Second Annual Report
Verification of
Commonwealth Edison's
Commitments Related to the
Downers Grove Substation Fire

presented to:

Staff of the
Illinois Commerce Commission

by:

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I. Introduction

The Illinois Commerce Commission (ICC or Commission) retained The Liberty Consulting Group (Liberty) to investigate the root causes and implications of an August 10, 2005, fire at Commonwealth Edison's (ComEd's) Downers Grove substation. Liberty's December 16, 2005, report contained eight conclusions and six recommendations. ComEd made a presentation to the ICC Staff on December 19, 2005, and submitted written responses to Liberty's recommendations on February 3, 2006. ComEd also made a presentation to the ICC on March 7, 2006. The ICC then retained Liberty to verify ComEd's compliance with its plan to implement Liberty's recommendations.

Liberty acquired information from ComEd, interviewed ComEd employees, and spent time on site inspecting ComEd's facilities. Liberty's on-site periods were:

- three weeks in October 2006
- two weeks in February 2007
- three weeks July/August 2007
- two weeks in December 2007
- one week in April 2008
- two weeks in May 2008
- two weeks in July/August 2008.

Liberty issued its first annual verification report on August 28, 2007. The public version of that report is on the ICC's web site.[1] That report indicated that ComEd met its commitments and Liberty completed its verification work on many of the action items arising from the Downers Grove substation investigation. Overall, Liberty found that ComEd was on schedule for the installation of fire protection enhancements at substations. Liberty did not find any instances in which ComEd failed to meet its commitments. However, there were other commitments that were either incomplete or for which Liberty had not completed its verification work. This second annual report provides an update on these items.

Liberty organized ComEd's commitments to the ICC in 37 action items based primarily on the company's February 3, 2006, response document. The following sections of this report describe each item and Liberty's verification work on each. The table immediately below provides the summary status of each action item.

[1] http://www.icc.illinois.gov/industry/publicutility/energy/electricity/electricreliability.aspx

#	Report	Item	Did ComEd meet its commitments and take actions as reported?	Is Liberty's verification work complete?	Date of Liberty's completion
1	II.B.1	Critiques of Downers Grove RCI	Yes	Yes	October 2006
2	II.B.2	Comparison with Pharmaceutical Company	Yes	Yes	October 2006
3	II.B.3	Self-Assessments	Yes	No	
4	II.B.4	Root Cause Analysis Training	Yes	Yes	October 2006
5	II.B.5	Benchmarking	Yes	Yes	February 2007
6	III.B.1	Distribution Joint Construction Training Programs	Yes	Yes	August 2007
7	III.B.2	Field Bulletin on Distribution Cable Joints	Yes	Yes	October 2006
8	III.B.3	Hydraulic Press Calibration	Yes	Yes	October 2006
9	III.B.4	Tracking Cable Space Joint Installations	Yes	Yes	October 2006
10	III.B.5	Engineering Approval of Cable Space Joint Installation	Yes	Yes	October 2006
11	III.B.6	Transmission Underground Quality Control Requirements	Yes	Yes	October 2006
12	III.B.7	Transmission Joint Training Benchmarking	Yes	Yes	August 2007
13	III.B.8	Transmission Joint Smoothness Specification	Yes	Yes	October 2006
14	III.B.9	Transmission Joint Construction Benchmarking	Yes	Yes	October 2006
15	IV.B.1	Responsibilities of the Operations Systems Engineer	Yes	Yes	February 2007
16	IV.B.2	Review Existing Reports for Adequacy	Yes	Yes	October 2006

#	Report	Item	Did ComEd meet its commitments and take actions as reported?	Is Liberty's verification work complete?	Date of Liberty's completion
17	IV.B.3	Analysis of Operating Cables Above Normal Ratings	Yes	Yes	May 2008
18	V.B.1	ComEd's Substation Fire Protection Plan		No	
19	V.B.2	Substation Prioritization	Yes	Yes	October 2006
20	V.B.3	Substation Inspections	Yes	Yes	October 2006
21	V.B.4	Thermographic Inspections	Yes	No	
22	VI.B.1	Substation Fire Response Procedure Training	Yes	Yes	August 2007
23	VI.B.2	Division of Authority between the OCC and the TSO	Yes	Yes	October 2006
24	VI.B.3	CSR Fire Response Procedure Improvement	No*	Yes	February 2007
25	VI.B.4	Substation Fire Drills	Yes	No	
26	VI.B.5	Fire Alarm Recognition and Priority Improvement	Yes	Yes	October 2006
27	VI.B.6	Site Fire Plan Creation		No	
28	VI.B.7	Operation of Circuit Switchers and Circuit Breakers	Yes	Yes	February 2007
29	VII.B.1	Single-Transformer Distribution Substations	Yes	Yes	February 2007
30	VII.B.2	Multiple-Transformer Substations – Transfer Capability	Yes	Yes	February 2007
31	VII.B.3	Multiple-Transformer Substations – Categories	Yes	Yes	February 2007
32	VII.B.4	At-Risk Distribution Customers	Yes	Yes	February 2007

#	Report	Item	Did ComEd meet its commitments and take actions as reported?	Is Liberty's verification work complete?	Date of Liberty's completion
33	VII.B.5	Feeders without Direct Ties to Other Substations	Yes	Yes	February 2007
34	VII.B.6	Distribution Substation Restoration Options and Tools	Yes	Yes	August 2008
35	VII.B.7	Communication of Distribution Substation Risk Assessment	Yes	Yes	August 2007
36	VII.B.8	Transmission Substation Categories	Yes	Yes	February 2007
37	VII.B.9	Transmission Substation Restoration Guide	Yes	Yes	February 2007

* # 24: ComEd met the commitments but did not meet its commitment date for reinforcing proper communications.

Even though Liberty has completed its verification work on many individual items, important verification work remains. ComEd's installation of important fire protection enhancements at substations will continue for the next couple of years. Liberty will also inspect substations with these improvements and observe or evaluate substation fire drills. Liberty will monitor ComEd's resolution of related substation issues such as battery capacity and standpipe electrical isolation. Another significant matter that will be included in future verification work includes the review of root cause investigation reports.

