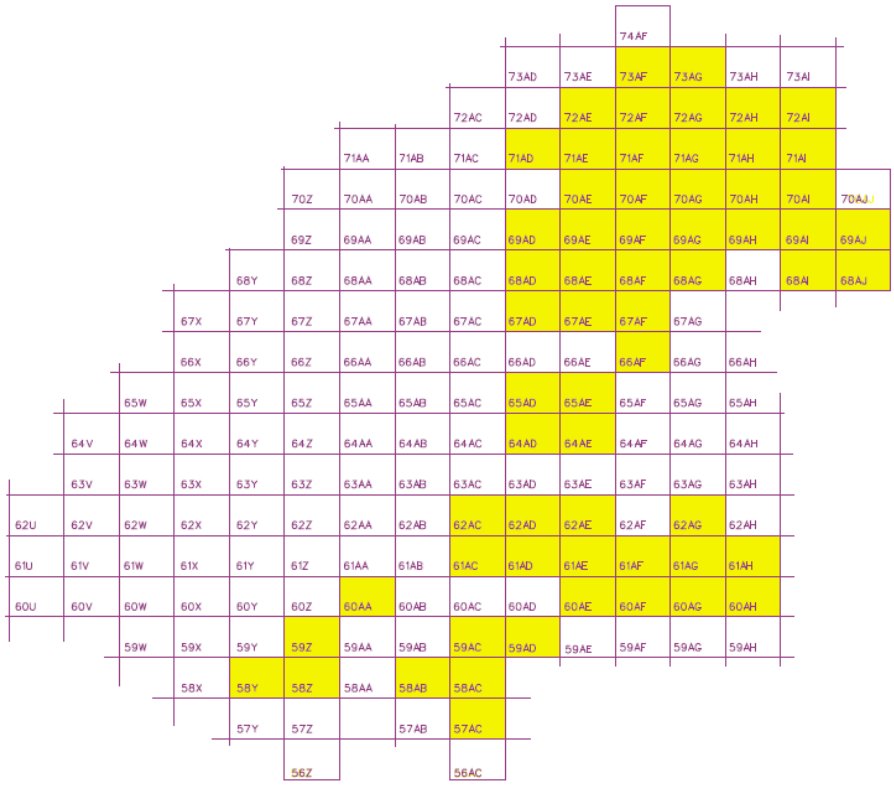

Figure 4-4: Graphical Display of LIC Network Depicting Affected Areas

The zones were organized with a zone boss who coordinated the work activity in terms of customer restoration and field assessment. In addition, field bosses managed the field activities, which included generator and shunt installations, limiter repairs, cable installation, and cable splicing in various manholes. These self-sufficient zones included Underground Cable and Splicing, Installation and Apparatus, Equipment and Services, Engineering, Overhead, Maintenance Services, Information Resources, Facilities, Clerical, Field Survey Teams, and Mutual Assistance and Contractor crews.

In the field, a central command site was established for the crews to meet and receive direction from the field boss. This was a point of contact for the crews to get briefings on job details and restoration status. The field bosses communicated routinely with the zone bosses on job

status, crewing, material, and priority. There were conference calls held generally every four hours between the zones and the Corporate Emergency Response Center (CERC) to discuss restoration status.

Restoration targeted M&S plates that had the greatest numbers of customers interrupted, affording the opportunity to restore the greatest number of customers in the least amount of time.

4.5.2. Secondary Underground Assessment

Inspection of manholes and service boxes can diagnose problems with cables and splices contained within the given structure, but some problems on the secondary system occur in the secondary cables running underground between manholes and service boxes, and these problems also need to be identified and addressed. In addition, the restoration process often involves pumping liquids out of underground structures in order for crews to gain access. Until all damage assessment is completed, the full extent of the repairs and the time necessary to restore customers to service is unknown.

The restoration process used by the crews working in numerous locations throughout the zones was as follows:

- Determine which transformers on the M&S plate had a primary supply
- Inspect transformer line hole for problems (blown limiters, etc.)
- Isolate the secondary by cutting mains on each corner
- Close network protectors to restore customers for one block in each direction
- Once several transformers in an area had been restored, splice the mains previously cut
- Continue this process until all customers in the zone are restored
- Conduct follow-up field surveys to verify customers were restored

As problems with the underground components were evaluated, sections of secondary cable that were known to have failed were cut away from the rest of the secondary system. Aboveground cable sections known as "shunts" were installed to bypass underground sections of secondary that were known to be defective. As the restoration process continued, a computerized voice response unit (VRU) called customers who were believed to have had power restored to confirm that, in fact, it had been. They were immediately put in communication with a customer service representative if they indicated that they were not back in service.

In addition, generators were used to restore customers in individual buildings and residential areas supplied from cable risers off the network distribution system. During the outage, a location was selected for a generator and the appropriate risers were cut isolating a selected group of residential customers. These customers were then transferred to a generator supply. The crews then followed up on checking risers and replacing them as necessary.

Once all customers were restored, a number of strategic structures on each M&S plate were selected where voltage and amperage readings were taken to make sure that there was continuity in all directions. Deficiencies were noted and referred for follow-up repair.

Figure 4-5 represents the restoration progress beginning Friday, July 21, 2006. All customers were restored by Tuesday, July 25.

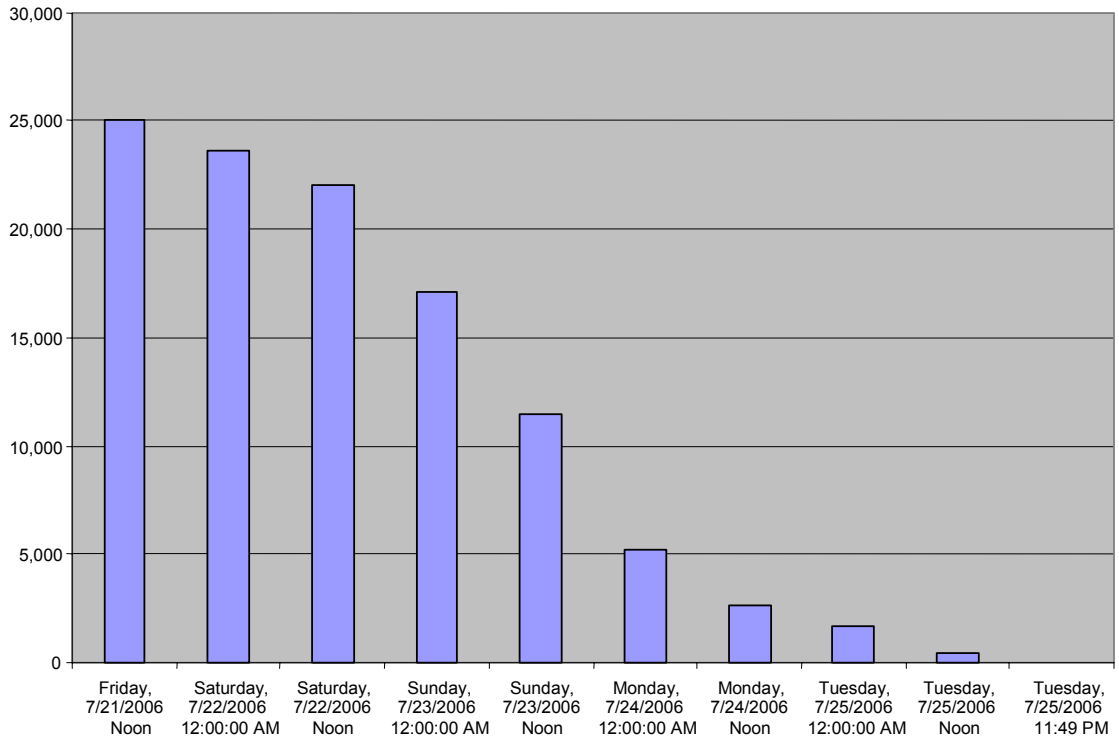

Figure 4-5: Display of Customer Outage by Date

4.6. Mutual Assistance, Contractor, and Company Forces

Beginning on Thursday, July 20, the Corporate Emergency Response Center (CERC) contacted 14 utilities and four contractor companies to obtain underground field crews. The first six underground mutual assistance crews arrived on Friday, July 21, from KeySpan and the Long Island Power Authority (LIPA). Additional crews continued to arrive on Saturday, July 22, and Sunday, July 23. Approximately 130 mutual assistance crews and contractor crews with underground skills were deployed during this event. Most of the mutual assistance crews were recalled by their companies between Thursday, July 27, and Monday, July 31, because of a forecasted heat wave approaching their own service territories. To help with the restoration, Con Edison made a second call for mutual assistance on Friday, August 4, and Saturday, August 5. Table 4-3 shows the mutual assistance Con Edison received.

Table 4-3: Mutual Assistance Utility Underground

Company	Crews
KeySpan/LIPA	12
National Grid	4
Duquesne Light Co.	5
PHI-PEPCO Holdings Inc.	5
AEP	3
NSTAR	9
PSE&G	34
Energy East	3

Table 4-4 shows the contractor crews deployed during the Long Island City Event.

Table 4-4: Underground Contractor Crews

Company	Crews
WA Chester	4
Hawkeye	23
Welshbach	8
State Electric	20

Table 4-5 shows when contractor and mutual assistance crews arrived and were released.

Table 4-5: Crew Mobilization and Demobilization

	# of Crews	Contacted	Arrived	Left
Contractor Crews				
WA Chester	4	7/21/2006	7/22/2006	7/24/2006
Hawkeye	23	7/21/2006	7/22/2006	8/12/2006
Welshbach	2	7/22/2006	8/3/2006	On going
State Electric Corp.	20	7/31/2006	8/1/2006	8/12/2006
Mutual Aid Crews				
Dusquesne Light Co.	5	7/21/2006	7/22/2006	7/27/2006
National Grid	4	7/20/2006	7/21/2006	7/28/2006
PHI-PEPCO Holding	5	7/20/2006	7/22/2006	7/30/2006
KeySpan/LIPA	12	7/20/2006	7/21/2006	8/3/2006
Energy East	3	7/21/2006	7/23/2006	7/30/2006
NSTAR	9	7/21/2006	7/23/2006	7/31/2006
AEP	3	7/20/2006	7/22/2006	7/31/2006
PSE&G	34	7/21/2006	7/23/2006	8/1/2006
NSTAR	9	8/4/2006	8/7/2006	8/13/2006
AEP	4	8/4/2006	8/5/2006	8/13/2006
PSE&G	18	8/4/2006	8/7/2006	8/12/2006

Table 4-6 shows the Con Edison resources assigned to help with the LIC event on Tuesday, July 25, 2006.

Table 4-6: Company Resources Assigned to Long Island City Response

ORGANIZATION	Crews
I & A	**166**
Manhattan	40
Bx/West	20
Brooklyn/Queens	84
Staten Island	1
Maintenance Services	21
UNDERGROUND	**180**
Manhattan	68
Bx/West	27
Brooklyn/Queens	60
Staten Island	9
Maintenance Services	16
CABLE	**25**
Manhattan	5
Bx/West	3
Brooklyn/Queens	12
Staten Island	1
Maintenance Services	1
Construction Management	3
FLUSH	**33**
Manhattan	4
Bx/West	3
Brooklyn/Queens	19
Staten Island	1
Clean Ventures	6
EMERGENCY	**33**
Manhattan	6
Bx/West	0
Brooklyn/Queens	27
Staten Island	0

OVERHEAD	**32**
Bx/West (Hawkeye Crews)	7
Brooklyn/Queens	25
Staten Island	0
CONTRACTORS - EXCAVATION	**26**
Construction Management	26
GAS OPERATIONS (people)	**68**
MH/Pump/Site Safety/Shunts, etc.	49
Mutual Assistance	6
Ice Cutting and Delivery	13
SSC	0
Brooklyn/Queens	0
ENERGY SERVICES (people)	
CPM	13
CSR	16

At peak, there were over 600 Con Edison, contractor, and mutual assistance crews working on the restoration of the LIC network.

4.6.1. Process

The Engineering Analysis group at the CERC was responsible for reaching out to the different utilities and contractors to request crews. In Astoria and College Point, a group was established to manage mutual assistance crews and contractors. When confirmation was obtained that a utility or contractor was going to release crews, the Engineering Analysis Group would then obtain the roster for the crew and the estimated time of arrival. A staging area was set up in Astoria. This information was provided to logistics for hotel reservations and to the group that was established at Astoria to receive and process the crews. The Engineering Analysis Group also made arrangements with the training coordinator to ensure

trainers were ready upon the arrival of the crews. The company provided the training, equipment, and tools required to perform the work as necessary.

Experienced retirees as well as company personnel were assigned as crew guides, managing approximately six to seven mutual assistance crews each. They assigned the work, facilitated communications, arranged material deliveries, and provided general technical support.

Utility vehicles were left parked at Astoria Yard at the end of the shift and the crews were transported to their respective hotels. Hotel accommodations were provided in three hotels by La Guardia Airport.

4.6.2. Assessment of Mutual Assistance

The acquisition and deployment of mutual assistance and contractor crews was effective and many of the processes put in place during the event will be considered for formal implementation. Some of the things that worked well were during this event were:

- Having a dedicated person and a scribe for the mutual assistance and contractor crews. A log was maintained at all times that tracked when the utility or contractor was contacted, commitment for crews was received, crew roster and estimated time of arrival.
- Having a contact person at the Astoria facility dedicated to communicate with Corporate Emergency Response Center regarding mutual assistance and contractor information allowed the operating organization to concentrate on the restoration effort. The person was responsible for meeting the group at the Astoria facility, escorting the group to their staging area, and scheduling training. Upon completion of training, a crew guide was assigned to interface with the crew.

- Using knowledgeable underground crew leaders to guide visiting crews was essential to address any safety or work related concerns.

Mutual assistance support among utilities is a well-established practice for overhead events, and on many occasions the company has offered or utilized mutual assistance support. However, this is the first time the company has been in need of underground skilled mutual assistance. The response from utilities and contractors to the company's request was favorable. The crews traveled from as far as Columbus, Ohio, and Pittsburgh, Pennsylvania. The overall process that was established worked well in managing the mutual assistance and contractor groups, allowing operations to concentrate on the restoration process while a separate group managed the logistics in support of the crews.

4.7. Demand Reduction Actions

During the event, Con Edison sought to reduce demand in the network through a number of mechanisms. These mechanism included voltage reduction, demand reduction requests to large and small commercial customers, requests to customers to move to alternate sources of supply where available, direct customer appeals made by employees in the field in impacted areas, appeals broadcast by the NYPD with mobile public address systems, and broadcast media appeals to reduce usage.

A team of personnel focused on reducing demand and tracking the demand in the Long Island City network. While this team was aware there were customer outages, they were unable to accurately determine how much demand reduction was a result of public appeals and how much demand reduction was a result of customer outages.

To illustrate the process that this team used during the Long Island City network event, the following is an analysis of the network demand on Wednesday, July 19:

- Based on a temperature-adjusted demand for Wednesday, July 19, the projected demand with no demand control measures and no customer outages for the LIC network would have been approximately 330 MW.
- The large customers contacted as part of the demand reduction effort included La Guardia Airport, the Bowery Bay Wastewater Treatment Plant, Rikers Island, the Citicorp building, MetLife, the Long Island Rail Road, Mount Sinai Hospital, the Memorial Sloan Kettering Research Facility, and the Triborough Bridge and Tunnel Authority.
- The Metropolitan Transportation Authority had reconfigured its system to remove demand from the feeders in the LIC network.
- Voltage reduction was in place on July 19, which further reduced demand.

During the outreach effort, Con Edison personnel made 400 calls to large customers within the network. Customers were apprised of current system conditions and requested to shift to emergency generation, if available, eliminate the use of all nonessential electric appliances, and reduce lighting and air conditioning use where possible. In addition, direct customer appeals were made by employees in the field in the impacted areas, and broadcast media appeals to reduce usage were made for the entire area.

4.7.1. Voltage Reduction

Con Edison follows American National Standards Institute standards that allow utilities to reduce voltage in emergency situations. Con Edison will reduce voltage by either 5% or 8% to help lower the electric usage on the network. The events of the Long Island City network outage unfolded quickly and Con Edison moved directly to an 8% voltage reduction. Figure 4-6 displays the voltage reduction over time.

