Con Edison

Law Department
Consolidated Edison Company of New York, Inc.
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October 19, 2000
By Hand

ORIG-FILES
C99-E-0930
COPIES:
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Hon. Janet Hand Deixler
Secretary
New York State
Department of Public Service
Three Empire State Plaza
Albany, New York 12223

Re: Case No. 99-E-0930 – Investigation of July 6, 1999 Power Outage of Con Edison's Washington Heights Network

Dear Secretary Deixler:

Enclosed for filing are an original and five copies of the Comments of Consolidated Edison Company of New York, Inc. ("Con Edison" or "the Company") on the Phase I and the Phase II Reports of EPRIsolutions, Inc. ("Reports"). On July 14, 2000, the Mayor's Advisory Task Force on Con Edison's Reliability ("Task Force") filed the Reports with the Public Service Commission ("Commission") and requested that Con Edison respond to the Reports. The Task Force also requested that the Commission adopt the Reports' recommendations and require Con Edison to report on its progress in complying with those recommendations (letter of Richard B. Miller, July 14, 2000).*

There has been extensive work by the Commission and the Staff of the Department of Public Service in this proceeding on these issues. In March 2000, following an extensive ten-month examination and analysis of the technical underpinnings of Con Edison's distribution system, its historic and planned budgets and expenditures, and other areas, the Staff issued its "Report on Consolidated Edison's July 1999 System Outages." Staff's report contained forty-four recommendations for Con Edison to act upon to achieve near and

* The Department of Public Service Staff, Richard Miller for the Task Force, and the Company agreed that Con Edison would file its comments on the Reports by October 19, 2000.

long-term operational improvements. Twenty of these are comprehensive recommendations addressing distribution system design, testing and monitoring and the implementation of the Company's own extensive internal and external review committee recommendations. The Commission's March 15, 2000 order in this proceeding found Staff's examination to be comprehensive and directed Con Edison to implement Staff's recommendations. Con Edison has filed work plans to implement the Staff's recommendations and reports quarterly to the Commission on its progress.

Con Edison's specific comments in response to the Task Force's recommendations demonstrate that the Company is already undertaking the large majority of the activities recommended by the Task Force. At the same time, we recommend that the Task Force's recommendations not be formally adopted as part of a Commission order or rule. From a cost and efficiency standpoint, it would be more reasonable to treat the Task Force recommendations informally for the Company to consider (except, of course, to the extent our specific comments identify a flaw in specific recommendations). It would be inefficient at this point in time to subject the Company to compliance with a new and additional set of recommendations that duplicate, in large part, the actions that the Commission and its Staff previously determined were reasonably necessary to maintain and enhance the reliability of the Company's system after carefully considering the benefits and costs of potential improvements. Consideration of new recommendations at this point in time would unnecessarily create the need to reevaluate the implementation plan for the Commission's recommendations to consider the cost and time involved to integrate new and additional activities into the Company's plans and its already ongoing efforts.

As demonstrated by the Company's response to the Task Force reports, the Company intends to be reasonably responsive to the EPRIsolutions recommendations, and the Company will be willing to confer with the Task Force respecting the means in which its recommendations have been or will be considered or carried out.

Sincerely,

Martin F. Heslin/dls

Martin F. Heslin
Senior Attorney

Enclosures

cc: Richard B. Miller

Comments of

Consolidated Edison Company of New York, Inc.

on

Phase I Report of

EPRIsolutions, Inc.

October 19, 2000

Action Plan No.1. Improve pre-summer load relief program (CRC-I, IRB3.12)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000

1. If New York City experiences a heat wave similar to or more severe than the one experienced in July 1999, problems could occur. There is a possibility that some feeder sections (not presently covered in the accelerated feeder load relief program) may exceed Con Edison's rating criteria. Based on this possibility EPRIsolutions recommends that Con Edison give priority to these feeder sections in its load relief program. EPRIsolutions recommends that by June 1, 2000, Con Edison perform a sensitivity analysis on the load forecast using a summer peak temperature similar to that experienced in 1999. The use of 1999 temperature data would permit the District Operators to analyze other possible consequences should such high temperatures occur in 2000. In addition, by conducting a sensitivity analysis of the load forecast using a higher-than-designed temperature under both normal and n-2 conditions, Con Edison will be able to determine the readiness of its network to meet a second consecutive year of high temperatures. When the analysis is completed, Con Edison should give first priority to addressing cable sections that could become overloaded under normal conditions.

Con Edison's Comments:

1. In preparation for summer 2000, Con Edison completed the most extensive system reinforcement program in its history. The load relief measures were based upon the results of its standard load relief study methodology that reflected the peak loads experienced in 1999 adjusted to the Company's 86 degree temperature variable design criteria. . The following points present the highlights of reinforcement completed by June 1, 2000:

   Distribution System Reinforcement

   - Reinforced 298 feeders (1368 underground sections, 1141 overhead spans). All planned feeder reinforcement work was completed.

   - Reinforced 170 network transformers. The Company had planned to reinforce 171 transformers by summer 2000. The remaining transformer is associated with a new business project where the Company is awaiting customer actions before performing the reinforcement.

   - Upgraded 9 unit substations. The Company plans to upgrade 4 additional unit substations in the fall.

   - In addition to the feeder reinforcement work stated above, the Company plans to upgrade an additional 73 feeders through paper cable and targeted stop joint removal under its system reliability program during 2000. As of June 1, 2000, the Company had upgraded a total of 57 feeders. This exceeded the Company's

plan to have completed 46 feeders by the summer.

In total, Con Edison installed more than 135 miles of new distribution feeder cable/wire in preparation for summer 2000.

Substation and Transmission Systems Reinforcement

- Replaced cross over assemblies at Harrison/Elmsford Substations
- Replaced three transformers at Jamaica Substation
- Upgraded Transformer #6 13kV breakers at Sherman Creek Substation
- Upgraded 13kV breakers at W. 19th Street Substation
- Upgraded 13kV breakers at Avenue A Substation
- Added supplemental transformer cooling at Avenue A Substation
- Upgraded 27kV disconnect switches at Corona #2 Substation
- Installed supplemental transformer cooling at Bensonhurst #1 Substation
- Installed 1-20 MVAR capacitor bank at Cedar Street Substation
- Replaced transformer #1, 2 and 3 at Greenwood Substation
- Replaced disconnect switches & cable at Vernon/Queensbridge Substations
- Replaced 13kV feeders 99031 and 99032 between Sherman Creek/Dunwoodie stations
- Established oil circulation at Rainey Substation
- Purchased and installed high voltage test sets at various stations
- Purchased and installed ground & test devices at various stations
- Installed bus tie breakers at Millwood West Substation

EPRIsolutions' Longer Term Recommendations:

1. Con Edison should forecast projected loads to the feeder level in total power (MVA), rather than real power (MW). At the present time, Con Edison uses power factor capacitors in the area substations but not in the networks. Different feeders will have different power factors, and the station capacitors have a secondary effect on the MVA demand on the feeders. These additional forecasts at the feeder level would provide planning engineers with better data to perform load flow and load relief studies.

2. Con Edison should investigate the feasibility of combining primary and secondary load flows in planning calculations. Combining primary and secondary load flows would enhance the accuracy of feeder and transformer load forecasting.

Con Edison's Comments:

1. Con Edison does not include the effects of substation capacitors when forecasting projected loads and load relief studies and load flows.

2. Con Edison has begun a project to develop an improved secondary model (CUFLINK) that will reflect load flows at actual service points rather than concentrated at each transformer. This is a long term project that is currently targeted for completion in 2003.

Action Plan No.4. Evaluate improved protective relays on certain network protectors. (CRC-5, IRB-3.10, IRB-3.13)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000:

1. Con Edison should continue its protective device coordination studies to ensure proper feeder coordination.

Con Edison's Comments:

1. Con Edison has conducted a major study that reviewed the design of the relay protection on the Washington Height network and has completed the replacement of all network protection relays where it was found that a feeder breaker could open instead of network protector relay operation. The Company also replaced all such units in the Yorkville network. A total of forty relays in the Washington Heights and Yorkville networks were replaced by June 15, 2000.

   The Tempo relays in isolated and spot networks, served from Sherman Creek and Hell Gate substations, were replaced with ETI microprocessor relays prior to summer 2000. The Tempo relays in critical isolated and spot networks and fringe areas system-wide are being replaced under the following schedule for replacement of such units.

Year	**2000**	**2001**	**2002**	**2003**
Quantity	270	1060	1010	650

   Con Edison has also identified two substations - Sherman Creek and Hell Gate - where, due to the double secondary winding transformers, a 13 kV feeder fault causes the voltage to drop significantly on that side of the station, while close to normal voltage is maintained on the other side of the station. Recent PVL computer simulations show that this results in significant current flows both in and out of various 13 kV network feeders via the distributed network grid as well as through isolated networks. Time-current coordination studies for 13 kV overcurrent relays vs. 120/208 V. and 277/480 V. network protectors were performed to identify those feeders where relay settings were required to be modified to prevent reoccurrence of undesirable breaker operations. Con Edison has completed the required modification of feeder relay settings at these stations.

   At Sherman Creek Substation, revised relay settings were issued to ensure proper coordination with network protector fuses at 265/460 Volt isolated networks in the event that a network protector should fail to open when backfeeding a 13 kV fault. These setting changes at Sherman Creek were completed prior to Summer 2000.

Calculations made for Hell Gate Substation showed that existing relay settings gave adequate coordination, and no further action was required.

Computer load-flow simulation studies (PVL) were run for Sherman Creek, Hellgate, E. 63rd ST, and Leonard St Substations to determine the magnitudes of 13kV fault contributions due to backfeed currents from the 120/208 Volt secondary distributed network. It was determined that, under certain operating configurations, there are cases where these current contributions can cause undesired tripping of 13 kV feeder overcurrent relays. This possibility can be eliminated by the application of directional overcurrent relays set to trip only for faults in the direction of normal load flow, and to not trip for backfeeding fault currents. At Sherman Creek Substation, the engineering work to implement this has been initiated.