II. Root Cause Analysis

A. Recommendation

Liberty recommended that ComEd assess its own root cause analysis methods and consider obtaining formal root cause training. More in-depth analyses would help ComEd determine the most effective changes it could make to cure underlying problems. In its determination of these changes, ComEd should not make its recommended actions contingent upon verifying that such action is consistent with common utility practice.

B. ComEd's Response and Liberty's Verification

ComEd agreed with the recommendation and indicated that it would take several actions to continue to improve its root cause process.

1. Critiques of Downers Grove Root Cause Investigation

ComEd said that it requested the Exelon Nuclear staff, which has experience with the root cause investigation (RCI) process, to review the Downer's Grove RCI report. ComEd committed to having its Performance Assessment staff review the critiques from Liberty and Exelon Nuclear of the Downers Grove RCI in order to strengthen its RCI process. ComEd indicated that this action would be complete by April 1, 2006.[2]

In its first annual report, Liberty indicated that it verified and closed this commitment.

2. Comparison with Pharmaceutical Company

ComEd committed to comparing its root-cause process with a pharmaceutical company located in the area by March 1, 2006. ComEd said that it would review the observations and incorporate identified improvements to strengthen the ComEd corrective action and root cause analyses programs.[3]

In its first annual report, Liberty indicated that it verified and closed this commitment.

3. Self-Assessments

ComEd committed to completing by March 1, 2007, two self-assessments of root-cause investigations. The assessments were to verify organizational compliance to the governing RCI (Root Cause Investigation) requirements and to include items such as a review of the scope of the RCI and a review of the effectiveness of key corrective actions.[4]

[2] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[3] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[4] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

In its first annual report, Liberty stated that ComEd met its commitment but that Liberty's review was not complete because it observed some weaknesses in ComEd's root cause analysis reports.

Liberty reviewed 17 RCI reports prepared by ComEd after the Downers Grove fire report. Simply from the number of reports, it is apparent that ComEd has been committing the resources and conducting root cause investigations on important incidents. ComEd assigns the corrective action tasks that result from the investigations to specific organizations and managers, assigns a due date for completion of each task, and enters the task in the action-tracking sub-system of ComEd's PassPort work management system. ComEd's performance assessment organization assures the completion of action tasks. It reviews, on a bi-weekly basis, completed action tasks for compliance to the RCI team assignments and it monitors the action tracking system for past-due task completions.[5]

The quality and depth of ComEd's investigations varied. Some, such as the draft report on the Plainfield substation fire, seemed to determine valid root causes, which in turn can result in effective corrective actions. Others did not conclude with valid root causes. ComEd could improve the presentation and organization of all of the reports to show clearly how ComEd determined the causes and why corrective actions are necessary and sufficient. The effectiveness of corrective actions determines the real value of the investigations. Liberty noted several instances in which the same or similar problems or causes arose in later reports.

Liberty will continue to review ComEd's RCI reports and make suggestions on how ComEd could improve the investigations and the resultant reports.

4. Root Cause Analysis Training

ComEd indicated that it subscribes to well known system for training related to root cause analyses and problem investigation.[6]

In its first annual report, Liberty indicated that it verified and closed this commitment.

5. Benchmarking

ComEd reported that it consults with other companies and experts within and outside of the electric utility industry to draw upon their knowledge base to improve its programs and standards, or bring greater value to its customers by becoming more efficient. ComEd said that it does not use benchmarking as a justification for adopting the least rigorous standard.[7]

In its first annual report, Liberty indicated that it verified and closed this commitment.

[5] Interview, Performance Asset, August 7, 2008.
[6] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[7] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

III. Cable Splicer Training and Quality Control

A. Recommendation

Liberty recommended that ComEd study and improve the quality of the training, instructions, and supervision given to personnel who perform critical operations like installing cable connections. A properly installed joint should not be the weak link in a cable system. However, ComEd has experienced several instances in which poor workmanship or the failure to recognize an unsatisfactory connector installation has caused serious problems. ComEd should require certification of personnel who install cable splices. ComEd should keep records of joint construction to augment other means of accountability in the workplace.

B. ComEd's Response and Liberty's Verification

ComEd agreed with the recommendation and indicated that it would take several actions to identify and implement various training, quality control, and inspection improvements relating to underground cables.

1. Distribution Joint Construction Training Programs

ComEd's response indicated that it would review the distribution cable joint construction training and qualification program requirements for adequacy, and modify the program requirements for underground splicers by May 1, 2006. Thereafter, ComEd said it would implement a modified training program to close identified training gaps by December 1, 2007. ComEd planned to use this program for both new and refresher underground splicer training.[8]

In its first annual report, Liberty indicated that it verified and closed this commitment.

2. Field Bulletin on Distribution Cable Joints

ComEd indicated that it issued a Field Bulletin on January 20, 2006, that highlighted several areas of cable preparation and joint installation. ComEd also said that is it had begun communicating the Field Bulletin to construction crews and engineering personnel.[9]

In its first annual report, Liberty indicated that it verified and closed this commitment.

3. Hydraulic Press Calibration

ComEd indicated that it would evaluate and create hydraulic press routine maintenance and calibration requirements by March 15, 2006.[10]

In its first annual report, Liberty indicated that it verified and closed this commitment.

[8] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[9] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[10] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

4. Tracking Cable Space Joint Installations

ComEd's response indicated that by May 1, 2006, it would develop a checklist for cable-space joint installations, and that the checklist would include a method to track who installed the joint. After development of the checklist, ComEd indicated that it would perform periodic QC audits during the installation of cable space joints.[11]

In its first annual report, Liberty indicated that it verified and closed this commitment.

5. Engineering Approval of Cable Space Joint Installation

ComEd said that it would require specific approval from Engineering before it installs a new joint in the cable space of a substation.[12]

In its first annual report, Liberty indicated that it verified and closed this commitment.

6. Transmission Underground Quality Control Requirements

ComEd said that it implemented quality control (QC) requirements for transmission cable and component construction and installation. Construction specifications contained the QC requirements, which required the use of a checklist and sign off by the splicer and a supervisor for joint and termination construction. ComEd indicated that it would apply the QC requirement to work performed by both ComEd and contractor employees. ComEd also said that it determined the record retention requirements for worker qualification and for tracking who installed which joints.[13]

In its first annual report, Liberty indicated that it verified and closed this commitment.

