Joint Legislative Audit and Review Commission

SCC Review of Underground Electric Transmission Lines

Commission Briefing

November 13, 2006

Study Mandate

- HJR 100 (2006) requires JLARC to review the factors and criteria used by the State Corporation Commission (SCC) in evaluating underground transmission lines

- Three specific issues were examined
  - Construction and long-term operating costs
  - Effect on property values and feasibility of payment by surrounding property owners
  - Feasibility of using underground lines

In This Presentation

- Background
- Types of Underground Transmission Systems, Extent of Use, and Costs
- SCC Policies Affect Transmission Line Cases
- Factors Considered by the SCC in Reviewing Underground Transmission Lines
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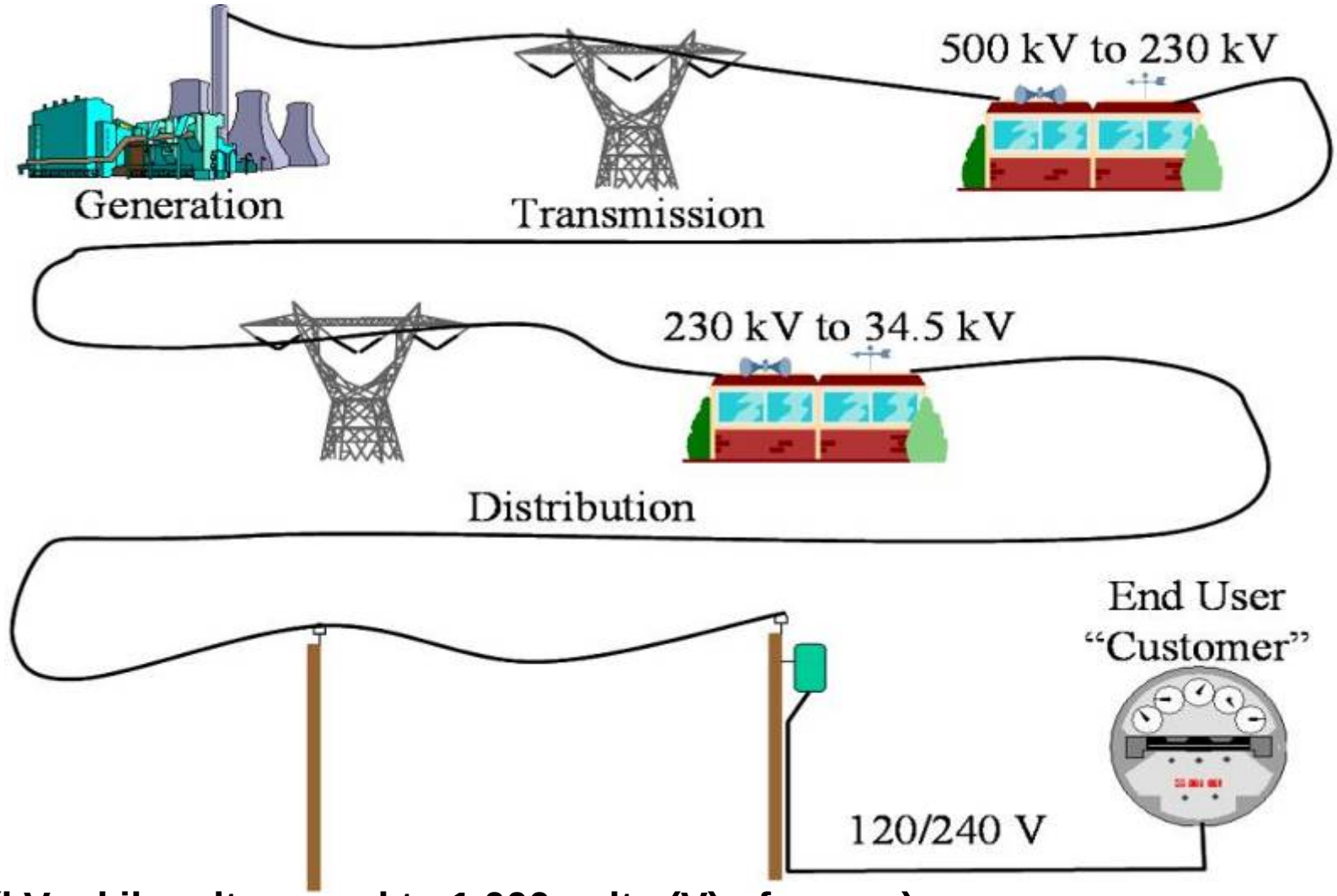
Components of the Power System



(kV = kilovolts, equal to 1,000 volts (V) of power)

Transmission Lines Can Be Overhead or Underground

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Background on Electricity

- Virginia is a net importer of electricity
- Electricity usage generally increases each year
- Electric facilities are built to supply peak demand
  - Over the course of a year, about 100 hours of peak demand account for 2% of electricity consumption

Organizations Outside of Virginia Also Regulate Electricity Transmission

- PJM
  - regional transmission organization conducting regional planning (includes Virginia's utilities)
- NERC (North American Electric Reliability Council)
  - establishes mandatory reliability standards
- FERC (Federal Energy Regulatory Commission)
  - oversees NERC
  - regulates interstate transmission of electricity
  - implements Energy Policy Act of 2005

Limitations in the Availability of Information Affected the Study's Scope

- Industry reports not available
  - Dominion very cooperative with the study effort but declined to provide some information because of FOIA
- 99 transmission lines reviewed by SCC since 1972
  - 23 cases were excluded from staff analysis (cases involved a generator or industrial customer)
  - 76 cases analyzed in report
    - 17 involved undergrounding, 10 resulted in undergrounding
- Study relied on final orders and SCC reports