EPRIsolutions' Longer Term Recommendations:

1. Although not related to network protector relaying, EPRIsolutions recommends that Con Edison investigate relaying in area substations. EPRIsolutions recommends that Con Edison revisit the adequacy of existing station bus protection schemes because: (1) each network can only be supplied from one substation; (2) present loads on some networks exceed 250 MW, and Con Edison's design criteria do not include sustaining double faults. Traditional bus protection schemes used by the electric utility industry may be not be sufficient to ensure the high reliability sought for Con Edison's networks. . Increased reliability of the bus protection can be achieved in a number of ways. One is achieved by making the centralized system (as described above) more dependable by improving measurements and computations with digital technology. Other options involve the use of distributed bus differential schemes, which can be made possible with the application of new communication technologies to substations. Improved protective relays would reduce false or undesirable tripping of components and will sustain high network reliability. Improved protective differential schemes for n-2 condition at the substation bus will prevent an n-4 or greater contingency at the network feeder level. This prevents cascading failures of the network feeders, which can cause total network collapse.

Con Edison's Comments:

1. By design, no fault within a network will lead to the tripping of two load buses at the substation.

Action Plan No.5. Investigate installation of equipment to sectionalize those networks feeders that bifurcate to supply geographically diverse sections of a network. (CRC-66, IRB-3.1 1, IRB-3.13).

EPRI Solutions' Recommendations for Completion or Initiation by June 1, 2000:

1. EPRIsolutions recommends that Con Edison initiate an accelerated schedule to install sectionalizing switches on bifurcated feeders (feeders that serve different parts of the same network). EPRIsolutions believes that the installation of sectionalizing switches would allow unfaulted sections of such feeders to be re-energized and would speed restoration of service, thereby enhancing overall network reliability. EPRIsolutions also recommends that Con Edison equip the sectionalizing switches with fault indicators, which would allow field crews to quickly identify faulted branches. EPRIsolutions recommends that Con Edison install these fault indicators in as many taps and spurs as possible prior to the summer 2000 peak.

Con Edison's Comments:

1. Con Edison has installed thirteen sectionalizing switches equipped with directional fault indicators in seven residential networks in order to evaluate their effectiveness, examine the feasibility and benefits of an expanded program, and gain operational experience. The evaluation will consider the costs versus benefits of feeder sectionalizer/fault indicator installation and examine potential improvements in feeder processing time and system reliability in terms of SAIFI, CAIDI, probability of loss of load, and reduced exposure to above design criteria contingencies. Completion is targeted for year end 2001.

EPRI Solutions' Longer Term Recommendations:

1. For the long term, Con Edison should study the feasibility of splitting the Washington Heights network into at least two networks, depending on the load which would need to be supplied through an n-i contingency at the transmission supply, substation transformer, and substation bus. The utility should also analyze the outage history of each major component at the Sherman Creek substation and the probability of failures when considering this n-i criteria.

Con Edison's Comments:

1. Con Edison has retained a consultant to evaluate options (including network split and adding additional feeders) for improving the reliability of the Washington Heights network. The consultant's report is expected by year-end 2001.

Action Plan No.7. Reduce the number of stop joints that have demonstrated a greater susceptibility to failure than comparable components. Review methods to improve splice conditions. (CRC-9, CRC-14, IRB-3.4, IRB-3.5, IRB-3.6, IRB-3.13)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000:

1. Con Edison should replace existing stop joints with known inferior performance, and such replacements should be based on clearly defined priorities, i.e., the most critical feeders. The elimination of defective stop joints would remove one of the key causes of last summer's Con Edison network feeder system failure.

2. Con Edison should initiate the effort to implement written guidelines for the selection of feeders and components by June 1, 2000. Selection guidelines would further improve installation of the most appropriate accessories.

Con Edison's Comments:

1. In order to improve system reliability, Con Edison is implementing a planned capital programs (reinforcement, new business, burnouts, and reliability) to effect the removal annually of approximately 1500 thermally sensitive components (i.e., Elastimold 2w-1w and pre-1993 Raychem 3W-1W stop joints) until these components are eliminated from the distribution system.* At that rate of removal and using the current estimate that there are approximately 13,000 of these joints in the distribution system, the removal of these components would be completed in about 9 years (by 2008). The Company is continuing efforts to establish the total population and location of these components, and the population estimate may increase. As of June 1 2000 under the Company's summer 2000 preparedness program, the Company identified and removed 929 thermally sensitive stop joints. As of the end of September 2000, the Company has removed 1070 Elastimold 2w-1w and pre-1993 Raychem 3W-1W stop joints. The Company plans to remove a total of 1492 of these stop joints by year-end 2000. The Company has also discontinued the use of custom-designed stop joints with taps. In addition to the removal of thermally sensitive stop joints, the Company has established a backbone feeder program that provides for re-conductoring of backbone feeders in each network to optimize their support of the network during contingencies.

2. Con Edison's prioritization and selection of PILC cable sections and components for removal for its pre-summer 2000 preparedness program was based on written guidelines. These criteria for prioritizing the removal of PILC cable and components have more recently been incorporated into a draft specification, EO-4097, that is

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* Con Edison's Reliability Program reflects current system design criteria and is adjusted annually to incorporate the system performance experience of the prior year and trends that emerge from the accumulation of operating experience. Such experience may warrant reprioritization of expenditures in order to improve the overall effectiveness of the Reliability Program.

expected to be finalized by November 15, 2000.

EPRIsolutions' Longer Term Recommendations:

1. Con Edison should analyze the suitability of using separable dead-break connectors (straight, 1-way/ 2-way) to connect transformer taps or spurs.

2. Con Edison should investigate new splice designs to simplify installation and reduce jointing times. Separable dead-break connectors are a simple, factory pre-tested product, which could also serve as relatively quick disconnects for fault location and sectionalizing.

3. Con Edison should include working in confined spaces in the splicer training program. In addition, the utility should improve the content of remedial training to further challenge experienced splicers.

Con Edison's Comments:

1. Con Edison's present practice is to use separable dead break connectors (hammerheads) on transformers and dead break splices on spurs. Con Edison is using molded disconnectable splices, with test points for all T-Tap splices. This allows for the quick disconnection of failed sections or transformers. The Elastimold 600 amp terminations (hammerheads), used at all network transformers purchased since approximately 1973, also function as disconnects. This equipment provides quick-disconnect functionality at reasonable cost. All transformers that have been reconditioned and reinstalled have been modified to include the hammerheads.

2. See comment No. 1 above.

3. Con Edison trains its field personnel, including splicers, to work in confined spaces and will continue this training. The Distribution Splicer training program presently requires candidates to perform secondary exercises for about 2-3 hours within a splice box (confined space). Candidates perform live work under the direction of an Instructor and are familiarized with the conditions for safe work in these spaces. The Company's Learning Center, under the direction of the line managers, is presently preparing a series of on-the-job training assignments for candidates to be performed during their 3-6 month field assignment with a senior Splicer. These assignments are will serve as a field guide for candidates to assure they are exposed to a wide variety of job tasks in the field. One of the required on-the-job training exercises will be the planning and execution of a secondary crab replacement within a splice box.

   The Learning Center is examining revisions to its current Splicing Refresher ESP-0024 course and has conducted a pilot presentation to splicers and managers on August 1, 2000. Additional revisions based on feedback from the presentation are being developed and another pilot presentation is planned for the second quarter of

2001. The revisions are expected to include exercises.

Action Plan No.8.

Develop more comprehensive procedures for operators to follow when network conditions exceed second contingency status, particularly procedures that would relieve over-loaded feeders and transformers. (CRC-I 0, IRB-3.12)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000:

1. Con Edison should schedule training sessions with field personnel to review procedural changes in the specifications to ensure understanding and compliance.

Con Edison's Comments:

1. Field and control center personnel have received training on the new procedures and systems incorporated into specification EO-4095 "Distribution System Operation under Contingency Conditions." Each region conducted pre-summer 2000 drills involving simulated multiple network contingencies requiring operational responses and practice on the new procedures and systems.

EPRIsolutions' Longer Term Recommendations:

1. To complement its present load curtailment plans, Con Edison should develop contract-based demand side management (load curtailment) programs for application during peak and emergency load periods.

2. Con Edison should update its existing customer database with an easy-to-use/ access relational database that can access or "relate" all required fields. This would allow distribution system operators to relate each customer to a specific feeder and provide an estimate of load reduction that would be realized if that customer were curtailed, all while avoiding duplication of information.

Con Edison's Comments:

1. On August 7, 2000, Con Edison filed with the Public Service Commission tariff leaves instituting a Voluntary Load Reduction Program under which customers, both full-service and retail access and those taking service from the New York Power Authority, the New York City Public Utility Service, or the County of Westchester Public Utility Service Agency, would be compensated for load reductions during periods when Con Edison determines, in its judgment, that system reliability would be enhanced by reduction in customer load. Details of the program are stated in the Company's filing letter (see Appendix A). The program became effective on August 17, 2000 pursuant to an order of the Public Service Commission issued August 16, 2000 in Case 00-E-1330.

2. Con Edison has created an on-line database – Emergency Operations System (EMOPSYS) – that provides by network and individual customer the amount of available customer generating capacity and the amount of load reduction that the customer is able to achieve on a voluntary basis. This database is also available in hardcopy format in each of the Company's regional distribution control centers and operators have been trained in its use for achieving load reduction. The database has a sort function that allows an operator to search for particular information. The database is being continually updated to reflect the latest known customer information. The updated listing currently includes over 2,300 customers.

Action Plan No. 9b. Review the procedures for water-cooling transformers during contingencies. (CRC-I 2! IRB-12)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000:

1. Con Edison should schedule training sessions with field personnel to review procedural changes in the specifications and to ensure understanding and compliance as soon as possible after the new specifications are approved. (See Action Plan 8 recommendations). These sessions should specifically stress visual identification of corroded transformers.

2. Con Edison should sort its backlog of "minor" maintenance problems (CINDE-Mainsaver computer system) by problem type and by age of complaint. The utility should also look for other maintenance issues that have been uncorrected for an extended period, and which may no longer be considered "minor" issues (such as corrosion), and begin to correct them before summer 2000.

Con Edison's Comments:

1. Field personnel have been trained in the revised corrosion inspection procedure (inspection before use of water spray and post-event inspection and testing for units that experienced overload or water-cooling to assess the integrity of the unit.) Control Center personnel have been trained in accessing the records of transformer inspections (Cinde/Mainsaver data base) and in the new corrosion-inspection procedure.

