DIRECT TESTIMONY
OF
HYDE M. MERRILL
ON BEHALF OF
PIEDMONT ENVIRONMENTAL COUNCIL
BEFORE THE
STATE CORPORATION COMMISSION OF VIRGINIA
CASE NOS. PUE-2007-00031 AND PUE-2007-00033

Q: PLEASE STATE YOUR NAME AND DESCRIBE YOUR PROFESSIONAL TRAINING AND BACKGROUND.

A: My name is Hyde M. Merrill. I have a doctorate in electrical engineering from MIT. I have been an independent consulting engineer since 1998. For the preceding 18 years, I worked as a consultant at Power Technologies, Inc., doing power system planning studies and developing tools for power system planning and operation. I worked for American Electric Power Service Corporation for seven years after graduating from college. I have been an adjunct professor at Rensselaer Polytechnic Institute and a visiting assistant professor at MIT. I was elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for "contributions to decision analysis considering conflicting objectives and risk in electric power systems." I have published approximately 80 technical papers and book chapters, including roughly two dozen on strategic planning in electric power. My curriculum vita is Exhibit HMM-1.

Q: HAVE YOU PREVIOUSLY PROVIDED TESTIMONY AS AN EXPERT WITNESS OR PROVIDED EXPERT CONSULTING SERVICES?

A: Yes, I have testified before the Michigan Public Service Commission and before the Federal Energy Regulatory Commission (FERC). In front of the FERC, I identified significant deficiencies in the planning procedures of an independent system operator. The FERC agreed and granted the relief sought. I have advised government agencies, including the World Bank, the Inter-American Development Bank, the US Congress Office of Technology Assessment, the

New York State Energy R&D Authority, and the public utilities commissions of New York, Quebec, Panama, Venezuela, Tasmania, and Peru. I have also advised utilities, R&D organizations, and others on power system planning and operation. I have worked in nearly 40 countries. This present assignment is the first time I have advised or provided testimony on behalf of an environmental conservation group.

Q: WHAT TOPICS DO YOU PROPOSE TO ADDRESS IN YOUR TESTIMONY, DR. MERRILL?

A: Counsel for the Piedmont Environmental Council asked me to evaluate: (1) the Prepared Testimony of various witnesses who appear before the Virginia State Corporation Commission on behalf of Dominion-Virginia Power Company (DVP or Dominion) and Trans-Allegheny Interstate Line Company (TrAILCo, a wholly-owned subsidiary of Allegheny Energy) (Applicants), and (2) studies and reports performed by those witnesses and by PJM Interconnection, L.L.C. (PJM), the regional power system operating and transmission planning organization, with respect to the proposed Prexy-502 Junction-Mt. Storm-Meadow Brook-Loudoun 500-kV line (Loudoun line). I focus on the propositions set forth in those testimonies and the consistency of those propositions with engineering analysis and evidence. The present application is for a segment of the Loudoun line within Virginia.

Q: WHAT IS YOUR OVERALL CONCLUSION?

A: The Commission should deny approval and certification of the Loudoun line.

Q: WHY?

A: Planning studies by Applicants and PJM used unrealistic assumptions and unreliable data. The studies led to key conclusions that PJM has since repudiated and to other conclusions that are also incorrect. The studies ignored lower cost and more electrically robust alternatives that

would cause much less environmental damage. Approving this line will lead to increasing reliance by the East Coast on remote coal-fired power plants with continuing or increasing transmission congestion, transmission losses, risk of cascading blackouts and environmental damage. It will harm the ratepayers.

Q: HOW DO YOU PROPOSE TO SUPPORT THIS CONCLUSION?

A: I propose to do so by addressing the following six questions. Each has to do with statutory criteria in Va. Code §56-46.1, except as otherwise noted.

1. In regard to §56-265.2 (adverse effects on rates), is the Loudoun line economically justified and will it provide direct economic benefit to the ratepayers who will pay for the line? As explained below, the answer is: no.
2. Is the line needed to ensure reliable electric service in Northern Virginia? As explained below, the answer is: no.
3. Is the line needed to ensure reliable electric service regionally? As explained below, the answer is: no.
4. In regard to §56-265.2 (effects on reliability, environmental impact, and rates) as well as §56-46.1, do the transmission planning procedures of DVP, Allegheny, and PJM use industry-standard methods based on reliable data and assumptions, and are they properly focused and likely to yield optimal results? As explained below, the answer is: no.
5. If a proposed Amos-Bedington-Kemptown 765-kV line is built, then will the Loudoun line become redundant? As explained below, the answer is: yes.
6. In regard to §56-265.2 (effects on reliability, environmental impact, and rates) as well as §56-46.1, will the construction of major new east-west transmission, beginning with the

Loudoun line, lead to an optimal, balanced, and robust regional power system? As explained below, the answer is: no.

Q: REGARDING YOUR QUESTION 1, WHAT IS YOUR UNDERSTANDING OF THE APPLICANTS' TESTIMONY ON RATEPAYER ECONOMIC BENEFITS OF THE LOUDOUN LINE?

A: DVP witness Stephen R. Herling says on p. 19, "Initial analyses indicate that the 502 Junction-Loudoun line may reduce system generation production cost by over $140 million per year and gross payments by load customers by over $600 million per year." His numbers are consistent with, and I assume are based on, the year 2010 results of the PJM Transmission Expansion Advisory Committee (TEAC) analysis in Figure 1.