7. Transmission Joint Training Benchmarking

ComEd's response indicated that it benchmarked its requirements with other utilities and established criteria for a transmission joint construction training and qualification program. ComEd was to follow this by the development of an associated training program by November 1, 2006.[14]

In its first annual report, Liberty indicated that it verified and closed this commitment.

[11] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[12] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[13] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[14] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

8. Transmission Joint Smoothness Specification

ComEd said that it would revise transmission joint construction specifications by April 1, 2006, to include a required connector smoothness factor in transmission joints during new construction.[15]

In its first annual report, Liberty indicated that it verified and closed this commitment.

9. Transmission Joint Construction Benchmarking

ComEd said it would review existing transmission underground construction specifications for completeness by benchmarking against cable design companies and other utilities.[16]

In its first annual report, Liberty indicated that it verified and closed this commitment.

[15] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[16] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

IV. Heavily Loaded Feeders

A. Recommendation

Liberty recommended that ComEd develop guidelines for dealing with heavily loaded feeder systems.

To repair a faulted cable, ComEd transferred load to a circuit at the Downers Grove substation. The added load caused the functioning circuit to exceed its normal rating for many hours during the months preceding the Downers Grove substation fire. The heavily loaded circuit contained the joint that failed and started the fire. Liberty concluded that ComEd did not have procedures or guidelines for operations, engineering, and construction related to heavy loading on a feeder over an extended period.

B. ComEd's Response and Liberty's Verification

ComEd agreed with the recommendation and stated that it would take several actions to provide guidance to its operations personnel for dealing with heavily loaded feeders.

1. Responsibilities of the Operations Systems Engineer

ComEd's response said that, by March 1, 2006, it would review and clarify the responsibilities of the Operations Systems Engineer to include:[17]

- Prioritizing repairs based on circuit loading levels and durations above normal loading,
- Monitoring repair status,
- Expediting repairs, and
- Escalating issues when repairs are delayed.

In its first annual report, Liberty indicated that it verified and closed this commitment.

2. Review Existing Reports for Adequacy

ComEd's response indicated that by March 1, 2006, it would review its existing reports, tools, and reporting processes for adequacy and make modifications based on this review. The reports, tools, and processes that it was to review included PI Historian, System Control and Data Acquisition (SCADA), electronic and paper maps, Switching Routine Database, BRIO reports from Passport,[18] the Distribution Load Management Program, and the weekly "out of configuration" (Operations Report 0003 or OPS0003) report.[19]

[17] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[18] BRIO is the trade name of the software module in Passport that structures reports. Passport is ComEd's work management system.
[19] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

In its first annual report, Liberty indicated that it verified and closed this commitment.

3. Analysis of Operating Cables above Normal Ratings

ComEd said that by March 1, 2006, it would complete its analysis of data collected from other utilities and research organizations such as the Electric Power Research Institute (EPRI) and National Electric Energy Testing Research & Applications Center) (NEETRAC) regarding industry practices for operating 12kV cables between normal and emergency loading levels. ComEd would then revise its operating guides to include guidance for operation of these cables as practical.[20] Based on its research, ComEd concluded that there was no defined industry practice for operating cables between their normal and emergency limits. Therefore, ComEd created its own cable operating guidelines.

ComEd revised its loading guidelines and performed various analyses because of Liberty's review and questions over the period from January 2006 through April 2008. ComEd's analyses are now consistent with the current operating guidelines. However, Liberty believes that under the loading assumptions used by ComEd, a few feeders with extremely high load factors may approach loading limitations under extreme weather conditions. Liberty suggests that ComEd investigate the need for special ratings for those feeders as necessary.

ComEd currently flags any hours that cables are operated above normal ratings. Liberty suggests that ComEd ensure that this data is preserved for potential future cable life expectancy analyses.

ComEd met its commitments and took the actions reported for this item. Liberty considers this item verified and closed.

[20] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

V. Substation Vulnerability to Fires

A. Recommendation

Liberty recommended that ComEd continue to inspect, evaluate, and implement changes at substations with vulnerabilities to fires like those that have occurred in the past. It should evaluate substations that are similar in design to Downers Grove to determine which have the potential to result in long duration outages to a large number of customers. It should implement the lessons learned from the Downers Grove and other earlier fires in a manner that mitigates this potential loss of service to customers. It should continue and complete as soon as practical its infrared inspections of joints in cable spaces. It should develop a formal method for prioritizing cable-space fire-protection enhancements to reduce the outage risks caused by cable space fires. It should determine the timeliness and cost-effectiveness of various options to reduce quickly the most vulnerable substations.

B. ComEd's Response and Liberty's Verification

ComEd agreed with the recommendation and said it would take several actions to develop and implement improvements at substations to reduce the risk of customer and equipment outages caused by fires.

1. ComEd's Substation Fire Protection Plan

ComEd's response indicated that its newly formed fire-protection engineering group developed a substation fire-protection plan for its cable-space substations similar to Downers Grove for 2006 and 2007, and that the design and fieldwork for this plan was underway. This plan specified additional fire protection improvements for approximately 120 of ComEd's substations.[21] These improvements include items such as:

- Wrapping of concentric neutral cable joints and adjacent cables
- Installation of floor penetration seals
- Installation of fire detection systems
- Installation of fire suppression systems
- Relocation of identified substation battery main feeds from the cable space to the first floor for substations similar to Downers Grove.
- Site fire pre-plans with fire department training

Liberty verified that by January 4, 2006, ComEd developed a comprehensive multi-year substation fire-protection plan for 350 substations and several tunnels. Since the date of the response, ComEd determined that 130 substations[22] out of the 350 substations have similar risk of fire as the Downers Grove substation. With the exception of the installation of fire suppression systems, ComEd had scheduled completion of all planned fire protection actions on these 130 substations as follows: 45 by the end on 2007, 67 by the end of 2008, and the remaining by the

[21] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[22] Response to Data Request # 425.

end of 2010.[23] ComEd scheduled the completion of fire-suppression system installations by the end of 2014.

a. ComEd Reporting of Fire Protection Enhancement Work Completed for Cable-Space Substations Similar to Downers Grove

In October 2006, Liberty began monitoring ComEd's progress in completing its cable-space substation fire protection program. Liberty verified that engineering and fieldwork under this plan was underway.[24] Liberty also verified that the program[25] included the six action items listed above.

