ICC Docket No. 10-0467

Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 3.01 – 3.07
Date Received: November 24, 2010
Date Served: December 14, 2010

REQUEST NO. JVS 3.04:

Please refer to page 12 of Dr. Hemphill's testimony (ComEd Ex. 40.0). Please explain by what mechanism the Commission ordering ComEd to engage in a project would result in imposing an unfunded mandate.

RESPONSE:

ComEd objects to data request, JVS 3.04, because it is vague and unclear. Subject to and without waiving the foregoing objection and its General Objections, ComEd responds as follows:

As stated and explained in Dr. Hemphill's Rebuttal Testimony, "Staff seeks to impose an unfunded mandate." ComEd Ex. 40.0, 12:248-49. Dr. Hemphill further explained in his Rebuttal Testimony that because the $45 million of costs Staff seeks to mandate "are not included in rates, then the Commission would be ordering ComEd to undertake investment and incur operating expenses that ComEd cannot fully recover." Id. at 12:249-13:253. *See* also ComEd's Response to Staff Data Request JVS 3.05.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

Dr. Hemphill is unresponsive here as well. If it is Dr. Hemphill's opinion that it is an unfunded mandate because ComEd did not include the project in the rate case, he should state so and identify the mechanism that prevented/prevents ComEd from including this project in the current or future rate cases.

SUPPLEMENTAL RESPONSE:

ComEd's Response to Staff Data Request JVS 3.04 raised valid objections; and Dr. Hemphill was responsive to Staff Data Request JVS 3.04. ComEd continues to maintain its objections. Subject to and without waiving the foregoing objection and its General Objections, ComEd responds to the supplemental request as follows:

It is not Dr. Hemphill's opinion that "it is an unfunded mandate because ComEd did not include the project in the rate case." It is Dr. Hemphill's opinion that Staff is seeking to have the Commission impose an unfunded mandate because Staff seeks entry of an order compelling ComEd to undertake the UUFR program – a program that was not in place during the test year or any pro forma period – while at the same time failing to account for the costs of that program in the revenue requirement in the pending rate case. While it is unclear what Staff means by the mechanism that would result in imposing an unfunded mandate, the "mechanism" as Dr. Hemphill would use that term would be the order that Staff wants the Commission to enter.

If the question is to identify the mechanism that prevented/prevents ComEd from including the UUFR project in the current or future rate cases, the request is very broad and covers a host of issues regarding the difficulty of addressing this type of program through traditional regulation. This issue has been addressed in the following data request responses (attached as JVS 3.04 SUPP_Attach 1) in ICC Docket No. 10-0527: AARP 1.03, AG 1.02, IIEC 1.05, IIEC 1.06, IIEC 1.07, IIEC 1.20, and IIEC 1.34. See also ComEd's Response to Staff Data Request JVS 3.05 in this proceeding. In short, including the UUFR costs in a "future" rate case does not provide anything close to cost recovery.

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Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 4.01 – 4.06
Date Received: November 24, 2010
Date Served: December 14, 2010

REQUEST NO. JVS 4.04:

Please refer to page 15 of Mr. McMahan's testimony (ComEd Ex. 33.0). Please explain Mr. McMahan's concern that ComEd would not have reasonable assurance of getting the money to spend if ComEd was ordered by the Commission to undertake the UUFR project irrespective of whether ComEd receives approval of its alternative regulation proposal.

RESPONSE:

ComEd incorporates its Objections and Response to Staff Data Request JVS 3.04 and JVS 3.05 as its Objections and Response to Staff Data Request JVS 4.04.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

For the same reasons as stated by Staff counsel for JVS 3.04, Mr. McMahan needs to be more responsive to this DR.

SUPPLEMENTAL RESPONSE:

ComEd incorporates its objections and Supplemental Response to Staff's Supplemental Data Request to JVS 3.04 as its objections and Supplemental Response to Staff's Supplemental Data Request to JVS 4.04. Further answering, Mr. McMahan concurs with the opinions expressed by Dr. Hemphill in ComEd's Supplemental Response to Staff's Supplemental Data Request to JVS 3.04.

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**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 3.01 – 3.07
Date Received: November 24, 2010
Date Served: December 14, 2010**

REQUEST NO. JVS 3.05:

Please refer to page 12-13 of Dr. Hemphill's testimony (ComEd Ex. 40.0). Does Dr. Hemphill believe ComEd would not be allowed to recover reasonable expenses incurred as the result of a Commission ordered investment? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the reasonable incurred costs would not be fully recoverable from a Commission ordered investment. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

RESPONSE:

ComEd objects to data request, JVS 3.05, because it is vague and unclear. Subject to and without waiving the foregoing objection and its General Objections, ComEd responds as follows:

ComEd interprets data request JVS 3.05 to refer to Staff's proposal to mandate $45 million in operating expenses and capital investment over 18 months on the UUFR program without approval of ComEd's proposal in ICC Docket No. 10-0527 and without providing a means to recover those costs in the current rate case. In this situation, it is Dr. Hemphill's opinion that -- notwithstanding the reasonableness of the actual costs incurred – at a minimum, ComEd would not be allowed to recover the operating expenses and would not be allowed to recover a return of and on the capital investment between the time made and the time rates take effect pursuant to a future tariff filing reflecting the undepreciated capital investment.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

Dr. Hemphill was not responsive to this DR. Staff was referring to ANY Commission ordered investment. If it is Dr. Hemphill's opinion that reasonable expenses of ANY Commission ordered investment will not be allowed recovery, he needs to state so clearly. If it is Dr. Hemphill's opinion that reasonable expenses of ANY Commission ordered investment will be allowed recovery, he needs to state so clearly.

SUPPLEMENTAL RESPONSE:

ComEd's response to Staff Data Request JVS 3.05 raised valid objections; and Dr. Hemphill was responsive to Staff Data Request JVS 3.05. ComEd continues to assert its original objections. ComEd further objects to the Supplemental Request because it is vague, overbroad and unduly burdensome. The request fails to identify the assumed facts of the hypothetical. Subject to and without waiving the foregoing objections and its General Objections, ComEd responds as follows:

Dr. Hemphill understands the reference to "investment" to exclude O&M expenses in view of the supplemental request. Notwithstanding the reasonableness of the costs incurred, it is Dr. Hemphill's opinion that ordering an investment to be made would not allow a recovery on and of the investment from the time made until the effective date of new tariffs reflecting the investment. It is also Dr. Hemphill's opinion that it is impossible to know with certainty whether the Commission will find particular costs to be reasonable in a future rate case, and that parties may have good faith disputes as to whether particular costs are reasonable.

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**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 4.01 – 4.06
Date Received: November 24, 2010
Date Served: December 14, 2010**

REQUEST NO. JVS 4.05:

Please refer to page 15 of Mr. McMahan's testimony (ComEd Ex. 33.0). Does Mr. McMahan believe ComEd would not be allowed to recover reasonable expenses incurred as the result of a Commission ordered investment? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the reasonable incurred costs would not be fully recoverable from a Commission ordered investment. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

RESPONSE:

ComEd incorporates its Objections and Response to Staff Data Request JVS 3.05 as its Objections and Response to Staff Data Request JVS 4.05.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

For the same reasons as stated by Staff counsel for JVS 3.05, Mr. Mahan needs to be more responsive to this DR.

SUPPLEMENTAL RESPONSE:

ComEd incorporates its objections and Supplemental Response to Staff's Supplemental Data Request to JVS 3.05 as its objections and Supplemental Response to Staff's Supplemental Data Request to JVS 4.05. Mr. McMahan is not a rate policy witness and he has not formed an opinion regarding the subject to Staff's Supplemental Data Request to JVS 4.05.

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Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 3.01 – 3.07
Date Received: November 24, 2010
Date Served: December 6, 2010

REQUEST NO. JVS 3.07:

Please refer to page 13 of Dr. Hemphill's testimony (ComEd Ex. 40.0). Please explain avenues other than section 9-244 ComEd may utilize to receive a determination of prudence with respect to future projects or programs.

RESPONSE:

ComEd objects to data request, JVS 3.07, because it calls for a legal opinion. Subject to and without waiving the foregoing objection and its General Objections, ComEd responds as follows:

It is Dr. Hemphill's understanding that, assuming it is legally proper, one "avenue" besides Section 9-244 to receive a determination of the prudence of undertaking a project or program to be implemented in the future would be for the Commission to make a finding that it is prudent to undertake such a program or project as part of an order approving a rider to recover the costs of such project or program. Dr. Hemphill understands that Section 8-503 of the Public Utilities Act would not be an "avenue" to receive a determination of prudence with respect to future projects or programs that enhance the provision of adequate service or facilities but are not necessary to provide adequate service or facilities, such as the UUFR program.

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**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 3.01 – 3.07
Date Received: November 24, 2010
Date Served: December 14, 2010**

REQUEST NO. JVS 3.03:

Please refer to page 12 of Dr. Hemphill's testimony (ComEd Ex. 40.0). Please explain the current reliability level that is required by law and please quantify the extent that the UUFR project exceeds that level. Please be specific and please reference the applicable sections of the PUA.

RESPONSE:

ComEd objects to data request, JVS 3.03, because it calls for a legal opinion. Subject to and without waiving the foregoing objection and its General Objections, ComEd responds as follows:

ComEd's reliability and performance standards are established by the Public Utilities Act and relevant sections of the Commission's rules, e.g., 83 Ill. Admin. Code Part 411. Please see the Direct Testimony of Ms. Michelle Blaise, ICC Docket No. 10-0527, ComEd Ex. 4.0, 12:191-201, which describes the reliability benefits of the UUFR project.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

Dr. Hemphill is not responsive in this response. He references Part 411 which contains reliability reporting requirements, not required reliability levels. The reference to Ms. Blaise's testimony in ICC Docket No. 10-527, ComEd Ex. 12:191-201 describes reliability benefits of the UUFR project – it does not appear to quantify the extent that the UUFR project exceeds the current reliability level that is required by law as discussed by Dr. Hemphill. Please have Dr. Hemphill respond to the question with specific references to the applicable sections of the PUA.

SUPPLEMENTAL RESPONSE:

ComEd continues to object for the reasons previously stated. Contrary to the suggestion in the supplemental request, Dr. Hemphill did not testify on p. 12 of ComEd Ex. 40.0 "that the UUFR project exceeds the current reliability level that is required by law." Rather, Dr. Hemphill made the general statement that "[t]here are many things that ComEd – or any utility for that matter – could do to improve reliability beyond the levels that are required by the applicable laws, regulations, and regulatory decisions." ComEd Ex. 40.0, 12:233-35. However, it is Dr. Hemphill's understanding and belief that the UUFR project is not necessary to meet the current reliability level that is required by law. While ComEd is not required to create new information that does not already exist in response to a data request, ComEd will provide Dr. Hemphill's understanding of applicable minimum requirements in this Supplemental Response to the Supplemental Request to JVS 3.03.

Dr. Hemphill's understanding is that all reliability requirements are set forth in the Public Utilities Act ("PUA") or Commission Rules. Some requirements are quantitative, while other requirements are qualitative. Dr. Hemphill's understanding is that the PUA does not contain any quantitative requirements, but does contain the following qualitative requirement:

220 ILCS 5/8-401	"Every public utility subject to this Act shall provide service and facilities which are in all respects adequate, efficient, reliable and environmentally safe and which, consistent with these obligations, constitute the least-cost means of meeting the utility's service obligations."

In Dr. Hemphill's opinion, ComEd's current service meets this qualitative requirement.

While not specifically stated as service quality requirements, it is Dr. Hemphill's understanding that the following provisions of the PUA address reliability or service standards to some extent:

220 ILCS 5/1-102	Contains legislative findings and intent, including "It is further declared that the goals and objectives of such regulation shall be to ensure (a) Efficiency: the provision of reliable energy services at the least possible cost to the citizens of the State …" and "(c) Reliability: the ability of utilities to provide consumers with public utility services under varying demand conditions in such manner that suppliers of public utility services are able to provide service at varying levels of economic reliability giving appropriate consideration to the costs likely to be incurred as a result of service interruptions, and to the costs of increasing or maintaining current levels of reliability consistent with commitments to consumers."
220 ILCS 5/8-102	Authorizes the Commission to conduct or order a management audit or investigation of any public utility and specifically provides that "[t]he Commission may conduct or order a management audit or investigation only when it has reasonable grounds to believe that the audit or investigation is necessary to assure that the utility is providing adequate, efficient, reliable, safe, and least-cost service and charging only just and reasonable rates therefor, or that the audit or investigation is likely to be cost-beneficial in enhancing the quality of service or the reasonableness of rates therefor."

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220 ILCS 5/8-406	Sec. 8-406. Certificate of public convenience and necessity. "The Commission shall determine that proposed construction will promote the public convenience and necessity only if the utility demonstrates: (1) that the proposed construction is necessary to provide adequate, reliable, and efficient service to its customers and is the least-cost means of satisfying the service needs of its customers or that the proposed construction will promote the development of an effectively competitive electricity market that operates efficiently, is equitable to all customers, and is the least cost means of satisfying those objectives; (2) that the utility is capable of efficiently managing and supervising the construction process and has taken sufficient action to ensure adequate and efficient construction and supervision thereof; and (3) that the utility is capable of financing the proposed construction without significant adverse financial consequences for the utility or its customers."
220 ILCS 5/8-505.1	"Sec. 8-505.1. Non-emergency vegetation management activities. (a) Except as provided in subsections (b), (c), and (d), in conducting its non-emergency vegetation management activities, an electric public utility shall: (1) Follow the most current tree care and maintenance standard practices set forth in ANSI A300 published by the American National Standards Institute and the most current applicable Occupational Safety and Health Administration regulations regarding worker safety."

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220 ILCS 5/16-101A	" Sec. 16-101A. Legislative findings. (a) The citizens and businesses of the State of Illinois have been well-served by a comprehensive electrical utility system which has provided safe, reliable, and affordable service. The electrical utility system in the State of Illinois has historically been subject to State and federal regulation, aimed at assuring the citizens and businesses of the State of safe, reliable, and affordable service, while at the same time assuring the utility system of a return on its investment. (d) A competitive wholesale and retail market must benefit all Illinois citizens. The Illinois Commerce Commission should act to promote the development of an effectively competitive electricity market that operates efficiently and is equitable to all consumers. Consumer protections must be in place to ensure that all customers continue to receive safe, reliable, affordable, and environmentally safe electric service."
220 ILCS 5/16-125	" Sec. 16-125. Transmission and distribution reliability requirements. (a) To assure the reliable delivery of electricity to all customers in this State and the effective implementation of the provisions of this Article, the Commission shall, within 180 days of the effective date of this Article, adopt rules and regulations for assessing and assuring the reliability of the transmission and distribution systems and facilities that are under the Commission's jurisdiction."

Dr. Hemphill's understanding is that there is no Commission rule setting forth a quantitative requirement that is directly impacted by the UUFR Project. Dr. Hemphill's understanding of the Commission's rules addressing service standards and reliability is as follows:

83 Ill. Adm. Code Part 200	Addresses reports of accidents by fixed public utilities other than pipelines transporting liquids. Does not contain quantitative operating/reliability requirements.
83 Ill. Adm. Code Part 265	Addresses protection of underground utility facilities. Does not contain quantitative operating/reliability requirements.

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83 Ill. Adm. Code Part 305	Addresses requirements for construction of electric power and communication lines. Adopts portions of the National Electrical Safety Code.
83 Ill. Adm. Code Part 410	Addresses standards of service for electric utilities and alternative retail electric suppliers.
83 Ill. Adm. Code Part 411	Addresses electric reliability.
83 Ill. Adm. Code 411.20	"'Controllable interruption' is an interruption caused or exacerbated in scope and duration by the condition of facilities, equipment, or premises owned or operated by a jurisdictional entity, or by the action or inaction of persons under a jurisdictional entity's control and that could have been prevented through the use of generally accepted engineering, construction, or maintenance practices. "
83 Ill. Adm. Code 411.100	a) Each jurisdictional entity shall provide services and facilities that, in accordance with the Act and other applicable statutes, provide an adequate, efficient and reasonable level of reliability giving appropriate consideration to the costs and benefits of changing or maintaining the level of reliability.
83 Ill. Adm. Code 411.140	Establishes service reliability targets but specifically provides that exceeding the service reliability targets is not, in and of itself, an indication of unreliable service, nor does it constitute a violation of the Act or any Commission order, rule, direction, or requirement.

Please note: Dr. Hemphill is neither an attorney nor an engineer. His views and opinions on the subjects of this response are in the context of his testimony concerning how the Commission should address optional activities not required to meet minimum levels of service reliability.

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**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 4.01 – 4.06
Date Received: November 24, 2010
Date Served: December 14, 2010**

REQUEST NO. JVS 4.03:

Please refer to page 14 of Mr. McMahan's testimony (ComEd Ex. 33.0). Please explain the current reliability minimum standards. Please be specific and please reference the applicable sections of the PUA.

RESPONSE:

ComEd incorporates its Objections and Response to Staff Data Request JVS 3.03 as its Objections and Response to Staff Data Request JVS 4.03.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

For the same reasons as stated by Staff counsel for JVS 3.03, Mr. McMahan needs to be more responsive to this DR. To the extent the "minimum standards" Mr. McMahan referred to in his testimony are based on technical criteria, and not legal mandates, Mr. McMahan should clearly state so with appropriate explanation of the technical criteria and how they were derived.

SUPPLEMENTAL RESPONSE:

ComEd incorporates its objections and Supplemental Response to Staff's Supplemental Data Request to JVS 3.03 as its objections and Supplemental Response to Staff's Supplemental Data Request to JVS 4.03. Further answering, Mr. McMahan concurs with the opinions expressed by Dr. Hemphill in ComEd's Supplemental Response to Staff's Supplemental Data Request to JVS 3.03.

Please note: Mr. McMahan is an engineer, not an attorney nor a witness testifying on rate policy. Dr. Hemphill testifies concerning rate policy.

COMMONWEALTH EDISON COMPANY
RESPONSE TO THE ILLINOIS COMMERCE COMMISSION STAFF
MAY 4, 2010 REQUEST FOR INFORMATION
FOR THE 2009 ANNUAL RELIABILITY REPORT PART C
PURSUANT TO 83 ILL. ADM. CODE PART 411.120

Contact: Mary Vincent, Regulatory Strategies & Services 312-394-4730

REQUEST NO. ENG 3.16:

Does your company have any policy regarding what minimum level of service reliability a customer or group of customers can experience before your company will take action to improve their reliability? If so, please indicate what criteria your company uses.

RESPONSE:

Worst 1% Circuits as ranked by CAIDI, SAIFI and CAIFI:
ComEd issues specifically targeted reinforcement work to improve the overall reliability of the 1% worst performing circuits for SAIFI, CAIFI, and CAIDI reliability indices in each operating area during the prior year.

Customer Target:
ComEd completes an extensive analysis of failure modes, and will issue work if required, to improve the level of service reliability for customers who have experienced more than six interruptions each year, three years in a row, or more than eighteen hours of interruption time each year, three years in a row, and whose circuits are not already being addressed under the other reliability programs.

ICC Docket No. 10-0527

Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 5.01 – 5.04
Date Received: October 15, 2010
Date Served: November 2, 2010

REQUEST NO. JVS 5.01

Referring to the Urban Underground Facilities Reconstruction ("UUFR") program described in ComEd Ex. 4.0 please calculate the cost of the UUFR project per expected customer outage/interruption avoided.

Please provide all supporting documents, calculations and workpapers. Staff notes that the term "expected customer outage/interruption avoided" has also been referred to as the "Estimated Incremental Avoided Customer Interruptions" by the company.

RESPONSE:

ComEd does not rely solely on cost per avoided customer interruption for determining reliability program investments. The cost per avoided customer interruption methodology does not measure other benefits (e.g. customer satisfaction and costs to other than ComEd). In addition, many projects – including the proposed UUFR program – are directed at specific operational considerations.

Subject to those significant limitations, if ComEd were to calculate the cost per avoided customer interruption by using initial cost of the program and ten years of expected avoided customer interruptions, the cost per avoided customer interruption for the UUFR program would be $148. The calculation factors in degradation over ten years.

Please see JVS 5.01_Attach 1 for the cost per avoided customer interruption calculation.

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Cost per Avoided Customer Interruption from Previous Assessments

Reliability Program	$ Per ACI	Program Cost	SAIFI Impact										
			Years 1-10	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Proposed UURF Program	$148	$45,000,000	-0.080	-0.009	-0.009	-0.009	-0.008	-0.008	-0.008	-0.008	-0.007	-0.007	-0.007	Assumes 2.9% mainline underground degradation; reduced based on manhole work completed
Existing Mainline Underground Cable Testing and Replacement Program	$20	$3,200,000	-0.043	-0.005	-0.005	-0.005	-0.005	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	Assumes 3% mainline underground degradation
12kV Distribution Automation	$23	$15,100,000	-0.170	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017	-0.017	Does not use a degradation factor
Lightning Enhancement	$38	$2,200,000	-0.016	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	Assumes 5% degradation
Worst Performing Circuit	$44	$3,900,000	-0.023	-0.003	-0.003	-0.003	-0.003	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	Assumes 5% degradation
Vegetation Management Program	$199	$49,000,000	-0.065	-0.026	-0.020	-0.013	-0.007	0.000	0.000	0.000	0.000	0.000	0.000	Assumes 25% vegetation degradation
Underground Residential Design Cable Replacement/Injection	$415	$23,900,000	-0.015	-0.002	-0.002	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.001	-0.001	Assumes 5.3% URD cable degradation

Customers Served 3,781,274

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**Commonwealth Edison Company's Response to
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JVS 5.01 – 5.04
Date Received: October 15, 2010
Date Served: November 2, 2010**

REQUEST NO. JVS 5.02

Please calculate the cost of the current maintenance program, explained in ComEd's response to JVS-4.01, per expected customer outage/interruption avoided for that program.

Please provide all supporting documents, calculations and workpapers. Staff notes that the term "expected customer outage/interruption avoided" has also been referred to as the "Estimated Incremental Avoided Customer Interruptions" by the company.

RESPONSE:

ComEd does not rely solely on cost per avoided customer interruption for determining reliability program investments. The cost per avoided customer interruption methodology does not measure other benefits (e.g. customer satisfaction and costs to other than ComEd). In addition, many projects – including the proposed UUFR program – are directed at specific operational considerations.

Subject to those significant limitations, if ComEd were to calculate the cost per avoided customer interruption by using initial cost of the program and ten years of expected avoided customer interruptions, the cost per avoided customer interruption for existing mainline underground cable testing and replacement program is $20. The calculation factors in degradation over ten years.

Please see the attachment to ComEd's Response to Staff Data Request JVS 5.01 labeled as JVS 5.01_Attach 1 for the cost per avoided customer interruption calculation.

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**Commonwealth Edison Company's Response to
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JVS 5.01 – 5.04
Date Received: October 15, 2010
Date Served: November 2, 2010**

REQUEST NO. JVS 5.03

Please provide 5 or more examples of the cost per expected customer outage/interruption avoided for current and recently completed projects and programs in distribution (overhead and underground) and substation maintenance. Please include at least 1 overhead distribution project or maintenance program and at least 1 substation maintenance program.

Please provide all supporting documents, calculations and workpapers. Staff notes that the term "expected customer outage/interruption avoided" has also been referred to as the "Estimated Incremental Avoided Customer Interruptions" by the company.

RESPONSE:

ComEd objects to this data request, JVS 5.03, because its inquiry into the cost per expected customer outage/interruption avoided for current and recently completed projects and programs in distribution (overhead and underground) and substation maintenance is irrelevant and not reasonably calculated to lead to the discovery of admissible evidence in this proceeding for consideration of ComEd's proposed alternative rate regulation programs.

Subject to and without waiving the foregoing objection or its General Objections, ComEd responds as follows:

ComEd does not rely solely on cost per avoided customer interruption for determining reliability program investments. The cost per avoided customer interruption methodology does not measure other benefits (e.g. customer satisfaction and costs to other than ComEd). In addition, many projects – including the proposed UUFR program – are directed at specific operational considerations.

Subject to those significant limitations, if ComEd were to calculate the cost per avoided customer interruption by using initial cost of the program and ten years of expected avoided customer interruptions, the cost per avoided customer interruption for five additional distribution reliability programs is shown in the table below. The calculation factors in degradation over ten years.

Reliability Program	$ Per ACI
12kV Distribution Automation	$23
Lightning Enhancement	$38
Worst Performing Circuit	$44
Vegetation Management Program	$199
Underground Residential Design Cable Replacement/Injection	$415

Please see the attachment to ComEd's Response to Staff Data Request JVS 5.01 labeled as JVS 5.01_Attach 1 for the cost per avoided customer interruption calculation.

The substation maintenance programs do not follow the same model to calculate cost per avoided customer interruption. Substation programs are designed to help mitigate risk associated with substation events. Factors are considered such as the number of customers served from each piece of substation equipment. Historically, substation outages have had a relatively small contribution to overall SAIFI.

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Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 5.01 – 5.04
Date Received: October 15, 2010
Date Served: November 2, 2010

REQUEST NO. JVS 5.04

Please provide the cost per expected customer outage/interruption avoided for the following projects:

1. The utility Electric Vehicle ("EV") pilot described in ComEd Ex. 2.0
2. The Distributed Automation ("DA") Smart Grid Illustrative DA Techologies described in ComEd Ex. 2.0, pages 9-14.
3. The Advanced Metering Infrastructure ("AMI") described in ComEd Ex. 3.0

Please provide all supporting documents, calculations and workpapers. Staff notes that the term "expected customer outage/interruption avoided" has also been referred to as the "Estimated Incremental Avoided Customer Interruptions" by the company.

RESPONSE:

The utility EV pilot described in ComEd Ex. 2.0 and the AMI technologies described in ComEd Ex. 3.0 are not expected to avoid interruptions and are being proposed for other benefits. Therefore the cost per expected customer outage/interruption has no bearing on these projects or the justification for them.

Similarly, the illustrative DA technologies described in ComEd Ex. 2.0, pages 9-14 have not been included for approval in this proceeding and the combined cost per expected customer outage/interruption avoided has not been quantified at this time. However, please see ComEd's response and objection to JVS 5.03 for the cost per avoided customer interruption for ComEd's 12kV DA projects that currently exist.

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Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 6.01 – 6.09
Date Received: December 6, 2010
Date Served: December 16, 2010

REQUEST NO. JVS 6.01:

Please refer to page 6 of Dr. Hemphill's testimony (ComEd Ex. 6.0). Does Dr. Hemphill believe that the benefits of the UUFR project outweigh its costs? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the UUFR project benefits would exceed its costs and please quantify the amount of net benefits in such circumstances. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

For all questions: Please provide all supporting work-papers. To the extent applicable, all documents and work-papers should be provided in Excel format with working formulas.