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Underground Lines Are a Small Percentage of All Transmission Lines

- In U.S., about 0.5 to 0.6% of 230 kV and above
- In Europe, about 2% for 220 to 300 kV and 0.5 % for 380 to 400 kV (2003 data)
- In Virginia, 1.3% of 230 kV lines are underground
  - Alexandria: 6.2 miles
  - Arlington: 11.1 miles (and 18.3 miles of 69 kV)
  - Fairfax: 9.3 miles
  - Norfolk: 5.6 miles

Finding

- There is no consensus on which underground technology is “best” for high voltage transmission

Several Types of Underground Lines Are in Use or Under Development

- "HPFF"
  - More widely used and longer track record
  - More expensive and may leak insulating fluid
  - Dominion and SCC staff consider its use prudent
- "XLPE"
  - Newer technology with increasing use and potential
  - Typically 20% less expensive and has no fluid to leak
  - In the U.S., use at higher voltages a recent development but seems increasingly favored
  - Some experts question its long-term durability
  - Dominion proposes to build a 0.5 mile XLPE line in Arlington

Finding

- Underground lines typically cost four to ten times more than overhead lines

Ratio of Underground to Overhead Costs Typically Between About 4 to 1 and 10 to 1

- Dominion (for 230 kV, estimates in 2005-06)
  - 6.1 - 7.4 to 1 for XLPE
  - 7.5 - 9.7 to 1 for HPFF
- Other experts
  - 7 to 1 median for North American sources
  - 10 to 1 median including European sources
  - Averages
    - 3.8 to 1 at 115 kV
    - 6.1 to 1 at 230 kV
    - 8.5 to 1 at 345 kV
    - 9.6 to 1 at 400 kV

Several Factors Explain Higher Cost of Undergrounding

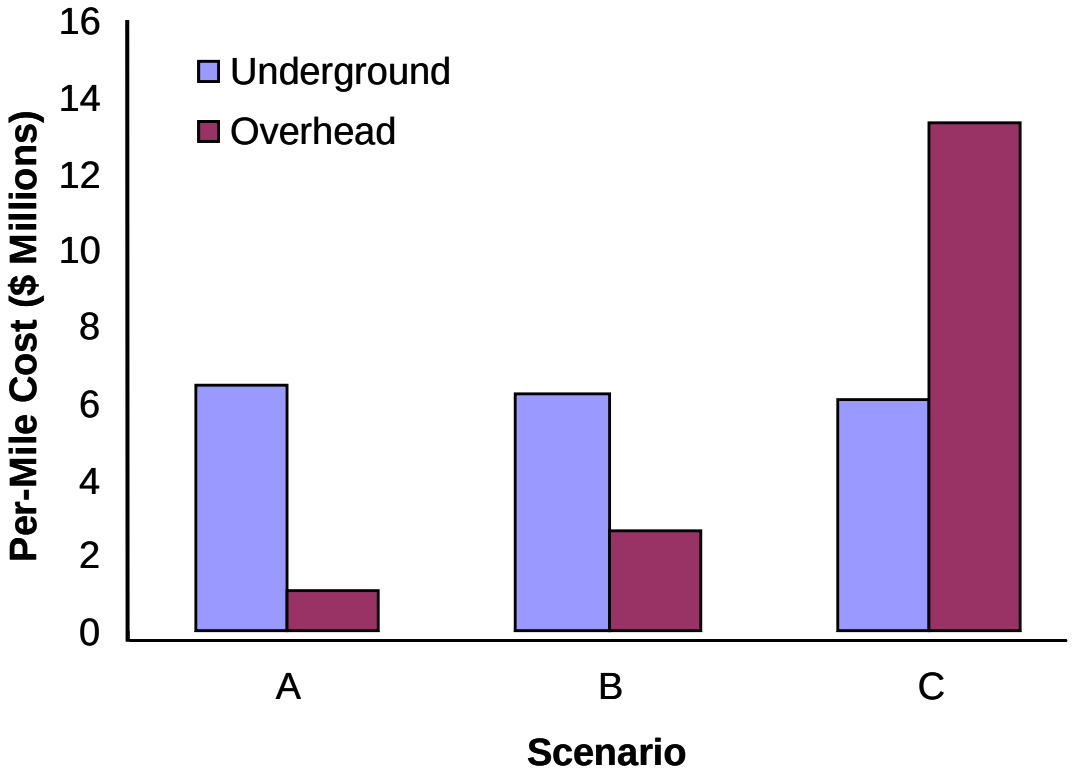
- Need more insulation and cooling than overhead lines, which can use circulating air
- Presently, higher cost of copper vs. lower cost of aluminum used in overhead lines
- Including “lifecycle” factors reduces costs but not substantially
  - Underground lines may cost less to maintain and have lower “line losses” but cost more to repair
- Higher labor costs because of continuous trenches and more complex installation

Complexity of Underground Installation: Splicing Cables in a Vault

Finding

- Underground lines can be very cost competitive in some unique circumstances – for example, situations in which acquiring wide easements or right-of-way in a densely populated area is very expensive

Cost of Overhead Projects (Particularly Right-of-Way Cost) Has Major Impact on Underground Cost-Competitiveness



A: estimates for 2005 assuming typical installations, use of XLPE
B: estimates for 2001 SCC case; higher overhead cost
C: estimates from 1988-89 for proposed Fairfax Co. line w/very high ROW costs for overhead line
(All cost estimates from Dominion)

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Commissioners Are Routinely Required to Balance Competing Statutory Factors

