

MMP Investigation of Con Ed 71 Line Outage

Introduction

The 71 Dunwoodie-Rainey line (“the 71 line”) is a high-pressure fluid-filled cable approximately 15 miles in length. It is an underground facility that runs from Dunwoodie, which is north of New York City, to Queens. Consolidated Edison (Con Ed) owns and maintains the line, which was installed in 1963. This facility reduces the transfer capacity of the Dunwoodie-South interface by 700 MW when it is out of service. The Dunwoodie-South interface governs the amount of energy that can flow south into New York City and any limitation on this interface significantly impacts both the energy flow into New York City and energy prices within the city. This line experienced two outages between July and December 2002, resulting in the reduction in the transfer capacity of this interface during substantially all of this period. The 71 line tripped on July 13th, 2002 and was restored to service on October 15th, 2002. It also tripped on October 21st and was restored to service on December 1st, 2002. The NYISO initiated an investigation of the outage on August 22nd, 2002.¹

The NYISO Operations Department and the Market Monitoring and Performance Department (MMP) conducted an investigation of these two outages. The focus of the Operations Department was to ensure compliance with NYISO requirements for transmission facility outage reporting. The MMP was tasked with analyzing Con Ed’s performance in restoring the facility, Con Ed’s relevant procedures, timeliness of communications, the state of the facility prior to and during the failure, and the market impact.

The NYISO’s investigation included site visits and review of documentation. The site visits were conducted on September 6th, October 1st, October 25th, and November 14th. The site visits on September 6th and October 1st evaluated the repair work associated with the July 13th incident, and the site visits on October 25th and November 14th evaluated the repair work associated with the October 21st outage. MMP staff met with Con Ed staff to ensure a comprehensive understanding of the events that caused the line to trip and Con Ed’s efforts to restore it. MMP staff also reviewed documentation provided by Con Ed and additional public data obtained from the NYISO website. This report summarizes the results of the NYISO’s investigation into the two events.

Site Visits

The September 6th site visit was conducted at Con Ed’s Corporate Headquarters. The focus of this site visit was to determine the level of effort Con Ed was applying to restore the 71 line. Interviewing Con Ed staff, the MMP Team learned that a 48” water main break had blasted a two-inch hole through the cable casing, forced contaminants into the insulating dielectric fluid, and damaged the shielding on the conductors. Con Ed staff reported that the resulting damage was at a level Con Ed had not previously encountered. Thereafter, the MMP team reviewed the schedule of restoration activities (Appendix I) and route sheets, which show crew compositions, work locations, work activities, and hours worked (Appendix II). The team’s conclusion, based on these documents and the interview, was that Con Ed was working continuously on their repair effort and was taking prudent actions to address repairs and restoration of Feeder 71.

The second site visit was conducted on October 1st at the Webster Cooling Plant. The focus of this audit was to reevaluate Con Ed’s efforts to restore the facility from the outage of July 13th. The MMP team interviewed Con Ed staff and learned that the dielectric fluid had been heavily contaminated by the water intrusion. Con Ed reported it had replaced thirty thousand gallons of oil

¹ On August 22, 2002, MMP and Operations met to discuss MMP’s September 6th site visit

and had at least forty thousand gallons yet to process. In light of time requirements needed to replace such a large volume of oil, Con Ed chose to filter and evacuate the dielectric fluid rather than replace it. To accomplish this, Con Ed contracted with a firm from Canada that owns high capacity flush and filter units; two units were used in parallel on each of the two cooling loops to supplement Con Ed's own lower capacity units to expedite cleaning the oil. A total of over 980,000 gallons of throughput following the first fault were circulated, filtered and treated in order to reach acceptable moisture levels. Thereafter, the MMP team reviewed the route sheets for September 2nd, September 17th, and September 28th (Appendix III), the updated schedule of restoration activities (Appendix IV), and Flush and Filter Reports from the laboratory (Appendix V). Based on these documents and the interview, the MMP team concluded that the Con Ed repair team and laboratory were working continuously and in a professional manner to restore the line.