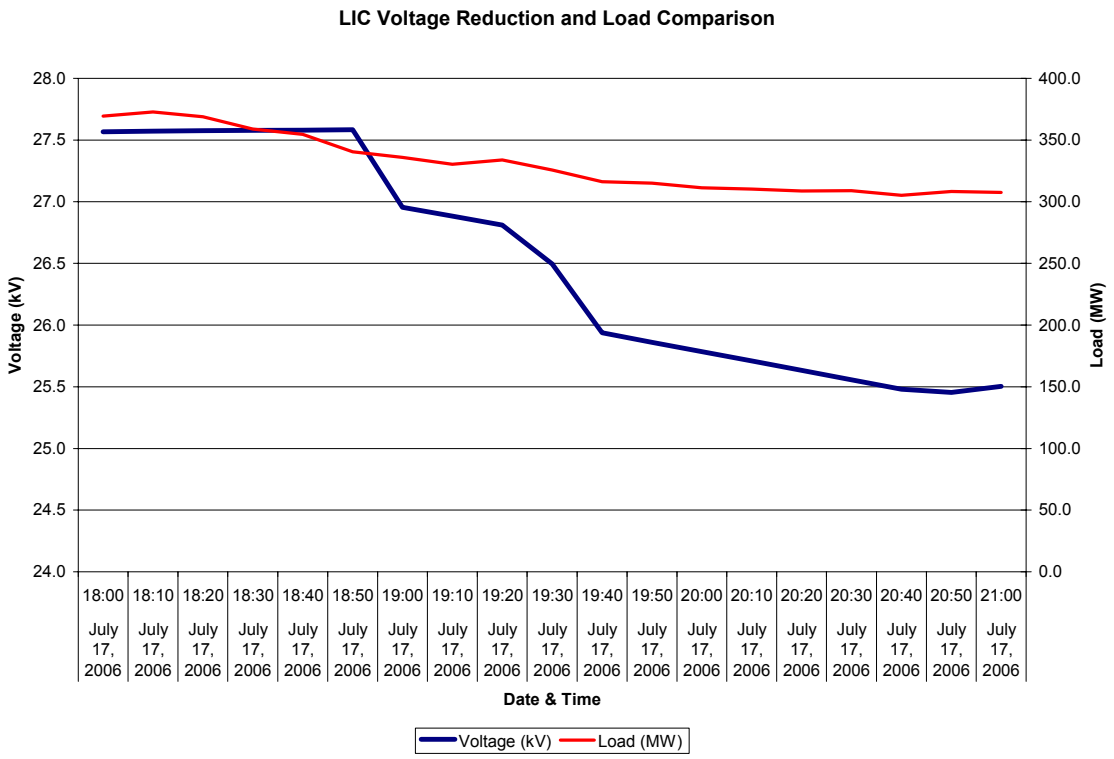

Figure 4-6: Voltage Reduction

Voltage reduction is effective because many of the electronic devices utilized by customers use power in proportion to the voltage level. If voltage drops, equipment demand should reduce correspondingly. However, various customers' loads respond differently. Experience indicates that an 8% voltage reduction may result in a 5.2% power reduction.

4.7.2. Demand Reduction Requests

4.7.2.1. Company Facilities in LIC Network

Con Edison facilities reduced nonessential demand on Tuesday, July 18, and Wednesday, July 19. Con Edison's Learning Center, located in the LIC network, closed, thereby reducing network demand by an estimated 400 kW.

4.7.2.2. Customer Facilities

In addition to reducing energy consumption at Con Edison facilities within the affected area, company personnel actively appealed to all customers using press releases, messages broadcast from police vehicles, and leaflets distributed in the LIC network by company personnel.

At the inception of the LIC network event, Monday evening, July 17, Energy Services personnel contacted large customers located in the network. Con Edison maintains a secure database of large customer account listings and contact information known as the Emergency Operating System (EMOPSYS). Many of these customers, such as hospitals and other large businesses, have their own emergency generators on site, and, in addition to reducing demand, may be able to shift demand to emergency generation.

Con Edison's contact efforts included notification of an 8% voltage reduction in addition to requesting that customers take steps to conserve energy by eliminating nonessential usage. This customer outreach effort continued for much of the week. Multiple calls were made to these same customers apprising them of the evolving status and reaffirming the request for energy conservation. Through efforts including customer phone calls, press releases, and in-field outreach, the network demand was significantly reduced from the peak that was experienced on Monday, July 17.

In response to Con Edison's initial call for assistance, several customers switched to existing on-site emergency generation, including Citicorp, the Bowery Bay Wastewater Treatment Plant, and the Triborough Bridge and Tunnel Authority. In certain cases, Con Edison

supplemented customers' on-site generation with additional mobile generators; this was the case at the Bowery Bay Wastewater Treatment Plant and Rikers Island.

On Wednesday, July 19, calls were made to specific customers requesting that they curtail operations and take steps to eliminate all electricity use. Customers responded by halting industrial operations and shortening office hours. In addition, Citicorp and MetLife decided to shut down on portions of Wednesday. Figure 4-7 displays the response of Citicorp on Wednesday, July 19, and Thursday, July 20, relative to Monday, July 17, and Tuesday, July 18.

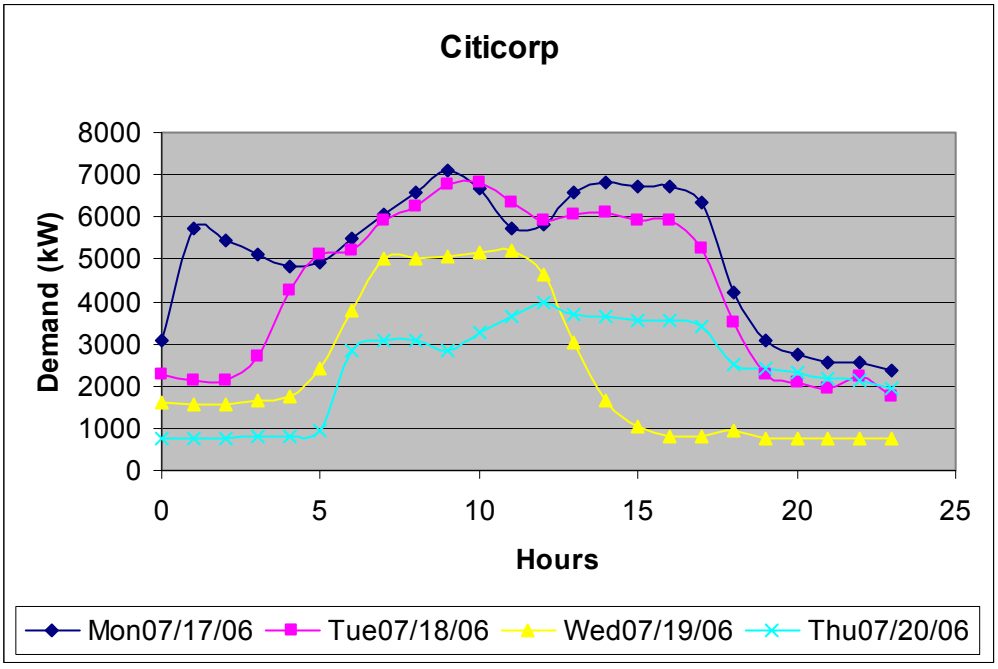

Figure 4-7: Citicorp Daily Electric Demand

Energy Services personnel made efforts to contact over 400 large customers in the LIC network between Monday, July 17, and Thursday, July 20. The calls were made to solicit customer conservation efforts, give updates on system status, and provide customers with an

opportunity to identify specific needs. Con Edison estimates that 65 MW of demand from large customers was removed from the LIC network as a result of direct customer appeals, diversion to emergency generation and, in the case of La Guardia Airport, a shift of electric loads from the West to Central Substation.

In addition, in response to requests from critical customers, Energy Services personnel worked to deploy generators to Mount Sinai Hospital, Memorial Sloan Kettering Research Facility, Bowery Bay Wastewater Treatment Plant, and New York City Department of Corrections – Rikers Island.

4.7.3. Demand Response Programs

Con Edison's Marketing and Sales group offers demand-management and energy-efficiency-related activities and programs. Among these are a Targeted Demand-Side Management (DSM) program and a System Wide program that NYSERDA and Con Edison jointly promote to foster effective DSM opportunities and new DSM initiatives through a coordinated marketing plan in the company's service area. A critical and ongoing part of this DSM initiative is the promotion of strategic demand-management opportunities that shape customer demands, such as the NYISO's Emergency Demand Response (EDRP) and Special Case Resources (ICAP) programs and Con Edison's Distribution Load Relief Program (DLRP) and Direct Load-Control (DLC) program. These programs help balance supply and demand for electricity, especially during times of peak customer demand, and increase the overall reliability of the electric system.

Con Edison annually solicits customers to participate in demand response programs. The New York Independent System Operator (NYISO) estimates that in the Con Edison service

territory there are 470 MW of demand reduction enrolled either through Con Edison or through other providers. Con Edison also has approximately 90 MW of demand reduction enrolled in its Distribution Load Relief Program (DLRP).

Con Edison Marketing and Sales account executives promote these programs, which enable the NYISO and Con Edison to call upon these large customers to curtail their energy usage during times of need. Additionally, the account executives can, and often do, reach out to assigned customers who have decided not to actively participate in these programs. Due to the relationship developed by the account executive and the education of the customer on the potential problem, virtually all customers contacted reduced energy requirements in their facilities. Their willingness to assist Con Edison during these periods is a direct result of the relationship fostered and the proper and timely exchange of information.

4.7.3.1. Emergency Demand Response Program (EDRP) and Special Case Resources (SCR)

Con Edison facilitates NYISO demand reduction programs in its service territory. Customers enrolled in these programs are called upon to reduce demand during a NYISO-called emergency. NYISO indicated to Con Edison after the event that it estimated a reduction of almost 13 MW in the LIC network.

4.7.3.2. Distribution Load Relief Program (DLRP)

This program works similar to the EDRP program, but is sponsored by Con Edison. Approximately 1.1 MW is enrolled under DLRP within the LIC network.

4.7.3.3. Direct Load Control Program (DLC)

Con Edison operates a system-wide Central Air Conditioning Direct Demand Control Program in which a customer agrees to allow Con Edison to adjust the on-off cycles of the customer's air-conditioner while the fan continues to operate. To date, Con Edison has installed more than 15,000 units in residential facilities capable of reducing demand by 19 MW, and more than 4,000 thermostats in small businesses capable of reducing demand by 6.1 MW. Con Edison utilized this program to reduce customers' central air-conditioning demand and remove approximately 0.6 MW off the LIC network.

Table 4-7 below displays when and in which zones the various demand-management programs were implemented:

Program	Date Start	Time Start	Date End	Time End	Network
ICAP	7/18/2006	13:00	7/18/2006	22:00	Zone H,I,J
EDRP	7/18/2006	13:00	7/18/2006	22:00	Zone H,I,J
DLRP	7/18/2006	08:00	7/18/2006	13:00	LIC
DLRP	7/18/2006	13:00	7/18/2006	22:00	LIC Non-SCR Customers
DLC	7/18/2006	09:30	7/19/2006	08:00	Queens Only
DLC	7/18/2006	13:00	7/18/2006	22:00	All Non-Queens
ICAP	7/19/2006	10:35	7/19/2006	19:00	Zone J
EDRP	7/19/2006	10:35	7/19/2006	19:00	Zone J
DLRP	7/19/2006	07:00	7/19/2006	10:35	LIC
DLRP	7/19/2006	10:35	7/19/2006	22:00	LIC Non-SCR Customers
DLRP	7/19/2006	19:00	7/19/2006	22:00	LIC
DLC	7/19/2006	08:00	7/19/2006	07:00	All NYC
DLRP	7/20/2006	07:00	7/20/2006	19:00	LIC
DLC	7/20/2006	08:30	7/20/2006	19:00	Queens Only

Table 4-7: Schedule of Demand-Management Programs During LIC Event

4.7.4. Assessment of Demand Response

Through the cooperation of customers, utilization of demand response programs and actions of Con Edison operators, significant demand reduction was achieved. Based on system loads throughout the event, the demand reduction achieved ranged from approximately 22 MW to 97 MW. Table 4-8 shows the maximum estimated demand reductions that resulted from the various demand response measures taken from Monday, July 17 to Thursday, July 20.

	Demand Reduction (MW)			
Demand Management Resource	**7/17 (Mon)**	**7/18 (Tue)**	**7/19 (Wed)**	**7/20 (Thu)**
Voltage Reduction of 8%	21.0	16.9	12.3	12.0
Voluntary demand reduction	-	-	-	-
Company Facilities in LIC	-	0.4	0.4	0.4
Customers	-	31.3	70.6	48.3
Demand Shedding	-	-	-	-
Emergency Demand Response (EDRP)				
and Special Case Resources (SCR)	-	12.9	12.9	-
Distribution Load Relief Program (DLRP)	-	0.5	0.5	0.5
Direct Load Control (DLC)	0.6	0.6	0.6	0.6
Maximum estimated demand reduction	21.6	62.6	97.3	61.8

Table 4-8: Demand Reduction Methods and Estimated Results in LIC Network

Demand reduction due to the 8% voltage reduction resulted in an estimated maximum of 21 MW of reduced demand on July 17. The LIC network was taken out of voltage reduction on July 23 at 08:15.

Customer demand reduction provided an estimated maximum of 71 MW of demand reduction on July 19. Table 4-9 shows an overview of the large customers who responded to the company's request. Additionally, demand response programs provided an estimated maximum of 14 MW of demand reduction on July 18 and July 19.

Customer	7/18 (Tue)	7/19 (Wed)	7/20 (Thu)	Comments
CitiCorp*	1.5	5.9	3.0	Tue: Ran onsite emergency generator & reduced general building load
				Wed: Sent staff home by 1PM
				Thu: Operated building load at 5MW; full power late afternoon
MetLife*	1.5	3.3	2.4	Wed: Sent staff home in afternoon
				Thu: Operated building at 1MW
Dept of Corrections* (Rikers)	12.0	23.0	19.7	Wed: Ran on-site emergency generation to supply load
				Thu: Ran on-site emergency generation to supply load
Celtics Holding Corp**	-	0.2	0.2	
Long Island Railroad**	4.4	7.7	7.8	
Board of Education (multiple facilities)**	1.6	2.5	2.5	
Allied Extruders - 1.0MW**	0.3	0.4	0.2	
NYC Transit Authority*	-	10.0	-	Wed: Reduced train service in Queens
NYC DEP (Bowery Bay Waste Water)	5.0	7.5	7.5	Tue: Ran onsite emergency generators to power parts of plant
				Wed: Used onsite generators to power 65% of plant
				Thu: Operated at 100% with Con Ed supplied generation
Port Authority*	5.0	5.0	5.0	Tue: Inadvertent impact to one terminal reduced load
				Wed: Transferred load to another network
United Nations Credit Union**	-	1.0	-	
Avalon Bay - .5MW**	-	0.5	-	
Verizon - .5MW**	-	0.5	-	
National Wholesale Liquidators - .5MW**	-	0.5	-	
Home Depot - .7M**	-	0.7	-	
Mt. Sinai - .7MW**	-	0.7	-	
Memorial Sloan Kettering - .7MW**	-	0.7	-	
TBTA - .5MW**	-	0.5	-	
Total Large Customer VLR**	**31.3**	**70.6**	**48.3**	

Table 4-9: Estimated Customer Electric Usage Reduction

* = Modified value since the initial August 2, 2006, report

** = New customer information since the initial August 2, 2006, report

Based on subsequent analysis, this demand reduction, especially during Wednesday, July 19, was not enough to explain the reduction in electric system usage. As part of Con Edison's further investigation, the company has attempted to estimate the forecasted load and reduced forecasted load from Monday, July 17 to Thursday, July 20, to better review the company's demand response. This is shown in Figure 4-8.