RESPONSE:

Under the terms and conditions as proposed under Rate ACEP in Docket No. 10-0527, yes. Dr. Hemphill believes that the benefits described by ComEd witness Blaise at ComEd Ex. 4.0, pages 12-14, outweigh the costs described at pages 14-16. To the extent that cost recovery under Section 9-201 means the UUFR project would have practical or mandatory preference over other projects that ComEd considers to be a higher priority, the cost-benefit analysis would change. Dr. Hemphill does not believe that the benefits of the UUFR project exceed its costs if one of the costs is the loss of the benefits of other higher priority projects.

ICC Docket No. 10-0527

Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 6.01 – 6.09
Date Received: December 6, 2010
Date Served: December 16, 2010

REQUEST NO. JVS 6.09:

Please refer to pages 12-16 of Ms. Blaise's testimony (ComEd Ex. 4.0). Does Ms. Blaise believe that the costs of the UUFR project exceed the benefits of the UUFR project? If your response is anything other that an unqualified "no", please explain. Please explain if your answer(s) would be different with cost recovery under section 9-201 or section 9-244.

For all questions: Please provide all supporting work-papers. To the extent applicable, all documents and work-papers should be provided in Excel format with working formulas.

RESPONSE:

No. Ms. Blaise believes that, when judged in isolation, the benefits described in her testimony (ComEd Ex. 4.0) on pages 12-14, outweigh the costs described at pages 14-16. That is, Ms. Blaise believes that there would be net benefits to customers if ComEd could proceed with the UUFR project under circumstances that provide for recovery of the additional cost of that project, so as to have no potential displacement of other higher priority work. However, if the intended question is whether there would be net benefits to proceeding with the UUFR project under circumstances that would or could result in the displacement of other higher priority work, Ms. Blaise doubts that there would be.

Ms. Blaise has no opinion on cost recovery under different provisions of the Act and refers Mr. Stutsman to Dr. Hemphill's testimony and data requests, as well as legal briefing.

ICC Docket No. 10-0467

**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 4.01 – 4.06
Date Received: November 24, 2010
Date Served: December 6, 2010**

REQUEST NO. JVS 4.01:

Please refer to page 14 of Mr. McMahan's testimony (ComEd Ex. 33.0). Does Mr. McMahan believe that the UUFR project is necessary in order for ComEd to provide adequate, efficient, and reliable service? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the UUFR project is necessary. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

RESPONSE:

As stated on p. 14 of Mr. McMahan's Rebuttal Testimony (ComEd Ex. 33.0):

> "ComEd's existing manhole inspection and maintenance practices are well within the range of business and engineering decisions that a reasonable utility would make based on the information known. ComEd's existing manhole maintenance and inspection cycle is consistent with the inspection recommendation by Siemens that was prepared for The Commonwealth of Massachusetts Department of Telecommunications & Energy. ComEd's manhole inspection procedure CM-CE-P319, formerly CM-CE-221002, Inspection Process for Distribution Manholes and Components, inspects the structural integrity and the condition of the joint, cable and all cable support components."

As also stated on p. 14 of Mr. McMahan's Rebuttal Testimony (ComEd Ex. 33.0), "the UUFR project is a means of improving reliability to customers above those minimum standards."

See also ComEd's Response to Staff Data Request JVS 3.01.

Mr. McMahan has no opinion on different provisions of the Act and refers Mr. Stutsman to Dr. Hemphill's testimony and data requests, as well as legal briefing.

ICC Docket No. 10-0467

**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 3.01 – 3.07
Date Received: November 24, 2010
Date Served: December 6, 2010**

REQUEST NO. JVS 3.01:

Please refer to page 12 of Dr. Hemphill's testimony (ComEd Ex. 40.0). Does Dr. Hemphill believe that the UUFR project is necessary in order for ComEd to provide adequate, efficient, and reliable service? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the UUFR project is necessary. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

RESPONSE:

No. As Dr. Hemphill testifies in ICC Docket No. 10-0527, the UUFR program goes above and beyond what is needed for ComEd to meet its statutory obligations. ICC Docket No. 10-0527, ComEd Ex. 6.0, 6:119-21. Dr. Hemphill's opinion does not depend on which provision of the Act the program is proposed under. Also, as stated by the Commission in its Order in Docket No. 07-0566:

> The Commission service rules do not contain a prohibition on investing to improve service or a bar to providing more beneficial services. Indeed, they contain minimum and not maximum requirements.

Docket No. 07-0566, p. 137 (Order, Sept. 10, 2008).

ICC Docket No. 10-0467

**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 3.01 – 3.07
Date Received: November 24, 2010
Date Served: December 14, 2010**

REQUEST NO. JVS 3.02:

Please refer to page 12 of Dr. Hemphill's testimony (ComEd Ex. 40.0). Does Dr. Hemphill believe that the UUFR project is prudent? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the UUFR project is prudent or not prudent. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

RESPONSE:

ComEd objects to this Staff Data Request, JVS 3.02, because it is vague and unclear. Staff Data Request JVS 3.02 does not identify the "UUFR project" decision or action for which it seeks a "prudence" opinion. ComEd also objects to this Staff Data Request, JVS 3.02, because it seeks information beyond the scope of this docket and is not reasonably calculated to lead to the discovery of admissible evidence. Subject to and without waiving the foregoing objections and its General Objections, ComEd responds as follows:

As Dr. Hemphill testifies in his Rebuttal Testimony in ICC Docket No. 10-0527, it is unclear if the Commission would find the UUFR to be prudent under traditional regulation. ICC Docket No. 10-0527, ComEd Ex. 6.0, 20:426-31. The UUFR program would provide reliability levels that go above and beyond what is necessary for ComEd to meet its statutory obligations. ComEd expends its limited investment resources on those projects needed to fulfill its obligations. Investing in UUFR under traditional regulation would displace investments in higher priority projects. As indicated in Dr. Hemphill's Rebuttal Testimony (ComEd Ex. 40.0, 12: 239-243), "The policy question the Commission must answer when confronted with a proposal to enhance an already reliable system like ComEd's is not 'Does this program provide further reliability improvement?' but 'Does the additional reliability improvement provided by this program warrant the added cost to customers?'" In Dr. Hemphill's opinion, ComEd's proposal to implement the UUFR program pursuant to Section 9-244 under the terms and conditions ComEd has proposed in ICC Docket No. 10-0527 is prudent and reasonable. Since no proposal for recovery of costs under Section 9-201 for the UUFR project has been proposed or presented, there is no basis for Dr. Hemphill to consider or form an opinion on cost recovery under Section 9-201. In Dr. Hemphill's opinion, it would not be prudent to require the UUFR project to be undertaken without providing a means of recovering the costs of that work and investment so as to avoid displacing other higher priority work.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

Dr. Hemphill was not responsive to this DR. The DR was not asking him for his opinion on the prudence of the Commission's actions. Staff is seeking Dr. Hemphill's opinion on the prudence of the UUFR Project. If Dr. Hemphill believes the UUFR Project is only prudent under a 9-244 filing and imprudent in all other circumstances, he should state that and explain why. If Dr. Hemphill's beliefs are otherwise, he should state that and explain why.

SUPPLEMENTAL RESPONSE:

ComEd's response to Staff Data Request JVS 3.02 raised valid objections; and Dr. Hemphill was responsive to Staff Data Request JVS 3.02. ComEd continues to assert its original objections. Prudence is generally considered as the standard of care which a reasonable person would be expected to exercise under the same circumstances encountered by utility management at the time of its decision or action based on information known at the time of the decision or action. Staff Data Request JVS 3.02 is a hypothetical that refers generally to the "UUFR Project" and asks whether the "UUFR Project" is prudent. JVS 3.02 fails to specify (i) the hypothetical action or decision regarding the "UUFR project" that is the intended subject of the question and (ii) the information or knowledge management is assumed to have at the time of its hypothetical action or decision. At a minimum, assumptions regarding the funding for such work and/or the priority of the work that would or could be displaced are needed.

The request for "Dr. Hemphill's opinion on the prudence of the UUFR Project" is incomplete and unclear, and Dr. Hemphill is unable to form an opinion or respond to that question in its current form. A "project" is not a decision or action, so it is neither prudent nor imprudent in isolation. Management decisions or actions with respect to a project may be prudent or imprudent, but a decision or action (e.g., a decision to proceed with a project under a specific funding scenario) needs to be specified.

If the intended question is whether it would be prudent to proceed with the UUFR project under circumstances that would or could result in the displacement of other higher priority work, Dr. Hemphill's opinion is that it would not be prudent to do so. Similarly, if the question is whether it would be prudent to proceed with the UUFR project under circumstances that provide for recovery of the additional cost of that project so as to have no potential displacement of other higher priority work, Dr. Hemphill's opinion is that it would be prudent to undertake the UUFR project under those circumstances.

ICC Docket No. 10-0467

**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 4.01 – 4.06
Date Received: November 24, 2010
Date Served: December 14, 2010**

REQUEST NO. JVS 4.02:

Please refer to page 14 of Mr. McMahan's testimony (ComEd Ex. 33.0). Does Mr. McMahan believe that the UUFR project is prudent? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the UUFR project is prudent or not prudent. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

RESPONSE:

ComEd incorporates its Objections and Response to Staff Data Request JVS 3.02 as its Objections and Response to Staff Data Request JVS 4.02. Mr. McMahan concurs with ComEd's Response to Staff Data Request JVS 3.02.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL

Mr. McMahan, like Dr. Hemphill, was not responsive to this DR. Staff is seeking Mr. McMahan's opinion about the prudence of the UUFR project, similar to what is requested in 3.02 from Dr. Hemphill.

SUPPLEMENTAL RESPONSE:

ComEd incorporated its objections and Supplemental Response to Staff's Supplemental Data Request to JVS 3.02 as its Supplemental Response to Staff's Supplemental Data Request to JVS 4.02. Further answering, Mr. McMahan concurs with the opinions expressed by Dr. Hemphill in ComEd's Supplemental Response to Staff's Supplemental Data Request JVS 3.02.

ICC Docket No. 10-0527

**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 6.01 – 6.09
Date Received: December 6, 2010
Date Served: December 16, 2010**

REQUEST NO. JVS 6.08:

Please refer to page 7 and pages 12-14 of Ms. Blaise's testimony (ComEd Ex. 4.0). Does Ms. Blaise believe that the UUFR project is prudent? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the UUFR project is prudent or not prudent. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

For all questions: Please provide all supporting work-papers. To the extent applicable, all documents and work-papers should be provided in Excel format with working formulas.

RESPONSE:

ComEd incorporates its Objections and Responses to Staff Data Request JVS 3.02 and the Supplemental Request to Staff Data Request JVS 3.02 from ICC Docket No. 10-0467 as its Objections and Response to Staff Data Request JVS 6.08. Ms. Blaise concurs with ComEd's Responses to Staff Data Request JVS 3.02 and the Supplemental Request to Staff Data Request JVS 3.02 from ICC Docket No. 10-0467 which is attached and labeled as JVS 6.08_Attach 1.

ICC Docket No. 10-0467

**Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 3.01 – 3.07
Date Received: November 24, 2010
Date Served: December 14, 2010**

REQUEST NO. JVS 3.02:

Please refer to page 12 of Dr. Hemphill's testimony (ComEd Ex. 40.0). Does Dr. Hemphill believe that the UUFR project is prudent? If your response is qualified (i.e., anything other than "yes" or "no"), please identify every circumstance under which you believe the UUFR project is prudent or not prudent. Please explain if your answer would be different with cost recovery under section 9-201 or section 9-244.

RESPONSE:

ComEd objects to this Staff Data Request, JVS 3.02, because it is vague and unclear. Staff Data Request JVS 3.02 does not identify the "UUFR project" decision or action for which it seeks a "prudence" opinion. ComEd also objects to this Staff Data Request, JVS 3.02, because it seeks information beyond the scope of this docket and is not reasonably calculated to lead to the discovery of admissible evidence. Subject to and without waiving the foregoing objections and its General Objections, ComEd responds as follows:

As Dr. Hemphill testifies in his Rebuttal Testimony in ICC Docket No. 10-0527, it is unclear if the Commission would find the UUFR to be prudent under traditional regulation. ICC Docket No. 10-0527, ComEd Ex. 6.0, 20:426-31. The UUFR program would provide reliability levels that go above and beyond what is necessary for ComEd to meet its statutory obligations. ComEd expends its limited investment resources on those projects needed to fulfill its obligations. Investing in UUFR under traditional regulation would displace investments in higher priority projects. As indicated in Dr. Hemphill's Rebuttal Testimony (ComEd Ex. 40.0, 12: 239-243), "The policy question the Commission must answer when confronted with a proposal to enhance an already reliable system like ComEd's is not 'Does this program provide further reliability improvement?' but 'Does the additional reliability improvement provided by this program warrant the added cost to customers?'" In Dr. Hemphill's opinion, ComEd's proposal to implement the UUFR program pursuant to Section 9-244 under the terms and conditions ComEd has proposed in ICC Docket No. 10-0527 is prudent and reasonable. Since no proposal for recovery of costs under Section 9-201 for the UUFR project has been proposed or presented, there is no basis for Dr. Hemphill to consider or form an opinion on cost recovery under Section 9-201. In Dr. Hemphill's opinion, it would not be prudent to require the UUFR project to be undertaken without providing a means of recovering the costs of that work and investment so as to avoid displacing other higher priority work.

SUPPLEMENTAL REQUEST PER ICC COUNSEL'S 12/7/2010 E-MAIL:

Dr. Hemphill was not responsive to this DR. The DR was not asking him for his opinion on the prudence of the Commission's actions. Staff is seeking Dr. Hemphill's opinion on the prudence of the UUFR Project. If Dr. Hemphill believes the UUFR Project is only prudent under a 9-244 filing and imprudent in all other circumstances, he should state that and explain why. If Dr. Hemphill's beliefs are otherwise, he should state that and explain why.

SUPPLEMENTAL RESPONSE:

ComEd's response to Staff Data Request JVS 3.02 raised valid objections; and Dr. Hemphill was responsive to Staff Data Request JVS 3.02. ComEd continues to assert its original objections. Prudence is generally considered as the standard of care which a reasonable person would be expected to exercise under the same circumstances encountered by utility management at the time of its decision or action based on information known at the time of the decision or action. Staff Data Request JVS 3.02 is a hypothetical that refers generally to the "UUFR Project" and asks whether the "UUFR Project" is prudent. JVS 3.02 fails to specify (i) the hypothetical action or decision regarding the "UUFR project" that is the intended subject of the question and (ii) the information or knowledge management is assumed to have at the time of its hypothetical action or decision. At a minimum, assumptions regarding the funding for such work and/or the priority of the work that would or could be displaced are needed.

The request for "Dr. Hemphill's opinion on the prudence of the UUFR Project" is incomplete and unclear, and Dr. Hemphill is unable to form an opinion or respond to that question in its current form. A "project" is not a decision or action, so it is neither prudent nor imprudent in isolation. Management decisions or actions with respect to a project may be prudent or imprudent, but a decision or action (e.g., a decision to proceed with a project under a specific funding scenario) needs to be specified.

If the intended question is whether it would be prudent to proceed with the UUFR project under circumstances that would or could result in the displacement of other higher priority work, Dr. Hemphill's opinion is that it would not be prudent to do so. Similarly, if the question is whether it would be prudent to proceed with the UUFR project under circumstances that provide for recovery of the additional cost of that project so as to have no potential displacement of other higher priority work, Dr. Hemphill's opinion is that it would be prudent to undertake the UUFR project under those circumstances.

ICC Docket No. 10-0527

Commonwealth Edison Company's Response to
Illinois Commerce Commission ("STAFF") Data Requests
JVS 1.01 – 1.05
Date Received: September 7, 2010
Date Served: September 28, 2010

REQUEST NO. JVS 1.05:

Referring to the current program described on pages 6-7, lines 74-90, of ComEd Ex 4.0.

a) For each year in the period 2000 through 2009 please indicate:
   a. The amounts budgeted and the amounts spent for:
      i. mainline cable inspecting, testing, repair and replacement;
      ii. joint inspecting, testing, and replacement;
      iii. Manhole inspecting, repaired or refurbishment; and
      iv. New Manholes built
   b. The number of
      i. Mainline cable segments experiencing 2 or more failures in the last 36 months (Please indicate the total population size)
      ii. Mainline cable segments inspected;
      iii. mainline cable segments tested
      iv. mainline cable segments that were repaired or replaced;
      v. joints inspected;
      vi. joints tested
      vii. joints replaced;
      viii. Manholes inspected;
      ix. manholes repaired or replaced;
      x. new manholes built
   c. Please indicate backlogs for each preventive and corrective maintenance item indicated in (b) above.
   d. Please indicate the total cable segment lengths in b.i. through b.iv. above.

To the extent applicable please provide the above response in Excel format with working formulas.

RESPONSE:

a)
   a.
      i. 2000 thru 2007 data is not readily available. The below table includes the actual expenditures. The program work is mainly cable replacement/ repair, but would also include other related work such as joint replacement, and manhole improvements.

Year	Budget	Actual
2009	$ 6.1M	$ 4.2M
2008	$ 6.2M	$ 5.3M

The 2009 actual spend was less than budget, due to budget dollars being used to off-set other program expenditures. The Cable Diagnostic testing budget dollars were used to offset expenses for an emergency generator deployment and the Cable replacement budget dollars were used to support other programs such as URD proactive cable replacement. The Cable replacement program completed the original scope of work (20 circuits) and 3 additional circuits prior to using funds for other programs.

ii) Joint inspection is part of both the Cable Diagnostic (included above) process and the Manhole inspection process (included below). There is not a separate program for Joint inspections; thus, amounts of budget and spend specific to joint inspection are not readily available.

Testing is part of both the Cable Diagnostic (included above) process and the Mainline Replacement process (included above). There is not a separate program for Joint testing; thus, amounts of budget and spend specific to cable diagnostics are not readily available.

Replacement is part of the Mainline Replacement process (included above). There is not a separate program for Mainline Replacement; thus, amounts of budget and spend specific to mainline replacement are not readily available.

iii) 2000 and 2001 data is not readily available. The inspection costs are provided below. Repairs performed in response to the inspection are completed as Corrective Maintenance "CMs". They are not performed under a specific program, thus specific amounts of budget and spend are not readily available.

Year	Budget	Actual
2009	$ 0.6M	$ 0.7M
2008	$ 0.6M	$ 0.7M

iv) There is not a separate program for New Manholes built; thus, amounts of budget and spend specific to construction of new manholes are not readily available. New Manholes are also often installed as part of a larger project for a New Business installation, Facility relocation or Capacity Expansion project. Therefore, even if separate "new manhole" data were available, it would not be indicative of new manholes constructed on account of the condition of the old manhole.

b.

i) Below is a table indicating the number of circuits that experienced 2 or more mainline cable failures in 36 months. The data is by circuit and not readily available by cable segment.

36 month period	Number of Circuits with 2 or more faults in 36 months
2009 - 2007	559
2008 - 2006	601
2007 - 2005	580
2006 - 2004	487
2005 - 2003	457
2004 - 2002	442
2003 - 2001	475
2002 - 2000	454
2001 - 1999	478
2000 - 1998	504

ii) The requested data not readily available. Mainline cable segments are not currently being inspected. The joints between cable segments (i.e., the cable visible in the manhole) are inspected as part of the annual manhole inspection program for Chicago. However, the exact number of joints inspected at each manhole is not tracked or recorded.

iii) Below is a table with the number of circuit segments VLF tested since 2003. Prior to June 2003 VLF testing data is not readily available.

Year	Number of Cable Segments Tested
2009	105
2008	174
2007	165
2006	216
2005	241
2004	191
2003	66

iv) Below is a table with the number of circuit segments replaced due to the programmatic cable testing and replacement programs since 2007. Programmatic cable replacement data is not readily available prior to 2007.

Year	Sections Replaced from Straight Replacement	Sections Replaced from Test Failure
2007	31	12
2008	20	24
2009	23	11

v) The requested data are not readily available. Joint inspection is included as part of the annual manhole inspection program for Chicago. However, the exact number of joints inspected at each manhole is not tracked or recorded.

vi) ComEd's tracking mechanism for testing does not independently track joints tested. See response to subpart a.b.v, above.

vii) The data requested are not readily available. Joints are replaced as required by their condition or in response to an emergent cable failure. The specific number of joints replaced is, however, not tracked on an annual basis.

viii) The requested information is in the table below for years 2009 – 2005. Data is not readily available prior to 2005.

Year	Manholes Inspected
2009	7,187
2008	6,951
2007	6,969
2006	6,955
2005	6,990

ix) The data requested are not readily available. See response to subpart a.a.iv, above.

x) The data requested are not readily available. See response to subpart a.a.iv, above.

c) Please see the tables below for backlogs relating to Joint Issues and Manhole Repair. These data are not readily available prior to 2006. Historical backlog data for other items listed are not separately tracked and recorded and are therefore not readily available.

Related to subpart a.b.vii above:

Year	Backlog of Joint Issues
2009	405
2008	253
2007	212
2006	134

Related to subpart a.b.ix above:

Year	Backlog of Manholes Requiring Repair
2009	3,698
2008	2,791
2007	1,241
2006	349

d) Total cable length is not readily available for subpart b.i to b.iii. Related to subpart b.iv, below is a table with the number of miles replaced due to the programmatic cable testing and replacement programs since 2007. Programmatic cable replacement data is not readily available prior to 2007.

Year	Miles Replaced from Straight Replacement	Miles Replaced from Test Failure
2009	5	6
2008	4	6
2007	7	3

Reliability Centered Maintenance for Distribution Underground Systems

By: Wanda Reder & Dave Flaten

Abstract

With the technical advent of predictive testing for electric distribution facilities, Reliability Centered Maintenance (RCM) principles can now be applied to maintain underground systems. This paper reviews the history and concepts of RCM, discusses the typical RCM underground process, identifies technical steps for applying RCM to manage distribution underground cable, and discusses the benefits along with the key success factors for managing underground facilities in this fashion. Finally, a case study is discussed demonstrating the application and results of RCM for distribution underground systems.

I. HISTORY

Clearly from the perspectives of the customer, regulator and the stockholder, effectively managing underground reliability is becomingly increasingly important. There is a fine line to balance between managing cost and performance. Reliability Centered Maintenance (RCM) is a systematic approach to define optimal strategies of routine maintenance where system functionality can be preserved in the most cost-effective manner [1]. Historically, underground distribution systems have been maintained in a reactively where cable is repaired after failure; the process may repeat numerous times before replacement occurs. Now, however, the actual condition of cable can be assessed with predictive diagnostics. With the resulting information, RCM principles can be utilized to manage distribution underground facilities to prioritize maintenance activities. This new approach avoids outages and targets limited financial and human resources to areas that are in greatest need of attention.

II. CONCEPTS

Getting the greatest performance impact for the lowest possible cost, or the "biggest bang for the buck", is the fundamental principle of RCM. Therefore, analysis and diagnostics need to be targeted toward the underground system components with the highest probability of failure.

As shown in Figure 1, the focus for routine underground maintenance is narrowed until a lean program with specific, cost-effective objectives is created. At the bottom, a cost prohibitive program is defined which replaces all underground cables and components. However, by tracking historic performance and determining the customer load criticality the fundamental maintenance program can be refined. Then predictive diagnostics can be applied to the areas with the most severe need. Results will identify cable and accessory locations requiring repair and cables that need to be replaced in total. These prospective projects can be targeted considering the severity of the defects and the number of customers affected. Project implementation can then be performed within the limits of the human and financial resources. If performance goals cannot be met, then a plan can easily be drafted to determine the resources required to achieve acceptable performance levels. By applying Reliability Centered Maintenance to underground distribution facilities in this manner, a cost-effective, and narrowly focused program that prevents the most likely causes of critical underground failures is ensured.

Figure 2 shows a typical distribution underground RCM process flow. The scope of the study is defined, then pertinent plant, historic performance and predictive data can be collected to form the underground RCM plan. This data is used and continues to be collected in an ongoing process.

