

991-M-172

PUBLIC SERVICE COMMISSION OF THE DISTRICT OF COLUMBIA
1333 H STREET, N.W., 2nd FLOOR, WEST TOWER
WASHINGTON, D.C. 20005

REPORT AND ORDER

May 16, 2003

FORMAL CASE NO. 991, IN THE MATTER OF THE INVESTIGATION INTO
EXPLOSIONS OCCURRING IN OR AROUND THE UNDERGROUND DISTRIBUTION
SYSTEMS OF THE POTOMAC ELECTRIC POWER COMPANY, Order No. 12735

Before the Commission:

Angel M. Cartagena, Jr., Chairman
Agnes A. Yates, Commissioner
Anthony M. Rachal III, Commissioner

APPEARANCES:

Paul H. Harrington, Kirk J. Emge, and Mindy L. Herman, *Potomac Electric Power Company*; Elizabeth A. Noel, Sandra Mattavous-Frye, Barbara L. Burton for *Office of the People's Counsel*; Herbert Harris for *District of Columbia Consumer Utility Board*; Leslie H. Nelson for *District of Columbia Government*; Brian Lederer for *International Brotherhood of Electric Workers*; John K. Keane, Jr., Paul S. Buckley, and Beverly J. Burke, for *Washington Gas Light Company*.

TABLE OF CONTENTS

I.	<u>Introduction</u>	2
II.	<u>Background and Procedural History</u>	2
A.	<u>PEPCO's Order No. 11716 Compliance Report</u>	5
B.	<u>OPC's Manhole Report</u>	6
C.	<u>ABB Reports</u>	7
D.	<u>PEPCO's First Annual Manhole Report</u>	9
E.	<u>Paper Insulated Lead Covered Power Cables ("PILC") Report</u>	10
F.	<u>ABB Network Load Model</u>	11
III.	<u>Investigative Record</u>	15
IV.	<u>Commission Directives to Date</u>	15
V.	<u>Stone and Webster Assessment Report</u>	16
VI.	<u>PEPCO's Comprehensive Plan</u>	32
VII.	<u>Resolution of Designated Issues</u>	40
A.	<u>Issue 1: What are the cause(s) of the manhole incidents on the PEPCO underground distribution system?</u>	40
a.	Parties' Position	40
b.	Commission Decision	41
B.	<u>Issue 2: What is the current status of PEPCO's actions in response to manhole incidents, including PEPCO's actions in response to orders of the Commission issued in this proceeding?</u> 43	
a.	Parties' Positions.....	43
b.	Commission Decision	44

C.	<u>Issue 3: What is the condition of PEPCO's underground distribution system compared to industry standards and other objective criteria?</u>	46
a.	Parties' Position	46
b.	Commission Decision	46
D.	<u>Issue 4: What is the capability of the primary and secondary network system to carry peak load during normal and contingency situations?</u>	46
a.	Parties' Positions	46
b.	Commission Decision	47
E.	<u>Issue 5: What is the current status of the Georgetown Project, including its expected impact on manhole incidents?</u>	48
a.	Parties' Positions	48
b.	Commission Decision	48
F.	<u>Issue 6: Is the Georgetown Project adequate for PEPCO's underground system to achieve standards for quality of service both within the target area, as well as outside of the target area in Georgetown, and in the rest of the District of Columbia?</u>	49
a.	Parties' Positions	49
b.	Commission Decision	49
G.	<u>Issue 7: Do PEPCO's design, construction, operation and maintenance plans and practices conform with prudent utility practice and its obligation under D.C. Code § 34-1101?</u>	50
a.	Parties' Position	50
b.	Commission Decision	50
VIII.	<u>Conclusions</u>	51
IX.	<u>Ordering Clauses</u>	53

Appendix A: Stone and Webster Recommendations

I. INTRODUCTION

1. By this Report and Order, the Public Service Commission of the District of Columbia ("Commission") issues findings, and adopts certain measures, resulting from our investigation of the manhole explosions that began occurring throughout the District of Columbia in early calendar year 2000. This Report and Order is the culmination of an extensive investigation carried out by the Commission in conjunction with the parties to this proceeding and an independent consultant hired by the Commission. Based on the extensive record developed during this proceeding, the Commission adopts several measures that must be put into effect by the Potomac Electric Power Company ("PEPCO") to address the problems identified and documented through our investigation. The Commission believes that these measures will increase the safety and reliability of PEPCO's electric distribution network. While the possibility of manhole incidents and explosions can never be completely eliminated, we strongly believe that the measures adopted herein will minimize the number of incidents and their impact, on District of Columbia residents and businesses, once they have been implemented by PEPCO.

II. BACKGROUND AND PROCEDURAL HISTORY

2. On February 18, 2000, the first of three manhole explosions and fires occurred in or around PEPCO's underground distribution system in the District of Columbia. The first explosion happened near 3215 M Street, N.W. and affected several manholes located on the north side of M Street near that address. The second explosion occurred four days later, on February 22, 2000, at a manhole located on L Street between 9th and 10th Streets, N.W. There was a third incident on March 3, 2000, at a manhole located at the intersection of 2nd and K Streets, N.E.¹

3. On February 25, 2000, PEPCO submitted a preliminary report to the Commission indicating that it hired a consultant, ABB Power T&D, Inc. ("ABB"), specializing in forensic investigations, to examine the damaged electrical cables in Georgetown, and to determine the cause of the explosions and fires.² Subsequently, on February 29, 2000, Washington Gas Light Company ("WGL") filed a preliminary report with the Commission, after conducting its own investigation, concluding that natural gas was not involved in the manhole fires.³ Pursuant to Section 34-1101 of

¹ See Formal Case No. 991, *In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Order No. 11625, rel. March 6, 2000 (hereinafter "Order No. 11625").

² PEPCO's Preliminary Report on the Georgetown Manhole Fire, filed February 25, 2000 (This document was transferred from GD-32 to Formal Case No. 991).

³ WGL's Report on PEPCO Manhole Fire in Georgetown on February 18, 2000, filed February 29, 2000 (This document was transferred from GD-32 to Formal Case No. 991). It should be noted that after filing its initial response, WGL's culpability for manhole incidents has not been examined, and the Commission's focus has been the underground distribution facilities of PEPCO. However, recent events may require renewed Commission inquiry into the extent, if any, to which natural gas may be involved in manhole incidents. See Petula Dvorak and Clarence Williams, *Manhole Blast Shakes Georgetown*, The Washington Post, February 20, 2003, at A 26.

the D.C. Code,⁴ and because these incidents clearly posed a hazard to the general public, the Commission opened Formal Case No. 991 to investigate the causes of the manhole incidents.⁵ The Commission scheduled a hearing for March 22, 2000, and directed PEPCO and WGL to appear and respond to nine specific issues.⁶

4. At the March 22, 2000, hearing, PEPCO submitted its "Underground Facilities Report," in response to the questions posed by the Commission in Order No. 11625.⁷ The report described PEPCO's underground network distribution systems, outlined PEPCO's preliminary findings as to the manhole incidents, discussed PEPCO's initial mitigation strategy to address the incidents, and summarized PEPCO's maintenance and operating procedures for its network system. At the March 22nd hearing, PEPCO indicated that it was investigating the use of grated and tethered manhole covers, as well as advances in cable insulation materials, which it suggested had the potential to reduce public safety hazards.⁸ PEPCO further outlined a number of preventive measures it initiated as a result of the explosions, including a plan to conduct inspections of manholes located in the District of Columbia at the rate of 5,000 per year.⁹ However, in light of the continuing public safety

⁴ D.C. Code, 2001 Ed. § 34-1101 (Commission is to ensure that the facilities and services furnished by public utilities operating in the District of Columbia are reasonably safe and adequate).

⁵ Order No. 11625 at 2.

⁶ The nine issues established by the Commission were: (a) the extent to which salt and other chemicals used to treat District streets for snow and ice contributed to or caused corrosion of utility cable insulations and to what extent, if any, this might have contributed to the explosions or fires; (b) the extent, if any, to which natural gas may have been involved; (c) the extent to which the District roadways and sidewalks have become more porous to chemical runoff and the extent, if any, the proliferation of street cuts may have aggravated the leakage of chemicals to underground facilities; (d) the state of the sewer system in the District and the extent to which conditions in the system might have allowed sewer gas to escape into the underground areas near the manholes in question to create an environment susceptible to explosion; (e) PEPCO's current measures to provide maintenance for its distribution system, including spending and staffing levels as well as trends over the last five years, and the extent to which PEPCO's measures are safe, reliable, and consistent with industry practice; (f) the steps PEPCO is taking to coordinate its investigation with other D.C. agencies and utilities: specifically, the D.C. Department of Public Works, the D.C. Fire Department, the Water and Sewer Administration, and WGL; (g) the short and long term solutions for preventing a recurrence of these explosions; (h) the extent to which PEPCO has conducted tests to determine whether there is a common factor in each incident that may have caused the explosions and fires; and, (i) the extent to which less flammable insulation can be deployed in PEPCO's facilities.

⁷ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, PEPCO's Underground Facilities Report, filed March 20, 2000 ("Underground Facilities Report"). The Office of the People's Counsel of the District of Columbia ("OPC"), the Government of the District of Columbia ("District Government"), WGL, and PEPCO's consultant, Electric Power Research Institute ("EPRI") also filed comments on the causes of the manhole explosions.

⁸ Underground Facilities Report at 47.

⁹ See *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, March 22, 2000, Hearing Transcript at 76.

threat posed by the manhole explosions, the Commission directed PEPCO to significantly increase the number of annual manhole inspections from its proposed level of 5,000.¹⁰

5. On May 9, 2000, the Commission directed PEPCO to implement a number of additional remedial measures, and to file monthly manhole inspection reports beginning June 30, 2000, with subsequent reports due at the end of each month.¹¹ Subsequently, on May 24, 2000, PEPCO filed a report stating, among other things, its intention to conduct a six-week test program for grated and tethered manhole covers, to be conducted by EPRI beginning in June 2000. The Commission concluded, however, that PEPCO's May 24th report failed to demonstrate how PEPCO intended to institute those remedial measures designed to address the continuing manhole incidents.¹² Therefore, the Commission ordered PEPCO to file a comprehensive plan that addressed among other things, the advantages and disadvantages of using grated or tethered manhole covers in vulnerable areas of the District of Columbia, along with a timetable for possible implementation.¹³ In addition, PEPCO was directed to file an annual report detailing all manhole incidents for the previous calendar year, no later than January 31st of each succeeding calendar year. The annual report was to categorize the manhole incidents as "manhole fires," "smoking manholes," or "manhole explosions," and required a progress report detailing the methods used by PEPCO to address and correct the causes of these incidents.¹⁴

6. Due to the age of PEPCO's underground facilities, the Commission also ordered PEPCO to review the condition of its low-voltage cable and distribution systems, and solicited information regarding the appropriateness of a low-voltage cable replacement program for cables

¹⁰ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Order No. 11660, rel. April 5, 2000. On April 6, 2000, John M. Derrick, Jr., Chairman, President and CEO of PEPCO, filed a letter stating that PEPCO would increase the number of yearly manhole inspections to 10,000. See Letter of John M. Derrick, Jr., Chairman, President and CEO of PEPCO to Jesse P. Clay, Jr., Commission Secretary, dated April 6, 2000.

¹¹ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Order No. 11679, rel. May 9, 2000 (hereinafter "Order No. 11679"). The Commission wanted information regarding PEPCO's progress in developing non-destructive cable tests, whether PEPCO had evaluated improvements in cable limiters and their coordination with network protectors and network fuses, and whether it was feasible to phase out paper-insulated primary cables and replace them with dielectric insulated cables.

¹² *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Order No. 11716, June 16, 2000, at 2 (hereinafter "Order No. 11716").

¹³ *Id.* at 6.

¹⁴ A "smoking manhole" is a manhole incident in which smoke, but no visible flame is escaping from holes in the cover or around the cover's edge. A "manhole fire" is a manhole incident in which flame is visible at holes in the manhole cover or around the cover's edge and the cover remains sealed in its frame. A "manhole explosion" is a manhole incident, in which the release of energy from the manhole occurs, and one or more manhole covers are dislodged from their respective frames, or other debris, such as cement or dirt, is projected into the air.

older than 20 years.¹⁵ PEPCO was also directed to file a preliminary plan on the desirability and feasibility of assuring proper separation of primary circuits, secondary circuits, and transformers in its underground facilities. The Commission further prescribed additional information to be included in the monthly manhole inspection reports.¹⁶

A. PEPCO's Order No. 11716 Compliance Report

7. On July 21, 2000, PEPCO filed its first Order No. 11716-compliance report, asserting that its system continued to provide reliable service to its customers despite the manhole incidents. PEPCO asserted that it was committed to identifying appropriate solutions to the manhole incidents, and that it would continue to: (a) expand the existing PEPCO installation criteria by installing 1,000 slotted vented manhole covers in year 2000 at manhole underground enclosures with secondary cables that are in high volume pedestrian traffic areas; (b) contract with ABB to develop an appropriate network system-modeling tool for the Georgetown area as a means of load and reliability analysis and determining possible changes in system design for the Georgetown area; (c) carry out an independent inspection and assessment of PEPCO's network facilities and equipment in the Georgetown area; and, provide recommendations regarding cable sizing and separation; (d) submit amended underground inspection reports to include the expanded list of information; and, (e) pursue paper-insulated lead cable ("PILC") improvement technology as it develops.¹⁷

8. PEPCO also stated in its report that its plans include the continued use of paper-insulated lead-coated power cables, although PEPCO believes that there is no evidence to support the replacement of PILC at this time. PEPCO stated that consideration of alternatives would be addressed in the submission of the Commission-mandated annual report due January 31, 2001.¹⁸ PEPCO stated that it would also provide its recommendations on cable testing at that time. PEPCO emphasized that it follows the industry practice of replacing damaged PILC with Ethylene Propylene Rubber ("EPR") insulated cable when it is appropriate and where it will not reduce the reliability of the circuit.¹⁹

¹⁵ Order No. 11716 at 6.

¹⁶ The reports were to include the following additional information: (a) The general location of the manholes inspected, including the street or streets where the manholes are located and the blocks bounding the street, e.g., "M" Street, N.W., between 23rd and 28th Streets; (b) The number of manholes inspected in the month, broken down as to the number of manholes containing primary cables only, both primary and secondary cables, and secondary cables only; (c) The number of primary cable problems found; (d) The number of secondary cable problems found; (e) The type of cable problems found in each manhole, categorized as to the physical degradation or damage of the cable, overheating, overloading, damaged splice, and deteriorated cable or splice due to age; (f) The number of manholes with problems; (g) The corrective action taken for each cable and manhole problem found; and (h) Other general conditions of the manhole such as whether it contained water, oil, grease, debris, and whether the manhole cover and the manhole are in good mechanical condition.

¹⁷ *Id.* at 4-5.

¹⁸ *Id.* at 8.

¹⁹ *Id.*

9. PEPCO also stated in its Order No. 11716 compliance report that it obtained the initial EPRI testing results relating to the possible use of slotted manhole covers. Based on the EPRI testing results, PEPCO began installing slotted manhole covers in high-volume pedestrian traffic areas in the District of Columbia.²⁰ PEPCO also indicated that it was considering the installation of tethered manhole covers in high volume, pedestrian traffic areas that are exposed to environmental intrusion of foreign substances (water, chemicals, etc.) and include structures hosting equipment that is susceptible to environmental intrusion. PEPCO stated, however, that it is difficult to build a tethered cover strong enough to resist the impact of an explosion.²¹

10. PEPCO concluded its first Order No. 11716 compliance report by indicating that its immediate efforts to address the manhole incidents would focus on the installation of slotted manhole covers and its increased manhole inspection and maintenance regimen.²² PEPCO concluded that its long-term underground infrastructure improvement strategy would be developed by examining industry practices and assessing the recommendations of its consultant, ABB.²³

B. OPC's Manhole Report

11. On November 3, 2000, the Office of the People's Counsel ("OPC") filed its manhole report with the Commission based, in large measure, on the analysis of its consultant, Downes Associates Inc. ("Downes").²⁴ Downes' report was based on its review of the reports and data made available by PEPCO to the Commission during the summer months of calendar year 2000, and PEPCO's internal documents, provided by PEPCO in response to OPC's discovery requests.