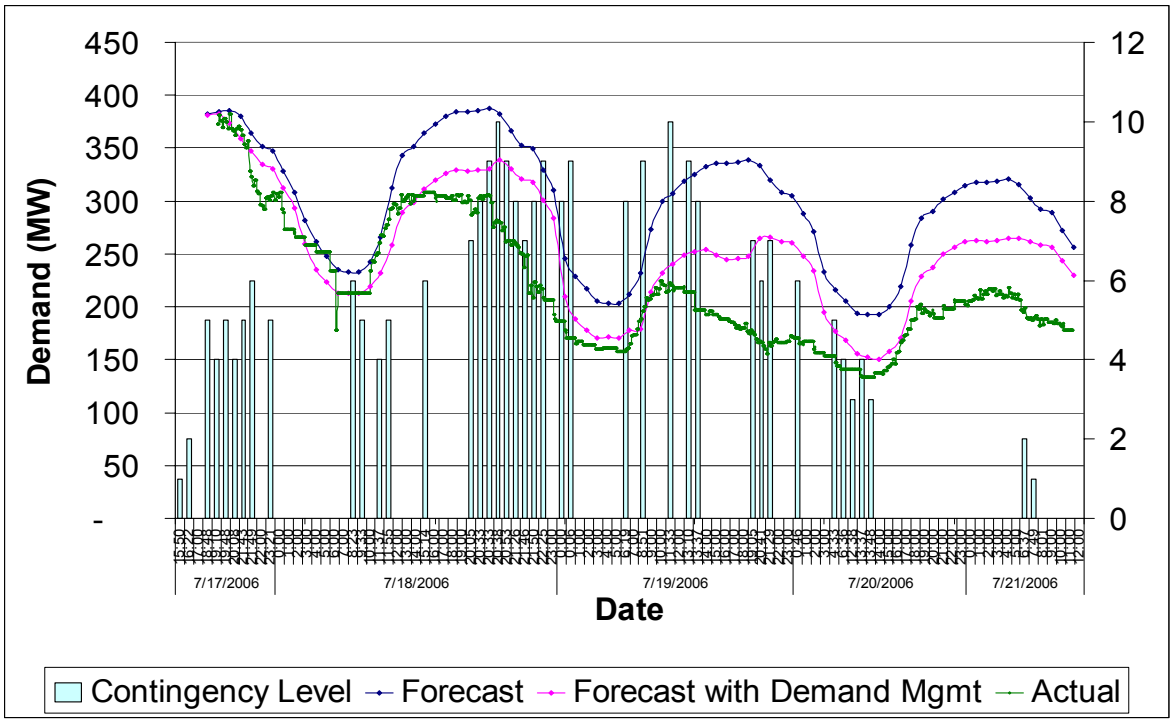

Figure 4-8: Forecasted Electric Demand in LIC Network versus Actual Demand

The area between the "Forecast with Demand Management" curve and the "Actual" curve is unaccounted for demand reduction that in retrospect, was likely due to a combination of voluntary load reduction by small commercial and residential customers (which Con Edison was unable to quantify), and customer outages, (which Con Edison was also unable to quantify). Table 4-10 shows the percentage difference between the average actual load and the average forecast with demand reduction, as well as the number of customer outages that would account for that difference if it is assumed that 100% of the difference was due to customer outages.[4]

[4] The "inferred customer outages" figure in the chart assumes that 100% of the difference between the average forecast with demand reduction and the actual load was due to customer outages. However, Con Edison does not know what percentage of the difference was due to customer outages, as opposed to voluntary reduction.

Date	Average forecast with Demand Reduction (MW)	Average Actual Demand (MW)	Percentage Difference	Inferred Customer Outages
July 17, 2006	346	333	3.8%	4,400
July 18, 2006	284	264	7.2%	8,300
July 19, 2006	225	180	20.0%	23,000
July 20, 2006	222	180	18.8%	21,600
July 21, 2006	249	201	19.6%	22,600

Table 4-10 Average Forecast with Demand Reduction vs. Actual Demand

The data in Table 4-10 was not available during the LIC outage. Energy Services advised operators of the extent of demand reduction efforts with respect to large customers and of the voltage reduction estimates made by Distribution Engineering. At the time, a significant reduction in demand from all sources (a maximum of 62.6 MW on Tuesday, July 18, and a maximum of 97.3 MW on Wednesday, July 19), coupled with additional voluntary reduction from small commercial and residential customers, were thought to be consistent with the number of customer outage calls at the time.

In retrospect, it appears more likely that the majority of the difference between forecasted load with demand reduction and actual load was due to customer outages. Table 4-10 shows a calculation of the inferred customer outages if the unaccounted for demand reduction is strictly customer outages. Overall, the inferred customer outages match fairly well with the company's estimates made on the morning of Friday, July 21.

Conclusion

Demand reduction efforts appear to have been helpful in reducing system demand. Overall, the load on Wednesday, July 19, was reduced by 97.3 MW, which is more than 25% of the forecasted peak load that day. Graphical displays of the demand reduction data would likely have helped the operators better understand what was happening on the system. But such data has limitations. For example, even retrospective estimates do not

quantify what demand reduction is obtained from small residential and commercial customers. Nor, to date, has Con Edison found any literature to provide industry estimates that could be used as a proxy for small customer demand reduction. Con Edison is continuing to look for ways to achieve better demand reduction results from small residential and commercial customers.

4.8. Emergency Generators

Deployment of mobile generators supported LIC network restoration effort in a number of ways by providing:

• Area customer restoration (overhead pick-up)

• Support to isolated critical customers (Mount Sinai Hospital, Rikers Island, etc.)

• Targeted area relief by picking up individual demand centers (Phipps Housing, etc.)

• Support/cautionary measures to the electric system (Rainey PURS Substation).

As the LIC network emergency unfolded on Monday, July 17, Con Edison began preparing and dispatching mobile generators. These activities were initially coordinated through the Distribution Engineering Command Post (DECP), which had a Central Field Service (CFS) position manned around the clock. Customers provided with mobile generators included Mount Sinai Hospital, Bowery Bay Wastewater Treatment Plant, Memorial Sloan Kettering Research Facility, and Rikers Island. On Thursday, July 20, the Corporate Emergency Response Center (CERC) was mobilized and the Energy Services desk assumed responsibility for coordinating generator deployment activities. By Wednesday evening, July 19, Con

Edison had approximately 16 generating units available for customer needs and was working with various vendors to secure additional units. The logistics desk continued its efforts in securing additional units from its vendor contacts throughout the Northeast.

By Sunday, July 23, Energy Services through its coordination with the various interacting organizations had placed on-line and energized 32 units, representing a total capacity of 13.6 MW. Con Edison then began a two-pronged approach: installing generators on isolated portions of the overhead distribution system and at specific residential and commercial demand centers so as to supply power to as many customers as possible. By Friday, July 28, the company had procured, deployed, and energized 43 generators, with a total capacity of 18.3 MW.

By Friday, August 4, the company had 54 units on-line and energized, representing a total capacity of 24 MW, which supplies over 2,100 residential and commercial customers within the LIC network.

In the weeks that followed, Energy Services coordinated the generator demobilization effort as all customers were restored to the system. Figure 4-9 displays the geographical extent of the generator deployment in the LIC network.

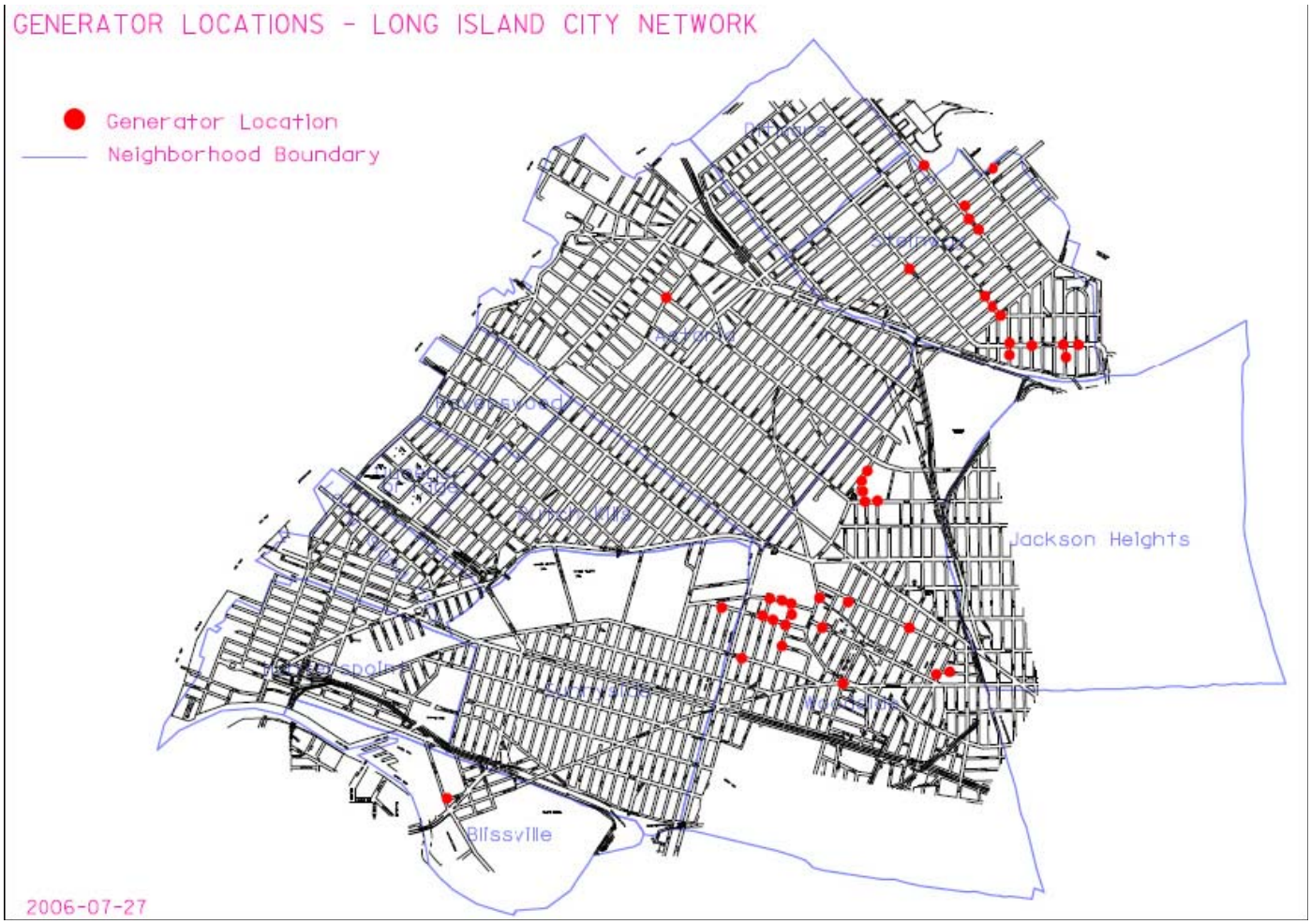

Figure 4-9: Geographic deployment of emergency generators on July 27, 2006

Once Con Edison established the CERC, the Energy Services department functioned as the single point of contact between CFS and all other groups in coordinating requests for generators. The responsibilities associated with this coordination effort expanded to including generation deployment status information, generator logistical support, engineering analysis, crew deployment for physical generator hook-up/disconnect, and customer communication issues concerning generator maintenance outages and safety-related remediation issues.

The following summarizes the roles and responsibilities assumed by various Con Edison organizations for generator deployment:

Electric Operations (Engineering) - analyzed demand pockets and/or customers who could provide additional load relief to the local distribution if shifted to a mobile generator.

Central Field Services - made contacts with vendors, identified unit availability (type and size), physically secured requested generators, mobilized units to requested locations, and established/maintained the operational capability (start-up, maintenance and fueling) of all deployed/energized units.

Emergency Management - acted as the principal liaison with the New York City Office of Emergency Management (NYCOEM) for generator deployment considerations as identified by governmental agencies.

Public Affairs - acted as the principal liaison with various local elected officials, for generator deployment considerations.

Electric Operations – Construction Forces - responded to generator deployment locations to perform the initial generator to customer/distribution hook-up (cable runs, connections, etc.) and to establish the initial site safety set-up (barricades, cones, shunt boards, etc.). They were also called upon to record the generator's operational performance (load, fuel, etc.), monitor unit and site conditions and eventually disconnect the unit.

Environment, Health and Safety (EH&S) - acted as subject-matter experts in site-safety related issues and performed periodic inspections of these energized sites to evaluate the safety status of the set-ups. Deficiencies were reported to the Energy Services Desk in the CERC.

Security Services - provided security related assistance in terms of acquiring security officers working around the clock to guard the generating units against theft and vandalism, and for

safeguarding the general public at each location. Security Services and personnel from the Facilities Group performed spot inspections on the security guards at the generator sites. In addition, the generators themselves were surrounded with barricades and tape, and high voltage signs were displayed as visual cues reminding the public to remain at a safe distance. Figure 4-10 shows these precautions.

Figure 4-10: Mobile Generator Set Up in LIC

Distribution Engineering - functioned as a technical support group and the authors of various company specifications and/or operational procedures, including grounding requirements associated with the use of mobile generators. Some generators, as determined by engineering analysis, required field grounding as an added precaution.

4.8.1. Assessment of Emergency Generator Response

Mobile generators were deployed during the LIC event to address customer concerns as well support the network restoration effort via the targeting of load pockets that could be isolated from the system. The initial LIC event centered around 27 kV feeder contingencies, in which

generation deployment was best used by de-loading the major load contributors such as the Department of Environmental Protection (DEP), Bowery Bay Wastewater Treatment Facility, and Rikers Island where generator needs were for significant type (265/460 V) and sized (2 MW) units. However, as the LIC event moved from a feeder contingency condition to a local secondary network distribution condition, the generator deployment strategy shifted to the use of smaller sized 120/208 V generators (< 1 MW) to provide support to the local distribution system and customers with less load such as apartment complexes and small commercial establishments.

Con Edison's generator deployment efforts during this event focused on the needs of the company's overall customer base. In the case of an area outage, Con Edison does not typically supply generators to its smaller customer base because the magnitude of such an undertaking would greatly diminish the resources available to make repairs to the distribution system. The deployment of smaller generators to support distribution repairs in the LIC network supported the company's restoration efforts.

Since the LIC event initiated with a heat wave that impacted other operational areas as well (Staten Island, Manhattan and Westchester), the flexible deployment of generators was critical to meeting the needs of the company's distribution systems and our customers. Although Con Edison experienced some issues with the timeliness of securing additional generators, overall Con Edison had acquired an ample inventory of generators to address the needs at hand. There were a few instances where Con Edison rearranged the generator configuration at a given site in order to redeploy units so they could be more efficiently utilized (i.e., some were oversized for the application).

The coordination efforts between the various groups involved in generator deployment went well. A few areas for continued improvement were noted. During peak deployment periods, the availability of Central Field Services (CFS) (technicians and drivers) and of Electric Construction personnel to hook up the units was occasionally a constraint. However, this was more of an issue in the very early stages of the event where there were competing priorities and resources were being ramped up.

Energy Services became a critical resource in assisting in several non-routine activities throughout the event. Energy Services was called upon by Electric Operations (Engineering) to assist in analyzing load reduction opportunities in specific load pockets that would provide distribution load/voltage system relief. Energy Services effectively identified locations that would achieve the desired load reduction utilizing minimal generator resources. Overall generator deployment was effective from both a procedural and process standpoint.

4.9. Environment, Health and Safety Response

Corporate and field Environment, Health and Safety (EH&S) organizations both responded to events associated with the LIC network outage. Field EH&S staff worked around the clock in the LIC network throughout the event providing EH&S guidance and support (including applicable safety talks) and ensuring that safe work practices were followed. Corporate EH&S mobilized on Thursday, July 21, at approximately 13:00 to support the CERC. CERC and the EH&S Control Room were initially staffed primarily by individuals shown on the on-call schedule for the week of July 17. Twelve-hour relief schedules were established to assure continuous staffing at those two locations and in critical field-support positions. The Chemical Lab personnel were mobilized to satisfy sampling and analysis needs, and

Environmental Response Team (ERT) personnel provided continuing on-site support. Full staffing at the CERC was maintained through Wednesday, July 26. Overall, EH&S functioned as an integral component of the emergency management structure while simultaneously addressing the day-to-day requirements in the field.

Upon activation, EH&S personnel assessed the environmental, health and safety aspects of the incident and, in conjunction with field EH&S groups, provided technical subject matter expertise and resources to address the following:

4.9.1. EH&S Communication

- Developed content for the environmental, health and safety-related aspects of the incident action plan (IAP) and field safety talks.
- Developed and communicated daily safety messages addressing such topics as work area protection, atmospheric testing, personal protective equipment, electrical safety, and heat stress.
- Worked with field EH&S personnel to analyze injury events and disseminate critical safety information as well as lessons learned.
- Established and maintained ongoing communication with environmental regulatory agencies.