- Utility Facilities Act* requires utilities to obtain a certificate of public convenience and necessity
- Certificates can be issued only after SCC complies with requirements of Section 56-46.1 (Enacted in 1972)
- Electric utilities required to provide electric service at "reasonable" rates (Section 56-234)
- SCC empowered to investigate utilities to determine whether they conserve energy and capital resources (Section 56-235.1)

*Sections 56-265.1 -265.9 of *Code of Virginia*

SCC Policies Affect Transmission Line Cases

- SCC interprets terms not defined in statute
  - Statute does not define “cost”
  - SCC will use “judicially crafted” factors
  - In contrast, commissioners do not use cost estimates for environmental externalities
- SCC’s hearing process affects information reviewed in transmission line cases
- Virginia Supreme Court presumes that SCC orders are correct

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Finding

- SCC cites higher costs in limiting use of undergrounding

SCC Has Required Some Additional Expenditures to Comply With Statutory Factors

- Commissioners state that cost alone does not determine the outcome of cases
  - SCC has approved some additional expenditures to minimize adverse impacts of overhead lines
- Costs of a transmission line project are paid by all ratepaying customers of the utility
- SCC guidelines do not require utilities to submit estimated cost of undergrounding

Undergrounding Has Been Approved When Less Costly or When Ratepayers Are Not Affected

- Undergrounding can be less expensive where land are values high due to ROW costs
  - Underground 230 kV lines require about 25 ft wide ROW vs 120 ft for overhead lines
- Has been approved if costs paid by third party but Dominion no longer favors this practice
- Cost concerns cited in three final orders that rejected undergrounding
  - SCC staff indicate commission limits its use to avoid setting precedent

Overhead Lines Are Not Feasible in Some Areas

Finding

- SCC cites reliability and operational concerns in limiting use of undergrounding

Reliability Concerns Drive Transmission Line Planning and Approval

- Section 56-46.1 states SCC “shall consider any improvements in service reliability”
- New transmission lines are built because of increased demand and NERC reliability standards
- Experts vary on whether overhead or underground lines are more reliable
  - Agreement that underground lines take longer to repair
  - Adding redundancy complies with NERC standards and reduces length of outage, but increases cost
- Operational concerns created by underground lines can be addressed, but at additional cost

SCC Has Cited Operational and Reliability Concerns

- Cited by commissioners in a 1988 Chesterfield Co. case
- Cited by SCC staff and hearing examiner in a 2001 Loudoun Co. case
- Commissioners rejected hearing examiner's recommendation of undergrounding in 2002 Loudoun Co. case
  - Final order noted that Dominion had established "sufficient reliability concerns"

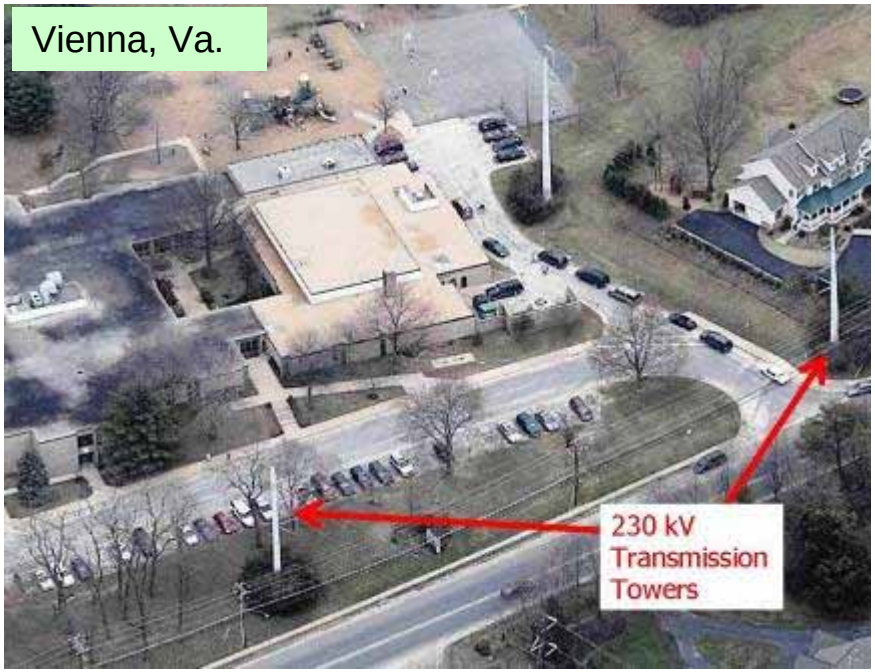
Finding

- SCC complies with statutory factors by modifying overhead lines instead of approving undergrounding

SCC Must Consider Environmental Factors

- Section 56-46.1 requires SCC to “to minimize adverse environmental impact”
  - Includes impact on historic resources plus human health and safety
- Most prominent health concern is EMF
  - No causal link to cancer established
  - Some studies report increased risk from magnetic fields of 4 milliGauss or more
- HPFF lines produce negligible magnetic fields but XLPE may be higher than overhead

Citizen Concerns Cite Proximity of Schools



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Everyday Objects Emit Magnetic Fields