12. OPC concluded that: (a) PEPCO's current data collection and record-keeping efforts were insufficient to properly record and analyze the reasons for system failures; (b) PEPCO's records were maintained in an outdated format making it difficult to readily access data using an electronic database query; (c) PEPCO's records contained insufficient information on the age of the equipment and inventory, making it difficult to ascertain the reliability and rate of deterioration of PEPCO's equipment and inventory, and the underground distribution system on the whole; and (d) PEPCO's internal annual construction plans and load data reveal that some substations throughout the District are incapable of handling the increased demand for electric power on both a system-wide basis and in

²⁰ *Id.* at 23.

²¹ *Id.* at 25.

²² *Id.* at 45.

²³ *Id.*

²⁴ *Formal Case No. 991, In the Matter of the Investigation Into Explosions Occurring In Or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Office of the People's Counsel's Motion to File A Supplemental Report to Comments Filed On May 15, 2000, Evaluating PEPCO's Report About the Cause or Causes of the Manhole Explosion and In Response to the June 8, 2000, Staff Report, filed November 3, 2000 (hereinafter "OPC's Manhole Report").

many individual circuits within PEPCO's system.²⁵

13. Therefore, OPC proposed six recommendations for the Commission and PEPCO's consideration in formulating remedial efforts for enhancing the stability and functionality of PEPCO's underground distribution system. OPC suggested that PEPCO should: (a) develop a comprehensive remedial plan that allows it to adequately predict cable failure problems in order to develop preemptive plans and perform timely maintenance and repairs; (b) be encouraged to continue the Reliability Inspection Reporting Program started in March 1999; (c) continue the Emergency Random Manhole Inspections ordered by Commission Order No. 11660; (d) establish internal procedures to fill in gaps in data relating to PEPCO's distribution system; (e) mechanize its data collection and record-keeping processes to a computer-based data reporting management system so data is readily available; and (f) implement a fully developed geospatial information system ("GIS") to provide the Company with an advanced diagnostic tool for investigating failures in the distribution system.²⁶

C. ABB Reports

14. In January 2001, PEPCO filed its preliminary report on the study performed by ABB on the Georgetown underground electric distribution system.²⁷ PEPCO contracted with ABB to perform an independent evaluation and assessment of PEPCO's underground electric distribution system in the Georgetown area, and to assist PEPCO in developing an appropriate network load-flow modeling tool for its underground distribution network.²⁸ ABB also was contracted to perform an independent inspection and assessment of PEPCO's network facilities, and an evaluation of PEPCO's

²⁵ *Id.*

²⁶ *Id.* at 2-3. PEPCO filed a response to OPC's proposed remedial measures on May 14, 2001. PEPCO specifically addressed OPC's recommendations by asserting: (a) that it currently has a procedure in place for the collection of data and material for selected equipment failures; (b) that it is committed to continuing the detailed inspection of an additional 10,000 manholes during 2001; (c) that it is currently capturing the data on a feeder-by-feeder basis during its maintenance work and manhole inspections in accordance with orders issued by the Commission; (d) that it reiterates its position that age is not a significant determining factor when considering replacement of primary and secondary equipment; and, (e) that it is in the process of developing a GIS system. See *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Response of PEPCO to The Office of the People's Counsel's Motion to Defer Action on the Distribution of Proceeds From Sale of PEPCO's Generation Assets and To Take Other Actions Related to PEPCO's Underground Distribution System, Appendix A, filed May 14, 2001 (hereinafter "PEPCO's May 14, 2001, Response to OPC's Motion").

²⁷ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, PEPCO's Report on ABB's Study on the Georgetown Underground Electric Distribution System, filed January 15, 2001 (hereinafter "PEPCO's Report on ABB Study"); See also, PEPCO's Report on ABB's Final Report on Georgetown Area Network System Evaluation, filed June 13, 2001 (hereinafter "PEPCO's Report on ABB's Load-Flow Model").

²⁸ *Id.* A network load-flow modeling tool is a computer model of the electric distribution network infrastructure used to simulate the performance of the distribution system under varying load conditions to identify potential weak spots in the distribution system.

engineering design practices. PEPCO represented that it intended to utilize the results of ABB's assessment, together with its own investigations, in proposing corrective measures and implementation plans to the Commission.²⁹

15. ABB's evaluation study consists of three areas -- system analysis, engineering design practice, and diagnostic and condition assessment. Based on a "generally accepted practices ("GAP") survey, ABB did not recommend any changes in PEPCO's standard practice.³⁰ In reviewing PEPCO's engineering design practices utilized for the Georgetown low voltage AC network, ABB made 10 specific recommendations that: (a) PEPCO continue the current manhole vault maintenance program; (b) PEPCO's maintenance inspection scope of work be expanded in selected manholes and sidewalk handholes, as defined by the load analysis results, to include spot ground testing, spot checking of soil resistivity measurements, and verification of proper cable limiter application; (c) PEPCO consider enhancing the present thermographic inspection method and a thermographic camera or a temperature measurement device with increased measurement accuracy should be investigated for improving the inspection data collection process; (d) PEPCO's load-model results be used to validate engineering design assumptions and to assist with more efficient maintenance resource management; (e) PEPCO review the network ampacity design criteria for Terracotta ductbank applications based on the results of the detailed load-model and a revalidation of present and past design assumptions; (f) PEPCO consider replacement, or reconfiguration of the infrastructure where infrastructure has deteriorated, where overloads are identified, or where deficiencies exist due to circuiting congestion relative to present design and construction standards; (g) based on the results of the short circuit model being developed, PEPCO review the Georgetown system and determine if it is necessary to adjust short circuit levels in the system to improve the clearing of faults, with three phase and line to ground (arcing) fault clearing to be evaluated independently; (h) based on the results of the short circuit model, PEPCO consider increasing the use of cable limiters to determine if improvements can be achieved in the area of cable protection; (i) where there is a potential problem, utilize arc-resistant tape on primary cable according to current PEPCO standards in areas where it has not already been applied and where they are common with secondary cables to reduce the incidence of arcing faults, PEPCO consider applying arc-resistant tape on secondary splices when they are in close proximity to primary splices; (j) PEPCO continue investigating the application of sectionalizing switches for certain portions of the underground network feeders because the configurations of the 3 sub-networks in Georgetown are more suited to the application of sectionalizing than other parts of the PEPCO low-voltage grid network.³¹

16. Based on its diagnostics and condition assessment, ABB recommends: (a) advanced diagnostics of primary feeder cables continue to be evaluated; (b) PEPCO continue its manhole inspection program, which should be helpful in reducing the incidents of underground events; (c)

²⁹ *Id.* at 1.

³⁰ See *ABB Power T&D Company, Inc. Report for PEPCO*, rel. January 15, 2001, at 2 (hereinafter "ABB Study").

³¹ *Id.* at 3-4.

PEPCO should continue its existing network unit field test and inspection program; and (d) based on the dissolved gas analysis and general oil analysis, PEPCO follow up on the recommendations made on network transformer unit numbers N00391, N02191, N02180, and N00253.³²

17. In commenting on the ABB recommendations, PEPCO stated that it agreed, for the most part, with the recommendations contained in ABB's study and that it would integrate ABB's recommendations into its overall manhole-event mitigation strategy. PEPCO further stated that, based on the ABB study recommendations and other findings for mitigating manhole events, it would: (a) undertake the system enhancements recommended by ABB, as outlined in the report; (b) follow the recommendations of its internal PILC task force; and, (c) complete its current commitments of inspections, reporting, and manhole cover installations.³³ In addition, PEPCO stated that it intended to continue to work with ABB to develop an accurate load analysis model as a tool to target its maintenance efforts in areas where there is the most potential for underground system overloads, thereby strengthening its ability to predict and prevent manhole events. The load model would also indicate whether PEPCO's engineering design practices need to be modified to assure continued system reliability.³⁴

D. PEPCO's First Annual Manhole Report

18. On February 1, 2001, PEPCO filed its first annual report on manhole events in the District of Columbia.³⁵ For calendar year 2000, PEPCO reported that there were 48 manhole events, including 22 manhole explosions, 17 smoking manholes, five manhole fires, and four manhole events outside the reporting categories. Additionally, of the 48 events, PEPCO reported that 28 involved primary feeders, while 15 incidents related to problems with secondary cables.³⁶ PEPCO also summarized those remedial efforts taken to address the manhole events. PEPCO represented that it inspected 10,516 manholes and selectively replaced 1,800 solid manhole covers with slotted covers during the year 2000. Further, as part of its remedial efforts, PEPCO reiterated that it submitted its PILC cable report and ABB's assessment of its underground infrastructure and design practices to the Commission.³⁷

³² *Id.* at 4. See also, *ABB Power T&D Company, Inc. Final Report on Georgetown Area Network System Evaluation*, rel. June 13, 2001 (hereinafter "ABB Load-Flow Model Study").

³³ PEPCO's Report on ABB Study at 15.

³⁴ *Id.*

³⁵ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, PEPCO's Annual Manhole Report, filed February 1, 2001.

³⁶ *Id.* at 2.

³⁷ *Id.* at 3. PEPCO submitted a chart listing the manhole events, categorized as prescribed by Order No. 11716.

E. Paper Insulated Lead Covered Power Cables ("PILC") Report

19. In Order No. 11679, the Commission directed PEPCO to provide a "statement as to whether it is feasible to phase out paper-insulated lead (primary) cables and replace them with solid dielectric insulated cables."³⁸ PEPCO subsequently formed a task force (that included its consultant, ABB) to develop a long-term strategy for the continued use and ultimate replacement of PILC. The primary objective of the task force was to research and recommend adequate alternatives to the 1500 miles of PILC currently being used in PEPCO's underground system that would assure comparable capacity, reliability, and size that could be accommodated in existing ducts.³⁹ PEPCO filed its first PILC report on February 27, 2001.⁴⁰

20. ABB observed that, based on a generally accepted practices ("GAP") survey, electric utilities typically use some form of lead coated cable for primary feeders and that the vast majority of them are paper-insulated lead-coated cables.⁴¹ ABB reported, however, that some of the surveyed utilities are replacing PILC cables due to factors such as cost, availability, and concern over the use of lead. ABB also reported that the industry trend seems to be toward utilities establishing failure replacement programs in which faulted sections of PILC feeder cables are replaced with solid dielectric cable. According to ABB, wholesale replacement of PILC cables did not appear to be warranted, desirable, or feasible for any of the utilities surveyed by ABB.⁴²

21. Based on the task force reports, PEPCO indicated that it would implement a two-year trial period of installing EPR cables on selected existing maintenance projects, and that it would continue its current practice of installing EPR cables for new installation. PEPCO further indicated that it would pursue research and development partnering arrangements for development of new splicing techniques or methods of eliminating any splicing problems encountered.⁴³

22. On May 22, 2001, PEPCO announced its intention to modernize the "business corridor" of Georgetown on "M" Street, N.W., from 28th to 35th Streets and on Wisconsin Avenue, N.W., from the C&O Canal to S Street, N.W.⁴⁴ Under PEPCO's proposed modernization plan,

³⁸ Order No. 11679 at 4.

³⁹ *Id.* at 2.

⁴⁰ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Report of PEPCO on Alternative Design Proposal to PEPCO's 15KV Paper Insulated Lead Covered Power Cables, filed February 27, 2001 (hereinafter "PILC Report").

⁴¹ *Id.*

⁴² *Id.*

⁴³ *Id.* at 4.

⁴⁴ *PEPCO Announces Plans to Rewire Its Underground Electric System in Georgetown*, PEPCO News Release, May 22, 2001, at 2.

PEPCO would replace the electric distribution system, reduce the amount of cable and conduit under the sidewalks by installing cables and conduit along the streets, and build new conduit to separate high-voltage (13kV and 4kV) from low-voltage (120 and 240 volt) systems.⁴⁵ PEPCO also announced that it would begin upgrading the residential distribution system in Georgetown from north of M Street to P Street, N.W., and from 27th Street to Wisconsin Avenue, N.W. The upgrade includes pulling out old cables, installing new cables and switching mechanisms on new transformers, reconfiguring new cables in a way that reduces smoke and fire (should faults occur), adding new conduit and rebuilding old (as necessary), and rebuilding and adding new manholes.⁴⁶

F. ABB Network Load Model

23. On June 13, 2001, PEPCO filed its report on ABB's network load-flow model.⁴⁷ PEPCO requested ABB to construct computerized mathematical models that accurately represent its 13kV, 4kV primary, and associated secondary network distribution systems in the Georgetown area, showing connectivity between wires, switches, transformers, and other equipment. ABB developed the model and carried out computer simulation runs to evaluate the base case power flow as well as system performance under various contingencies. From these and additional simulations, areas of the system were ranked based on the probability of outages, resulting overloads, low-voltage conditions, and customer interruptions.⁴⁸

24. In addition to developing a load-flow model, ABB reviewed PEPCO's peak demand forecasting methodology to determine if the present system would be able to accommodate future load while meeting the performance objectives of the system. ABB evaluated PEPCO's 10-year forecast and its plans for modernizing the Georgetown electrical distribution infrastructure. ABB's evaluation found it unlikely that there would be relatively high amounts of peak demand growth in the Georgetown area due to minimal amounts of vacant land available for the kind of development that drives load growth. ABB did recognize, however, that additional demand would be created as existing properties were upgraded and made several recommendations to address the additional load forecasts.⁴⁹ ABB projected a total load growth in Georgetown for calendar years 2000-2002 to be .5 percent to one percent over the two-year period, which PEPCO stated was in line with its projection of 1.7 percent for the same two-year period.⁵⁰ ABB found that PEPCO's load forecasting methods, for the most part, reflected best practices of the industry.⁵¹

⁴⁵ *Id.* at 3.

⁴⁶ *Id.* at 2-3.

⁴⁷ PEPCO's Report on ABB's Load-Flow Model at 1.

⁴⁸ *Id.* at 4.

⁴⁹ *Id.* at 5.

⁵⁰ *Id.*

⁵¹ *Id.* at 6. Load growth projections after 2002 were not available during the course of this investigation.

25. ABB also reviewed PEPCO's plan to modernize the Georgetown area backbone system to determine whether an upgrade would address the issues identified by the load model. ABB concluded that, from a feeder-loading standpoint, all of the network groups have additional capacity to handle reasonable load growth.⁵² From a capacity standpoint, ABB found that the 4kV system appears to have adequate capacity except for a small area that may experience loads up to 113 percent of current capacity during peak periods.⁵³

26. Subsequently, by Order No. 12036, the Commission sought comment from the parties regarding the reports filed in the record as of June 2001, including the recommendations contained in PEPCO's Order No. 11716 Compliance Report, PEPCO's Annual Report on Manhole Incidents, PEPCO's preliminary and final reports on the studies conducted by ABB on the Georgetown Underground Electric Distribution Systems as well as the ABB studies, PEPCO's Report on its Paper-Insulated Lead-Covered Cables, OPC's Manhole Report, and PEPCO's Response to OPC's Manhole Report.⁵⁴ The Commission also ordered PEPCO to file schedules for implementing ABB's recommendations, slotted manhole-cover installations, quarterly reports on the two-year EPR cable initiative, quarterly manhole inspection reports, as well as a detailed report on PEPCO's Georgetown modernization project.⁵⁵

27. In compliance with Order No. 12036, PEPCO filed three appendices outlining its implementation plan regarding ABB's Recommendations, its Georgetown Modernization Project, and its Manhole Inspections Quarterly Progress Report.⁵⁶ OPC alleged that PEPCO's reports were replete with deficiencies, and requested that the Commission direct PEPCO to provide relevant data, commit adequate resources to implement the findings of PEPCO's consultants, describe the events and the data collected from PEPCO's system from an engineering perspective, and implement the specific recommendations identified by OPC's engineering consultants.⁵⁷

28. By Order No. 12114, the Commission adopted a procedural schedule and designated

⁵² *Id.* at 7.