4.9.2. Regulatory Interaction

- Secured emergency authorizations and established reporting protocol for emergency generators.

- Negotiated administrative relief associated with removal of asbestos-containing material (ACM) from electrical subsurface structures.
- Established and communicated hazardous substance release-reporting protocol during the emergency.
- Communicated with EPA that emergency operating conditions were in effect for PCB spill cleanups.

4.9.3. Procedure and/or Training Curricula Development

- Worked with The Learning Center and Distribution Engineering to develop specialized training curricula for underground emergency response. Provided training for mutual-assistance crews and retired employees.
- Established guidelines for mutual-assistance crews with regard to the use of uninsulated tools.
- Provided EH&S-related input for on-the-job training material developed for support personnel from other Con Edison organizations (Gas Operations and Substations).
- Developed on-the-job training for site safety representatives and generator guards.
- Developed guidelines for the safe handling of dry ice for employees and the public.
- Revised existing heat stress on-the-job training to specifically incorporate actual conditions associated with the response.
- Worked with Electric and Gas Operations to develop a secondary cable component handling/collection guideline.

4.9.4. Safety Equipment

- Coordinated the procurement of safety equipment for mutual-assistance crews and Con Edison response support with the logistics section, including safety harnesses, rescue devices, and safety vests.

4.9.5. In-the-Field Support

- Conducted field visits for around-the-clock observations of work crews over a seven-day period. Focused on reinforcing safe work practices, distributing water to promote hydration, and emphasizing the daily safety message of the incident action plan.
- Conducted field inspections of emergency diesel generator setups, specifically in the context of public and employee safety. Identified site-protection improvement opportunities. Worked on grounding issues with field personnel and verified acceptability of earth grounding on diesel generators connected to overhead secondary.
- Identified shunt-protection improvement opportunities for areas exposed to high public traffic.

Between July 17 and July 25, two company employees were reported as injured, while several vehicles were damaged due to manhole fires or from transformer explosions. No members of the public were injured.

4.10. Outage Assessment – Determining Customers Interrupted

4.10.1. Customer Calls and Outage Data Collection

Customer calls are important in a network area in order to determine the number of customers affected. Unlike a radial supplied area (overhead), the loss of a feeder does not equate to a loss of customers. That is, if a feeder de-energizes, the design of the system allows the electricity to flow to the customer through another feeder, keeping the customer on. This is true even during multiple contingencies. Therefore, the company does not know that a network customer supplied from the secondary system has lost service until a customer calls to report the outage.

Customers and others (such as municipal agencies and public safety offices) relay service-related problems to Con Edison by contacting the Con Edison Customer Service Call Center (Call Center) at 1-800-75-CONED. The Call Center representative records the customer's problem and creates a service request (trouble ticket or B ticket) that is managed by Con Edison's Emergency Control System (ECS). Trouble tickets are sent to the appropriate Control Center where they are dispatched to a field crew for assessment and correction of the problem. The company's Outage Manager System accumulates the number of reported outages from ECS to provide an overall count.

In network-supplied areas, ECS updates the trouble ticket with the proper network designation. The customer outage count associated with each job can also change based on the following criteria:

- If the job is in a network-supplied area, the initial customer outage count will be "one." The customer outage count can be increased by an operator in the control center. The outage count can also change when an operator combines multiple jobs into a single or "lead" job. This determination is usually made by the operator reviewing the map of the area where the outages are occurring, or from field verification.
- If the job is in not in a network, ECS has rules that associate service requests to common transformers and feeders to determine if they are out of service. This entry can also be manually changed by an operator to reflect actual conditions found in the field.
- If the job is initially created as a non-outage job, the operator can manually make a customer count entry if conditions indicate customers were affected.
- An operator can decrease the customer outage count by using the partial restoration function. A partial restoration indicates the portion of customers restored on that service request. A service request may have multiple partial restorations noted. The customer outage count is decreased each time a partial restoration is noted.

On Monday, July 17, when the system entered the fifth and sixth contingency, customer calls reporting outages increased. On Tuesday, July 18, the network contingencies escalated. There was increased trouble ticket volume as the feeder contingencies impacted the secondary system. On Wednesday, July 19, during the beginning of the network demand pickup, the LIC network was in a ninth contingency, customer outage calls increased throughout the day.

Figure 4-11 illustrates the cumulative number of trouble tickets generated in the LIC network from July 17 to July 20.

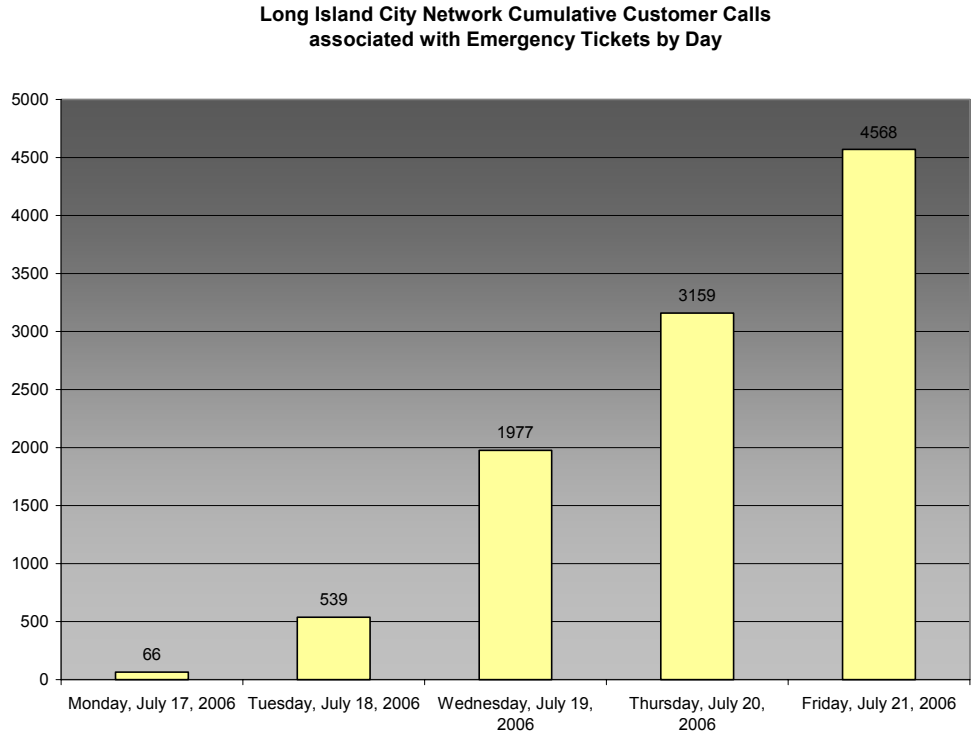

Figure 4-11[5]: LIC Network Cumulative Electric Emergency Tickets by Date

On Thursday, July 20, based upon the observations of Con Edison employees and other reports, Con Edison became concerned that the customer outages reported by Outage Manager and ECS did not accurately reflect conditions in the LIC network. As a result, the company conducted a field survey of the area encompassing the three zones, described earlier, where the customer call locations had been plotted on maps in order to get a better understanding of the affected area and number of customers out of service.

[5] Figure 4-11 displays corrected emergency ticket counts from Figure 5-3 displayed in Con Edison's Part 105 Compliance Filing dated September 25, 2006.

4.10.2. Field Surveys

The area of the Long Island City network where the secondary system was damaged initially comprised an area described by 62 Mains and Service (M&S) plates (or geographic maps of sections of the network). On Thursday night, July 20, employees were dispatched to survey these areas by automobile and annotate on the M&S, by street, areas that had no power. A public appeal was made to customers who had power to leave their lights on in order to aid in the assessment of customer outages.

By Friday morning, July 21, the company developed an estimate, based on field surveys of 39 plates and an estimate of 17 other plates, of the number of customers without service in the three zones. The company provided an estimate of approximately 25,000 customer outages for the affected area.

The use of field surveys to estimate the number of customers out of service produced rough estimates. This process, however, provided the best estimates under the circumstances, and was more accurate than relying on calls from customers.

The company also used the initial survey results during the restoration process. Because the survey results identified streets, they helped the company dispatch crews for damage assessment and repair. Ongoing assessments identified additional secondary damage on nearby plates that were combined into one of the three initial zones and assigned to work crews to expedite restoration. The zone 1 and zone 3 restorations were coordinated from the company's Astoria facility. The restoration of zone 2 was coordinated from the company's College Point facility.

4.11. Communications

During power outages and other emergencies, Con Edison communicates with customers, city and state agencies, elected officials, the news media, and other individuals and entities. Over the course of the LIC event, Con Edison communicated with customers, the public and elected officials, and communicated and coordinated with the Department of Public Service (DPS), New York City Office of Emergency Management (NYCOEM), the New York City Police Department (NYPD), the Fire Department of the City of New York (FDNY), and other agencies and organizations.

A communications chronology, with a time line of the events and communication that took place between Monday, July 17, and Wednesday, July 26, 2006, is provided in the Appendix attached hereto.

4.11.1. Communication with Department of Public Service

Con Edison has an established communications infrastructure through which it communicates with DPS staff. In accordance with company practice, from July 16 through July 26 – that is, from the time the company mobilized its resources in anticipation of extreme weather and peak customer demand, until all LIC network customers were restored – Con Edison systematically communicated with DPS staff.

The DPS had representatives at the Distribution Engineering Command Post (DECP) from July 17 to July 20, when CERC opened. The DPS representative monitored system events and had access data screens and activities in the DECP, including the status-report meetings that the DECP held every four hours with the Brooklyn/Queens control room to discuss events taking place on the LIC network. During this period, a DECP liaison provided the DPS staff

representative with updates on system events, including LIC network feeder outages and other data. The DPS staff representative was provided with a desk and telephone.

Con Edison's DECP liaison, an engineer with the company's Distribution Engineering department, also communicated, primarily by e-mail, but also by telephone, with DPS representatives monitoring system events from other locations. Beginning at 20:37 on July 17, the DECP liaison e-mailed a status report to the DPS staff generally on a two-hour basis (00:00, 02:00, 04:00, etc.). The reports provided detailed information about the LIC event, as well as service outages caused by thunderstorms in Westchester County. The reports contained the following status information (not all topics were covered in all reports):

- La Guardia Airport and Rikers Island status
- Feeders out in Long Island City network
- Generator status
- Voltage reductions
- Customer communications
- Emergency Demand Response Program (EDRP)/special case resources (SCR) requests
- Westchester estimated time of restoration (ETR)
- Mutual assistance crews at Long Island City and Westchester
- Long Island City demand
- Customer outages in Long Island City
- Customer outage list for Westchester by municipality
- Feeder status

The DECP liaison sent these reports until the afternoon of July 20, after the CERC was established and became responsible for communications with staff. During this time, the DECP liaison sent the DPS staff more than 70 e-mails, including 26 two-hour status reports and numerous responses to staff's requests for information.

When Con Edison opened the CERC, the DPS staff was provided with a round-the-clock desk position in the CERC with telephones, VPN and wireless Internet access. The DPS personnel

staffed the desk at the CERC everyday, until service was restored to all Long Island City customers. The DPS staff also had round-the-clock access to a Con Edison legal liaison.

During the CERC, company personnel were available at all times to communicate with and answer inquiries from the DPS staff in person or by telephone or e-mail. The DPS representatives had access to all data screens in the CERC and participated in the CERC status conferences that were generally conducted every four hours. Upon request, the company's senior vice president of Electric Operations spoke with DPS staff. The legal liaison provided documents requested by staff, and tours of CERC and the LIC network area were arranged for visiting commissioners from the Public Service Commission (PSC) and other DPS personnel. These tours included visits to the Brooklyn/Queens command centers, customer service areas, and work sites.

DPS staff was updated with periodic reports on Con Edison's efforts to restore customers to service in Long Island City, as well as in Westchester County, where thunderstorms had interrupted service to about 45,000 customers. Reports containing the following status information were sent by e-mail on a two hours basis beginning at 16:00 on July 20 until 18:00 on July 21:

- Feeders out in Long Island City
- New York City Police Department assistance
- Outages in Long Island City
- Voltage reductions
- Customer communications
- Emergency demand response program (EDRP)/special case resources (SCR) requests
- Westchester estimated time of restoration (ETR)
- Customers out in LIC network
- Long Island City demand
- Mutual assistance crews

- Customers contacted re: demand reductions
- Customer outage list for Westchester by municipality
- Feeder status
- Generator status

Beginning at 20:00 on July 21 and continuing until all LIC network customers were restored, reports containing the following status information were sent to the DPS staff at about 08:00, 12:00, 16:00, and 20:00 each day:

- Feeders out in Long Island City
- Mains and service plates restored
- Voltage reductions
- Customer communications
- Long Island City ETR
- Westchester ETR
- Customers out in LIC network
- Long Island City demand
- Customers contacted re: demand reductions
- Other items, including Rikers Island restoration
- Mutual assistance crews in LIC and Westchester*
- Customer outage list for Westchester by municipality*

*Provided at 08:00 and 16:00

DPS staff was notified at 23:49 on Tuesday, July 25, 2006, that the restoration of customers had been completed. In addition, the legal liaison provided staff with copies of press or media releases. The legal liaison also responded to e-mail, telephone, and in-person requests for information from DPS staff. In addition to numerous telephone conversations between DPS staff and various company personnel over this period, the legal liaison sent more than 100 e-mails to staff, including 35 periodic reports and responses to other information requests.

Con Edison maintains a Central Information Group (CIG), which is available around the clock to communicate current system information to company personnel and external groups,

including DPS staff, on an around-the-clock basis. DPS staff normally receives alerts from CIG about system events. At the onset of the Long Island City event, CIG quickly responded to a request from the DPS staff to add particular staff members as recipients of CIG's system status report and other communications concerning the LIC event.

CIG prepared and issued a system status report every two hours during the LIC event. CIG sent this report by e-mail to people inside and outside of Con Edison, including the three DPS staff members who directly monitored events occurring on the LIC network, as well as other events on the distribution system during that period.

The system status report updated the status of Con Edison's electric system in the following areas:

- Customer outages – number of customers out of service by borough/county
- Distribution feeder status – feeders out of service by feeder number and network, time of outage, estimated time of restoration, and number of multiple contingencies, including the LIC network feeder outages
- Crewing – number of crews by shift, type, and region; number and types of crews transferred among regions
- System demand – forecast and instantaneous current system demand
- Transmission system information
- Weather forecast and weather alerts
- Status of Distribution Engineering Command Post (DECP)

CIG sent a total of 114 system status reports to staff from July 16 to July 26.

Throughout the LIC network event, CIG prepared and issued alerts concerning electric system incidents. These alerts were sent via the Communication Notification System (CNS) to people inside and outside of Con Edison, including the three members of the DPS staff who monitored events occurring on the LIC network, as well as other events on the distribution system during that period. The company uses CNS alerts to notify DPS staff of events on the

distribution system and events that must be reported under PSC guidelines. The CNS sends a voice message, plus a follow-up e-mail containing the text of the CNS message that provides a near-real-time alert describing events on the company's electric system. The CNS messages and e-mails for events occurring on the LIC network covered incidents such as:

- Voltage reduction in Long Island City network
- Manhole and carbon monoxide evacuation events
- Customer outages over threshold levels triggering performance-mechanism communication requirements
- Emergency Demand Response Program (EDRP)/Special Case Resources (SCR) program activation
- Feeder outages, multiple contingencies, and next-worst contingencies; analyses and impacts on sensitive customers
- Activation of the Distribution Engineering Command Post (DECP) and Corporate Emergency Response Center (CERC)

From July 16 to July 26, CIG sent to DPS staff a total of 42 CNS messages concerning events that occurred on the LIC network.

4.11.2. Communications With Customers

Con Edison has a robust infrastructure in place to respond to incidents and emergencies, including customer communications, the handling of emergency calls received from customers, and customer care efforts.

When an event occurs, the Con Edison Call Center staffing increases and customer care efforts are initiated. Special messages are placed on the Call Center automated menu. Calls are made to customers using life-sustaining equipment (LSE) and those with medical hardships. Customer care efforts, such as the mobilization of the company's Outreach van and distribution of ice, are undertaken.

Prior to and at the onset of the LIC event the company communicated with its customers about emergency preparedness in a number of ways. These activities are detailed below.