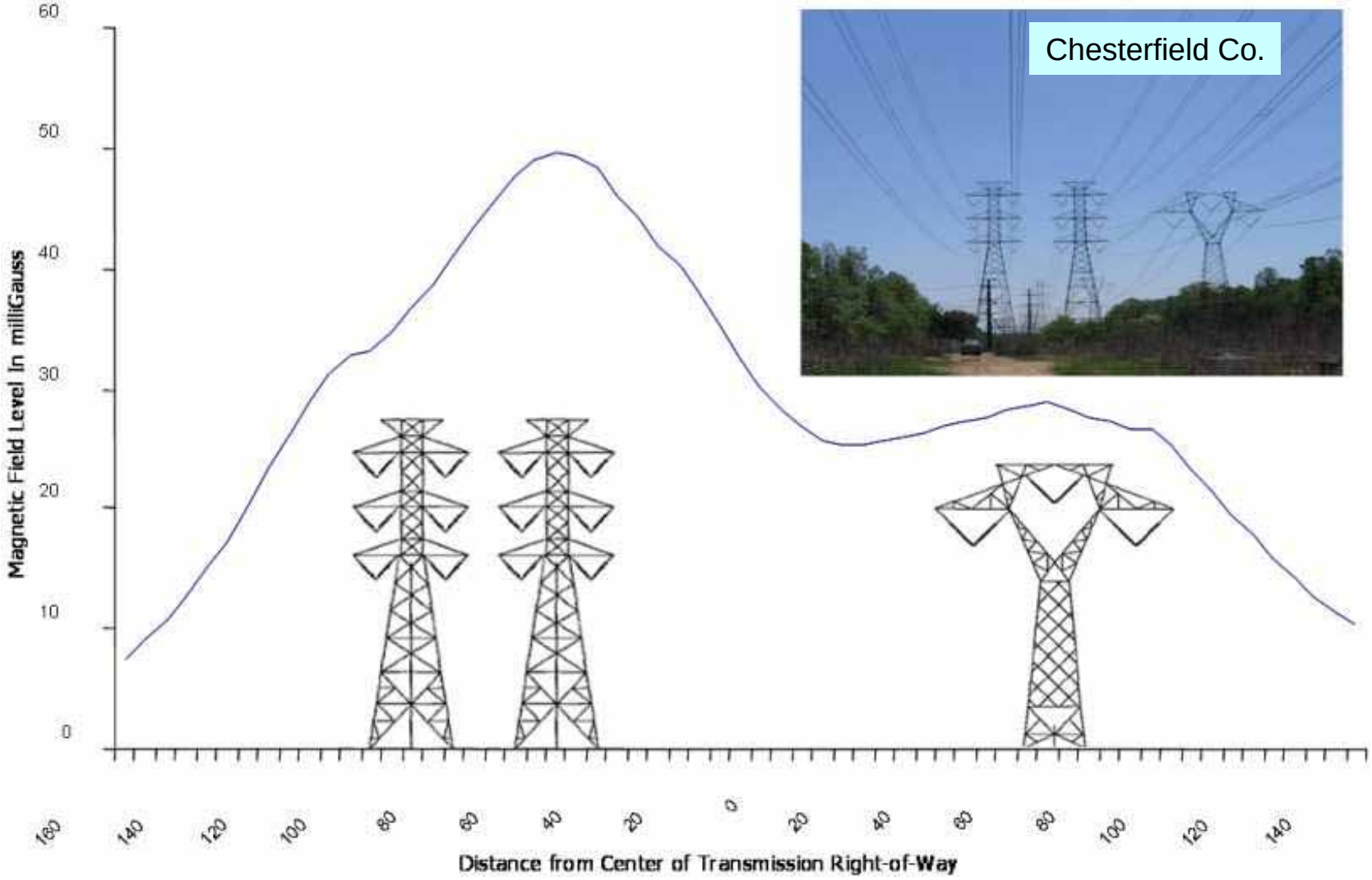
Cash Register
4.4 mG

Car Console
9.4 mG

Television (CRT)
19.9 mG

Laptop PC
20 mG

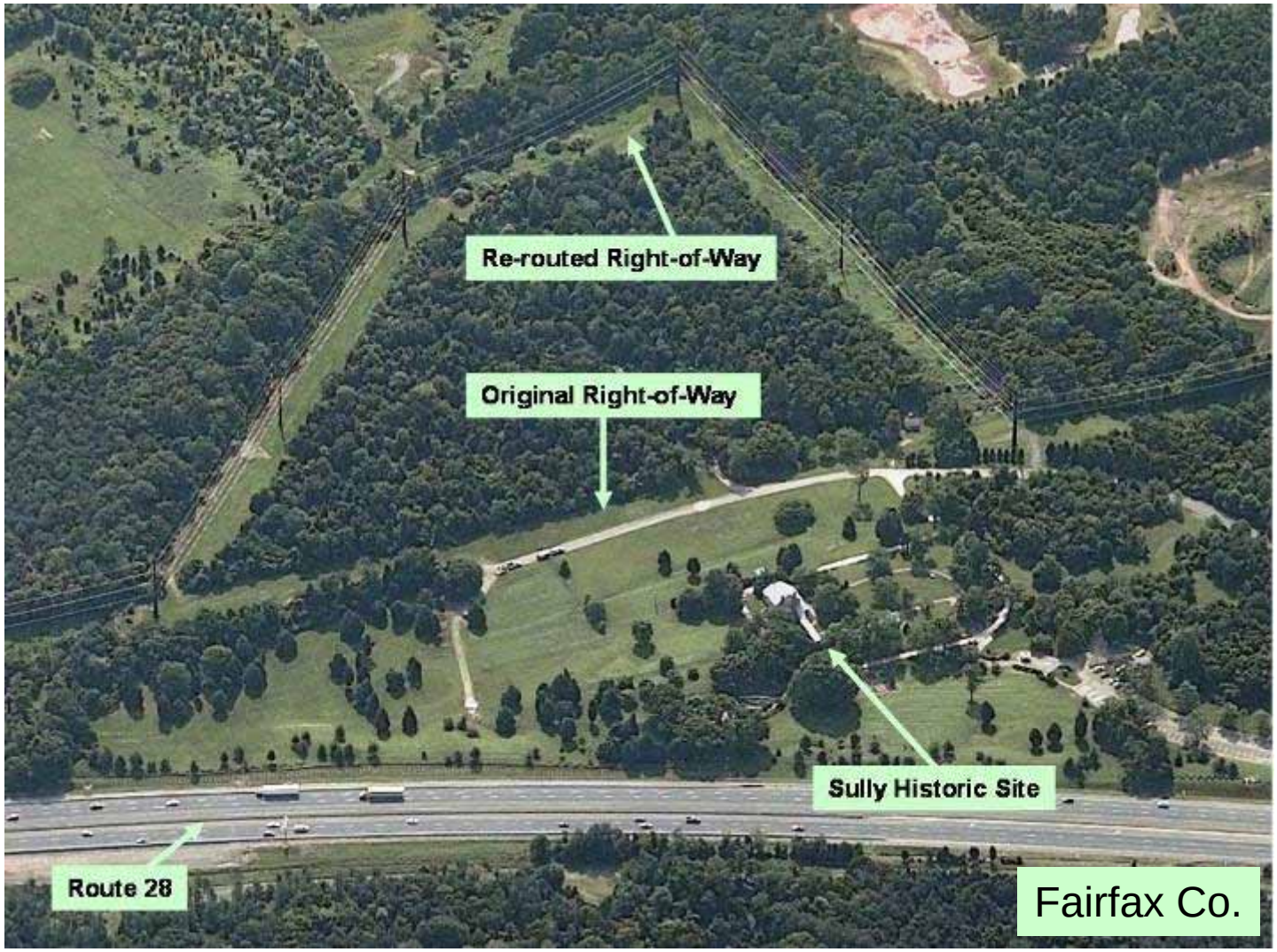
Magnetic Field Levels Vary Within Transmission Rights-of-Way