⁵³ *Id.*

⁵⁴ Order No. 12036, rel. June 26, 2001 at 18-19.

⁵⁵ *Id.*

⁵⁶ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Report of PEPCO in Response to Commission Order No. 12036, filed July 23, 2001.

⁵⁷ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Office of the People's Counsel's Comments in Response to Commission Order No. 12036, filed July 24, 2001, at 2. OPC also submitted its Downs Report II as appendix A.

issues to aid the disposition of the investigation and scheduled formal hearings for November 5-7, 2001.⁵⁸ At the November 6, 2001, hearing, the Commission requested that PEPCO submit a Comprehensive Plan that includes the current assessments of, and future plans for PEPCO's underground distribution and network facilities that are located in the District of Columbia.⁵⁹ At the conclusion of the hearings, the Commission suspended the remaining procedural dates pending issuance of a final report of the Commission's consultant, Stone & Webster Consultants, Inc. ("Stone & Webster").

29. In a confidential letter dated November 29, 2001, PEPCO raised several concerns relating to the potential security consequences of revealing its systems and network infrastructure in a detailed plan.⁶⁰ PEPCO requested that, instead of presenting the information related to its plans in documentary format, the Commission allow an *in camera* presentation for the Commission's review.⁶¹ This request was made in the shadow of the September 11, 2001, terrorists' attacks. In the interest of public safety, and to preserve the confidentiality of certain details of the underground network system, the Commission directed PEPCO to file an expurgated plan for the record.⁶²

30. In December 2001, Stone & Webster issued its assessment report of PEPCO's underground distribution system.⁶³ Thereafter, the Commission issued Order No. 12257, requesting

⁵⁸ Order No. 12114, rel. September 7, 2001. The designated issues were: (1) What are the cause(s) of the manhole incidents on the PEPCO underground distribution system; (2) What is the current status of PEPCO's actions in response to manhole incidents, including PEPCO's actions in response to Orders of the Commission issued in this proceeding; (3) What is the condition of PEPCO's underground distribution system compared to industry standards and other objective criteria; (4) What is the capability of the primary and secondary network systems to carry peak loads during normal and contingency situations; (5) What is the current status of the Georgetown Project, including its expected impact on manhole incidents; (6) Is the Georgetown Project adequate for PEPCO's underground system to achieve standards for quality of service both within the target area, as well as outside of the target area in Georgetown, and all of the rest of the District of Columbia; (7) Do PEPCO's design, construction, operation and maintenance plans and practices conform with prudent utility practice and its obligations under D.C. Code, 2001 Ed. § 34-1101?

⁵⁹ *Formal Case No. 991, In The Matter of the Investigation into Explosions Occurring in or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Transcript of November 6, 2001, Proceeding, Volume III at p. 512-513.

⁶⁰ *Formal Case No. 991, In The Matter of the Investigation into Explosions Occurring in or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Letter to Chairman Angel M. Cartagena, Jr., from John M. Derrick, Jr. Chairman of the Board and Chief Executive Officer of Potomac Electric Power Company, dated November 29, 2001. This Letter was submitted to the Chairman *ex parte*. In accordance with Section 108.8 of the Commission's Rules of Practice and Procedure, *ex parte* communications must be delivered to the Commission Secretary, and the Secretary must file such communication in the public files associated with the proceeding, however separate from the record upon which the Commission will rely in reaching its decision. A copy of such communication must be mailed to persons on the official service list.

⁶¹ *Id.* at 2.

⁶² Order No. 12293, rel. January 11, 2002, at 1.

⁶³ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the*

parties to file comments on Stone & Webster's Report.⁶⁴ Comments were filed by PEPCO,⁶⁵ OPC,⁶⁶ the District of Columbia Government ("District Government"),⁶⁷ and the International Brotherhood of Electrical Workers ("IBEW").⁶⁸ PEPCO,⁶⁹ OPC,⁷⁰ and the District Government filed reply comments.⁷¹ Soon thereafter, on February 8, 2002, PEPCO filed its expurgated comprehensive plan.⁷² A revised procedural schedule was subsequently issued establishing a briefing schedule on the designated issues and setting a community hearing for April 9, 2002.⁷³ The parties filed post-hearing briefs on the designated issues established by Commission Order No. 12114 in March 2002, with reply briefs in April 2002.⁷⁴

Underground Distribution Systems of the Potomac Electric Power Company, Stone & Webster's Assessment of the Underground Distribution System of the Potomac Electric Power Company, filed December 7, 2001 (hereinafter "S&W's Report").

⁶⁴ Order No. 12257, rel. December 17, 2001.

⁶⁵ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Comments of PEPCO on the Stone & Webster Final Report of December 7, 2001, filed January 7, 2002 (hereinafter "PEPCO's S&W Comments").

⁶⁶ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Preliminary Comments of the Office of the People's Counsel on Stone & Webster Final Report, filed January 11, 2002 (hereinafter "OPC's S&W Comments").

⁶⁷ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Comments of the Government of the District of Columbia on Stone & Webster Final Report, filed January 7, 2002 (hereinafter "District's S&W Comments").

⁶⁸ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Comments of Local 1900 International Brotherhood of Electrical Workers on Stone & Webster Final Report, filed January 7, 2002 (hereinafter "IBEW's S&W Comments").

⁶⁹ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Reply Comments of PEPCO on the Stone & Webster Final Report of December 7, 2001, filed January 25, 2002 (hereinafter "PEPCO's S&W Reply Comments").

⁷⁰ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Reply Comments of the Office of the People's Counsel on Stone & Webster Final Report, filed January 25, 2002 (hereinafter "OPC's S&W Reply Comments").

⁷¹ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Reply Comments of the Government of the District of Columbia on Stone & Webster's Final Report, filed January 25, 2002 (hereinafter "District's S&W Reply Comments").

⁷² *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Comprehensive Plan of PEPCO, filed, February 8, 2002 (hereinafter "PEPCO's Plan").

⁷³ Order No. 12317, rel. February 13, 2002.

III. INVESTIGATIVE RECORD

31. In conducting this investigation, the Commission used the initial Orders issued in this proceeding as a framework for collecting and analyzing the information submitted by the parties. The information includes filings made by PEPCO regarding all its initiatives to determine the causes of, and remedies for, the manhole incidents, and the results of studies conducted by PEPCO's consultants, EPRJ and ABB. OPC's filings include the findings and recommendations made by its consultant, Downes Associates. Furthermore, the record includes the assessment report developed by the Commission's independent consultant, Stone & Webster.⁷⁵ The record also includes the transcript of a legislative-type hearing held on March 22, 2000, the direct testimony, exhibits, and transcripts of the formal hearings held on November 5-7, 2001, and the April 9, 2002, public hearing transcript. Finally, the record includes the post-November 2001 hearing briefs and reply briefs, discussing the seven issues designated by Order No. 12114,⁷⁶ PEPCO's quarterly progress and manhole inspection reports, as well as PEPCO's calendar year 2001 and 2002 annual manhole reports.

32. In the following sections, we discuss the steps taken during this investigation to ensure public safety and the reliability of the District of Columbia's electric distribution system. We next discuss Stone & Webster's report, as well as the parties' comments on the report and our findings. In addition, we summarize PEPCO's Comprehensive Plan, the parties' comments on the Comprehensive Plan, and our directives designed to improve the Comprehensive Plan. Our analysis of the parties' positions on the seven designated issues follows, and includes our decision as to each issue. Finally, we summarize our conclusions and issue directives for PEPCO's implementation.

IV. COMMISSION DIRECTIVES TO DATE

33. Section 34-1101 of the District of Columbia Code charges the Commission, among other things, with ensuring that the facilities and services furnished by public utilities operating in the District of Columbia are "reasonably safe and adequate."⁷⁷ In keeping with its mandate, the Commission directed PEPCO to conduct various studies and to institute a number of remedial actions during the course of our investigation aimed at ensuring public safety and the reliability of the District's electric distribution system. PEPCO was required and continues to submit periodic progress reports on these actions and studies. Specifically, PEPCO was required to: (a) submit a plan for increasing manhole inspections from 5,000 a year, employing a revised comprehensive manhole inspection system and submit quarterly reports of the results of the inspections and remedial actions

⁷⁴ *Id.*

⁷⁵ Stone & Webster's Report was entered into the record by Order No. 12557. See Order No. 12557, rel. December 17, 2001.

⁷⁶ Order No. 12114, rel. September 7, 2002, Attachment A.

⁷⁷ See D.C. Code, 2001 Ed. § 34-1101.

taken; (b) provide monthly and annual reports of manhole incidents categorized as to primary and secondary cable failures, smokers, fires, and explosions, and identify whether incidents involve solid or slotted manhole covers and file quarterly reports; (c) continue PEPCO's initiative to install slotted manhole covers in sidewalks and crosswalks based on results of the EPRI study; (d) provide quarterly status reports on the two-year trial of EPR cable installation as a replacement for PILC; (e) submit an implementation plan including a chart for implementing the 14 recommendations made by ABB, and submit quarterly progress reports on the plan; (f) clarify the extent to which PEPCO would implement ABB's recommendations; and (g) file an expurgated comprehensive plan on PEPCO's underground distribution and network facilities.

34. PEPCO complied with the Commission's directive by: (a) advising the Commission that it would increase the number of yearly manhole inspections from 5,000 to 10,000; (b) filing a report detailing its intention to conduct a six-week test program for slotted and tethered manhole covers, to be conducted by its contractor, EPRI; (c) filing its preliminary report on the study performed by ABB on the Georgetown Underground Electric Distribution System; (d) filing its PILC report; (e) filing its report on ABB's network load-flow model; (f) continuing to file quarterly reports of manhole inspections and remedial actions; (g) filing status reports describing the progress it had made in addressing the recommendations from ABB in its study on the Georgetown Underground Electric Distribution; (h) filing annual reports detailing manhole incidents in the District of Columbia, and continuing to file monthly reports of manhole incidents; and (i) filing its expurgated comprehensive plan.

35. The Commission continues to provide oversight of PEPCO's operations to ensure that the remedial actions proposed by PEPCO, as well as those previously mandated by the Commission, are implemented comprehensively and in a timely fashion. PEPCO remains obligated to file an annual manhole report, quarterly reports of manhole inspections and remedial actions; and quarterly status reports on the two-year trial EPR cable installation projects the reports directed by previous Commission orders.

V. STONE & WEBSTER ASSESSMENT REPORT

36. Because the Commission recognized the need for an independent assessment of PEPCO's underground electrical distribution system, we hired the firm of Stone & Webster.⁷⁸ As part of its assessment, Stone & Webster reviewed and evaluated all filings and studies submitted by all parties to the Formal Case No. 991 docket. Stone & Webster conducted its assessment during the period of May through November 2001. On December 7, 2001, Stone & Webster issued its report entitled "Assessment of the Underground Distribution System of the Potomac Electric Power Company."⁷⁹

⁷⁸ See Request for Proposal for Independent Review and Evaluation of PEPCO's Assessment of Its Underground Electric System issued January 9, 2001.

⁷⁹ See *supra* note 63.

37. Generally, Stone & Webster's Report indicates that overloading -- instances where the demand being placed on the system is more than the system is designed to handle -- was a primary factor in the cause of the cable and splice failures leading to the manhole fires, explosions, and incidents of smoke emanating from manholes.⁸⁰ The report emphasizes, however, that PEPCO is above average, when compared to the electric industry as a whole, in how it designs, builds, and maintains its electrical distribution system.⁸¹

38. Stone & Webster's findings and recommendations are summarized as follows: (a) based on its review and examination of ABB's Georgetown area network system evaluation, and other elements of its assessment, Stone & Webster finds that overloading is a primary factor in cable and splice failures, which may ultimately lead to manhole smoking incidents, fires, and explosions. Stone & Webster recommends that PEPCO's analytical electrical modeling of the network system to determine overloaded portions of the network be expedited from its four-year plan (end of 2005) to a targeted completion date of Spring 2003; (b) based on Stone & Webster's physical inspections and observations, it recommends that the networks serving the Adams Morgan area be given high priority in terms of the modeling effort because it shows significant overcrowding resulting from load growth; (c) based on the high primary fault current levels on PEPCO's system, and the experience of the Tampa Electric Company, Stone & Webster recommends PEPCO perform a technical feasibility study, to be completed in nine to twelve months, of the application and installation of high speed, electronically controlled fuses and other current-limiting devices designed to limit fault currents by fast fault clearing; (d) PEPCO should continue its trial installation of a remote monitoring system for network transformers and protectors;⁸² (e) PEPCO should evaluate the applicability of new technologies such as the above-ground meter and real-time fault location schemes that allow crews to quickly locate faulted cables under the street; (f) PEPCO should consider alternate protection schemes for isolated spot networks; (g) because the Georgetown Project will separate primary from secondary cable circuits, reduce temperature buildup and improve heat dissipation, reduce the probability of a secondary cable failure propagating into a primary circuit failure (and vice versa), and make repairs easier, Stone & Webster recommends that PEPCO capture all as-built Georgetown Project construction records in a form suitable for input into its GIS database; (h) PEPCO should perform network system modeling of the Georgetown Project design in order to evaluate the adequacy of the design before it is constructed; (i) although Stone & Webster's field inspections noted good workmanship in manholes, primary splice failures have been involved in a number of manhole incidents. Therefore, Stone & Webster recommends a splicing-repair log be kept containing dates of installation, crew members performing the work, materials used, and other information deemed suitable for GIS database entry; (j) based on the anticipated Georgetown construction activity, the manhole inspections and repairs program, the suggested expedited modeling of electrical networks, and the 30 percent decrease in underground and conduit staffing levels that occurred over the past

⁸⁰ S&W's Report at 6.

⁸¹ *Id.* at 7.

⁸² Stone & Webster notes that Consolidated Edison of New York employs real time remote monitoring on all 24,000 of its network transformers and protectors.

decade, Stone & Webster recommends that PEPCO conduct a work force staffing analysis to assess the adequacy of its work force to meet these demands, and suggests that this analysis be completed within three to four months;(k) based on its review and examination of EPRI's manhole cover test results, and the performance of recently installed slotted manhole covers, Stone & Webster recommends that PEPCO continue its ongoing installation and evaluation of slotted manhole covers; and (l) Stone & Webster recommends modifications to the manhole repair prioritization schedule to assure timely repairs and additions to the information contained on the manhole inspection reports so as to develop a more comprehensive database.⁸³

39. Stone & Webster also examined the overall integrity of PEPCO's underground system, and found that: (a) the integrity of major components of PEPCO's underground system, namely distribution substations, network systems, and the 13kV and 4kV radial systems, are acceptable with the exception of sections of the Georgetown area which are characterized by overcrowded facilities due to load growth beyond the design criteria of the affected underground facilities, and overloading of circuits during both normal and single contingency (e.g., loss of one primary) conditions; (b) the distribution substations employ designs, materials, and protection practices that are equal to or better than those of other metropolitan utilities; (c) the distribution substations are designed to provide a high level of reliability and service continuity; (d) the 47 low-voltage network systems generally located in commercial areas are well designed, protected in accordance with or better than industry practice, use equipment and materials that are standard in the industry, and evidence good workmanship in manholes, transformer vaults, and bus holes; and; (e) the 13kV and 4kV radial systems deployed mainly in residential areas are consistent with utility industry practices, and the 13kV systems uses the latest materials available in the industry.⁸⁴

A. Parties' Comments

40. PEPCO generally agrees with Stone & Webster's findings and recommendations and indicates a willingness to voluntarily implement Stone & Webster's recommendations. PEPCO does express some reservation, however, with the proposed time frame for completion of its network modeling and the underground staffing level analysis. PEPCO also agrees with Stone & Webster's findings that overloading is a contributing cause of failures, and more specifically, that overloads in Georgetown have occurred due to recent commercial expansion and resultant load growth.⁸⁵ PEPCO notes, moreover, that Stone & Webster rejects age as a primary source of the problems in Georgetown.⁸⁶

41. Additionally, PEPCO supports Stone & Webster's recommendation to expedite the

⁸³ *Id.* at 6-7.

