REPORT OF THE
STATE CORPORATION COMMISSION

Second Annual Report on the Pilot Program to Place Certain Transmission Lines Underground

TO THE GOVERNOR,
THE COMMISSION ON ELECTRIC UTILITY REGULATION, AND THE JOINT COMMISSION ON TECHNOLOGY AND SCIENCE

COMMONWEALTH OF VIRGINIA
RICHMOND
2009

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STATE CORPORATION COMMISSION

December 1, 2009

TO: The Honorable Timothy M. Kaine, Governor of Virginia
Commission on Electric Utility Regulation
Joint Commission on Technology and Science

The State Corporation Commission is pleased to submit its second annual report regarding progress on the pilot program to construct qualifying electric transmission lines underground, as required by Chapter 799 of the 2008 Acts of Assembly (House Bill 1319).

Respectfully submitted,

Mark C. Christie
Chairman

Judith Williams Jagdmann
Commissioner

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EXECUTIVE SUMMARY

House Bill 1319[1] ("HB 1319") of the 2008 Regular Session of the Virginia General Assembly (the "Act") established a pilot program to construct four qualifying electrical transmission lines of 230 kilovolts ("kV") or less in whole or in part underground.[2] Among other provisions, the Act established the criteria necessary for certain transmission line projects to qualify for the pilot program. In addition, the Act directed the State Corporation Commission ("SCC" or "Commission") to "report annually to the Commission on Electric Utility Restructuring,[3] the Joint Commission on Technology and Science, and the Governor on the progress of the pilot program by not later than December 1 of each year that this Act is in effect."

As of the date of this report, the Commission has approved two of Dominion Virginia Power's transmission line projects for inclusion in the HB 1319 pilot program: (1) a two-mile segment of the Pleasant View–Hamilton 230 kV transmission line previously approved as an overhead line and (2) the 0.71-mile Beaumeade–NIVO 230kV transmission line, both of which are located in Loudoun County.[4] Two more qualified transmission lines of 230 kV or less may be approved for inclusion in the pilot program from utility applications submitted before July 1, 2012.

The Commission will continue to file annual reports on December 1 of each year until the pilot program has been completed and will file a final report no later than December 1, 2012. While it is premature to evaluate the pilot program at this time, the final report will include an analysis of the entire pilot program and make recommendations about the continued placement of transmission lines underground in the Commonwealth of Virginia, as required by the Act.

Although the primary focus of this report is the HB 1319 pilot program, the report will also address two experimental underground transmission line projects not directly encompassed in HB 1319,[5,6] both of which were approved by the Commission prior to enactment of the Act. The Commission believes that all relevant experience gained from these two experimental projects should be considered in conjunction with the HB 1319 projects for making recommendations about the placement of transmission lines underground in the Commonwealth of Virginia.

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[1] Chapter 799 of the 2008 Acts of Assembly (see Appendix A).

[2] The Act specified one qualifying project and directed the State Corporation Commission to approve three additional qualifying projects.

[3] The Commission on Electric Utility Restructuring established pursuant to Chapter 885 of the Acts of Assembly of 2003, was continued, effective July 1, 2008, as the Commission on Electric Utility Regulation (§ 30-201 of the Code of Virginia).

[4] Appendix B provides the pilot status of all transmission line applications (230 kV or less) filed since the effective date of the Act, including those that did not qualify for the pilot program.

[5] The Commission approved the two experimental 230 kV underground projects to enable DVP to gain experience with cross-linked polyethylene ("XLPE") solid dielectric cable. These two experimental projects include the 2200-foot Clarendon-Ballston project in Arlington County and the 5.5-mile Garrisonville project in Stafford County (see Appendix C for additional details and Appendix D for construction updates and photographs).

[6] To date and unrelated to any pilot program, the Commission has approved approximately 35 miles of 230 kV transmission lines for underground construction that employ high-pressure fluid-filled ("HPFF") cable technology. These underground lines are located in various areas of DVP's service territory, including Alexandria, Arlington, Fairfax, and Norfolk. In most cases the lines were located underground in highly congested urban areas because overhead construction was not feasible.

I. BACKGROUND AND INTRODUCTION

A. Historical Background

The placement of electric transmission lines has long been a topic of intense public interest. While the vast majority of transmission lines in the United States have been constructed overhead, a small proportion of such lines have been located underground, including in Virginia. In recent years the feasibility of placing more lines underground has been a topic of interest within the Virginia General Assembly. In 2005, the Joint Commission on Technology and Science ("JCOTS")[7] first began to study the technological feasibility of burying transmission lines. In 2007 JCOTS created the Underground Transmission Lines Advisory Committee to produce a policy statement with possible legislative implications for 2008. As a result of their deliberations, JCOTS and its Transmission Lines Advisory Committee developed an outline for proposed legislation for a pilot program to study the construction of underground transmission lines.

B. Legislation Establishing the Pilot Program

By legislation enacted in 2008 (see Appendix A), the Virginia General Assembly established a pilot program to construct four qualifying electrical transmission lines of 230 kilovolts or less in whole or in part underground. The Act directed the SCC to "report annually to the Commission on Electric Utility Restructuring, the Joint Commission on Technology and Science, and the Governor on the progress of the pilot program by no later than December 1 of each year that this Act is in effect." In addition, the Act stated that the SCC "shall submit a final report to the Commission on Electric Utility Restructuring, the Joint Commission on Technology and Science, and Governor no later than December 1, 2012, analyzing the entire program and making recommendations about the continued placement of transmission lines underground in the Commonwealth."

Specifically, the Act directed the SCC to approve as a qualifying project, and part of the pilot program, an approximately 1.8-mile section of DVP's Pleasant View–Hamilton transmission line, which had been granted a certificate of public convenience and necessity for overhead construction by the SCC prior to the effective date of the Act, and three additional qualifying projects from among "applications submitted by public utilities for certificates of public convenience and necessity for the construction of electrical transmission lines of 230 kilovolts or less filed between the effective date of [the] Act and July 1, 2012." For purposes of the Act, a project shall be qualified to be placed underground, in whole or in part, if it meets all of the following criteria:

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[7] The JCOTS was created by the 1997 Virginia General Assembly as a permanent legislative commission to generally study all aspects of technology and science. Each year, the JCOTS identifies technological issues of interest, develops a work plan, and creates advisory committees to study those issues. Once the studies have been concluded, advisory committees issue their final reports and recommendations, including legislative proposals.

1. An engineering analysis demonstrates that it is technically feasible to place the proposed line, in whole or in part, underground;

2. The estimated additional cost of placing the proposed line, in whole or in part, underground does not exceed 2.5 times the cost of placing the same line overhead, assuming accepted industry standards for undergrounding to ensure safety and reliability. If the public utility, the affected localities, and the State Corporation Commission agree, a proposed underground line whose cost exceeds 2.5 times the cost of placing the line overhead may also be accepted into the pilot program; and

3. The governing body of each locality in which a portion of the proposed line will be placed underground indicates, by resolution, general community support for the line to be placed underground.

The Act also included language relative to (1) lines that might complete a network for qualifying projects that include only radial service, (2) lines that would need to be completed within a specific amount of time to facilitate an economic development agreement, (3) qualifying projects chosen pursuant to the Act but not fully recoverable as charges for new transmission facilities pursuant to subdivision A 4 of § 56-585.1 of the Code of Virginia, (4) the placement of existing or future overhead facilities in the same area or corridor as a pilot project, (5) a requirement that utilities must seek low-cost and effective means to improve the aesthetics of new overhead transmission lines and towers, and (6) the necessary documentation required in the event four applications meeting the requirements of the Act are not submitted to the SCC. Complete details can be found in the Act provided in Appendix A of this report.

II. HB 1319 PILOT PROJECT SELECTION PROCESS

A. Scope of SCC's Legislative Responsibilities

The Virginia General Assembly, through the legislative process, imparts certain responsibilities upon the SCC relative to the regulation of electric utility companies, including the certification of proposed electric transmission lines. The Commission's authority and responsibility with regard to the construction of new transmission lines is established by Title 56 of the Code of Virginia ("Code"), primarily by §§ 56-265.2[8] and 56-46.1. Specifically, § 56-265.2 of the Code requires public utilities to obtain a certificate of public convenience and necessity ("certificate" or "CPCN") from the Commission in order to construct facilities for use in public utility service.[9] Section 56-46.1 of the Code establishes certain procedural requirements and identifies specific factors to be considered in the approval process. Additionally, the Commission is

[8] Utilities Facilities Act

[9] This requirement is applicable to transmission lines not considered ordinary extensions or improvements in the usual course of business, including all transmission lines capable of carrying 138 kilovolts.

authorized to issue its own rules and regulations to facilitate the implementation of its statutory responsibilities. Furthermore, pursuant to the Act, the Commission has now been directed to select a number of qualifying transmission lines to be placed underground as part of a new pilot program in effect for the period 2008–2012.

B. Synopsis of the Transmission Line Application and Certification Process

A utility's application for a certificate to construct and operate a transmission line typically includes supporting written testimony for the certificate and a map and sketch of the applicant's preferred route, as well as other alternative routes that have been considered. The applications also include other information in accordance with the Staff's Guidelines of Minimum Requirements ("Guidelines"). The Guidelines request that the applicant address four major categories: (1) the necessity for the proposed project including estimated cost; (2) a description of the proposed project and alternatives considered; (3) the impact of the line on scenic, environmental, and historic features including impacts on residences and businesses; and (4) the health aspects associated with the electric and magnetic fields that will be generated by the proposed line.

Typically, after an application is filed, the Staff reviews the application for general content, the Commission enters an order for "notice and hearing", any intervening respondents file testimony, the Staff develops a report on the application, and a formal regulatory proceeding ensues in accordance with the SCC's Rules of Practice and Procedure. After a hearing, including public comment and expert testimony, and an opportunity to file post-hearing legal briefs or make oral arguments, the hearing examiner enters a report summarizing the evidentiary record and making recommendations. The applicant, respondents, and the Staff may file comments on the hearing examiner's report. Then, after reviewing the record in the case and post-hearing legal briefs, the Commission makes a decision and issues a final order and, if the proposed line is approved, a certificate for the line and route.

C. Outline of Pilot Project Selection Process

In accordance with the Act and in addition to reviewing an application for general content, need and routing, the Staff now analyzes the potential for any proposed transmission line of 230 kV or less to be constructed underground and included in the pilot program. As part of this determination, the Staff may request additional technical and cost analyses not already included in the utility's application. In its report on the application, the Staff will comment on whether or not the proposed transmission line potentially meets the criteria to be a qualified project in accordance with § 4 of the Act and recommend for or against inclusion of the transmission line in the pilot program. After the hearing, including public comment and expert testimony, the hearing examiner will enter a report summarizing the evidentiary record and making recommendations, including recommending for or against inclusion of the line in the pilot program. Finally, if the proposed transmission line is granted a certificate of public convenience and necessity, the Commission will also decide for or against inclusion of the line in the pilot program.