2. Con Edison has prepared a draft revision to procedure EO-10,110, "Inspection and Maintenance of Network Type Distribution Equipment," to require that Cinde/Mainsaver repair work be categorized by priority, problem type and date of origin and that the following factors be considered in prioritizing repair work: location, risk to public safety and property, reliability (engineering need), age of the equipment, critical bank rating, type of installation (e.g., isolated or grid), and efficient utilization of work forces. This revision is expected to be finalized by November 15, 2000.

EPRI Solution's Longer Term Recommendations:

1. The failure rate of transformers on the Con-Edison system is low. While failures can be caused by many different factors, including corrosion, EPRIsolutions finds that this is not a problem at Con Edison. However, EPRIsolutions recommends that Con Edison track failure rates of transformers to ensure lengthened maintenance intervals do not increase operational risks to system.

2. Con Edison should supply the transformer inspectors/testers with severity criteria to judge corrosion damage, estimate life expectancy, and recommend replacement where necessary.

3. Con Edison should track visual inspections during both scheduled and unscheduled site visits to make sure that all transformers are visually inspected at least once every two years. At present, as part of the utility's work order system, operators are required to visually inspect transformers at least once every year or two during site visits. EPRIsolutions recommends that such inspections could be done during either scheduled or unscheduled visits but that all such inspections be tracked.

4. Con Edison should evaluate the maintenance cycle for refurbished transformers to ensure that it is adequate. At present, refurbished transformers are considered "new" for the purposes of maintenance.

5. Con Edison should complete its investigation into the feasibility of installing temperature sensors on network transformers. These could be installed initially on network transformers with a high probability of overloading under adverse conditions (as depicted by the PVL program) and ultimately on all network transformers. The installation of real-time temperature monitors would provide the data necessary for engineers to perform transformer capability analysis under normal and emergency conditions.

6. Con Edison should develop a computer program to determine real-time transformer capability based on top oil and winding operating temperatures.

Con Edison's Comments:

1. Tracking of the transformer failure rate has been an ongoing practice that the Company intends to follow in order to assess inspection schedule changes.

2. Con Edison provides new inspectors and supervisors with a Learning Center training program in transformer inspection, including corrosion damage identification, corrosion severity (including both written and photographic benchmarking information), and classification. Supervisors provide on-the-job training to inspectors.

3. Con Edison is revising its Engineering Specification EO-1184, "Periodic Inspection, Maintenance and Reporting of Distribution Underground Cables and Joints" to require that an inspection report to be submitted following completion of any work in a manhole. These inspections will be tracked through Con Edison's inspection data acquisition system known as CIMOES. Data collected from the field is recorded on inspection forms or on hand held computers for entry into CIMOES.

4. Con Edison's specification, EO-10110, "Inspection and Maintenance of Network Type Distribution Equipment," has been revised to consider the original age of refurbished transformers. A refurbished unit has had its tank rebuilt and a new, corrosion resistant paint system applied. Under the revised specification, a refurbished transformer tank will be considered to be new for inspection scheduling

purposes, but the inspection of its the core and coils, via fluid sampling, will be based on the year of its original manufacture.

5. Prior to summer 2000, Con Edison installed analogue temperature sensors on 59 Manhattan network transformers selected on the basis of overload probability. The Company has begun installation of temperature sensors on approximately 30 transformers in the Brooklyn/Queens region and on approximately 25 transformers in the Bronx/Westchester region (expected completion in 2001).

6. Con Edison has developed and made operational a program to determine real-time transformer capability. Control Center operators have been trained in the use of this program. Previously network transformer temperature was monitored as a status change from OK to hot. This did not indicate what thermal stress the transformer had been subjected to and for how long. The application developed and incorporated into the operator's workspace at the regional electric control centers, nicknamed RT3 (Real-Time Transformer Temperature), displays transformer temperatures based on calculations using industry standard equations. This was completed for the Summer 2000 load period. One of the goals of equipping a sampling of Manhattan transformers with analog temperature gauges is to validate the accuracy of the equations used to calculate these temperatures. The transformer temperature data received from these new sensors is transmitted into the operator workspace, along with the currently displayed calculated values. Both sets of data provide the operators and support staff with a valuable tool to identify more accurately and quickly those units that may be approaching an unacceptable temperature level.

Action Plan No.10. Increase the reporting availability of existing remote monitoring equipment. (CRC-I 3)

EPRI Solutions' Recommendations for Completion or Initiation by June 1, 2000:

1. Con Edison should initiate development of a process to evaluate the overall availability of the monitoring system by June 1, 2000. Data showing the percent of monitors reporting at the time of the Washington Heights shutdown is not available, and the overall availability of the monitoring system is not normally tracked. The percent of monitors available is only known for each separate location or piece of equipment, and because the number of monitors varies from site to site, this data cannot be combined to provide information on system-wide monitor availability. Higher reporting levels will result in more accurate secondary load analysis. This availability should be tracked over the long term to verify that the monitoring system as a whole is in good order and is available. Up-to-date data is a necessity to properly evaluate equipment loads and temperatures during emergency situations. The need for up-to-date information will become more and more important as new and improved methods of calculating loads and temperatures in real time are used.

Con Edison's Comments:

1. Con Edison tracks availability of RMS monitors in reports that show (for each network and aggregated by region) the number of monitors available and unavailable and the percentage availability. Availability is based on reporting within two hours of the run time of the report. Reports can be run any time, and each region runs the report once per week. System-wide RMS availability data can be aggregated from the three separate regional reports.

EPRIsolutions' Longer Term Recommendations:

1. Con Edison should investigate the feasibility of installing temperature sensors in manholes, transformer vaults, and on all critical transformers with real-time data capability.

2. Con Edison should incorporate temperature data into the WOLF and PVL programs.

3. Con Edison should develop kWh-to-kW conversion curves for commercial, industrial, and residential customers using customer billings.

4. When network transformers fail to report actual loading through the remote monitoring system, the average load of the nearby transformer is automatically entered into the PVL program. This method of estimating load reduces the accuracy of the PVL analysis program. Accurate transformer secondary loading data from the RMS is critical to PVL calculations, and reporting of 95% or more of the available RMS units would provide more accurate analysis.

5. Con Edison should use conversion curves to estimate data points for non-reporting units.

Con Edison's Comments:

1. Con Edison is examining the feasibility of installing manhole temperature sensors in a demonstration project in its Hunter network in Manhattan. The Company is currently lab testing five sensors for installation. Con Edison has installed 59 temperature sensors on Manhattan network transformers, selected on the basis of overload probability, and is planning to install approximately 55 sensors on transformers in the Brooklyn/Queens and Bronx/Westchester regions.

2. Con Edison will incorporate temperature data into WOLF and PVL.

3. Con Edison has begun a project (CUFLINK) to improve the secondary model(s) to reflect loads at actual service points. The company will develop and validate the conversions of kWh to kW for a specified time of day and day of week and will utilize validated results to reflect the associated loads at service points on the model(s). The target completion date is June 2003.

4. Con Edison has revised procedure EO-10,110, , "Inspection and Maintenance of Network Type Distribution Equipment," to establish a minimum 95% RMS reporting target.

5. See comment No. 3 above.

Action Plan No.12. Develop and implement methods and procedures to reduce feeder outage duration. (CRC-I 6! IRB-3.9)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000:

1. EPRIsolutions is unable to make a recommendation because Con Edison's "Feeder Process Review" report was not published until after work on this project was completed.

EPRIsolutions' Longer Term Recommendations:

1. Con Edison should develop plans to install fault sensors wherever possible. Fault indicators would aid in fault location, thereby reducing restoration times and the probability of multiple-feeder outages. New fault location devices show promise in detecting and locating faults with four to five impulses, versus several hours of thumping at 600 impulses per hour.

2. Con Edison should re-certify feeders after repairs whenever possible. Reducing the time to restore feeders that are out of service due to a fault could have a significant effect on reducing the overall probability of serious multiple contingencies. Reductions in restoration times also reduces the thermal loading on nearby feeder components, thereby lessening the probability of cascading outages.

3. Con Edison should continue to develop and investigate the use of new fault-locating devices and techniques.

Con Edison's Comments:

1. Con Edison has installed thirteen sectionalizing switches equipped with directional fault indicators in seven residential networks in order to evaluate their effectiveness, examine the feasibility and benefits of an expanded program, and gain operational experience. The evaluation is to consider the costs versus benefits of feeder sectionalizer/fault indicator installation and examine potential improvements in feeder processing time and system reliability in terms of SAIFI, CAIDI, probability of loss of load, and reduced exposure to above-design criteria contingencies. Completion is targeted for year-end 2001.

2. A Con Edison team of subject matter experts has been established to analyze and redesign our feeder restoration process. The team has identified improvements that we expect will save approximately three to five hours of restoration time on average per feeder. These were implemented prior to the summer. Longer-term changes that require more extensive technology improvements are being studied. We also have an R & D project using wave identification for fault locating in the beta test stage.

Con Edison's has revised its procedure CSP 5-0-7, "Coordination and Communication Required During Feeder Processing" to implement feeder processing methods that are anticipated to reduce feeder outage times. The revised procedures include:

- Elimination of the need to ground T. A. rectifier stations. The T. A. grounds are considered to be sufficient.
- Tracing current will be released once the fault is located instead of waiting for the feeder grounds to be placed.
- The reactor neutrals will be switched closed when hi-pot is successfully passed, rather than waiting for all work on the feeder to be completed.
- Feeder grounds will be placed for the work being done. Grounds will not be placed in anticipation of other work that may be done.
- Grounds will no longer be required to perform dress up work such as installation of arc proofing.
- The station operator will be put into place and the station test set will be readied prior to final testing for feeder restoration.

These new processes are anticipated to reduce average feeder outage time from 3 to 5 hours.

In addition to the process-related changes, the Company has worked with its vendors to develop a cold shrink splice that will reduce repair time on the feeder. The first vendor's joint has been approved and placed in our material management system. The training on installation is complete.

In order to expedite feeder processing, the Feeder Management System (FMS) has been installed in all regional control centers and has provided enhanced ability to view current up-to-the moment status of the distribution feeder operating process. The result is reduced calls to the District Operator and a more proactive response to the feeder process.