The third site visit, conducted to investigate the second outage, was performed on October 25th, and was held at the Webster Cooling Plant. The focus of this site visit was to determine Con Ed's progress in uncovering the cause and location of the new fault, and if there was a connection between this outage and the July 13th outage. From the MMP team's interview of Con Ed's personnel, the team learned that Con Ed had located the fault, south of the location of the water main intrusion on July 13th. While at the site, the team inspected Con Ed's progress in digging freeze pits on both sides of the fault and how they had completed excavation of the fault area. In addition, the team was shown an x-ray of the fault. This x-ray revealed a bend in one of the conductors. Con Ed informed the team that the faulted section of conductor was slated for removal and submission to an independent laboratory to ascertain the cause of the fault. In addition, Con Ed planned to replace a total of approximately 1700' of cable with new cable with its northern section attached to the cable that was replaced during the July 13th outage and its southern end attached to the cable that was installed in 1963. Later, the MMP team requested and reviewed the following documents: Task Milestone Report for repairs and restoration (Appendix VI), Sequence of events Recording Report (Appendix VII), and the USi report covering the failure investigation of the electrical failure of Feeder 71 on October 21st, 2002.² Also reviewed were oil re-pressurizing data (Appendix VIII), and hipot testing data (Appendix IX). Based on these documents and the interview, the MMP team agreed that the second outage was not a result of Con Ed restoring the facility following the July 13th outage either prematurely or contrary to their procedures. In addition, the team concluded that the work performed in restoring the line was being done in a timely and professional manner.

The MMP team returned to conduct the final site visit on November 14th following Con Ed's decision to extend the anticipated return date of the facility from November 27th to December 04th. The team again met and interviewed Con Ed staff at the Webster Cooling Plant. The focus of this site visit was to determine the reason for the extension of the return date. The team observed Con Ed's splicing process; both ends of the 1700' of replacement conductor associated with the second fault were being spliced to the existing cable. In addition, the team was informed that Con Ed's laboratory and an independent laboratory had tested the dielectric fluid in the vicinity of the fault and found the fluid to have unacceptable levels of moisture. To expedite the flushing process, Con Ed again arranged for the two Canadian flush and filtration units to be installed on the system to remove the excess moisture. Afterwards, the MMP team reviewed an updated Task Milestone Report for repairs and restoration (Appendix X) and Con Edison Lab Sequence Reports (Appendix XI) to validate the need for the extension. The team compared the Task Milestone Report from this site visit with the one supplied after the October 25th site visit. The team found that the Task Milestone Report from October 25th did not include tasks associated with moisture removal. Based on the moisture levels found in the oil, the team concluded that the extension was reasonable. The team reviewed Time Sheets for Splicing Crews for November 9th, 14th, and 16th (Appendix XII) and verified that repair work was being done in a timely manner.

² Con Ed has not released this Report to the NYISO but has allowed the MMP staff to review it.

The MMP staff concluded from the site visits that Con Ed applied an appropriate level of manpower resources to its investigation and repair of the line. Con Ed's documents confirm that repair crews were working around the clock on weekends and holidays as well as during the workweek to restore the line. The Task Milestone Reports show that Con Ed developed a well planned schedule to diligently perform repair and restoration tasks to minimize the duration of the outage by having repair crews work on different tasks in parallel whenever possible. These facts are consistent with Con Ed's stated commitment to restore the facility as quickly as possible. Moreover, Con Ed's responses to the first fault, having designed and built portable in-line cleaning filters, and to the second fault, immediately scheduling replacement of the cable section, are consistent with their commitment to system reliability.

Procedure Review

The MMP team also reviewed certain Con Ed procedures to verify that Con Ed had performed the work in accordance with its own guidelines for these types of repairs. The MMP team analyzed pressure charts (Appendix XIII) and pressurization pump operating charts (Appendix XIV) from June 13th through the July 13th for the pumping plant at Dunwoodie substation. From these charts, the team concluded that there was no indication of a leak on the 71 line prior to the failure. Therefore, the leak was "instantaneous", and no preventive action could have been taken.