⁸⁴ *Id.*

⁸⁵ PEPCO's S&W Comments at 2.

⁸⁶ *Id.* at 2.

timeline for the network-modeling program.⁸⁷ PEPCO also supports Stone & Webster's recommendation to give priority to Adams Morgan. In addition, PEPCO provided a listing of its District of Columbia networks prioritized by the order in which modeling is to be performed.⁸⁸ PEPCO represents that it will investigate the use of electronically controlled fuses (similar to those used by Tampa Electric Company) and the installation and expansion of various types of fault locating equipment, including aboveground meter and real time fault locating schemes.⁸⁹ PEPCO will continue its trial installation of a remote monitoring system for network transformers and protectors (similar to those used by Consolidated Edison of New York), and will implement revised criteria for the design and application of cable limiters. PEPCO indicates that the revised criteria require the use of limiters on all secondary mains originating from a low-voltage network bus.⁹⁰ PEPCO will continue to investigate the application of the "circular" close characteristics of each spot network to increase circuit reliability.⁹¹ PEPCO represents that it maintains "as built" construction records of the Georgetown Project in suitable form for input into its GIS database, and that a splicing and repair log has been maintained since early 2001.⁹² PEPCO asserts that it has already performed network system modeling of the Georgetown Project to assure the adequacy of the design using both the PEPCO owned *EasyPower* software program and ABB's model to confirm PEPCO's results.⁹³

42. PEPCO represents that it has installed slotted manhole covers based on EPRI's research results, and will continue to install such covers at appropriate manholes. PEPCO states that it will also document the effects of debris resulting from the use of slotted manhole covers when performing manhole incident investigations.⁹⁴ PEPCO asserts that it has been using a revised prioritization classification for corrective actions identified from manhole inspections since October 2001, and that it will continue to use the new classification as well as include the additional information recommended by Stone & Webster, including reporting outstanding corrective actions, in the quarterly reports to the Commission.⁹⁵ Finally, PEPCO represents that it performs work force staffing analysis throughout the year as conditions change that impact the volume of work to be completed. However, PEPCO indicates that it will review its staffing needs based on Stone &

⁸⁷ *Id.* at 3.

⁸⁸ *Id.* at 5.

⁸⁹ *Id.* at 7.

⁹⁰ *Id.*

⁹¹ *Id.* at 8.

⁹² *Id.*

⁹³ *Id.* at 9.

⁹⁴ *Id.*

⁹⁵ *Id.* at 9-10.

Webster's recommendations associated with Georgetown and network modeling activities.⁹⁶

43. OPC characterizes Stone & Webster's report as a starting point for identification of necessary and appropriate remediation and additional changes necessary to the PEPCO system.⁹⁷ But OPC asserts that the report does not represent a final and definitive set of answers as to the possible causes for the manhole explosions.⁹⁸ OPC agrees with certain findings in Stone & Webster's Report but asserts that there needs to be further study regarding the age of PEPCO's equipment, the effectiveness of a fully implemented GIS, and the effectiveness of slotted manhole covers. Specifically, OPC agrees with Stone & Webster's position that overloading can cause degradation of PEPCO's underground system and may be the cause of future incidents unless aggressive steps are undertaken.⁹⁹ Furthermore, OPC interprets Stone & Webster's findings as evidence that PEPCO's Georgetown distribution system was not constructed to meet the current needs of that community and that PEPCO failed to recognize that the Georgetown system was not built to accommodate today's load needs.¹⁰⁰

44. OPC also agrees with Stone & Webster that an enhanced inspection program is necessary and vital to PEPCO's mitigation efforts. OPC maintains that PEPCO's manhole inspection reports should be more inclusive, enhanced, and incorporated into GIS to prevent potential problems on the distribution system.¹⁰¹ It is OPC's contention that Stone & Webster misinterpreted OPC's position that age is a factor for system planning purposes. OPC contends that its focus on age is centered on PEPCO's denial that age is a significant determining factor in system planning for replacing primary or secondary facilities, and this has resulted in a substantial error in developing a system remediation plan.¹⁰² Arguing that Stone & Webster misinterprets OPC's conclusion regarding the role of GIS and does not fully recognize the benefit of a fully implemented GIS, OPC recommends that PEPCO implement a fully developed GIS to provide the company with a tool that it can use to predict future trouble areas and plan effective remediation.¹⁰³ OPC contends that PEPCO has been slow to implement GIS and that PEPCO's GIS efforts should be accelerated.¹⁰⁴ OPC

⁹⁶ *Id.*

⁹⁷ OPC's S&W Comments at 3.

⁹⁸ *Id.*

⁹⁹ *Id.* at 5.

¹⁰⁰ *Id.* at 6.

¹⁰¹ *Id.* at 7-9.

¹⁰² *Id.* at 9-15.

¹⁰³ *Id.* at 16.

¹⁰⁴ *Id.* at 18.

recommends that the Commission encourage PEPCO to incorporate *EasyPower* load-modeling and manhole inspection results into GIS.¹⁰⁵

45. OPC asserts that Stone & Webster's conclusions regarding slotted manhole covers are unsubstantiated and incomplete, and reiterates its argument that slotted manhole covers were not necessarily justified by the EPRI research, and moreover, may create more problems than they help to mitigate.¹⁰⁶ Therefore, OPC asserts that the Commission should solicit more information concerning the use of slotted manhole covers and the associated costs and benefits. OPC suggests an appropriate course of action might include: (a) further testing of manhole covers under different experiment parameters at the Lenox facility; (b) defining specific inspection procedures for already installed slotted covers; and (c) limiting the installation of additional slotted covers until all benefits and risks are appropriately assessed.¹⁰⁷

46. The District Government supports most of Stone & Webster's recommendations.¹⁰⁸ However, the District Government raises concern over the need for adequate voltage control and reactive power supply on PEPCO's system, as well as the issue of overvoltages. Specifically the District Government: (a) supports Stone & Webster's recommendation that PEPCO construct the load-flow models needed to allow proper analysis of actual loading on its network systems;¹⁰⁹ (b) recommends that the Commission require PEPCO to supply load-flow computer models of all of its network systems to allow proper analysis of load-flow under both normal and contingency conditions;¹¹⁰ and (c) recommends that a thorough evaluation of PEPCO's voltage control and reactive power arrangements for retail operations be conducted in this proceeding. The District Government believes such an evaluation is necessary to rule out those reactive power arrangements as a cause of the manhole incidents, or identify them as a cause that requires corrective action. Moreover, the District Government believes Stone & Webster's Report has not addressed the role of voltage control in limiting manhole incidents.¹¹¹

¹⁰⁵ *Id.*

¹⁰⁶ *Id.* at 20.

¹⁰⁷ *Id.* at 20-21.

¹⁰⁸ District's S&W Comments at 2.

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

¹¹¹ *Id.* at 3. The fraction of a load on a substation that serves a customer's requirements is called "real power," while the fraction of the load on the substation that decreases the substation's ability to deliver real power is called "reactive power." Reactive power increases transmission and distribution system losses. Because reactive power decreases the amount of power that gets to the customer to satisfy their requirements, the amount of power supplied must include both the actual amount needed plus the amount (reactive power) that must inevitably be lost during transmission and distribution.

47. The District Government also contends that PEPCO may not have adequate reactive power in its system as a result of its sale of the PRG Generating Station.¹¹² The District Government asserts that power from that facility is destined to the wholesale electricity market and, therefore, may not be a source for the reactive power needs of the District of Columbia. The District Government suspects that the District of Columbia is unprotected by the reactive output of generators.¹¹³ The District Government further contends that the frequent occurrence of manhole incidents may be indicative that capacitors and other equipment are not sufficient to provide adequate reactive power and voltage support.¹¹⁴

48. IBEW also supports many of Stone & Webster's recommendations. Specifically, IBEW believes Stone & Webster's recommendations will help PEPCO in its efforts to continue to improve overall system reliability.¹¹⁵ IBEW contends that PEPCO has a highly skilled workforce, that the overall system is very reliable, and that the practices in use today are within, or above, the industry norm. Further, it recommends that staffing levels should be monitored to ensure that they are kept at an adequate level in light of the Georgetown Project and Stone & Webster's recommendation to expedite network modeling.¹¹⁶ IBEW summarizes "that there is no way to eliminate manhole explosions or fires from ever happening again, but the adoption of the recommendations of this report will help keep them to a minimum."¹¹⁷

B. Parties' Reply Comments

49. PEPCO rejects many of the assertions made by OPC regarding PEPCO's performance in mitigating manhole explosions in the District of Columbia. According to PEPCO, OPC misstated the facts regarding PEPCO's manhole inspection program by alleging that PEPCO had no formal plan to routinely inspect underground facilities prior to the series of manhole events that led to the opening of this case.¹¹⁸ PEPCO asserts it filed a report with the Commission three days after the Commission established Formal Case No. 991, documenting that PEPCO established a manhole inspection program in March 1999, prior to the manhole incidents in early 2000.¹¹⁹ PEPCO contends that OPC's statement that PEPCO was ordered to do 10,000 manhole inspections per year is incorrect as evidenced by Order No. 11660, which only directed PEPCO to significantly increase the number of

¹¹² *Id.* at 3.

¹¹³ *Id.*

¹¹⁴ *Id.* at 4.

¹¹⁵ IBEW's S&W Comments at 2.

¹¹⁶ *Id.*

¹¹⁷ *Id.*

¹¹⁸ PEPCO's S&W Reply Comments at 2.

¹¹⁹ *Id.*

manhole inspections. PEPCO maintains that it voluntarily chose to specifically increase the level of annual inspections to 10,000 in response to the Commission's directive.¹²⁰ PEPCO takes exception to OPC's consultant's (Downes) recommendations regarding the type of data that can be obtained through physical inspections of manholes. PEPCO states the only items that can be revealed by a physical inspection are the identification of type of cable used, notation of physical damage, and the serial numbers of adjacent transformers and other equipment.¹²¹

50. PEPCO also contends that OPC misstated the testimony of its witness, Mr. Gausman, regarding PEPCO's ability to serve the Georgetown load.¹²² PEPCO avers that Mr. Gausman's testimony that "load is not a problem in Georgetown" referred to loading on the primary feeders, which PEPCO contends, was not a problem at the time of the March 22, 2000, hearing.¹²³ PEPCO reiterates its position that overloading is a contributing cause of failures and more specifically, that in the case of Georgetown, overloads have occurred due to recent commercial expansion and resultant load growth.¹²⁴

51. PEPCO rejects OPC's contention -- that PEPCO failed to adequately model secondary networks -- as being without merit.¹²⁵ PEPCO argues that the capability to efficiently model secondary systems did not exist until recently.¹²⁶ Moreover, PEPCO disagrees that the GIS version promoted by OPC is the panacea for remedying the existing problems with PEPCO's electric distribution system.¹²⁷ PEPCO also states that there is no evidence in the record to support OPC's contention that the failures in Georgetown resulted from the age of the cable.¹²⁸

52. PEPCO rejects OPC's assertion -- that slotted covers performed worse than solid cover manholes in an EPRI test -- as being unsupported by the record.¹²⁹ Additionally, PEPCO argues that OPC misstates the conclusions reached by the Commission in the November 2001 hearings, regarding the submission of a Comprehensive Plan.¹³⁰ Finally, in response to the District Government's

¹²⁰ PEPCO's S&W Reply Comments at 3. See also *supra* note 10.

¹²¹ *Id.* at 4.

¹²² *Id.* at 5-6.

¹²³ *Id.* PEPCO contends that this is still is not a problem in Georgetown or anywhere on PEPCO's system.

¹²⁴ *Id.* at 7.

¹²⁵ *Id.*

¹²⁶ *Id.*

¹²⁷ *Id.* at 8.

¹²⁸ *Id.* at 10.

¹²⁹ *Id.* at 12-13.

comments, PEPCO maintains that they are a reiteration of the District Government's arguments that were addressed in Formal Case No. 945, and are irrelevant to the manhole incidents.¹³¹

53. In response to PEPCO's assertion that OPC has incorrectly identified age as the cause of the manhole incidents, OPC argues that it has never asserted that age alone is the primary source of PEPCO's problems.¹³² Rather, OPC contends that it has advocated, when looking at the distribution system from a planning perspective and when examining its shortcomings from a manhole incident mitigation perspective, that the age of facilities is an important factor.¹³³ OPC argues that PEPCO's position on overloading contradicts statements PEPCO made earlier in this proceeding that disavowed loading as a potential cause of manhole incidents.¹³⁴ OPC suggests that the Commission should be concerned with PEPCO's admission on its remediation plan for distribution facilities that face overloading. OPC contends that PEPCO's admission implies that other parts of its systems are subjected to overloading.¹³⁵

54. The District Government contends that PEPCO should use new load-flow computer models to evaluate potential current and voltage problems under light as well as heavy load factors.¹³⁶ The District Government asserts that PEPCO's concession that overloading is a contributing cause of failure is contrary to PEPCO's statement in its objection to the District's Data Request No. 1-1, and PEPCO's argument at the November 2001 hearings.¹³⁷ The District Government contends that Stone & Webster's report does not refute OPC's contention that age of the cable is a primary factor in manhole incidents.¹³⁸

55. The District Government also contends that PEPCO's proposed implementation of Stone & Webster's recommendations should not be limited to high load or heavy load conditions.¹³⁹ The District Government notes, moreover, that PEPCO's plans for continued installation of slotted manholes may be an appropriate short-term response to the on-going problem in the underground

¹³⁰ *Id.* at 14-15.

¹³¹ *Id.* at 15-17.

¹³² OPC's S&W Reply Comments at 2.

¹³³ *Id.* at 3-4.

¹³⁴ *Id.* at 4-5.

¹³⁵ *Id.* at 5.

¹³⁶ District's S&W Reply Comments at 1.

¹³⁷ *Id.* at 2.

¹³⁸ *Id.*

¹³⁹ *Id.*

system, but not a solution.¹⁴⁰

C. Discussion

56. The comments filed in this proceeding reflect a consensus supporting the Commission's adoption of Stone & Webster's findings and recommendations. With the exception of the time frame for completing network modeling, and the extent and level of details required in the underground staffing analysis, PEPCO agrees to fully implement the 12 recommendations contained in Stone & Webster's report. OPC, the District Government, and IBEW agree that PEPCO should implement all 12 recommendations, although OPC does not concur with the continued installation of slotted manhole covers.

57. PEPCO raised doubts, in its comments regarding its ability to complete its network modeling initiative by Spring 2003, as recommended by Stone & Webster. PEPCO presented a table listing the networks to be modeled, by substation, in order of priority, and stated that every effort will be made to comply with the proposed revised schedule, if possible.¹⁴¹ PEPCO has also not committed itself to performing the proposed underground staffing analysis, stating that it will further review its staffing needs.¹⁴² Stone & Webster recommends that PEPCO conduct a work force staffing analysis to assess the adequacy of its work force to meet increased demands caused by the anticipated Georgetown construction activity, manhole inspections and repair program, and expedited modeling of its networks. The proposed analysis is also designed to assess the impact of the 30 percent decrease in underground and conduit staffing levels that occurred over the past decade.¹⁴³ Neither OPC nor the District Government offered any comments on PEPCO's proposal. IBEW suggests that staffing levels should be monitored to ensure that they are kept at an adequate level in light of the Georgetown Project and Stone & Webster's recommendation to expedite network modeling.¹⁴⁴

58. The Commission determines that PEPCO should be almost done with its modeling initiative and therefore, PEPCO is directed to file a detailed report of its modeling efforts and the results, with a schedule for completing the network modeling, within 30 days from the issuance of this report,¹⁴⁵ and provide quarterly progress reports to the Commission's Productivity Improvement

¹⁴⁰ *Id.*

¹⁴¹ PEPCO's S&W Comments at 5.