3. Con Edison is conducting an R&D project to develop a "new fault locating system" that would achieve real-time fault locating by analyzing the transient waveform of the operating fault. The project's first field trial was completed on June 5, 2000 using a staged fault. The basic fault-locating algorithm appears to have worked but communication difficulties were encountered. This problem is being addressed, and the next planned step is use portable field units to locate faults in four to five high voltage impulses. This would be followed by an operational trial and shakedown period, paralleled with concurrent development of extension to real-time capability.

Action Plan No.13. Undertake or sponsor a research program to develop a maximally effective method for testing the reliability of feeder cables, including an examination of whether over-temperature testing has any practical application in a network environment. Establish a test facility to test older cables and splices. Continue to support R&D to develop improved cable fault locating, proof testing, recertification, and failure analysis. (CRC-I 7, IRB-3.2, IRB-3.3, IRB-3.4)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000:

1. By June 1, 2000, Con Edison should initiate development of a long-term plan to test cables that have been overloaded or may be expected to become overloaded. Such testing of critical cables would improve Con Edison's ability to predict cable failures and eliminate imminent faults.

2. For cable loadings, Con Edison is using maximum conductor temperatures as specified by industry standards. However, as utilities increase the loading on their distribution systems - including the load on paper insulated lead covered (PILC) cables - to better utilize their existing assets, operating temperatures will increase. As a result, an increase in cable and joint failures caused by higher mechanical and thermal stresses can be expected unless load relief reinforcements result in reduced conductor temperatures. Therefore, EPRIsolutions recommends that Con Edison perform an analysis to determine actual conductor temperatures of its cable systems. The results could then be compared to other operating cable systems.

3. Con Edison should continue with pre-summer dc testing of feeders until better testing systems are available. Such testing would detect some incipient faults. The major disadvantage of dc testing is that it is destructive for some types of cable and can only show one defect at a time. Sometimes several consecutive tests are necessary to eliminate all defects.

Con Edison's Comments:

1. Con Edison intends to incorporate into its hi-pot test program feeders that experienced overloads, exceeding emergency rating, during the summer and include this criteria into specification EO-4019, "Testing of AC Feeders Operating at 4kV to 33kV. Each year, Con Edison's load relief program provides for full reinforcement of all network feeders to meet forecast peak load under N-2 contingency conditions. Consequently, Con Edison does not "expect" feeders to become overloaded.

2. Con Edison has commenced a multi-year project to enhance its existing thermal modeling techniques in order to better predict actual conductor temperature and improve feeder reliability.

3. Con Edison is continuing its pre-summer DC high potential feeder testing program and is examining alternatives to such testing.

EPRIsolutions' Longer Term Recommendations:

1. Con Edison should analyze the performance of "dry" stop joints versus "wet" stop joints, i.e., joints without or with a reservoir of impregnant or fluid within the joint casing.

2. Con Edison should analyze the impact of the asymmetrical short-circuit current on cable installations and joints. If necessary, Con Edison should start to reinforce the system.

Con Edison's Comments:

1. The failure rate of "wet" stop joints cannot be calculated because their population is not known. Con Edison does not install and is eliminating all oil reservoirs and reducing oil impregnated paper lead covered cable (PILC) from the distribution system. This is consistent with Con Edison's philosophy of removal of lead and oil filled equipment from the distribution system, for various reasons including environmental.

2. Con Edison will be performing this analysis and determining if there is any correlation between failures and distance from the area station. Investigation results would be incorporated, as appropriate, into our reliability program.

Action Plan No.14. Evaluate if additional shop field tests to identify incipient problems prior to reinstallation of a refurbished transformer in the field are required. (CRC-I)

EPRIsolutions' Recommendations for Completion or Initiation by June 1, 2000:

1. EPRI's recommendation is to move forward with the BIL testing. Con Edison agrees and has already purchased this test equipment and is waiting on delivery of it. Also, the Con Ed specification EO-10.504 mentioned above had already been modified to include BIL testing even though they did not have the test equipment.

Con Edison's Comments:

1. A Basic Impulse Level (BIL) test unit has been purchased, delivered and installed. The Transformer Shop has developed a Transformer Shop Operating Procedure (TOP) on the use and training for this new equipment. The Transformer Shop personnel have been trained in its operation and BIL testing of refurbished network transformers is taking place. This unit was incorporated into the production line on May 26, 2000. The equipment and testing is being done in accordance with IEEE Standard C57.98. This will increase the reliability of the refurbished network transformers being installed on the distribution system.

EPRIsolutions' Longer Term Recommendations:

1. Con Edison should review failure data to determine any correlation between failure rate and age of refurbished and new transformers. In other words, even if the transformers seem to be failing at the same rate, are the refurbished units failing earlier or later than the new units? They may simply be taken out of service for repair earlier. If so, changes in the maintenance cycle to permit inspections of refurbished units might help find these failures before they occur.

2. Con Edison should review its maintenance procedures for refurbished transformers, which are currently classified as "new" transformers and inspected as such, to ensure that the inspection schedule is adequate.

3. Recently, maintenance intervals have been lengthened for both new and refurbished units, and the intervals get progressively shorter as the units age. Con Edison should track transformer failure rates to ensure that the increased inspection and test intervals do not result in higher transformer failures.

Con Edison's Comments:

1. Tracking of the transformer failure rate has been an ongoing practice and will continue to be followed in order to assess inspection schedule changes.

2. Con Edison's specification, EO-10110, "Inspection and Maintenance of Network Type Distribution Equipment," has been revised to consider the original age of reburbished transformers. A refurbished unit has had its tank rebuilt and a new, corrosion resistant paint system applied. Under the revised specification, a refurbished transformer tank will be considered to be new for inspection scheduling purposes, but the inspection of its the core and coils, via fluid sampling, will be based on the year of its original manufacture.

3. See comment No. 1 above.

Action Plan No.15.

Efforts should be made to make manhole inspections more effective through instrumentation (e.g., differential temperature sensors) to augment visual inspections and better utilize non-scheduled visits to expand the inspection program. (IRB-3.8)

EPRIsolutions'Recommendations for Completion or Initiation by June 1, 2000:

1. Con Edison should improve reporting on the completion of category C work orders, i.e., those with no immediate impact on system integrity.

2. A 15-year inspection cycle for highly loaded distribution Systems has been appropriate in the past. To increase reliability, Con Edison should determine by June 1, 2000, whether the 15-year cycle should be reduced, and also by June 1,2000, it should consider prioritizing such inspections based on loading, known flooding, road salt, etc.

Con Edison's Comments:

1. Con Edison is moving from a strictly time based inspection cycle to an inspection program that prioritizes inspections based on operational data including failure analysis.

EPRIsolutions' Longer Term Recommendations:

1. Con Edison should develop user-friendly data acquisition and data warehousing systems. A user-friendly, efficient inspection system would enable the inspection of a greater number of important manholes, which would lead to early repairs and a reduction in in-service failures.

2. Con Edison should develop an inspection system that does not require personnel to enter a manhole.

3. Con Edison should investigate the use of remote sensors for condition assessment.

Con Edison's Comments:

1. Con Edison uses an inspection data acquisition system known as CIMOES. Data collected from the field is recorded on inspection forms and on hand held computers for entry into CIMOES. Con Edison is revising its Engineering Specification EO-1184, "Periodic Inspection, Maintenance and Reporting of Distribution Underground Cables and Joints" to require an inspection report to be submitted following completion of any work in the manhole. Con Edison is to examine the development of lower cost data acquisition systems to supplement or as an alternative to the use of the expensive portable units currently used. Manhole inspection data are currently available through a readily accessible intranet data warehouse that allows sorting and classification of data. Con Edison plans to enhance its data management capabilities to include trending. Con Edison expects that the total number of manhole inspections each year will increase significantly as a result of its inspections associated with telecommunications use of the distribution system. Such inspections will augment the current inspection program.

2. Over the long term, deployment of the Secondary Underground Network Data Acquisition System (SUNDAS) to monitor the network system is expected to provide improved intelligence on the condition of underground facilities that will enable the Company to refine its manhole inspection program and to respond more proactively and efficiently to potential manhole problems.

3. See comment No. 2 above.

APPENDIX A

August 7, 2000

Hon. Janet H. Deixler,
Secretary
State of New York Public
Service Commission
Three Empire State Plaza
Albany, NY 12223

RE: Case 96-E-897
Voluntary Load Reduction Program

Dear Secretary Deixler:

Enclosed for filing with the Public Service Commission (the "Commission") are new and revised schedule leaves issued by Consolidated Edison Company of New York, Inc. ("Con Edison" or the "Company") applicable to its customers in the City of New York and the County of Westchester. This filing reflects revisions to the Company's Schedule for Electricity Service, P.S.C. No. 9 - Electricity. Appendix A identifies the leaves being added and the leaves being revised.

Although the Company's schedule leaves are issued August 7, 2000 to become effective on September 7, 2000, for reasons explained below, the Company respectfully requests that the Commission approve this filing to be effective on short notice, *i.e.*, on August 17, 2000.

Summary of Proposed Changes

The Company is proposing to institute, under new Rider U - Voluntary Load Reduction Program under which customers, both full-service and retail access and those taking service from the New York Power Authority ("NYPA"), the New York City Public Utility Service ("NYCPUS"), or the County of Westchester Public Utility Service Agency ("COWPUSA"), will be compensated for load reductions during periods when Con Edison determines, in its judgment, that system reliability would be enhanced by reduction in customer load. The Company's judgment may be based on system supply criteria or on the level of customer demand in a particular portion of the Company's transmission and distribution system. The amount of notice provided to customers will depend on the circumstances that lead the Company to designate a particular period a "Load Reduction Period." Whether through the operation of emergency generators or load curtailment, participating customers will be required to demonstrate reduction of no

less than 100 kW for at least four hours. Payment will be based on the number of kilowatthours not taken. Because customers will be free to decide whether to participate in a particular load reduction period, customers will incur no penalty for failure to reduce load.

Payment will be based on the NYISO market price less the otherwise applicable Market Supply Charge energy charge component but will not be less than 30 cents per kWh.

Under revisions to the provisions on Segregated Service, General Rule III-12, and Emergency Generating Facilities, General Rule III-13, customers operating emergency generation during a Load Reduction Period would be exempt from the otherwise applicable requirement that a customer operating emergency generation except in the limited circumstances listed in General Rule III-13 must take service from Con Edison under Service Classification ("SC") No. 3 or 10.