The MMP team discussed with Con Ed personnel during the interviews their procedure governing circulating pumps tripping off. From the interview and the dispatch logs, the team knew three primary and three backup circulation pumps on the 71 line tripped between approximately 0330 and 0405 (Appendix XV) as a result of the sudden decrease in pressure prior to the first outage. The team felt the loss of the circulation pumps had no impact on the outage itself and that there was no need to verify the associated procedure.

The MMP team reviewed procedures EO-6065 and 0900-0019/02, Para. 4.1 a (4) that are the procedures governing low-pressure alarms on High Pressure, Fluid Filled cables (Appendix XVI). The team discovered through interviews with Con Ed staff that the control room does not see pressures on the facility, but the station operator relays this information to the control room. The team also learned that the relays on the cable are not activated by indications of low pressure, only by an electrical fault or a defective control system. Procedure 0900-0019/02, Para. 4.1 a (4) does not indicate what are acceptable operating pressures for the cable, and a pressure threshold that would require a facility to be removed from service. The MMP team reviewed the pressure charts and pressurization pump operating charts for the period from approximately 0300 through 0400 on July 13th. Based on this information, the team concluded that there were no actions taken contrary to the procedure.

Procedure EO-6065, Section 5.0 states that only an electrical failure or a defective control system would cause a transmission facility to trip. Interviews with Con Ed staff confirmed only these two conditions would cause the 71 line to trip. The MMP team reevaluated the schedule of repair and restoration activities from the first site visit. Based on the work scheduled by the Repair Supervisor, the MMP team concluded that Con Ed recognized the cause of the 71 line tripping as an electrical fault (Appendix XVII) and scheduled repair tasks accordingly.

The MMP team has concluded:

1. Con Ed followed its procedures, which conform to accepted industry practices, in all aspects of this event.
2. It is possible that the applicable Con Ed procedures may not have authorized the system operator to manually de-energize the cable under the circumstances as they were then apparent. The NYISO recommended that Con Ed consider reviewing Procedure 0900-0019/02, Para. 4.1 a (4) to define when a facility must be taken out of service based on low fluid pressure.

This Procedure (900-19/02 Para.4.1a) was subsequently revised by Con Ed on 12/24/02 and now defines when a feeder is to be removed from service on low fluid pressures.

Market Impact

MMP has reviewed the specific circumstances of the outage relevant to current market rules and the rules governing TCC revenue and forced outages to determine whether Con Ed had an incentive to delay its return of the line to service. MMP also reviewed monthly revenues from Con Ed's TCC holdings (Appendix XIII) and the total TCC megawatts from which the revenues were earned (Appendix XIX). In addition, the NYISO has reviewed Con Ed's tariff (Appendix XX) regarding revenues from TCC holdings indicating a 90% TCC revenue offset to the energy costs Con Ed may charge. While Con Ed TCC revenues were higher during the outage than the previous year, the increased revenues began prior to the line outage and coincident to the modeling of the load pockets in the DAM. Similarly, the higher TCC revenues continued after the line was returned to service. The MMP concluded the TCC market is working properly. Therefore, the NYISO is not recommending any TCC rule changes at this time.

The NYISO's commitment and dispatch software ("SCUC") for the day-ahead market uses outage information to generate a model of the power system as it is anticipated to be in real-time. An accurate SCUC model is essential for optimizing system resources and for day-ahead real-time price convergence. The MMP reviewed the daily SCUC model and the real-time system configuration for the duration of the both outages. It was found that on July 13th, the day the line initially tripped, the facility was out of service in real-time but modeled in service in the Day-Ahead Market. Similarly, On October 21st, the day the line tripped for the second outage, the facility was out of service in real-time but modeled in service in the Day-Ahead Market. These are transient disparities that occur with any forced outage. It was also found with the first outage that on October 16th, the day after the facility was restored to service, the facility was in service in real-time but modeled out of service in the Day-Ahead Market. Similarly with the second outage, on December 2nd, the day after the facility was restored to service, the facility was in service in real-time but modeled out of service in the Day-Ahead Market. Both were a result of the line being restored earlier than scheduled. Con Ed staff indicated that the restoration work had proceeded faster than anticipated resulting in the facility being restored sooner than scheduled.