¹⁴² *Id.* at 10-11.

¹⁴³ S&W's Report at 6.

¹⁴⁴ IBEW's Comments at 2.

¹⁴⁵ PEPCO represented that it would give high priority to the networks serving the Adams Morgan area in terms of its modeling effort and complete its review of that area by last summer (2002) because it shows significant overcrowding resulting from load growth. However, to date PEPCO has not advised the Commission of the results of its review. Recent events make it imperative that PEPCO complete its Adams Morgan modeling initiative immediately. *See Clarence Williams, D.C. Manhole Fire Forces Power Outage, The Washington Post*, February 20, 2003, at B 8.

Working Group ("PIWG").¹⁴⁶ This information will enable the Commission to track the progress of PEPCO's modeling efforts.

59. The Commission also determines that a work force staffing analysis should be developed that includes a projection of work force requirements in the near term (over the next six months), mid-term (over the next six to 18 months), and long-term (18 months and beyond) from the date of issuance of this Report and Order, as well as a hiring plan for meeting the projected staffing needs. PEPCO's proposal is to be submitted to the PIWG for its review within three months from the issuance date of this Report and Order.

60. OPC's objection to the continued installation of slotted manhole covers is based on its claim that slotted manhole covers were not necessarily justified by the EPRI research.¹⁴⁷ OPC is also concerned that the use of slotted manhole covers will lead to additional accumulation of debris in the District's manholes. OPC's concerns are refuted, however, by the preponderance of the evidence in the record, which demonstrates that the installation of slotted manhole reduces the severity of manhole events. Slotted covers have been used for many years by other utilities providing service in environments similar to the District of Columbia.¹⁴⁸ In fact, PEPCO has a longstanding practice of installing open gratings over transformer vaults, where the issue of debris accumulation also applies.¹⁴⁹ PEPCO began its program of installing slotted manhole covers in sidewalks and crosswalks prior to the Commission's investigation.¹⁵⁰ Stone & Webster examined PEPCO's initiative and concluded that, based on the available data, PEPCO has followed a reasonable course of action.¹⁵¹ The Commission agrees with PEPCO's decision to use slotted manhole covers. The District has experienced manhole incidents, since PEPCO started installing slotted manhole covers, and the record in this proceeding indicates that those incidents involving manholes with slotted covers have been less severe than incidents involving solid manhole covers.¹⁵² We believe that this experience outweighs any concern we may have about accumulation of debris in the District's manholes. Because the accumulation of debris is a legitimate concern, however, we direct PEPCO to

¹⁴⁶ See generally 15 DCMR §§ 513.5 - 513.7 (1982) for a discussion of the role of the PIWG.

¹⁴⁷ OPC's S&W Comments at 19-21.

¹⁴⁸ S&W's Report at 17.

¹⁴⁹ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, PEPCO's 2001 Annual Manhole Events In the District of Columbia, filed January 31, 2002, at 4 (hereinafter "2001 Manhole Report").

¹⁵⁰ PEPCO's Brief at 16.

¹⁵¹ S&W's Report at 8.

¹⁵² *Id.* at 9. PEPCO indicates that of the 39 reportable manhole events in the District of Columbia in 2002, eight involved manholes fitted with slotted covers, with only two events involving explosions and displacement of the manhole covers. See *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Report of PEPCO on 2002 Manhole Events in the District of Columbia, filed January 30, 2003, at 5 (hereinafter "2002 Manhole Report").

carefully monitor debris accumulation and conditions in manholes with slotted covers. PEPCO is to report the results of this monitoring in its quarterly manhole inspection reports to the Commission.

61. The parties to this proceeding have disparate views regarding the age of PEPCO's cables and whether age is a primary or secondary factor contributing to the District's manhole incidents. OPC contends that when looking at the distribution system from a planning perspective, and when examining its shortcomings from a mitigation perspective, the age of the facilities is an important factor.¹⁵³ The District Government opined that, in those parts of a system affected by chronic overloading, age of the cable could be a significant factor in manhole incidents.¹⁵⁴ PEPCO asserts that none of the manhole incidents to date can be attributed to age alone.¹⁵⁵ In its report, Stone & Webster indicates that age alone is not a factor, but that the age of the cable can contribute to a manhole incident. Stone & Webster supports this proposition by stating that underground cable has an indeterminately long life if never overloaded or exposed to harsh physical and environmental stress.¹⁵⁶

62. We conclude that the record demonstrates that, while age is not the primary source of the problems experienced in PEPCO's underground distribution systems, the age of the system components can be a contributing factor in manhole incidents. The parties recognize that overloading will cause cable failure and that a cable that has experienced deterioration, due to either age or adverse environmental conditions, will fail more readily, when overloaded, than a new cable. We believe that the results of the Commission-ordered facilities' inspections, together with a well-populated GIS, as directed below, will provide useful information in assessing the impact of equipment age relating to future manhole incidents and will, in addition, provide PEPCO with operational and maintenance benefits for enhancing the reliability of the underground distribution system.

63. The record developed in this proceeding also supports our adoption of Stone & Webster's recommendation regarding GIS implementation. OPC asserts that PEPCO should implement a fully developed GIS because such a system will permit PEPCO to predict future trouble areas, thereby allowing the company to plan effective remediation. Although PEPCO is currently implementing GIS, OPC believes that PEPCO has moved too slowly to the detriment of District ratepayers.¹⁵⁷ Neither the District Government nor IBEW offered comments on this issue. Stone & Webster asserts that GIS would provide PEPCO with operational and maintenance benefits but warns that the tools for analyzing system loading and cable heating are not standard features in GIS

¹⁵³ OPC's S&W Comments at 10.

¹⁵⁴ District's S&W Reply Comments at 2.

¹⁵⁵ PEPCO's S&W Reply Comments at 10.

¹⁵⁶ S&W's Report, Appendix B.

¹⁵⁷ OPC's S&W Comments at 18.

products.¹⁵⁸ The parties agree, therefore, that GIS is not the ideal tool for analyzing system loading and cable heating. In contrast, the parties agree that network modeling is the appropriate tool for analyzing system loading and cable heating. Therefore, consistent with both OPC and Stone & Webster's respective recommendations, the Commission finds that the public interest will be served by requiring that network modeling be part of PEPCO's GIS implementation.

64. OPC, relying on the Downes Report, argues that a full GIS implementation can be accomplished in three years.¹⁵⁹ Stone & Webster contends that PEPCO's pace of GIS implementation is sufficient, especially in comparison with the urgent need for network modeling.¹⁶⁰ Given Stone & Webster's assertion that the problems causing manhole incidents will be more directly addressed by network modeling, the Commission believes that the public interest is sufficiently protected by allowing PEPCO to continue implementing GIS at its current pace. Within three months of this Report and Order, PEPCO is to submit a schedule for fully implementing GIS, with major tasks, milestones, and expected completion dates to the PIWG for its review. Thereafter, PEPCO is to submit quarterly progress reports to the PIWG.

65. A close review of the record demonstrates, beyond dispute, that PEPCO has an extensive and comprehensive formal plan to routinely inspect its underground facilities.¹⁶¹ Whether the inspections resulted from PEPCO's initiative, or resulted from the Commission's orders, is unimportant. What is important is the fact that PEPCO has demonstrated a willingness to mitigate manhole incidents by increasing the number of manhole inspections performed in the District of Columbia. The goal of PEPCO's plan is to ensure that all manholes are routinely inspected as a preventive measure. The Commission finds that PEPCO's plan meets this goal and that its manhole inspections will facilitate PEPCO's initiatives in improving its underground distribution system.¹⁶² The Commission, therefore, expects PEPCO's to continue inspecting 10,000 manholes per year.

66. The Commission is concerned with respect to PEPCO's initiative in modeling its secondary systems. OPC contends that, until recently, PEPCO did not have, and failed to acquire, the ability to adequately evaluate its distribution system and to properly maintain and plan for necessary upgrades to meet the demands of that distribution system.¹⁶³ PEPCO argues, in response, that its capability to efficiently model secondary systems did not exist until recently. PEPCO concedes, however, that a software program previously existed to model secondary network loads but argues

¹⁵⁸ S&W's Report, Appendix B at 125-127.

¹⁵⁹ OPC's S&W Comments at 16-18.

¹⁶⁰ S&W's Report, Appendix B at 127.

¹⁶¹ See 2001 Manhole Report.

¹⁶² PEPCO represents that additional secondary cables have been installed and the capacity of several transformers have been increased as a result of the inspections. See PEPCO's S&W Comments at 6.

¹⁶³ OPC's S&W Comments at 4.

that the program was cumbersome to use and was not capable of accurately modeling entire secondary network groups.¹⁶⁴

67. Stone & Webster disputes PEPCO's contention regarding the existence of models for accurately and efficiently modeling secondary network groups.¹⁶⁵ Stone & Webster identified three digital computer programs that were available in the 1960's to conduct analytical modeling of secondary networks. Moreover, Stone & Webster maintains that the *EasyPower* program purchased by PEPCO was commercially available in the early 1990's and used by Virginia Power to model its secondary networks during that same period.¹⁶⁶ The Commission is persuaded, by Stone & Webster's report that PEPCO could have acquired, prior to the initiation of this investigation, secondary network modeling software that would have allowed it to model its secondary network. The Commission believes that PEPCO was slow in recognizing the capability and usefulness of existing models for accurately modeling secondary network groups. Nevertheless, PEPCO has significantly increased its ability to accurately and efficiently model its secondary networks during the course of this proceeding and has committed to modeling all of its secondary networks as expeditiously as possible.¹⁶⁷

68. As to the District Government's issues regarding adequate voltage control and reactive power, the District Government submits that since the sale of its Potomac River Generating Station ("PRG"), PEPCO may not have adequate reactive support in its system because power from that facility is destined for the wholesale electricity market.¹⁶⁸ The District Government contends that because PEPCO does not have arrangements with the owner of PRG to supply reactive power to the District, the District of Columbia is unprotected by reactive output of generators. Furthermore, the District Government surmises that the frequency of the manhole incidents may be indicative that capacitors and other equipment are not sufficient to provide adequate reactive power and voltage support.¹⁶⁹ The District Government argues, therefore, that a thorough evaluation of PEPCO's voltage control and reactive power arrangements for retail operations must be conducted as part of the Commission's investigation into the cause of the manhole incidents.

69. PEPCO responds that this issue, regarding voltage control and reactive power, was fully addressed in Formal Case No. 945 and that the District Government has failed to demonstrate any causal connection between voltage control, reactive power, and any of the manhole incidents that have occurred in the District of Columbia.¹⁷⁰ PEPCO asserts that the Formal Case No. 945 Settlement

¹⁶⁴ PEPCO's S&W Reply Comments at 7.

¹⁶⁵ S&W's Report at 61-62.

¹⁶⁶ *Id.* Other utilities include the City of Richmond Indiana, Niagara Mohawk, Atlanta Power, Northern States Power, and Portland Electric.

¹⁶⁷ PEPCO's S&W Comments at 12.

¹⁶⁸ District's S&W Comments at 3.

¹⁶⁹ *Id.* at 4.

Agreement included specific provisions addressing market power or reliability concerns.¹⁷¹ Furthermore, PEPCO avers that it has contracts in place with a supplier to provide the necessary power to maintain local area reliability, including the provision of ancillary services that includes any required reactive power.¹⁷²

70. The Commission finds that the issues of adequate voltage control and reactive power have been thoroughly examined and resolved in Formal Case No. 945. Specifically, PEPCO's "Local Area Support Agreement" obligates the PRG owner to provide needed power to PEPCO.¹⁷³ The District Government's concern and suspicions, therefore, are unjustified and without merit.

71. There is some merit, however, to the District Government's concern regarding the effect of light load conditions and overvoltages on cable failures. The District Government contends that PEPCO's proposed implementation of Stone & Webster's recommendation focuses too narrowly on heavy or high load conditions.¹⁷⁴ The District Government argues that PEPCO's system conditions under light loads should also be examined because, under light load conditions, voltage can be high and swing to excessive levels.¹⁷⁵

72. The Commission has considered the District Government's allegation that the manhole incidents were caused, in part, by overvoltage caused by low current, which is different from undervoltage caused by high current (overload). Our examination of the evidence reveals that the distribution system problems have been caused by overload conditions (which are the same as high current and undervoltage conditions) and not by overvoltage conditions (which are the same as low current).¹⁷⁶ Further, as part of its investigation, Stone & Webster physically inspected various sections of failed cable and found signs of thermal, rather than voltage-induced, failure patterns.¹⁷⁷ Moreover, the Commission's examination reveals that sustained overvoltages would cause widespread failures of light bulbs, customer appliances, and other connected devices before voltage reached a level sufficient to damage cable insulation. Because the District Government has failed to present the Commission with any high-voltage complaints from customers, as evidence to sustain its assertion, the

¹⁷⁰ PEPCO's S&W Reply Comments at 15-16.

¹⁷¹ See Formal Case No. 945, *In The Matter of The Investigation into Electric Service Market Competition and Regulatory Practices*, Order No. 11576, rel. December 30, 1999, at 31-32.

¹⁷² PEPCO's S&W Reply Comments at 17.

¹⁷³ See Formal Case No. 945, *PEPCO's Petition for an Eligible Facility Determination for Generating Facilities and Authorization to Transfer Certain Generation Assets to an Affiliate, Exhibit F*, filed September 19, 2000.

¹⁷⁴ District's S&W Reply Comments at 2.

¹⁷⁵ *Id.*

¹⁷⁶ S&W's Report at 35.

¹⁷⁷ *Id.* at 37.

Commission finds that overvoltages can be eliminated from consideration as a cause of secondary cable failures.¹⁷⁸

73. The Commission finds that the record developed in this proceeding is devoid of any evidence that overvoltage caused any of the manhole-related events. Moreover, the Commission finds that PEPCO's improved failure investigation policy should allow it to detect any future instances of cable failures due to overvoltages. More importantly, PEPCO's analytical modeling of its distribution system will allow it to address this question. Running light-load cases will either confirm or put to rest any question of overvoltages (other than lightning) as a cause of manhole events. In summary, the Commission concludes that although overvoltage or light load conditions have not been implicated in manhole incidents, PEPCO should include light load cases in its analytical modeling of its networks so as to confirm or refute the relevance of overvoltage to cable failures.

¹⁷⁸

None of the other parties to this proceeding presented evidence of overvoltage complaints by District ratepayers.

VI. PEPCO'S COMPREHENSIVE PLAN

A. Summary

74. During the November 2001 hearings, the Commission requested that PEPCO submit a comprehensive plan to include a current assessment of, and future plans for, its underground distribution and network facilities.¹⁷⁹ The Commission requested the plan as a tool to evaluate PEPCO's planning methodology and to assess PEPCO's ability to anticipate and respond to changing conditions in its underground distribution system. PEPCO filed an expurgated comprehensive plan on February 8, 2002.¹⁸⁰ The plan outlines the process used to develop PEPCO's short and long-range construction program and describes PEPCO's engineering analysis, system operation criteria, and technology advancements required to meet the continued load growth and maintain system reliability within its electric distribution service area.¹⁸¹ The plan is divided into four sections:

- Section 1: Overview of the Planning Process contains a brief description of the annual process of reviewing PEPCO's electric system to identify potential changes in load growth and the subsequent activities undertaken to maintain and improve system reliability;
- Section 2: Meeting Load Growth details the elements involved in conducting PEPCO's annual review of system changes and the development of projects and activities designed to meet future electric load growth;
- Section 3: Maintaining System Reliability addresses the programs PEPCO has established to improve and maintain the reliability of the existing electric system; and
- Section 4: Summarizes responses provided by PEPCO to various Commission requests made as part of this investigation into the District's manhole incidents.