III. HB 1319 PILOT PROGRAM PROGRESS

A. Introduction

As previously stated, the Act established a pilot program to construct four qualifying electrical transmission lines of 230 kilovolts ("kV") or less in whole or in part underground. For the first pilot project, the Act directed the SCC to approve an approximately 1.8-mile section of DVP's Pleasant View–Hamilton 230 kV transmission line, which originally had been granted a certificate of public convenience and necessity ("CPCN") for overhead construction by the SCC prior to the effective date of the Act. In addition, the Act directed the SCC to approve three additional qualifying projects from among applications submitted by public utilities for the construction of electrical transmission lines of 230 kilovolts or less filed between the effective date of the Act and July 1, 2012.

From the effective date of the Act through November 1, 2009, the SCC had received nine applications from public utilities for CPCNs for the construction of electrical transmission lines of 230 kV or less. Delmarva Power & Light Company ("Delmarva") submitted one application and Appalachian Power Company ("APCo") submitted four applications for 138 kV *overhead* transmission lines. Virginia Power submitted two applications for *overhead* transmission lines and two applications for 230 kV *underground* transmission lines, one of which, in accordance with the Act, was for a portion of a transmission line previously approved by the SCC as an overhead line. Brief summaries of the two transmission line applications approved for the pilot program are provided below. The pilot status of all transmission line applications (230 kV or less) filed since the effective date of the Act, including those that did not qualify for the pilot program, are provided in Appendix B.

B. Transmission Lines Approved for the Pilot Program

From the effective date of the Act through November 1, 2009, Virginia Power filed two applications for approval and issuance of CPCNs to construct and operate the following 230 kV transmission lines as HB 1319 pilot projects:

- Pleasant View–Hamilton: 1.8-mile underground segment, 230 kV cross-linked polyethylene ("XLPE")[10] cable, mostly on the W&OD Trail in Loudoun County (modified requests in SCC Case Numbers PUE-2008-00027 and PUE-2008-00042). The Commission approved the request in accordance with the Act on May 28, 2008. The project is on schedule to energize the line in the fall of 2010.

[10] Although the dominant underground transmission line technology in the United States for decades has been high-pressure fluid-filled ("HPFF") pipe, XLPE is considered by some as an emerging technology that is gaining in popularity and use at certain voltages. XLPE cable is often referred to as "extruded" cable, because of the method used to apply the solid polyethylene insulation to the electrical conductor. Cost is often noted as an advantage of XLPE over HPFF.

- DVP Beaumeade–NIVO: 0.71-mile, 230 kV XLPE underground transmission cable in Loudoun County. DVP requested the line be included as an HB 1319 pilot project and the Loudoun County Board of Supervisors approved a resolution on September 2, 2008, indicating general community support for the lines to be placed underground. The Commission approved the request in accordance with the Act on January 26, 2009 (Case Number PUE-2008-00063).[11] An in-service date of April 2010 is anticipated.

Summaries of two other approved, but separate from HB 1319, experimental underground transmission projects are provided in Appendix C.

IV. CONCLUSIONS

The SCC has initiated a pilot program to construct four qualifying electrical transmission lines of 230 kV or less in whole or in part underground as required by the Act. This report primarily addresses the status of nine transmission lines that either have been or are being evaluated for inclusion in the pilot program. The nine transmission lines are identified in Appendix B.

As of the date of this report, two transmission lines have been approved for inclusion in the pilot program. As required by the Act, two more qualified transmission lines may be approved for inclusion in the pilot program by 2012. Separate from the Act, the Commission has also approved the construction of two other experimental underground transmission line projects.

Experience gained from these projects will provide insights for evaluating the potential efficacy of placing transmission lines underground. Although construction of these projects is incomplete, it appears at this early stage that underground construction costs may be highly variable and project dependent, particularly with respect to topography and soil conditions.

A summary of the estimated costs for these experimental and pilot projects, as well as comparisons with overhead cost estimates, is provided in Table 1. In addition, attached as Appendix D to this report is an evaluation from Virginia Power that presents

[11] The SCC hearing was convened on January 26, 2009, and the Commission issued its Final Order on May 29, 2009. In its Final Order, the Commission noted that if the cost to ratepayers were the overriding concern in this proceeding, the proposed transmission line would be constructed overhead at a total cost of $7.9 million. However, Dominion proposed to install the line as an underground pilot project pursuant to HB 1319. The Staff examined the proposed project under HB 1319, and recommended that the project might qualify as a pilot project, and that it would provide Dominion with additional experience regarding use of XLPE cable. The Hearing Examiner concluded that (1) it is technically feasible to construct the line underground; (2) the cost of installing the underground line is 1.3 times the cost of installing an overhead line; and (3) the governing body of Loudoun County has expressed its support for undergrounding the line. The Commission agreed with the Hearing Examiner that the Company's proposal complied with the requirements of HB 1319, and approved construction of the line underground as a pilot project.

a more detailed synopsis and construction photographs of DVP's underground transmission projects.

The Commission will continue to file annual reports on December 1 of each year until the pilot program has been completed and will file a final report no later than December 1, 2012. The final report will include an analysis of the entire pilot program and make recommendations about the continued placement of transmission lines underground in the Commonwealth.

Table 1. Cost Estimates for Experimental and HB 1319 Pilot Underground ("UG") Transmission Projects and Comparisons with Overhead ("OH") Estimates

Project	**Length (miles)**	**Estimated OH Cost**		**Estimated UG or Hybrid Cost**		**Ratio of UG to OH Costs**
		Project	Line Mileage	Project	Line Mileage	Mileage Basis
HB 1319 (2008) Pilot Program for Underground Transmission Projects						
Pleasant View–Hamilton	10 OH/ 2 UG	$69.6 million	$7 million per mile	$106.4 million (69.6 OH + 36.8 UG)	$14.2 million per mile (UG section)	2.0
Beaumeade–NIVO	0.71	$7.9 million	$4.2 million per mile	$11.1 million	$8.6 million per mile	2.0
Experimental Underground Projects Unrelated to the Pilot Program						
Clarendon–Ballston	0.42	N/A	N/A	$15 million	$9.5 million per mile	N/A
Garrisonville	11	$14.76 million	$0.9 million per mile	$120 million	$9.8 million per mile	10.8

Table 1 Notes:

1. Total project costs include transmission work at substations, transition station costs for hybrid lines, and land acquisition costs (if applicable). Project costs do not include distribution work at substations.
2. Line mileage costs do not include transition stations or transmission work at substations, which could distort the mileage cost for short underground segments. DVP estimates the cost per mile for Pleasant View-Hamilton would have been $2 million higher but for the fact that the company already owned the land on the W&OD Trail.
3. The OH estimate for Garrisonville assumes $10 million (2006) for overhead line construction and $4.76 million to construct the Garrisonville switching station. DVP reportedly indicated a willingness to mitigate visual impacts by using galvanized steel monopoles and routing the line down the center of the right of way, which would have changed the original estimate submitted with the application for the line from $9.4 million to $10 million (Hearing Examiner's Report, PUE-2006-00091, p.50).
4. DVP did not analyze an overhead option for Clarendon– Ballston.
5. The breakdown of underground project costs is provided as follows:
    a) Pleasant View–Hamilton: $36.8 million total includes $5.7 million for transmission work at Hamilton substation and $2.8 million for terminal stations and land.
    b) Beaumeade–Nivo: $11.1 million total includes $4.9 million in substation transmission work
    c) Clarendon–Ballston: $15 million total includes $11 million in substation transmission work
    d) Garrisonville: $120 million includes $11.9 million in substation transmission work

APPENDIX A: HOUSE BILL 1319
(CHAPTER 799 OF THE 2008 ACTS OF ASSEMBLY)

CHAPTER 799

An Act to establish a pilot program to place certain transmission lines underground.

[H 1319]

Approved April 2, 2008

Be it enacted by the General Assembly of Virginia:

1. *§ 1. There is hereby established a pilot program to construct qualifying electrical transmission lines of 230 kilovolts or less in whole or in part underground. Such pilot program shall consist of a total of four qualifying electrical transmission line projects, constructed in whole or in part underground, as set forth in this act.*

§ 2. A. Notwithstanding any other law to the contrary, as a part of the pilot program established pursuant to this act, the State Corporation Commission shall approve as a qualifying project a transmission line of 230 kilovolts or less that has received a certificate of public convenience and necessity from the State Corporation Commission prior to the effective date of this act that approved construction of an electrical transmission line in a right of way located upon land owned by a regional park authority used by the general public for park and recreation purposes, provided that the construction of such electrical transmission line has not commenced prior to the effective date of this act. The project shall be constructed in part underground, and the underground portion shall consist of a double circuit.

The State Corporation Commission shall approve such underground construction within 30 days of receipt of the written request of the public utility to participate in the pilot program pursuant to this section. The Commission shall not require the submission of additional technical and cost analyses as a condition of its approval, but may request such analyses for its review. The Commission shall approve the underground construction of one contiguous segment of the transmission line that is approximately 1.8 miles in length that was previously approved for construction upon or immediately adjacent to the right of way of the regional park authority, provided that the underground construction shall be located within the boundaries of such existing right of way upon the land owned by the regional park authority, excluding any substation or transition locations which may be required as a part thereof. The Commission shall make a finding establishing the termini of the underground portion of the line. The remainder of the construction for the previously approved transmission line shall be aboveground pursuant to the terms of the certificate of public convenience and necessity. The Commission shall not be required to perform any further analysis as to the impacts of this route, including environmental impacts or impacts upon historical resources.

The approval for constructing the above-described portion of the previously approved electrical transmission line as a double circuit underground shall not impair or delay the implementation of the certificate of public convenience and necessity and no further notice, testimony, or hearings shall be required in connection with such approval. The electric utility may proceed to acquire right of way and take such other actions as it deems appropriate in furtherance of the construction of the approved transmission line, including acquiring the cables necessary for the underground installation. Approval of a

transmission line pursuant to this section for inclusion in the pilot program shall be deemed to satisfy the requirements of § 15.2-2232 and local zoning ordinances with respect to such transmission line and any substations or transition locations that may be required.

B. If the qualifying project approved in subsection A provides only radial, rather than networked, electric service, there shall be a presumption of need in applications filed for a certificate of public convenience and necessity for electrical transmission lines that will complete the network for such qualifying project. The State Corporation Commission shall give priority on its docket for any such application of a public utility. Upon written request of the public utility for participation in the pilot program pursuant to this section, the Commission shall approve the construction of such additional network facilities in whole or in part underground, and such additional network facilities shall be considered a qualifying project for purposes of this act. The Commission shall not require the submission of additional technical and cost analyses as a condition of such approval, but may request such analyses for its review.

§ 3. In reviewing applications submitted by public utilities for certificates of public convenience and necessity for the construction of electrical transmission lines of 230 kilovolts or less filed between the effective date of this act and July 1, 2012, the State Corporation Commission shall approve three applications for qualifying projects to be constructed in whole or in part underground, as a part of the pilot program. The three qualifying projects shall be in addition to the qualifying project described in subsection A of § 2. If a public utility submits an application for a certificate of public convenience and necessity for an electrical transmission line that completes the network for a qualifying project as set forth in subsection B of § 2, the approval of such application shall constitute one of the three additional projects to be approved pursuant to this section.