In Liberty's first annual verification report, Liberty indicated that, up to August 2007, ComEd's progress in its fire prevention enhancement work was consistent with the program developed in 2006.

In December 2007, ComEd reported that, in addition to the cable space substations similar to Downers Grove, it added cable space substations not similar to Downers Grove and added special cases (such as oil filled equipment inside control buildings) substations to its substation fire prevention program. ComEd also reported that it had advanced the schedule for completions of cable wrapping at 12 substations and penetration sealing at 3 substations from 2008 to 2007. As of December 12, 2007, ComEd had completed all of its 2007 scheduled work except for cable wrapping at two substations (one of which had been originally scheduled for 2008).[26] ComEd completed this work in early 2008.

During on-site periods in April and July 2008, Liberty verified that ComEd was still on track with its scheduled substation fire protection program work. In addition, ComEd reported that it was enhancing its original fire protection program by including more automatic fire suppression technology than originally planned. Manual water deluge fire-suppression systems require human actions to connect fire department water tankers to system standpipes, resulting in some delay in initiating fire-suppressing water. Automatic fire suppression systems do not require human intervention and provide immediate and automatic response to cable space fires. Three of the 19 water deluge fire suppression systems installed by June 2008 were automatic. In July 2008, ComEd reported that it scheduled the installation of 11 more suppression systems before the end of 2008. Two of these will be automatic systems that selectively activate spray heads only in the areas of fires. Three of the systems will use nitrogen-water misting nozzles (rather that water spray nozzles) to provide more effective fire suppression. ComEd originally planned to install manual fire suppression systems at most of the substations identified for fire suppression enhancement. However, ComEd reported that it was continuing to evaluate whether it should install automatic fire suppression systems at more substations than originally planned, and whether to retrofit some substations with automatic systems where it had already installed manual systems.

[23] Response to Data Request # 461.
[24] Response to Data Request 424; and Interview, Fire Protection Engineering Manager, of October 12, 2006.
[25] Response to Data Request # 425.
[26] Interview, Fire Protection, December 11, 2007.

The table below shows ComEd's status of implementing fire protection measures as of June 30, 2008.[27]

Project	Total Planned	Total Complete	Last Year of Planned Installation
Cable Wrap	141	119	2008
Penetration Seal	140	139	2008
Fire Detection	38	34	2009
Fire Suppression	119	19	2014
Battery Leads	64	52	2009
Site Pre-Plans	353	164	2010

Liberty found that, as of July 2008, ComEd's fire-protection program work for its cable space substations similar to Downers Grove was consistent with its commitment and to its plan developed in 2006. ComEd was on track in completing all fire protection enhancements consistent with its 2006 schedule. ComEd is continuing to evaluate the effectiveness of various types of suppression systems. Liberty will continue to verify that ComEd is completing fire-protection enhancement work in its cable space substations similar to Downers Grove consistent with its program.

b. Liberty's Substation Visits

In its first annual report, Liberty indicated that it had inspected the fire protection work completed at six cable space substations up through August 2007. In all cases, Liberty found all penetrations sealed, battery-related leads relocated from the cable space to the main floor, cable joints and nearby cables wrapped, fire shields installed under control cable pans, exposed control cables near power cable wrapped, fire-proofing installed on cable space hatch doors, and site fire pre-plans in place.

Liberty inspected three cable-space substations in December 2007,[28] four in April 2008,[29] one in May 2008,[30] and three in July and August 2008.[31] Liberty found that the fire protection program work, including site fire pre-plans, battery cable relocations, and installing cable and joint wrappings, penetration sealing, and water deluge fire suppression systems, had been completed consistent with the ComEd 2006 program work schedule. Liberty will continue to periodically inspect cable space substations for compliance to ComEd's 2006 fire-protection program plan.

c. Other Concerns in Identified in Cable Space Substations

Liberty inspected substations for general conditions while verifying the completion of fire protection work. Liberty found that substations were well maintained and observed no abnormal conditions except as described below.

[27] Response to Data Request #514 and Interview, Fire Prevention Engineering Manager, July 31, 2008.
[28] Substation Inspections on December 6 and 12, 2007.
[29] Substation Inspections on April 15 and April 16, 2008.
[30] Substation Inspection on May 21, 2008.
[31] Substations Inspection on July 30 and August 5

(1) Possible Shock Hazard at Water Deluge System Standpipes

In July 2007, Liberty identified a concern of a possible shock hazard for anyone in contact with the water deluge system standpipes installed in the substations with manual water deluge fire-suppression systems. It was possible that the standpipes might be at a some voltage above ground potential, under certain substation or line fault conditions.[32] During the 2008 inspections, Liberty verified that ComEd satisfied this concern by installing insulated flanges in the water pipes for the systems.[33] In April 2008, Liberty observed that ComEd had retrofitted the header water valve flanges on the fire suppression systems at three substations inspected with electrical isolation gaskets. ComEd reported that insulated flanges were installed on all 19 water fire suppression systems currently installed and would insulated flanges on the remaining installations.[34] Liberty will continue verification that ComEd is installing flange insulation during future substation inspections.

(2) Water Deluge System Drain Valves

In April 2008, Liberty observed cases where drain valves on the water deluge system were not plugged or locked. Liberty's concern was that because the pipes contained water only when needed for fire suppression, these valves might be left in the open position, reducing water pressure at the sprinkler heads during fires. ComEd reported that it would investigate installing plugs on the valves. Liberty will continue verification that drain valves are plugged during future substation inspections.