SCC Has Complied With Environmental Factors by Modifying Overhead Lines

- Environmental concerns have been cited as a reason to avoid undergrounding
- SCC has not found that health and safety effects justify undergrounding
  - Commissioners have not adopted “prudent avoidance”
  - Policy of avoiding homes may minimize exposure
- Undergrounding has not been used to protect historic resources

SCC Reroutes Lines Instead of Undergrounding



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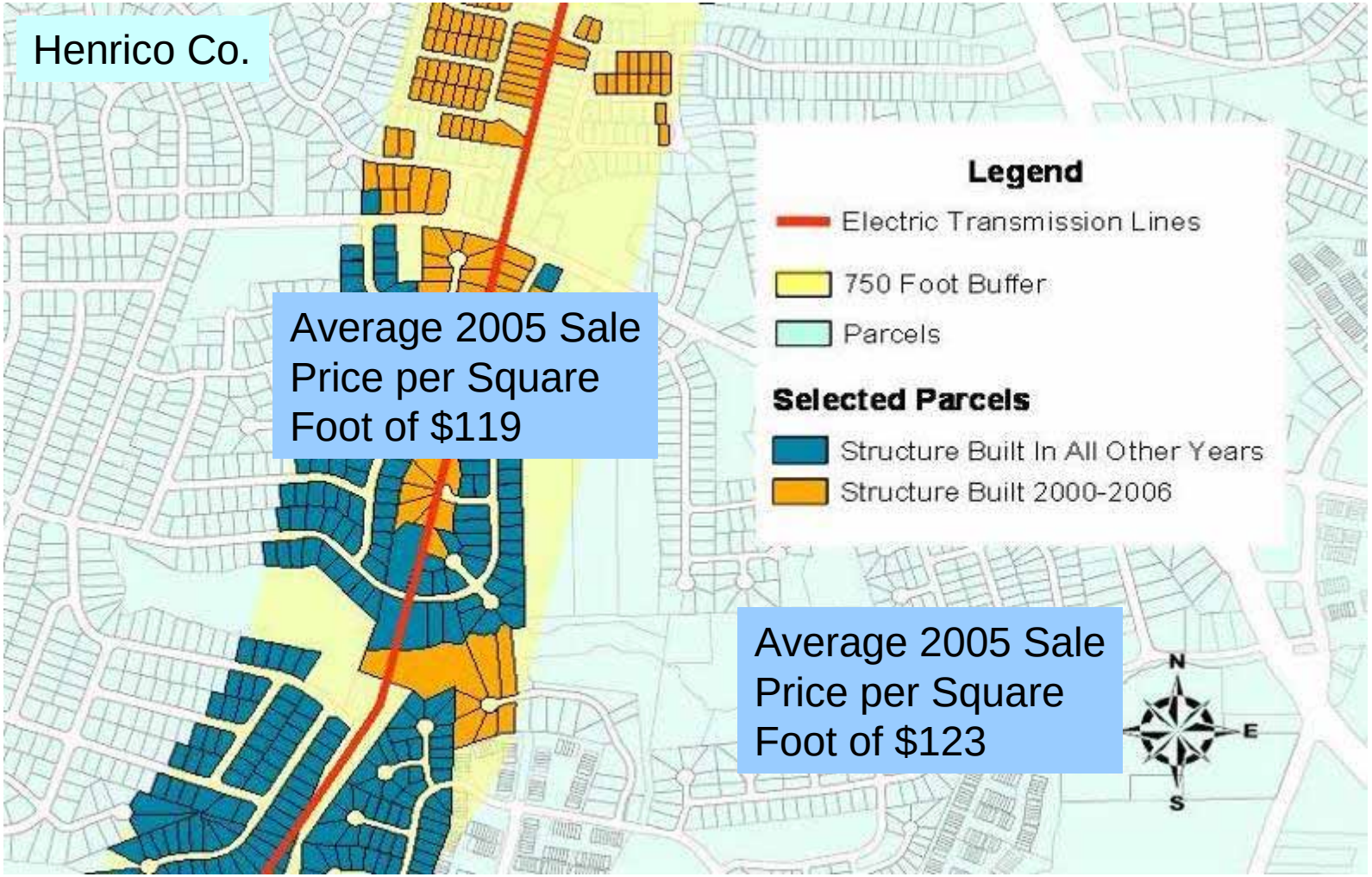
Finding