§ 4. For purposes of this act, a project shall be qualified to be placed underground, in whole or in part, if it meets all of the following criteria:

1. An engineering analysis demonstrates that it is technically feasible to place the proposed line, in whole or in part, underground;

2. The estimated additional cost of placing the proposed line, in whole or in part, underground does not exceed 2.5 times the cost of placing the same line overhead, assuming accepted industry standards for undergrounding to ensure safety and reliability. If the public utility, the affected localities, and the State Corporation Commission agree, a proposed underground line whose cost exceeds 2.5 times the cost of placing the line overhead may also be accepted into the pilot program; and

3. The governing body of each locality in which a portion of the proposed line will be placed underground indicates, by resolution, general community support for the line to be placed underground.

§ 5. A. If the State Corporation Commission identifies an application as a potentially qualified project for purposes of the pilot program, the Commission shall request that the

public utility provide technical and cost analyses for placing the proposed line overhead and for placing the proposed line, in whole or in part, underground.

B. If any application relates to the construction of a proposed line to meet a specific and identifiable industry's needs, and the project must be completed by the public utility within a specific amount of time to facilitate an economic development agreement, then such application need not include the two analyses, so long as the public utility provides documentation regarding the economic development agreement.

§ 6. The State Corporation Commission shall report annually to the Commission on Electric Utility Restructuring, the Joint Commission on Technology and Science, and the Governor on the progress of the pilot program by no later than December 1 of each year that this act is in effect. The State Corporation Commission shall submit a final report to the Commission on Electric Utility Restructuring, the Joint Commission on Technology and Science, and the Governor no later than December 1, 2012, analyzing the entire program and making recommendations about the continued placement of transmission lines underground in the Commonwealth.

§ 7. For any qualifying project chosen pursuant to this act (regardless of whether such project is chosen pursuant to § 2 or 3) and not fully recoverable as charges for new transmission facilities pursuant to subdivision A 4 of § 56-585.1, the State Corporation Commission shall approve a rate adjustment clause. The rate adjustment clause shall provide for the full and timely recovery of any portion of the cost of such project not recoverable under applicable rates, terms, and conditions approved by the Federal Energy Regulatory Commission and shall include the use of the fair return on common equity most recently approved in a Commission proceeding for such utility, as defined by subsection A of § 56-585.1. Such costs shall be entirely assigned to the utility's Virginia jurisdictional customers. The Commission's final order regarding any petition filed pursuant to this subsection shall be entered not more than three months after the filing of such petition.

§ 8. If a transmission line is included in the pilot program pursuant to § 3 that includes only radial, rather than networked, electric service, there shall be a presumption of need in applications for a certificate of public convenience and necessity for electrical transmission lines that will complete the network for such qualifying project. The State Corporation Commission shall give priority on its docket for any such application of a public utility.

§ 9. Approval of a proposed transmission line for inclusion in this program shall not preclude the placing of existing or future overhead facilities in the same area or corridor by other transmission projects.

§ 10. Public utility companies granted a certificate of public convenience and necessity for a proposed transmission line not included in this program or not otherwise being placed underground shall seek to implement low-cost and effective means to improve the aesthetics of new overhead transmission lines and towers.

§ 11. The provisions of this act shall not be construed to limit the ability of the State Corporation Commission to approve additional applications for placement of transmission lines underground.

§ 12. If four applications are not submitted to the State Corporation Commission that meet the requirements of this act, the State Corporation Commission shall document the failure of the projects to qualify for the pilot program in order to justify approving fewer than four projects to be placed underground, in whole or in part.

§ 13. Insofar as the provisions of this act are inconsistent with the provisions of any other law or local ordinance, the provisions of this act shall be controlling.

2. That an emergency exists and this act is in force from its passage.

Legislative Information System

APPENDIX B:
PILOT STATUS OF TRANSMISSION LINE APPLICATIONS (230 KV OR LESS)

This Appendix provides the pilot status for all transmission line applications of 230 kV or less submitted since the effective date of the Act, including those that either did not qualify for the program or have yet to be evaluated. From the effective date of the Act through November 1, 2009, the SCC had received nine applications from public utilities for certificates of public convenience and necessity for the construction of electrical transmission lines of 230 kV or less. Delmarva Power & Light Company ("Delmarva") submitted one application and Appalachian Power Company ("APCo") submitted four applications for 138 kV *overhead* transmission lines. Virginia Power submitted two applications for *overhead* transmission lines and two applications for 230 kV *underground* transmission lines, one of which, in accordance with the Act, was for a portion of a transmission line previously approved by the SCC as an overhead line. Brief summaries of these transmission line applications are provided below. Table 2 also summarizes the extent to which each transmission line meets the criteria necessary to qualify for the pilot program, as well as the pilot status of each line.

Virginia Power Transmission Lines

From the effective date of the Act through November 1, 2009, Virginia Power filed four applications for approval and issuance of certificates of public convenience and necessity to construct and operate the following 230 kV transmission lines:

- Pleasant View–Hamilton: 1.8-mile underground segment, 230 kV cross-linked polyethylene ("XLPE") cable, mostly on the W&OD Trail in Loudoun County (modified request in SCC Case Nos. PUE-2008-00027 and PUE-2008-00042). The Commission approved the request in accordance with the Act on May 28, 2008. The project is on schedule to energize the line in the fall of 2010.

- DVP Beaumeade–NIVO: 0.71-mile, 230 kV XLPE underground transmission cable in Loudoun County. DVP requested the line be included as an HB 1319 pilot project and the Loudoun County Board of Supervisors approved a resolution on September 2, 2008, indicating general community support for the lines to be placed underground. The Commission approved the request in accordance with the Act on January 26, 2009 (Case Number PUE-2008-00063). An in-service date of April 2010 is anticipated.

- Hayes–Yorktown: 8-mile, 230 kV overhead/underground hybrid transmission line in York and Gloucester Counties. HPFF underground construction is being proposed for 3.8 miles in order to cross the York River. The line is expected to be in service by June 1, 2012. The Commission has yet to determine whether this is a qualified underground pilot project relative to HB 1319. The SCC hearing has been scheduled for February 9, 2010(Case Number PUE-2009-00049).

- Remington CT–Gainesville: 25-mile, 230 kV overhead transmission line in Fauquier and Prince William Counties. The line is expected to be in service May 1, 2012, and, as proposed, would be located on structures to be constructed for the new Meadowbrook-Loudoun 500 kV transmission line approved in Case Number

PUE-2007-00031. The Commission has yet to determine whether this is a qualified underground pilot project relative to HB 1319. The SCC hearing has been scheduled for December 15, 2009 (Case Number PUE-2009-00050).

APCo Transmission Lines

From the effective date of the Act through November 1, 2009, APCo filed four applications for approval and issuance of certificates of public convenience and necessity to construct and operate the following 138 kV transmission lines:

- Sunscape: 1.4-mile, double-circuit 138 kV overhead transmission line in an urbanized area of southwestern Roanoke County (SCC Case Number PUE-2008-00053).

- Matt Funk: 4.5-mile, double-circuit 138 kV overhead transmission line in southwestern Roanoke County (Case Number PUE-2008-00079).

- Huntington Court–Roanoke: 6-mile, double-circuit 138 kV overhead transmission line in the Roanoke area (Case Number PUE-2008-00096).

- Lockhart Extension: 138 kV transmission line and associated substation in Dickenson County, Virginia (Case Number PUE-2008-00116).

The Commission approved three of APCo's projects for overhead construction (a final order for Huntington Court–Roanoke had not been issued as of the date of this report). APCo did not request that any of the above proposed projects be considered as HB 1319 underground pilot projects. The Commission Staff, after reviewing the applications, recommended that constructing the proposed transmission lines underground would not be reasonable. The governing localities did not indicate, by resolution, general community support for the lines to be placed underground. After convening evidentiary hearings, including public comment and expert testimony, and reviewing the hearing examiners' reports summarizing the evidentiary record, the Commission did not identify APCo's applications for Sunscape, Matt Funk or Lockhart as potentially qualified projects for purposes of the pilot program.

Delmarva Transmission Line

From the effective date of the Act through November 1, 2009, Delmarva filed one application for approval and issuance of a certificate of public convenience and necessity to construct and operate the following 138 kV transmission line:

- Oak Hall–Wattsville: four-mile, 138 kV overhead transmission line in Accomack County. Delmarva proposes to install the line adjacent to an existing 69 kV line and operate both lines as a double circuit. Existing wooden poles would be replaced with taller steel poles. The Commission has yet to determine whether

this is a qualified underground pilot project relative to HB 1319. The SCC hearing has been scheduled for March 23, 2010 (Case Number PUE-2009-00106).

Table 2. Pilot Status of Transmission Line Applications (230 kV or Less)

TRANS. LINE / SCC CASE No.	FEASIBILITY TEST	COST TEST*	RESOLUTION BY LOCALITY	PILOT STATUS
Dominion Virginia Power 230 kV Transmission Lines				
Pleasant View–Hamilton PUE-2008-00027 Filed 4/21/2008	Technically Feasible	Not Applicable	Not Applicable	Required by Act
Beaumeade–NIVO PUE-2008-00063 Filed 7/21/2008	Technically Feasible	1.4 times the cost of OH for the total project	Approved 9/2/2008	Requested by DVP; Approved by SCC
Hayes–Yorktown PUE-2009-00049 Filed July 1, 2009	To be determined	To be determined	To be determined	To be determined
Remington CT–Gainesville PUE-2009-00050 Filed June 15, 2009	To be determined	To be determined	To be determined	To be determined
APCo 138 kV Transmission Lines				
Sunscape PUE-2008-00053 Filed 6/20/2008	Detailed UG engineering analysis not completed	3 times the cost of OH for undergrounding the total route	None Filed	Did not qualify
Matt Funk PUE-2008-00079 Filed 8/18/2008	Detailed UG engineering analysis not completed	Cost analysis not completed	None Filed	Did not qualify
Huntington Court–Roanoke PUE-2008-00096 Filed 10/10/2008	To be determined	To be determined	None Filed	To be determined
Lockhart Extension PUE-2008-00116 Filed 12/19/2008	Detailed UG engineering analysis not completed	Cost analysis not completed	None Filed	Did not qualify
Delmarva 138 kV Transmission Line				
Oak Hall–Wattsville PUE-2009-00106 Filed 9/24/09	To be determined	To be determined	None Filed	To be determined

* The estimated cost should be less than 2.5 times the cost of overhead unless otherwise agreed to by the public utility, the affected localities, and the State Corporation Commission.

APPENDIX C:
EXPERIMENTAL UNDERGROUND TRANSMISSION LINE PROJECTS SEPARATE FROM THE HB 1319 PILOT PROGRAM

This Appendix provides a summary of two experimental underground transmission line projects not encompassed in Chapter 799 of the 2008 Acts of Assembly (HB 1319). These are included in this report for the purpose of aggregating and tracking all ongoing underground transmission line pilot projects in one document. The experience gained from these two projects, in addition to the HB 1319 pilot projects, should be useful in making recommendations about the continued placement of transmission lines underground in the Commonwealth. A summary of these two projects is included in Table 3.