0-7803-6420-1/00/$10.00 (c) 2000 IEEE

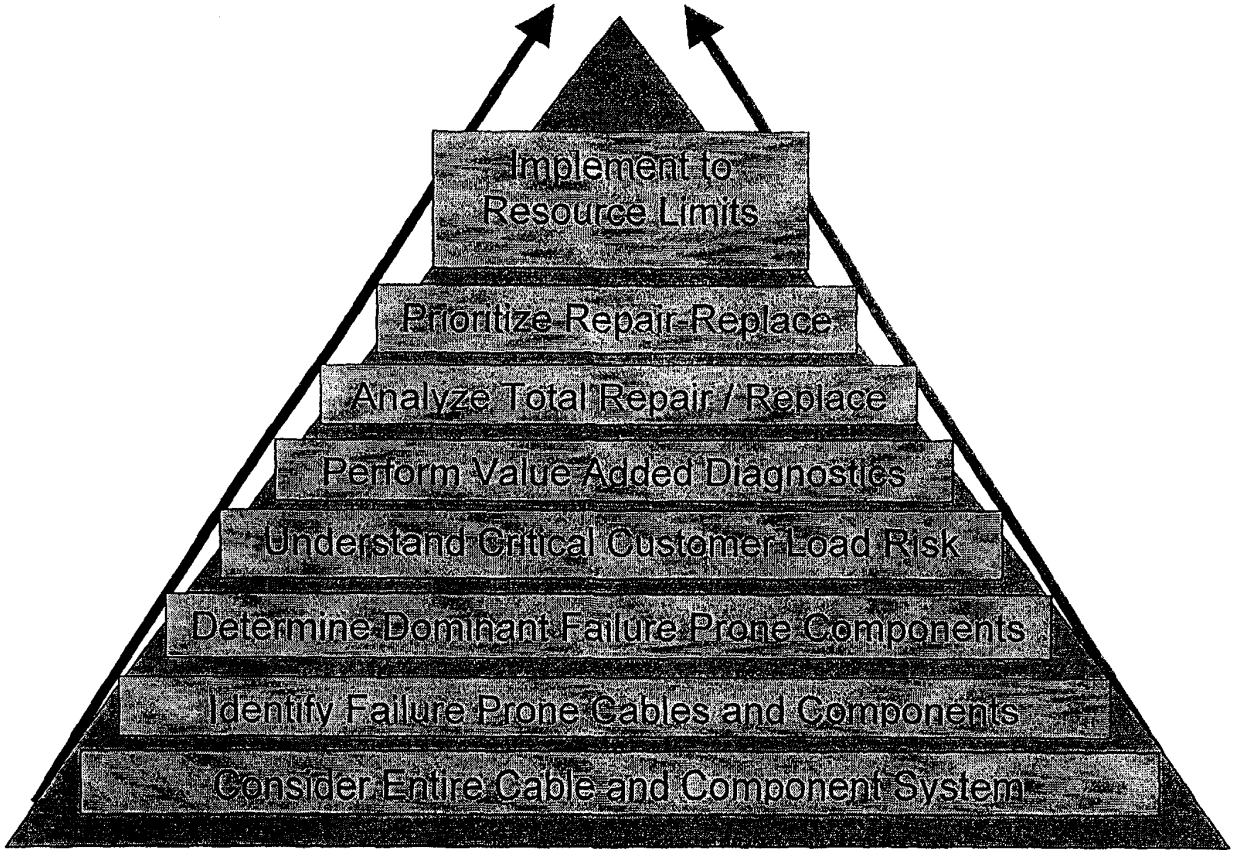

Fig. 1 – Optimal Focus for Distribution Underground Reliability Centered Maintenance

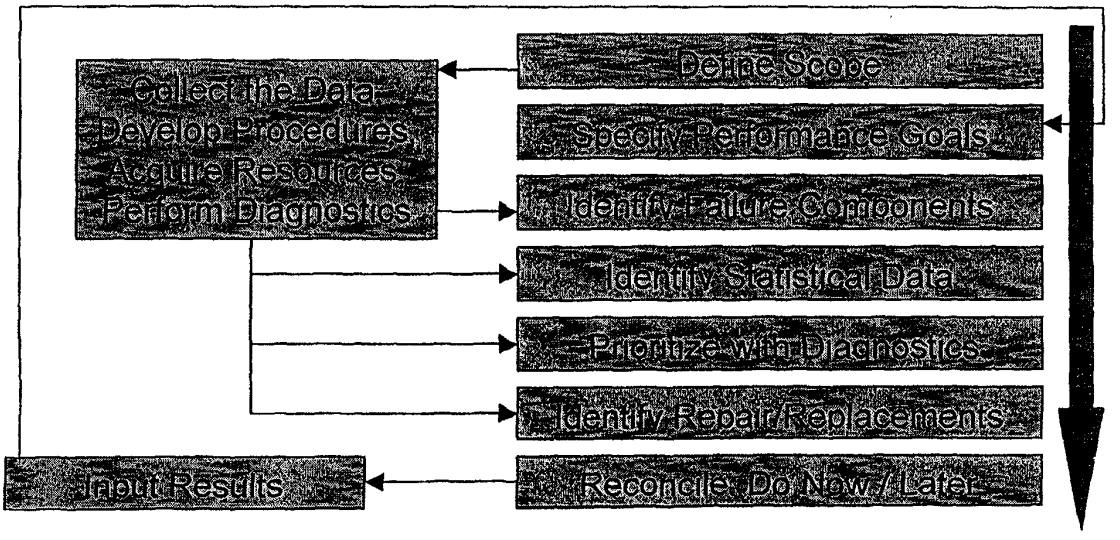

Fig. 2 – Typical Distribution Underground Reliability Centered Maintenance Process Flow

III. TECHNICAL STEPS

The follow six steps are typically followed to implementing distribution underground RCM:

1. *Establish the Scope:* Initially boundaries are established to define work limits. Scoping underground maintenance efforts could include some or all of the following: feeders, taps, critical customers, certain geographic areas, specific cable vintages and/or other problematic components.

2. *Identify What is Not in the Scope:* Determine the elements that do not affect the goals of the program. Items that probably will not be included are: dig-ins, gophers or other animal related outages, and ground settling. Things that may or may not be included are overloading, neutral corrosion, and lightning protection.

3. *Specify Performance Goals:* Seek to achieve the level of performance needed to meet company reliability objectives. Define the distribution underground contributions that are expected from program implementation.

4. *Identify the Problem:* Understand where historic problems have been derived: feeders, URD, accessories, cable etc. Understand the accuracy of the information collected. To the extent possible, determine the cause of the problems - material selected, workmanship or some other phenomena. Analyze the trends by component and target diagnostics accordingly to achieve corresponding improvements.

5. *Identify Resources Available:* Usually, the scope is limited by resource constraints. Defining these constraints is useful in determining a viable approach and realistic outcome. Consider field resources, computer systems, data gathering tasks, and financial limitations.

6. *Create Necessary Procedures:* Procedures need to be developed for predictive diagnostics and corresponding repairs or replacement. In addition, new tracking requirements are also likely. Therefore, a successful program must incorporate the definition of these new procedure requirements.

IV. CASE STUDY

This case study reviews the state of predictive diagnostic cable testing technology and shows the results from applying it in a distribution underground RCM program to reduce cable failures and the ensuing customer outages.

Predictive Cable Testing: State of the Technology

Predictive Diagnostic Cable Testing technology has developed into a very effective tool for improving electric system reliability because utilities can repair cable and accessories before failure. For example, over the last two years one particular service provider has diagnosed over 11 million feet of utility cable and associated accessories to locate anomalies likely to cause future failures. In the cable systems tested to date, 3,300 locations have been recommended for repair. Assuming repairs are made, 3,300 future cable system outages would be prevented. This proactive approach also saves significant costs as compared to the traditional maintenance technique of entirely replacing cable. [2]

Performance Benefits

Northern States Power Company (NSP) implemented distribution underground RCM on feeders in the Minneapolis/St. Paul area. Later benefits for predictive testing were quantified. The methodology identified trends for frequency of outages caused by cable failures and compared results for tested cables with those for untested cables. Figure 3 is a diagram of the methodology utilized. [3]

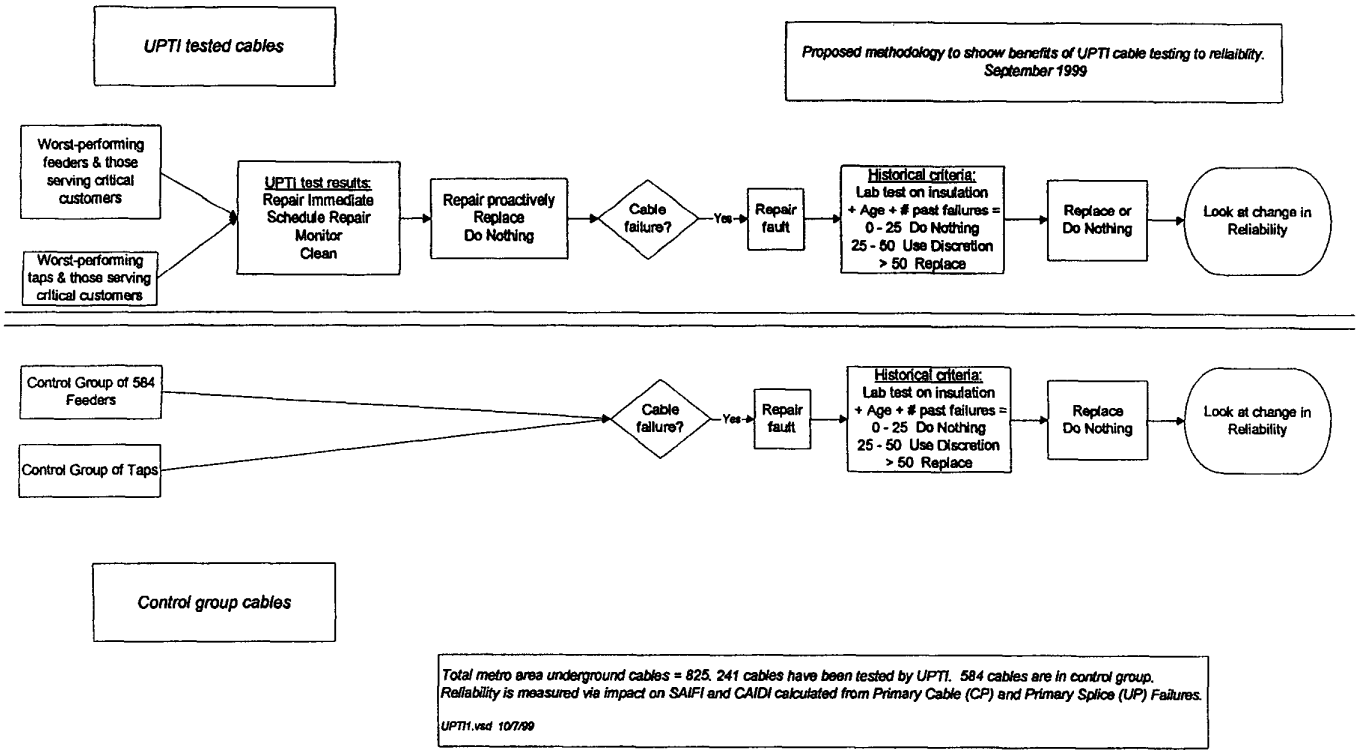

Fig. 3 – Methodology utilized to show benefits of predictive cable testing and repair on the reliability of feeders at Northern States Power Company [3].

Predictive cable testing was performed on 241of NSP's worst performing metro feeders (2600 sections) in the Minneapolis and St. Paul area in 1998 and 1999. These feeders represented one-third of the metro feeder system. Tremendous reliability benefits where achieved after repairs were performed on 40% of the recommended locations. NSP did an analysis comparing the System Average Interruption Frequency Index (SAIFI) of the feeders tested and repaired compared to the remaining 554 feeders not tested. As shown in Figure 4 (top trend line), after a long, hot, summer in 1999, SAIFI of the tested group improved by 40%. Comparing the outages that would have occurred to what actually occurred following predictive testing and repair, approximately 45,000 customer outages were avoided.

When investigating the performance of the remaining 554 metro feeders, performance was improving since 1993 due to new installations (bottom trend line in Figure 4). Replacements were targeted during this period based upon historic outages and overloading conditions surfacing during the hot summers of 1995 and 1996. Even though this group was progressively improving from 1993 through 1998, after the hot summer of 1999, their performance decreased. Consequently, performance improvements from predictive testing and repair are even more valid after understanding trends from the control group.

Cost-Effectiveness

One technique utilized to prioritize reliability projects is to divide the cost of the project by the number of customer outages avoided: lower ratio projects are more effective. At NSP, performing targeted repairs rather than replacing cable entirely reduced the cost per avoided customer outage from the costly range of $300 - $350 for replacement to the manageable range of $40 - $50 for repaired cable. [3] This now compares favorably with line clearance, which is typically $20 per avoided customer outage on feeders and $60 - $80 for taps. Therefore utilities today can proactively improve reliability and get performance enhancements at a cost similar to line clearance. [2]

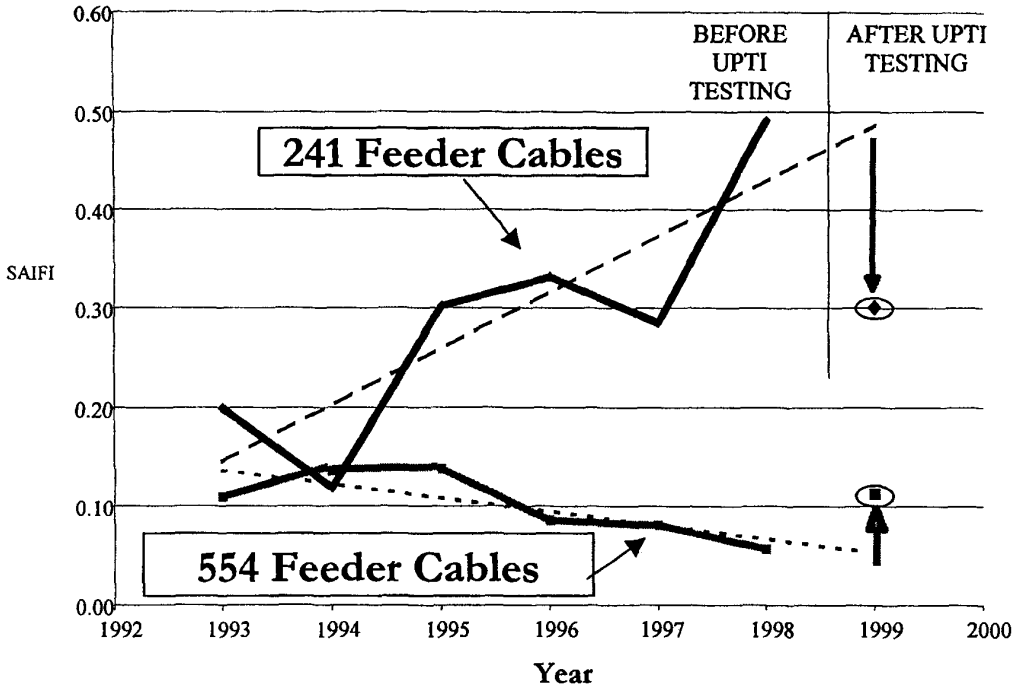

Fig. 4 - Reliability Improves 40% After Testing and Repairing 40% of Recommended Locations On Worst Performing Feeders. Remaining 554 Feeder Get Worse (SAIFI Increases) After Hot Summer of 1999

Where cable replacement is required, predictive testing can identify actual field conditions and provide the necessary information to prioritize efforts in order to maximize performance improvement relative to the investment. Therefore, now with predictive testing techniques available, reacting to historic outages and utilizing this as sole criteria for cable replacement no longer has a place in utility decision-making [2].

A Proven Technology for Today's Needs

Today, predictive diagnostic underground testing can assess cable system condition and recommend locations to be repaired, replaced and left in service, all based on the severity of the anomaly detected. General recommendations have been formulated from extensive cable testing and are continuously reviewed and refined as more results are accumulated. The final repair recommendations are usually molded to a utility's system, considering their protection, reliability concerns, frequency of local transients, and other factors which accelerate underground distribution problems.

V. BENEFITS

The following summarizes the benefits of distribution underground RCM. With underground RCM, benefits are achieved because tasks are avoided to save costs, and added / modified to improve the system design and operations. Typically predictive diagnostics reveals 2/3 of URD, which are scheduled for replacement, actually can be kept in service reliably in the near future. Performing predictive diagnostics and taking action for repair or replacement prior to the outage occurring avoids the need for resources to dispatch and repair the fault. With predictive diagnostics, inadequate protection for surges, lightning arrestors and better grounding may be added after analyzing the results. Predictive diagnostics can also alter the prioritization of scheduled events and change operating procedures. Two specific examples include 1) the use of neutral corrosion testing to prioritize further cable assessment and 2) noting overloaded cables to determine the aging impact, changing operation practices and adjusting design criteria.

Operating practices may be changed to address cable failures. High voltage DC hi-potting, for example, has proven detrimental for the life of aged extruded cable and now can be measured with the new testing methods. By applying new diagnostics techniques, proof testing with these practices are no longer needed and consequently aged systems can be expected to last longer. By implementing predictive diagnostics, the impacts of design surfaces improvement opportunities: examples include the ageing impacts caused from excessive electrical stress (volts/mill), inappropriate backfill, lack of conduit protection, various insulation types and by not having jackets.

Upon final implementation of the underground RCM strategy, there will be more realistic expectations of performance and the cost to mitigate performance risk. The most severe defects can be targeted for repair or replacement thereby avoiding the outages they would have caused. By utilizing diagnostics on new and aged installations, workmanship problems can be mitigated by applying timely and appropriate training. Finally, for new installations, problematic accessories can be detected prior to energizing the cable, thereby avoiding premature component failures.

Throughout the course of implementing an underground RCM program, opportunities surface for efficiency improvements; for example, improvements in coordinating switching, reporting severe problems and taking timely action, and assigning process responsibility to ensure an efficient flow for this new cable management approach. Other examples of benefits for underground RCM include understanding stocking supply requirements, scheduling repairs, implementing training programs, and adequately budgeting to achieve desired performance outcomes. Granted, these areas are generally known to be in need of improvement; however, routine implementation of RCM for underground facilities ensures optimal results and continuous improvement due to iterative gains made over time.

VI. KEYS TO UNDERGROUND RCM SUCCESS

There are a few keys to successful implementation of a comprehensive underground RCM program. First, create a utility position that has the responsibility to manage the underground plant, similar to the role of a tree-trimming manager. Second, focus on appropriate data collection to understand the root causes and their controllable elements. In addition, when collecting data, efforts should be focused initially on gathering information that is relevant to the immediate outages and severe problems. Over time, data collected iteratively, will provide sufficient information to satisfactorily project outcomes. Third, maintain discipline to ensure area distribution engineers are applying distribution underground RCM consistently; for example, train for data tracking, include repair of predicted defect locations in the budgeting prioritization schemes, and create a common understanding of tolerable outage levels

VII. CONCLUSION

RCM has been successfully implemented in numerous industries, including many aspects of electric generation and power delivery. To implement a distribution underground RCM program, the concepts, technical steps and a typical implementation process were described. An application of distribution underground RCM was successfully applied at NSP where they were able to achieve cost-effective underground performance improvements. In addition, NSP found they were able to manage the underground feeder system at a cost similar to the cost for their overhead facilities. In conclusion, field results have proven predictive diagnostics are now available to cost effectively implement distribution underground RCM.

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ComEd
A Unicom Company

A Blueprint for Change

Executive Summary for the Investigation Report By Commonwealth Edison To the Illinois Commerce Commission Illinois Public Officials And the Customers of Commonwealth Edison

September 15, 1999

With the publication of the attached Reports, ComEd Chairman John Rowe is announcing today that ComEd has completed a comprehensive investigation into the outages of July and August and the integrity of the entire system. The Investigation Report maps out the specific events, details the recent improvements achieved through round-the-clock inspection, repair and replacement activities, and offers a comprehensive blueprint and preliminary timetable for the steps necessary to ensure that ComEd's service meets or exceeds industry standards.

Completed in a one month, 24-hour-a-day effort, consisting of hundreds of pages of analysis, charts, diagrams and photographs, and central to the $20 million ComEd emergency response effort that was launched in August, industry observers described the Report, the investigation and the ComEd response as "unprecedented" in the history of publicly-owned utilities.

The major findings reveal serious issues in the transmission and distribution system, especially in the areas of system maintenance, planning and design. The intensive investigation was primarily designed as a comprehensive diagnosis concerning the health of the system. In medical terms, the Report concludes that ComEd's transmission and distribution (T&D) system is in serious, but stable condition, and that the overall prognosis is good. Mr. Rowe described the results as "sobering, but essential." "For the first time, we have a clear and complete picture of what and where the problems are," he said. He added: "We also have a clear idea of exactly what needs to be done, and when."

Along with the Report, the company announced a plan today it described as a "two-year recovery program", aimed at bringing service reliability up to or beyond industry norms. As elements in the prioritized action plan, ComEd pledged accelerated and ongoing efforts to address the issues identified by the investigation.

To address the problems related to system inspection and maintenance, ComEd has already launched a 24 hour/7 days a week campaign to repair, replace or upgrade major equipment such as transmission lines, substations, feeder cables and other components. Priority repairs and upgrades will be competed before the start of summer 2000.

To address the T&D system design problems, which stem in part from the sometimes sporadic evolution of the system since the 1930's, ComEd will within 90 days complete a comprehensive System Optimization Study that is intended to map out the changes needed to re-tool the system for service in the next century.

Over the past twelve months, ComEd has been working with the Illinois Commerce Commission (ICC), the City, the Legislature, public interest advocates and others to improve its distribution system in the City of Chicago, in the suburbs and in rural areas.

In October 1998, in response to the extraordinary level of storm-related service interruptions experienced that year and a series of inquiries by the ICC and the Attorney General, ComEd accelerated its tree trimming program (fallen limbs are responsible for approximately 17% of service interruptions) and increased its three-year construction budget by $300 million. ComEd agreed to additional commitments in a May 1999 settlement with the City, bringing the total amount of committed reliability-related improvements in the City to $1.1 billion.

Finally, in discussions with the Legislature, ComEd committed to an additional $2 billion in improvements to the system outside the City over the next five years.

These initiatives demonstrated a commitment by ComEd and the corresponding public officials to improving the T&D system based on the information available at the time.

However, the dramatic events in Chicago over the last 45 days, and the results of the equally dramatic ComEd response, have convinced the company, as well as many customers and public officials, that ComEd's management of its distribution business requires truly radical change. ComEd must:

- **Find the problems in the design and maintenance of the entire system;**
- **Face the problems with clear management accountability; and**
- **Fix the problems so customers across the system receive service which meets and exceeds industry norms.**

ComEd needs a performance revolution in its transmission and distribution system to match the performance revolution it has begun in its nuclear business. This Report sets definite goals and a definite timetable for these radical changes.

Over the past six weeks, ComEd has spent more than $20 million on inspection, investigation, analysis and repair of the T&D system. Looking at the overall construction, operations and maintenance budget, ComEd expects to continue this level of effort, spending $100 million more than originally budgeted over the remainder of the year, and a total of more than $1.5 billion over the next two years. By year-end ComEd will present, to the ICC, the City and others, an enforceable plan detailing what ComEd will spend, where it will be spent, and when the projects will be completed. As part of that plan, ComEd will provide supporting documentation demonstrating the benefits of its proposed spending. ComEd intends to be held accountable for any future failures to get the work done on schedule.

In the end, however, we know that our customers will not judge us on the basis of how much we have spent or how many projects we have completed. Our customers – and the ICC and the City of Chicago – will judge us by *whether we have improved our ability to deliver power in a reliable fashion.*

ComEd's Response to the ICC August 20 Request

As a procedural matter, the attached Investigation Report responds to specific requests in the August 20, 1999 ICC letter to ComEd Chairman John W. Rowe. But moving beyond the specific requests in the August 20 letter, the attached Report is also intended to present the ICC, other government officials and ComEd's customers and stakeholders with a complete, clear snapshot of where ComEd is today. To that end, the Investigation Report provides a comprehensive account of ComEd's investigation and response concerning the service interruptions of July and August in Chicago. It also looks beyond the summer outages and charts a far-reaching course for ComEd's future and for improving performance and reliability for its customers.

In addition, as a companion piece to the Investigation Report, ComEd is releasing under separate cover today the first scheduled Implementation Report under the May 1999 Settlement Agreement with the City of Chicago (Implementation Report), as requested by Mayor Daley in his August 14, 1999 letter to Mr. Rowe. The Implementation Report provides, among other things, details of specific T&D upgrade projects within the City that are currently underway and planned for the immediate future.

One of the purposes of the Investigation Report is to present ComEd's explanation of the latent deficiencies that caused certain parts of the T&D system to fail in late summer, and ComEd's action plan to address them. For much of the past 18 months, ComEd has endeavored to address the obvious faults in the system. But today, although many of the more visible faults have been cleared away, other, less obvious but more substantial deficiencies are coming to light. The extremely thorough work underlying the Investigation Report has revealed real problems in system design, inspection and maintenance, and in

the management of those systems.

These problems have heretofore escaped the recognition of responsible managers and independent evaluations alike. As set forth in the System Reliability section of this Report, the performance of the ComEd system compared favorably with industry norms until stressed by the extremes of weather and load experienced in 1998 and 1999. In the end, it is ComEd's challenge to find and resolve those problems as expeditiously as possible, so that it can continue the business of delivering power and focus on restoring public confidence in its service.

The Investigation Report includes an immense amount of information about ComEd, about how it is organized, how it operates, and how it will improve its reliability of service. With the help of the special task force made up of ComEd specialists and industry experts, ComEd has identified five key areas where it can and will improve its performance:

- **Maintenance**
- **Equipment Protection and Monitoring**
- **Load and Capacity**
- **System Optimization**
- **Organization and Management**

By implementing the recommendations outlined in the Report, ComEd believes it will be able to produce the only kind of results that count – *results that can be seen and felt by ComEd's customers and the officials who represent their interests.*

The Investigation Report is organized around these five critical areas. For each area it provides a detailed account of ComEd's findings, the most urgent concerns identified as a result of those findings, and the steps that ComEd will take or has taken to address those concerns and improve reliability. The Report provides a detailed and comprehensive explanation of the problems ComEd has identified, along with an equally detailed and comprehensive explanation of the proposed solutions. Beginning December 15, 1999, ComEd will present quarterly status reports on the implementation of the program outlined in the Report to the ICC, the City and other appropriate officials.

Background

"Nothing Matters If We Don't Keep the Lights On"

It is certainly fair to say that the events of July and August triggered a series of alarms at ComEd regarding the extent of the T&D challenges ComEd faces. But it would be overly simplistic, and a disservice, to suggest that ComEd, the City, the ICC, public interest advocates, and other concerned leaders were unaware of or unresponsive to the serious nature of the T&D deficiencies long before July 30.

In 1998, the Board of Directors of Unicom, the parent company of ComEd, selected John Rowe to be Chairman and Chief Executive Officer of Unicom and ComEd. Mr. Rowe assumed these positions on March 16, 1998, with a mandate from the Board to deliver increased shareholder value while meeting ComEd's continuing public service responsibilities, implementing the Illinois Restructuring Act and building a competitive energy business.

To ComEd, John Rowe's message from the top was simple and unambiguous, and heard from the very first: "Nothing matters if we don't keep the lights on."

Obviously, "keeping the lights on" is a fundamental requirement of ComEd's public service obligation, and it became the number one objective in Mr. Rowe's strategic plan (Unicom Directions) that was unveiled in July of 1998. However, as a series of mainly weather-related outages occurred over the course of his first eight months with ComEd, Mr. Rowe became increasingly concerned that the public's experience of ComEd's reliability and ComEd's assessment of its own performance did not match up.

Mr. Rowe regularly told public audiences about the internal discussions which reflected this disconnect. "The T&D people tell me we're in the 1st or 2nd quartile for national reliability," he explained. "So I say to them: 'If we're so good – then why are so many customers mad at us?'"

By the fall of 1998, Mr. Rowe was questioning whether the T&D budget was sufficient to address ComEd customer needs, and he asked the T&D division to present a budget that allowed for substantial performance improvements. As a result, ComEd expanded its three-year (1999-2001) capital budget for T&D improvements by $307 million, and its tree-trimming program by $30 million.

And in 1998, John Rowe was far from alone in his concerns about ComEd's distribution operations.

More than a year ago, the ICC, the Mayor of Chicago, the Legislature, the Attorney General, the Citizens Utility Board, several suburban mayors and other respected voices raised serious concerns about the condition of some of the company's T&D equipment and infrastructure. The ICC and the Attorney General, for example, launched a series of inquiries and meetings. The City of Chicago had previously initiated an arbitration

proceeding. ComEd believed at the time, and said through its new Chairman, that the issues raised by these entities were legitimate, and ComEd agreed to address them.