The Company presently contemplates that the program would be in effect through the remainder of the NYISO Summer Capability Period (through October 2000) and throughout the next NYISO Winter Capability Period (November 2000 through April 2001). Before the next Summer Capability Period, the Company would decide whether to extend the program and whether any modification of the terms and conditions is appropriate.

The Company proposes to recover the costs of this program, including customer payments and administrative expenses, through adjustments to the Monthly Adjustment Charge on a current basis.

Other tariff changes

When Rider P was filed earlier this year, the Company inadvertently omitted to include references to the new rider in the Special Provision of each Service Classification that lists riders available to customers in that classification. As a housekeeping matter, revised tariff leaves with references to Rider P are being filed herewith.

Conclusion

The Company respectfully requests that the Commission approve on short notice the tariff leaves filed today. In past years, the Company has had the voluntary cooperation of customers to reduce their loads when the Company believes that extreme measures are essential to preserve the system infrastructure and the availability of service to all customers. However, customers have informed the Company that their cooperation is costly and should be compensated. We are informed that similar compensated load-reduction programs are being provided at the system operator level in New England and in the PJM area.

This filing is also consistent with one of the Commission's recommendations issued in Case 99-E-0930 (Proceeding to Investigate Con Edison Power Outages of July 6, 1999). Recommendation V-18 states that the Company "should consider a more formal program for using customer-owned emergency generators as a strategic load management tool during critical distribution system event like that of July 1999."

Under the 1997 settlement agreement in this proceeding, approved by the Commission on September 23, 1997, the Company is permitted to propose tariff changes that have *de minimis* effect. Because this tariff will provide the Company with immediate flexibility to address reliability issues, the Company respectfully requests emergency adoption of this filing. A proposed form of emergency notice for publication in the State Register is enclosed. Newspaper publication will be made on August 23 and 30, and September 6 and 13, 2000, or as directed by the Commission following the Commission's action on this filing.

The Company is serving copies of this filing upon all parties to this proceeding by regular mail.

Very truly yours,

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

By:_____
Joel H. Charkow
Director
Rate Engineering

c: Service List in Case 96-E-0897
Richard King, Office of General Counsel, Department of Public Service
Harvey Arnett, Department of Public Service

Comments of

Consolidated Edison Company of New York, Inc.

on

Phase II Report of

EPRIsolutions, Inc.

October 19, 2000

Section A: Analysis of the Design of Con Edison's Network Distribution System

I. Analysis of the Feeders in Con Edison's Network Distribution System.

EPRIsolutions' Recommendation:

1. Based on capacity considerations, EPRIsolutions recommends no changes in the number of network feeders at this time.

Con Edison's Comments:

Each year, Con Edison's performs a load relief study of its distribution system to determine the relief measures that are required to reinforce the system in order to meet the peak loads forecast for the upcoming summer period. These measures may include, among others, adding transformers, increasing transformer capacity, shifting load, increasing the capacity of feeder sections or adding new feeders. Based on the study, the Company develops and implements a plan to reinforce each network before the summer period. Based on its summer 2000 load relief study, Con Edison installed a total of 14 new network feeders to meet forecast peak loads. Con Edison's 2001 load relief study is in progress, and based on that study, Con Edison will determine whether to install any additional feeders prior to the 2001 summer period.

Section A: Analysis of the Design of Con Edison's Network Distribution System

I. Analysis of the Feeders in Con Edison's Network Distribution System.

EPRIsolutions' Recommendation:

2. EPRIsolutions recommends that Con Edison continue to examine individual feeder capacities on an annual basis as well as the aggregate feeder capacity for the network. A study of all the networks with emergency margins less than 30% should be undertaken to determine both the maximum attainable network capacity and when (which year) that capacity would be reached. Based on the results of such a study, Con Edison should formulate what would be the best approach to serving loads in excess of such a limit, such as adding new feeders, shifting load, splitting the network, and other countermeasures.

Con Edison's Comments:

Con Edison's annual Ten-Year Area Substation and Feeder Relief Plan and its annual distribution system load relief study examine substation capacity, network capacity, individual and aggregate network feeder capacity, and network transformer capacity. These studies, which are conducted each year for each substation and each network regardless of the existing network feeder emergency capacity margin, provide relief plans designed to expand substation capacity and network capacity as necessary each year to meet forecast network load growth. The annual Ten-Year Area Substation and Feeder Relief Plan considers the impact of projected network load growth on the capacity of the substation to supply that load and develops a plan to assure reliable substation supply through substation capacity expansion or network reconfiguration (e.g., shifting load between networks). The annual distribution load relief study considers the impact of forecast peak network load for the following year on the capacity of the network facilities (feeders, transformers, etc.) that will serve that load. The study develops a relief plan, that will be implemented prior to the summer peak season, to assure that these facilities will have adequate capacity to supply that load at system design conditions. That plan may include increasing transformer capacity, shifting load, increasing the capacity of feeder sections or adding new feeders. Con Edison believes that these annual studies fully achieve the short-term and long-term planning aims of this recommendation

Section A: Analysis of the Design of Con Edison's Network Distribution System

II. Analysis of Substations in Con Edison's Network Distribution System

EPRIsolutions' Recommendation:

1. EPRIsolutions recommends that Con Edison eliminate the practice of connecting three feeders from a single network to the same substation bus.

Con Edison's Comments:

Implementation of this recommendation would not improve the reliability of networks and would add significant costs. EPRIsolutions' concern is that if three feeders from a single network are connected to one substation bus section, the failure of that bus could result in a contingency more severe than the design criteria. Con Edison's network design dispels this concern. Con Edison's network design electrically separates the feeders supplied by the same bus section. When two or more feeders emanate from the same bus section, they are diversified throughout the network. In addition, major and minor bus sections are alternated throughout the network. Electrically separating feeders and alternating bus sections is designed to limit feeder association so that the loss of a bus section would result in feeder loadings that are equivalent to the loading condition resulting from a local first contingency, i.e., the feeder loadings will not exceed their normal loading ratings. The networks are designed to operate within normal feeder ratings with the loss of two associated or companion feeders – a condition producing much more severe loading consequences than the loss of a bus section with two or three network feeders that are electrically separated.

The cost to implement this recommendation for existing substation busses would be substantial and would not be justified. To begin with a bus section failure is a low probability event and occurs infrequently. The cost to reduce all bus sections to a maximum of two feeders (if the space were available) would be $23,250,000 for the 13kV substations ($250,000 per 13kV feeder position) and $19,600,00 for the 27kV substations ($400,000 per 27kV feeder position) for a total of $42,850,000.* Even if these modifications were incorporated, the improvement in reliability would be marginal.

* Limiting the number of feeders on each bus section to a maximum of two would require additional substation space that is nonexistent in some instances.

Section A: Analysis of the Design of Con Edison's Network Distribution System

III. Analysis of Residential vs. Commercial Network Standards

EPRIsolutions' Recommendation:

1. Con Edison, in general, applies the same strict network reliability rules (contingency planning) to both commercial and residential networks. EPRIsolutions recommends, however, that the feeders of residential networks, due to their longer lengths, get proportionally higher priority in feeder plans (load relief and reliability reinforcements). This includes, but is not limited to, the replacement of PILC cables and stop joints. This will ensure parity in the performance of commercial and residential feeders.

Con Edison's Comments

The concept of prioritization is not relevant to Con Edison's load relief program. The annual load relief program provides all feeders in all networks, commercial and residential, with all reinforcement relief that is required to meet the forecasted peak load each year.

Con Edison prioritizes its reliability program projects according to feeder performance and feeder characteristics. Feeder performance is measured by the failure rate normalized in failures/mile. The major feeder characteristics considered are age, cable type (i.e. PILC, Solid Dielectric), length of feeder, number and type of joints, and the importance of the feeder to the network. The length of a feeder influences this analysis since the number of potential failure components (sections of cable and joints) is included in the selection process. These criteria are applied on a system-wide basis to select the feeders that have the greater potential for failure and do not consider whether a feeder is located in a residential or commercial network. However, if Con Edison has experienced significantly poorer performance in a particular network, Con Edison normally targets resources to address the basis for such performance. For example, in the early 1990s, Con Edison focussed resources in the Yorkville network to improve performance in that network. As another example, following the July 1999 outages, Con Edison gave priority in its reliability projects to the networks that experienced the most feeder failures. These networks included Washington Heights, Cooper Square, Williamsburg, and Long Island City.

Section A: Analysis of the Design of Con Edison's Network Distribution System

III. Analysis of Residential vs. Commercial Network Standards

EPRIsolutions' Recommendation:

2. Con Edison should continue to target for reinforcement residential (as well as commercial) network feeders that appear in the list of the 5% worst feeders in multiple years.

Con Edison's Comments:

Con Edison's reinforcement program is not a targeted program. The reinforcement program provides all feeders in all networks, commercial and residential, with all reinforcement relief that is required to meet the forecasted peak load each year. Con Edison's reliability program addresses the worst performing 5% of feeders (network and radial) by including these feeders in the group of feeders (about 25% of all feeders) that are "hi-pot" tested each year and by selecting these feeders for the removal of thermally sensitive stop joints.

Section A: Analysis of the Design of Con Edison's Network Distribution System

III. Analysis of Residential vs. Commercial Network Standards

EPRIsolutions' Recommendation:

3. Con Edison should conduct a study to determine a maximum optimal load for each residential network so that these networks are not extended beyond this load. EPRIsolutions is not aware of such a study being done at this time.

Con Edison's Comments:

Con Edison's annual Ten-Year Area Substation and Feeder Relief Plan examines annually whether substation capacity is adequate to serve the load of the network under applicable contingency criteria for the substation. When it is forecast that substation capacity can no longer serve the network load, the plan will include a plan to reconfigure the network by shifting load to another network or splitting the network. In addition to the annual review of actual and projected loading versus substation/network capacity, a load modeling program is used to analyze in detail each network. This model provides detailed information concerning maximum loading under adverse conditions such as feeder failure and partial network shutdowns. The output of this model is used by the electric system operators as guidance for abnormal conditions.