Clarendon-Ballston 230 kV Transmission Line

On February 2, 2007, Virginia Power filed its application with the SCC for the 2200-foot Clarendon-Ballston 230 kV transmission line in Arlington County. The utility proposed the construction of the line under streets in the highly urbanized area because there was no practical overhead route for the line.

In addition, the utility proposed the use of a different underground construction technology, XLPE, than in past projects. Previous underground transmission projects in urban areas employed high pressure fluid-filled ("HPFF") cable. Virginia Power argued that the proposed facility would provide the utility an opportunity to gain experience with XLPE lines operating at 230 kV. The utility noted that any failures could be managed with limited service disruption since the proposed facility would be located in an urban area with significant transmission facilities already in place. The utility also noted that the cost of underground urban construction for an XLPE line is reasonably comparable to HPFF construction.

The Commission approved the line by its Final Order of May 25, 2007, in Case Number PUE-2006-00082. In approving the line, the Commission commended DVP's decision to use a different technology for the project and encouraged the utility to investigate and employ new technologies while also considering the reliability of its system and financial impact on all ratepayers. The Commission also directed the utility to inform the Commission's Division of Energy Regulation of the progress of this installation and to provide information on cost, engineering, construction, and future operation.

In its application, DVP noted that the estimated cost of the proposed underground 230 kV transmission line was $4 million. This correlates to approximately $9.6 million per mile equivalent. The 230 kV work at the substations was expected to cost an additional $11 million for work at the substations. The utility did not perform comparable cost estimates for either HPFF technology or overhead construction. The utility also expected construction to require nine months, with an anticipated completion date of May 2008; however, as of the date of this report, the completion date was extended to December of 2009 primarily due to unforeseen difficulty in obtaining local permits.

Garrisonville 230 kV Transmission Line

On August 30, 2006, Virginia Power filed its application with the SCC for the five-mile Garrisonville 230 kV overhead transmission line in Stafford County. On February 27, 2007, DVP filed a Motion for Leave to File Underground Alternative Supplement. The utility attached to its Motion an Underground Alternative Supplement which presented the underground alternative as part of the utility's direct case to be considered along with its other proposals.[12]

To address the cost and visual impact issues, the utility proposed treating the Garrisonville project as an underground XLPE pilot project, which would allow the cost to be recovered through the ratemaking process. The utility stated that the prospect of gaining further experience and familiarity with the construction, operation and performance of XLPE technology through a much larger underground project could justify incurring the additional cost of underground construction and recovering it from the broad range of the utility's customers. According to the utility, apportioning the costs across the utility's entire rate base would add approximately 10 cents to every Dominion residential customer's monthly bill. On a percentage basis, bills would increase approximately one-tenth of one percent.

The Commission approved the underground line by its Final Order of April 8, 2008, in Case Number PUE-2006-00091. In approving the line, the Commission emphasized that their approval of this project as an underground pilot project, and the rate treatment afforded thereto, in no way established a precedent for future transmission lines, either in the subject right-of-way or elsewhere.

Virginia Power originally estimated the cost of the proposed 230 kV underground transmission line to be $70.4 million. This correlates to approximately $14 million per mile. The 230 kV substation work was expected to cost an additional $11.9 million, for a total project cost of $82.3 million. The total cost for the overhead alternative was estimated to be $14.16 million, a $68.14 million difference. Thus, the underground option was expected to cost approximately six times the cost of the overhead alternative. The utility also expected preconstruction activities and construction to require a total of

[12] The preferred underground alternative ("Option 1") will consist of two transmission circuits and be constructed with a spare conduit to add an additional cable in the event the rating needs to be increased in the future. Constructing two underground double circuits will assure that service to Garrisonville Switching Substation would be maintained in the event of a fault on the new line and will provide transfer capability and redundancy equivalent to the proposed overhead line. From a transmission planning perspective, Option 1 of the underground alternative provides an electrically acceptable alternative to the proposed overhead line. Option 1 would assure continued service to Garrisonville substation, at a higher cost, by providing transfer capability and redundancy equal to the proposed double circuit overhead line configuration. In the event of an extended outage on one underground circuit, the Garrisonville station could continue to receive service from the other until the outage is repaired. The Utility recommended against using an underground alternative that consisted of only 1 circuit ("Option 2") built in a radial configuration. Although less expensive at $48.44 million (still 3.4 times the overhead alternative), Option 2 would have been less reliable.

thirty-six months,[13] with an anticipated completion date of June 2009. The overhead alternative was expected to require twenty-four months, including six months for preconstruction and eighteen months for construction. The target date is now 2010.

Adverse soil conditions, large amounts of rock in the right-of-way, unfavorable topography, and interstate road crossings have resulted in significant increases in the cost estimates for this project. As opposed to conventional trenching, these difficult conditions necessitate directional drilling to depths in the range of sixty to seventy feet. Additional costs shall also be incurred for larger gauge cable due to poorer thermal dissipation at such depths. The latest cost estimate is $120 million ($11 million per mile *excluding* land acquisition costs) or approximately eight times the project cost using overhead construction.

Table 3. DVP Experimental Transmission Line Projects Separate From HB 1319

PROJECT	**LENGTH/ EST. COST**	**CONSTRUCTION STATUS**	**APPLICATION**
Clarendon – Ballston 230 kV (Arlington County) PUE-2006-00082 Filed: 2/2/2007 Approved: 5/25/2007	2,200 feet $15 million for 230 kV work (incl. $11 million for substation)	Under construction; expected completion date of December 2009	Initiated by DVP, approved by Commission (OH option not feasible, and to gain experience with XLPE technology)
Garrisonville 230 kV (Stafford County) PUE-2006-00091 Filed: 8/30/2006 Approved: 4/8/2008	11 miles[14] $120 million (incl. $7 million for substation work)	Under construction; expected completion date of May 2010	Initiated by DVP, approved by Commission (to gain experience with XLPE technology on a longer project)

[13] Eighteen months for preconstruction activities (acquiring underground rights and clearing right-of-way) and eighteen months for construction.

[14] DVP notes that the new underground transmission line is effectively eleven miles long when considering it is a networked transmission line. The line will run approximately 5.5 miles from the existing "252 Line" into Garrisonville substation and then approximately 5.5 miles back to the 252 Line along the same 5.5 mile right of way but creating two distinct 5.5-mile double-circuit underground paths.

APPENDIX D:
DOMINION VIRGINIA POWER REPORT TO THE SCC

Underground Transmission Line Projects Update

October 29

2009

This report presents a synopsis of Dominion Virginia Power's underground transmission line projects .

HB 1319

R. Matthew Gardner, Ph.D.
Electric Transmission Planning and Marketing
Dominion Virginia Power

Table of Contents

Introduction

This report presents an overview of Dominion Virginia Power's ongoing underground transmission line projects. Projects both directly related to House Bill 1319 and others not related to HB1319 are included for the purpose of gaining a complete perspective on Dominion's latest experiences with the design and construction of underground transmission lines.

House Bill 1319 Pilot Program Progress - Dominion Projects

Pleasant View—Hamilton 230 kV Transmission Line

On April 14, 2005 in Case Number PUE-2005-00018, Dominion Virginia Power (DVP) filed with the Virginia State Corporation Commission (hereafter referred to as "the Commission") an application for approval and certification of electric transmission facilities in Loudoun County, Virginia consisting of a new overhead 230 kV single circuit transmission line from the Company's existing Pleasant View Substation to a new 230 kV-34.5 kV substation to be constructed at a location east of the Town of Purcellville ("Hamilton Substation") and the Hamilton Substation. On February 15, 2008, the Commission issued a Final Order in Case No. PUE-2005-00018 approving the proposed overhead transmission facilities along a route identified in that proceeding as the "Modified D Route." The Modified D Route is located, in part, on or adjacent to existing Company right-of-way along the W&OD Trail Park, which is owned by the Northern Virginia Regional Park Authority and used by the general public for park and recreational purposes ("W&OD Trail").

On April 21, 2008 pursuant to § 2.A of HB 1319 (2008), DVP requested to participate in the pilot project for the construction of underground 230 kV transmission facilities for a portion of the transmission line previously approved by the Commission in Case No. PUE-2005-00018, and sought approval to construct such underground transmission facilities, including associated terminal stations. In accordance with HB 1319 §2.A and to mitigate concerns over the visual impact of overhead lines on the W&OD Trail, the Company proposed to construct underground an approximately 1.7-mile section of the previously approved overhead Pleasant View – Hamilton transmission line. In order to transition from the overhead line to the underground cables, two terminal stations will be constructed proximate to the W&OD Trail. The proposed Underground Transmission Line will be located entirely within existing, Company-owned right-of-way along the W&OD Trail, except for the short distances where the underground line will enter the two terminal stations. This Pilot Project requires the purchase of land on which to construct the two terminal stations (approximately 1.2 acres for the fenced area of each terminal station, plus additional acreage for screening) and the acquisition of a new 40-foot wide right-of-way between the terminal stations and W&OD Trail.

On May 6, 2008 the Commission approved the request to place 1.8 miles (the original 1.7 miles along the Trail plus the incremental sections to connect to the transition stations) of the line underground as a part of HB 1319. On May 21, 2008, as a result of cooperation with local residents and officials to further

minimize the potential impacts of the line on private property, DVP proposed a Modified Request to move the North terminal station further from the Trail. This resulted in a revised total underground section of approximately 2 miles in length.. On May 28, 2008, the Commission approved the Modified Request.

Construction of the overhead sections of the Pilot Project is underway. Construction of the underground sections will begin in late 2009 or early 2010 The total capacity of the line is 1047 MVA in order to provide network transfer capability equivalent to the previously approved overhead line and redundancy in the event of an outage on one of the underground cables comprising the underground circuit. This transmission line is a radial transmission line and therefore not as reliable as a networked line due to having only a single source feeding the substation. If there was only one set of cables, the new substation could be out of service for many days; whereas with a second set of cables installed, an outage of the line due to a cable or underground splice failure should last only a few hours at most. By initially installing a second set of cables in accordance with the overall network capacity design requirements, the line will be able to be restored to service much faster if there is a cable or splice failure on one set of cables.

The underground transmission line will use cross-linked polyethylene ("XLPE") solid dielectric underground cable encased in concrete duct bank for protection with two cables per phase, conduit for communications and shield wires, and spare cable conduits for additional underground transmission facilities if needed in the future. The proposed XLPE cable system will consist of two parallel duct banks, each with three (3) cables installed for a total of six (6) cables. The two duct banks will be separated by a minimum of 8 feet to 15 feet to reduce mutual heating effects in order to maximize the ampacity of the circuit.

The current cost estimate for the hybrid line project amounts to approximately $106.6 million with roughly $69.6 million associated with the cost of the 10-mile overhead portion of the line (approximately $7 million per mile *including* land acquisition costs) and roughly $37M million associated with the cost of the 2-mile underground segment of the line (approximately $18.5 million per mile *excluding* land)[1]. This project is on schedule to energize the line in fall of 2010.