In particular, Mr. Rowe acknowledged that the Mayor had a strong case. As a result, Mr. Rowe decided to settle the arbitration initiated by the City rather than prolong it through litigation. This decision resulted in a historic settlement in which the City secured a binding contractual commitment from ComEd with reliability-related T&D investments and expenditures that tally more than $1 billion. The implementation of that Agreement is the subject of the report to the City which was also released today.

In addition, ComEd's leadership worked in close cooperation with the mayors and the Legislature to bring about the 1999 legislation which resulted in a $2 billion commitment by ComEd to T&D and other upgrades in areas outside the City. But the very fact that the company had previously challenged these legitimate T&D concerns raised an issue at ComEd almost as serious as the problems in the T&D system itself. As Mr. Rowe candidly observed last month: "It is a bad thing when you get better information from the Mayor of Chicago, a variety of aldermen and a variety of suburban mayors than you are getting from your own management reporting channels."

By last winter, Mr. Rowe recognized that ComEd needed an outside expert to help break through logjams in internal information flow, and to bring an independent perspective to the company. In February 1999, Mercer Management, an outside consultant with extensive experience in the industry, was brought in to conduct a comprehensive, unbiased, hard-eyed look at ComEd's service reliability and other critical systems. Substantial portions of that early and continuing assessment are incorporated in the attached Report.

ComEd also sought input from the communities it serves through the Green Board process, which the Chairman launched last winter. ComEd went to the communities to find out how it was doing, then used that information as a touchstone against which to test the T&D claims of the company's internal management personnel. It was an effort to focus not on ComEd's assessment of its programs, but on the customers' views of their service.

The process worked. Out of more than 400 participating wards and municipalities, 31 communities initially rated as "red", meaning that service was unacceptable. Less than a year later, the company's concentrated response had reduced the number to only two (though the number increased to eight after this summer's outages). The process also served as a kind of an early warning system, helping ComEd's leadership to quickly identify and respond to communities where reliability problems needed the most attention. For example, before 1999, the Village of Flossmoor had experienced what the Mayor described as frequent, lengthy and intolerable service interruptions. Following a focussed response via the Green Board process, the Mayor saluted the local ComEd manager for his "extraordinary performance" and thanked John Rowe for his "leadership in redirecting ComEd priorities and funds to the issue of electric reliability and particularly for the work that has been performed to date in our Village."

For all these reasons, in the spring of 1999 – four months before the events of July 30 – ComEd began searching for a new leader to take over the T&D team and guide it through the major upgrades promised to the City and the Legislature. The company tapped Carl Croskey, a respected figure in the energy distribution industry with a solid reputation and 25 years of experience. But before Mr. Croskey could even start, the lights in West Bucktown began flickering out.

What Went Wrong?

As is now widely known, and as was spelled out in some detail in ComEd's September 1, 1999 chronology to the Mayor of Chicago, the first major blackout of the city's late summer heatwave began beneath the manholes which dot California Avenue. In the early morning hours of Friday, July 30, the 12 kilovolt line feeding into Cortland Substation's Transformer 1 short circuited. ComEd switched the customers served by that line to one of the two remaining transformers, and service continued largely uninterrupted until late in the morning.

Then at 11:24 a.m. the cable known as Line 5348 suffered a fault feeding into Cortland's Transformer 3. The fault triggered the circuit breaker on Line 5348 and Transformer 3 went down. And in the first of the series of domino falls that were to plague the city that weekend, the last remaining transformer at Cortland then began to overload. Within minutes it, too, was shut down, and with it went Cortland Substation and over 10,000 customers. It was the hottest day of the summer, and the hands on the clocks in West Bucktown had stopped at just about high noon.

ComEd dispatched a work crew immediately. The workers were inside the manhole and had the cable repaired in little more than an hour. But as was later reported in the press, what they did not know was that Line 5348 had failed in not one place, but two. A smaller fault was lurking behind the larger one, where it could not be detected by test equipment. When the switch was thrown and the cable re-energized, the hidden fault shorted out and two more transformers went down, this time at the Northwest Substation. By 4:30 p.m. the power was gone and the AC was out in nearly 100,000 homes centered around Independence Park.

But despite the stopped clocks, alarms bells were ringing across the city as concerned officials at ComEd, the ICC, the City and other organizations realized that the situation they had feared and worked together for months to prevent was now unfolding during what the *Chicago Tribune* later calculated was the fourth hottest week of the century.

As all of Chicago is now only too aware, the hidden fault on Line 5348 and the shutdown at the Cortland Substation was only the beginning. Cortland marked the first of a series of outages that weekend, spanning four days as July rolled into August. Public anger rose along with the temperature as a series of T&D components failed over the next five weeks, disrupting activities throughout the city. The manhole fires at Cortland Avenue on August 9 and 10 left more than 8,200 customers without power. Failures at two

substations resulted in the Loop outages of August 12, sparking business closures and traffic disruptions as workers went home early. Ten days later another outage affected three Chicago icons – Meigs Field, Lake Shore Drive and the Field Museum. And when three out of four transformers at a downtown substation failed, another icon was in the news as service to the Richard J. Daley Center was disrupted just as the business day began.

ComEd's Emergency Response

The unrelenting series of highly visible, back-to-back service interruptions which struck in July and August dramatically exposed the true depth of problems that have troubled customers, ComEd and public officials for a number of years. The company's response was unprecedented.

ComEd hit the ground running. The Chairman spoke plainly to the public. ComEd met frequently with concerned and involved representatives of the ICC, the City of Chicago and various wards and municipalities to keep them apprised of ComEd's progress and to invite and welcome their input.

Two days before the August 12 outage, Mr. Rowe assigned David Helwig to head up a new T&D task force to address the outages. Mr. Helwig is one of the industry's most experienced turnaround experts and a skilled engineer with a background in both T&D and nuclear programs. Working under Oliver Kingsley, Mr. Helwig had already been recognized for his success and discipline in introducing fundamental change within ComEd's troubled nuclear programs, and Mr. Rowe asked him to step in and bring the same focus to T&D improvements. Within 48 hours, Mr. Helwig's mission was expanded to running the T&D organization on an interim basis, pending the arrival of Carl Croskey, and to leading an emergency, system-wide assessment of the condition of the equipment.

By the time the last service was restored on August 12, ComEd had already dispatched more than 700 men and women to open manholes and explore substations across the City in a broad but focused effort to search out and prevent any avoidable interruptions. All told, during the past six weeks, ComEd devoted an estimated 250,000 additional manhours and over $20 million to the response, above and beyond normal operations.

According to industry professionals, the month-long effort which began on August 10 is unprecedented in its speed, scope and intensity. Dr. Karl E. Stahlkopf, Vice President – Power Delivery at the Electric Power Research Institute (EPRI), is recognized throughout North America as one of the industry's most experienced and respected experts. Dr. Stahlkopf has participated closely in ComEd's investigation since shortly after it began. Comparing ComEd's mobilization of people, money and material to Operation Desert Storm, Dr. Stahlkopf called it "the fastest, fullest, most comprehensive T&D investigation ever launched in the history of the industry." Dr. Stahlkopf characterized both the investigation and the resulting Report as a "clear-eyed, hard-hitting effort by the company to take a blunt look at itself, its equipment, its design, its personnel and its operations."

The overall response has proceeded on two parallel tracks. The first mission was to inspect and assess the actual equipment—the material condition assessment. The second parallel mission was the expert analysis of the system design itself.

For the material condition assessment, one of the most critical imperatives was to map out and identify the nature and extent of the most serious and time-sensitive challenges, and to do so quickly. The scope of the tasks completed in the days since the outages is nothing short of extraordinary. During the first ten days alone, ComEd employees inspected virtually every one of ComEd's 888 substations. They completed some 1387 inspections of the underground system alone. By August 30 – barely two weeks after the task force was first convened – ComEd employees had identified 212 potential faults in cables and transformers, and had already repaired 114 of them.

In tandem with this massive assessment of the material condition of its T&D system, Mr. Helwig assembled a team of the most experienced experts in America to assess the operation and management of its T&D system, drawing extensively on the technical expertise of the EPRI and consulting with such industry leaders as General Electric, Kenny Construction and Asea Brown Boveri (ABB).

By August 14 (two days after the critical failures that shut down the South Loop), ComEd had already assembled 25 best-in-class technical experts from the EPRI to assist with a technical review of system capabilities. Known worldwide as the preeminent electric power research and development organization, the EPRI experts were chartered with leading a complete, "no holds barred" assessment of ComEd's system deficiencies. Working almost non-stop for 12 days, many of these experts have participated since the beginning of this investigation. The results of their work were presented to a panel of industry experts in formal sessions on August 26 and September 10. The panel acted with new voices to challenge old ways of thinking, and to present solutions ranging from time-tested to cutting edge. ComEd has also extended invitations to the ICC and the City of Chicago, who have been participating in the investigation and weighing the analysis as the results of ComEd's technical review panels began to pour in.

With brutal candor, and with aggressive specificity, both ComEd's own professionals and its team of nationally recognized experts from outside the company have been

probing, testing and scrutinizing the T&D system, and ComEd has taken an unflinching look at an unflattering reflection. The attached Report is the result of that initial search.

But ComEd recognizes that people are not only asking about what happened to Line 5348 at Cortland Substation. People are not only asking about what happened to the cable. They also want to know what happened to ComEd.

The real answer to that question does not turn on which lines short-circuited or which transformers overheated or which substations lost power. The real answer to that question must address why all of the many fail-safes and redundancies programmed into the system failed to prevent the outages. And that answer is a slightly longer story.

Task Force Findings – Latent Deficiencies in Cables and Companies

As with the hidden fault on Line 5348, ComEd has found that it solved one set of problems only to find another set lurking behind the first. Not all of them can be quickly fixed.

ComEd understood that there were issues with its T&D system – that is why it had been working so closely over the past year with the ICC, the City and numerous other interested parties to address those problems. Nevertheless, the extent of the problem was not anticipated. There are serious issues with both the maintenance and the design of the system. But with the initial investigation complete, these issues can now be fully addressed.

The findings of the investigation are based substantially, but not exclusively, on investigations by the task force. July 30 was not the first time alarm bells rang on this watch. The ICC, the Mayor of Chicago, and Mr. Rowe all raised concerns about ComEd's T&D system as much as 18 months ago, and have put a great deal of effort into identifying and prioritizing the T&D challenges and projections leading into the year 2000 and beyond. Some of the credit for the impressive results the task force was able to generate in such a short time must go to these parties, and to the far-ranging evaluation, debate and cooperative analysis that they contributed to the matter.

As noted above, ComEd has identified five areas of operations in which it failed to meet the expectations of itself and its customers. A detailed description of the steps ComEd has taken and will continue to take in pursuit of improvement is set forth below and in the Report. Given the recent outages, however, today both ComEd and the community have come to recognize that the problems identified in its earlier assessments run farther and deeper than could previously have been understood, and that each of these five factors played a part in the outages of July and August 1999.

(1) **Maintenance**: As the tortured summer saga of Line 5348 suggests, the investigation found that a utility like ComEd needs to be painstaking in the care and feeding of its T&D components. The team found that other major cities operate T&D equipment that is no newer, no older -- not fundamentally different from ComEd's. The task force findings pinpoint the crucial difference between ComEd's equipment – which failed this summer – and similar systems elsewhere that did not: ComEd has been unable to provide the rigorous care and maintenance that the T&D system requires for optimal reliability.

It was generally found that while ComEd's inspection programs seemed appropriate, there were only imperfect mechanisms in place to ensure execution. It looked good on paper, but the repeated outages made the truth of the matter painfully clear. It is not certain, from a review of the records, how often inspections were actually performed, and the inspections that were performed may have been too passive, too cursory, to truly maintain the system.

Additionally, the Report concludes that ComEd needs to ensure better follow-up on maintenance requests. While virtually all T&D emergencies are dealt with immediately, there appear to be altogether too many deficiencies which, had they been identified and addressed sooner, would not have become critical in the first place. Too often, the priority of requests for maintenance was not recognized, and the request was simply added to a list. The Report also indicates that routine maintenance requests on the list were rarely tracked to ensure follow-up, and that the list was rarely updated to indicate which requests had already been addressed.

Specifically, the Investigation Report presents the following findings about ComEd's maintenance program:

- Management Systems. ComEd's maintenance program is hampered by incomplete definition, lack of focus, historic budget swings, suboptimal work planning and inconsistent supervision.

- Equipment Monitoring and Capacity Management. Too much of ComEd's maintenance work is reactive rather than preventive, driven by actual or pending equipment failures, because of insufficient monitoring and inadequate capacity (monitoring and capacity are discussed separately below).

- Program Execution. ComEd's maintenance program has been hindered because of gaps in equipment condition monitoring, inconsistent training and work practices, and unclear priorities.

- Recordkeeping and Documentation. ComEd maintenance efforts are often made more difficult by incomplete operating histories of components due to gaps in data capture, inattention to detail, and lack of workforce discipline.

Solution. ComEd has already begun to implement the experts' recommendations

regarding its maintenance program. First and foremost, ComEd has continued the massive inspection and repair program that it initiated on August 10. This intensive effort has been sustained across all areas of the T&D system and (as of September 10) led to:

- 4,346 completed, state-of-the-art inspections
- 8,828 items requiring maintenance
- 2,304 completed repairs

The details of these efforts are contained in the Report. ComEd will continue with its accelerated inspection and repair program. The Report makes detailed recommendations regarding the required maintenance of every aspect of ComEd's T&D system, but the general thrust of the recommendations is simple: provide the necessary authority and make the managers directly accountable for the performance of the system. That one, single change will carry all the other changes in procedures (different inspection schedules, methods, records, and tracking) down to the people who have to implement them.

(2) Equipment Protection and Monitoring: As mentioned above, ComEd's physical equipment is largely comparable to that of other utilities in major metropolitan areas. In addition to improving its maintenance practices, however, ComEd needs to strengthen its equipment monitoring and protection. By improving its monitoring practices, ComEd will be better able to predict when certain types and pieces of equipment are likely to wear out or fail. Predicting (and thus preventing) the on-line failure of a component helps protect the equipment around it: when one component fails, the power originally carried by that component must travel through alternative routes using the surrounding components. This is what happened on July 30, when the sudden overload caused by the failure of Line 5348 acted to shut down the adjacent transformers.

Specifically, the Investigation Report presents the following findings about ComEd's equipment protection and monitoring:

- Maintenance Program Ownership. It was not always clear who was responsible for specific elements of ComEd's protection and monitoring program. Even when the responsible party was clearly identified, he or she was not always held accountable, in a meaningful way, for the performance of those elements.

- Calibration Maintenance. ComEd has not kept pace with the necessary relay calibrations, and its efforts to do so are hampered by the same types of issues described above with respect to other types of systems maintenance.

- Root Cause Analysis. ComEd has not effectively tracked and analyzed information about relay failures, and thus cannot analyze or address the root causes of those failures.

- Equipment Condition Monitoring. ComEd has not implemented a consistent program of equipment monitoring across its system, thus limiting its ability to detect incipient failures.

Solution. As with the maintenance program, the Report makes detailed recommendations regarding the protection and monitoring of ComEd's T&D equipment, including the utilization of readily available but state-of-the art monitoring devices. Also as with the maintenance program, the general thrust of the recommendations is to give managers the necessary authority and then make them directly accountable for the performance of the system.

(3) T&D Load and Capacity: It is obvious from the system failures this summer that the ComEd power delivery system is overloaded at some points. ComEd was aware that certain substations were overloaded at times of peak summer demand and was working to address the situation as outlined in its agreement with the City of Chicago. But the recent investigation revealed that the extent of the problem had been underestimated. ComEd's experts calculate that the T&D system is five to ten percent deficient in its capacity to carry the peak load which must be contemplated in the wake of this summer's experiences. The problem is not a lack of power. Between construction, importation and its fleet of nuclear plants, ComEd expects to have a sufficient supply of power. The problem is that the distribution system cannot reliably deliver the power to its customers at peak times. ComEd needs to redesign some parts of its system to make better use of the physical components that are already in place, and invest in greater capacity to help it carry the load.

Specifically, the Investigation Report presents the following findings about the load and capacity of ComEd's T&D system:

- Substation Capacity. Upon initial review, it appears that almost a third of ComEd's large substations (approximately 73) operate above capacity at times of peak demand, and that 27 of those substations require expedited corrective actions. Three of those 27 substations are located in the City of Chicago (Crosby at 1180 North Crosby, Lakeview at 1141 West Diversey, and Northwest at 3501 North California), and 24 are located outside the City.

- Distribution Feeder Capacity. Upon initial review, it appears that almost one fifth of ComEd's small substations and feeders (approximately 880) operate above capacity at times of peak demand; 185 of those small substations and feeders are located in the City.

ComEd has already begun to implement the experts' recommendations regarding load and capacity issues. ComEd is continuing its ongoing assessment of the load and capacity of its existing substations in order to properly prioritize necessary repair and replacement. At the same time, ComEd is working to determine which substations will required additional equipment – or where ComEd will need additional substations – and how ComEd will surmount the difficulties inherent in expanding or installing substation capacity. ComEd will repair, upgrade or otherwise increase the capacity of the substations requiring expedited action by June 15, 2000. The other substations will be addressed by June 15, 2001. The extensive improvements to the material condition of the equipment

will also help ease the load on the transformers until all of the various repairs, replacements, and additions are completed.

(4) T&D System Optimization: The distribution system serving downtown Chicago has evolved over the years to a condition that is particularly sensitive to inaccuracies in planning and the impacts of maintenance outages and equipment failures. Its apparent radial design is really an arrangement of radial arms of electrical loops similar to that employed in many highly reliable European designs, except with less capacity and configuration redundancy. It is the uniformly high loads carried on the system and the limited load transfer capability which combine to make this an unforgiving situation. Additionally, the ComEd system was found to contain some unique and limiting features which compound the impact of equipment outages and failures.

Achievement of improved service reliability will require the careful balancing of capacity additions and configuration enhancements.

Specifically, the Investigation Report presents the following findings about the load and capacity of ComEd's system design:

- System Design. ComEd's downtown distribution system lacks some of the features which provide high reliability and flexibility in other US and European designs.

- Delivery Capacity. Additional power delivery capacity is needed to provide the operating flexibility and contingency management capability needed to ensure highly reliable service.

- System Operation. Traditional contingency planning criteria applied to this system will not provide the requisite reliability for such an important area.

Solution. ComEd has already begun to implement the experts' recommendations with regard to its system design. Recognizing that quality system design is the fundamental building block for delivering reliable service, ComEd has retained Asea Brown Boveri (ABB) to collaborate with ComEd system planners to diagnose faults in the system design and identify ways to remedy those faults. Led by Lee Willis, a world- renowned expert in electric utility system planning, ABB is objectively reviewing the design and performance of ComEd's T&D system. Using advanced, proprietary models to understand the dynamics of power flows, ABB has completed its initial diagnostic review comparing ComEd's system to other designs, evaluating the system's capability to deliver reliable service, and considering options for improvement.

With ABB's preliminary analysis complete, ComEd is now in a position to go forward with the more detailed assessment that is currently underway. The ongoing System Optimization Study, which will be complete by year-end, involves further system modeling and sensitivity analyses. The study will identify the best way to increase the capacity of the system through some combination of capacity improvements (e.g., increased transformer

and line capacity) and configuration enhancements (e.g., loops and networking, more and better switching). A number of the world's foremost equipment manufacturers have been asked to devise practical solutions tailored to the system's needs in order to implement those solutions as quickly as possible. Until that time, ComEd will focus on improving efforts at upgrading, maintaining and monitoring the system in its current configuration.

(5) **Organization and Management:** As the results of the investigation have unfolded, a wide variety of underlying organization and management issues have surfaced. A series of realignment workshops used to establish the transition organization for T&D (as described below) identified further evidence of the same issues, confirming the findings of the investigation with respect to organization and management issues. The issues identified in the Report fall into five categories, all related to just "doing the work": leadership, organization design, work processes, information systems and staff.

Solution. As with the other areas of concern identified in the investigation, ComEd's senior management and the interim T&D leadership moved immediately to implement the experts' recommendations with regard to ComEd's organization and management. Over the past 45 days ComEd has made selective changes to the composition of the T&D senior management team and has established a disciplined, interim organization to implement the immediate drive to inspect and repair the system components. This interim organization has already initiated many of the internal measures recommended by the experts, including:

- Re-evaluating the entire T&D budget to ensure that resources are being allocated to the programs that will most benefit from expenditures.

- Developing specific performance goals for the T&D program, to assist in gauging (and enforcing) progress.

- A general "house cleaning" -- e.g., inserting of new leadership, participating in a public and no-holds-barred review of shortcomings, and instigating stepped-up employee dialogue and communications.

To the extent that ComEd's efforts along these lines have already yielded results, those results are set forth in the Report.

Although these moves only scratch the surface, they have set the stage for a more thorough restructuring of the T&D organization. Among the initiatives that ComEd will pursue over the next 90 days (set forth in detail in the Report), ComEd will:

- Aggressively recruit new members for the T&D management team and provide additional training for existing managers.

- Educate employees about new practices and goals, then hold them accountable for the attainment and implementation of those practices and goals.

- Track the continuing execution of the many new programs that ComEd has set in motion over the last 45 days.

Each of these five factors – maintenance, equipment protection and monitoring, load and capacity, system optimization, and organization and management – likely played some role in the outages that occurred in July and August. Improvements in these five areas will go a long way toward preventing similar service interruptions in the future. ComEd expects the results of the above actions to be as significant and far-reaching as those recently brought about by Oliver Kingsley and David Helwig in ComEd's Nuclear Generation Group.

A Blueprint for Change

The Road Ahead

The Mayor has said that the company needs to start at Ground Zero.

He says ComEd had better change.

We agree. **And we have.**

ComEd recognizes that fundamental change in T&D performance requires an across-the-board effort. *A chain is only as strong as its weakest link.*

That is why, with this Report, ComEd is announcing a new, two-year recovery program, designed to accelerate fundamental change within Commonwealth Edison. It calls for new initiatives and new ideas that range across the board. A five part plan that calls for new people, new programs, new perspectives, new proposals – and most importantly – new performance.

New People

ComEd is seeking to recruit and promote a new generation of managers and leaders with vision, discipline and talent. Under the new leadership of professionals like John Rowe, David Helwig and Carl Croskey, that process has already begun. For example, for the next several weeks, David Helwig will continue to direct the investigation into the summer's outages and the efforts to create a program to address the problems identified in that investigation. Carl Croskey, joined by other new leaders, will take over the execution of the program in his capacity as Senior Vice President in charge of ComEd's energy delivery business.

New Programs

ComEd is seeking and proposing core, fundamental change. New programs mean new discipline and accountability, especially for the T&D maintenance programs. It means accelerating steps to protect vital equipment and to monitor it with simple, readily available

and yet state-of-the-art technology. It means advancing construction and enhancement programs to increase system capacity. And most of all it goes directly to ComEd's plans for a highly focussed effort to identify and design a system that is fully optimized and ready to meet the needs of a new century.

New Perspectives

ComEd recognizes the benefits of the cleansing power of daylight. ComEd and its customers will benefit from the continued, bare-knuckled scrutiny by the public, public officials and outside experts representing many disciplines and perspectives.

ComEd invites this scrutiny and also welcomes appropriate participation by the ICC, the City, the Attorney General, Cook County, the Citizens Utility Board, suburban municipalities and other interested parties. Throughout its investigation ComEd has invited each of these entities to forge a cooperative, forward-looking partnership to address the most crucial needs of the people we collectively serve. And ComEd remains ready to join in such a partnership now.

New Performance

ComEd stands ready today to match rhetoric with resources – a commitment of bottom-line dollars to the largest, most accelerated capital improvement program in the history of the company.

This new and accelerated commitment of dollars represents not only ComEd's investment in the future – but also its confidence in the future. ComEd understands why

people are angry, and why people want more than another series of promises. Both the public, and the public officials who represent them, deserve to know that these new pledges are backed up by hard dates, firm standards and an enforceable timetable.

Timetable

ComEd has already accomplished much. In the words of John Rowe, ComEd's employees "have worked with ever-increasing intensity, making radical improvements in record time." But there is still much more to be done. Over the next three months ComEd will continue to implement the recommendations set forth in the Report. ComEd will be laying cable, installing monitors, training inspectors and upgrading transformers. Each of these steps is part of a larger, front-loaded program, which ComEd will continue to implement over the next two years:

By December 15, 1999:

System Load, Capacity and Design

- Complete Comprehensive T&D System Optimization Study
- Establish and Prioritize Plans to Relieve Load Capacity Shortfalls
- Establish New ComEd Planning Criteria for Forecasting Load
- Complete Sensitivity Analyses Needed to Prioritize Work

Inspection, Maintenance and Monitoring

- Submit 1st Quarterly Status Report to ICC, City and Others
- Establish New Process for Scheduling and Allocating Field Work (including maintenance and monitoring)
- Continue Acceleration of ComEd Vegetation Management Program
- Establish New Schedule for Inspections; Replace Faulty Monitoring Equipment

Management

- Redesign Organization, Core Processes and Information Systems/Technology
- Establish Processes to Enhance and Enforce Commitment Tracking (such as repairs, replacements, upgrades, etc.)

City Projects (as per Settlement Agreement)

- LaSalle Substation: install and activate second 138 kV transformer
- Northwest Substation: develop plan for upgrades
- Kingsbury/Ohio Substations: develop plans to accelerate upgrades
- State Line to Taylor: complete installation of 138kV line (#0702)

By June 15, 2000:

System Load, Capacity and Design

- Repair, Replace or Upgrade the 27, High Priority, Major Substations
- Repair, Replace or Upgrade All Identified, High Priority, Small Substations and Feeders

Inspection and Maintenance

- Submit 2nd & 3rd Quarterly Status Reports to ICC, City and Others (on March 15 and June 15, respectively)
- Optimize Maintenance & Tracking on Any Remaining Substations and Feeders (major and small and feeders operating in excess of capacity)
- Achieve 4-Year Tree Trimming Cycle
- Complete Aerial Inspection of Overhead Transmission Lines

City Projects (as per Settlement Agreement)

- Washington Park to Taylor: complete installation of third 138kV line (#13701)
- Northwest Substation: complete upgrade of Terminal 2 12kV switchgear

By December 15, 2000:

Maintenance

- Submit 4th & 5th Quarterly Status Reports to ICC, City and Others (on September 15 and December 15, respectively)
- Establish Single Source Data Base for Misoperation Information

System Design

- Implement Performance Metrics for Capacity Planning

Management

- Implement a Fully Integrated Work Management Program at ComEd

By June 15, 2001:

System Load, Capacity and Design

- Repair, Replace or Upgrade Any Remaining, High Priority, Major Substations
- Repair, Replace or Upgrade Any Remaining, High Priority, Small Substations and Feeders

Maintenance

- Optimize Maintenance and Tracking on Any Remaining Substations (operating in excess of capacity)
- Submit 6th & 7th Quarterly Status Reports to ICC, City and Others (on March 15 and June 15, respectively)

ComEd has set a formidable series of tasks for itself. We know that fundamental change takes time. To complete the revolution described here today will take more than the 45 days since the outages that have outraged many customers. ComEd will have a better perspective on the final timetable when the System Optimization Study is issued in December, but it intends that those changes will take place over a two-year timetable.