Most of Section 2 is expurgated. Section 4 does not detail a plan but merely identifies information currently being provided to the Commission by PEPCO through the PIWG, the Productivity Improvement Plan ("PIP"), as well as existing reporting mechanisms created in response to

¹⁷⁹ *Formal Case No. 991, In The Matter of the Investigation into Explosions Occurring in or Around the Underground Distribution Systems of the Potomac Electric Power Company*, November 5, 2001, Transcript of Proceedings at 141-153.

¹⁸⁰ *See supra* ¶ 29.

¹⁸¹ PEPCO's Plan at 1.

Commission Orders in Formal Case Nos. 982¹⁸² and 991.

1. Section 1 - Overview of the Planning Process

75. The plan provides an overview of PEPCO's electric system, planning organization, planning process (*i.e.*, meeting load growth), and the programs that PEPCO has established to improve and maintain system reliability. Each of these elements is summarized below.

2. Section 1.1 - Overview of PEPCO's Electric System

76. PEPCO's transmission and distribution ("T&D") electric system is an intricate network of circuits that allows PEPCO to manage the flow of electricity from generators to its end users. Distribution circuits radiate from the distribution substations to supply customers. PEPCO indicates its energy delivery system includes circuits that are completely underground.¹⁸³ PEPCO's T&D electric system consists primarily of substations that are remotely monitored and operated from its centralized control center. PEPCO owns nearly 1,000 miles of transmission lines, including a 100-mile, 500kV loop that encircles the District of Columbia metropolitan area.¹⁸⁴

77. PEPCO's substations are capable of supplying the load during peak periods and are designed to withstand the loss of one supply circuit without loss of load.¹⁸⁵ If capacity problems do occur, PEPCO's system is designed to allow switching, or the transfer of load, to other circuits or substations to relieve a localized problem.¹⁸⁶ PEPCO asserts that its distribution system is in good condition and is able to meet the currently projected peak load.¹⁸⁷

3. Section 1.2 Planning - Organization

78. PEPCO states that the electric system planning process takes place for the most part, within the "Asset Management Organization" with PEPCO's "Power Delivery Group." The responsibilities of the Asset Management Organization are to administer construction and maintenance programs, optimize assets to maximize system performance and value, perform system planning to manage growth and customer requirements, and develop strategic reliability programs.¹⁸⁸

¹⁸² See Formal Case No. 982, *In The Matter of the Investigation of PEPCO Regarding Interruption to Electric Energy Service During the Period January 14-19, 1999*, Order No. 11604, rel. February 10, 2000.

¹⁸³ PEPCO's Plan § 1, at 1.

¹⁸⁴ *Id.*

¹⁸⁵ *Id.* at 1.

¹⁸⁶ *Id.* at 2.

¹⁸⁷ *Id.*

¹⁸⁸ *Id.* at 3.

4. Section 1.3 Planning Process – Meeting Load Growth

79. PEPCO asserts that, in meeting load growth, it analyzes the adequacy of the electric system to ensure that the system can meet both current and future demand. According to PEPCO, planning for future load growth starts with the development of load growth projections. Short-term summer peak forecasts are developed for three years and long range forecasting is done for a period of four to 10 years. PEPCO also states that it has developed engineering and operating criteria, which are applied to the design of new and modified systems.¹⁸⁹ The three major components of system planning criteria are voltage and reactive support, ratings of facilities, and reliability.¹⁹⁰

80. PEPCO explains that system planners develop the costs and schedules for the changes to the electric system, which will be proposed as candidates for inclusion in the construction process, only after the existing electric system and the requirements for new service hook-ups are reviewed.¹⁹¹ The construction budget process takes place during the second half of each year and culminates with the approval of the following year's budget and the selection of projects to be included in the 10-year forecasts of electric system additions. Projects may be added or deleted from the 10-year forecasts from year to year as required.¹⁹²

5. Section 1.4 Maintaining System Reliability

81. PEPCO has the following programs in place to investigate and address the conditions affecting the reliability of its electric system: (a) computer software and monitoring (SCADA & GIS); (b) load-flow analysis; (c) network monitoring; (d) reliability tracking and analysis; (e) standards and equipment (e.g. paper insulated load covered ("PILC") cable replacement, limiters, etc.; and (f) manhole inspection program and event mitigation.¹⁹³

82. *Computer Software and Monitoring (SCADA & GIS)* - System Control and Data Acquisition ("SCADA") are the primary tools used by system operators to monitor the electric system. The GIS involves transferring data and information from paper to an electronic format, which is being implemented in three phases -- distribution feeder maps, distribution plats, and remaining asset management information.¹⁹⁴

¹⁸⁹ *Id.* at 4.

¹⁹⁰ *Id.* at 6.

¹⁹¹ *Id.*

¹⁹² PEPCO did not include the 2002-2011 Ten-Year Forecast of Electric Plant Additions in its comprehensive plan because of "security reasons".

¹⁹³ *Id.* at 7.

¹⁹⁴ *Id.* at 8.

83. PEPCO utilizes *power flow analysis*, a computerized tool used to calculate power flows and voltages within a modeled electric system, to determine the location of conductor or equipment capacity overloads and to determine whether there are any voltage deficiencies on the feeder by modeling the primary mainline configuration.¹⁹⁵ PEPCO states it uses the *Power Simulator for Engineering* software for study of the transmission and sub-transmission systems, and *CYMDIST* software to study the mainline radial distribution system. For secondary network analysis, PEPCO uses *EasyPower* software to identify and take measures to keep the low-voltage AC network system design from being overloaded during normal operations and under contingency conditions. The analysis looks at customer demands and predicts theoretical voltages and currents on the components within the modeled system.¹⁹⁶

84. *Network monitoring* - PEPCO evaluates the electric system operations through network monitoring to capture operational data on various pieces of equipment located in the electric delivery system.¹⁹⁷ PEPCO anticipates that 10 to 20 percent of the networks will be retrofitted with remote monitoring capabilities by the end of 2003.¹⁹⁸ The future expansion of this network monitoring system for the entire low-voltage AC system will be evaluated by examining the operating history and projected benefits. The existing network monitoring systems for 35 network transformers that were installed in 1999-2000 is being retrofitted with conventional telephone lines. The proposed installations in Georgetown will use power line carrier technology, using 13kV feeders to transmit data from transformers to the Georgetown substation, and PEPCO's fiber optic lines, from the Georgetown substation to the control center and transformer shops, as the communication media.¹⁹⁹

85. *Reliability and Tracking Analysis* - The Reliability Services Division is responsible for investigating and performing the necessary corrective actions to maintain and improve overall system reliability.²⁰⁰ This program involves monitoring the performance of approximately 1,400 distribution feeders. To assist with outage management, the customer reliability personnel use the *Reliability Data Mart* ("RDM"), a tool that is used to track and analyze incidents of power interruptions. Historical outage data from January 1995 to present has been extracted, validated, and stored for RDM extraction.²⁰¹ The client side of RDM is *Oracle Discoverer* software. PEPCO asserts that the source of data for RDM is the legacy Trouble Processing System and that, once the *Outage Management System* ("OMS") comes online, OMS will be its primary source of data for the RDM.

¹⁹⁵ *Id.*

¹⁹⁶ *Id.* at 8, 9.

¹⁹⁷ *Id.* at 9.

¹⁹⁸ *Id.* § 3 at 17.

¹⁹⁹ *Id.*

²⁰⁰ *Id.* at 20.

²⁰¹ *Id.* at 21-22.

RDM is presently used to investigate distribution feeder reliability performance and it will subsequently be used for determining corrective action to improve service reliability.²⁰²

86. *Standards and Equipment* - Limiters are used to reduce the possibility of cable faults failing to clear and to minimize cable damage.²⁰³ PEPCO states that it will follow Stone & Webster's recommendation to investigate the use of electronically controlled fuses and the installation and expansion of various types of fault locating equipment for use on primary cable feeders.²⁰⁴ PEPCO is also considering increasing the current rating of the interrupter to 600-800 amperes.²⁰⁵ PEPCO asserts that, while PILC has a record of reliability, it is still pursuing alternatives because of the concerns regarding future supply reliability.²⁰⁶

87. *Manhole Inspection Program and Event Mitigation* - A manhole inspection program was developed in late 1999 and initiated in January 2000, which includes scheduled and random inspections.²⁰⁷ PEPCO indicates that a program team reviews inspection data daily. Problems that are identified through this process are assigned a priority code and referred to the appropriate department for corrective action and entered into a database. PEPCO's goal is to perform 10,000 inspections per year.²⁰⁸

B. OPC's Comments on the Plan

88. OPC contends that PEPCO's comprehensive plan reflects a considerable advance from PEPCO's initial position and represents a sound outline of system planning, design, and maintenance resources for an underground distribution system.²⁰⁹ Additionally, OPC states that PEPCO's plan incorporates many of the changes to existing practices that the Formal Case No. 991 process fostered. OPC believes, however, that the plan can be improved if PEPCO addresses six specific parts of the

²⁰² *Id.* at 22.

²⁰³ *Id.* at 38.

²⁰⁴ *Id.*

²⁰⁵ An interrupter is a current-limiting device much like a fuse, but used in high current applications such as substation feeders or in primary cable feeders and splices in manholes. It is called an interrupter because it interrupts (stops) high-current faults. It breaks the circuit, stops current from continuing to flow past it and protects devices such as cables and high voltage oil-filled switches "downstream" from it in the circuit.

²⁰⁶ *Id.* at 40.

²⁰⁷ *Id.* § 1, at 10.

²⁰⁸ *Id.* at 11.

²⁰⁹ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Comments of the Office of the People's Counsel on PEPCO Expurgated Comprehensive Plan, filed March 8, 2002.

plan. Specifically, these are: (a) cable failure analysis and development of cable replacement priority models; (b) linkage of various databases to the GIS to produce useful output, including trend analysis; (c) examination of additional SCADA systems and remote monitoring of existing portions of the underground system, including the use of heat and smoke detection devices in the distribution system beyond the substation and transformer level; (d) evaluation of current short-term and long-term load forecasting methods that permitted overloading conditions, such as those experienced in Georgetown, to exist undetected; (e) monitoring and assessment of the effect of debris on equipment in manholes as a consequence of using vented manhole covers; and (f) reporting and coordination with the PIWG process.²¹⁰

89. OPC recommends that the Commission fashion benchmarks and milestones to ensure that new distribution systems are implemented on schedule and in a comprehensive manner. Accordingly, OPC recommends that PEPCO be required to update its plan on a regular basis, either annually or according to some other schedule that conforms with the Commission's and PEPCO's planning schedules.²¹¹ Finally, OPC is troubled by the idea of PEPCO as the sole arbiter of what may be disclosed as part of the public record in formulating its comprehensive plan. OPC requests that the Commission set up alternative procedures for reviewing highly confidential aspects of PEPCO's plan.²¹²

C. Discussion

90. The Commission believes it is important to recognize that PEPCO made a significant effort in preparing its plan, addressing the transmission system and overhead portions of the distribution system, as well as the District of Columbia underground distribution system. Although we find that the plan filed by PEPCO is broader than the issues specifically under consideration in this proceeding, we also believe that there are some critical parts missing.

91. For example, PEPCO's distribution projects discussed in Section 2.3 lack details regarding the annual amounts to be invested in the projects over the next 10 years, the level of specific investment in the respective secondary and primary underground systems, and how much of the anticipated overload is due to new customers, reliability, or other system-planning drivers.²¹³ Further, although the plan provides an overview of its planning process that incorporates its construction program, the plan does not include planning outputs, such as a 10-year forecast of customers, load growth, or peak load, nor does it compare these outputs to historical trends.²¹⁴ Moreover, forecast methodologies and assumptions are not included, possibly because portions of the plan have been

²¹⁰ *Id.* at 3-4.

²¹¹ *Id.* at 4.

²¹² *Id.* at 6-8.

²¹³ PEPCO's Plan, § 2, pp. 18-23.

²¹⁴ *Id.* § 1.1.

expurgated.

92. PEPCO's 10-year power delivery information systems plan addresses PEPCO's SCADA, substation automation via RTUs, distribution automation, trouble processing system, GIS, and the *EasyPower* secondary network analysis program.²¹⁵ While the plan includes background and explanatory information on these systems, it does not provide the implementation status for each element of the plan, nor anticipated completion dates, installation milestones, nor annual budget estimates.

93. PEPCO's discussion of its long-term technology improvement plan is extensive and includes an analysis of limiters, the use of PILC in comparison to EPR cable, and new splicing techniques. Also, electronically controlled fuses and fault locating equipment are discussed.²¹⁶ Again, it is neither clear what the current implementation status is for each project, nor what the anticipated target dates are for accepting or rejecting the technologies under consideration. Additionally, PEPCO has not included any forecasts or plans regarding manpower staffing levels. The Commission believes this is an important issue, particularly given the increasing power delivery workload due to secondary system modeling, the Georgetown Project, and the manhole inspection program and repairs resulting from those inspections. The Commission's concern is heightened by the fact that these efforts are being performed in the face of PEPCO's recent workforce downsizing.²¹⁷

94. Hence, the Commission finds that the plan can be improved by the addition of a manpower plan and a summary containing the following information specific to the District's underground system: (a) customer growth projections by District of Columbia wards (including historical comparisons); (b) load growth projections, encompassing commercial and residential development by District of Columbia wards (including historical comparisons); (c) a listing of underground distribution projects, such as the Adams-Morgan neighborhood project (including budgets, time schedules, and expected benefits) by primary and secondary systems, and by District of Columbia wards affected, but not specific locations; (d) listing of power delivery information system projects with implementation schedules, annual costs, and milestones; (e) listing of new technology investigations with decisions, annual costs, and implementation schedules; (f) targeted reliability indices (including historical comparisons); (g) and manpower forecast for the power delivery organization (including historical comparisons). The summary should cover a 10-year planning

²¹⁵ *Id.* § 3.

²¹⁶ *Id.* § 3, p. 39.

²¹⁷ While PEPCO provides an overview of its electric system planning process and organization in Section 1, the details on the application of this process have been substantially expurgated. Although the general information and flow chart of the planning process appear to be acceptable, it is not possible to comment on system planning criteria, forecast methodologies, and assumptions, or load growth projections. Further, it is unclear how PEPCO monitors and tracks progress against each plan element because PEPCO's plan does not address this subject. Moreover, PEPCO's plan is lacking quantified performance goals (e.g., reliability index targets), milestones or decision dates, completion dates, and costs. Without such targets, as well as a reporting format, it is difficult to systematically gauge progress and degree of success in implementing the plan's elements.

horizon while historical comparisons should provide at least five years of history.

95. In addition, consistent with OPC's recommendations, PEPCO is directed to file with the PIWG quarterly progress reports on the implementation of the plan. This information will facilitate our continuing oversight and monitoring system.²¹⁸ Further, OPC recommends that PEPCO should update the Comprehensive Plan on an annual basis. We believe that OPC's recommendation is reasonable and agree that the Plan should be updated on an annual basis and filed with the Commission by February 15th of each year, together with the PIP.

²¹⁸ It is unclear how PEPCO monitors and tracks progress against each Plan element because the Plan does not address this subject. Clearly, a Plan reporting format is needed. As regards the confidential treatment of portions of PEPCO's Plan, the Commission will not require PEPCO to provide an in-camera session for the Commission's review of the information it claims should not be disclosed for security purposes. The Commission relies on the veracity of PEPCO's security claims. However, it is clear that the Commission has the authority to obtain any information it deems necessary in performing its regulatory function. See D.C. Code, 2001 Ed. § 34-1118.