(3) Station Battery Sizing

While inspecting cable space substations in 2006 and 2007, Liberty observed that the 48-volt batteries in some TDC substations were physically smaller than the batteries in other TDC substations. Liberty requested that ComEd review the adequacy of battery size because battery performance was critical for the operation of substation protective equipment. In July 2007, ComEd completed initial battery sizing studies, based on IEEE[35] Standard 485, which required that a battery adequately perform for at least for 8 hours following the loss of charging voltage. ComEd conducted this study on the 28 TDC substations and the 4 TSS substations with 48-volt batteries. ComEd reported in December 2007, that 23 of 32 substations with 48-volt batteries were undersized, based on the IEEE standard and the direct-current (dc) loading demands[36] in the substations.[37] In April 2008, ComEd reported that, upon review by a consultant and because of revised circuit switcher dc loading data, ComEd had revised the number of substations with undersized batteries to 26. It also reported that the batteries had already been replaced at the three most critical substations, that it planned to replace a total of four batteries in 2008, and that

[32] Interview, Fire Protection, July 24, 2007.
[33] Response to Data Request # 480Sup, and Interview, Fire Protection, December 11, 2007.
[34] Response to Data Request #502.
[35] Institute of Electrical & Electronics Engineers.
[36] Circuit breakers, circuit switchers, and motor operated air break switches require considerable dc current when they are operated to interrupt faults and isolate faulted lines or buses. Sometimes, several of these devices may need to operate at the same time.
[37] Response to Data Request #497.

it scheduled the remaining undersized batteries to be replaced within 5 years.[38] In July 2008, ComEd reported that it typically takes about 6 hours after a battery or charger alarm is received by load dispatchers to transport one of the three portable batteries and to replace a defective battery or charger with the portable equipment.[39] ComEd also reported that it has not had any battery failures under operational conditions during the last ten years.[40] Liberty will continue to monitor ComEd's progress in replacing substation batteries.

(4) Cable Joint Replacements

Liberty observed during substation inspections on July 30, 2008, that one joint had been recently been replaced in each of the two substations cable spaces inspected that day.[41] These had been identified as suspect by the thermographic inspection program. ComEd reported that it conducted annual thermographic inspections of cable joints in substation cable spaces and rejected any joints warmer (>1 degree) than the surrounding conductor. ComEd, via NEETRAC,[42] conducted forensic evaluations on joints removed from cable spaces and found that heating (poor connection) was likely caused by oxidation that developed in the joint connector due to observed installation workmanship, including inadequate conductor preparation, improper crimping of the connector, and using inadequate amounts of joint compound. None of the connectors in the rejected joints were determined to be improperly manufactured. ComEd estimated that, since the cable space joint thermographic inspection program started in 2005, 20 to 40 cable space joints have been rejected and replaced.[43] This finding leads Liberty to believe that cable joint assembly training and quality control was an issue prior to the cable-splicer training enhancements implemented in 2006. See Section III.B.1, above.

Liberty will review additional joint inspection and rejection data during the next verification period.

(5) Cable Space Substation Failures

As reported in the first annual report, ComEd experienced one cable failure in May of 2007 and one cable joint failure in June of 2007, in cable space substations. The fire protection enhancements in these two substations functioned as intended and limited damage in the cable spaces.

Since the first annual report, ComEd had one lead-cable failure at a substation (the Downers Grove fire was caused by a plastic joint failure). The fire protection measures installed at that substation limited fire and damage to just one cable.[44] On May 5, 2008, another fire occurred in the cable space of a substation from a continuous arcing fault not related to either a cable or a joint failure. This substation did not have a water suppression system nor had the sealing of cable penetrations been completed. The sealing of the cable penetrations had been scheduled to be

[38] Response to Data Request #500.
[39] Responses to Data Requests #516 and #517.
[40] Response to Data Request #516.
[41] Substation Inspection Reports, July 30, 2008.
[42] NEETRAC is the National Electric Energy Testing Research and Applications Center
[43] Interview, Cable Engineering, August 6, 2008.
[44] Interview, Fire Prevention Manager, April 16, 2008.

completed about 2 weeks after the fire occurred. Some minor damage to the switchgear above the cable space would have been prevented had the cable penetrations been sealed.[45]

2. Substation Prioritization

ComEd's response indicated that its plan addresses the priority of implementing fire protection improvements at substations using a method similar to the method suggested in Liberty's report.[46] ComEd based its prioritization on:

- Potential for stranded load during peak load conditions
- Number of cable joints
- Percent of poly (plastic) feeder cables[47]
- Number of critical customers at each substation
- Percent of unfilled penetrations
- Substation load
- Number of substation circuits.

In its first annual report, Liberty indicated that it verified and closed this commitment.

3. Substation Inspections

ComEd's response to Liberty's recommendations indicated that it conducted visual inspections and inventoried the condition of over 100 substations with cable spaces. It used the information obtained from the inspections to plan the work required and in the prioritization discussed immediately above.[48]

In its first annual report, Liberty indicated that it verified and closed this commitment.

4. Thermographic Inspections

ComEd's response indicated that it performed thermographic (infrared) inspections at 83 substations that contain poly (plastic) cables and joints; it made repairs on circuits that have shown "hot spots" at these substations.[49] By the end of 2006, ComEd said that it would perform thermographic testing at approximately 70 additional TSS and TDC cable space substations. By the end of 2007, it will review substation layouts to determine if there are additional cables spaces. ComEd will thermo-scan any additional cable space areas identified during this review.[50]

Liberty verified that by January 31, 2006, ComEd performed thermographic inspections on cable joints in cable spaces in 83 substations. ComEd replaced eight first section cable runs and two

[45] Review of TDC 454 Substation Fire, May 20, 2008.
[46] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[47] These cables are more susceptible to fires.
[48] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[49] Infrared thermography is a thermal analysis tool used for preventive maintenance. An inadequate cable joint could be detected by causing a temperature reading higher than the adjacent cable.
[50] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

lead joints because of hot joints identified by the thermographic inspections. ComEd also identified other non-joint related problems with this program. [51]

Liberty verified that during March and April 2006, ComEd completed the thermographic inspections on 67 additional substations.[52] ComEd reported that it has conducted a drawing review of its substation layouts to identify substations that might have cable spaces. ComEd said that it is performing field inspections, which will be complete by the end of 2007.[53]

In August 2007, Liberty considered all action items verified and closed, except for one. Liberty was to verify later whether ComEd performed the substation field inspections by the end of 2007 for possible additional cable spaces.

In December 2007, Liberty verified that ComEd conducted drawing reviews of its substation layouts to identify additional substations that might have cable spaces. ComEd committed to complete these reviews by the end of 2007, to field inspect those substations identified by review of drawings, and to inspect thermographically power cable joints in any additional cable spaces. ComEd reported that it identified 34 additional substations as having cable spaces (but not necessarily containing high voltage cables or similar to the configuration at the Downers Grove substation). ComEd also reported that it conducted thermographic inspections on all power cables and joints located in the newly identified cable spaces.[54]

In July 2008 substation inspections, Liberty learned that ComEd discovered through inspections and repaired additional cable space joints. See Section V.B.1.c (4), above. Liberty requested additional information from ComEd on its thermographic inspections and will keep this item open to review that information.