But far sooner than this, we intend to, indeed we must, produce discernable and measurable improvements in performance. By next summer, ComEd's customers will be experiencing fewer interruptions, and those that do occur will be shorter in duration. Make no mistake, however. So long as there are snowstorms, windstorms, wildlife and Mother Nature's trick bag, there will always be times when electrical power systems fail. The commitment ComEd is undertaking is to bring its performance up to the highest levels that can be achieved within the limits of the practical world in which we live.

The events of the past two months have been sobering to everyone in the ComEd house. There is no satisfaction in finding these problems. But there is some satisfaction, at long last, in facing them.

And at the same time, in closing, some real world perspective is in order. As noted at the outset, in medical terms, the T&D system is in serious but stable condition. The prognosis – including the immediate prognosis – is, in fact, good. As the *New York Times* observed on Monday, reporting the views of the North American Electric Reliability Council, our utility systems are not falling apart.

Yes, America this summer suffered a troubling series of major outages. New York City was hit by its worst blackout in over 20 years. Half a million customers lost power in New Orleans. In both these cities, as in Chicago, the systems proved vulnerable to the twin summer challenges of extreme heat and extreme demand.

But today autumn is coming to Illinois and with it a seasonal reduction in both temperature and demand. Given the extraordinary, accelerated and highly focussed T&D

improvement campaign that was launched a month ago, ComEd is staking its future on its ability to meet next summer's challenges before Memorial Day comes to pass.

ComEd knows that it has to act quickly. ComEd understands that, with the release of this Report, the time for explanations is past. ComEd recognizes that, from this day forward, it will be judged by only one measure – performance.

We are aiming higher – for our company, for our customers and for the communities we serve – yours. And make no mistake. The end goal of this response, and the overall goal of this company, is to ensure that – among America's major metropolitan utilities – Chicago and ComEd are second to none.

As for anything less, John Rowe put it bluntly in the aftermath of the August outages. He said: **"I will not tolerate it. And you will not have to."**

# # #

Attachment 1. ComEd's Responses to 1st Liberty Report

Two-1 Expedite the transition from the interim organization to a permanent T&D Operations organization. Some organizational improvements should be made.

The establishment of the interim organization following the July and August 1999 outages was a firm and positive step toward recovery from what appears to be years of confusion and disorientation in T&D Operations. ComEd's September 15, 1999 Transmission and Distribution Investigative Report laid the groundwork for improvements that must be made regarding the organization and structure of T&D. In addition to completing the initiatives contained in that report, T&D Operations should:

1. Complete the return to an organization based on the regional division of responsibility for, and ownership of, the T&D system.

2. Reduce the number of direct reports to the SVP of T&D (other than administrative and staff assistants) to a number between six and ten.

3. Develop mission and function statements for all major groups and departments within T&D Operations that do not focus on achieving budget numbers but rather on completing projects, tasks, and activities necessary to maintain the T&D system in optimum condition and delivering high quality service to customers. ComEd should specify internal responsibilities and identify departments and groups that interact with departments and groups outside T&D.

4. Develop a hierarchy of goals and objectives that flow from corporate as well as T&D goals and objectives down to the lowest managerial level. ComEd should ensure that every employee can personally identify with at least one goal or objective.

5. Develop a proper balance between controlling costs and providing the highest practical quality of service to customers.

ComEd may have already started implementation of these improvements. The incremental costs of them are minimal. Liberty's review of specific functions within T&D resulted in additional organizational recommendations. These changes primarily concern the separation of distribution system and substation maintenance. Refer to Chapters Nine and Eleven of this report.

Finally, the axiom "change is inevitable," is certainly true of the utility industry. Indeed, ComEd, and T&D Operations, will undoubtedly face numerous challenges and opportunities in the near future that may result in the need to make further organizational changes. Among these is the establishment of a regional transmission network. Other structural changes may be made

necessary by the continuing evolution of deregulation and customer choice. Nevertheless, the basic functions of electric transmission and distribution have not changed fundamentally and will not likely be altered by market developments or revised regulations. These events and conditions notwithstanding, T&D Operations should avoid making any organizational changes that are not absolutely necessary after completing those needed to fully recover from its current situation. Furthermore, as recommended in the 1991 management audit, ComEd should establish a central group, reporting to Corporate Planning, to evaluate any contemplated organizational changes before they are implemented.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree, with exception

The attached organization charts illustrate the Distribution Group organizations. Selected features include the following:

1. The functions within ComEd Energy Delivery (CED) have been divided between two Executive Vice Presidents reporting to the President of Exelon Energy Delivery.

2. CED Operations have been reorganized into eight regions. This arrangement will reduce the number of customers served and employees managed in each region and will focus accountability for service reliability customer response.

3. This structure provides executive management with frequent and direct access to each portion of the business unit and its leadership.

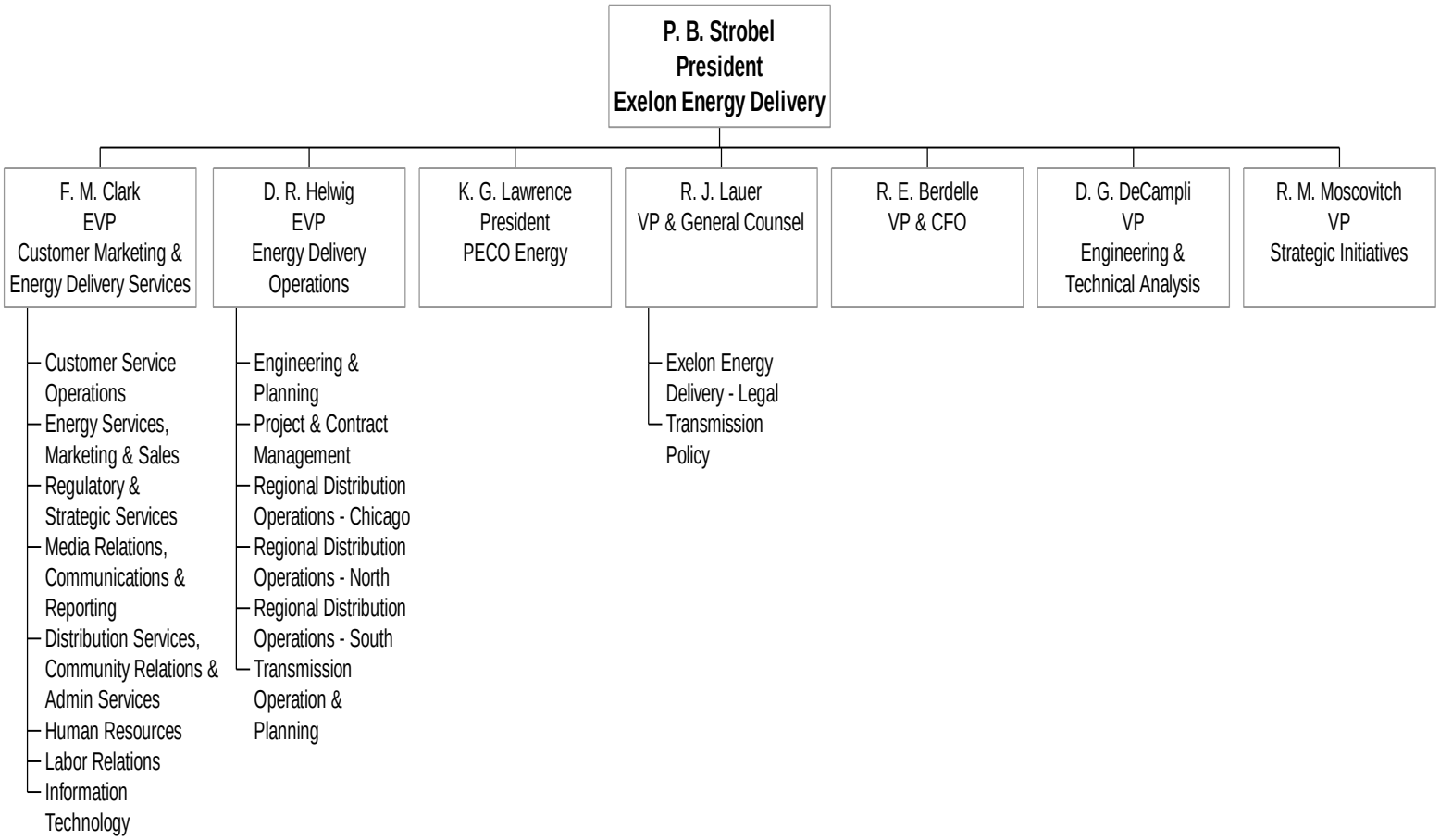
4. Any subsequent organizational changes will be made in consultation with the President of Exelon Energy Delivery.

5. Mission and function statements addressing responsibilities for achieving service quality have been developed for all major departments within CED Operations.

6. A hierarchy of goals and objectives which balance financial responsibility with the achievement of service quality improvements has been developed. These goals and objectives will be communicated to all employees and will be used as the basis for their performance incentive compensation.

ComEd will provide a balance between controlling costs and providing the highest practical quality of service to customers through a more rigorous budget development process, project challenge reviews, productivity measures, and strengthening project management and controls.

Investigation of Commonwealth Edison's Transmission and Distribution Systems
ComEd Responses to First Liberty Report - February 14, 2001
Attachment 1



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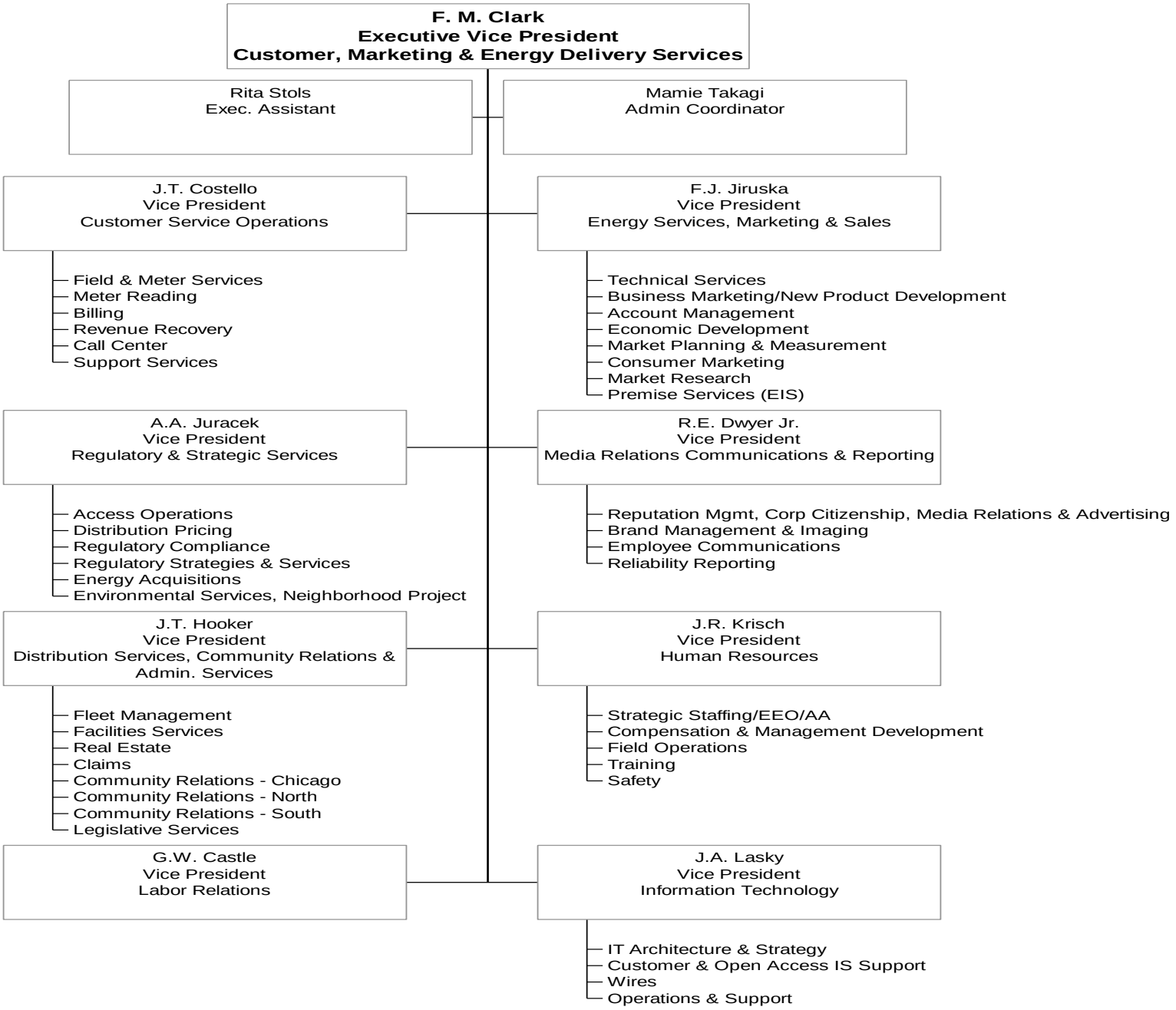

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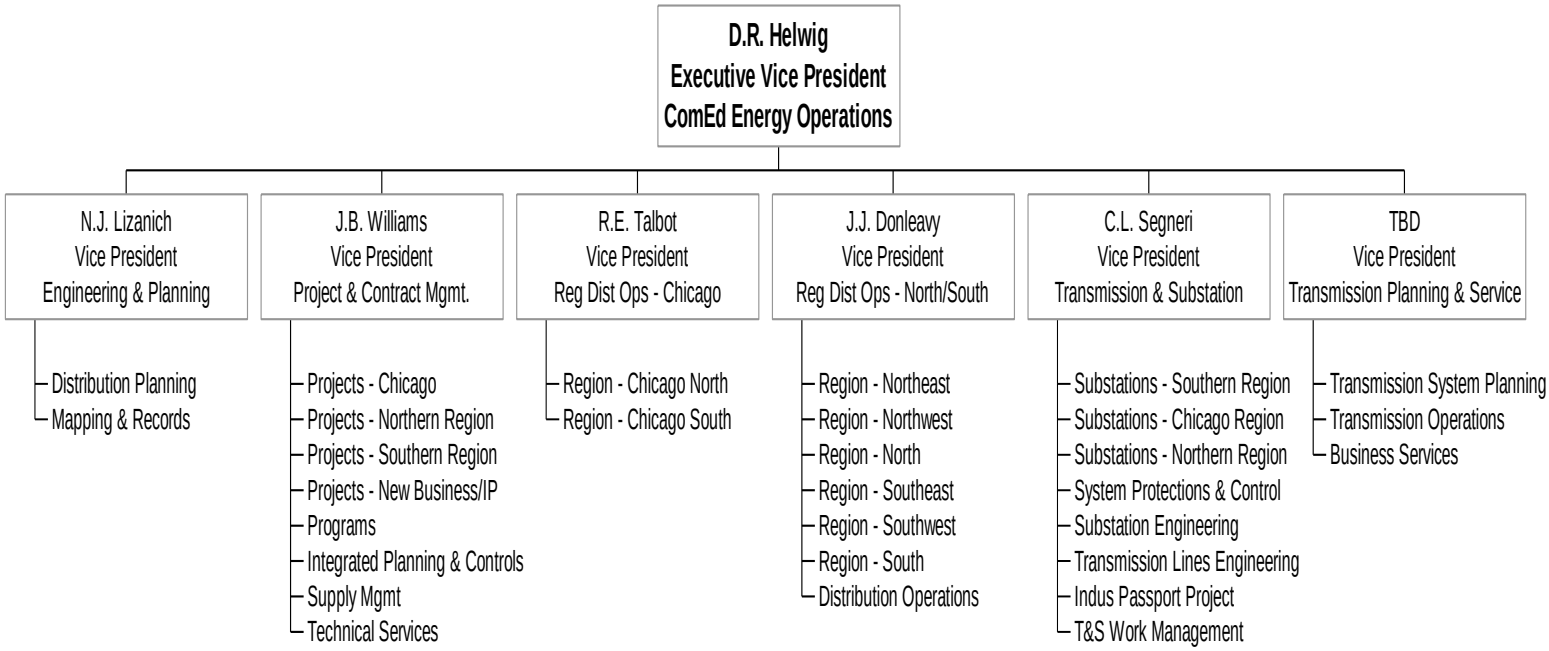

Three-1 ComEd should dedicate the necessary funds to maintain and improve the reliability of its T&D systems.

In late 1998, ComEd increased both its capital and O&M budgets in order to recover from an unusually high number of storms that increased service interruptions during the year. The enhanced budget was also intended to provide funds to reinforce areas that had been identified as trouble spots in the system. In May 1999, ComEd agreed to additional budget commitments that the company said would bring the total amount for reliability-related improvements in Chicago to $1.1 billion. Commitments outside Chicago amounted to more than $2 billion over the next five years.

The T&D capital budget increase that ComEd made in late 1998 totaled $307 million. The table below shows the components of that increase.

ComEd's Additions to 1999-2001 Capital Expenditure Plan ($ x 1,000)

Item	1999	2000	2001	Total
Infrastructure Refurbishment	$12,025	$20,305	$16,960	$49,290
Targeted Reliability Programs	$19,950	$21,950	$22,570	$64,470
Distribution System Automation	$15,675	$34,745	$33,330	$83,750
Reliability Improvements Subtotal				$197,510
Independent Power Producers	$13,140	$10,000	$7,250	$30,390
Fossil Generation Interconnection	$16,210	$28,000	$34,890	$79,100
Interconnections Subtotal				$109,490
Totals:	$77,000	$115,000	$115,000	$307,000

As shown by this table, ComEd planned only about $198 million for projects aimed at reliability improvement. ComEd designated the remaining $109 million to transmission system interconnection projects.

In late 1997, the Governor of Illinois signed the Illinois Electric Service Customer Choice & Rate Relief Law of the 1997 Act, which established a process to introduce competition into the electric industry in Illinois under a less regulated structure. Unicom, ComEd's parent company, subsequently announced several business and operational objectives designed to focus efforts on responding to the changes that were expected to develop from the 1997 Act. Among those decisions was ComEd's announcement that it would sell its fossil generating stations. This decision resulted in the $79 million increase in the T&D capital budget.

The 1997 Act, as it applies to ComEd, also provided for a 15 percent residential base rate reduction commencing on August 1, 1998, and an additional 5 percent residential base rate reduction commencing on May 1, 2002. Prices for the supply of electric generation are expected to transition from cost-based, regulated rates to rates determined by competitive market forces.

The law allows ComEd to recover a portion of any of its costs that might otherwise be unrecoverable under market-based rates. Nonetheless, ComEd recognized the need to take steps to address the portion of such costs that are not recoverable. These steps could include more cost control efforts.

It is likely that a root cause of many of the service interruptions experienced by ComEd's customers in recent years relates to less than adequate funding of T&D activities during the 1990s. ComEd should not permit future cost control efforts to inhibit identified repairs and enhancements planned for its T&D systems.

This is a high priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree

ComEd is committed to maintaining and improving the reliability of its T&D system. We are also committed to maintaining the transmission and distribution system in a reliable state of readiness and to delivering high quality service to our customers, and will dedicate the funds necessary to do so.

We continue to focus on completing capital and O&M projects and tasks in order to improve the performance of the T&D system. Our system optimization projects are examples of our commitment to improve system reliability. Our expenditures have resulted in improving reliability since Summer 1999. The 12-month rolling average for the average number of interruptions per customer shows a 26.2% improvement System-wide and 21.9% improvement for the City of Chicago when comparing July 1999 to July 2000. The 12-month rolling average for the length of interruptions per customer shows a 37.1% improvement System-wide and a 56.4% improvement for the City of Chicago when comparing July 1999 to July 2000.

Each year ComEd uses its evaluation of the T&D system as the basis for developing the annual budget and projecting expenditures. To ensure we are planning ahead for both system reliability and for the funding needed to achieve that reliability, ComEd Energy Delivery has developed three-year strategic goals with quantified performance targets for improvement in year-over-year customer satisfaction and system reliability. A multi-year plan of improvements to achieve these goals is being developed and will be completed by the third quarter of 2001.

The suggestion is made that a root cause of many of the service interruptions relates to the level of funding of T&D activities during the 1990's. Attempting to answer the question of whether there was inadequate funding of T&D in the 1990's that was a root cause of service interruptions requires a speculative „what if" inquiry as to what design, maintenance, and operating practices would have been followed if there had been higher funding levels. Pursuing this inquiry would seem to serve no productive purpose at this time, particularly given ComEd's acceptance of the

liberty recommendation that it "should dedicate the necessary funds to maintain and improve the reliability of its T&D system." What ComEd has concluded in its analysis is that the design, maintenance and operating practices of the past were the root cause of service interruptions. These practices have been substantially overhauled for the purpose of improving the reliability of the T&D system. ComEd's commitment is that funding levels sufficient to implement improved practices are, and will continue to be, available to the T&D organization.

Four-1 ComEd should demonstrate, and the ICC may choose to independently confirm, that the company is effectively using reliability information.

After the outages in July and August 1999, the ICC's revised reporting requirements, and the restructuring of the electric industry in Illinois, ComEd implemented many organizational and process changes, some of which directly relate to the assessment and use of reliability information. It was not in the scope of Liberty's review to assess those changes, and during Liberty's review it was too early to assess the effectiveness of those changes. ComEd should be required to demonstrate that its assessment and use of reliability information are effective and consistent with good utility practices. This demonstration should go far beyond the annual reporting requirements of the ICC. It should include things such as:

- not just listing projects and programs, but establishing objectives for those programs related to reliability, measuring results against those objectives, and producing definitive results from the programs.

- not just how much money has been spent in targeted areas, but the reliability results from those areas in which money has been spent.

- not just a list of worst performing circuits and the work planned, but the reliability results of the circuits that had been poor performers.

- not just outage indices, but evidence that the indices were calculated using accurate information, such as customers being correctly related to system devices and causes being consistently identified. ComEd should test and audit the accuracy of its interruption reporting system. Tests or standardizing checks of the new system against older outage reports may be able to let ComEd understand trends sooner.

- not just repairs and improvements, but areas in which there can be cost savings along with improved reliability.

- not just overviews, but specific examples of how ComEd has balanced reliability and cost, and has factored reliability into system design and refurbishment.

The benefits of implementing this recommendation are (1) greater assurance that outage information is accurate, reliable, and consistent, and (2) more effective use of that information. This should lead to improved system reliability by providing confidence that the information and analysis lead to more cost-effective and correctly targeted improvements. It also will provide the ICC with greater assurance that ComEd's reported reliability information presents an accurate assessment of ComEd's system. It is practically impossible to place a quantitative value on these

benefits. However, Liberty's view is that this recommendation is cost-effective and will bring ComEd in line with good utility practices.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd agrees that we should effectively assess and use reliability information. We will:

1) Benchmark for best practices with other utilities
2) Engage industry experts such as EPRI to assist in the identification of good utility practices
3) Assess our practices against these identified practices
4) Complete this analysis and provide the results by June 1, 2001

Five-1 ComEd should justify the way it adjusts the historical peak electrical loads for 5-year forecast for weather.

ComEd's process for determining the effects of weather on peak-load demand before the Summer of 1999 was based on a 15-year average peak-day weather adjustment. After the events of 1999 ComEd increased their weather adjustment to a 90th percentile adjustment. This would suggest that the forecast would be exceeded statistically once in ten years compared to once in two years. Liberty did not review this recent change in detail. While ComEd's change was certainly a step in the correct direction, it may not be appropriately justified. That is, ComEd should be able to explain why the weather adjustment should not, for example, be at the 95th percentile, which would equate to a prediction of exceeding the forecast once every 20 years.

As part of ComEd's evaluation of its weather adjustment criteria, a more sophisticated review of the weather-load relationship should be undertaken. This review should not only consider the weather variables currently in the model but also others such as degree-days-cooling, solar radiation, day of the week, and various variable integration periods. In addition, a sensitivity analysis of the preferred weather-load relationship should be conducted for each customer class as well as the system as a whole to assist in the risk analysis of the process. The results of this analysis should be included in ComEd's annual corporate load forecast publication to allow review and comment by the affected parties.

This is a medium priority recommendation that should be implemented by March 31, 2001.

ComEd Response: Agree

90th Percentile Weather Adjustment

ComEd has changed its historical practice of adjusting the historical peak electrical loads for the 5-year forecast for weather. Loads will be expected to approach design criteria approximately only once every ten years – a marked contrast to the prior design criteria under which loading would hit design levels approximately every two or three years.

This change in weather adjustment was based on recommendations from an independent consulting firm following its review of Chicago area summer weather conditions and ComEd's planning practices. The consulting firm indicated that ComEd's revised practice is prudent and consistent with the practices of top-performing utilities. In addition, ComEd's selection of 90th percentile weather conditions for system design has recently been validated by the March 2000 Final Report of the DOE Power Outage Study Team. The DOE team stated that "A criterion of 1 in 10 years is more commonplace in the industry". ComEd believes that the recommendation of its outside consultant, along with the validation provided by the recent DOE Team Report

provides sufficient justification for its use of a 90th percentile weather adjustment for load forecasting. ComEd will also agree to re-evaluate the use of the 90th percentile weather adjustment in the analysis of weather adjustment criteria described in the paragraph below.

Analysis of Weather Adjustment Criteria

ComEd will undertake an evaluation of its weather adjustment criteria, including the weather variables currently in the model but also other variables such as degree-days-cooling, solar radiation, day of the week, and various variable integration periods.
ComEd will continue to work with industry experts to select the variables that are most appropriate for load adjustment of feeders and substation transformers. This evaluation will be completed by March 31, 2001.

Customer Class

ComEd agrees to conduct an analysis of the weather-load relationship for each customer class as well as the system as a whole. This analysis will be completed by March 31, 2001 and will be included in the next annual load forecast publication.

Five-2 ComEd should implement a "First Contingency" criterion for its distribution feeder design process.