VII. RESOLUTION OF DESIGNATED ISSUES

96. In Order No. 12114, the Commission designated seven issues for the parties' consideration in determining the cause, or causes of, and remedies for the manhole explosions.²¹⁹ The designated issues in this report are addressed *in seriatim* below. These issues are discussed by setting out the key concerns and positions of the parties, examining the record, and finally, our decision of the issues.

A. Issue 1: What are the cause(s) of the manhole incidents on the PEPCO underground distribution system?

1) Parties' Positions

97. OPC observes that several problems, such as splice failures, cable failures, improper installations, and the general age and condition of the system itself, have contributed to the manhole incidents that have occurred in the District of Columbia.²²⁰ OPC states that certain over-arching problems have caused the incidents and that, in some cases, precise causes have been identified for specific incidents. OPC claims that the real issue in this proceeding is the "larger and more pervasive inquiry" of whether PEPCO's record keeping and planning processes have been adequate to prevent incidents from occurring.²²¹ OPC further claims that the "cause" of the manhole incidents lies in PEPCO's failure to provide reasonably safe and adequate service as required by Section 34-1101 of the D.C. Code. OPC recommends that the Commission find and conclude that PEPCO has not, in the past, done all it could to plan and maintain its underground distribution system.²²² OPC questions PEPCO's old practices, as well as PEPCO's implementation of new procedures, related to such things as GIS and detection of thermal and gas levels. OPC concludes that other causes of the manhole incidents include failure analysis, lack of thoroughness of manhole inspections and remediation of problems that have been detected, the use of slotted manhole covers and the potential adverse effects on system reliability and security, delay in implementation of advanced system sensor devices, and the overall effects of aging equipment under normal and overload operating conditions.²²³ OPC emphasizes that recent commercial expansion and resultant load growth should not excuse PEPCO from planning and preventing overloading problems in the District of Columbia before the system exceeds its design capabilities.²²⁴

²¹⁹ Order No. 12114, rel. September 7, 2001, Attachment A.

²²⁰ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Initial Post-Hearing Brief of the Office of the People's Counsel, filed March 29, 2002 (hereinafter "OPC's Brief") at 10.

²²¹ *Id.*

²²² *Id.* at 11.

²²³ *Id.* at 14.

98. PEPCO avers that manhole events cannot be completely eliminated and notes that they occur in other systems.²²⁵ PEPCO asserts that it identified only one event (Adams Morgan in 2001) where the cable that failed overloaded at the time of the failure.²²⁶ PEPCO admits, however, that overloading could have been a contributing cause in recent failures and more specifically, in the case of Georgetown, overloads have occurred due to recent commercial expansion and resultant load growth.²²⁷ PEPCO indicates the steps it has taken to identify the causes of underground failures, including changes to its data collection and analysis methods, more expansive and comprehensive inspections, and the implementation of a GIS system. PEPCO affirms its commitments to implement the ABB report's 14 recommendations and the Stone & Webster's recommendations.²²⁸

99. PEPCO rejects OPC's allegation that PEPCO has failed to meet its statutory obligations, and notes the reliability of its underground network systems for serving dense urban loads.²²⁹ PEPCO also contends that OPC's claims of inadequate record-keeping are not supported by the evidence, asserting that it has a comprehensive planning process in place as set forth in its Comprehensive Plan.²³⁰ PEPCO claims, moreover, that it continues to examine methods to operate more efficiently, using new technology, to provide safe and reliable service in the District of Columbia.²³¹

2) Commission Decision

100. The Commission concludes that the record developed in this proceeding, when

²²⁴ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Post-Hearing Reply Brief Proposed Conclusions of Law of the Office of the People's Counsel, filed April 17, 2002 (hereinafter "OPC's Reply Brief") at 3.

²²⁵ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Initial Brief of PEPCO, filed March 29, 2002 (hereinafter "PEPCO's Brief") at 7.

²²⁶ *Id.*

²²⁷ *Id.*

²²⁸ *Id.* at 10-12. PEPCO has indicated that it has fully implemented all of ABB's recommendations. See *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Second Quarter 2002 Status Report of PEPCO in Response to Commission Order No. 12306, filed September 18, 2002..

²²⁹ *Formal Case No. 991, In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Reply Brief of PEPCO, filed April 17, 2002 (hereinafter "PEPCO's Reply Brief") at 18.

²³⁰ *Id.*

²³¹ *Id.* at 19.

considered as a whole, amply supports the finding that overloading was a primary factor in cable and splice failures, which ultimately lead to the manhole incidents in the District of Columbia.²³² PEPCO's underground systems, like most underground systems, require a large number of connections to various primary and secondary cables. These connections are in underground vaults (i.e., manholes) with the openings covered by manhole covers. Unlike overhead systems, which rely on air as the primary insulating medium, underground systems rely on insulating material along a cable to provide the necessary insulation. Splices and connections are much more complicated than overhead construction because of the need to maintain insulation integrity. Underground systems are very unforgiving, as compared to overhead systems, in that any failure of the insulation results in significant damage that requires substantial repair time.²³³

101. Electrical short-circuits – otherwise known as “faults” – result when there is a release of large amounts of energy. A short circuit that is not quickly disconnected could result in overheating of wiring and, perhaps, even a fire. A fault in electrical facilities (e.g., cable, splices, taps, transformers, and switches) located in a manhole will often result in significant energy release because the facilities are in an enclosed space. Another source of energy release in a manhole comes from the combustion of flammable gas produced by the decomposition of overheated cable insulation. Overloaded cables (whether from load current or fault current) produce quantities of combustible gases that, if ignited, can release significant energy in the manhole.²³⁴

102. Overheated cables and accessories (such as splices) can produce smoke and result in smoking manholes. If ignited, a manhole fire results. Under the right conditions, ignition can result in an explosion. The explosion causes a rapid air pressure rise in the manhole. If the pressure rise is sufficient, the manhole cover can lift to relieve the pressure. Under more severe conditions, the roof of the manhole may lift. Another safety concern relates to faults in oil-filled equipment, such as switches, cable terminal compartments, and transformers, which can rupture the enclosure and result in fire if filled with oil. Because this equipment is frequently in underground vaults with venting, fire and smoke emanate from the vault. Compartment faults typically result in tremendous amounts of energy delivered to the arc, producing pressures that rupture the compartment. These incidents have occurred around the country in the network systems operated by many utilities, and are an industry problem.²³⁵

103. The record also demonstrates that, while age is not the primary source of problems in PEPCO's underground distribution systems, the age of the system components can be a contributing factor in manhole incidents. The parties recognize that overloading will cause a cable failure, and a

²³² S&W's Report at 16, 34-37. See also PEPCO's S&W Comments at 2.

²³³ S&W's Report at 16.

²³⁴ *Id.*

²³⁵ *Id.* During its inspections of PEPCO's facilities S&W confirmed failures due to overloaded cables. See S&W's Report at 37, Figure 8, Overheated Secondary Cable Removed from Georgetown after Manhole Incident. Figure 8 depicts cable with damaged insulation due to excessive electric current without any indication of fire damage.

cable that has experienced deterioration, due to either age or adverse environmental conditions, will fail more readily, when overloaded, than a new cable.²³⁶

B. Issue 2: What is the current status of PEPCO's actions in response to manhole incidents, including PEPCO's actions in response to orders of the Commission issued in this proceeding?

1) Parties' Positions

104. According to OPC, the record demonstrates that PEPCO's response has been slow and, in some cases, inadequate, particularly in the areas of inspection record keeping, reporting, and failure analysis.²³⁷ OPC notes that PEPCO established a separate failure analysis group that was not fully functional at the time of its filing.²³⁸ Therefore, it is impossible for OPC to know whether PEPCO will properly implement its reliability analysis program. OPC strongly supports continuation of the manhole inspection process that has resulted in procedures by which all of PEPCO's 57,000 manholes will be inspected. OPC believes that PEPCO has refined its response time and prioritization of necessary repairs based on these inspections.²³⁹

105. OPC reiterates its reservation regarding PEPCO's use of slotted manhole covers, stating that the record does not support the use of such covers, and suggests that the Commission should restrict the use of such slotted manhole covers until the issue is further investigated.²⁴⁰ OPC asserts that there is no evidence that PEPCO tracks the effect of debris and otherwise monitors the adverse consequences of electing to install slotted manhole covers.²⁴¹ OPC also claims that it is reasonable to believe, based on the record developed in this proceeding, that PEPCO has been slow to develop and implement PILC cable replacement programs and that the installation of newer cable technologies at an earlier juncture could have reduced manhole incidents.²⁴²

106. PEPCO states that it has filed numerous reports during the course of this proceeding detailing its actions in response to the manhole incidents. Some of its remedial actions include the establishment of a centralized reliability services organization, the development of GIS in conjunction with the development of an OMS system, as well as actions taken in response to recommendations of

²³⁶ See *supra* ¶¶ 61-62.

²³⁷ OPC's Brief at 14-15.

²³⁸ *Id.* at 15.

²³⁹ *Id.*

²⁴⁰ *Id.* at 16.

²⁴¹ OPC's Reply Brief at 3.

²⁴² OPC's Brief at 16-17.

ABB and Stone & Webster.²⁴³ PEPCO further submits its comprehensive manhole inspection program as evidence of its remedial efforts in addressing the manhole incidents. PEPCO states that it has had a manhole inspection program for many years and that the program was expanded in scope in January 2000, and again in April 2000, to double the number of inspections per year to 10,000. PEPCO indicates that it will also make the changes recommended by Stone & Webster concerning priority codes and additional information to be included in the manhole reports.²⁴⁴

107. PEPCO claims that its use of slotted manhole covers is reasonable because it prevents the accumulation and ignition of combustible gases or minimizes the impact of manhole. PEPCO maintains that it will track the effect of dirt, debris, and other materials on its underground facilities over time as part of its ongoing trend analysis.²⁴⁵ PEPCO further asserts that in calendar year 2001, PEPCO and ABB jointly developed a load model for Georgetown, and also purchased the *EasyPower* program for modeling the remaining underground network systems. PEPCO states that it will evaluate Stone & Webster's recommended modeling schedule.²⁴⁶

108. Finally, PEPCO states that it established an internal task force in December 1999 to develop a long-term strategy for the continued use and ultimate replacement of PILC on its underground primary distribution system. PEPCO concedes that it has used EPR cable in the District of Columbia since the late 1970's, but asserts that there are several reasons why EPR could not be used in certain areas such as Georgetown. PEPCO claims that it has now developed a new splicing technique that can join PILC and EPR cables.²⁴⁷

2) Commission Decision

109. The Commission finds that PEPCO has satisfactorily implemented previous directives aimed at eliminating the occurrence of manhole incidents in the District of Columbia. The record is replete with status reports detailing the specific steps taken by PEPCO to address this problem. For example, the expanded manhole inspection program has been fully functional since 2000 and appears to be on the right track with the implementation of Stone & Webster's recommended enhancements. PEPCO has met the goal of 10,000 inspections per year, and the results have initiated proactive repairs and maintenance. With regard to slotted manhole covers, Stone & Webster examined the reasonableness of this decision and concluded that, based on the available data, PEPCO has followed a reasonable course of action. We agree with, and thereby adopt, Stone & Webster's finding regarding PEPCO's manhole inspection program. We direct PEPCO, moreover, to carefully monitor debris accumulation and conditions in manholes with slotted covers while it carries out its

²⁴³ PEPCO's Brief at 13-14.

²⁴⁴ *Id.* at 14-16.

²⁴⁵ *Id.* at 16-18.

²⁴⁶ *Id.* at 18-19.

²⁴⁷ *Id.* at 19-21.

inspections.

110. Consistent with Stone & Webster's recommendation, PEPCO has developed a load model to model the networks in Georgetown. PEPCO has also used the *EasyPower Program* for many months now. However, the current status of the secondary network load modeling is unclear because PEPCO has not been required to submit a periodic status report. Therefore, the Commission directs PEPCO to include the status of the load modeling effort in each of the forthcoming quarterly reports. The status report should list the specific set of secondary networks that have been completed, the set of networks where the modeling is in progress, a summary of the results, and the list of corrective actions planned and taken based upon the results.²⁴⁸

111. PEPCO also established a PILC task force to develop a long-term strategy for the continued use, and ultimate replacement of PILC in its underground primary cable system. PEPCO also established a failure analysis group. PEPCO represents that it has conducted failure analyses of all major systems events and other significant events in an efforts to determine the cause of equipment failures.²⁴⁹ The Commission directs PEPCO to file a report that summarizes the results of the failure analyses conducted for calendar year 2002, 30 days from the issuance date of this Report and Order, and subsequently, to file an annual report on the results of the failure analysis group.

112. We also find that PEPCO continues to apprise the Commission of the impact of its remedial strategies as required by our orders. PEPCO's calendar year 2002 manhole report provided information demonstrating that it had implemented all of ABB's recommendations, a progress report on EPR cable installation, and a quarterly report on manhole inspections.²⁵⁰ During 2002, there were a total of 39 reportable manhole events in the District of Columbia, compared to 62 events recorded in calendar year 2001.²⁵¹ PEPCO also reported that it had performed a total of 31,185 manhole inspections through 2002.²⁵² In its most recent quarterly report, PEPCO indicates that its PILC task force had completed its EPR cable strategy, and that based on an anticipated lead-time of six months for cable acquisition, the target date for full integration of the EPR cable has been set for May 2003.²⁵³ PEPCO is to include its final report on the EPR replacement program in the first quarter 2003 report

²⁴⁸ PEPCO represents that, of the 43 networks within the District of Columbia, it has completed modeling of 12 feeder groups from six different substations and that input of equipment configurations to the model has been completed for 28 network feeder groups. 2002 Manhole Report at 7.

²⁴⁹ 2002 Annual Manhole Report at 3.

²⁵⁰ See 2002 Manhole Report at 1.

²⁵¹ *Id.*

²⁵² *Id.* at 2.

²⁵³ See Formal Case No. 991, *In the Matter of the Investigation into Explosions Occurring In or Around the Underground Distribution Systems of the Potomac Electric Power Company*, Fourth Quarter 2002 Status Report of PEPCO in Response to Commission Order No. 12306, filed April 16, 2003, at 4.

to the PIWG. The culmination of these initiatives and the record taken as a whole demonstrate that PEPCO is committed to providing safe and reliable electric service to its District customers.

C. Issue 3: What is the condition of PEPCO's underground distribution system compared to industry standards and other objective criteria?

1) Parties' Positions

113. OPC criticizes PEPCO's historic operating and planning protocols and believes that the condition of portions of PEPCO's underground system can and should be significantly improved. OPC concedes, however, that PEPCO's most recent remediation actions are a marked improvement.²⁵⁴ PEPCO cites several references, such as the respective ABB and Stone & Webster reports, in supporting its position that PEPCO is above average, when compared to the electric industry as a whole, in how it designs, builds, and maintains its electrical distribution system.²⁵⁵

2) Commission Decision

114. The record supports the conclusion that PEPCO's planning, design, construction, operation, and maintenance of its systems are as good as and, in some respects, better than industry practices as evidenced by the findings in the ABB and Stone & Webster reports.²⁵⁶ The Commission finds that, with the exception of load-flow modeling, PEPCO has generally taken adequate remedial measures to address and mitigate the District's manhole situation. Stone & Webster's review found, and we agree, that the integrity of major components of the underground system is acceptable with the exception of sections in the Georgetown area, which are crowded and overloaded. However, the current condition of PEPCO's underground system, on a cable-by-cable basis, will not be known until the load-flow modeling is complete. The Commission has already directed PEPCO to file a detailed report of its modeling efforts and the results, within 30 days from the issuance of this report.²⁵⁷

D. Issue 4: What is the capability of the primary and secondary network system to carry peak load during normal and contingency situations?