Beaumeade-NIVO 230 kV Transmission Line

On July 21, 2008, (Case No. PUE-2008-00063) DVP filed with the Commission to build in Loudoun County, Virginia, two new 230 kV underground transmission lines approximately 0.71 miles long from a proposed expansion of DVP's existing Beaumeade Substation to a new 230/34.5 kV substation ("NIVO Substation") constructed on land owned by DuPont Fabros. On May 29, 2009 the Commission issued a

[1] Excluding land acquisition costs: The underground line segment is to be located along existing company right-of-way and therefore no land purchase was required for the UG portion other than the short sections of underground required to reach the two transition stations. An appropriate per-mile cost comparison of the underground portion versus the overhead portion should include land acquisition costs duly prorated and scaled for the underground segment. These costs would add approximately $2 million per mile to the underground line for a total of $20.5M per mile.

Final Order approving the construction of the transmission line as an HB 1319 underground pilot project. The underground transmission lines will be built primarily on a combination of existing DVP right-of-way within the W&OD Trail and existing VDOT right-of-way along Smith Switch Road, south of Beaumeade Substation. Both of the new proposed lines will occupy the same concrete encased duct bank consisting of eight 6-inch conduits. Each line will be comprised of three XLPE solid dielectric cables with a rating of 524 MVA.

While probably feasible to construct the new transmission lines proposed in the application overhead, the utility proposed the construction of the Beaumeade–NIVO 230 kV lines underground as a pilot project under HB 1319. Although the project is electrically configured as two transmission lines, this is considered to be a single project for the purposes of HB 1319. As part of the HB 1319 pilot program, the project will enhance and expand the utility's experience with the construction, operation, and performance of XLPE technology. Further, the estimated additional costs of placing these lines underground meet the requirements of HB 1319. DVP has worked closely with Loudoun County officials during the project's planning phase and has general community support for the placement of these transmission lines underground.

The proposed route for the project is approximately 0.71 miles long and will require a new 30-foot wide right-of-way for only a small portion of its length. Approximately 0.20 miles of the proposed route will be located within existing DVP-owned right-of-way along the W&OD Trail, and approximately 0.33 miles will be located within existing VDOT right-of-way along Smith Switch Road. DVP will need to acquire a new 30-foot right-of-way on the DuPont Fabros property for approximately 0.15 miles of the proposed route, and the remaining 0.03 miles of the route will be located on the property to be acquired for the proposed Beaumeade Substation expansion.

An estimated in-service date of spring 2010 is projected for the project. The estimated cost of the project is $11 million. This represents a 140% higher cost than the equivalent overhead solution.

Key Attributes of Dominion Pilot Projects

The Pleasant View – Hamilton underground transmission line (portion) and the Beaumeade – NIVO underground transmission line are designed differently. In the case of Pleasant View – Hamilton, the underground transmission line is to be constructed in two duct banks; whereas the Beaumeade – NIVO underground transmission line is to be constructed in a single duct bank. These design differences stem from the anticipation of future capacity demands. The two duct bank design is useful in the long term as future networking of the line is anticipated. A networked transmission line can potentially be more heavily loaded than can a radial transmission line. This distinction occurs because a networked transmission line serves any load tapped off of the line in addition to its service as a conduit for the transfer of bulk power across the bulk electric system. While future networking of the Beaumeade – NIVO line is yet technically feasible, it is not anticipated that this line will need to be networked like the Pleasant View – Hamilton line... Thus the upfront construction of the Beaumeade – NIVO line is most accommodating to the immediate radial nature of the line's loading demands.

Table 1: Underground Transmission Line Project Attributes (Pilot-related)

Transmission Line	Case Number	Date Filed	Feasibility	Cost Test	Pilot Status
Pleasant View—Hamilton 230 kV	PUE-2008-00027	April 21, 2008	N/A	N/A	Required by Act
Beaumeade—NIVO 230 kV	PUE-2008-00063	July 21, 2008	Feasible	Less than 2.5 times the cost of overhead (1.4 times total cost)	Initiated by DVP

Experimental Underground Transmission Line Projects Unrelated to House Bill 1319

This section provides a summary of two underground transmission line projects unrelated to Chapter 799 of the 2008 Acts of Assembly (HB 1319). These are included in this report solely for the purpose of aggregating and tracking all ongoing underground transmission line pilot projects in one document. A summary of these two projects is included in Table 3.

Garrisonville 230 kV Transmission Line

On August 30, 2006, Virginia Power filed its application with the SCC for the 5-mile Garrisonville 230 kV overhead transmission line in Stafford County. On February 27, 2007, DVP filed, among others, a Motion for Leave to File Underground Alternative Supplement. The company attached to its Motion an Underground Alternative Supplement which presented the underground alternative as part of the Company's direct case to be considered along with its other proposals.[2] This new transmission line will run approximately 5.5 miles from the existing 252 Line into Garrisonville Substation and then back to the 252 Line along the same 5.5 mile right of way. This line is effectively 11 miles long when considering it is a networked transmission line.

[2] The preferred underground alternative ("Option 1") will consist of two transmission circuits and be constructed with a spare conduit to add an additional cable in the event the rating needs to be increased in the future. Constructing two underground circuits will assure that service to Garrisonville Switching Substation would be maintained in the event of a fault on the new line and will provide transfer capability and redundancy equivalent to the proposed overhead line. From a transmission planning perspective, Option 1 of the underground alternative provides an electrically acceptable alternative to the proposed overhead line. Option 1 would assure continued service to Garrisonville substation by providing transfer capability and redundancy equal to the proposed double circuit overhead line configuration. In the event of an extended outage on one underground circuit, the Garrisonville station could continue to receive service from the other until the outage is repaired. The Company recommended against using an underground alternative that consisted of only 1 circuit ("Option 2") built in a radial configuration. Although less expensive at $48.44 million (still 3.4 times the overhead alternative), Option 2 would have been less reliable.

The Garrisonville project was proposed as an underground XLPE project, which will enhance and expand the Company's experience and familiarity with the construction, operation and performance of XLPE technology through a much larger underground project. The additional cost for underground construction would be recovered through the ratemaking process. The Commission approved the underground line by its Final Order of April 8, 2008, in Case No. PUE-2006-00091. In approving the line, the Commission emphasized that their approval of this project as an underground pilot project, and the rate treatment afforded thereto, in no way established a precedent for future transmission lines, either in the subject right-of-way or elsewhere.

Initial Estimates

Virginia Power originally estimated the cost of the proposed 230 kV transmission line to be $70.4 million. This correlates to approximately $14 million per mile equivalent. The 230 kV substation work was expected to cost an additional $11.9 million, for a total project cost of $82.3 million. The total cost for the overhead alternative was estimated to be $14.16 million, a $68.14 million difference. Thus, the underground option was expected to cost approximately 5.8 times the cost of the overhead alternative. The company also expected preconstruction activities and construction to require a total of 36 months,[3] with an anticipated completion date of June 2009. The overhead alternative was expected to require 24 months, including 6 months for preconstruction and 18 months for construction.

Project Challenges

Adverse soil conditions, large amounts of rock in the right-of-way, and unfavorable topography have contributed to significant increases in both the cost projections and construction duration for this project. As opposed to conventional trenching, these difficult terrain conditions necessitate directional drilling to depths in the range of up to 125 feet. For the sections of the line that require drilling, conventional concrete encased construction is untenable. In these cases, conduit is pulled after the drilling is completed. Conduit is necessary to facilitate the pulling of the XLPE cables. Additional costs have also been incurred due to significant increases in cable costs that occurred with the commodity price escalation of 2008. Currently, the estimated cost of the completed project is $120 million – a more than 45% overage and a multiple of near 8.5 times the cost of the equivalent overhead solution. The challenges addressed in this section have also contributed to delays in the projected project completion date. The current target date for energizing the new substation at Garrisonville is May 2010.

Construction Challenges

As mentioned, the adverse terrain and road crossings (namely, Interstate 95) along the Garrisonville right-of-away necessitate the use of horizontal directional drilling (HDD) as opposed to the conventional trenching methodology. For the portions of the line which can be placed underground via the trenching

[3] 18 months for preconstruction activities (acquiring underground rights and clearing right-of-way) and 18 months for construction

methodology, the configuration in Figure 1 can be used. However, when HDD is required, the configuration of Figure 2 must be used.

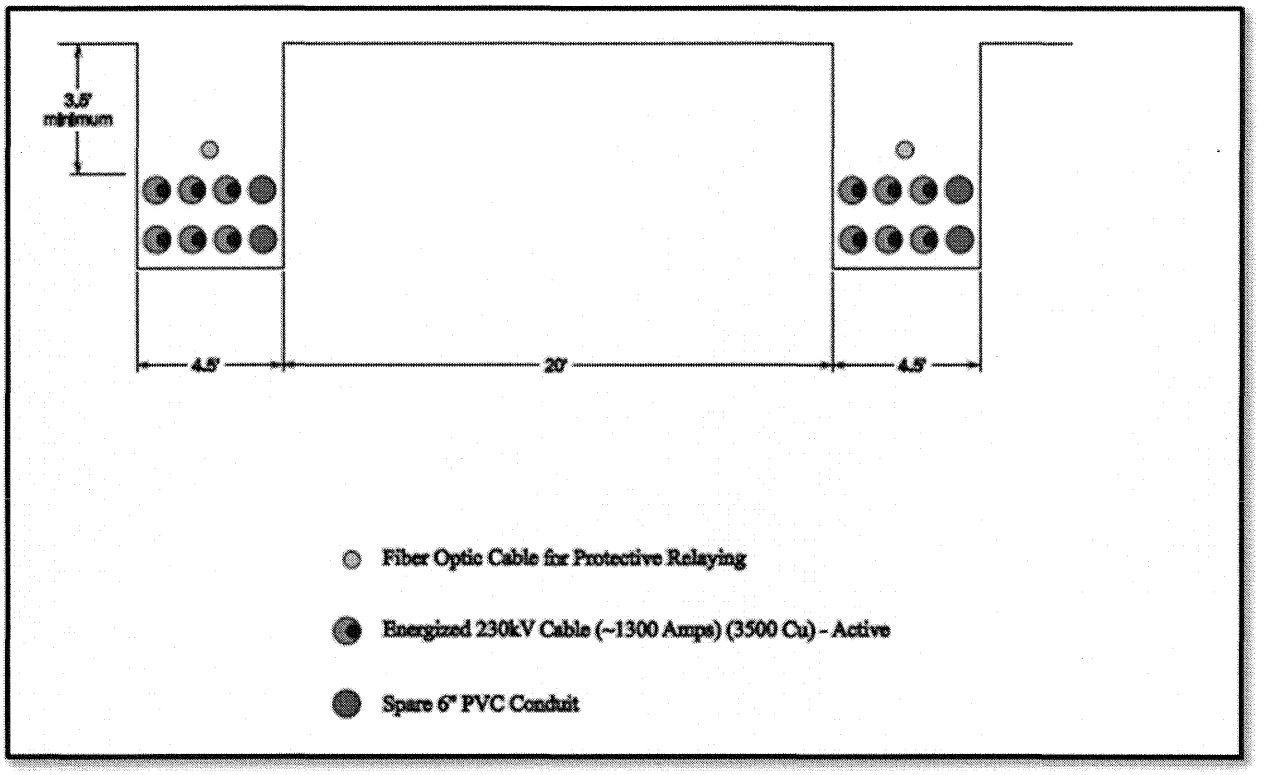

Figure 1: Garrisonville Project -- Trenching Configuration.