Section A: Analysis of the Design of Con Edison's Network Distribution System

III. Analysis of Residential vs. Commercial Network Standards

EPRIsolutions' Recommendation:

4. Con Edison should continue to install additional sectionalizing switches on bifurcated feeders (and fault locating devices) in residential networks.*

Con Edison's Comments:

Con Edison is evaluating the potential for the installation of sectionalizing switches, equipped with fault indicators, in residential networks to mitigate the effects of feeder outages during multiple contingencies. Sectionalizing switches have been installed on 13 feeders in seven residential networks to evaluate their effectiveness and gain operational experience. The effectiveness of the sectionalizing switches in the initial pilot project is being monitored in order to determine the feasibility and benefits of an expanded program. The benefits of sectionalizing switches in terms of reduced probability of loss of load, or reduced exposure to multiple (i.e., above design criteria) contingencies is to be evaluated against the cost of installation (about $125,000 per switch) and the potential reliability benefits derived from alternate reliability projects such as the replacement of thermally sensitive stop joints and associated PILC cable

* EPRIsolutions has clarified that it recommends that sectionalizers be installed where appropriate and not necessarily on each bifurcated feeder.

Section A: Analysis of the Design of Con Edison's Network Distribution System

III. Analysis of Residential vs. Commercial Network Standards

EPRIsolutions' Recommendation:

5. Although the number of customer interruptions involved is not large, Con Edison should examine the secondary network to reduce the number of customer outages due to secondary main problems and service connections.

Con Edison's Comments:

The number of customer interruptions, due to network secondary main problems is extremely low. For 1999, the interruption rate was 5.4 per 1,000 customers and the last 5 year average is 15.64 per 1,000 customers. Based on the 1999 and the 5 year average statistics, a customer can expect to have an outage due to secondary main problems once every 185 years and once every 64 years respectively. At the current time, improving the reliability of the (13kV and the 27kV) network feeders is a higher priority and is expected to result in more significant reliability and performance benefits.

We are evaluating the implementation of an advanced remote monitoring system for our secondary networks. This Secondary Underground Network Data Acquisition System (SUNDAS) will monitor the network system more extensively than any system in the world and is the first of its kind in the utility industry. This enhanced system uses the secondary grid for two-way power line carrier communications. Our present Remote Monitoring System (RMS) system provides only three-phase current and the network protector position. It also provides 5 data points that can be used to monitor water level, vault entry, etc. The latest version of RMS has voltage and transformer top oil temperature capabilities. SUNDAS provides this information as well as voltage, phase angle, relay status, and the capability of remote relay setting changes as well as remote operation of the protector. While system-wide installation of this system is a long-term project, a full network scale demonstration is underway in the Company's Hunter network. SUNDAS is expected to assist the Company in identifying problems before they cause outages and addressing them proactively. In addition, a new program (CUFLINK) is expected to assist in identifying secondary mains that require reinforcement. This program would distribute network load on the secondary grid rather than concentrating the load on the network transformer busses. Better modeling would promote faster identification and relief of problems.

In addition, as discussed elsewhere in these comments, Con Edison is enhancing its manhole inspection program, and this is expected to improve performance on the secondary grids.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

I Investigate improvements to thermal modeling techniques and data inputs to cable rating methods (CRC-2, CRC-4, IRB-3.1)

EPRIsolutions' Recommendations:

1. Con Edison should develop and implement a system for rating individual sections of cable. This system would be based on a model that reflects actual installation conditions and parameters and accommodates contingencies greater than n-2.

2. Con Edison should include the loading of secondary cable in the feeder-rating program.

3. In the final stage of rating development, Con Edison should rate the systems by temperature rather than current-carrying capacity.

Con Edison's Comments:

Con Edison has commenced a multi-year project to enhance its existing thermal modeling techniques in order to better predict actual conductor temperature and improve feeder reliability.

Ampacity ratings of 13 kV, 27 kV and 33 kV primary distribution cables installed in underground conduit are normally calculated using the Cable Ampacity Rating Program (CARP) subroutine of the Poly-Voltage Load Flow program (PVL).

CARP calculates the cable ampacity in a 2, 4, 6, or 8 concrete duct bank configuration where all cables in the duct bank are of the same construction and operating at the same loss factor. The cable is rated based on the hottest occupied duct called the reference duct. Conductor temperature limitations are dictated by the cable insulation. To account for unequal loading of cables in the duct bank, a multiplier is applied to all other cables in the duct bank other than the reference duct. CARP is limited in its adaptability to accept actual current flows extracted from the load flow program to calculate the ratings of cables under normal and emergency conditions.

We are developing a new thermal modeling program called Underground Systems Ampacity Program, USAMP, that is intended to provide more accurate modeling in a duct bank occupied by different cables with different loadings and loss factors. It would be capable of modeling multiple-duct bank installations and external heat sources such as steam mains. Inputs to this program can be either conductor temperatures or conductor currents and the corresponding output can be provided in either current or temperature. USAMP was initially developed to analyze one section of cable at a time making it a cumbersome and time-consuming process and ineffective as a real time tool.

Con Edison's goal is to configure USAMP for every section of cable on every feeder simultaneously (batch mode operation) with interfaces to the real time monitoring data

and the network load flow analysis tool. This program would be an engineering tool as well as an operator tool to identify overloaded cables and their temperatures quickly and accurately.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

II. Review existing methods of rating cables and transformers, giving special attention to the effects of high ambient temperatures on equipment performance. (CRC-3, IRB-3.1, IRS-3.7)

EPRIsolutions' Recommendation:

1. Con Edison should revise the ampacity program to better account for higher soil temperatures and higher thermal rho.

Con Edison's Comments:

Con Edison has maintained thermal probes for many years and has increased the number of probes to gather additional data. Adjustments, as appropriate to reflect this data, are made to the ampacity program.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

II. Review existing methods of rating cables and transformers, giving special attention to the effects of high ambient temperatures on equipment performance. (CRC-3, IRB-3.1, IRS-3.7)

EPRIsolutions' Recommendation:

2. Con Edison should develop a Dynamic Thermal Circuit Rating system flexible enough to calculate short- and long-term ratings and to factor in previous loading.

Con Edison's Comments:

See comments to Section B, I, Recommendations 1, 2, and 3.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

II. Review existing methods of rating cables and transformers, giving special attention to the effects of high ambient temperatures on equipment performance. (CRC-3, IRB-3.1, IRS-3.7)

EPRIsolutions' Recommendation:

3. Con Edison should use the largest cable suitable for each duct.*

Con Edison's Comments:

Con Edison has implemented a policy standardizing the cable size for the main run of its 13kV and 27kV feeders. A cable design specification to provide guidelines to the operating areas is being prepared.

* EPRIsolutions has clarified that this recommendation is not intended to apply to feeder taps or to feeder sections at the end of a feeder line.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

II. Review existing methods of rating cables and transformers, giving special attention to the effects of high ambient temperatures on equipment performance. (CRC-3, IRB-3.1, IRS-3.7)

EPRIsolutions' Recommendations:

4. Because short-circuit currents can affect the performance of joints and terminations, Con Edison should correlate failures with the distance to the Area Substation.

5. Con Edison should analyze the mechanical impact of asymmetric short-circuit currents on cable installations in manholes and on cable conductors within a joint.

7. Con Edison should perform an analysis to correlate failures with the short-circuit frequency, magnitude, and duration. The results should allow Con Edison to prioritize test and maintenance tasks.

Con Edison's Comments:

Con Edison will be performing this analysis and determining if there is any correlation. We plan to incorporate investigation results, as appropriate, into our reliability program. Using PQ nodes, we will analyze the magnitude of the faults and the voltage depressions.

The analysis of PQ node data is on 6 sample networks. The PQ node data acquired has the Minimum Voltage Magnitude in kV and per unit, the duration is in milliseconds and cycles, the date/time of the event. These PQ node data recordings are triggered events and represent the secondary network voltage. The triggered events that correspond to OA's in 1999 have been identified and the voltage dips are being calculated. The voltage dips will give us an indication of the severity of the short circuit magnitude. The data still has to be investigated. The expected completion date is year-end 2000.

The PQ node graphs are indicating a low percentage dip in voltage, with a few cycle duration, at the substation bus, before the feeder breaker trips. This is a good indication that the system fault current has a low magnitude as a result of high impedance ground faults.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

II. Review existing methods of rating cables and transformers, giving special attention to the effects of high ambient temperatures on equipment performance. (CRC-3, IRB-3.1, IRS-3.7)

EPRIsolutions' Recommendation:

6. Con Edison should verify the rating of feeder sections 1M04 (250kcmil) and 1M01 (2/OAWG), as they seem too high. See Table B-I.

Con Edison's Comments:

This must have been a typographical error on Table B-1. The sections of both feeders (1M01 and 1M04) are the same size PILC cable, 250 kcmil, and have the same rating of 310 amps for normal and 370 amps for emergency.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

III. Undertake or sponsor a research program to develop a maximally effective method for testing the reliability of feeder cables, including an examination of whether over-temperature testing has any practical application in a network environment. Establish a test facility to test older cables and splices. Continue to support R&D to develop improved cable fault locating, proof testing, re-certification, and failure analysis. (CRC-17, IRB-3.2, IRB-3.3, IRB-3.4)

EPRIsolutions' Recommendations:

1. Con Edison should continue to support research into the testing of new and aged cable systems and to develop and demonstrate new diagnostic techniques.

2. Con Edison should support research to determine the effect of prolonged over-temperature on aged PILC cables.

Con Edison's Comments:

Con Edison is assessing the thermal characteristics of various vintages of paper insulated lead covered (PILC) cables in order to better understand their performance, evaluate the remaining life of the cable, and guide the replacement program. This analysis includes examination of power factor, dryness of tapes and moisture content. If the performances of any cables are in question, Con Edison would implement a test program.

Cable Technology Laboratories, Inc (CTL) has been contracted to evaluate the characteristics of pre-World War II belted paper insulated cables and to determine if they could be loaded to the same temperature level as shielded paper insulated cables.

CTL will conduct the following tests on the Pre World War II belted cables:

- Dissipation factor and measurement of the sheath temperature during the test
- Determination of thermal resistance of belted cable insulation at 60 C, 85 C, and 110 C steady state conductor temperatures
- Calculation of the temperature in the interstice of the three insulated conductors
- Breakdown tests on the belted cable samples at 1.2 times rated voltage with incremental conductor current for a duration of five days for each specimen

Testing will be performed at CTL and the statistical evaluation of the test data with corresponding computations will be performed at Underground Systems (USI).