1) Parties' Positions

115. While primary and secondary network systems appear capable of carrying peak loads in normal and contingency situations, OPC asserts that the record is clear that in some District areas

²⁵⁴ OPC's Brief at 17-18.

²⁵⁵ PEPCO's Brief at 21-23.

²⁵⁶ ABB Study at 2-3; S&W's Report at 53-54.

²⁵⁷ See *supra* ¶ 58.

peak load capability is not adequate.²⁵⁸ OPC attributes this to inadequacies in PEPCO's long-term overall strategic planning process.²⁵⁹ OPC contends that PEPCO now acknowledges this and secondary network load modeling, inspections, and GIS implementation should significantly improve PEPCO's capabilities.²⁶⁰

116. PEPCO states that its system planning organization applies detailed planning criteria to PEPCO's transmission and distribution (primary and secondary) systems to establish maximum loading on each circuit and piece of equipment, as well as to set the allowed operating contingencies during emergencies.²⁶¹ PEPCO asserts, therefore, that the primary system's ability to carry peak loads, during normal and contingency conditions, cannot be questioned.²⁶² PEPCO acknowledges that it is installing additional secondary cables in Georgetown to correct potential base case peak load overload conditions and that the Georgetown Project will correct peak overload conditions.²⁶³ PEPCO also maintains that OPC's criticism for not having a network system load model prior to 2000 is without merit and that it acted reasonably in searching for, and ultimately selecting, the *EasyPower* load model program.²⁶⁴

2) Commission Decision

117. The record remains incomplete in determining the capability of PEPCO's primary and secondary network system to carry peak load during normal and contingency situations. Reiterating Stone & Webster's findings, the real capability of PEPCO's underground system will not be known until the load-flow modeling is complete. Although we find that the primary and secondary systems have been designed according to sound engineering practices, PEPCO's actual in service capability is determined either by actual performance or by load-flow modeling. Until the load-flow modeling is complete, the network systems' capability will be determined either through the inspection of PEPCO's facilities or by the absence, or minimal occurrences of, failures and other manhole events. In Georgetown, the capability to handle first contingency peak overload conditions will not be available until the construction is complete.

²⁵⁸ OPC's Brief at 18.

²⁵⁹ *Id.*

²⁶⁰ *Id.* at 19.

²⁶¹ PEPCO's Brief at 23.

²⁶² PEPCO's Reply Brief at 22.

²⁶³ 2002 Annual Report at 6.

²⁶⁴ *Id.* at 23.

E. Issue 5: What is the current status of the Georgetown Project, including its expected impact on manhole incidents?

1) Parties' Positions

118. OPC claims there is insufficient critical information in the record, such as a capital budget and detailed design drawings to make conclusions with respect to the current status of the Georgetown Project.²⁶⁵ However, it concedes that, at least hypothetically, it expects a significant improvement in reliability as a result of the Georgetown Project, if PEPCO designs and installs a new distribution system that is properly structured to meet loads with ample room for expansion.²⁶⁶

119. PEPCO states it has filed a detailed description of the Georgetown modernization project in response to Commission Order No. 12036.²⁶⁷ PEPCO articulates its reasons for the modernization project including the fact that the Georgetown area has experienced two percent higher growth than the system average. Moreover, it alleges that the distribution system in Georgetown is fully used and new facilities are required to support additional growth.²⁶⁸

2) Commission Decision

120. Again, the Commission concludes that PEPCO has fully informed the Commission as to the status of the Georgetown modernization project. The Georgetown project is a major cable replacement and upgrade of PEPCO's distribution system. PEPCO's reports show that it is using the latest industry standards for manhole size, separation of primary and secondary systems, newer materials (e.g., EPR cable systems, PVC ducts, and URD technologies), and improved cable ratings.²⁶⁹ We also conclude that the project will eliminate the crowded manholes, separate primary from secondary cable circuits, thus reducing the probability of a secondary cable failure propagating into a primary circuit failure, reduce temperature buildup and improve heat dissipation, and make repairs easier in the event of future failures. PEPCO represents that based on ABB's load model, it was able to identify areas of the Georgetown network that projected overloading under peak conditions and that it took corrective action to provide cable capacity to eliminate the overload conditions with all six of the 13kV circuits in service in Georgetown.²⁷⁰ We will continue to monitor construction progress in Georgetown. Accordingly, PEPCO is to submit quarterly progress reports on the Georgetown project

²⁶⁵ OPC's Brief at 19

²⁶⁶ *Id.*

²⁶⁷ PEPCO's Brief at 24.

²⁶⁸ *Id.*

²⁶⁹ S&W's Report at 25.

²⁷⁰ 2002 Manhole Report at 6.

to the PIWG.

F. Issue 6: Is the Georgetown Project adequate for PEPCO's underground system to achieve standards for quality of service both within the target area, as well as outside of the target area in Georgetown, and in the rest of the District of Columbia?

1) Parties' Positions

121. OPC reiterates its contention that it has not been provided access to detailed plans for any phase of the Georgetown project and, therefore, the record is incomplete as to this issue.²⁷¹ Additionally, OPC is not aware of any specific benchmarks established by PEPCO for standards of quality inside or outside the Georgetown target area.²⁷²

122. PEPCO, citing the testimony of its witnesses Sim and Gausman, asserts that the Georgetown project will address the previously identified causes of the events in Georgetown.²⁷³ PEPCO also claims that its reliability programs extend to all areas of the District of Columbia and that it will use the same techniques that it used in Georgetown to determine whether infrastructure changes are necessary in areas outside of Georgetown.²⁷⁴ PEPCO reiterates its contention that it has provided substantial information concerning the Georgetown project as well as other infrastructure projects in its Comprehensive Plan. Further, in compliance with Order No. 12339, PEPCO alleges that it continues its research, discussion, and review of criteria and measures to identify and assess distribution productivity improvement projects, such as the Georgetown project, and that it reports its findings to PIWG, as directed by the Commission.²⁷⁵

2) Commission Decision

123. We are of the opinion that the Georgetown Project addresses the conditions found in the Georgetown area, and thereby should reduce the number of manhole events. PEPCO is directed to continue to work with the PIWG to establish system reliability indices and determine if it is useful to report these indices for the District of Columbia only, rather than for the entire PEPCO system. The Commission finds that the application of the same techniques used in Georgetown, as proposed by PEPCO, will assist in determining whether infrastructure changes are necessary outside of

²⁷¹ OPC's Brief at 20.

²⁷² *Id.*

²⁷³ PEPCO's Brief at 25-26.

²⁷⁴ *Id.*

²⁷⁵ PEPCO's Reply Brief at 26.

Georgetown.²⁷⁶

G. Issue 7: Do PEPCO's design, construction, operation and maintenance plans and practices conform with prudent utility practice and its obligation under D.C. Code § 34-1101?

1) Parties' Positions:

124. OPC alleges that many of PEPCO's former practices did not conform to prudent utility obligations as required by Section 34-1101 of the D.C. Code. OPC believes that PEPCO's new practices are more likely to conform to prudent utility practice depending on how PEPCO implements its plans and procedures over time.²⁷⁷ However, OPC disagrees that the replacement of solid manhole covers with slotted covers meets the D.C. Code's requirement of prudent utility practices, arguing that the slotted covers may increase manhole incidents and pose a potential security threat.²⁷⁸

125. PEPCO, again relying on the testimony of witnesses Sim and Gausman from the November 2001 hearings, avers that its design, construction, operation and maintenance plans, and practices conform to, or exceed, prudent industry practice as well as the obligations under Section 34-1101 of the D.C. Code.²⁷⁹ PEPCO cites to the ABB and Stone & Webster findings that PEPCO is above average when compared with other utilities, as evidence that it conforms to prudent utility practice and its obligations under the D.C. Code. PEPCO asserts that, in fact, in several respects, its practices exceed industry standards.²⁸⁰

2) Commission Decision

126. We conclude that PEPCO's planning, design, construction, operation and maintenance of its underground systems meet the requirements of Section 34-1101 of the D.C. Code. We affirm, and adopt as our own, Stone & Webster's finding that the integrity of major components of the underground system is acceptable with the exception of sections of the Georgetown area.²⁸¹ This finding generally considers the engineering design, construction, materials, operation, maintenance, and inspection practices used by PEPCO during the investigation. However, they do not include an examination of actual loading on facilities and equipment during normal or single contingency

²⁷⁶ PEPCO represents that it has developed an enhanced secondary load modeling capability to perform analyses of the networks outside of Georgetown to assure that all networks meet current design, and to evaluate the heating effects due to various cable and conduit arrangements and materials. *See* 2002 Annual Report at 6.

²⁷⁷ OPC's Brief at 21.

²⁷⁸ *Id.*

²⁷⁹ PEPCO's Brief at 27.

²⁸⁰ PEPCO's Reply Brief at 27.

²⁸¹ S&W's Report, § 5.

conditions because PEPCO has not yet completed development of the load-flow models needed to perform this analysis.

VIII. CONCLUSION

127. Upon review of the entire record before us, the Commission concludes that overloading is and remains a primary factor in cable and splice failures, which may ultimately lead to manhole smoking, fires, and explosions. In this regard, we adopt the findings of our consultant, Stone & Webster, and note that both PEPCO²⁸² and OPC²⁸³ generally agree that overloading is a primary factor in manhole explosions.²⁸⁴ The record developed in this proceeding clearly demonstrates that the possibility of these events cannot be completely eliminated.²⁸⁵ OPC urges the Commission to conclude that PEPCO's operating and planning procedures prior to the commencement of this case, were not sufficient to ensure safe and reliable electric service in the District.²⁸⁶ Further, OPC requests that we determine that PEPCO did not do all that it could to plan and maintain its underground distribution systems within the constructs of prudent utility practice.²⁸⁷ We disagree with OPC in light of the findings made by both ABB and Stone & Webster that PEPCO's planning, design, construction, operation and maintenance of its systems are as good as and, in some respects, better than industry practices.²⁸⁸ The Commission is persuaded by these findings that came from two separate sources and were not contradicted by any of the parties participating in this proceeding. The record is clear that PEPCO has taken, and continues to take, appropriate steps to ensure safe and reliable electric service to its District of Columbia customers.

128. Notwithstanding the above conclusion, the Commission agrees with OPC that the Commission must continue to scrutinize PEPCO's practices through periodic reporting requirements and by continuing to review any modifications to planning and operating protocols. To this end, PEPCO is directed to prepare a plan for implementing all the remedial and investigative actions mandated by the Commission, as a result of this investigation, as well as those undertaken by PEPCO's own initiative. The plan should contain, among other things, target dates for completing the remedial or investigative actions, reporting requirements for documenting and reporting the progress of implementing the plan, and methods for evaluating the impact of the remedial actions and the results of the investigative actions.

²⁸² See *supra* ¶ 40.

²⁸³ See *supra* ¶ 43.

²⁸⁴ S&W's Report 17-20.

²⁸⁵ See PEPCO'S Brief at 7.

²⁸⁶ OPC's Brief at 22.

²⁸⁷ *Id.*

²⁸⁸ S&W's Report at 7-8.

129. Moreover, to facilitate our continuing oversight responsibility, the Commission will use the PIWG as its on-going monitoring and oversight system to assure that the remedial actions are implemented in a timely manner. We also conclude that PEPCO has made a significant effort in preparing its Comprehensive Plan. The plan addresses the transmission system and overhead portions of the distribution system, as well as the District underground distribution system. Although PEPCO's plan is broader than the issues specifically under consideration in this case, we will require PEPCO to provide the additional information, as outlined above in paragraph 94.

130. In connection with future filings, PEPCO shall provide the parties notice of all subsequent filings to facilitate the Commission's review of PEPCO's compliance with the Commission's directives, and assessment of PEPCO's implementation of remedial steps outlined in this Report and Order. Finally, we emphasize that the Commission will not hesitate to use its enforcement authority to ensure that PEPCO's electrical services are provided in a manner that is consistent with Commission Orders and as required by law.²⁸⁹

²⁸⁹

See D.C. Code, 2001 Ed. §§ 34-301(2) and 34-1103.

THEREFORE, IT IS HEREBY ORDERED THAT:

131. PEPCO shall continue to comply with the Commission's earlier directives as outlined in Section IV of this Report and Order, and PEPCO shall prepare a plan for implementing all the remedial and investigative actions mandated by the Commission, as a result of this investigation, as well as those undertaken by PEPCO's own initiative. The plan should contain, among other things, target dates for completing the remedial or investigative actions, reporting requirements for documenting and reporting the progress of implementing the plan, and methods for evaluating the impact of the remedial actions and the results of the investigative actions;

132. PEPCO shall implement S&W's recommendations as directed in this Report and Order;

133. PEPCO shall carefully monitor debris accumulation and conditions in manholes with slotted covers, when responding to manhole incidents and during scheduled manhole inspections, and report its findings in its quarterly reports on manhole inspections and manhole incidents;

134. PEPCO shall continue its current pace of GIS implementation, and submit within three months of the issuance date of this Report and Order, a schedule for on-going and planned implementation, with major tasks, milestones, expected completion dates, costs, and plans for financing these programs including proposed amortization periods to the PIWG for review and tracking. Subsequently, PEPCO should submit quarterly progress reports to the PIWG;

135. PEPCO shall include light load (overvoltage) cases in its analytical modeling of its networks so as to determine the role, if any, of overvoltage in cable failures and resultant manhole incidents;

136. PEPCO shall file the status and quarterly reports on network load modeling with the PIWG as set forth in paragraph 58. The report shall list the specific set of secondary networks that have been completed, the set of networks where the modeling is in progress, a summary of the results, and the list of corrective actions planned and taken based upon the results;

137. In addition to submitting the results of the modeling of the Georgetown Project Design to the PIWG for review, PEPCO shall submit quarterly progress reports on the Georgetown Project to the PIWG;

138. PEPCO shall file a report that summarizes the results of the failure analyses conducted for calendar year 2002, 30 days from the issuance date of this Report and Order, and subsequently, to file an annual report on the results of the failure analysis group to the PIWG;

139. PEPCO shall file the additional information not included in its expurgated comprehensive plan as outlined below, within three months of the issuance date of this Report and Order:

- (a) Customer growth projections by District of Columbia wards (including historical comparisons);
- (b) Load growth projections encompassing commercial and residential development by District of Columbia wards (including historical comparisons);
- (c) Listing of underground distribution projects, such as the Adams-Morgan neighborhood project (including budgets, time schedules, and expected benefits) by secondary vs. primary system by District of Columbia wards affected, but not specific locations;
- (d) Listing of power delivery information system projects with implementation schedules, annual costs, and milestones;
- (e) Listing of new technology investigations with decisions, annual costs, and implementation schedules;
- (f) Targeted reliability indices (including historical comparisons); and
- (g) Manpower forecast for the power delivery organization (including historical comparisons).

The summary should cover a 10-year planning horizon while historical comparisons should provide at least five years of history.

140. PEPCO shall file an updated Comprehensive Plan annually with the Commission by February 15th of each year. The updated Plan shall contain, among other things, the progress of implementation during a preceding year, and amendments for subsequent years. This filing should be incorporated into the Productivity Improvement Plan ("PIP") annual filing in Formal Case No. 766, which is also required on February 15th of each year. In addition, PEPCO should file quarterly progress reports on the Plan implementation with the PIWG.

141. PEPCO is to develop a work force staffing analysis that includes a projection of work force requirements in the near term (over the next six months), mid-term (over the next six to 18 months), and long-term (18 months and beyond) from the date of issuance of this Report and Order,

as well as a hiring plan for meeting the projected staffing needs. PEPCO's proposal is to be submitted to the PIWG for its review within three months from the issuance date of this Report and Order; and

142. PEPCO is directed to work with the PIWG to develop target system reliability indices for the District of Columbia, only.

A TRUE COPY:

BY THE DIRECTION OF THE COMMISSION:

CHIEF CLERK


SANFORD M. SPEIGHT
ACTING COMMISSION SECRETARY