The use of a maximum design loading of 100 percent (or more) may not allow adequate reserve margin for unexpected weather anomalies, as well as both unplanned outages and scheduled operations. This depends on the assumed weather conditions and contingency design criteria. Most utilities use what is commonly referred to as a "First Contingency" basic design that attempts to allow adequate margin for the loss of the single, worst-case element in the distribution system. This critical element is usually either the loss of a substation transformer or a main feeder element, usually in the first mile of the feeder. Adopting this criterion would require that ComEd systematically analyze the design on the distribution system and determine what changes would have to be made in order that single-event failures could be accommodated by system switching without exceeding "normal" equipment ratings. Some utilities would rather use "emergency" ratings for their contingency analysis, but this frequently leads to capacity issues caused by elements of the normal system being out of service or reduced in capacity because of normal system activities like line construction and maintenance for periods of time that exceed the basic time-limit assumptions generally present in emergency rating analysis.

In no case should any element in the system be designed to operate above 100 percent of its "normal" rating when the system is in its usual configuration. The benefit of implementing such a criterion would be a more reliable electric delivery system. Anytime a system is operated above its "normal" capacity, loss of equipment life occurs. Frequent reliance on emergency ratings ultimately leads to untimely and premature equipment failures.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree, with exception

It has been ComEd's long-standing practice to design the feeder system to prevent loading in excess of normal ratings, with all equipment in service. ComEd agrees that a single contingency criterion for loss of a substation transformer, as well as main line feeder segments, including substation exits and the portion of the feeder closest to the substation, is an appropriate means to reduce customer outage time and is consistent with good utility practice. Outage time is reduced in the event of a feeder failure, by providing the capacity to switch loads to adjacent circuits. It is not expected that this criterion would apply to short overhead radial laterals that supply a small

number of customers and are readily repairable or for short underground laterals that supply a single transformer.

ComEd uses emergency ratings consistent with the duration of the repair of an unplanned, forced equipment outage. Emergency ratings are based loading after switching load to restore service during the expected repair time for the failed equipment. Under peak load conditions, an underground cable is expected to be subject to emergency loading levels for one day or less during the repair of a failed cable. An overhead conductor would be subject to emergency loading levels for two to four hours during repair of an overhead line. Underground cable loads are expected to follow the daily load cycle for that feeder or substation. During non-peak conditions, or where feeder loading under abnormal conditions does not exceed normal ratings, underground cable repair may take as long as 10 days.

Utility industry equipment rating practice recognizes that greater loss of life occurs during infrequent emergency conditions compared to normal conditions. To prevent unnecessary loss of thermal life, emergency equipment ratings will not be used during planned outages. Normal ratings apply during planned outages. Normal and emergency ratings are selected to result in a reasonable, safe, reliable and economic service life for cables, conductors and transformers, consistent with industry standards.

ComEd will finalize its planning philosophy and guidelines document to clarify its criteria for feeder and substation transformer system planning and design by April 1, 2001. This review will include benchmarking of ratings of similar utilities to ensure that our practices are consistent with industry standards.

Five-3 ComEd should develop a "Remaining Life" data base and review process that includes recording of overloading events, replacement plans, and a double contingency design under certain circumstances.

Most utility equipment is designed and installed in manner that allows it to operate for many years. However, operating and installation practices can shorten the expected life. In addition, some equipment does not achieve its expected life due basic design or manufacturing flaws.

ComEd's practice of routinely thermally overloading equipment reduced its life expectancy. Occasional overloading and its accompanying loss-of-life is an accepted utility practice. However, when these excursions occur, ComEd should record the events for significant circuit elements such as substation transformers and main feeder elements. As chronological age, combined with thermally stressed use degrade the remaining life of the facility, ComEd should implement plans for replacement or should develop operational alternatives. For instance, if a particular length of main feeder is approaching the end of its probable life, the "First Contingency" design factor may no longer be appropriate for the surrounding facilities. At that point, ComEd should go to a "Double Contingency" design where the loss of the degraded facility is automatically assumed as the first contingency. This strategy would allow ComEd to extract "all" the life from the facility before replacing it and without unduly affecting its customers.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd has recently begun using a computer program to track the degree and duration of equipment loadings in excess of normal or emergency ratings on significant circuit elements. ComEd agrees to begin long-term tracking of overloads and other parameters that may warrant the need for additional diagnostic measures, additional preventive maintenance, operating restrictions, or equipment replacement. ComEd also agrees to use this information to implement operating restrictions, planning limitations, or contingency plans when warranted. ComEd will begin incorporating the information obtained through this long-term tracking in its planning activities beginning June 1, 2001.

Five-4 ComEd should establish an annual, formalized, objective review of the distribution load forecast processes that quantifies the assumptions and the accuracy of the forecast for each projected year.

This review should include performance indicators for the relative accuracy of feeder load projections and transformer load projections. The review should include a written explanation of significant deviations in forecasted load and assumptions and the proposed remediation action. The review process would identify weaknesses in the forecast processes such as inadequate modeling of weather effects on electric demand and energy. A retrospective review would include a comparison of actual electric loads with remodeled (re-forecasted) loads using the actual weather parameters from the season being studied. Adaptation of such a review process will ultimately reduce both construction and operating costs and improve system reliability. Results of the review should be distributed to ComEd's management as well as the affected operating personnel.

The critical forecast variables include actual historical loads, actual weather conditions, assumed correlations between weather & load, base growth rates, and probable operating contingencies.

The review should include tabular as well as graphical results of the relative forecast accuracy for the last five years minimally. Additionally, statistical data such as standard deviations, confidence limits, and sensitivity analysis should be included.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree, with exception

ComEd agrees with the intent of this recommendation. We are currently developing a formalized annual review process to validate the assumptions and quantify the accuracy of our load forecasts. The formalized annual review will provide feedback and be used to identify areas where we can refine our forecasts and models.

In December 2000, we will complete a review of the 2000 forecasted load and compare that with the actual and weather adjusted 2000 peaks. The purpose of this review is to validate the weather adjusted peak and load growth assumptions used in the prior plan and to improve the initial loading assumption used as a basis of the 2001 forecast.

Analyzing data prior to 1999 would be of limited value since we have significantly modified the basis for forecasting and data capture. In 1999 we were in a recovery mode and attempting to identify the most heavily loaded feeders and transformers for immediate loading relief. The

forecast developed under those conditions was limited, and done without new forecasting models and programs. Additionally, we changed our temperature design basis from a one-in-two (50%) weather model and load forecast based on supply forecast to a one-in-ten (90%) weather profile and a load forecast based on historical data plus identified load.

Going forward we will establish an annual, formalized, objective review of the assumptions and the accuracy of our actual forecast. That information will be fed back into the forecasting process and used to improve future forecasts.

Five-5 ComEd should formalize distribution planning guidelines for determining when load relief should begin for circuits and transformers. In addition, ComEd should develop a formalized procedure for producing its annual five-year load forecast and budget review.

These guidelines should formalize as company policy that distribution feeders have the ability to accommodate a first contingency failure that requires switching of additional load onto a feeder without exceeding the seasonal "normal" rating of that feeder. Second contingency failures would then have the emergency rating available, thus significantly improving system reliability.

In conjunction with this policy, remediation projects should begin whenever the normal loading of a feeder approaches 90 percent of the seasonal "normal" rating. Projects to reduce the load on a feeder approaching 90 percent of it normal seasonal rating should begin far enough in advance such that the projects can be completed as the 90 percent mark is reached. The combination of these two planning criteria would greatly increase the ability of operators to switch loads without overloading circuits.

Liberty notes, however, that care must be taken in formulating these policies so that they are not overly restrictive. Planning, by its very nature, relies in part on the intuition and experience of the people doing the planning. Policies should provide a clear direction for keeping the distribution system in the proper condition for delivering reliable power. However, the policies should not prevent the person doing the planning from using his or her experience to override a policy that will not work in a particular circumstance. Deviations from a policy should be documented and justified so that, for example, other planners and management can understand why the deviation occurred.

The benefits of this recommendation are the more consistent application of reasonable policy and increased system reliability. Actual implementation of the policies in the distribution system could involve initial considerable costs since it represents such a significant deviation from past practice.

The five-year forecast procedure should specify the guidelines for data collection, weather assessment, and reliability planning criteria. In addition, the procedure should include a timetable for completing each significant milestone of the process such as weather adjustment, historical load determination, forecast completion date, project completion date, and historical forecast performance review.

This is a medium priority recommendation that should be implemented by March 31, 2001.

ComEd Response: Agree.

ComEd will formalize distribution planning guidelines for load relief and develop a formalized procedure for producing its annual five-year plan. We are in the process of developing these guidelines for feeder and transformer loading and contingency planning. These new planning guidelines will be implemented by March 31, 2001. The forecast and five-year plan is being developed consistent with our commitments in ComEd's response to Recommendation Five-4.

Five-6 ComEd should move from its SAS-based feeder forecast program to a state-of-the-art forecast computer environment.

There are several good options available to implement this recommendation. First, there are good load forecast software packages available on the market that are specifically designed to perform utility load forecasting. The benefits to this approach include:

- There exists a wide, common interest customer base that shares the same generic interests in the software.
- Computational techniques and error-checking have the review of a much greater number of users.
- Motivation by the vendor is high to improve and enhance the software.

A second approach is to use a commercially available database program. There are several choices that would be effective for ComEd. ComEd would have to develop (either themselves or through an outside contractor) a "program" that would use the database software in the manner appropriate for ComEd. The advantages to this approach are:

- The program can be customized to precisely fit the needs of ComEd.
- Data importing from other sources such as ComEd's SCADA system could be simplified.
- Data exporting to other applications and users is greatly simplified.
- The forecasts could be done on a PC allowing much greater ease in training and of operation.

This is a low priority recommendation that should be implemented by June 1, 2002.

ComEd Response: Agree

ComEd agrees with this recommendation and intends to migrate to a new forecasting process. The new process will utilize a standard utility load forecasting program and a commercially available and supported database program.

ComEd has already moved to this database for storage and utilization of SCADA data. We use various temporary extraction programs to export this data into spread sheets for use in developing our current feeder forecast.

Our next steps are to continue to work with our consultant ABB to develop a migration path from our current programs and processes for feeder forecasting to the new process. This will utilize a utility load forecasting program and the PII Historian real time database as the foundation of our new feeder forecasting and planning process. The migration process is scheduled for completion by June 1, 2002.

Six-1 ComEd should review or correct several specific items in its Engineering Standard Practices and cable rating program.

Liberty discovered several matters in the design standards that it believes ComEd should review or update to improve the standards. These matters included: the use of a switch or fault-interrupting device at "Y"-joints, ensuring that there is a process to review and incorporate where appropriate new devices and equipment that has been developed in the industry, updating the standards to reflect appropriate in current industry standards, use of design examples, the removal of ground trips from frequently operated reclosers, and reviewing the maximum pulling tensions for installing cables. Liberty did not consider any of these items to be critical to safety or reliability. In addition, ComEd should ensure that its cable rating program correctly accounts for the load and loss factor relationship and for circulating currents in cable shields.

This is a low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree, with exception

ComEd will review or correct several specific items in its Engineering Standard Practices and the Cable Rating Program.

Use of a Switch or Fault-interrupting Device at "Y" Joints Review Findings

The elimination of Y joints at all locations in the distribution system located in the Chicago Region is simply not practical or feasible. ComEd does install sectionalizing devices to avoid the use of Y joints in areas where sufficient space is available. In many areas of Chicago, the infrastructure in public rights-of-way imposes constraints on the use of switches or fault interrupting devices. When reconfiguring or upgrading a line, ComEd will install switches or fault interrupting devices where space is sufficient. In this way, the use of Y joints will be minimized.

As a method to improve the effectiveness of fault locating on circuits with Y joints, ComEd is working with a manufacturer of fault indicators to develop a suitable device for installation on 3/C paper insulated lead covered (PILC) cable. Initial trial quantities have been shipped and installations are planned to be available by April 1, 2001.

Updating Standards to Reflect Industry Standards

ComEd continues to review and incorporate new devices and equipment emerging in the industry. One individual is devoted on a full-time basis to coordinate, track and support research and development efforts with research organizations such as EPRI, DSTAR and NEETRAC. This individual identifies or request projects for future ComEd participation based on feedback

from internal organizations. In addition, the T&D Operations Research Coordinator communicates the results of completed research projects, new products or technology for further investigation and application on the distribution system. As part of their job responsibilities, Equipment Specialists review new material and technologies for application on the distribution system in an effort to improve operating, reliability, and cost effectiveness.

Updating standards to reflect current industry standards is an on-going process. ComEd participates in standards setting committees such as IEEE, AEIC, and NESC. As new standards are formulated, their impact on ComEd is reviewed and the associated changes are incorporated.

Removal of Ground Trips from Frequently Operated Reclosers

Engineering Standard Practice (E.S.P.) 5.7.1, Methods of Limiting the Frequency and Extent of Momentary Service Disturbances, will be reviewed for changes in the practice of removing ground trips with current industry standards. This review will be completed by April 2001. Any incorporated changes to the existing document will be made available to engineering personnel immediately through the Company intranet and published in hardcopy format by June 2001.

Review of the Maximum Pulling Tension for Installing Cables

A review of Engineering Standard Practices (E.S.P.) 3.8.1, Calculation of Cable Pulling Tensions will be undertaken for conformance to industry guidelines. This review will focus on paper insulated cables. The maximum sidewall bearing pressure data for this type of cable needs to be reviewed and will be revised accordingly. The data for extruded dielectric cables in E.S.P. 3.8.1 follows the research and recommendations made in EPRI Report EL-3333, dated February 1984, and the AEIC Guide G5-90, Underground Extruded Power Cable Pulling Guide. In addition, a Windows-based computer program is currently under review, with the intent to replace the original DOS-based computer program referenced in the E.S.P. Any identified changes to the E.S.P. resulting from this review or introduction of new software will be issued by June 2001.

Circulating Currents in Cable Shields

ComEd will review typical recent feeder load profiles to determine if the load and loss factor for cable ratings are appropriate. This will be completed by June 1, 2001.

ComEd has established standards for grounding cable sheaths in order to reduce circulating current. These standards can be found in ComEd's *Distribution Construction Underground Standards* Section C5145 and C5165.

Six-2 ComEd should review and correct as necessary its Load Ratings Book.

ComEd chose to rate aggressively its cables. Therefore, ComEd should review and reaffirm all of the ampacity tables in sections 2 and 3 of it Load Ratings Book. As part of the review efforts, a complete set of documented calculations should be developed and maintained for each table. Tables, such as the one on page 25 of section 3, which shows multiple ampacities for the same cable, should be eliminated or have specific conditions included to show which rating should be used.

ComEd's definition of emergency was not consistent with national standards. ComEd's ampacity tables implied that the emergency rating was a continuous rating. However, the Association of Edison Illuminating Companies *(AEIC)* recommends specific limits for operating a cable at emergency ratings based on the type of cable. These limits range from 36 hours once per year to 1,500 cumulative hours over the life of the cable. When assigning emergency ratings to its cable, ComEd should base those ratings on the same standards cable manufacturers use when building the cable.

This is a low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd will review the assumptions used for cable ratings and include additional documentation with published ratings. Page twenty-five of the *Load Capability Book*, Load Capabilities of Paper-Insulated, Lead-covered 12kV, 3/c, Cables in Conduit with Other Cables, will be revised to identify the conditions under which the alternate ratings for a given cable size are to be used. The association of Edison Illuminating Companies (AEIC) guides, the same ones used by cable manufacturers, will be used for conductor temperature limitations and emergency duration. This will be completed by June 1, 2001.

Seven-1 **ComEd should reduce the testing interval for distribution system protection relays and develop a program to catch up on the backlog of relay testing that has developed.**

ComEd neglected relay package testing in recent years. ComEd should review the distribution system protection bus and line relay testing intervals and reduce them to no longer than five years for major maintenance. Utilities across the country typically test distribution relays on a one- to five-year interval. ComEd's present practice of 14 years for testing of relays is inconsistent with good utility practice.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd will perform a benchmark study of other utilities to identify appropriate testing intervals and best practices. The benchmarking study will be completed and intervals adjusted by March 1, 2001.

A work-down curve for catching up with the backlog of relay testing is contained in ComEd's monthly report. The work-down curve will be modified after test intervals are adjusted and a new schedule is developed. If adjustments are required, a new schedule and work-down curve will be developed by March 1, 2001.

In addition, ComEd will analyze historical feeder relay maintenance data by type and application. Using this information, criteria will be developed to validate the appropriateness of these test intervals. The collection and analysis of historical data will be completed by September 1, 2001.

Seven-2 ComEd should implement a program to install fuses on all laterals and taps in accordance with the ComEd Standards.

ComEd was not following its current standards to fuse laterals and taps from the main feeders. By installing the required fuses, the reliability of the distribution system will improve. (Subsequent to July 1999, ComEd has implemented a program to identify all fuses and laterals which at not fused. As of early 2000, ComEd had identified 353 unfused taps on 4kV systems and 2,264 unfused taps on 12kV systems.)

This is a high priority recommendation that should be implemented by September 1, 2000 for the program. Field implementation should be accomplished within five years or June 1, 2005.

ComEd Response: Accept

ComEd implemented a program in September, 1999 to check for and install fuses on all taps in accordance with Company standards. Fuse installations have been completed for approximately 1,500 feeders as of year-end 2000. All taps will be fused in accordance with Company standards by June 1, 2005.

Seven-3 ComEd should develop a formalized procedure to replace old and obsolete feeder protection relays with microprocessor-based relays.

There are literally thousands of existing electro-mechanical relays in service that are functioning adequately. However, the functionality of those relays are marginal in comparison with that of the microprocessor-based relays, and the maintenance requirements are much greater with the older style relays. Finally, when the problematic reclosing relay used by ComEd is added to the equation, ComEd should follow its own, in-house recommendation and develop a formalized plan to replace old and obsolete feeder protection relays with microprocessor-based relays.(Subsequent to the time frame of this report, ComEd chose to upgrade the feeder and bus backup relays at the Jefferson Substation.)

An added benefit to replacing the older electromechanical feeder relays with the microprocessor relays includes the ability to provide better protection logic that can be used to minimize cable basement fire damage.

This is a medium priority recommendation that should be implemented by December 31, 2000 for development of the procedure. Field implementation should be accomplished within ten years or June 1, 2010.

ComEd Response: Agree

All new feeder relays installed will be microprocessor relays.

Additionally, a formal procedure will be developed to determine if replacement programs for feeder relays are required. ComEd will gather and analyze historical relay maintenance data and develop criteria for determining which relays need to be replaced. Based on those findings, ComEd will develop an appropriate replacement program for feeder relays. The collection and analysis of historical data will be completed, and any subsequent replacement programs will be defined by September 1, 2001. Field implementation schedules will be determined based on these evaluations.

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Seven-4 **ComEd should review its system and install reclosers on feeder taps in accordance with its standards on the basis of load and at the midpoint on lines that have a length of 5 miles or more.**

Reliability of the system will be increased by the additional sectionalizing recommended. Main feeder taps with loads in excess of 17 percent should have reclosers installed in accordance with the ComEd standards. An in-house report recommended that reclosers be installed at the mid-point for lines longer than 5 miles. Implementation of both practices will improve system reliability. Use of modern electronically controlled reclosers will provide added reliability to the system with more sophisticated protection functions.

This is a medium priority recommendation that should be implemented by June 1, 2001 for identification of the locations and by June 1, 2005 for field implementation.

ComEd Response: Agree.

ComEd will develop design criteria for the use of sectionalizers and reclosers and will install devices in accordance with those standards. We will establish the design criteria by May 1, 2001 and will complete the review of all feeders against these standards by June 1, 2001. An installation schedule based on performance and reliability considerations will be developed by September 1, 2001.

Seven-5 ComEd should evaluate the application of neutral grounding inductors on large distribution power transformers and apply neutral inductors on each 12kV distribution power transformer rated 40 MVA and above.

ComEd's historical standard practice was to ground substation transformers with neutral inductors. That practice has been questioned internally in recent years. As a result, newer substations like the Warrenville TDC have no neutral grounding inductors. ComEd should investigate the application of placing an individual neutral grounding inductor on each transformer in existing substations where a common neutral grounding reactor is now used. ComEd should investigate the use of an individual neutral grounding inductors on each new transformer. The individual neutral grounding inductors minimize ground fault damage to distribution equipment by minimizing the fault current and limiting the damaging effects to the power distribution transformer by limiting the through-fault current on the transformer.

This is a low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd will consult with EPRI and other industry experts to evaluate the application of neutral grounding inductors on large distribution power transformers. The Company will conclude this evaluation by June 1, 2001.

Seven-6 ComEd should provide the regional TISs with a common technical manager.

The TISs provide a technical service and need technical leadership. That technical leadership was dissolved in September 1999. TISs perform technical duties that need the direction and leadership of a technical leader.

This is a low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

The TI groups are responsible for cable fault locating and investigation of complaints regarding power deliver (reliability) and power quality. TI work is closely coordinated with that of other regional work groups under the control of regional management. Work performed by the TI groups directly impacts customer service on a regional basis. As a result, ComEd believes that regional TI resources need to be directed by and accountable to regional management.

However, ComEd agrees that uniform technical direction of the eight regional Technical Investigations groups is beneficial. Technical direction includes determination of training requirements and oversight of development of training programs, standardizing tools, methods and processes, and incorporating lessons learned. A functional leader for this discipline will be established by March 1, 2001.

Seven-7 ComEd should replace incandescent indicating lamps with LED type lamps.

Incandescent indicating lamps have a high failure rate. Incandescent indicating lamps have to be replaced several times a year, which is costly in terms of materials and labor. LED-type indicating lamps have a relatively long life, 10-20 years, and typically have a simple payback in approximately one year. By having a highly reliable indicating lamp, a substation operator can much more quickly determine the condition of circuit breakers and other devices in the substation. The time to restore power to the customer is shorter and there is less chance of a switching error. In short, reliability to the system will be improved and ComEd will see a high return on their investment.

This is a low priority recommendation that should be implemented by June 1, 2002.

ComEd Response: Agree, with exception

ComEd presently uses LED-type lamps in new substations and on new equipment installed at existing sites. ComEd agrees to replace incandescent indicating lamps with LED-type lamps when an LED-compatible incandescent lamp fails, or when an obsolete incandescent lamp assembly fails. ComEd does not believe that a wholesale effort to change incandescent lamps to LED-type will improve reliability or save money.

The use of SCADA has significantly changed the routine and non-routine switching procedures that occur at a substation to the point that an operator may not even be present to view the indicating lamps while switching is being performed. Aside from the extended life of the lamp, the use of the LED lamps will have a very minimal impact on the operation of a station. A wholesale program to change all incandescent lamps would, however, result in significant costs including:

- The cost for control circuitry design reviews and possible changes due to the additional leakage current of LEDs;
- The cost for replacement of the resistor-plug mounting devices where required; and
- The cost of labor needed to remove equipment from service while this modification is made.

During normal routine site inspections or investigations of automatic operations ComEd Substation Operators look for abnormal conditions through inspections. This includes a detailed inspection of equipment status, including reviewing lamp indication, protective relay targets, annunciator displays, and visual inspections of the equipment and mechanical flags. Operators do not rely solely on panel lights during this inspection process. Additionally, if an operator finds a burned out lamp, the bulb is replaced. If the lamp assembly is compatible with an LED, the lamp

will be replaced with an LED bulb and cap. Should the bulb still not illuminate, possibly signaling a failed series resistor, a Maximo work order ticket is generated to have Substation Construction personnel replace the entire lamp assembly, and an LED-type replacement will be used.

ComEd does not believe that cost savings would result from a wholesale changeout of incandescent bulbs. With current usage and bulb life expectancy of a direct LED replacement bulb and cap for the G.E. ET-6 incandescent bulb, the LED bulb/cap assembly can cost up to eight times as much as the incandescent and may have a payback between five to eight years. If there is an incompatibility between the entire incandescent lamp assembly and the LED bulb, a replacement LED socket would be required and payback is minimally 20 years.

Based on the five to eight year payback at locations that support a direct incandescent for LED replacement, ComEd agrees to modify substation operator routines to have failed ET-6 socket incandescent bulbs replaced with a compatible direct replacement LED and respective colored cap. This recommendation will be implemented by March 31, 2001.

Eight-1 ComEd should use to its full potential the available technology that locates lightning strokes in relation to its T&D system.

A series of long-term goals that ComEd should pursue are:

- Provide major transmission line (345kV and 765kV) location mapping information into a computer database that can be overlaid with the lightning stroke database to accurately locate lightning faults to major transmission lines. This database could be used by transmission dispatchers to quickly locate lightning damage to transmission lines and help restore service.

- Provide 138kV transmission line location mapping information into a computer database that can be overlaid with the lightning detection database to accurately locate lightning faults to 138kV transmission lines.

- Provide distribution line location mapping information into a computer database that can be overlaid with the lightning detection database to accurately locate lightning faults to distribution lines.

ComEd demonstrated that it has the capability through its access to the Global Atmospherics Inc. lightning detection system to compare the locations of lightning strokes to the locations on transmission and distribution lines. A long-term goal of ComEd should be to provide the capability to its transmission dispatcher to help pin point faults on the transmission system. And ultimately, ComEd should expand this capability to its distribution dispatchers. The benefit would be the ability to quickly locate and dispatch troublemen to the location of the damaged line.

This is a low priority recommendation that should be implemented by June 1, 2002.

ComEd Response: Study.

ComEd agrees to utilize available technology to determine the effectiveness of current and potential lightning protection methods and to identify locations where additional protection is needed for both Transmission and Distribution facilities, and has implemented this recommendation.

ComEd has recently purchased a lightning detection system that is now in use at both its Distribution and Transmission Operation Centers. It dynamically displays real time lightning information that is used to proactively manage storms. The stored information is also used for cause analysis when reporting outages.

On longer circuits such as transmission lines (138kV, 345kV, 765kV) the lightning detection system can be used to locate lightning faults. The Company will evaluate implementing a computer database that will incorporate this feature by June 1, 2002. ComEd will also investigate using this technology for locating lightning faults on the distribution system, but as noted by Liberty in its report, the detection systems currently available are not precise enough to locate many of the lightning faults on the distribution system.

Eight-2 ComEd should discontinue the use its new 34 kV line lightning protection design until it can explain the high outage rate on the 34 kV line in the Northwestern Region.

Evidence of a high number of lightning outages and lightning arrester failures raises the question as to whether the new 34kV line design provides adequate protection. In its own Lightning Protection Analysis of the Distribution System report (January 1998), ComEd recommended that a comprehensive monitoring program be developed to track the performance of all new 34kV lines built with arrester protection. That recommendation was not followed.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Study

In 1993, ComEd published the results of a comprehensive lightning protection analysis that led to the development of a "new" 34kV lightning protection design. The analysis showed that installing arresters on all 3 phases was more reliable and more cost effective than a static shield wire design. ComEd implemented the new standard in 1993, and since then it has been utilized in the design of at least twelve 34kV feeders.