Based on the results of the testing, evaluation, and additional analysis, Con Edison plans to examine the paper cable removal program for reprioritization. We expect the results will help establish the life expectancy and loading limits of these cables during emergency conditions

Con Edison is continuing the R&D effort to develop an Automated Mobile Cable Testing System to improve documentation procedures and reduce testing setup time. This mobile van will contain the very low frequency (VLF) test equipment and the standard fault locating equipment, which will be computerized. The fully equipped van will be delivered to Con Edison in February 2001. Con Edison plan to evaluate the feasibility of VLF (0.1 Hz) AC testing of network feeders, including its ability to locate incipient faults and reduce the probability of operating failures. The Company plans to use the VLF test set to test some of the feeders included in the Spring 2001 feeder hi-pot test program.

The feasibility of thermal testing of network feeders is the subject of an R & D effort that will examine increasing distribution feeder load to emergency limits by varying the angle-regulating device connected to a feeder in order to simulate the thermal stress that might be experienced during contingencies on a hot summer day

Another active R&D project is evaluating the feasibility of using partial discharge detection to locate incipient faults and other anomalies on feeders before their failure. Partial discharge detection is a non-destructive diagnostic testing technique that is applied to a feeder while it is operating at normal voltage and carrying load.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

IV. Should Con Edison replace its paper insulated lead covered cables (PILC) more rapidly?

EPRIsolutions' Recommendation:

1. Con Edison should perform aging studies in the laboratory to investigate the performance of aged PILC systems under high continuous loading. Such tests could show that the accelerated replacement of PILC is necessary. One of the reasons, among others, could be the lack of remaining life or the need for higher emergency operating capabilities.

Con Edison's Comments:

See comments on Section B, III, recommendations Nos.1and 2.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

IV. Should Con Edison replace its paper insulated lead covered cables (PILC) more rapidly?

EPRIsolutions' Recommendation:

2. Con Edison should correlate short-circuit data with feeder and joint failures, If the correlation is positive, Con Edison should prioritize feeder testing and maintenance based on the results.

Con Edison's Comments:

See comments on Section B, II, recommendations Nos. 4, 5, and 7.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

IV. Should Con Edison replace its paper insulated lead covered cables (PILC) more rapidly?

EPRIsolutions' Recommendation:

3. Con Edison should investigate the performance characteristics of different cable designs, various types of paper and impregnate and various types of lead sheath.

Con Edison's Comments:

Con Edison is investigating the thermal characteristics of various designs and vintages of paper insulated lead covered (PILC) cables.

Constant improvements to paper, impregnates, and lead sheaths by the cable industry have improved PILC cables over the years. These component changes cannot be identified by Con Edison on installed paper cables. Con Edison maintains a cable and joint failure database which tracks: date of failure, feeder, structure, cable spec (type of cable), manufacturer, year of manufacture, and cause of failure. Con Edison is not aware of any problematic vintage associated with types of paper, impregnates, or lead sheaths.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

V. Improve the performance of PILC cable accessories: Reduce the number of stop joints that have demonstrated a greater susceptibility to failure than comparable components. Review methods to improve splice conditions. (CRC-9, CRC-14, IRB-3.4, IRB-3.5, IRB-3.6, IRB-3.13)

EPRIsolutions' Recommendation:

1. Con Edison should accelerate the replacement of Con Edison modified Elastimold stop joints, especially those with taps.

Con Edison's Comments:

Con Edison has established a prioritized program for the removal of thermally sensitivity stop joints from the distribution system to improve feeder performance. Con Edison plans to remove approximately 1950 thermally sensitive stop joints, including Elastimold stop joints, in 2001.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

V. Improve the performance of PILC cable accessories: Reduce the number of stop joints that have demonstrated a greater susceptibility to failure than comparable components. Review methods to improve splice conditions. (CRC-9, CRC-14, IRB-3.4, IRB-3.5, IRB-3.6, IRB-3.13)

EPRIsolutions' Recommendation:

2. Con Edison should investigate new stop-joint designs, such as those with integrated insulating fluid reservoirs.

Con Edison's Comments:

Con Edison has developed and deployed a new splicing configuration that reduces the use of stop joints. However, Con Edison is eliminating all reservoirs and is reducing oil impregnated paper lead covered cable (PILC) from the distribution system. This is consistent with Con Edison's philosophy of removal of lead and oil filled equipment from the distribution system, for various reasons including environmental.

V. Improve the performance of PILC cable accessories: Reduce the number of stop joints that have demonstrated a greater susceptibility to failure than comparable components. Review methods to improve splice conditions. (CRC-9, CRC-14, IRB-3.4, IRB-3.5, IRB-3.6, IRB-3.13)

EPRIsolutions' Recommendation:

3. Con Edison should investigate the use of new stop joint designs that can allow faster installation. If successful, this would reduce outage time.

Con Edison's Comments:

Con Edison understands the importance of reducing feeder processing time and is examining all aspects of feeder processing, including the splicing component, to achieve efficiencies that should reduce processing time. During the summer 2000, the average processing time was significantly reduced as compared to the most recent three-year average.

Section B: Analysis of the Cable Used in Con Edison's Feeder Networks

VI. Should Con Edison improve the ability of its feeders to dissipate heat, e.g. should the cable be surrounded by materials such as special heat dissipating sands?

EPRIsolutions' Recommendation:

1. Con Edison should utilize newly developed distributed temperature sensing technology to identify hot spots along the cable run and mitigate the hot spots by applying fluidized thermal back fill or other appropriate measures.

Con Edison's Comments:

Although soil resistivity and ambient soil temperature measurements vary over a wide range, these measurements seldom exceed the design values of 30°C for ambient soil temperature or 75°C-cm/watt for soil resistivity. Additional probes will be installed for the summer 2001 to continue monitoring the soil characteristics.

One of the rationales for Con Edison's current project to improve thermal modeling of feeders is to avoid sensor monitoring of the entire system. To the extent that hot spots are identified, the appropriate mitigation is the installation of cable with higher current capacity. This is more practical and economic than the use of thermal backfill because it does not require street excavation. In addition, future street excavation by other parties can disturb or eliminate thermal backfill.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

I Is it feasible for Con Edison to use non-destructive tests as an alternative to hi-pot testing?

EPRIsolutions' Recommendation:

1. Con Edison should continue research into new fault-locating techniques to reduce outage time and electric stress on electric insulation.

Con Edison's Comments:

See Con Edison's comments on Section B, III, recommendations Nos.1 and 2.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

1 Is it feasible for Con Edison to use non-destructive tests as an alternative to hi-pot testing?

EPRIsolutions' Recommendation:

2. Con Edison should develop new techniques to assess the condition of lead sheaths without removing the arc-proofing tapes.

Con Edison's Comments:

EPRIsolutions explained that these tools are are under development by EPRI and others and are not presently commercially. When the new tools are developed, Con Edison expects to evaluate them for possible application.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

I Is it feasible for Con Edison to use non-destructive tests as an alternative to hi-pot testing?

EPRIsolutions' Recommendation:

3. In 2001 hi-pot test program, Con Edison should test PILC cables that experienced overloads exceeding emergency rating during the summer of 2000. Con Edison should then correlate test results and visual observations with overloads, readjust the test program as necessary, and feed information into laboratory test program.

Con Edison's Comments:

Con Edison plans to incorporate into its hi-pot test program feeders that experienced overloads, exceeding emergency rating, during the summer and include this criteria into specification EO-4019, "Testing of AC Feeders Operating at 4kV to 33kV." Con Edison evaluates and considers all prior-year feeder failures (open automatics and hi-pots) in determining its annual reliability program.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

I Is it feasible for Con Edison to use non-destructive tests as an alternative to hi-pot testing?

EPRIsolutions' Recommendation:

4. Con Edison should continue research into diagnostic techniques that have defect-location capabilities.

Con Edison's Comments

See Con Edison's comments on Section B, III, recommendations Nos. 1 and 2.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

II. Is Con Edison's maintenance program for feeder connections at substations adequate?

EPRIsolutions' Recommendation:

1. Con Edison experienced a failure of the though-bushing connection. The failure was due to the use of an inadequate connector. It was not related to a maintenance issue. Standard connections do not normally require any maintenance if they are installed properly and the bolts are torqued to the manufacturer's specifications. Outdoor high-voltage substations are routinely inspected using infrared cameras. These cameras can detect loose or inadequately sized equipment by showing excessive temperatures at the connections or joints. Con Edison has an existing infrared (IR) program to predict these types of problems. However, infrared techniques are not routinely used for through bushings and most distribution class equipment, since this equipment is blocked by safety barriers and is not directly accessible to IR camera surveys.

Con Edison's Comments:

Con Edison has completed and implemented the redesign of the Sherman Creek Substation breaker through-bushings.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

III. Should Con Edison adopt new and/or improved maintenance programs for manholes?

A. New and/or improved maintenance programs.

EPRIsolutions' Recommendations:

1. Con Edison should develop a user-friendly data acquisition and data warehouse systems for manhole inspections.

2. Con Edison should base its manhole inspection schedule on an analysis of failures that includes the type of equipment, installation conditions, and failure modes.

3. Con Edison should implement a tracking system for C-faults.

Com Edison's Comments:

Con Edison uses an inspection data acquisition system known as CIMOES. Data collected from the field is recorded on inspection forms or on hand held computers for entry into CIMOES. Con Edison is revising its Engineering Specification EO-1184, "Periodic Inspection, Maintenance and Reporting of Distribution Underground Cables and Joints" to require an inspection report to be submitted following completion of any work in the manhole. Con Edison is to examine the development of lower cost data acquisition systems to supplement or as an alternative to the use of the expensive portable units currently used.

Manhole inspection data are currently available through a readily accessible intranet data warehouse that allows sorting and classification of data. Con Edison plans to enhance its data management capabilities to include trending.

Con Edison is moving from a strictly time based inspection cycle to an inspection program that prioritizes inspections based on operational data including failure analysis.