[51] Response to Data Request # 426.
[52] Response to Data Request # 467.
[53] Response to Data Request # 428, and Interview, Fire Prevention Manager, October 12, 2006.
[54] Response to Data Request # 428Sup, and Interview, Fire Protection, December 11, 2007.

VI. Dispatcher and Operator Training

A. Recommendation

The fire at the Downers Grove substation revealed weaknesses in the manner in which ComEd responded to the emergency. Specific areas were acknowledgement of fire alarms at the Operations Control Center (OCC), clear instructions for Customer Service Representatives (CSR), division of authority between the OCC and Transmission System Operations (TSO), and de-energization of equipment. Liberty recommended that ComEd should:

- Improve dispatcher and operator training and qualifications related to substation fires, including instilling in its load dispatchers the expediency of returning system configurations to normal, de-energizing equipment under proper circumstances, acknowledging alarms, and absolute decision-making authority over the areas of the system for which they have jurisdiction.
- Train its Customer Service Representatives to be clear about whether a structure fire exists.
- Re-evaluate the priority given to substation fire alarms and the actions that dispatchers take after receiving such an alarm.
- Develop mechanisms that would reduce the verification time in determining that a fire exists at one of its substations.
- Have on-site accessible site fire plans and a direct access number to the dispatcher for fire personnel.

B. ComEd's Response and Liberty's Verification

ComEd agreed with the recommendation and stated it would take several actions to strengthen training for operations personnel and to raise the awareness of the actions that its personnel should take during off-normal conditions such as a substation fire.

1. Substation Fire Response Procedure Training

ComEd reported[55] that several fire-response training initiatives were underway. ComEd issued a "First Responder" procedure on June 30, 2005. ComEd trained the incident commanders on the procedure; ComEd indicated that it would train Operations' field personnel by July 1, 2006.

In its first annual report, Liberty indicated that it verified and closed this commitment.

2. Division of Authority between the OCC and the TSO

During November 2005, ComEd reported that it held meetings with Transmission and Distribution Operations to reinforce that Operations Shift Managers have the authority and

[55] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

responsibility to de-energize equipment, and determine the necessary extent of equipment isolation in the event of fire or catastrophic event.[56]

In its first annual report, Liberty indicated that it verified and closed this commitment.

3. CSR[57] Fire Response Procedure Improvement

In its response to Liberty's 2005 report, ComEd reported that it was re-evaluating and modifying the CSR process for providing accurate and timely information related to substation emergencies in order to capture the immediate attention of the Operating Dispatcher. ComEd also indicated that it would establish a 3-way communication acknowledgement process.[58] ComEd committed to complete this by March 1, 2006.[59]

In its first annual report, Liberty indicated that ComEd met its commitments except for being late with regard to reinforcing the use of proper communications with CSR personnel.

4. Substation Fire Drills

ComEd said that it would perform drills that will include a scenario for a substation fire. ComEd also committed to hold drills periodically and involve Site Restoration Management, Operations and Load Dispatchers, Area Operators, and other departments as applicable. ComEd will invite local fire department(s) to participate in the appropriate portions of the drill. Lessons learned from these drills will be cascaded through the organization. ComEd indicated that it would hold the first drill by May 1, 2006.[60]

As indicated in the first annual report, ComEd held substation fire drills on April 19, 2006, and on May 2, 2007.

ComEd conducted a third substation fire drill at its TSS 65, Ohio substation on May 21, 2008. Liberty monitored the drill at the substation. Three ComEd drill controllers in the substation monitored actions taken. A City of Chicago emergency operations coordinator and fire fighters were on site. ComEd's Site Restoration Management Site Restoration Management (SRM) team leader and substation operator made decisions and instructed the fire fighters on ComEd's substation fire fighting procedures and reviewed the site fire pre-plans. The mobile command center was on-site. ComEd used the new satellite and cell phone communication systems and had portable toilets, water, and food on site. The testing group arrived to analyze technical problems. Environment and safety personnel were on-site. There was a discussion of whether personnel were incorrectly allowed into the control building after the fire department gave the all clear but before being safety and environmental personnel did the same.

[56] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[57] CSR is Customer Service Representative.
[58] "3-way communication" or "3-part communication" involves reporting back information or direction so that both parties have a clear and consistent understanding.
[59] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[60] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

Liberty found that ComEd conducted the drill at the substation as planned and conducted a lessons-learned meeting following the drill.[61] Liberty considers this commitment verified, however this action item remains open to monitor future drills.

5. Fire Alarm Recognition and Priority Improvement

ComEd reported that it initiated improvements for the dispatcher and operating departments to reduce fire response times. ComEd has modified the priority of fire alarms from priority two (2) to priority one (1). Starting January 13, 2006, both Transmission Systems Operations (TSO) and distribution Operations Control Center (OCC) receive fire alarms from the same substation, where previously ComEd segregated the transmission and distribution substations. In addition, SCADA fire alarms received at the OCC have a unique audible sound. ComEd said that it completed this action on January 20, 2006.[62]

In its first annual report, Liberty indicated that it verified and closed this commitment.

6. Site Fire Plan Creation

To assist firefighters, ComEd indicated that it would create site fire pre-plans for TSS and TDC substations and applicable transmission tunnels. These plans were to include descriptions of fire systems, hazards, site geographic layouts, and 24-hour emergency contact numbers. The plans would be on file at the site. ComEd contracted with an industry consultant for development of these site fire plans. ComEd said it would complete all TSS and TDC Chicago substations by the end of 2007; it would complete TDC substations similar to Downers Grove by 2008. ComEd planned to install site fire plans at all substations with a building containing electrical power equipment or relay control equipment by the end of 2011.[63]

As indicated in the first annual report, ComEd provided contract documents with an industry site fire-plan consultant and a list of substations that had fire plans completed by September 29, 2006.[64] That document showed that 30 substations had completed site fire plans.