ComEd believes that the new lightning protection design is fundamentally sound. In fact, the performance curves obtained from an independent study shown on page VIII-9 in Liberty's report demonstrates the superior protection provided by the 3-phase arrester installation. Since the vast majority of 34KV Lines with the new lightning protection appear to be performing adequately, ComEd believes that it would be premature to change our new standard lightning protection design based on the performance of a single 34kV line. Additional study of the performance of the 34kV line, L12374, as well as the performance of the other lines constructed using the new design standard is necessary before making such a sweeping change in designs. ComEd has been unable to determine why the internally recommended program to monitor 34kV lightning performance was not implemented.

ComEd recognizes that L12374 has not performed as well as other lines. ComEd will first analyze L12374 to determine if the lightning-related outages point to a systemic problem with the new lightning protection design or if they are unique to this particular line. ComEd will examine relevant data to determine if the lightning protection itself is in question, or if the interruptions occurred because L12374 received abnormally high lightning exposure or if problems other than lightning might have tripped the line and been recorded as lightning. ComEd will also analyze the reliability of the other lines that were constructed using the new lightning protection standard and compare their performance with other 34kV lines on the ComEd system. Once this analysis is complete, ComEd will make appropriate modification to its lightning protection design standard.

Specific Actions

ComEd will investigate the cause of the outage rate on the L12374 in Northwest Region. This investigation will focus on several issues:

- Was the line designed in accordance with ComEd standards? Specifically, did the design conform to Engineering Standard Practice (ESP) 7.5.5.1? (This ESP was renumbered to 5.7.5.5 in 1999). This ESP provides the "new 34kV lightning protection design" referred to in Liberty's recommendation.
- Was the line constructed in accordance with ComEd standards? Specifically, does the physical construction conform to Engineering Standard Practice (ESP) 7.5.5.1 and appropriate 34kV Construction standards in place at the time of its construction?
- Investigate for evidence of line of outages caused by conditions other than lightning.
- Compare performance of L12374 to the other lines built after 1993 to the new standards and to lines not built under the new standard.

This investigation will be completed by 4/1/01 and shared with the ICC and Liberty Consulting.

The findings of ComEd's investigation will dictate the appropriate course of action. If the investigation shows L12374 was **not** built according to ComEd standards:

- Plans will be issued and executed to bring the line into conformance by 8/1/01.
- Re-training of the design and/or construction resources will be performed to prevent future cases of nonconformance.
- A review will be performed to determine if the investigation should be broadened to review other 34kV lines for conformance to the standards.

  If this path is chosen, it will be completed by 5/1/01 except where otherwise noted.

If the investigation shows L12374 **was** built according to ComEd standards:

- ComEd will widen the investigation to verify that the protection schemes and equipment on the line are operating correctly and not causing unnecessary trips. If the protection schemes are found to be faulty, then they will be corrected and the lightning standard cannot be judged by this case.

  If this path is chosen, it will be completed by 4/30/2001.

If the investigation shows L12374 line **was** built according to ComEd standards **and** the line protection is adequate:

- ComEd will review the 1993 lightning study that instituted the 34kV lightning protection design:

1. The study will be reviewed to verify assumptions against current industry practices and data resources.

2. ComEd will review utilizing external expertise to validate or refute the study's recommendations. One possible source will be to have EPRI Solutions model a typical 34kV line in ComEd territory and determine if the present standard has acceptable performance.
3. Appropriate standards will be issued based on the results of the review.

If this path is required, it will be completed by 7/31/2001.

Eight-3 **ComEd should install shielding in all new substations to provide direct-stroke lightning protection. Furthermore, ComEd should review all existing substations and develop a program to provide direct-stroke protection where economically feasible.**

To meet good utility practices, ComEd needs to provide better lightning protection in its substations through the proper use of shield wires, lightning masts, and other shielding devices. Some substations on the ComEd system have adequate protection as a result of properly shielded transmission line routing, large adjacent structures, and buildings. An example of such a substation is the LaSalle 138-12 kV TDC in downtown Chicago. However, other substations are vulnerable to direct lightning strokes.

This is a high priority recommendation that should be implemented by May 1, 2001.

ComEd Response: Accept

ComEd will develop standards for direct stroke lightning protection for all new substations. Once the standards are finalized, the Company will perform a cost benefit analysis to determine whether or not shielding should be installed at existing substations. The Company will then develop a prioritized list for direct stroke protection, installation costs, and anticipated reliability improvements associated with the installation of the overhead shield wires in existing substations to determine if a retrofit program is feasible and warranted.

The implementation of this recommendation will be completed by May 1, 2001.

Eight-4 ComEd should investigate its practice of not grounding the shield wires of all transmission lines to the substation ground grids.

Good utility practice dictates that the shield wires of transmission lines should be connected to the substation ground grids. Better grounding and better lightning protection will exist if those shield wires are connected to the substation ground grid. Liberty learned that ComEd has begun recording the locations where the shield wires are not connected to the substation ground grid and has grounded at least one such installation. It also appears that a recent internal investigation has begun on this matter. Later, ComEd indicated that it had investigated and changed this practice.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Accept

This recommendation has already been implemented.

ComEd has modified its practice for static wire grounding at substations. All future static wire installations dead ending at the substation shall be solidly grounded. When maintenance is performed on the existing substation terminal insulated static wire dead-end assemblies, they shall be replaced with conventional, non-insulated assemblies and shall be solidly bonded at the switchyard dead-end structure.

Eight-5 ComEd should provide lightning protection for underground transmission lines.

The lightning protection standard should include as a minimum direct-stroke protection and lightning arresters. ComEd has a major investment in underground cable. Moreover, many of the underground transmission line cables are essential to reliable service, especially in the downtown Chicago region. Proper direct-stroke shield protection of the underground cable terminations and proper lightning arrester protection at the terminals is a minimal investment to provide lightning protection to the underground transmission lines. This is a high priority recommendation that should be implemented by May 1, 2001.

ComEd Response: Study

ComEd will benchmark industry practices and consult with EPRI to evaluate the appropriate application of lightning protection to underground transmission cable terminals. A recommendation for appropriate application based on this analysis will be completed by 5/1/01.

Nine-1 The distribution planning group should present the annual summer loading data to the distribution dispatchers by March 31 or earlier.

The senior dispatchers need the summer loading data, as indicated in the 5-year plan and the ELCP (Emergency Load Conservation Program), presented to them no later than March 31 to (1) arrange and schedule construction and maintenance projects for the Spring and (2) allow the dispatchers to be well-prepared for summer load emergency conditions. Presently, the data is presented about May 1. In the long run, the distribution system should be planned and maintained such that dispatchers need not be particularly concerned about hot summers.

This is a medium priority recommendation that should be implemented by March 31, 2001.

ComEd Response: Accept

ComEd customarily completes its load projection in March of each year. Annual load and capacity projections will be presented to distribution dispatchers by March 31, 2001 and each year thereafter.

Nine-2 ComEd should include in their restoration procedures priority to installing temporary connections, portable generators, or portable transformers during repair work when loads cannot be picked up by normal switching.

Sometimes repairs may require much more time to accomplish than at first determined. When normal switching cannot restore service to interrupted customers, ComEd should have plans in place to install temporary connections, portable generators, or portable transformers while the repair work is in progress.

This is a medium priority recommendation that should be implemented by June 1, 2001 for a plan and June 1, 2002 for field implementation.

ComEd Response: Agree

When loads cannot be picked up by normal switching, priority is given to installing temporary connections, portable generators, or portable transformers during repair work. This process is formalized in the Company's Emergency Restoration Plan and the use of the Centralized Command Center (at the DDC). The Company is focusing on every reasonable means of expediting the restoration of service. Dispatchers constantly question the field forces on restoration times and any possible means to expedite service to our customers including the deployment of temporary generation for outages that are anticipated to be well beyond the average duration. More mobile generators, extra cable equipment, and spare transformers are now available to help restore customers faster. As part of the emergency restoration plan, generators and spare equipment are located throughout the City and other regions to facilitate these faster repair times. Additionally, SWAT trucks, containing critical spare materials, are stocked and ready to go in restoring service to customers as quickly as possible. Where routes have been needed in the City to enable the rapid deployment of replacement substation transformers, they have been preplanned and permitted.

ComEd has 17 generators available to provide service to customers during service restorations throughout the service territory. These generators have been used in the City of Chicago and in regions other than Chicago. Of the 17 generators, 14 are located outside the City of Chicago.

In the event of an emergency, ComEd follows the defined procedures outlined in the T&D Emergency Response Manual (ERM-001). These procedures allow the organization to move forward in a timely manner to get power back to customers and/or restore the system to normal operation. This integrated plan details three response types. For each plan, roles & responsibilities, committed resources, and detailed process flows are defined.

- *Storm Restoration Process (SRP)* - To get power back to the customers as quickly and safely as possible and to keep the customers informed about the progress of our restoration efforts during a storm situation.

- *Transmission Operations Emergency Plan (TO Emergency Plan)*– To optimize resources during periods of inadequate system generation and/or transmission related problems. It is designed to minimize impact on customers by incorporating ComEd policies, North American Electric Reliability Council (NERC) Policies, and Mid-America Interconnected Network (MAIN) Operating Guides.

- *Site Restoration Management (SRM)* - To coordinate all site restoration activities and provide structured leadership that stresses safety and communication among working groups. This team is called into action whenever equipment outages occur at any ComEd T&D facility or customer location that require the coordinated effort of multiple departments over an extended period of time or under emergency time constraints.

Nine-3 ComEd's dispatchers should be monitoring, via SCADA and PI-historian software, transformer and cable temperatures, at least where over-temperature conditions may exist.

This should be done so the dispatchers (and the planners) can determine if transformers in substations and cables leaving substations should be de-rated due to over-temperatures. The PI-historian software can record any overloaded or over-temperature condition for future reference by the planners and maintenance engineers. Possibly, critical cables could be monitored for excessive temperatures.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree.

ComEd agrees that monitoring of equipment and conditions should be done and began implementing this at high priority locations in 2000. We agree that substation transformers require temperature alarms/monitoring and this should be implemented. We agree that monitoring of overload conditions should be done and a field inspection and engineering review should follow any such instances. A procedure to define and govern this activity will be developed and implemented by June 1, 2001.

Nine-4 ComEd should plan to install remote monitoring of network protectors.

This would provide a means to monitor network protector positions and to quickly determine when a network problem occurs. This would be a large undertaking (ComEd has about 2,000 network protectors) and should not receive priority over completion of SCADA as planned. Consolidated Edison in New York City has had SCADA on its network protectors for several years.

This is a low priority recommendation that should be implemented by June 1, 2001 for a plan and June 1, 2005 for field implementation.

ComEd Response: Study

As recognized by Liberty in making this recommendation, this project would be a significant undertaking for ComEd because of the large number of network protectors (2000) in ComEd's system. Our preliminary analysis of deploying a remote monitoring system indicates that this system will cost between five and ten million dollars and will have little or no impact on SAIFI or CAIDI performance. ComEd is reluctant to commit to adopting this system until we can fully understand the risk mitigation and economic benefits associated with a remote monitoring system (RMS).

ComEd will develop a business case and implementation plan by May 31, 2001, before committing to deploying RMS. ComEd will state in the business case the extent to which it has adopted Liberty's recommendation. Prior to the deployment of RMS, ComEd will commit to visual inspections of network protectors at critical locations on peak days.

Nine-5 ComEd should prepare an Emergency Distribution Load Shedding Plan indicating clearly defined procedures to determine when to shed load, what load to shed, and who to notify.

ComEd uses one of the load shedding steps in the Bulk Power Group's Emergency Load Conservation Plan (ELCP), which is intended to provide for transmission system stability. ComEd needs a similar plan to provide guidelines for shedding distribution load to prevent equipment failure due to extreme overload conditions. Although the plan cannot replace the knowledge of senior load dispatchers, it would help minimize both unnecessary equipment failures and unnecessary outages. The present ELCP step 15A database used to select the optimum circuits to shed is very effective and its use should be continued, except that the Chicago Loop circuits should be included.

This is a medium priority recommendation that should be implemented by March 31, 2001.

ComEd Response: Accept

This recommendation has already been implemented.

ComEd has developed a Distribution Load Management Program that is in compliance with the recommendation. The plan is currently in "trial mode" and any necessary modifications will be implemented.

Nine-6 ComEd should have procedures that (1) allow troublemen and operators to perform repairs more often, and (2) provide quick access to repair crews.

When an interruption occurs, typically only one troubleman or operator is called to investigate, particularly in the suburban areas. Since safety concerns limit the work one person can perform, ComEd should consider having more troublemen on duty at all times, with the ability to work together to perform minor repair work. Although ComEd had crews working second and even third shifts in some regions, ComEd should consider having a small repair crew in each region on-duty at all times to respond quickly to interruptions. Presently travel from home, to shop, and to job increases repair times. Also, repair crews should be trained and allowed to re-energize equipment, without waiting for troublemen.

This is a medium priority recommendation that should be implemented by March 31, 2001.

ComEd Response: Accept

This recommendation has already been implemented.

Nine-7 ComEd should accelerate the implementation of the digital mapping (CE*GIS) of their equipment and have it integrated into the interruption location software.

ComEd's dispatchers used the SCADA to identify open circuit breakers, and ODS with phone-in interruption reports to locate interrupted customers. The CE*GIS system will sometimes speed up the identification process.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree.

The electrical connectivity data for the regions outside of Chicago has been entered into CE*GIS. By June 1, 2001, the electrical connectivity data for the City of Chicago will be entered into CE*GIS. This data will be integrated into the existing Operating Dispatch System (ODS), as well.

Nine-8 The distribution construction and maintenance organization should be separated from the substation group.

The construction and maintenance work for distribution and substations are not only both intense, but also different in manpower skills and equipment.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Accept

This recommendation has already been implemented.

Effective with the reorganization of the Distribution Group, as discussed in response to Recommendation Two-1, the distribution construction and maintenance organization and the substation group have been separated at the Regional Lead level in the organization.

Nine-9 ComEd should reduce and prioritize the maintenance backlog.

ComEd should (1) prioritize maintenance items by similar fashion as used for substation maintenance, (2) use line and underground contractors to catch up and stay current with maintenance, and (3) stop pursuing outside work that takes manpower away from ComEd maintenance. ComEd should provide funding for distribution maintenance as necessary until all backlogged repair work is caught up and optimized maintenance procedures are in place and proven to maintain reliability. ComEd cut back on maintenance expenses on a per customer basis during the 1993 to 1995 period. This contributed to the large backlog that existed in 1999.

This is a high priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Accept

ComEd has implemented a work management process designed to prioritize, schedule and monitor the actual performance of maintenance work.

Nine-10 ComEd should integrate the various databases used to track distribution equipment, construction, and maintenance.

There is no convenient way to obtain an overview of all ComEd equipment, construction, and maintenance programs for the distribution system.

This is a low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd agrees with this recommendation and is in the process of implementing it. Com Ed is in the process of implementing the Indus Passport system and CE-GIS as discussed in response to Nine-7. The accompanying databases will be used to track distribution equipment, construction and maintenance. A staged rollout of the Indus Passport System is scheduled for completion by December 31, 2001.

Nine-11 ComEd should increase the frequency of the pole inspection program, which includes 25 specific items to inspect and other items to upgrade, to every four years.

An indication that an inspection program should be intensified is the quantity and types of problems found by the inspections. If few critical defects are identified in thorough inspections, the inspection repeat time could be extended. This is not the case for ComEd's pole inspections.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response**:** Agree

ComEd agrees to implement a 4-year pole inspection cycle including the main stems of the feeders and taps off the main stems. This will include all distribution poles. The 4-year cycle will be implemented in the year 2002, after the completion of the one-time inspections currently underway. ComEd will evaluate and implement the most effective method for accomplishing the 4-year cycle.

ComEd performed a one-time inspection of 1950 circuits (4 and 12kV) in year 2000 and plans to complete another 1950 circuits in 2001. ComEd also performed an inspection of 134 circuits at 34kV in year 2000 and plans to complete another 134 circuits in 2001. The current program consists of inspecting the main stem of the feeders and identifying all unfused taps off the main stem. These inspections will leverage the greatest benefit to our customers in years 2000 and 2001.

Nine-12 ComEd should expand the maintenance testing of cables to include all priority cables.

Since cable failures are a significant cause of known interruptions, diagnostic testing should be continued and expanded. Priorities should be based on worst performing cables (those that have had previous failures) and critical cables (those for which failure results in the greatest number of interrupted customers).

This is a high priority recommendation that should be implemented by March 31, 2001.

ComEd Response: Agree, with exception

ComEd agrees that diagnostic testing should be continued and expanded, with priorities based on worst performing cables and critical cables. The Company has been exploring new techniques for testing cables, however, the viability of these techniques is still in question. ComEd is actively working with industry research groups to identify the most reliable cable testing procedures that will provide tangible results.

Listed below is a description of the research initiatives and the dates when final reports will be completed. Research has been primarily in cooperation with Electric Power Research Institute (EPRI) and the National Electric Energy, Testing, Research, and Application Center (NEETRAC). Once the cable-testing procedures are validated, ComEd will develop schedules to expand maintenance testing. The implementation date of this recommendation is contingent on completing the research and achieving successful results. The research is projected to conclude by the end of 2002.

Testing to Date

As a result of 1998-cable space investigation, ComEd initiated a pilot project that involves the assessment and, if necessary, replacement of first-section cables for distribution circuits served by substations with cable spaces. The project consists of testing substation exit cables and replacing cable that fails these tests. The pilot project is scheduled to be completed by yearend 2003. As the project progresses, on-going analysis will compare the actual field performance to the results generated utilizing the Tan Delta diagnostic tool.

In addition to the extruded dielectric pilot program utilizing the Tan Delta methodology, ComEd has pursued diagnostic techniques that utilize partial discharge. Techniques examined include both in-service and out-of-service methods. Limited methods are applicable to long circuits constructed with paper insulated lead covered (PILC) cable with multiple taps. To date, partial discharge techniques employed on PILC cable in the field and laboratory tests have not

confirmed the accuracy of this diagnostic method. The technology required to locate potential failures in the underground distribution system is still developing.

ComEd has been actively involved with the Electric Power Research Institute and the National Electric Energy, Testing, Research and Application Center to evaluate cable assessment techniques. Enclosed below are on-going research and technology initiatives involving underground cable assessment and diagnostics.

Electric Power Research Institute (EPRI):

- Tailored Collaboration Agreement 7322-006 entitled "PILC Distribution Cable Assessment Study". Participation includes ComEd, ConEd, Northern States Power, BC Hydro and PSE&G. Project deliverables include recommendations on specific measures, methods, and test procedures that can be applied including description of any in-situ tests for PILC distribution cable assessments. The final report was issued in the fourth quarter of 2000. Conclusions and recommendations for future work identified in the report are under review.

- Tailored Collaboration Agreement 45122-001 entitled "Condition Evaluation of PILC Underground Cables on ComEd 12.5 kV System". This project involved diagnostic testing of certain PILC cables using KEMA to identify locations of partial discharge. Specific samples that indicated high levels of PD were sent for laboratory analysis and are presently under evaluation. Since the PD testing was performed, cable faults have occurred in locations that were not diagnosed as problematic through the KEMA PD detection.

- EPRI Underground Distribution Infrastructure 00-04 entitled "Estimation of Remaining Life of PILC Distribution Cable". This project builds on a planned 1999 tailored collaboration project intended to evaluate diagnostic tools suitable for assessing the state of the paper, oil, and lead sheath in aged PILC distribution cable. Methodology for estimating future performance will be sought. This project will leverage a new supplementary-funded effort examining condition assessment potential diagnostic techniques for Paper-Insulated, Lead-Covered (PILC) cable assets. It will apply the methodology to assessments of the state of aged PILC systems and use this information to estimate future performance. This is a new project for year 2000, final report is due third quarter 2002.

- EPRI Underground Distribution Infrastructure 97-03 entitled "In-Service Evaluation of Distribution Cables". This project will correlate results from studies of various EPR cables and TR-XLPE cables on the Orange & Rockland distribution system, along with laboratory aging work. Additionally, because EPR manufacturers use different proprietary compound formulations, this work will determine whether performance and life expectancies of different EPRs can be generalized. This is an ongoing project, final report is due fourth quarter 2001.
- EPRI Underground Distribution Infrastructure 99-06 entitled "Estimation of Remaining Life of Aged XLPE-Insulated Cables". This project's objective is to quantify the ability of in-situ diagnostics to predict remaining life by combining emerging and newly available cable test diagnostics with results from EPRI cable-aging projects from recent years. An inherent limitation of currently employed in-situ diagnostic techniques such as partial discharge and

low-frequency testing is their inability to effectively predict future performance in terms of months or years of reliability. In-situ diagnostic testing at 6 utility sites completed; cables removed and tested at BICC. Service-aged cables can be ranked for future performance. Comparison with in-situ test data gives preliminary estimates of remaining life. The Phase 2, of the project underway, final report due second quarter 2001.

National Electric Energy, Testing, Research and Application Center:

- 99-365 entitled "Diagnostic Testing of Underground Distribution Cable Systems". This project evaluated various manufacturers diagnostic testing methods to assess the integrity of underground cables systems. Participating companies included Southern Company, Florida Power & Light, Virginia Power, Southwire, Union Carbide, GRESCO, PSE&G, Southern California Edison, Electric Power Research Institute, South Carolina Electric & Gas. The research showed that none of the diagnostic testing techniques that were evaluated could accurately determine the condition of underground cable systems.

- 99-356 entitled "Feasibility Study on the Use of Neural Networks for Underground Cable Diagnostics". Participating companies included Southern Company, Florida Power & Light, Virginia Power, Southwire, Union Carbide, GRESCO, PSE&G, Southern California Edison, Electric Power Research Institute, South Carolina Electric & Gas. The project determined that it is feasible to use neural network techniques to evaluate partial discharge signatures measured with cable diagnostic equipment. As a result, in June 2000, the NEETRAC members voted to continue research that would develop the necessary neural network algorithms that could provide accurate cable assessment.

Nine-13 ComEd should expand the distribution equipment inspection program.

The program should be expanded to include:

- Periodically inspect all distribution line, cable, and equipment connections, arresters, capacitors, transformers and switch contacts using infrared thermographic viewers. These inspections will detect loose connections and contacts, and inoperative and overheated devices. Also, a limited visual inspection of lines, equipment, and cable terminations can be performed with the infrared inspections.

- In addition to network protector transformers, periodically test the oil in all transformers, 500 kVA and larger, and test for dissolved gases, moisture, dielectric strength, and evidence of sludging. These tests can detect incipient defects, water contamination, and excessive aging of the oil.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree/Study

ComEd will expand its distribution equipment inspection program by performing infrared inspections of 4kV and 12kV overhead equipment in the City of Chicago. The first phase of this program has begun and ComEd plans to inspect all Chicago feeders by the end of 2001. Maintenance items identified will be repaired prior to the next inspection cycle. ComEd will review the quantity and severity of items found during the 2nd cycle and use this information to evaluate the effectiveness of the 1st cycle. ComEd will use this information to determine the appropriate cycle for subsequent inspections.

For distribution equipment outside the City of Chicago, ComEd agrees to implement an infrared inspection of the main feeder stem in conjunction with the 4-year overhead feeder inspection program. ComEd will use the results from both of these inspections to determine the appropriate cycle for future inspections. This will be implemented beginning with the 2002 program since the two year accelerated program will be finished in 2001.

ComEd performed similar inspections on our 34kV system in the 1990's. The 2nd cycle of inspection produced a significant reduction in the number of items found. ComEd's experience with infrared testing during this program is the driving reason for performing an evaluation to determine the appropriate infrared inspection cycle.

ComEd will develop criteria for oil testing of distribution transformers 500 kVA and larger. The new criteria will be developed and field implemented by 5/01/01. ComEd will also benchmark

oil testing practices of similar utilities to ensure that our practices are consistent with industry standards.

Ten-1 ComEd should develop proactive programs to track the age, loading, and physical condition of its distribution system so that repairs, refurbishment, and replacements can take place before system failures occur.

ComEd's distribution system is extensive and so this is not an easy recommendation to meet. However, good utility practice suggests that ComEd should start to get away from its strictly reactive mode and begin developing formal and systematic programs that will cause actions to be taken before there are system failures. These efforts start with improved distribution system planning but can extend to better operational feedback, improved and forward-looking maintenance efforts, and the extension of problem analysis to similar situations in which the problem has not yet occurred.

ComEd should improve the accuracy and method used to track the loading on cable and other equipment. An improved method of tracking overloaded cables would not only verify data for planning but also provide valuable information on cable condition prior to actual failure. ComEd should develop a cable testing program to identify aging cable that may have reached the end of its useful life.

ComEd has approximately 34,000 circuit miles of underground power distribution cable. With over 2,400 underground cable failures a year, underground cable failures are contributing significantly to the reliability of the distribution system. ComEd should develop a program to identify cables that are suspected to be close to the end of their useful life prior to cable failure and the resultant customer interruption.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree with exception.

ComEd will commit to the development of a tool to identify and determine the duration of cumulative overloads on circuits based on data captured from SCADA technology. This data, along with the data in the Cable Fault Tracking System, will be used to better evaluate the condition of the distribution system. Information obtained through the failure (Autopsy) analysis program is also entered into this database. The tool will be implemented by December 31, 2001. Information on the physical condition of the system will be obtained through repair and maintenance activities, and will be tracked in the Indus-Passport system. (Recommendation Nine-10). ComEd does not have the data needed to develop a historical database to track distribution cables by age, but we will begin tracking the install date on new underground cable installations by September 1, 2001.

Ten-2 ComEd must not allow the physical condition of its distribution system to deteriorate to a condition like that which was discovered in the Fall of 1999.

An improved and regular program of inspection and repair must be implemented. Similar to the recommendation above, ComEd must become more proactive and not wait until after a disaster to learn what kind of shape its system is in. Improved preventive maintenance and systematic inspection programs with assured follow-up on the inspection findings should become a regular part of the T&D culture at ComEd.

This is a high priority recommendation that should be implemented by March 31, 2001.