4.11.2.1. Communicating to Customers About Emergencies

During the course of the year, Customer Operations strives to educate customers regarding storm preparedness and energy issues, and to make them aware of the need to report emergencies.

Customer Operations uses a number of methods to communicate information to customers about reporting emergencies. The company's Web site advises customers to call the company during an outage and specify the location and extent of the damage in their neighborhood. Customers are also advised that should they see a hazardous condition, such as fallen electric wires, they should contact the company at the toll-free number.

This information is also featured in *Customer News*, the Con Edison newsletter, which is mailed to customers six times a year, and in *Spotlight*, a special publication for senior and disabled customers, which is mailed twice each year. These newsletters, as well as special summer and winter mailings to more than 1,000 community-based and human-services organizations also provide information on Con Edison's services and programs, safety tips, and storm and emergency preparedness.

For customers who depend on electricity to power life-sustaining equipment (LSE), Con Edison has a program that enables the company to contact them with important information in case of power outages. All residential customers receive an invitation to enroll in this program twice each year via an article and application in *Customer News*, and in the rights and responsibilities notice, which customers receive annually. Customers are also asked if they

use LSE when they apply for service. Information about LSE can also be found on the Con Edison Web site. Customers can notify the company at any time regarding their LSE status by calling the Con Edison toll-free number (1-800-75-CONED) or by visiting the Web site and completing an application online.

In addition, letters are mailed each year to LSE manufacturers and emergency agencies advising them of the program and encouraging them to alert those who purchase this equipment to register with Con Edison. All LSE customers on record with Con Edison receive a letter each spring reminding them that they are registered and outlining the LSE program.

Customers who have a medical hardship have an opportunity to enroll as a medical-hardship case each year. An application for enrollment is included with the rights and responsibilities notice mailed annually to every Con Edison customer. Customers can also enroll at any time by calling the company's toll-free number or by visiting the Con Edison Web site.

Throughout the year, Customer Outreach staffs local community events and accommodates requests for presentations to individual community groups. They bring and discuss materials related to Con Edison's services and programs and speak with people one on one or in groups about these programs. Staples of these discussions are the safe and wise use of energy, and how to prepare for and what to do in emergency situations, such as storms, power outages, and extreme weather conditions. Con Edison's *In Case of a Storm* brochure is an example of one of the publications the advocates distribute on a regular basis. This brochure provides storm-emergency tips, including avoiding fallen power lines, asks customers to call Con Edison

when they have a power outage, and includes information on preventing damage to electrical equipment. This brochure is available on the Con Edison Web Site.

4.11.3. Customer Care Efforts during the Long Island City Event

During the LIC event, company forces were mobilized to provide customer care. Customer Outreach advocates and Customer Operations personnel were located at the Customer Outreach customer information mobile vehicle as well as at other field locations in the affected area. They provided information to customers, answered their questions, and provided claim information and assistance.

In all, Customer Operations personnel staffed the following five field locations:

- Ditmars Boulevard and Steinway Street
- Newtown Avenue and 30th Avenue
- PS 2 – 75th Street and 21st Avenue
- 65th Street and 37th Avenue
- Astoria Boulevard and 29th Street

Each location was open for a minimum of 12 hours a day, starting in some locations at 06:00 and ending between 20:00 and 22:00.

The Con Edison personnel at these locations, as well as at the many claims- and ice-distribution locations discussed below, were Con Edison's visible presence in the communities. They directly communicated the company's concern and commitment to restore electricity as soon as possible. These representatives remained in the community every day until electricity was restored. Furthermore, company outreach personnel continue to meet with the public at two locations in the LIC network to show Con Edison's concern and commitment.

4.11.4. Customer Claims

Con Edison's electric rate schedule provides for a maximum reimbursement of $350 to residential customers for food-spoilage losses, and a maximum of $7,000 to commercial customers for losses of perishable merchandise. The company has adopted a flexible and liberal reimbursement policy for residential customers to address the extraordinary circumstances of this event and is making extensive efforts to assist customers in presenting claims for reimbursement.

With the approval of the PSC, Con Edison is reimbursing residential customers up to $350 for spoilage of food and medicine without the need for receipts or itemization of their losses. In addition, the $10 million cap on total reimbursements has been removed for claims relating to this event.

Due to the potential size of the impacted area and to facilitate the prompt processing and speedy payment of claims (the company sought to make payment within one week), the company established a large area of the network as eligible for reimbursement of spoilage losses. This avoided substantial claim payment delays while the company sought to determine if a particular claimant had lost service. This eligible area included not only the restoration work zones (zone 1, zone 2, and zone 3) but also adjacent areas encompassed by M&S plates where additional secondary damage was found and repaired. Indirect customers living in the designated plate area who submit claims are also being reimbursed. In a parallel effort to mitigate hardship to customers in the LIC network, the company, with the approval of the PSC, temporarily suspended normal collection activities, such as service disconnections, late-

payment charges, and no-access fees, to all customers in the LIC network, including those customers not affected by outages.

In order to facilitate the claim process, the company made claim forms and information about filing claims widely available. In addition, Customer Service personnel – as well as bilingual representatives from Customer Outreach, Customer Operations, and Claims – distributed claim forms in the affected areas and assisted customers with information and instructions about filing claims. Claim forms were available in English, Spanish, Italian, Korean, Greek, and Chinese. In all, Customer Operations personnel distributed claim forms at 12 locations. Claims information, forms, and assistance were also provided at ice-distribution locations and at senior centers.

In order to assist commercial customers with the claims process, over a five-day period beginning on July 24, teams walked the affected areas and visited more than 500 open stores with perishable merchandise. Claims personnel have continued to work in the affected area and have resolved several hundred claims on-site based on a visual evaluation. Con Edison is continuing to conduct field visits to assist commercial customers in filing claims for loss of perishable merchandise. On an ongoing basis, the company reviews all commercial claims submitted and, where necessary, contacts the claimant by phone or conducts an on-site visit to resolve the claim.

Four claims-processing centers were operated at:

- YMCA on Queens Boulevard and 32nd Street (opened July 21 and closed August 26)
- Sunnyside Community Center, 43-31 39th Street (opened July 26 and closed September 2)

- Commerce Bank, 31-04 Ditmars Boulevard (opened July 27 and remains open)
- LaGuardia Community College, 31-10 Thompson Avenue (opened July 25 and closed September 15)

The YMCA was open Monday to Friday, from 08:00 to 20:00, and on Saturday and Sunday, from 09:00 to 17:00. The Sunnyside Community Center was open Monday to Friday, from 08:00 to 20:00, and on Saturday and Sunday, from 09:00 to 16:00. LaGuardia Community College was open Monday to Friday, from 08:00 to 18:00. Commerce Bank is open Monday to Friday, from 08:00 to 20:00, on Saturday, from 09:00 to 16:00, and on Sunday from 11:00 to 16:00.

Claims information and assistance were also provided at the Public Statement Hearings conducted by the PSC, which were held on August 3, August 9, and August 10. Con Edison advocates, a Customer Operations manager, and bilingual Customer Operations representatives were present in the Outreach customer information van at the hearing locations.

Thus, to address this unique event, Con Edison took an over-inclusive and conservative approach to defining the boundary of the affected area for both bill payment purposes (such as suspending late payment and no access charges) and for determining claims eligibility. This approach, combined with the flexible policy the company adopted to facilitate the claim process, including relaxing eligibility requirements and relying on residential customers' representations that they were affected and suffered the claimed loss of perishable items, helped mitigate the hardships endured by direct customers and indirect customers within the LIC Network and accelerated the processing of reimbursement checks.

As of October 6, 2006, Con Edison has provided reimbursements totaling $13.6 million to approximately 37,700 claimants affected by this outage consisting of customers and claimants who are not customers. Con Edison is the only utility in New York State that provides reimbursement for spoilage losses resulting from a local distribution outage.

4.11.5. Dry and Wet Ice Distribution

Dry ice was distributed in protective paper bags that were placed into plastic bags. Safe-handling instructions were provided in both English and Spanish. The initial distribution point for dry ice was at Steinway Street and Ditmars Boulevard, the main outpost of the Red Cross for the event. The company added other locations based on need – a total of 10 locations throughout the affected area. A list of dry-ice distribution locations was provided via the Con Edison Web site home page and press releases. During the event 40,950 pounds of dry ice were distributed. Wet ice was also provided at some of these centers.

4.11.6. Outbound Calling

According to the normal protocol, upon completion of a job generated by customers' reports of "no lights," "no lights area," "flickering lights," "low voltage," and "side offs," customers received a call from Con Edison's automated calling system to confirm that their service was restored. The automated system provided customers with two options to communicate the status of their service:

- If the problem was resolved satisfactorily, the customer was advised to press 1.
- If this problem was not corrected, the customer was advised to press 2 and was connected with a CSR.

Also, as area restorations progressed, customers were called via an automated calling system to confirm that service was restored. Where customers indicated that service was not restored, a CSR called the customer.

4.11.7. Life-Sustaining Equipment (LSE)

Con Edison has a number of measures in place that identify customers using life-sustaining equipment (LSE) at their premises. On July 17, 2006, from 07:40 to 09:45, outbound interactive voice-response-unit calls were made to 2,376 LSE customers in the entire service area, including 58 LSE customers served by the LIC network.

The outbound call message for LSE customers referred to the severe weather and indicated that Con Edison's records showed there was LSE at the premises. The message recommended that the customer go to a hospital, call 911, or make other arrangements to make sure the equipment remained operable. The message also provided a priority toll-free number to call to speak to a representative and recommended battery backup for the equipment.

Additional calls were made to LSE customers in the LIC network as described below:

July 17, 2006
CSRs called all LIC network LSE customers about the 8% voltage reduction.

July 18, 2006
LSE customers in the LIC network were advised of the voltage reduction a second time through the company's automated calling system.

July 19, 2006
LSE customers in the LIC network were advised through the company's automated calling system of the steps they should take if they lose power.

July 20, 2006
Con Edison again called the 58 LSE customers served by the LIC network. Based on the revised outage estimate, Con Edison took the additional step of requesting the NYCOEM to check on the nine LSE customers Con Edison was unable to reach.

July 21 to July 28, 2006
CSRs continued to call LSE customers in the LIC network to check on the status of their service.

4.11.7.1. Medical-Hardship Customers

A customer can claim medical-hardship status if he or she has been officially certified as such. On July 17, Con Edison sent an outbound, interactive voice-response-unit call to all medical-hardship customers of record in the entire service area, including 44 served by the LIC network. The message to medical-hardship customers referred to the severe weather and indicated that the company's records showed there was medical hardship at the premises. The message recommended that the customer go to a hospital, call 911, or make other arrangements if necessary. The message also provided a priority toll-free number to call to speak to a representative.

Additional calls to medical-hardship customers were made as described below.

July 18, 2006
CSRs called all LIC network medical-hardship customers about the 8% voltage reduction.

July 19, 2006
Medical hardship customers in the LIC network were advised through the automated calling system that they could lose power.

July 20 - July 28, 2006
The company continued to call customers with medical hardships through the automated calling system to provide information.

4.11.8. Large and Critical Customer-Outreach Initiatives

In conjunction with the company's summer-preparedness effort, Energy Services personnel participate in presummer heat-wave drills; attend Incident Command System (ICS) training; reconcile the Emergency Operating System (EMOPSYS) database of large, sensitive and critical customers; review the Distribution Load-Relief Management Plan; and prepare and distribute "hard copies" of customer-contact files in the event that electronic files are not available. Energy Services also attends periodic meetings with NYCOEM, Port Authority of New York and New Jersey (PANYNJ) and the Triborough Bridge and Tunnel Authority (TBTA).

Critical customers include hospitals, prisons, schools, nursing homes, water and sewage treatment plants, government agencies, and research institutions. Critical customers may also include those that the NYCOEM and Westchester County Emergency Operations Center have deemed critical. In this instance, Energy Services becomes the conduit for all operational activities within the various jurisdictions, working with local police, fire, and emergency responders.

During a system emergency, Con Edison works with large, sensitive, and critical customers to:

- Notify them of system emergencies
- Request that they switch to emergency generation equipment to reduce demand on Con Edison's network system
- Coordinate demand-reduction and conservation efforts
- Deploy mobile emergency generators as needed

Energy Services may also be called upon to contact those customers participating in the company's Distribution Load-Relief Program (DLRP), as well as customers with on-site generation that might be able to participate in voluntary demand-reduction efforts. Energy

Services' EMOPSYS, a secure database of large, sensitive, and critical customer-account listings, contact information, and backup-generator availability and capacity, facilitates its ability to contact these customers during an emergency.

4.11.9. Demand-Side Management Communications

As described in detail in above, Con Edison took a number of actions during the event to reduce demand in the network, including demand reduction requests to large and small commercial customers, requests to customers to move to alternate sources of supply where available and direct customer appeals through employees in the field, the NYPD and media appeals. In addition, NYISO and Con Edison demand-management programs were activated.

4.11.10. Emergency Communications With New York City Agencies

On a daily basis, the Con Edison Office of Emergency Management (EM) is in contact with two primary agencies in New York City – the New York City Office of Emergency Management (NYCOEM) and the New York City Police Department (NYPD) Operations Division. Both Con Edison's daily and emergency-incident contacts with NYCOEM and NYPD officials concern electric, gas, and steam-system conditions, and projects of mutual concern, such as hurricane coastal storm planning. This communication is in addition to phone calls from Con Edison's Central Information Group (CIG), which consist of formal electric, gas, or steam system condition notifications. The company also communicates through Emergency Response Group field responders, who speak to their NYCOEM responder counterparts at fires, building collapses, and Con Edison system problems as defined by NYCOEM response guidelines.

During heat, wind, winter storms, and other significant events, it is common for Con Edison to have trained Energy Services managers, Distribution engineers, and Emergency Response Group members at NYCOEM and NYPD facilities, who stay in contact with EM staff and agency officials. It is also common to have trained NYCOEM and NYPD responders and officers at Con Edison facilities. These established protocols include the following emergency facilities:

1. Distribution Engineering Command Post (DECP): if sent by NYCOEM and NYPD senior management, a NYPD officer and the NYCOEM responder provide logistical support (police escorts, moving cars, closing roads, etc.) from the facility and gather Con Edison system information for their agency. They interface with EM staff around the clock. Both NYPD and NYCOEM responders were in the DECP during the Long Island City outages.

2. Corporate Emergency Response Center (CERC): the NYPD officer and NYCOEM responder present in the DECP moved to the CERC when it opened on July 20. They staffed the CERC 24 hours a day, seven days a week.

3. NYCOEM Emergency Operations Center (EOC): on July 18, in response to Long Island City power events, the City of New York opened its EOC. More than a dozen New York City agencies were present in the EOC. A Con Edison Energy Services manager and a distribution engineer were also present 24 hours a day. The company representatives communicated with EM staff, NYCOEM management, and other agencies about Con Edison's power problems in Long Island City and in other parts of the city. The Con Edison representatives provided answers to specific agency concerns. The staffing of the NYCOEM EOC facility by Con Edison is an established emergency-management protocol that started in 2001.

4. NYCOEM Field Command Post: the OEM placed its command bus in Astoria Park on July 19. EM staff placed a former Emergency Response Group member on the bus to communicate with Con Edison and NYCOEM field responders about specific work taking place in the LIC network.

4.11.11. LIC Outage Liaison Activities

During the LIC network power outage and the heat wave, the Emergency Management staff acted as liaison officers around the clock under the Incident Command System (ICS). The role of a liaison officer includes the following:

- Act as point of contact for staff from external response agencies such as the NYCOEM, the NYPD, and the Fire Department of New York (FDNY). By established protocol, EM provides information directly to NYCOEM, who then communicates with the New York State Emergency Management Office (NYSEMO).
- Act as a liaison with cooperating agencies such as the Port Authority of New York and New Jersey and the New York City Transit Authority
- Discuss the status of the event with these outside agencies, including such items as:
    - number of customer outages
    - geographic boundaries of such outages
    - sensitive customers without service
    - number of life-sustaining equipment (LSE) customers and contacts by the Customer Management Group
    - road closures
    - property damage
    - company's plans to mitigate the impact of the event and to return customers to service with estimated times of restoration
    - immediate notification of significant events as they occur, such as the loss (or restoration) of an electric network or an outage to a major or sensitive customer

EM liaison activity communications from July 17 to August 4, 2006, took place in two locations:

1. DECP, from July 17, at approximately 10:00, until the DECP was closed and a CERC was declared on July 20
2. CERC, from July 20 until it closed

Con Edison and NYCOEM initiated communications on the morning of Monday, July 17, due to the heat wave and anticipated high electric demand. More than 30 city, state, and federal agencies participated in the NYCOEM-sponsored "heat-call" telephone conference. During

this call, Con Edison described the status of the system at the time of the call and discussed any issues the company was aware of that might arise as a result of the severe weather.