In July 2008, ComEd provided an update to their schedule of fire plan creation.[65] That document listed the progress that ComEd is making and the future schedule by date and by substation. As of June 30, 2008, ComEd reported that its preparation and application of fire pre-plans were complete for its Chicago TSS and TDC substations, would be complete for its other TDC substations similar to Downers Grove by the end of 2008, and would be complete for all substations with a building containing power equipment by the end of 2011. As of July 31, 2008, Liberty verified that ComEd[66]

- had completed 65 site fire pre-plans in 2006
- had completed 90 site fire pre-plans in 2007

[61] Response to Data Request #510.
[62] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[63] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[64] Responses to Data Requests #443, #444 and #446.
[65] Response to Data Request #514.
[66] Interview, Fire Protection, July 31, 2008.

- has scheduled 67 substations for site fire pre-plans for 2008, 73 for 2009, and 60 for 2010

Fire pre-plans for the 155 substations scheduled for 2006 and 2007 are complete out of the 355[67] scheduled to be completed by the end of 2010. Nine substations are complete of the 67 substations scheduled for 2008. ComEd reported that the remaining 58 fire pre-plan documents are about complete and that all site fire pre-plans will be placed into the substations during the fall of 2008, after the fire departments are trained. The substation site fire pre-plans for the substations similar to Downers Grove will be in place by the end of 2008. Liberty found that, as of July 2008, ComEd's site fire pre-plan preparation program work for its cable space substations similar to Downers Grove was consistent with its commitment and to its plan developed in 2006. Liberty will continue the verification of ComEd's preparation of its substation site fire pre-plans.

7. Operation of Circuit Switchers and Circuit Breakers

ComEd reported that it would investigate and determine whether it can manually open circuit switchers and circuit breakers under load and fault conditions without DC control power. Based on the results of this technical investigation, ComEd will develop a technical document for the manual operation of circuit switchers and circuit breakers by March 1, 2006. ComEd will then determine the switching operations that it can perform in accordance with work practices and safety guidelines. If determined acceptable, training documents will be prepared by April 1, 2006. ComEd will also train personnel on manual equipment operations that they can perform without DC control power. ComEd will complete this by June 1, 2006.[68]

In its first annual report, Liberty indicated that it verified and closed this commitment.

[67] The original site fire pre-plan program included 353 substations. One more substation was added for 2008 and for 2010.
[68] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

VII. Risk-Based Analysis of Substations

A. Recommendation

Liberty recommended that ComEd conduct a risk-based analysis of all substations and make appropriate plans for the recovery of substations assuming a total loss of all substation equipment**.** ComEd should review all of its substations to identify substations that may be vulnerable to extended customer outages and the possible causes of those outages. ComEd should know where the system is vulnerable and have at least conceptual plans for dealing with a total substation loss. As part of this review, ComEd should review its portable equipment inventory to determine if additional equipment in this inventory would be beneficial.

B. ComEd's Response and Liberty's Verification

In its response, ComEd agreed with an alternative approach. ComEd said that it should approach this type of analysis differently for substations that serve transmission load only and for those that serve distribution customers directly because a greater variety of dynamic conditions affect substations that serve transmission load.

ComEd said that for substations that serve distribution load directly, it developed a strategy to address the complete loss of a substation with three focused objectives. First, ComEd categorized each substation based on the effect to customers of a total loss of the substation. Second, for each substation, ComEd developed initial restoration plans with a set of pre-planned restoration options. Third, ComEd used the effect on customers of a total substation outage so that ComEd management could evaluate mitigation options.

ComEd said that for substations that serve transmission load, it performed studies on the system that are highly dependent on many operational assumptions. These assumptions include, for example, which transmission lines are in-service, which generating stations are on-line, and how much power is being transferred between companies or regions. If one or more of these study assumptions does not match real time operations, the results may not be applicable. ComEd suggested that it approach the loss of a transmission substation from a broad perspective rather than performing system studies and developing substation specific transmission restoration plans for each individual transmission substation.

1. Single-Transformer Distribution Substations

ComEd said that by June 1, 2006, it would develop operational contingency plans for the total loss of each single-transformer distribution substation (TSS, TDC, SS, and DC) supplied by voltages between 12 kV and 138 kV. These contingency plans were to include the identification of switches that operators would use to complete customer restorations and, where 100 percent of customers cannot be transferred to other sources, the identification of the number and sizes of mobile transformers or generators needed to complete customer restorations. ComEd planned to include these plans in a database used by Operations as guides to determine restoration steps.[69]

[69] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

In its first annual report, Liberty indicated that it verified and closed this commitment.

2. Multiple-Transformer Substations – Transfer Capability

ComEd said that by July 1, 2006, it will have determined the transfer capability to adjacent substations for each multiple-transformer distribution substation (TSS, TDC, SS, and DC) at 90th percentile summer weather and during off-peak periods, assuming a total substation outage.[70]

In its first annual report, Liberty indicated that it verified and closed this commitment.

3. Multiple-Transformer Substations – Categories

ComEd reported that by July 1, 2006, it will have categorized each multiple-transformer distribution substation based on complete substation outage risk and possible restoration options. The purpose of the categorization was to allow for timely communication of the potential customer effect and determination of a possible, initial restoration strategy.[71]

In its first annual report, Liberty indicated that it verified and closed this commitment.

4. At-Risk Distribution Customers

ComEd responded that by October 1, 2006, it will have identified the number of customers at risk and critical customers at multiple-transformer distribution substations that do not have 100 percent transfer capability during 90th percentile weather.[72]

In its first annual report, Liberty indicated that it verified and closed this commitment.

5. Feeders without Direct Ties to Other Substations

ComEd said that by July 1, 2006, it will have identified the feeders at multiple-transformer distribution substations that do not have direct ties to feeders from other substations. ComEd said it would provide the list to Operations for emergency response restoration efforts.[73]

In its first annual report, Liberty indicated that it verified and closed this commitment.