ComEd Response: Agree

ComEd continues to support its commitment to improve and maintain the condition of its distribution system. The biweekly and quarterly reports provided to the Commerce Commission provide the detail for the preventive maintenance programs and the project plans. In addition, the reports provide system performance trends to track the effectiveness of the workplans. The system performance indicators will provide information that ComEd management uses to determine where adjustments need to be made to ensure a focus on performance improvement is sustained. Our response to Recommendation 3-1 indicates our commitment to provide the funds necessary to maintain system reliability.

Ten-3 ComEd should improve the accuracy of the system used to track distribution system transformer loading.

While the failure of distribution transformers does not appear to be a major contributor to ComEd customer interruptions, the current system produces information that cannot be relied on to make engineering judgments. In addition, more accurate information on transformer loading would allow ComEd to determine system reliability weaknesses before failures occur.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd will improve the accuracy of the system used to track distribution system transformer loading by ensuring that an annual review of transformer overloads is performed and that error correction processes are in place. ComEd plans to continue its ongoing program to investigate and correct apparent transformer overloads identified by its Transformer Load Management (LFM-Load Factor Method) Program. This recommendation will be implemented by June 1, 2001.

As acknowledged in Liberty's report, a distribution transformer failure caused by an overload is not a significant factor on the ComEd system. There are virtually no outages attributed to distribution transformer overloads. Typically only about 10% of the transformers investigated result in valid overloads that require replacement. ComEd runs the LFM Program to identify potentially overloaded transformers, investigates the accuracy of data for transformers loaded in excess of thermal capability, and determines the need for transformer replacement after tabulation of summer and winter peak season data.

The large number of apparent overloads identified by Liberty are not considered overloads by ComEd because they were well below the 165% of nameplate normal rating for distribution oil filled transformers. The transformers reviewed by Liberty are well below the threshold for data review used by ComEd. They do not require mitigation and would not be investigated until the reported load exceeded capability.

As recognized by Liberty in its report, the overloads in excess of 1000% were attributable to data errors, not actual overload conditions. These will be addressed in ComEd's annual review of transformer overloads.

Eleven-1 ComEd should improve the organization responsible for substation construction and maintenance.

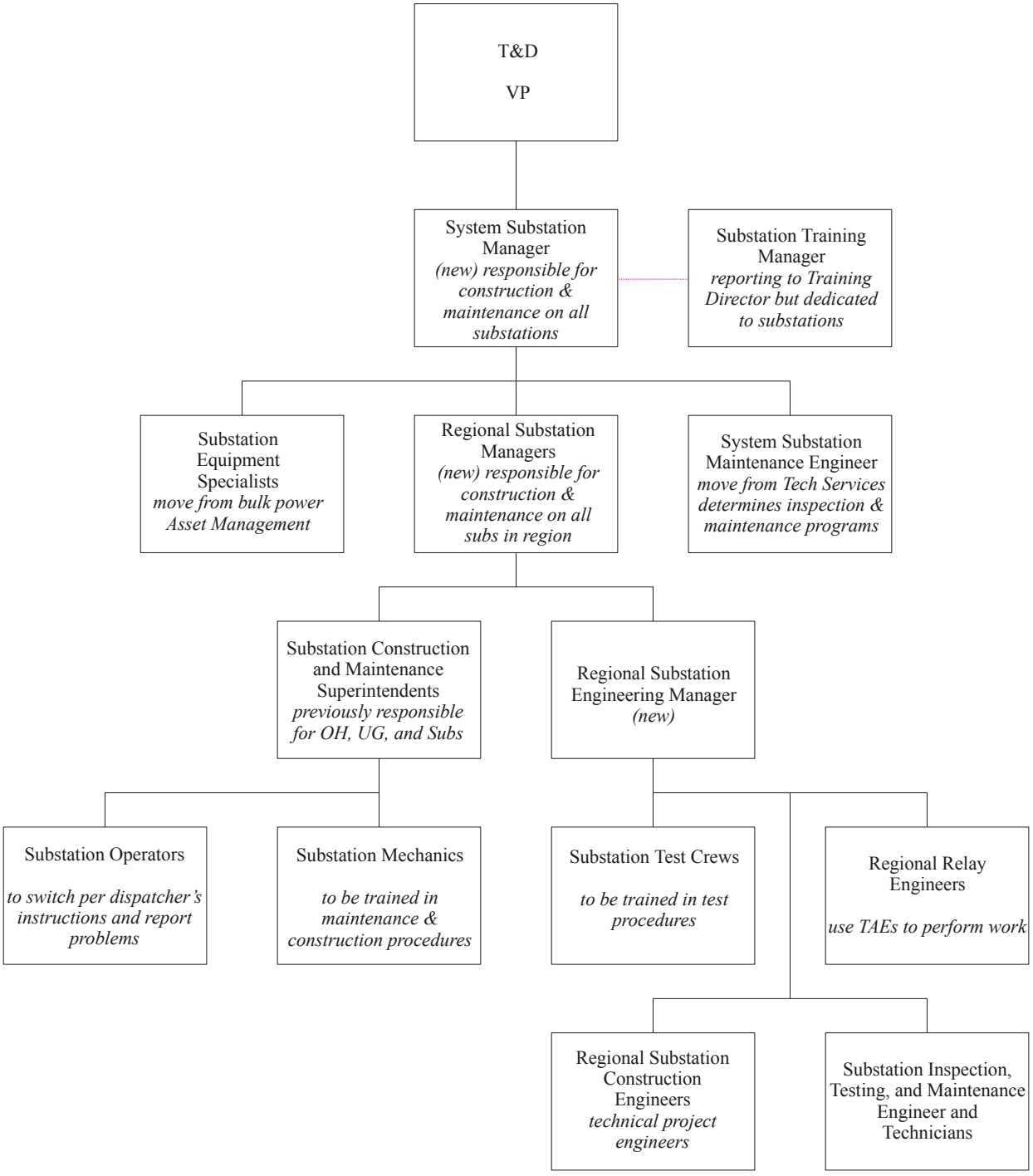
To improve substation maintenance and testing, and to promote individual accountability and group communications, ComEd should consider the benefits of a substation organization including the positions listed below and shown on the following chart.

- System Substation Manager
- System Staff Substation Maintenance Engineer and Equipment Experts
- Regional Substation Manager
    - Regional Substation Construction and Maintenance Superintendents
        - Substation Construction and Maintenance Mechanics
        - Substation Operators
        - Regional Substation Test Crews (mechanics)
    - Regional Substation Engineering Manager
        - Regional Substation Construction Engineers
        - Regional Relay Engineers (TAEs)
        - Regional substation Inspection, Testing, and Maintenance Engineers

As compared to the organization figure shown earlier in this chapter, the recommended organization would be along the lines displayed in the figure below.

This is a medium priority recommendation that should be implemented by December 31, 2000.

Investigation of Commonwealth Edison's Transmission and Distribution Systems
ComEd Responses to First Liberty Report - February 14, 2001
Attachment 1



ComEd Response: Agree

ComEd has established three regional substation organizations responsible for the maintenance and construction activities in their respective areas. This promotes accountability and alignment with the regional distribution operations organization. However, in order to promote and maintain consistency and overall coordination of common issues, ComEd will make additional organizational changes and assignments to establish a permanent and focused functional leadership responsible for substation activities. ComEd plans to have this functional leadership in place by the end of the first quarter of 2001.

Eleven-2 ComEd should promote accountability and responsibility for substation maintenance.

ComEd should consider using regional "Maintenance Engineers" to inspect maintenance and testing work performed, and to evaluate inspection comments and recommendations made by substation operators. They should take responsibility to see that corrective actions are made. These maintenance engineers in each region should ascertain that all inspection, testing, and maintenance practices are accordance with the RCM program and work procedures.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree

ComEd has already implemented this recommendation. ComEd has created the new Area Maintenance Engineer (AME) position which promotes accountability and responsibility for substation maintenance. The AMEs have ownership and accountability for the performance of equipment in the substations. Their duties include, but are not limited to, reviewing maintenance test results, reviewing recommendations from testing engineers, prioritizing and tracking corrective maintenance to completion, and providing
feedback on the effectiveness of preventive maintenance. They are also responsible for auditing inspection and maintenance results, investigating equipment performance trends, and verifying that inspection, testing, and maintenance activities satisfy RCM. A functional leadership for substation construction activities will be established to ensure that consistency and coordination is maintained across the ComEd system. See response to recommendation 11-1.

Eleven- 3 ComEd should review and upgrade as necessary the substation training programs for substation mechanics

Liberty observed poor circuit breaker maintenance practices performed by ComEd substation mechanics including not following the specific work procedures checklist, using improper lubricant, not performing diagnostic tests (at least insulation resistance and contact resistance) to prove that the circuit breakers were suitable for service, and leaving 15kV circuit breakers exposed to wet air.

This is a low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Accept

ComEd will review existing training for substation mechanics and work with the T&D Training Director to implement any required modifications.

This recommendation will be implemented by June 1, 2001.

Eleven- 4 ComEd should only perform work on non-ComEd equipment when that work is critical to the reliability of ComEd's system.

With a large backlog of its own maintenance tasks to perform, ComEd should not be pursuing construction, maintenance, and repair work on non-ComEd owned equipment. ComEd should agree to perform such work only if critical to the operation of ComEd's system.

This is a low priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree, with exception

ComEd will continue to focus the efforts of its substation crews and contractors on enhancing system reliability by working down the backlog of open maintenance items. The substation maintenance workdown curves show that the resources are being used per the plan (see ComEd's Bi-Weekly and Quarterly Progress Reports).

With a large backlog of maintenance tasks, ComEd will not be pursuing construction, maintenance, and repair work on non-ComEd owned equipment at the expense of ComEd maintenance work. ComEd may perform maintenance and repair work on non-ComEd equipment if it impacts the operation of ComEd's system or if our customers request our expertise and resources to restore or enhance their electrical equipment or service.

Eleven-5 ComEd should use outside contractors for substation maintenance to reduce the maintenance backlog.

To meet substation maintenance schedules and to make use of the expertise of others, ComEd should consider using the services of qualified substation testing and maintenance contractors to supplement ComEd mechanics, when needed to maintain maintenance schedules.

This is a medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Accept

This recommendation has already been implemented.

ComEd is using outside contractors to reduce maintenance backlog where appropriate. The Company is also using contractors to perform a larger share of the new installation work thereby freeing in-house forces to perform additional maintenance work. ComEd will continue to work to reduce maintenance backlogs to acceptable levels through the use of contractors to supplement the substation work force where appropriate.

Eleven-6 ComEd should complete upgrade work that is planned.

ComEd should complete its SCADA system per scheduled completion date of December 31, 2001. ComEd should complete planned upgrade work at the LaSalle and Northwest substations as soon as possible, to prevent recurrence of problems of July-August, 1999.

This is a high priority recommendation that should be implemented as soon as possible.

ComEd Response: Accept

ComEd presently has a program to install SCADA at all of its substations. These projects are on schedule for completion in 2004.

The upgrade work at the LaSalle Substation is complete. Substation work at Northwest is complete and cutovers will be completed before the Summer of 2001.

Eleven-7 ComEd should improve the RELAP program.

The RELAP organization should consider using substation inspection specialists from other utilities or substation testing firms to inspect and help qualify substations for maintenance, replacement, or upgrade.

These other experts can provide a wealth of knowledge and experience to assist the RELAP engineers determine equipment with high failure risk, and help determine the inspection and diagnostic testing procedures necessary to determine estimated reliable life in substation equipment.

ComEd should move RELAP to the substation organization. By working under the system substation manager, RELAP would be held responsible for the substation upgrade programs.

RELAP should have the authority to order additional diagnostic testing (primarily insulation tests) of substation equipment needed to properly evaluate equipment condition. It is important that RELAP have appraisals of equipment condition not only on the basis of inspections and past operation and maintenance history, but also on the results of recent diagnostic testing.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd agrees that we should improve the RELAP program. We will revisit the entire program and develop a revised program based on:

- A review best practices with other utilities and experts
- Input from internal and external substation maintenance and substation equipment experts, and
- Results of diagnostic tests as well as inspections and equipment performance history in the evaluation of equipment.

We will utilize the results of our best practice review, with the assistance of the EPRI and other experts in this area to establish a new RELAP program. This new program will define processes, procedures, and accountabilities including roles and responsibilities. The new program will begin implementation by June 1, 2001.

Eleven-8 ComEd should de-rate transformers to allow a planning margin that will minimize overloading of transformers.

A review of ComEd planning records indicates that estimating future loads is not an exact science. The de-rating contingency will provide greater lead-time to plan corrective actions before overloading may damage transformers. The planned loads for four transformers selected at random indicated the actual maximum loads for the period 1994 to 1998 ranged from a decrease of 19 percent to an increase of 31 percent. The planners used an annual estimated increase of 1-2 percent for these substations.

ComEd should include at least three factors when planning transformer loading. These are: (1) de-rate transformers to allow for margins necessary due to possible errors in estimating future loads, (2) de-rate transformers that have experienced thermal overloading, and (3) include margins that allow a transformer to pick up part of another transformer's load without exceeding the normal ratings during hot weather. The actual "de-ratings" should be based on these issues for each transformer.

This is a high priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree, offer alternate approach.

ComEd is currently reviewing our planning process and having our transformer loading criteria reviewed by external experts, as noted in ComEd's responses to Recommendations Five-4, Five-6 and Eleven-11. As part of the industry best practices review, we will determine how to incorporate error margins for forecasting and contingency allowances in our planning processes. We will also incorporate any transformer derate based on actual transformer conditions into our capacity plans.

This recommendation will be implemented by June 1, 2001.

Eleven-9 **ComEd should use more conservative weather adjustments in planning for loading on substations.** (Refer to Chapter Five on Distribution System Planning.)

This is a high priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Accept

This recommendation has already been implemented.

ComEd has already implemented a more conservative policy of weather adjusting peak loads. See ComEd's response to Recommendation Five-1.

Eleven-10 ComEd should determine acceptable transformer loss-of-life.

Since ComEd's basis for summer normal and summer emergency transformer load ratings imply that some loss-of-life is expected, ComEd should define and justify the loss-of-life associated with its ratings. By forcing this kind of a determination, and by recording loss-of-life data as recommended earlier, ComEd will be in a better position to make sound economic and reliability decisions.

This is a medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Accept

ComEd is in the process of reviewing acceptable transformer loss-of-life based on the current ratings, methodologies used in the loading guide, transformer test data and typical load. Once completed, transformer loss-of-life criteria will be established based on current transformer data.

This recommendation will be implemented by June 1, 2001.

Eleven-11 ComEd should have a formal, technical review made of its transformer loading criteria.

The transformer load ratings, based on ComEd's accepted transformer loss-of-life, should be reviewed by transformer engineers to verify that the ratings are correct, or suggest other ratings. While ComEd reviewed these loading criteria before, those reviews were not based on a stated and accepted loss-of-life.

This is low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree.

ComEd will complete an independent technical review of its transformer loading criteria by June 1, 2001.

Eleven-12 ComEd should take action to relieve overloading on TSS and TDC transformers and cables on the basis of realistic temperature predictions.

ComEd expects that some transformers and cables may be overloaded during the summer of 2000 if reinforcement projects are not completed and the temperatures experienced in 1999 are repeated.

This is high priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Accept

ComEd initiated load relief projects for TSS and TDC transformers and distribution cables for the Summer of 2000 which were based on peak making weather conditions expected to occur once every ten years. Refer to ComEd's response to Recommendation Five-1.

These projects will be completed by Summer 2001.

Eleven-13 ComEd should maintain thermal load records for substation transformers.

Whenever transformer winding temperatures exceed 100ºC, temperature-time records should be maintained as a thermal-load history of the transformer using PI-historian. The substation maintenance engineers and the RELAP group should analyze these records. These engineers can then evaluate the need to (1) intensify DGA testing on transformers that have been overloaded, and (2) determine the need to upgrade to a larger transformer. Presently, only the results of DGA testing is used as a guide for replacing or upgrading TSS and TDC transformers.

This is medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd agrees to maintain thermal loading records for substation transformers at stations with SCADA installations, consistent with our responses to items Five-3 and Nine-3. We will develop appropriate processes by June 1, 2001 for implementation of monitoring and analysis of transformer conditions in order to take appropriate corrective action.

Eleven-14 ComEd should conduct tests whenever a substation transformer experiences a temperature alarm.

ComEd should conduct dissolved gas tests and possibly Furfural tests[1] on transformers that exceed the "normal" alarm temperature. The substation maintenance engineer and the RELAP group should analyze the results. By the results of these tests loss-of-life can be estimated.

This is medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree, with exception

ComEd will conduct tests whenever a substation transformer experiences a temperature alarm. ComEd will perform DGA testing whenever a transformer is loaded beyond its emergency ratings or a high temperature alarm is received. DGA information is made available to the Area Maintenance Engineers and the RELAP groups for their review. However, the Transformer Specialists, who reside within the Substation Engineering Group, are the Subject Matter Experts and along with a Chemist from the Technical Labs, are the best qualified to analyze the DGA information and make technical recommendations for the appropriate corrective actions. ComEd currently conducts dissolved gas analysis tests on all of its substation class transformers on a routine basis. This recommendation was implemented in December 2000.

ComEd will also investigate the possibility of Furfural testing of overloaded transformers. This investigation will be completed by 6/1/01.

1. Furfural is produced by the thermal degradation of cellulose in oil. The theoretical age of the cellulose can be analytically determined by furfural content of oil in a transformer.

Eleven-15 ComEd should intensify testing and maintenance for transformers that may be heavily loaded.

For transformers that may be loaded near or in excess of the summer normal ratings, the radiators should be cleaned, temperature gauges calibrated, alarm set points and circuits verified, and a benchmark DGA test performed. These good utility practices should be performed in the spring or early summer. Also, the installation of thermal recording devices, if not already installed, should be considered.

This is medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Accept

ComEd is currently in the process of cleaning all the transformer cooling equipment and assuring that it and the monitoring equipment is ready for summer weather. This work is normally performed in mid to late May, after the various trees shed their seeds, to assure maximum performance through the summer.

ComEd currently conducts dissolved gas analysis tests on all of its substation class transformers on a routine basis. The Company will perform DGA testing whenever a transformer is loaded beyond its emergency ratings or a high temperature alarm is received. Results of these tests will be reviewed by substation engineering. This recommendation was implemented in December 2000.

ComEd will investigate the use of direct temperature sensors that utilize fiber optic technology. This technology is expected to provide more accurate thermal records based on the load and real time conditions.

Eleven-16 ComEd should reduce the substation maintenance backlog.

The work on all backlogged substation maintenance items should be intensified on the basis of priority and outage opportunities. ComEd should consider using the services of substation maintenance firms to supplement the ComEd crews. The new RCM program cannot be fully effective until the past maintenance is on schedule.

This is high priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree

ComEd has been focusing on reducing the backlog of high priority preventative maintenance and the high priority corrective maintenance for all substations. The outstanding backlog of maintenance items has been reduced from approximately 25,000 in September 1999 to approximately 11,600 by year-end. Contractors have been utilized to supplement ComEd's substation workforce to do both maintenance work and construction work which allows additional ComEd personnel to address the maintenance backlog. ComEd management will monitor the number, priority, magnitude, and age of each of the backlogged maintenance items and apply the necessary resources, utilizing both ComEd and outside contractors to work down the backlog. We will report our progress to the ICC on a regular basis.

Eleven-17 ComEd should establish substation test crews.

In order to perform the RCM required testing work, ComEd should have "substation testing crews," similar to those used by other utilities. The crews should be equipped with special vehicles and test equipment. These crews should receive special training in the operation of test equipment and the analysis of data. Maintenance engineers would provide technical guidance to the test crews.

This is medium priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd's Regional Substation Area Maintenance Engineering organization will be the local source of hands on maintenance technicians supporting the craft crews as the maintenance program is expanded and fully implemented.

Eleven-18 ComEd should consider having Substation Maintenance Programs reviewed by others.

ComEd should consider assembling a team of substation equipment maintenance experts made up of engineers from other utilities and several qualified substation inspection, testing, and maintenance contractors. This team would review ComEd's substation maintenance programs and help ComEd make determinations of the optimum procedures to follow and the best tools and materials to use based on the best judgments and experiences from the substation maintenance industry.

This is low priority recommendation that should be implemented by June 1, 2001.

ComEd Response: Agree

ComEd agrees, and we have had our substation maintenance programs reviewed by others. ComEd and EPRI Solutions completed a review of maintenance practices at the end of 1999.

Eleven-19 ComEd should evaluate all available cable testing procedures.

Because cable failures caused 11 percent of ComEd's interruptions, and cable testing wasn't performed for ten years, ComEd should continue its pilot cable testing programs. ComEd should also consider formally evaluating all available cable maintenance testing procedures. ComEd should assemble a team of cable testing experts from ComEd, other utilities, and professional cable testing firms to share knowledge of the various procedures, and evaluate the advantages of the various test methods (including DC hi-pot on non-XLPE cables).

With a large number of cables to test, a ten-year program could be established to perform maintenance tests on all cables. Therefore priorities are necessary. Liberty recommended in Chapter Nine to place priorities based on high failure rates and number customers interrupted by a failure. All cables leaving substations should be included in the latter category because of the potential for affecting large numbers of customers.

This is medium priority recommendation that should be implemented by December 31, 2000.

ComEd Response: Agree, with exception

ComEd agrees that once cable testing procedures are validated as accurate, cost-effective, and industry accepted, ComEd will develop plans and schedules to expand maintenance testing for cables. The Company has been exploring new techniques for testing cables; however, the viability of these techniques is still in question. ComEd is actively working with industry research groups to identify the most reliable cable testing procedures that will provide tangible results. The implementation date of this recommendation is contingent on completing the research, the last date of which fourth quarter of 2002.

Following are the research initiatives and the dates when final reports will be completed. Research has been primarily in cooperation with Electric Power Research Institute (EPRI) and the National Electric Energy, Testing, Research, and Application Center (NEETRAC).

Testing to Date

As a result of 1998-cable space investigation, ComEd initiated a pilot project that involves the assessment and, if necessary, replacement of first-section cables for distribution circuits served by substations with cable spaces. The project consists of testing substation exit cables and replacing cable that fails these tests. The pilot project is scheduled to be completed by year-end 2003. As the project progresses, on-going analysis will compare the actual field performance to the results generated utilizing the Tan Delta diagnostic tool.

In addition to the extruded dielectric pilot program utilizing the Tan Delta methodology, ComEd has pursued diagnostics techniques that utilize partial discharge. Techniques examined include both in-service and out-of-service methods. Limited methods are applicable to long circuits constructed with paper insulated lead covered (PILC) cable with multiple taps. To date, partial discharge techniques employed on PILC cable in the field and laboratory tests have not confirmed the accuracy of this diagnostic method. The technology required to locate potential failures in the underground distribution system is still developing.

ComEd has been actively involved with the Electric Power Research Institute and the National Electric Energy, Testing, Research and Application Center to evaluate cable assessment techniques. Enclosed below are on-going research and technology initiatives involving underground cable assessment and diagnostics that ComEd will rely upon in making decisions about cable testing initiatives.

Electric Power Research Institute (EPRI):

- Tailored Collaboration Agreement 7322-006 entitled "PILC Distribution Cable Assessment Study". Participation includes ComEd, ConEd, Northern States Power, BC Hydro and PSE&G. Project deliverables include recommendations on specific measures, methods, and test procedures that can be applied including description of any in-situ tests for PILC distribution cable assessment. The final report was issued in the fourth quarter of 2000. Conclusions and recommendations for future work are under review.

- Tailored Collaboration Agreement 45122-001 entitled "Condition Evaluation of PILC Underground Cables on ComEd 12.5 kV System". This project involved diagnostic testing of certain PILC cables using KEMA to identify locations of partial discharge. Specific samples that indicated high levels of PD were sent for laboratory analysis and are presently under evaluation. Since the PD testing was performed, cable faults have occurred in locations that were not diagnosed as problematic through the KEMA PD detection.

- EPRI Underground Distribution Infrastructure 00-04 entitled "Estimation of Remaining Life of PILC Distribution Cable". This project builds on a planned 1999 tailored collaboration project intended to evaluate diagnostic tools suitable for assessing the state of the paper, oil, and lead sheath in aged PILC distribution cable. Methodology for estimating future performance will be sought. This project will leverage a new supplementary-funded effort examining condition assessment potential diagnostic techniques for Paper-Insulated, Lead-Covered (PILC) cable assets. It will apply the methodology to assessments of the state of aged PILC systems and use this information to estimate future performance. This is a new project for year 2000, final report is due third quarter 2002.

- EPRI Underground Distribution Infrastructure 97-03 entitled "In-Service Evaluation of Distribution Cables". This project will correlate results from studies of various EPR cables and TR-XLPE cables on the Orange & Rockland distribution system, along with laboratory aging work. Additionally, because EPR manufacturers use different proprietary compound formulations, this work will determine whether performance and life expectancies of different

EPR cables can be generalized. This is an ongoing project, final report is due fourth quarter 2001.

- EPRI Underground Distribution Infrastructure 99-06 entitled "Estimation of Remaining Life of Aged XLPE-Insulated Cables". This project's objective is to quantify the ability of in-situ diagnostics to predict remaining life by combining emerging and newly available cable test diagnostics with results from EPRI cable-aging projects from recent years. An inherent limitation of currently employed in-situ diagnostic techniques such as partial discharge and low-frequency testing is their inability to effectively predict future performance in terms of months or years of reliability. In-situ diagnostic testing at 6 utility sites completed; cables removed and tested at BICC. Service-aged cables can be ranked for future performance. Comparison with in-situ test data gives preliminary estimates of remaining life. Phase 2, of project underway, final report due second quarter 2001.

National Electric Energy, Testing, Research and Application Center:

- 99-365 entitled "Diagnostic Testing of Underground Distribution Cable Systems". This project evaluated various manufacturers diagnostic testing methods to assess the integrity of underground cables systems. Participating companies included Southern Company, Florida Power & Light, Virginia Power, Southwire, Union Carbide, GRESCO, PSE&G, Southern California Edison, Electric Power Research Institute, South Carolina Electric & Gas. The research showed that none of the diagnostic testing techniques that were evaluated could accurately determine the condition of underground cable systems.

- 99-356 entitled "Feasibility Study on the Use of Neural Networks for Underground Cable Diagnostics". Participating companies included Southern Company, Florida Power & Light, Virginia Power, Southwire, Union Carbide, GRESCO, PSE&G, Southern California Edison, Electric Power Research Institute, and South Carolina Electric & Gas. The project determined that it is feasible to use neural network techniques to evaluate partial discharge signatures measured with cable diagnostic equipment. As a result, in June 2000, the NEETRAC members voted to continue research that would develop the necessary neural network algorithms that could provide accurate cable assessment.