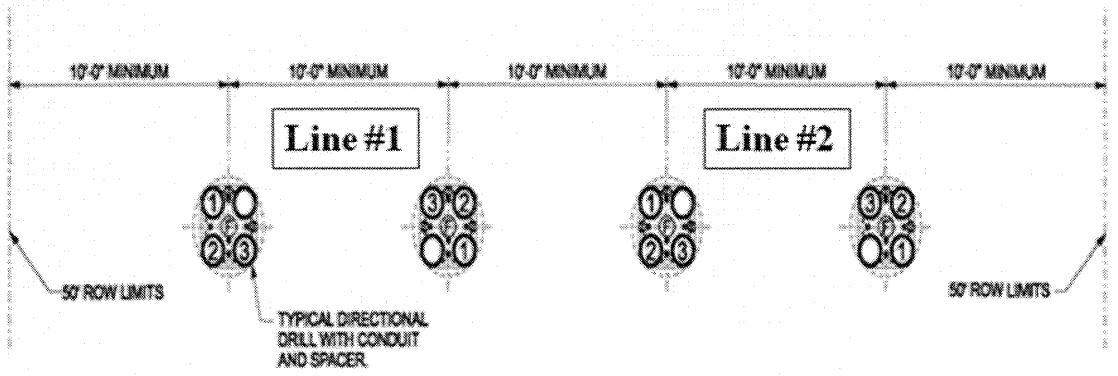

Figure 2: Garrisonville Project – Drilled-Hole Configuration.

Drilling and Trenching are very different methods of placing a cable underground. Trenching is, in general, a less intensive surface operation compared to drilling. Drilling, especially to depths of 125 feet or more as required in this project, can get far more complex and expensive than trenching.

Drilling Equipment

First, drilling requires specialized drill rigs as seen in Figure 3 (often transported and operated mounted on a semi-trailer) and other large, heavy equipment.

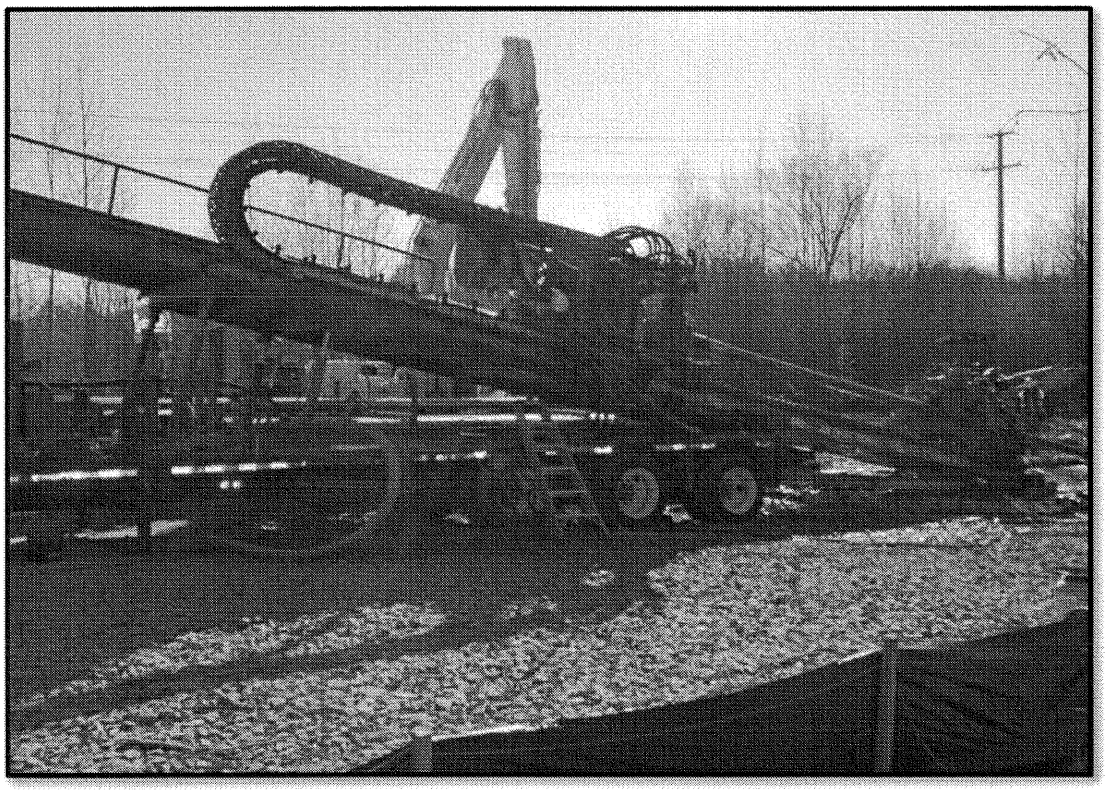

Figure 3: Horizontal Directional Drill Rig.

Drilling Process

Second, the drilling process is iterative. Each of the four holes in Figure 2 must have a diameter of 42 inches in order to properly accommodate four properly-sized conduits. These 42-inch holes are impossible to drill in a single step. Therefore, a reaming process is used. A pilot hole, followed by successively larger reams of 28 inches and 42 inches in diameter, respectively, are drilled. Figure 4 shows a drill bit, or reamer, used in the final stage of drilling a 42-inch hole.

Figure 4: 42-Inch Drill Bit (Reamer).

Drilling Progress

Third, the drilling progress is highly dependent on the soil conditions through which the drill must advance. In some cases drilling is extremely slow and can be as slow as 6 inches per hour. Some spans (drilled underground spans line between manholes) have presented completely untenable drilling conditions. In these spans, drilling has been abandoned and re-attempted in hopes of hitting different soil conditions. The first four holes spanning Interstate 95 took three months to complete.

In order to prevent the newly drilled holes from losing form or collapsing altogether after the reamer advances, a bentonite-based drilling mud is used to provide hydrostatic pressure. The fluid is also used to keep the drill bit cool and "clean" during cutting. Depending on the soil conditions through which the hole has been cut, this pressure placed on the drilling mud can escape the intended bored hole and erupt into the surrounding environment. This eruption of drilling mud is referred to as a "frac-out."

Drilling Challenges

Because of the impact on the environment, a frac-out is treated very seriously and drilling is stopped upon finding a frac-out until all material is recovered and the frac-out site is properly cleaned. To date,

nearly 300 frac-outs have been found and the lost drilling mud is estimated in the hundreds of thousands of gallons. These frac-outs have been up to 260 feet from the nearest approach of the hole's centerline and upwards of 100 feet above the centerline. Figure 5 shows a site of a frac-out. Note that two straw bale barriers are required for containment. Figure 7 shows the consistency of the drilling mud at one end of a drilling site.

Figure 5: Site of frac-out showing containment measures for the protection of the environment.

The drilling has also been associated with the manifestation of sink holes. The noise and vibration of drilling equipment has become problematic for some residents and businesses. Drilling operations activities require the usage of drill rigs, pipe stems, excavators, three reamers, water trucks, diesel generators, and large mud processing equipment. The noise level from the diesel generator and mud processing equipment is approximately 90 decibels. The noise generated by this equipment is extremely loud and uncomfortable, creating a constant vibration that can be sensed hundreds of feet away. Drilling operations (which typically run 12 hours per day, six days per week) have generated concerns from residents living close to drilling sites – concerns of foundations cracking and discomfort from the constant vibration. Mitigation efforts to reduce the side effects of drilling include the use of costly sound insulating walls as seen in Figure 6.

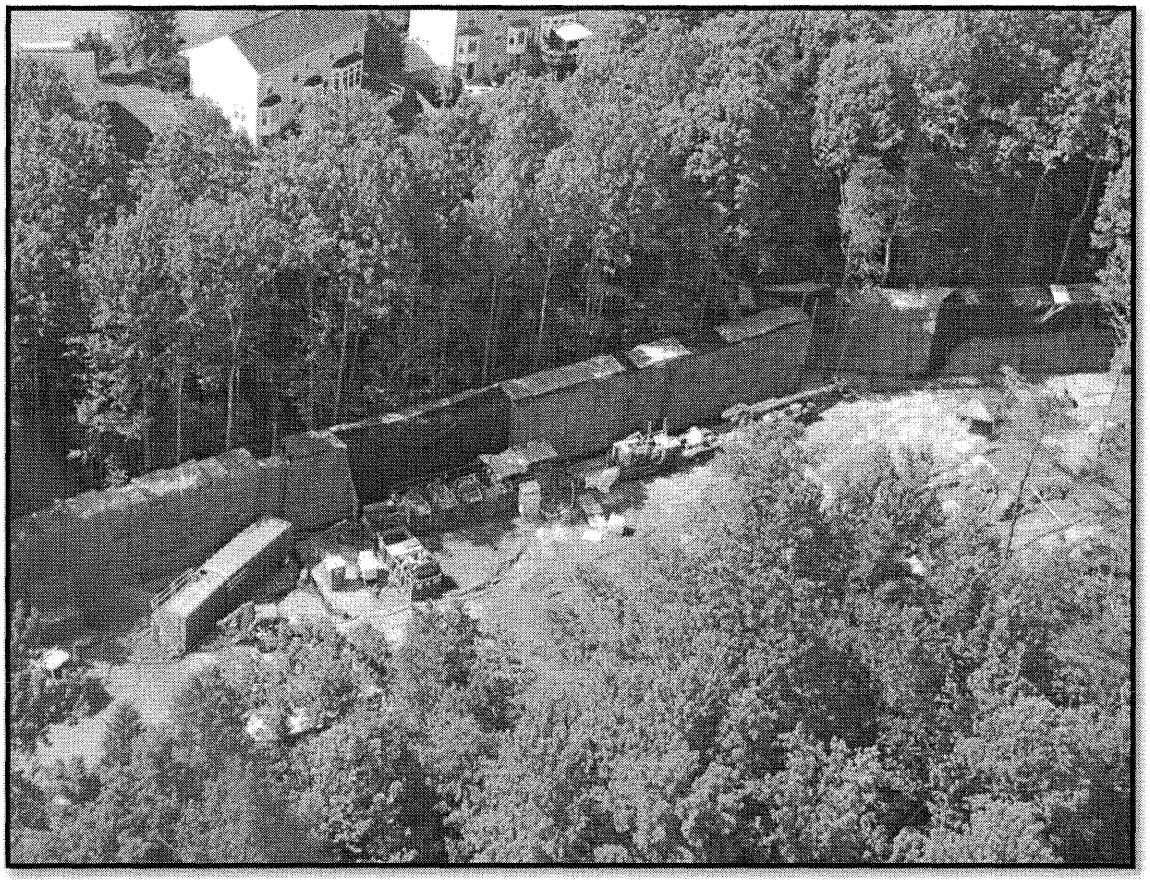

Figure 6: View of sound-insulating wall proximate to drilling site near Garrisonville underground line.

Underground Blasting

Due to the challenging terrain, directional drilling and conventional duct-bank installation have not been feasible in every location resulting in the use underground rock blasting. Small holes are drilled and explosives are used to fragment rocks and clear obstacles for duct-bank installation.