Through the LIC network outage, Con Edison was in constant communication with NYCOEM. The company held regularly scheduled conference calls every three to four hours (with the senior staff of NYCOEM except from 23:00 to 06:00 hours, when e-mail and phone calls were used). Con Edison provided status reports on the LIC network, such as feeder outages, customer outages, and, at times, more specific information as it pertained to major governmental customers, such as La Guardia Airport or the New York City Department of Environmental Protection's (NYCDEP) Bowery Bay Wastewater Treatment facility. Several of these customer-specific calls were held with senior officials at the Port Authority of New York and New Jersey and the Metropolitan Transportation Authority.

While Con Edison communicated primarily with NYCOEM, the company also had ongoing telephone discussions with the NYPD throughout the LIC network outage. Con Edison kept the NYPD informed of the status of the LIC network, and the NYPD provided support for Con Edison crews working on system restoration. For example, throughout the outage, the NYPD provided escorts for company crews working in the field, thus reducing the crews' emergency-response time.

4.11.12. Communications With Elected Officials and the Media

Con Edison's Public Affairs organization comprises several different departments: Media Relations; Government Relations; Local Public Affairs; Employee Communications; Creative Services; Strategic Partnerships; and Economic Development. During large-scale company

events, Media Relations and Government Relations serve as the company's primary communications organization to elected officials and the media.

Media Relations acts as the official voice of the company, communicating directly with all print, broadcast, and electronic media outlets. In order to assist the media in its coverage of events involving the company's electric, gas, and steam systems, there is a Newsroom page on Con Edison's Web site that contains general information, pertinent facts, and graphic depictions of the three energy systems. Every year, prior to the summer season, Media Relations releases information to the media on the company's hot-weather preparedness efforts and conducts interviews with interested reporters. The department also holds events for the press at the company's training center, where journalists receive instruction in the basics of electricity and the electric system, get to see the inside of a simulated manhole, and are able to put their questions to company experts.

Government Relations is responsible for communications with federal, state, and local elected officials, as well as with local community boards. The department is staffed with employees who have had significant experience working with elected officials at all levels of government. Throughout the year, Government Relations assists elected officials and their staffs with a wide range of energy-related issues. Government Relations also maintains local Public Affairs offices in each New York City borough that communicate with elected officials and community organizations at the local level about company information, such as planned infrastructure improvements and its summer-preparedness efforts.

In a crisis, the other sections of the Public Affairs organization support the communications effort in various ways: updating the Web site with pertinent information; producing graphic

materials when needed; keeping employees updated on system conditions; reaching out to affected nonprofit organizations and businesses; and providing telephone support for Media Relations to better manage the influx of additional event-related phone calls to the company's press office.

Appropriate Public Affairs personnel have also received training in the Incident Command System (ICS) and are qualified to assume key roles during a corporate emergency. Public Affairs has a Crisis Communications Plan, which is under Con Edison's Corporate Policy statements.

Public Affairs is staffed around the clock. When the company opens the Distribution Engineering Command Post (DECP), Public Affairs plays an active role, including participation in the regularly scheduled conference calls. From July 17 through July 20, all customer-outage information was received from the DECP. Whenever there is a full-scale event necessitating the activation of the CERC, Public Affairs plays an integral role in its day-to-day operations. Once the CERC was established on July 20, all information was received from the information liaison officer assigned to CERC.

Throughout the July heat wave and power outages in Queens, Media Relations staff distributed numerous press releases urging the public to conserve energy, giving updates on system conditions, and highlighting problems in the LIC network. Additional information regarding locations of ice distribution, and later, advice on submitting claims, were also the topics of press releases and media inquiries.

Local television and radio stations carried the energy-conservation message immediately. Throughout the event, the press office initiated and responded to thousands of press calls. All

press releases were blast faxed to an established list of media outlets and/or posted to PR Newswire. Starting on July 20, a special section of the home page on the corporate Web site was dedicated to providing pertinent information to customers. Messages included customer-assistance information, such as ice-distribution locations, claim-reimbursement information, links to claim forms, and restoration progress updates. In addition to the newsroom site, all press releases related to the Long Island City restoration were posted on this section as well.

In addition to using traditional media outlets, Public Affairs requested the Queens Chamber of Commerce and the Long Island City Business Development Corporation to urge their members, which include major businesses and community leaders in Queens, to reduce electric demand while Con Edison crews continued to rectify problems in the affected areas.

Kevin Burke, the company's CEO, held two press conferences. At a July 22 press conference at The Learning Center, he shared the latest information with the media about the situation in northwest Queens. He acknowledged that far more customers than originally thought were without power.

Mr. Burke spoke about the work of the company crews and the mutual-assistance crews, and assured the residents that restoring their power was the company's primary focus. Mr. Burke also described the design of the underground network system, highlighting the fact that 10 of the 22 primary feeders supplying the LIC network were de-energized at the same time. He described the differences between overhead systems and underground networks, and explained that an underground system like the one in Queens has so many different paths that it is difficult to know the number of customers affected. Because of the design and its usual reliability, Con Edison relies on calls from customers to know when they have no power.

The following day, Mr. Burke held a press conference at the company's Manhattan headquarters building. He provided a status report on the number of customers who had been restored, and stated that Con Edison had approximately 200 people from other utilities helping in the restoration effort. He said that the city had been tremendously supportive, citing the work of New York City Office of Emergency Management (NYCOEM), the New York City Police Department (NYPD), and the Fire Department of New York City (FDNY), along with the Red Cross. He talked about the temporary generators that were installed to supply power while the street work continued.

Mr. Burke described the status of the system and the restoration effort. He told the media that a restoration-planning organization also had been formed. Mr. Burke said that he had been out in the community talking to company crews and customers and that he would be out there again that night. He also said that the company would be very flexible in the reimbursement process, that claim forms were being handed out in multiple languages, and that there would be no need for customers to send receipts.

From the onset, staff in elected officials' offices or, in some cases, the officials themselves were given the name and phone number of a Government Relations staff member who would serve as their dedicated contact. Managers of federal, state, or local government relations were assigned to the corresponding elected officials. Elected officials and staff were given the manager's detailed contact information. Elected officials and their staffs were also provided with the Media Relations phone line in the event that the Government Relations representative could not be contacted immediately. A member of the Government Relations staff was also available 24 hours a day through this number and was able to assist an elected official's office.

Communication between elected officials and Government Relations staff continued throughout the LIC outage event to provide updates on the system status as information became available and to respond to inquiries from elected officials and their constituents. Government Relations staff also assisted in the coordination and, when possible, the implementation of requests from elected officials for water, dry ice, wet ice, and generators.

4.11.13. Environment, Health and Safety Communications With Environmental Regulatory Agencies

Con Edison's corporate Environment, Health and Safety (EH&S) organization initiated communications with the New York City Department of Environmental Protection (NYCDEP) and the New York State Department of Environmental Conservation (NYSDEC) concerning the deployment and operation of emergency diesel generators in portions of the LIC network. EH&S reviewed with the agencies the most appropriate approach and secured emergency authorizations for the emergency generators.

EH&S initiated phone contact with NYSDEC Region 2 on the need for an emergency authorization to deploy emergency diesel generators in the LIC network area and spoke with NYSDEC headquarters to inform them of the situation as well. EH&S subsequently met with NYSDEC Region 2 and discussed the 30-day emergency authorization covering deployment of the emergency generators in LIC network area. It was agreed that the company would send the NYSDEC a listing of all operating emergency generators deployed in the LIC network area, every other day. Consequently, deployment of generators under this emergency authorization would not require specific individual or borough permitting.

EH&S also worked with NYSDEC to secure a modified hazardous-substance release reporting protocol during the emergency and also negotiated temporary administrative relief associated with removal of asbestos-containing material from electrical subsurface structures.

Concurrently with contacting NYSDEC, EH&S spoke by phone to NYCDEP regarding the deployment and operation of mobile emergency generators in the LIC network area. NYCDEP requested a faxed listing of newly deployed and operating units as has been done in prior years. Following these initial notifications, EH&S provided the requested regular updates to both NYSDEC and NYCDEP.

EH&S contacted the U.S. Environmental Protection Agency to alert the agency about the circumstances, and to inform the agency that Con Edison might need temporary administrative relief on the response time for cleaning PCB-contaminated structures.

4.11.14. Communications Analysis

4.11.14.1. Communications With DPS Staff: Analysis

Con Edison has an established communications infrastructure through which the company communicates with the DPS staff. From Sunday, July 16 through Wednesday, July 26—that is, from the time the company mobilized its resources in anticipation of extreme weather and peak customer demand until all LIC network customers were restored—Con Edison systematically communicated with DPS staff. The company communicated through its Distribution Engineering Command Post (DECP), Corporate Emergency Response Center (CERC), and Central Information Group (CIG).

4.11.14.2. DECP Communications With DPS Staff: Analysis

The DPS staff's presence at the DECP facilitated communications between Con Edison and the DPS staff. At the DECP, DPS staff had access to real-time system information that permitted the DPS staff members on site to immediately update other DPS staff members stationed at other locations.

4.11.14.3. CERC Communications With DPS Staff: Analysis

During the CERC, Con Edison provided DPS staff with their own desk and phone in the CERC room that was staffed around-the-clock throughout the emergency according to the incident command structure (ICS). This arrangement allowed DPS staff immediate and 24-hour access to Con Edison personnel throughout the LIC network outage.

While the DPS staff communicated directly with the incident commander on duty, they did not interfere with the work that company personnel were performing and usually sought information from the legal liaison on duty instead. The legal liaison desk, which was staffed around the clock throughout the CERC, was the company's primary contact for communications with DPS staff.

Throughout the LIC network outage, the legal liaison desk provided DPS staff with periodic status reports containing information the DPS staff requested. The legal liaison desk accommodated the DPS staff's requests concerning the content and frequency of the reports. The legal liaison desk conferred with DPS staff to establish the nature of the information they sought and modified the reports over time to reflect DPS staff's needs. On July 20 and July 21, at the DPS staff's request, the legal liaison desk sent reports every two hours. On subsequent days, the legal liaison desk sent four reports per day to DPS staff.

This reporting process generally worked well. During future emergency events, however, communication between Con Edison and DPS staff during a CERC could be improved by using a standard format and information categories for the periodic reports. While the nature of each emergency event may require some information that is unique to that event, it is likely that there are certain types of information that will be standard for all emergency events and can be established in advance in the form of a report template.

During the CERC, the legal liaison desk generally sent the reports to the DPS staff at the expected intervals. On occasion, when particular information was not ready at the time a report was produced, the report indicated that a follow-up supplement would provide the missing information. On one occasion, a report due at 08:00 was delayed. DPS staff inquired about the status of the report indicating that it was important for briefing senior DPS management at the beginning of the workday.

At a meeting following the LIC network outage, the DPS staff informed Con Edison's vice president of emergency management that, for future emergency events when a CERC is activated, they preferred that a group other than the legal liaison desk act as their liaison for company information. The DPS staff did not, however, express dissatisfaction with the manner in which the legal liaison desk handled the staff's information or other requests during the LIC network outage. Con Edison has agreed to establish a new company liaison for DPS staff during emergency events.

4.11.14.4. CIG Communications With DPS Staff: Analysis

Throughout the year, CIG sends to the DPS staff messages concerning electric system incidents through the communication notification system (CNS). This process is well established and is understood to be satisfactory to the DPS staff.

During the LIC network outage, CIG sent CNS messaging in a timely manner to provide the DPS staff with near-real-time information on incidents occurring in Long Island City. At the onset of outage, CIG quickly responded to a request from the DPS staff that Con Edison add two DPS staff members to the company's distribution list for CNS messages.

CIG has provided the DPS staff with telephone numbers at CIG that staff may use at any time to obtain additional information about incidents communicated in CNS messages. DPS staff members frequently ask CIG for additional information about system events throughout the year. During the LIC network outage, however, DPS staff communicated with Con Edison primarily through the DECP and CERC.

4.11.14.5. Customer Outreach: Analysis

Customer Outreach educates customers regarding storm preparedness and the need to report emergencies. During system events, Customer Outreach also serves as a community presence.

During 2006 and prior to the LIC network event, many actions were undertaken by Customer Outreach to educate customers regarding storm preparedness and energy issues, and to make them aware of the need to report emergencies. Outreach will increase efforts to educate customers on reporting emergencies and service problems.

During the LIC network outage, due to the size of the affected area, Customer Outreach dispatched representatives to many field locations and made substantial use of the company's outreach van as a base at the locations.

4.11.14.6. Energy Services: Analysis

Energy Services is responsible for maintaining the lines of communication with large, sensitive, and critical-resource customers, and working to address these customers' specific needs. When Con Edison implements a CERC, Energy Services assists in the deployment of emergency generators to re-establish portions of the distribution system and meet specific customer needs.

During the period of July 17 through July 20, Energy Services made several hundred phone calls to large, sensitive, and critical-resource customers in the LIC network. These calls solicited customer conservation efforts, gave updates on the status of the system, and provided customers with an opportunity to voice specific needs. Energy Services secured significant load reductions as a result of direct customer appeals, diversion to emergency generation, and, in the case of LaGuardia Airport, a shift of electric loads from the West to the Central substation.

In response to requests from critical customers, Energy Services personnel worked to deploy generators to Mount Sinai Hospital, Memorial Sloan Kettering Research Facility, Bowery Bay Water Treatment Plant, and the New York City Department of Corrections – Rikers Island.

4.11.14.7. Marketing and Sales: Analysis

From July 17 through July 22, Con Edison's Marketing and Sales Department contacted hundreds of customers to provide updates on the status of the system, ask customers to reduce

their load, and allow customers an opportunity to express specific needs. Some of these customers were participants within the New York Independent System Operator's (NYISO) Installed Capacity Program (ICAP) and Con Edison's Emergency Demand Response, Distribution Load Relief, and Direct Load Control programs (EDRP, DLRP, and DLC). Other customers were large customers who did not participate in any formal curtailment program.

Marketing and Sales personnel, in collaboration with the company's Emergency Management staff, played an important communication role in coordinating the company's emergency response and restoration efforts with New York City's Office of Emergency Management (NYCOEM). Two Con Edison account executives staffed the utilities section of NYCOEM around the clock while it was mobilized. All Con Edison Marketing and Sales account executives were actively involved in reaching out to their assigned customers (generally large, sensitive, or critical-resource accounts) to inform them of the progress of restoration and to encourage them to continue to curtail their use of power.

Although all of the ICAP and EDRP customers who registered with Con Edison did curtail their load, NYISO has not yet supplied the actual load curtailment amounts to Con Edison. In addition, NYISO has not yet supplied to Con Edison similar data for other customers who registered with the NYISO.

When Con Edison was calling customers who participated in the EDRP and DLRP programs, the company found that the contact information for several customers was not up-to-date. The company had to establish new contact information, ensure that the appropriate individual was notified, and update the master list for the ERDP and DLRP.

4.11.14.8. Emergency Management: Analysis

Throughout the LIC network outage, Con Edison's communications with the New York City Office of Emergency Management (OEM), Police Department (NYPD), and other agencies was open, proactive, and timely. Con Edison answered questions and provided system information in an expeditious manner, based on the information available to the company at the time. Communications to and from multiple company and city sources, including the CERC, Con Edison Astoria Operations, the OEM Emergency Operations Center (EOC), OEM command bus, and OEM situation room, were generally consistent and uniform.

Although the quality of communications between the company and OEM were strong, the timing of information flows through numerous information paths created some misunderstandings. In discussions following the outage, OEM and Con Edison agreed to review the numerous information paths used and consider ways to mitigate duplicative communications.

Although Con Edison's Emergency Management Department provided the best information and statistics that were available to Con Edison at the time, OEM has expressed concern that the company was unable to provide accurate information about the number of customers who were without electric service during the outage. The company has acknowledged the inaccuracy of the customer outage count into the morning of Friday, July 21, and is examining how it can improve its ability to identify customer outages as they occur.