Each operating region is required to submit an "Inspection, Maintenance & Construction Activities" Quarterly Report to Distribution Engineering. Among other items, this report lists the annual CIMOES inspection goal and the categories of "C" faults with year-to-date progress.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

III. Should Con Edison adopt new and/or improved maintenance programs for manholes?

B. Efforts should be made to make inspections more effective through instrumentation (e.g. differential temperature sensors) to augment visual inspections and better utilize non-scheduled visits to expand the inspection program. (IRB-3.8)

EPRIsolutions' Recommendation:

1. Con Edison should continue to investigate and then apply remote sensing equipment to manholes.

Con Edison's Comments:

Con Edison is revising its Engineering Specification EO-1184, "Periodic Inspection, Maintenance and Reporting of Distribution Underground Cables and Joints" to require an inspection report to be submitted following completion of any work in the manhole.

Over the long term, deployment of the Secondary Underground Network Data Acquisition System (SUNDAS) to monitor the network system is expected to provide improved intelligence on the condition of underground facilities that may enable the Company to refine its manhole inspection program and to respond more proactively and efficiently to potential manhole problems.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

IV. Improve cable technology and maintenance to reduce feeder outage duration.

EPRIsolutions' Recommendation:

1. To provide an inexpensive means of sectionalizing short spurs of feeders, Con Edison should investigate the use of separable dead-break connectors for extruded cables. This is in addition to the installation of sectionalizing switches mentioned in Section A.

Con Edison's Comments

Con Edison is using molded disconnectable splices, with test points for all T-Tap splices. This allows for the quick disconnection of failed sections or transformers. The Elastimold 600 amp terminations (hammerheads), used at all network transformers purchased since approximately 1973, also function as disconnects. This equipment provides quick-disconnect functionality at reasonable cost. All transformers that have been reconditioned and reinstalled have been modified to include the hammerheads.

Section C: Analysis of the Adequacy of Con Edison's Network Maintenance Program

IV. Improve cable technology and maintenance to reduce feeder outage duration.

EPRIsolutions' Recommendation:

2. Con Edison should provide operators with readily available information regarding poor performing equipment, overloaded cables, and high short circuit stress.

Con Edison's Comments:

Con Edison has recently implemented electronic systems that provide in graphical format for control center operators and engineers real-time and next-event information on feeder status based on current feeder rating models. These systems incorporate actual system configuration and loading and display system status, loads, relationship to ratings or thermal limits, and projected or potential future operating parameters. Previously this data was presented in tabular format. As discussed previously, Con Edison is working to develop a dynamic cable rating system that is intended to provide operators and engineers with real-time loading data and perform enhanced contingency analysis (greater than the N-2 capability of the present system) for loss of up to 50% of a network's feeders.

Section D: Analysis of Con Edison' s Load Relief Program for Feeders and Substations.

I. Load relief program for feeders

EPRIsolutions' Recommendation:

1. EPRIsolutions recommends that Con Edison adopt a two-year load relief program for networks that will be heavily loaded in the summer of 2001.

Con Edison's Comments:

Con Edison's current load relief program maintains feeder loadings within system design parameters by implementing all feeder reinforcement measures needed to address forecast peak loading in the upcoming year. The Company evaluates all feeder failures and has found no indication that failures are resulting from overloaded feeders. Accordingly, implementation of a two-year load relief program to increase the loading margins of network feeders is not considered a priority for tha allocation of resources. Con Edison believes that its resources are more appropriately focused on its reliability program (particularly the removal of thermally sensitive joints and associated PILC cable) and the reduction of the time feeders are out of service (feeder processing time). The Company has also begun a three-year program to improve the loading margins of network transformers.

Section D: Analysis of Con Edison' s Load Relief Program for Feeders and Substations.

I. Load relief program for feeders

EPRIsolutions' Recommendation:

2. EPRIsolutions recommends that Con Edison investigate the merits of a three-year load relief program that could be implemented at some time in the future.

Con Edison's Comments:

Con Edison previously performed a 5-year study for the Yorkville Network, but found it to be inaccurate. A long-term load relief study can be done on a macro level, but on a feeder level, accuracy is lost. For example, information on additional new commercial, industrial or residential buildings loads (which have a large impact on load relief requirements) is not normally available far enough in advance for a three-year load relief forecast.

The present system of evaluating the network loads and feeder and network transformer loading on a yearly basis assures that the reinforcements are effective for the local area. Projecting specific feeder reinforcement beyond the one-year span introduces inaccuracies in forecasting load growth. Reinforcements that do not address needed relief or improve network reliability are not the most effective use of the Company's resources.

Section D: Analysis of Con Edison' s Load Relief Program for Feeders and Substations.

1. Load relief program for feeders

EPRIsolutions' Recommendation:

3. **EPRIsolutions finds the present substation relief plan acceptable and recommends no changes.**

Con Edison's Comments:

Con Edison's substation planning process is a priority effort and a cornerstone of the Company's overall high level of reliability performance.

Section D: Analysis of Con Edison' s Load Relief Program for Feeders and Substations.

II. Load relief program for substations.

EPRIsolutions' Recommendation:

1. After reviewing Con Edison's substation load relief plan EPRIsolutions sees no need for modification.

Con Edison's Comments:

Con Edison agrees.

Section E: Analysis of the Capital Plan for Con Edison's Distribution System

EPRIsolutions' Recommendation:

1. Con Edison's investment planning process should explicitly incorporate load uncertainty over a substantial portion of equipment life. Tools are available to support this type of forecasting. Longer-term probabilistic forecasts would provide for better decisions on the scale and timing of investments and provide insights into the risks associated with specific investment strategies.

Con Edison's Comments:

The implementation of a probabilistic approach to long-term forecasts of networks would provide insights into the risks associated with specific investment strategies. However as stated in the EPRIsolutions Report, "the state of the art in distribution investment planning is evolving and is just starting to offer methods and tools to analyze the two important uncertainties of future load and system performance."

Con Edison's forecasting and planning groups are tol assess available probabilistic tools, including "Load Dynamics" (a long–term load forecasting tool recently provided by EPRIsolutions) and evaluate applicability to network load forecasting at Con Edison.

Section E: Analysis of the Capital Plan for Con Edison's Distribution System

EPRIsolutions' Recommendation:

2. Con Edison should develop a capability to do value-based planning. We recognize that developing the necessary methodologies, data, and planning skills will take significant time. Value-based planning is not a new concept, but sophisticated tools to enable its application to distribution systems are just starting to be developed.

Con Edison's Comments:

EPRIsolutions has withdrawn this recommendation.

Section E: Analysis of the Capital Plan for Con Edison's Distribution System

EPRIsolutions' Recommendation:

3. EPRIsolutions suggests that the cable-testing program could be improved by some additional experiments and statistical analyses. Specifically, we suggest randomly selecting a subset of the cables normally selected for testing and not testing these cables. This would provide a control group, and the failure rate for this control group could be compared to the failure rate both for tested cables and all cables. This would provide a clear indicator of the ability of the selection process to identify cables that will fail.

Con Edison's Comments:

Con Edison plans to establish a statistically valid control group of feeders that are on the 2001 hipot list and not hipot test those feeders in 2001. The performance of this control group would be compared to performance of similar feeders that have been hipot tested in the 2001 program. To mitigate the risk is that there may be failures on the control group feeders during the summer, the control group would include no more than one feeder from any network, and Company would select an additional feeder from each network having a control group feeder and add these feeders to the 2001 hipot list.

Section E: Analysis of the Capital Plan for Con Edison's Distribution System

EPRIsolutions' Recommendations:

4. Con Edison should develop a more formal and quantitative prioritization process. The process should evaluate projects based on predicted impacts with respect to multiple well-defined scales of value. The values chosen should be meaningful throughout the organization. In our experience the implementation of such formal processes results in much more consistent and efficient use of funds and allows more learning over time.

5. In EPRIsolutions' judgment, Con Edison's corporate culture has a very strong reliability/customer service focus. However, for the purposes of senior management review and decision-making, Con Edison should develop better documentation of the connections between what is planned, what is done, and what the impact is.

Con Edison's Comments:

Con Edison has established an Asset Management Team to develop the recommended prioritization process.

Section E: Analysis of the Capital Plan for Con Edison's Distribution System

EPRIsolutions' Recommendation:

6. One final observation is important here for Con Edison and all electric utilities in general. Distribution planning has historically been decentralized and depends heavily on the judgments of the distribution engineers in the field. Reducing budgets because of centralized pressure to reduce costs should be avoided unless there is a clear understanding, on the part of the centralized planners, of the consequences of the reductions. There should be a natural reluctance to change a system that is working reliably and performing well. Further, changes should only be made with an accurate understanding of both the cost and reliability consequences of such changes. We note that for distribution Con Edison has increased both the number of employees and the level of investment since the 1999 Washington Heights blackout.

   Based on this assessment, EPRIsolutions cannot recommend a specific level of distribution investment spending for Con Edison. However, it should be noted that the recommendations in other parts of this report, concerning cable joints and other programs, would require significant funding.

Con Edison's Comments:

Planning and operations for Con Edison's electric distribution system are the responsibility of the Senior Vice President, Electric Operations, who has over thirty-eight years experience in the operation of the electric distribution system. He and his supporting team of engineers understand the behavior of the distribution system and the consequences of investment decisions and reach these decisions only after examining the impact on the safety and reliability of the system.

Section F: Analysis of whether Con Edison can lease its Underground Distribution System Facilities

EPRIsolutions' Recommendations:

a. Design and provide a mandatory annual three-day refresher course for telecom foremen.

b. Provide an additional field manual to telecom workers with actual photographs of different types of cable feeder deterioration, conduits, power feeder placement and identifications, etc. Frequent reference to such a manual in the field will help to keep the telecom workers aware of their work environment and assist in their reporting any anomalies to Con Edison.

c. EPRIsolutions does not see a concern regarding capacity issues.

Con Edison's Comments:

Con Edison provides an initial five-day training course for all telecom foremen. Con Edison is planning to provide a refresher course and is currently developing refresher course scope and period requirements.

Con Edison inspects all manholes for safety and environmental conditions, 72 hours prior to any telecom worker entering a structure. Con Edison personnel complete all repairs and clean ups before telecom personnel are allowed to enter the structure. In its five-day training course, Con Edison will examine providing telecom trainees with a field manual to promote safety.