Weather

Rain adversely affects the drilling and trenching processes and requires these processes to be halted. Each significant rain event can set the construction process back two or three days.

Cost Drivers

There are five main cost drivers associated with the Garrisonville project

1. Complexity – The complexity of constructing an underground line is far more extensive than that of an overhead line. These complexities demand more time and personnel. The Garrisonville project is involving 150 personnel.

2. Cable Costs – The price of underground cable can be more than 100 times that of overhead conductor. The cost of cable for the Garrisonville project is running about $850/line foot or $4.5 million per mile for each line.

3. Terrain – The severe grade variation has required HDD which has added significant costs to the project.

4. Soil Conditions – Adverse soil conditions have reduced the drilling rate, allowed for environmentally hazardous frac-outs, and contributed to the creation of sink holes.

5. Underground easement acquisition (Right of Way) – The previously purchased easements were for an overhead line. These easements did not provide underground rights which required Dominion to initiate new agreements with each landowner along the designated transmission line route.

Community Challenges

1. Works hours – Set backs from project challenges resulted in extended working hours for construction crews (Monday through Saturday 12 hours shifts). Hours have been adjusted in some locations due to community concerns.

2. Drilling – Numerous complaints from residents regarding noise levels, vibration, and traffic.

3. School – Provided morning and afternoon crossing guards to multiple school locations adjacent to construction thoroughfares.

4. Restoration – Extensive restoration throughout transmission line corridor; three athletic fields, tot-lots, street repaving, street cleaning, resident landscaping, etc.

5. Community Outreach – Communications Manager assigned full-time to project to address community issues and concerns.

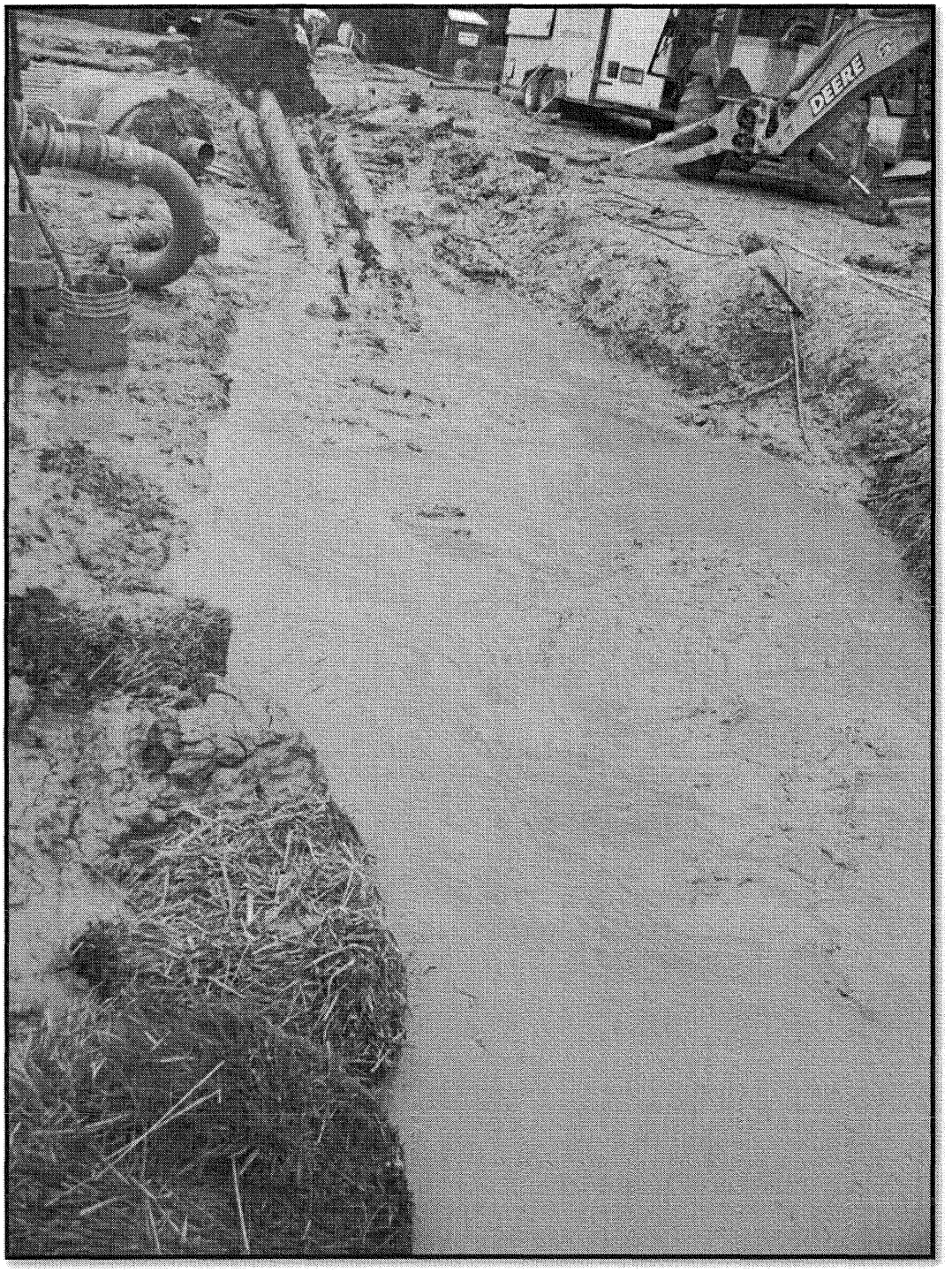

Figure 7: A picture of drilling mud at one termination of a drilling span.

Project Comparisons

Table 2 compares the underground (UG) versus overhead (OH) options for the Garrisonville project.

Table 2: Underground vs. Overhead Cost Comparison.

	Reliability: Line Outage Duration	Life Cycle (years)	Construction Time (months)	Personnel Required	Conductor and Cable Prices ($/line foot)	Total Costs per Line Mile ($)	Total Costs ($)
OH	Hours	70	18-24	20	$8.10	$1.3 million	$14 million
UG	Days	35	36+	150	$850	$11 million	$120 million

Clarendon-Ballston 230 kV Transmission Line

On February 2, 2007, Virginia Power filed its application with the SCC for the 2200-foot Clarendon-Ballston 230 kV transmission line in Arlington County. The company proposed the construction of the line under streets in the highly urbanized area because there was no practical overhead route for the line.

In addition, the company proposed the use of a different underground construction technology, XLPE, than in past projects. Previous underground transmission projects in urban areas employed high pressure fluid-filled ("HPFF") cable. Virginia Power argued that the proposed facility would provide the company an opportunity to gain experience with XLPE lines operating at 230 kV. The company noted that any failures could be managed with limited service disruption since the proposed facility would be located in an urban area with significant transmission facilities already in place. The company also noted that the cost of underground urban construction for an XLPE line is reasonably comparable to HPFF construction.

The Commission approved the line by its Final Order of May 25, 2007, in Case No. PUE-2006-00082. In approving the line, the Commission commended DVP's decision to use a different technology for the project and encouraged the company to investigate and employ new technologies while also considering the reliability of its system and financial impact on all ratepayers. The Commission also directed the company to inform the Commission's Division of Energy Regulation of the progress of this installation and to provide information on cost, engineering, construction, and future operation.

In its application, DVP noted that the estimated cost of the proposed 230 kV transmission line was $4 million. This correlates to approximately $9.6 million per mile equivalent. The 230 kV work at the substations was expected to cost an additional $11 million for work at the substations. The company did not perform comparable cost estimates for either HPFF technology or overhead construction. The company also expected construction to require nine months, with an anticipated completion date of May 2008. However, as of the date of this report, the completion date has been extended to December of 2009. This delay is due both to unforeseen difficulty in obtaining local permits and the challenges of coordinating with existing underground infrastructure and rock in the area. Figure 8 shows the metropolitan nature of the area in which the underground transmission line is being constructed.

Figure 8: Excavation for Clarendon -- Ballston underground transmission line.

Key Attributes of Experimental Dominion Transmission Line Projects Unrelated to House Bill 1319

Table 3: Experimental Underground Transmission Line Project Attributes

Transmission Line	Case Number	Date Filed	Date Approved	Length	Estimated Cost	Pilot Status
Clarendon—Ballston 230 kV	PUE-2006-00082	February 2, 2007	May 25, 2007	2,200 feet	$15 million *(including $11 million for substation work)*	Initiated by DVP, approved by Commission
Garrisonville 230 kV	PUE-2006-00091	August 30, 2006	April 8, 2008	11 miles total *(two 5.5-mile double-circuit underground paths)*	$120 million *(including $11.9 million for substation work)*	Initiated by DVP, approved by Commission

Analysis of Underground Transmission Line Technology and Applications

The use of underground transmission lines as an alternative to conventional overhead transmission lines addresses common public concerns associated with overhead transmission line aesthetics. The visual impact (or above-ground profile) of underground lines compared to that of overhead lines is smaller and typically more publicly acceptable than that of overhead lines. However, the aesthetic advantages of underground lines are only made possible via invasive and continuous trenching, excavation, blasting, boring, and directional drilling. In some cases, drilling depths can extend downwards to 125 feet. Conversely, overhead transmission lines have a comparatively superficial impact at distinct points corresponding to structure locations which can typically range from 400 to 1,200 feet apart depending on the terrain and routing. Thus, the impact of underground transmission lines compared to overhead transmission lines on historic districts (such as burial grounds and other buried artifacts) and the environment is severe. Figure 9 and Figure 10 depict the right of way clearing associated with the Garrisonville project.

Figure 9: Right of way being cleared for Garrisonville underground project.

Figure 10: Cleared right of way for Garrisonville project.

Figure 11 and Figure 12 present a good contrast between the environmental severity of overhead transmission line construction (Figure 11) and underground transmission line construction (Figure 12).

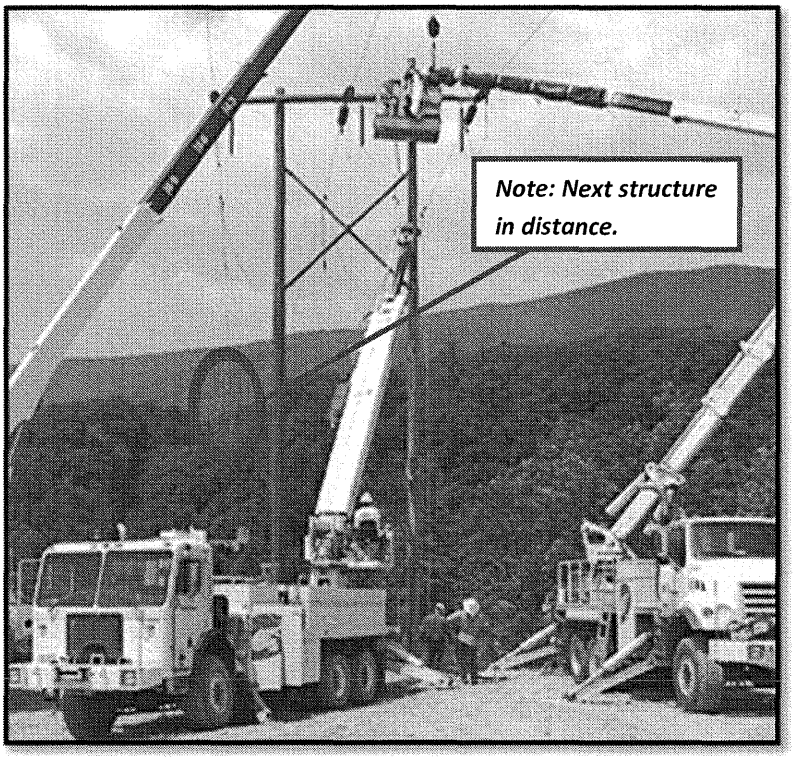

Figure 11: Construction of an arbitrary overhead transmission line.