Con Edison kept the OEM and NYPD apprised of LIC network feeder outages and estimated times for returning feeders to service throughout the event. The estimated return times for feeders changed often, which created some concern during the outage about the accuracy of

the feeder restorations times Con Edison was providing. In a post-event review with OEM, Emergency Management reviewed the reasons why feeder restoration times are subject to change. Con Edison recognizes the need to continue its efforts to better educate New York City representatives in this area.

OEM indicated that it was dissatisfied with the company's communications on Monday, July 17, about preemptive voltage reduction. OEM had equated the voltage reduction to a "Condition Red." based on prior education Con Edison had provided for OEM on this issue. This led to confusion for OEM. Emergency Management discussed this matter with OEM at a post-event review and will provide OEM with a revised definition on how preemptive voltage reduction can be utilized as a load management tool.

In addition to OEM, Emergency Management alerted the Port Authority of New York and New Jersey and the Metropolitan Transportation Authority before outages in the LIC network began to affect LaGuardia Airport and the subway system. These agencies were cooperative in reducing demand in response to the company's requests. The company's communications with these organizations were proactive, forthcoming, and timely.

4.11.14.9. Media Relations: Analysis

On Monday, July 17, in anticipation of the heat wave, Media Relations issued a general energy conservation release to the media. Over the next 10 days, the Media Relations office issued 14 press releases, organized two press conferences, and handled more than 3,000 media calls concerning electric system events, mainly in the LIC network. In addition, a corporate spokesperson provided interviews about the LIC event to all local and several national radio and television stations. Media Relations provided media outlets with information about the

outage and the need to conserve energy, and described overall system operations and the work being performed by field crews to restore power. All press releases and information on the distribution of ice and the company's reimbursement programs were posted on the home page of the Con Edison Web site.

4.11.14.10. Government Relations: Analysis

Con Edison Government Relations serves as both a resource and liaison between elected officials, government agencies, and the different departments within Con Edison. The Government Relations department facilitates communication among the parties, provides information regarding ongoing work throughout the company's service area, initiates discussions regarding upcoming projects, and assists in responding to officials' constituent inquiries. Government Relations also works throughout the year to educate elected officials and government agencies about the many issues affecting Con Edison and its customers.

Throughout the LIC network outage, Government Relations initiated and maintained contact with local community boards and federal, state, and local elected officials. Communication between elected officials and Government Relations staff served both to provide updates on the status of the system as information became available and to respond to inquiries from elected officials and their constituents. In addition, Government Relations staff received requests from elected officials for water, dry ice, wet ice, generators, and assistance for critical care customers. Government Relations worked within the CERC structure to communicate with other company departments to address these requests. Requests for water, dry ice, and wet ice were forwarded to Customer Operations and requests for generators were sent to Energy Services.

Responses to inquiries from elected officials were aided by close coordination between Con Edison Government Relations, the CERC room, and the company's Queens Public Affairs staff. Government Relations maintained a dedicated liaison with Queens Public Affairs 24 hours a day. Queens Public Affairs assisted Government Relations, Customer Outreach, and Media Relations throughout the event. Queens Public Affairs staff notified elected officials of the outage, assisted in the distribution of ice and claim forms, and oversaw media interviews in the field. In addition to working in the field, Queens Public Affairs maintained a representative at the local command post that Con Edison established in Astoria.

Members of the Government Relations staff first initiated contact with elected officials at all levels on Tuesday, July 18. Calls began at 09:00 hours and continued throughout the day. While the calls made in the early part of the day served to alert the offices about the outages in the LIC network, calls later in the day were designed to provide system status updates. Throughout the outage, Government Relations calls to elected officials either provided system status updates or responded to elected officials' specific inquiries. Government Relations continued regular communications with elected officials on a daily basis through Wednesday, July 26.

On Wednesday, July 19, Government Relations provided elected officials with updated system status reports throughout the day and late into the evening. Con Edison also informed the elected officials about dry ice locations and the company's request to commercial businesses to close for the day.

From Thursday, July 20 to Wednesday, July 26, Government Relations staff continued to provide elected officials with updated LIC network status information. They assisted in

arrangements for distribution of ice at specific locations and informed elected officials and community groups of the locations. Government Relations staff also provided claims information to elected officials and local community groups. Beginning on Thursday, July 20, Government Relations notified elected officials that the company's analysis of damage to the LIC network's secondary system was ongoing in an effort to provide an estimated service restoration target.

4.11.14.11. Communications With Environmental Regulatory Agencies: Analysis

EH&S was successful in establishing and maintaining open lines of communication with environmental regulatory agencies and keeping them fully apprised of Con Edison's activities and the implications for their area of interest. The environmental regulatory agencies were responsive and supportive, which facilitated Con Edison's ability to conduct system repairs in an appropriate and effective manner.

4.11.14.12. CERC Response: Analysis

Overall, Con Edison followed the applicable corporate emergency response procedures. A review of the full-scale incident CERC activities resulted in the need for the following changes:

- "CERCdocs," the documentation system for in full-scale incidents, was an effective tool for managing data from the event and was used by the large majority of participants. However, more training on the use of this application is needed to produce uniform documents from one ICS position to another.

- Company organizations thought not to be required were in fact needed during the LIC incident as these organizations provided other types of support outside their commodity (e.g.: Gas Operations).
- The LIC Network event raised awareness about the need to establish other positions to address specific needs associated with this type of an event. Examples are ice distribution, claims processing, and customer counts.
- Mutual-aid support required substantial effort and should be included as a unit under the Planning Section.
- As the incident entered its second week, support staff was brought in that may not have had ICS training. This will be corrected.
- Access to position guides upon arrival in CERC and more training on CERC positions would be useful. An Incident Management Assist Team should be in place to aid CERC staff in the use of their ICS-based position guides.
- Better incident situation tools (white boards, projection screens, computer screen messages, etc.) would facilitate dissemination of pertinent information to all full-scale incident staff

4.11.14.12.a. Information Flow/Analysis

Overall, information flow among all participants was very good. Each person who staffed an ICS position (including their assistants, deputies and support staff) communicated with each other and shared information. Interaction among participants was enhanced by information requests related to public health, safety, and welfare concerns from outside agencies such as the NYC OEM, NYPD, and the NYSDPS. Staffs from these outside agencies were present in CERC 24/7, which helped ensure timely communication and meaningful interaction. The

incident commander held numerous conference calls, there was wide-scale use of CERC documents, organizational charts were available, and an Incident Action Plan (IAP) was updated regularly. Information such as press releases and customer Voice Response Unit (VRU) messages were routed through the incident commander for approval. Video conferencing enhanced the quality and understanding of information being discussed among groups sited at various locations.

An after-action review and one-on-one conversations with full-scale incident CERC participants were conducted to identify areas for improvement as highlighted above.

4.11.15. Monitoring Customer Outages

Con Edison relies on customer calls to determine that service to customers supplied by the low-voltage network grid have lost service Unlike a radial supplied area (overhead), the loss of a network feeder does not equate to a loss of customers. That is, if a feeder de-energizes, the design of the system allows the electricity to flow to the customers through another feeder, keeping the customers in service. This is true even during multiple contingencies. Therefore, the company generally does not know that a network customer supplied from the secondary system has lost service until a customer calls to report the outage.

4.11.15.1. Con Edison's Call Center

Con Edison's Customer Operations Call Center operates 24 hours a day, seven days a week, 365 days a year, to accept reports of report outages and emergencies. When customers call the company's toll-free number, they reach the Call Center and an automated menu. After selecting the language, the first menu item is to report an emergency. Customers may report emergencies either via a self-service option or by talking to a customer service representative

(CSR). The self-service option is designed so that customers' responses to questions help determine the type of problem they are experiencing. Similarly, the Call Center is equipped with a robust emergency application on the customer information system. This system assists the CSRs to identify the nature of the problem and to issue a trouble ticket to the Con Edison Emergency Control Center(s), which dispatch emergency crews in response. All CSRs are trained to use the desktop application, are coached by supervisors, and receive informational newsletters on the use of the call system throughout the year.

4.11.15.2. Reporting an Outage and Tracking Customer Outage Total

Customer calls to the toll-free number originate from all parts of the company's service territory. The automated menu provided to callers at the start of the call is designed to prioritize emergency calls. After making the initial language selection (English or Spanish), customers are offered the following option:

> *To report an electric outage, a gas leak, a steam emergency, or other hazardous condition, press 1*

If 1 is pressed, the customer is given the option to report an electric outage, a gas leak, a steam emergency, or other hazardous condition.

When a storm or system event occurs, the automated menu provides a *special message* to inform callers about the nature and location of the event, and to direct customers who are currently experiencing service problems to use the self-service option (an interactive voice – response system) or speak to a representative to report individual outages, wires down, trees on wires, and other hazardous conditions. Following the special message, the customer is given the option to press 1 to report an electric service problem, downed wires, or other

electric condition. Special messages were utilized and updated throughout the LIC outage event.

The information provided by the customer is used to produce a trouble report in the Emergency Control System (ECS). Trouble reports contain codes that indicate the nature of the problem and are classified into two basic groupings in order to prioritize the response -- outage (i.e., "no light" – individual no-light report; "no light area" –areas without lights; "side off" – individuals with only partial service) and non-outage (e.g., low voltage or flickering lights). All outage reports have customer counts associated with them, while non-outage reports have no customer counts associated with them. Initial customer counts are determined by the type of trouble reports issued. In a network-supplied area, the initial customer outage count will be "1" for each outage report received. As trouble reports are received in ECS, the company's Outage Manager System (Outage Manager) aggregates and displays the total number of customers (metered accounts) interrupted based on the outage count contained on these reports. Company personnel obtain customer outages totals from the Outage Manager display.

Trouble reports are routed to the Regional Electric Control Centers (RECC). Under normal conditions, each Control Center's emergency operating general supervisor (EOGS) and the troubleshooter dispatcher (Emergency Desk) will review trouble reports and dispatch appropriate troubleshooters (overhead or underground crew) to provide information on the status of the electric facilities in the area and correct the problems. All secondary electric facilities (mains, services, transformers, limiters, etc.) are mapped on circuit diagrams called Mains and Services (M&S) plates. Each M&S plate covers approximately six square blocks. The EOGS and the Emergency Desk use information on M&S plates and the information

provided by field crews to determine the extent of the outage and the number of customers without service. After reviewing the trouble report(s), information from the field, and the M&S plate data, they may adjust the customer outage count by manual input on the trouble ticket in ECS. The customer outage count may also fluctuate based on the number of trouble reports issued and restoration of service to customers.[6] Outage Manager updates the customer outage total as outage counts on trouble reports are adjusted in ECS.

4.11.15.3. Communicating Customer Outage Total to the Public

Con Edison's Media Relations department is primarily responsible for providing information to the public concerning company operations, including incidents involving service outages. When large outage incidents occur, Media Relations provides outage information to the public through the various news media, through news releases and in response to media inquiries. The news releases are often timed to meet media deadlines for morning, evening, and late night news programs. Media Relations provides the location of the outage, the boundaries of the affected area, the estimated number of customers out of service, and if known at the time, the cause of the outage.

4.11.15.4. Customer Reports of Outages in Long Island City Network

Since the LIC event occurred on a weekday during normal business hours, the Call Center was fully staffed. Throughout the event, off-hours staffing was increased to accommodate the higher-than-normal call volume. In addition, to keep phone lines open for emergency calls

[6] In contrast, in radial areas the outage management system has rules that associate system components with particular customers. If the system determines a component is out of service, it assigns a customer count. An operator can also manually change the customer count to reflect actual conditions found in the field.

during periods of high call volume, the Call Center asked callers with non-emergency business to call back at a later time.

From July 17 through July 26, 2006, Con Edison's Call Center received a total of 565,710 calls for its entire service territory, including Westchester, for both emergency and non-emergency (e.g., billing and credit) matters; 535,486 of these calls were answered either through the self-service option or by a customer service representative (CSR). According to Con Edison's telephone carrier, Sprint, 9,727 calls (from 5,786 unique calling numbers) received a busy signal during this period, but 4,924 of these calling numbers called back during the period and made direct contact with the company.

From July 17 through July 26, 82,408 callers (15%) selected at the onset of their call the menu option for reporting an electric emergency. After hearing the system status message following this selection, 25,199 callers ended their call without reporting an outage, and 5,245 callers asked to speak to a representative but ended their call before speaking to a representative. For the remaining 51,964 calls, a total of 35,492 trouble reports were issued, including 8,075 trouble reports for outages in the Long Island City network.[7]

[7] Not all electric emergency calls result in the issuance of trouble reports. Customers selecting the electric emergency option may be calling back to obtain updated information on their previously reported emergency, or they may have selected the emergency option without actually having an emergency in order to reach a representative more quickly concerning non-emergency business. Other callers who hear the system status message learn that Con Edison is already aware of and responding to outages in their neighborhood and decide not to report their outage.

The detailed breakdown of the trouble reports by company operating areas and the Long Island City network is shown in the chart below. The chart includes outage related trouble reports and non-outage related trouble reports.

TROUBLE REPORTS ISSUED:										
Date	BK	MN	QN	SI	WS	BX	TOTAL	LIC Trouble Reports	% West	% LIC
17-Jul	705	108	374	478	2420	167	4252	66	56.90%	1.60%
18-Jul	459	130	1280	232	1878	7	4276	473	43.90%	11.10%
19-Jul	303	122	1974	65	4919	111	7494	1438	65.60%	19.20%
20-Jul	349	69	1530	41	2078	84	4151	1182	50.10%	28.50%
21-Jul	386	121	2551	389	2354	96	5897	1409	39.90%	23.90%
22-Jul	121	49	1197	189	765	55	2376	907	32.20%	38.20%
23-Jul	68	39	1253	56	209	24	1649	962	12.70%	58.30%
24-Jul	157	57	1034	61	320	53	1682	817	19.00%	48.60%
25-Jul	136	61	645	20	171	40	1073	466	15.90%	43.40%
26-Jul	117	53	544	1651	234	43	2642	355	8.90%	13.40%
TOTALS	**2,801**	**809**	**12,382**	**3,182**	**15,348**	**970**	**35,492**	**8,075**	43.20%	22.80%

The chart below shows the types of trouble reports (outage or non-outage) issued in the Long Island City network from July 17 through July 20.

LIC Network Trouble Reports Issued			
	Trouble Report Type		
Date	Outage	Non-Outage	Total
17-Jul	17	49	66
18-Jul	208	265	473
19-Jul	893	545	1438
20-Jul	483	699	1182
Total	1601	1558	3159

During the initial stages of the Long Island City event, the Control Center EOGS was prioritizing and dispatching work. As the Long Island City network contingency worsened, field resources were prioritized for response to public safety calls (e.g., smoking and burning manholes) and support for primary feeder restoration to fully restore the network.

Accordingly, the Control Center EOGS did not dispatch a crew to investigate each trouble report.

The following is a chronology, by day, of feeder outage status, emergency calls received and trouble tickets issued, and related communications.

Monday, July 17

A second contingency occurred in the LIC network at 16:22, and a fifth contingency occurred at 18:48. The network was in a fifth contingency at the end of that day. Con Edison received 10,600 emergency calls and issued 4,252 trouble reports. Westchester trouble reports totaled 2,420 (56.9% of the company total), while Long Island City trouble reports totaled 66 (2.0 % of the company total). Seventeen of the 66 LIC trouble reports were outages according to the trouble type reported.

During the day, Media Relations issued press releases urging general conservation both in Westchester and in northwest Queens during the heat wave and responded to media inquiries.

Tuesday, July 18

In the LIC network, the feeder contingency level ranged from four to six throughout the day until the level increased from six to ten from 20:05 to 20:38. The contingency level was reduced to seven by 21:46 and was at nine at the end of the day. As the contingency level in the LIC network increased, the Brooklyn Queens Control Center dispatched emergency crews to the priority jobs that involved feeder faults or manhole burnouts with customer outages, and as secondary burnout volume increased, emergency crew resources were fully engaged in manhole events to clear burnouts at splicing locations to expedite feeder restoration. This

activity impeded the Control Center's ability to respond to trouble reports of customer outages or to update customer outage counts.