Outage Reporting

It is a NYISO requirement that outage information is reported in a timely manner and changes to outage information are passed on to the NYISO as soon as reasonably possible. It is the NYISO's responsibility to get this information to the market participants. The MMP investigation also focused on the timeliness of the notification process.

Con Ed followed NYISO procedures in reporting the July 13th outage and its anticipated return date to the NYISO Operations Department. Con Ed updated the scheduled return time of the 71 line approximately 11 times for the facility during the first outage (Appendix XXI). MMP's investigation reviewed when Con Ed notified the NYISO with changes to the return date and when the NYISO supplied the market participants with these changes (Appendix XXII). The MMP team also reviewed the document supplied by Con Ed when updates were sent to the NYISO. The team cross-referenced the data in this report with the work being conducted on the cable based on the Task Milestone Report for Repairs and Restoration. The team concluded that Con Ed supplied updates on the return time for the 71 line to the NYISO in a timely manner and, furthermore, the updated return dates were reasonable.

Con Ed followed NYISO procedures and reported the October 21st outage and its anticipated return date to the NYISO Operations Department not later than 1600 on October 22nd. This was

within 21 hours of the discovery of the outage. The NYISO posted this information on its web site not later than 1700 on October 22nd. On November 4th, Con Ed extended the scheduled return time of the 71 line; the NYISO posted this extension not later than 1700 on November 4th.

For both of the 71 line outages, the NYISO verified that Con Ed complied with NYISO requirements for reporting the line outage and associated updates. The MMP team concluded that the NYISO Operations staff had properly followed the procedures set out in the Outage Scheduling Manual, Section 1.4.3, in posting outage information on the OASIS page of its website. The NYISO's conclusion is that information was passed from Con Ed through the NYISO to the market participants in a timely manner and in accordance with Con Ed and NYISO notification procedures.

Summary:

The site visits and review of Con Ed documentation from the July 13th outage found that Con Ed's response to the system events that led to the 71 tripping out of service was consistent with Con Ed's procedures and accepted industry practice. The team also found that the repair and restoration work was scheduled and performed with a level of diligence appropriate to Con Ed's obligation to maintain reliability.

The site visits and review of Con Ed documentation confirm that Con Ed also performed the investigation and repair of the October 21st outage with the level of diligence appropriate to meet its reliability obligations. The MMP found no evidence that Con Ed delayed any aspect of the work or that the company failed to take advantage of any reasonable opportunity to expedite progress. The MMP believes that Con Ed accomplished the restoration of the line in the shortest time frame feasible and consistently with good utility practice.

The investigation indicated that Con Ed performed its analysis and restoration in accordance with its current procedures. It is suggested that the procedure for responding to cable oil alarms be reviewed to consider manual removal of facilities from service under low oil pressure conditions. Con Ed subsequently made this change.

The MMP investigation into Con Ed TCC holdings did not identify extraordinary TCC revenues that could be identified as due solely to the outage. The MMP did not identify any aspects of the market that would warrant change.

The MMP also confirmed that Con Ed furnished the NYISO with timely updates with regards to the 71 line's status and expected return time, and the NYISO staff promptly posted these updates on the NYISO web site.

List of Documents Reviewed

- I. Schedule of restoration activities (Task Milestone Report)
- II. Route Sheets
- III. Route sheets for September 2nd, September 17th, and September 28th
- IV. Updated schedule of restoration activities (Task Milestone Report)
- V. Flush and Filter Reports
- VI. Task Milestone Report for repairs and restoration
- VII. Sequence of events Recording Report
- VIII. Oil re-pressurizing Data
- IX. HiPot Testing Data
- X. Task Milestone Report for repairs and restoration
- XI. Con Edison Lab Sequence Reports
- XII. Time Sheets for Splicing Crews for November 9th, 14th, and 16th
- XIII. Pressure charts
- XIV. Pressurization pump operating charts
- XV. Dispatch Logs
- XVI. Procedures EO-6065 and 0900-0019/02, Para. 4.1 a (4)
- XVII. Consultant report
- XVIII. Con Ed's TTC holdings
- XIX. TCC MW
- XX. Con Ed Tariff
- XXI. Con Ed Feeder 71 Scheduled Return Time Changes
- XXII. Schedule return time changes Timeline