- Final orders do not explicitly address impact of transmission lines on property values

Property Values May Be Decreased by Transmission Lines

- Property valuation studies indicate that transmission lines decrease property values
  - Overhead lines considered unsightly
  - Public fear that EMF causes cancer
- Many other objects may have a larger effect on property values than transmission lines
- Assessors in Virginia disagree about effect on property values

GIS Analysis Used to Examine Impact on Property Values



SCC Considers Effect on Property Values But Not Explicitly

- In a 1992 case, commissioners appear not to believe they had to consider property values
- One case noted concerns over eminent domain compensation
- 2001 Loudoun Co. case involved link between EMF concerns and decreased property values
- 2002 Loudoun Co. case involved whether landowners should have known line was planned
- 2004 Fauquier Co. case rejected EMF concerns and suggested landowners should be more aware of planned lines

Finding

- Feasibility of allowing surrounding property owners to pay for undergrounding is limited

Four Factors Limit Feasibility

- Obtaining accurate cost estimates for consideration by surrounding property owners may be problematic
- Characteristics of the property affected may affect willingness or ability to pay
- Anticipated increase in electricity rates may affect ability to pay
- Statutory restrictions may hinder use of special assessments

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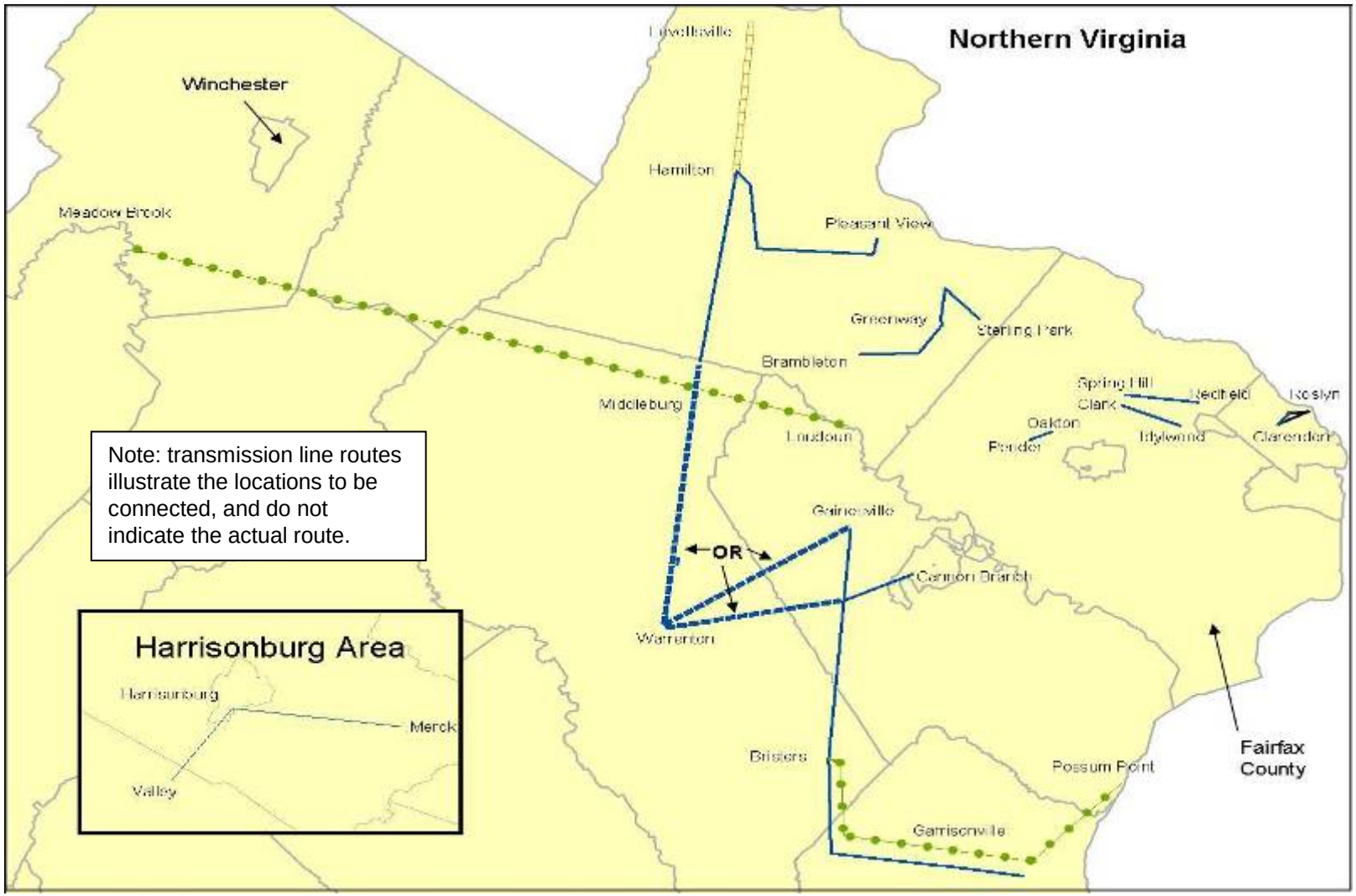
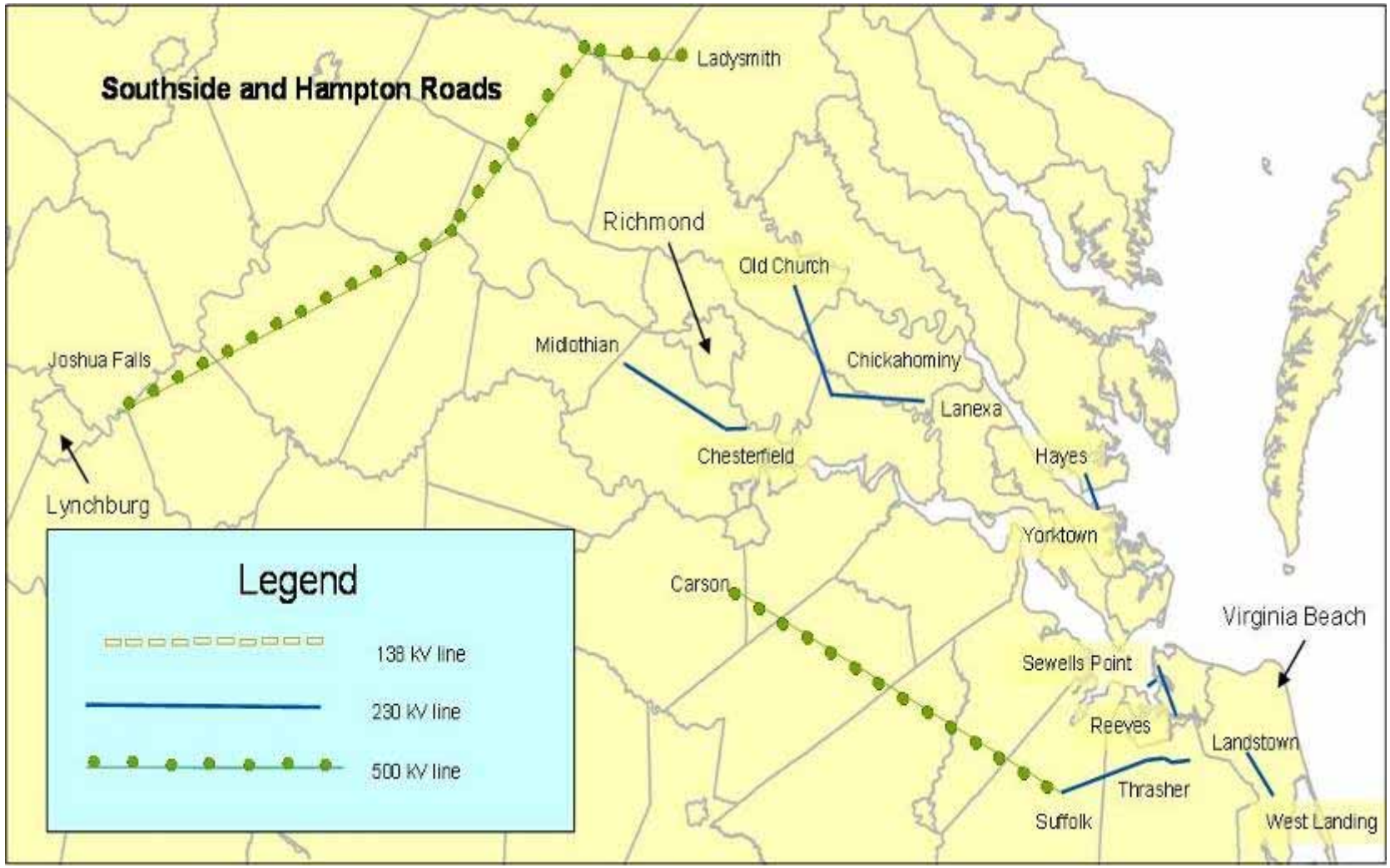
Dominion's Long-Range Plan Anticipates Several New Transmission Lines