Con Edison received 13,246 electric emergency calls on Tuesday. Trouble reports issued for the entire service territory totaled 4,276. Of this amount, 473 trouble reports (11% of the company total) were issued for the LIC network of which 208 were outage type tickets, bringing the total of LIC customer outage reports to 225. 1,878 trouble reports (43.9% of the company total) were issued for Westchester.[8]

Con Edison's Media Relations informed the news media that 2,000 customers in New York City, including 500 customers throughout Queens were without service.

Wednesday, July 19

The feeder contingency level in the LIC network ranged from eight to ten through the early afternoon, then declined to six and ended the day at seven.

The Call Center received 24,907 electric emergency calls. Total trouble reports issued for the service territory totaled 7,494. Of this amount, 4,919 trouble reports (65.6% of the company total) were issued for Westchester as the result of thunderstorm activity. Of the 1,438 trouble reports issued for Long Island City on July 19 (19.2 % of the company total), 893 were outage type reports, bringing the total of LIC customer outage reports to 1,118 at the end of the day.

Media Relations reported outage numbers to the media throughout the day. In advance of the evening news, Media Relations reported that 1,700 Queens customers were without service.

[8] Late that evening a severe storm hit Westchester interrupting service to about 35,000 customers.

For the late news, Media Relations reported that 2,100 customers in Queens did not have service.

Thursday, July 20

The feeder contingency level in the LIC network declined throughout the day from seven at the beginning the day to three by 13:34.

Con Edison received 9,427 electric emergency calls. A total of 4,151 trouble reports were issued for the service territory. Of this amount, 1,182 were for the LIC network (28.5% of the company total), and 2,078 were for Westchester (50.1%). Of the 1,182 trouble reports issued for the LIC network, 483 were outage type reports, bringing the total of LIC customer outage reports to 1,601 at the end of the day.

For the evening news, Media Relations reported 1,800 customer outages in Queens. For the late night news, they reported 2,100 customer outages in Queens.

Friday, July 21

The feeder contingency level the LIC network declined from three at the start of the day to zero at 08:21.

On Thursday, July 20, based upon the observations of Con Edison employees and other reports, Con Edison suspected that the customer outages reported by Outage Manager and ECS did not accurately reflect conditions in the LIC network. As a result, during the overnight period from July 20 to July 21, the company conducted a field survey and analysis of the areas where the customer calls had come from in order to get a better understanding of

the affected area and number of customers out of service. Based on this survey and analysis, the company developed a rough estimate of 25,000 customers without service.

At 09:00, Media Relations issued a press release stating that based on visual inspections and block-by-block surveys the company estimates that 25,000 customers are without power in northwest Queens. The release encouraged customers to call the company to report outages, and this resulted in the remaining volumes of trouble reports received later in the week.

4.11.15.5. Analysis of Customer Count Systems and Procedures

The customer outage numbers derived through ECS and Outage Manager did not reflect the actual number of customers that lost service during the LIC event. Although ECS and Outage Manager have worked well in tracking customer outages in past events, the company has not experienced a network secondary system outage of this scale in at least the past forty years – well before these systems were designed.

In this instance, Outage Manager performed as designed, and the outage numbers reported by Con Edison to municipal and elected officials and to the media were consistent with what Outage Manager reported. Nonetheless, the outage numbers were understated because the data on which Outage Manager and ECS rely was insufficient.

The accuracy of these systems depends on customer calls and manual updates to the customer outage count following field observations by field crews dispatched to assess and correct the condition in the field. For this event, the number of phone calls reporting electric service conditions did not reflect the outages that were occurring. At the same time, the majority of Con Edison's crews were responding to the large number of feeder outages and working to restore feeders and fully restore the primary system. Because of

this, the company did not have access to the field observations normally available when crews report to an individual outage and report back to the control center with information on additional customer outages.[9]

As such, with limited information from both customer calls and field observations, Outage Manager reported low outage numbers that left operators and the company's external communication organizations (such as, Government Relations, Media Relations, Central Information Group, and Emergency Management) with the impression that far fewer customers were out of service.

The company is evaluating ways to supplement the use of customer call data in the process of analyzing network trouble and determining customer outages. Nevertheless, customer calls will continue to be an important source of information for outage counts, and the company is undertaking a number of actions to encourage customers to report electrical problems, and to make the reporting process more efficient. Areas for improvement include streamlining the customer call process to make it easier to report outages, especially during significant events, while improving the quality of the information reported; using voice recognition technology; modifying messages and customer service representative scripts to simplify the reporting process while asking

[9] The company engaged a consultant to conduct a benchmarking survey with six domestic and six international utilities that manage underground secondary networks. The objectives were to document their processes and systems and determine if any leading practices exist that could be applied to the company's process and systems. The survey results indicate that the utilities' processes and systems have the following characteristics in common:

- They are dependent upon customers' calls (11 of 12).
- They have no automated means of analyzing secondary network trouble or determining customer outage counts (11 of 12).
- Their processes count metered customer accounts, rather than premises or people (12 of 12).

These characteristics are consistent with Con Edison's current practice.

more targeted questions; adding of phone lines to increase telephone capacity, and expanding the capacity of the self-service option for reporting emergencies. The company has already initiated action to make such improvements in the outage reporting process, as detailed below.

4.11.15.6. Outage Reporting Process Improvements

4.11.15.6.a. Accommodating Call Volume

To minimize busy signals, the company will increase the Call Center's capacity to handle calls by increasing its trunk line capacity (allowing for more calls). Using the Erlang B queuing theory formula that calculates line requirements based on busy hour traffic, the company has estimated 522 lines to handle the peak volume experienced this summer. To build in additional capacity as a contingency to address higher volumes than received this summer, capacity will be increased to 650 lines.

4.11.15.6.b. Automated Reporting Enhancement

The company has designed, tested, and implemented a streamlined and simplified automated outage reporting application to make it easier and faster for customers to report an outage and to speed the flow of outage information to operations (that is, the reporting time is reduced to about 90 seconds from about 3 minutes). In addition, customers reporting non-outage emergency conditions will be able to speak to a company representative more quickly.

4.11.15.6.c. Outage Message

To encourage customers who have service emergencies to remain on the line after they hear a system status message, Con Edison has modified its system status message to immediately ask customers to remain on the line if they have service problems. This addresses the fact that many callers ended their call without reporting an outage after hearing the system status message following selection of the emergency report menu option. Some of these callers may have concluded that reporting their otuage was not needed because the company was aware of outages in their neighborhood.

4.11.15.6.d. Outreach on Reporting Service Outages

To increase customers' awareness of the importance of calling to report electric trouble, the company will use customer communications, including bill inserts, to reinforce the need for customers to call when their electric service is affected. We will also explore ways to improve our database of valid customer telephone numbers to facilitate their reporting of outages using self-service tools.

4.11.15.6.e. New Customer Count Analysis Tools

In order to reduce reliance on customer calls in the process of analyzing network trouble and determining customer impacts, the company has developed and deployed a new program called the Network Trouble Indicator (NTI). It has been in use since September 25, 2006.

NTI is a computer-aided tool that analyzes data from existing network monitoring systems, as well as from calls from customers and other members of the public. NTI contains a complex algorithm that creates a severity index for each M&S plate within a

network, applying weighting factors not only to the types of trouble being reported to the company, but also to network equipment status data. It then uses the severity index to project early estimates of potential customers affected. NTI regularly updates its calculations as it receives additional trouble and equipment status data. It is designed to trigger alerts to operators and engineers that will heighten their early awareness of network problems and potential customer impacts early in an event. It will also alert them to the increasing severities of problems and their potential impacts if they occur.

The company plans to further enhance NTI between now and June 2007 by: refining the NTI algorithms based on additional experience; developing NTI rules that are responsive to summer and winter network events; and developing effective operator/engineer tools for visualizing NTI analysis results.

NTI is the first of several short and long-term recommendations aimed at improving the network trouble analysis and customer outage count processes. By June 2007, the company plans to complete its development and deployment of a new map-based graphics tool that will display the status of secondary network components and the locations of incoming trouble tickets. This will give operators and engineers a visual means of assimilating this information, identifying potential sources of network trouble, establishing the geographic bounds of the potential customer impact, and planning their response.

In the longer term, the company will also study the feasibility and costs of using automated metering technology for outage detection and incorporating the data in existing systems and processes, and explore other outage detection technologies.

4.12. Long Island City Secondary System Recovery

To restore customers to service as quickly as possible, crews often made temporary repairs to the secondary grid by over-the-ground shunts or by installing mobile generators. Prior to the conclusion of the LIC network event, the company assembled a dedicated team, the Long Island City Network Recovery Team (LIC NRT), to focus on all inspection and permanent repair work on the secondary-network grid in the affected areas of the network.

The LIC NRT consists of skilled electric-distribution engineers and field workers responsible for thoroughly inspecting subsurface structures containing equipment and low-voltage cables; identifying any deficiencies; and correcting those deficiencies in an expedited fashion to assure the integrity of the secondary-network grid in the affected areas of the LIC network. In addition, this team is responsible for communicating the status of the company's recovery efforts and responding to any local concerns among the constituents in the affected areas.

4.12.1. Staffing

Con Edison employees and contractor personnel are supporting the LIC network recovery process. The team is comprised of approximately 100 full-time company employees and up to 100 contracted employees, as needed, and reports to an Electric Operations vice president. Its management organization is based on the principles of the Incident Command System including Planning, Operations, Logistics, and Administration Section Chiefs, and Environmental, Health & Safety, External Agency, Customer Operations, and Public Affairs liaisons. The majority of the staff chosen for the team is men and women who have prior

experience in electric distribution and were drawn from various operating areas across the company.

The company's resources have been supplemented with contractor crews for tasks such as excavation, cable removal/installation, secondary splicing, and environmental operations. Con Edison will maintain the staffing level necessary to complete all work as scheduled in the company's Supplemental Report to the PSC, dated August 4, 2006 (Supplemental Report).

4.12.2. Restoration Phase

The general philosophies that guided the LIC network restoration included:

- Maximizing the number of energized primary feeders in order to support the installed capacity of the secondary network system;
- Certifying that network protectors were closed and their associated fuses intact in order to make certain that energized transformers were supplying the secondary-network system; and
- Verifying that the secondary-network system was capable of distributing the power throughout the secondary grid.

4.12.3. Permanent Network Restoration: Generator and Shunt-Removal Phase

The LIC NRT has developed priorities for completion of any outstanding work guided primarily by public safety and LIC network reliability. Generally, the priority of work is as follows:

- Connecting primary sections and network transformers previously isolated;
- Replacing transformers that were identified as needing replacement;
- Removing generators and returning the associated customers to the secondary-network system;
- Removing shunts and replacing their associated underground sections;
- Replacing open mains;
- Completing inspections of those locations identified by the analysis of the event or other emergent criteria; and
- Completing temporary repairs or repairs identified during inspections.

Through analysis, Engineering has identified additional locations requiring inspection. As the company progresses with permanent restoration, additional work may be identified and completed.

4.12.4. Emergency Generators

At the conclusion of the service restoration phase (during the week of July 24), a portion of the network was supported by the transfer of various customer demands to generators. Following the system peak demands on August 1 and 2, as many as 54 generators were on line at any given time.

The LIC NRT Engineering group reviewed system conditions and potential customer-related impacts for each generator installation. The team prepared a prioritization plan to schedule the return of these customers to the LIC-network secondary grid based on analysis of the following factors:

- Customer demand history
- Status of nearby transformers and/or associated switch checks
- Known open mains
- Structure inspections for limiter integrity
- Generator maintenance schedule
- Community festivals/events

In some cases, the customers were returned directly to the secondary grid. In other cases, engineering requested area inspections of structures for limiter checks and determined that repair or reinforcement work was needed in order to return the customer demand to the grid.

4.12.5. Secondary Shunt Removal

The shunt removal process mirrored the process performed for generator removal. Additionally, the team prioritized shunt removal in areas with heavy pedestrian traffic (i.e., school zones or areas with upcoming street fairs, etc.). Some of these locations required trenching and/or replacement/reinforcement of the secondary cables and structures prior to shunt removal.

4.12.6. Milestone Achievements

The LIC NRT has completed the removal of all emergency generators and secondary main shunts:

- All emergency mobile generators deployed in the LIC network were removed by August 18. This goal was achieved within a two-week period starting August 4.
- All secondary main shunts were removed by September 11.

4.12.7. Completion of Inspection and Construction Items

4.12.7.1. Transformers

In order to verify the integrity of the network transformers within the LIC network, the guidelines set forth in EO-10110 were used to identify those transformers that would be inspected based upon their potential overloaded condition during the event. Presently, a population of 212 transformers in the LIC network have been inspected per these guidelines.

There were 57 transformers initially identified for replacement in the Supplemental Report. As of October 6, forty-seven of these units have been replaced and restored to service, and four

have been repaired and restored to service. The remaining six units are pending a feeder outage, transformer replacement, or secondary ties.

Throughout the team's tenure, crews have been conducting inspections for various reasons and have identified additional units for replacement. A total of 77 network transformers has been identified for repair or replacement. Of the additional 20 units, 16 did not pass a pressure test; three did not pass a dissolved gas-in-oil test; and one needed equipment repairs before it could be put back into service. As of October 6, replacements for 10 of these units have been placed in service, and one unit has been repaired and restored to service. Overall, 62 of the 77 network transformers have been repaired or replaced and are in service.

4.12.7.2. Secondary Main Shunts

All 125 secondary shunts have been removed as of September 11.

4.12.7.3. Limiter Inspections

The LIC NRT Engineering group has initiated 521 limiter inspections; these inspections were completed throughout the restoration process and immediately after the formation of the LIC NRT by August 8, 2006. An additional 21 structure inspections for limiter checks (associated with generator and shunt removal) have been issued and completed by the LIC NRT.

4.12.7.4. Open Mains

In the Supplemental Report, the company had a total of 60 known open mains in the LIC network. All of the original 60 open mains have been repaired.

4.12.7.5. Secondary Main Inspections

Using the Poly Voltage Load flow model for the LIC network, Distribution Engineering identified 1,346 secondary mains that may have been overloaded due to the various feeder contingencies experienced during the event. Adjustments to screen for duplicate mains identified for different feeder contingencies reduced the population of mains inspections to 1,126. Each main either was or will be inspected to verify the condition of the secondary-grid cables and limiters. Also, additional work is anticipated as the LIC NRT Engineering group continues to evaluate field-report conditions.

As of October 6, the company has completed 448 secondary main inspections and has 678 inspections remaining. The remaining inspections will be completed by the dates specified in the Supplemental Report. From these inspections, the engineering team has generated new construction work in the form of secondary cable replacements, conduit replacements, and/or the maintenance or enlargement of subsurface structures.

4.12.7.6. Secondary Main Reinforcement/Replacement (Layouts)

As of October 6, 789 secondary main cable sections have been issued to construction, and 458 sections have been installed. Over 14,000 feet of conduit and over 100 structures have been enlarged in association with these secondary main installations. New York City's Department of Transportation in the borough of Queens has facilitated the expeditious progress of these installations. The company expects to install about 5,000 additional feet of conduit and enlarge about 50 more structures associated with the secondary main work.

4.12.8. Continued Customer Outreach

The LIC NRT has continued to promote and enhance customer satisfaction in its daily routine. Through its two project management offices, the company has kept in touch with the community and has continued to provide information about the LIC rebuilding efforts. The LIC NRT vice president and public affairs liaison have attended meetings with local community boards, local public associations, local city and state government officials, and commerce groups to discuss the recovery process and the team's mission and work, and to address any of the constituents' concerns.

4.12.9. Summary

By the end of 2006, the LIC NRT expects to complete the permanent restoration and inspection work identified in the Supplemental Report. All of the temporary restoration work completed during the event will be made permanent. All of the prescribed secondary-main inspection work in the affected areas will be completed. All of the prescribed transformer inspections in the network will be completed. Hundreds of sections of low-voltage cable sections (close to 25 miles) and, to date, 77 network-distribution transformers capable of providing almost 40 megawatts of power will have been replaced or added to the secondary-network grid in the LIC network. This work demonstrates the company's focus and commitment to thoroughly evaluate and restore the secondary grid in the affected areas as quickly as possible. The completion of all of this work will provide a strong and reliable secondary grid in the affected areas of the LIC network. When complete, the network will be returned to the company's Brooklyn/Queens Region of Electric Operations for continued safe and reliable operation.