6. Distribution Substation Restoration Options and Tools

ComEd's response indicated that by December 1, 2006, it will have developed a set of restoration options and tools for multiple-transformer distribution substations that can be deployed to assist in restoring customers as a result of catastrophic substation outage or supply-side interruptions. These restoration options and tools will include determining field connections

[70] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[71] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[72] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[73] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.

for mobile 34 kV-12 kV transformers, determining the appropriate levels of mobile equipment, and evaluating the use of 12 kV mobile switchgear.[74]

ComEd provided a package of information that documented its work on this commitment.[75] This information had four main parts:

- Evaluation of the possible use of mobile switchgear.
- Determination of appropriate levels of mobile equipment.
- A procedure for using portable 34 kV to 12/4 kV transformers.
- Strategy for repair of damaged transmission lines.

In February 2007, Liberty concluded that ComEd had met its commitment, but that ComEd should improve its analyses and evaluations to meet the intent of that commitment. Liberty kept this item open for a future review of any changes that ComEd may choose to make because of Liberty's identification of the weaknesses in ComEd's analyses and evaluations. Liberty requested an update to the status of all restoration equipment options in July 2008, but ComEd's response only addressed the current capability of the mobile generator fleet.[76]

Liberty briefly discusses each of the four main parts of the ComEd work package for this commitment in the following paragraphs.

Liberty pointed out weaknesses in ComEd's analysis of the possible use of mobile switchgear. ComEd used the Downer's Grove substation fire as its basis for the worst historical event that it had experienced. ComEd dismissed the use of mobile switchgear because it calculated a 5-day mobilization schedule, which approximated the length of customer outages at Downer's Grove. ComEd did not correctly consider that if Downer's Grove had been completely incapacitated that customer outages would have been much longer because of the inability to transfer substation load. ComEd should have used that basis to assess the possible use of mobile switchgear. ComEd stated that it would review new technology/mobile switchgear options as they become available. ComEd's analysis concluded the steps to restore portions of less damaged station equipment followed by replacement or repair of severely damaged was more prudent compared to installation of temporary equipment).

ComEd reported that for the summer of 2007, its then current mobile generator fleet and commitments coupled with load transfers, and mobile transformers could pick up the load at 99.8 percent of DC substations during on-peak conditions and 100 percent of DC substations during off-peak conditions. Similarly, ComEd stated that it could pick up the load at 21 percent of the TDC/TSS substations during on-peak conditions and 63 percent of the TDC/TSS substation during off-peak load conditions. Liberty classified the ComEd response as more of an examination of its current capabilities rather than an examination of the appropriate level of mobile generators to have on hand as intended. ComEd updated its mobile generator fleet and commitments in July 2008. In December 2007, ComEd added one 2 MW generator. In June 2008, ComEd added two additional 2 MW generators and 2 additional 2.5MW generators. Also

[74] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[75] Response to Data Request #455 Supplement.
[76] Response to Data Request #515.

in 2008, ComEd has the first right of refusal with its contractor for 5 generators. Liberty notes that ComEd is not designing its system to maintain full transfer capability between its substations.

ComEd issued a detailed and complete procedure for the use of portable 34kV to 12/4kV transformers in November 2006[77]. It was not clear to Liberty whether ComEd had or needed similar procedures for other types of portable equipment such as mobile generators and different mobile transformers. Liberty suggested that ComEd develop procedures for these items if not in existence and if they could facilitate the restoration of customer load.

ComEd addressed the repair strategy for the restoration of five classes of catastrophically damaged transmission lines of varied voltage, construction materials, and design configuration.

Class I - 69kV and 138kV wood structure lines,
Class II - 138kV steel structure lines,
Class III - 345kV short span steel structure lines,
Class IV - 345kV long-span, cross-country, steel structure lines, and
Class V - 765kV steel structure lines

Although ComEd examined each class thoroughly, it examined each independently and allowed the use of stock from other transmission classes. In addition, ComEd also maintains a stock of 345kV H-frame structures that could be used to temporarily replace certain classes, leaving the steel structures in stock and available to be used where required if multiple failures occurred. ComEd addressed the tangent tower configuration assuming that dead end structures and angle structures would be available through mutual assistance from other utilities. ComEd also stated that it would use wood pole structures as temporary construction for some transmission classes but their use may not be possible on limited rights-of-way. Liberty pointed out that if multiple classes of transmission lines were damaged at once (perhaps by a tornado), that insufficient emergency stock might not exist. Liberty also noted that dead end and angle structures might not be available if required via mutual assistance from other utilities. Liberty believes that ComEd should also determine what non-typical construction it would need in the limited right-of-way condition and consider the purchase of that stock.

ComEd has not taken action on any of the deficiencies or shortcomings in the ComEd analyses and evaluations identified by Liberty nor does it appear that they intend to do so. Liberty believes that it can make no additional progress on this item and considers its verification work closed.

7. Communication of Distribution Substation Risk Assessment

ComEd's response indicated that by October 1, 2006, it will have developed documentation to define and communicate the categorization of multiple-transformer distribution substations based on transfer capability and restoration strategies. ComEd also indicated that by January 1, 2007, it will have communicated the categorization/risk assessment, highlighting distribution substations where there is the greatest probability of extended interruptions given current strategies. ComEd

[77] Procedure CM-CE-890021.

reported that it had already developed complete outage recovery plans for some of these substations.[78]

In its first annual report, Liberty indicated that it verified and closed this commitment.

8. Transmission Substation Categories

In its response, ComEd said that by June 1, 2006, it would have categorized each transmission substation into one of three categories based on the impact to system security following a total loss. The results of this work will provide operators guidance as to relative importance of each transmission substation to the reliability of the transmission system. The first category will contain transmission substations where a large part of the transmission system might be lost on an uncontrolled basis for a total outage at peak load. The second category will contain transmission substations where it would need to shed customer load to prevent additional damage to transmission equipment. The third category will contain transmission substations where the transmission system would remain intact and there would be no stranded distribution load.[79]

In its first annual report, Liberty indicated that it verified and closed this commitment.

9. Transmission Substation Restoration Guide

In its response, ComEd said that by the end of 2006 and following the categorization assessment, it would produce a process document to guide transmission system operations following an event. The document was to include roles and responsibilities, emergency contact information, and reference to emergency procedures. In addition, ComEd said it would create a checklist of items to consider during the event and train Transmission Operations Shift Managers and Emergency Restoration Managers on this procedure by the end of 2006.[80]

In its first annual report, Liberty indicated that it verified and closed this commitment.

[78] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[79] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.
[80] ComEd's Response to the 2005 Liberty Report Recommendations, February 3, 2006.