Dominion's Long-Range Plan Anticipates Several New Transmission Lines



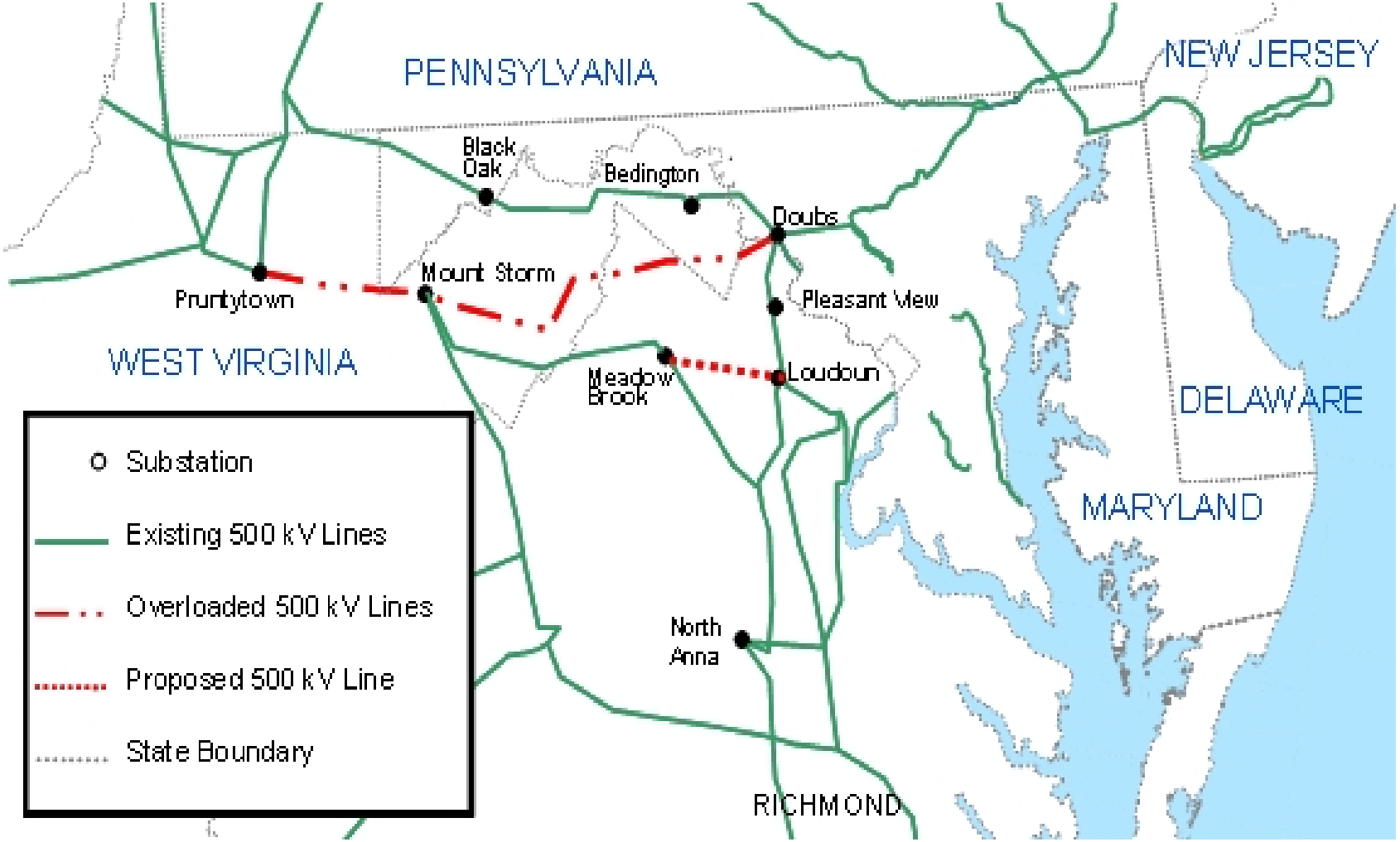
Finding

- Move toward regional and federal planning may diminish the role of the SCC

Transmission Planning and Approval Are Changing

- PJM's regional planning identified need for several new lines in Virginia
  - Several Virginia projects result from or affected by out-of-state transmission needs
  - Dominion may recover most project costs from out-of-state utilities
- By altering the SCC's role, these changes may also affect use of undergrounding
- Changing authority of federal regulators also appears to be affecting SCC's role

New Transmission Line in Virginia Proposed To Address Overloaded Lines in West Virginia



Finding

- Improvements in review of and planning for transmission lines may decrease calls for undergrounding

Recommendations

- Amend FOIA to exempt from disclosure confidential proprietary business information provided to JLARC
- Direct SCC to acquire resources to replicate load projections, load flow studies, & contingency analyses
- Direct SCC to determine which external cost factors should be consistently addressed, and how
- Amend Section 56-46.1 to specifically include underground transmission lines

Improved Coordination Between Utilities and Localities May Address Some Public Concerns

- Dominion staff report challenges staying abreast of changing local conditions
- SCC staff and Dominion assert that localities need to include utility plans in local planning
  - Suggest that a utility's ownership of easements constitutes public notice of intentions
  - SCC staff also argue that Dominion should change its planning process
- Local planning staff desire more information and coordination
  - Localities may benefit from greater regional cooperation

Insufficient Planning and Coordination May Have Resulted in Previous Need to Bury Lines

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Landowners May Be Less Concerned With Pre-Existing Transmission Lines

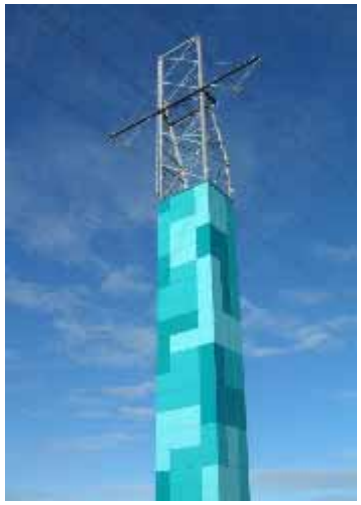
Loudoun Co.

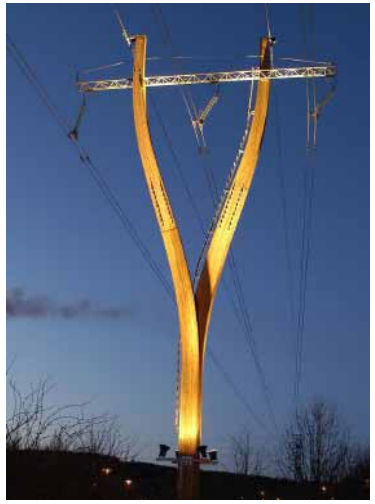
Recommendations

- Amend Section 15.2-2223 to direct local governments to include electric transmission infrastructure needs in their comprehensive plans. Also, direct utilities to provide their long-range plans to local governments and State agencies

- Amend Section 56-265.2 (C) to require utilities to include a GIS map as part of their application to the SCC

Alternative Designs Could Be Considered



Key Findings

- Undergrounding is feasible, in certain circumstances, and new technologies may allow for greater use
- An underground line is typically four to ten times more expensive than an overhead line, but it may be more cost-competitive if there are very expensive right-of-way costs
- SCC rarely supports use of undergrounding primarily because of costs and reliability
- SCC seeks to address environmental and property value concerns associated with overhead lines, but through means other than undergrounding
- More transmission lines are planned in Virginia, and improved coordination and availability of information could enhance decision-making

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