Figure 12: Construction of a portion of the Garrisonville line (trenched portion).

Transmission lines are typically built overhead throughout the country for reasons of economic expedience, technical feasibility, reliability, operability, and environmental stewardship. Therefore, underground transmission lines are generally considered as an alternative to overhead lines in the very limited cases where no viable overhead line routes are available. Examples include highly urbanized areas (e.g., certain areas in Northern Virginia) or where customers have agreed to pay for the underground service and the service was of a radial configuration. For these reasons, utilities in the Commonwealth of Virginia have little experience with underground transmission line technology compared to overhead transmission line technology.

Underground transmission lines, though designed to replace overhead transmission lines, intrinsically possess technically challenging attributes that must be addressed in order to serve as an adequate substitute for overhead lines. The most pervasive attribute inherent to underground transmission lines is higher capacitance which leads to voltage rise on the line. Therefore, as is the case in the Pleasant View – Hamilton and Garrisonville lines, shunt reactors are necessary to mitigate damaging over-voltage situations which would occur at almost any loading level – heavy or light. While other underground transmission lines in a networked configuration may be taken out of service as a last resort during periods of light loading when voltage rise problems occur, radial lines such as the Pleasant View – Hamilton line are not afforded such a luxury.

A limiting factor to the maximum distance between splices of underground cable is the size of the reel on which the cable is initially wound. Transportation constraints then limit the size reel that can be used. During installation of the cable, pulling tensions imposed on the cable must also limit the amount of cable that can be pulled through conduit between vaults. Cable splices are physically the weakest points of an underground transmission line. They must be immobilized so that they are not stressed by tensions resulting from thermal expansion and contraction. The vaults that are used to house and immobilize the underground cable splices are substantial and the walls of the vaults must also be reinforced so as to withstand the thermally induced forces that work to stretch and compress the cable.

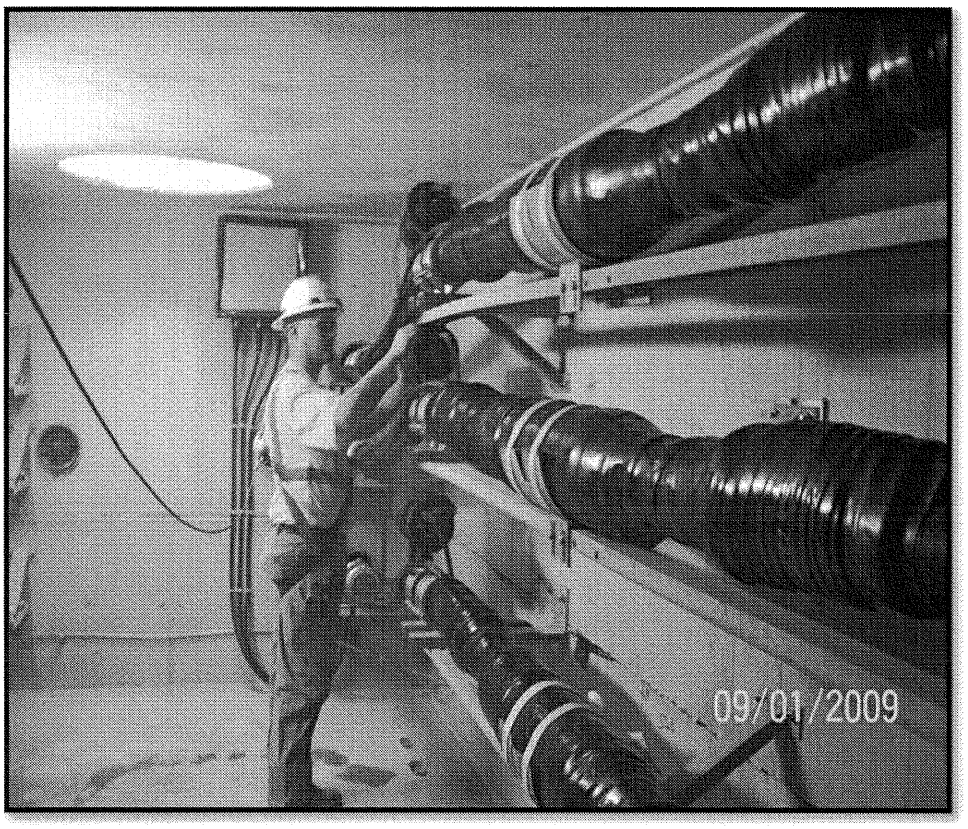

Figure 13: View of vault interior and cable splice along Garrisonville underground transmission line.

Whereas underground transmission lines may not be subject to the temporary/momentary outages associated with overhead transmission lines, it is generally accepted that underground outages are of longer duration than overhead outages. To ensure adequate reliability, underground transmission lines are typically constructed as double circuits utilizing separate duct banks and require significantly different protection schemes. For safety reasons, it as advantageous to locate duplicate underground circuits in separate duct banks allowing for repairs on either circuit while allowing the other to remain energized. "Dig-in" is an example of both a hazard associated with underground lines and also a cause of underground outages.

Underground transmission lines are hardly similar in design, size, and operation to underground distribution lines. Figure 14 shows a size comparison between the size of underground 230 kV transmission line cable (same type as used in Garrisonville) and typical 35 kV underground residential distribution (URD) cable. Further, an entire typical neighborhood can be fed by the single URD cable pictured below. However, the electric AC transmission network is necessarily operated in three phases – requiring three of the larger cables pictured (at 230 kV).

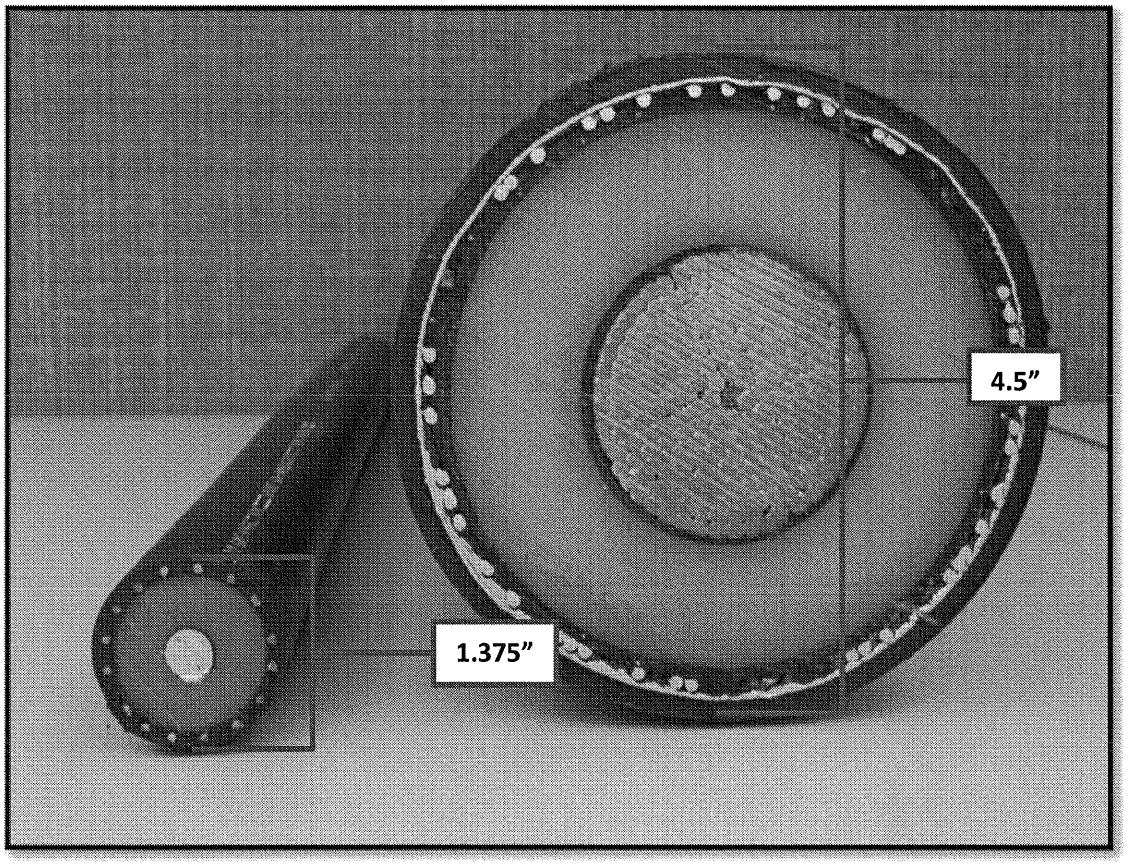

Figure 14: Comparison between underground residential distribution 35 kV cable (LEFT) and underground 230 kV transmission cable (RIGHT).

Ultimately, the construction, operation, and maintenance costs of underground transmission lines compared to those of conventional overhead transmission lines pose significant concerns. While some additional costs can be identified in the design and engineering phases of underground transmission line projects as identified above, the potential for significant additional costs arises in the land and material acquisition, construction, and maintenance/repair phases. Drastic fluctuations in the costs of copper throughout the project have resulted in drastic increases in costs of XLPE cable. While aluminum (the primary component in overhead conductors) costs have increased, the per-mile cost increases of aluminum pale in comparison to the per-mile cost increases of copper. In the past three years, the cost per mile of aluminum that would be used in the overhead conductors has increased by approximately $7,000 per mile whereas the cost of copper used in XLPE cable has increased well over $1.8 million per

mile during the same time period. Also, the costs of boring and trenching are estimated based upon geological surveys that may not reveal unfavorable ground conditions until encountered after construction of underground lines are well underway. For example, the costs associated with the Garrisonville 230 kV Transmission Line project (reference Table 3) are currently expected to exceed original project estimates by over 45% due to the factors discussed in this report.

Conclusions

The purpose of this report is to provide a basic description of projects participating in the pilot program established by HB 1319 along with an analysis of the key issues facing the projects. Two approved underground transmission line project have been identified in this update: Pleasant View -- Hamilton 230 kV Transmission Line and Beaumeade -- NIVO 230 kV Transmission Line. Both of the projects are in the early/pre-construction phases thus rendering only a partial understanding of the issues and impacts of the pilot project. The report also provides a summary of two experimental underground transmission line projects unrelated to HB1319 for the purpose of presenting issues likely to be relevant upon further development of projects participating the pilot program. Experience to date indicates that cost and potential cost variance continues to drive concerns associated with the construction of underground transmission lines.