Figure 1
Economic Effects of Loudoun ("502 Junction") Line
[Source: PJM TEAC, "Market Efficiency Analysis Preliminary Results" (Feb. 21, 2007)]

	Change in Production Cost ($Millions)		Change in Load Payment ($Millions)		Change in Generation Revenue ($Millions)		Change in Congestion Costs ($Millions)	
Upgrades	2007	2010	2007	2010	2007	2010	2007	2010
502 Junction Line	-153.2	-140.4	-726.0	-621.2	83.4	168.8	-809.4	-790.1

Mr. Herling explains that "Total System Generation Revenues [called 'Change in Generation Revenue' in Figure 1] represents the change in payments made to generators." Exhibit HMM-2.

Q: DO YOU AGREE THAT THE LOUDOUN LINE IS ECONOMICALLY JUSTIFIED?

A: No. PJM's own analysis showed that the line's cost would be greater than its benefit. Figure 1 shows that the line's economic benefit — a reduction in production cost — would be $140.4 million in the 2010 test year. The annualized cost of the line would be about $200 million per year.

Q: WHY DO YOU SAY THAT THE LINE'S ECONOMIC BENEFITS ARE THE REDUCTION IN GENERATION PRODUCTION COSTS?

A: PJM asserts that sometimes there is congestion on west-to-east transmission paths. Operators respond to this congestion mainly by redispatching generation. Redispatch has higher generator operating costs (mainly fuel) than the optimal dispatch that would be possible if there were no congestion. Building a new line may reduce congestion and hence may reduce generator operating costs.

It is true that changes in congestion may also affect real-time prices, payments by ratepayers, and generator revenues. But these only have to do with payments among the parties within the market. As Figure 1 shows, and as I will now discuss, these are only tangentially related to the actual cost of producing power.

There is an important difference between costs and prices. In PJM, the prices that generators bid — which in theory are the derivatives (in the calculus sense) of the generators' production costs — determine generator revenues and prices paid by consumers. Generators' production costs — themselves (not their derivatives) — are not included in the market settlement. Figure 1 captures the effects of the Loudoun line on prices (which determine load payments and congestion costs) and on generation production costs.

Q: DO YOU AGREE THAT THE LOUDOUN LINE WILL CAUSE RATEPAYER COSTS TO GO DOWN?

A: No. As shown in Figure 1, construction of the Loudoun line will cause net PJM ratepayer costs to increase by $168,800,000 in PJM's 2010 test year.

Mr. Herling explained in response to Piedmont's discovery that "Since all congestion charges are rebated back to load customers in the form of FTR revenues[,] then the change in system generator revenues provides an estimate of the change in net payments made by total PJM system load [ratepayers] . . ." Exhibit HMM-3. The conclusion is clear: Mr. Herling must agree that net ratepayer costs will go up in the 2010 test year if the Loudoun line is built. Figure 1 shows that the increase would be $168.8 million.

Q: ARE THERE OTHER SCENARIOS IN WHICH RATEPAYER COSTS GO DOWN?

A: Yes. Mr. Herling advances one 30-year projection that shows Generation Revenues (ratepayer costs) increasing for several years because of the Loudoun line. But after some years, Mr. Herling claims that there is a turnaround, with benefits to the ratepayer of the Loudoun line rising to more than $2 billion per year in the 28th, 29th, and 30th years. See Exhibit HMM-3.

Q: IS THIS 30-YEAR PROJECTION REALISTIC?

A: The 30-year projection is the average of three future generation scenarios that PJM studied. To my knowledge, no one has demonstrated or even claimed that the three scenarios are equally probable, so averaging them has no theoretical basis in statistics or probability. Furthermore, the first 10 years are interpolations based on simulations of years 1 (2007), 4 (2010), 7 (2013), and 10 (2016). The last 20 years are pure straight-line extrapolations of the

first ten, "validated" with simulation data from year 15 (2021). A 20-year extrapolation based on such a meager underlying analysis is highly speculative and unreliable.

One scenario is arguably the most likely of the three because it embodies the most balanced generation expansion pattern. In this scenario, ratepayers will pay much more over the 30 years if the Loudoun line is built.

Q: DR. MERRILL, CAN YOU EXPLAIN WHY YOU AND MR. HERLING DRAW OPPOSITE CONCLUSIONS FROM THE SAME TABLE?

A: I believe the explanation lies in Mr. Herling's use of the word "gross" as opposed to "net". Mr. Herling says that in the 2010 PJM test year the Loudoun line would make ratepayers' "gross" costs go down. But it is the "net" cost that ratepayers see and pay. These will go up if the Loudoun line is built. See Figure 2, which I discuss next and which is based on Figure 1.

Q: CAN YOU EXPLAIN HOW "GROSS" AND "NET" COSTS ARE RELATED?

A: Yes. To best understand this explanation, it may be helpful to remember:

- "Net" costs are what the ratepayer sees and pays.
- "Gross" costs and "congestion" costs or "FTR rebates" are only bookkeeping entries.

With that clarification, let us turn to the year 2010 "Change in Generation Revenue" column in Figure 1.

"Net" costs to the ratepayer are mathematically the difference between two PJM bookkeeping entries in Figure 1, as shown in Figure 2.

Figure 2
The Loudoun line will make net customer costs increase
(2010 PJM test year)

$ 621,200,000	Decrease in gross ratepayer payments
790,100,000	Decrease in FTR rebates to ratepayers
168,900,000	Net increase in rate payer costs
$ 168,800,000	Corrected, probably rounding error

Specifically, as shown in Figure 2 the Loudoun line will reduce "gross payments by load customers by over $600 million per year" — actually by $621.2 million. One might conclude that the Loudoun line will save the ratepayers this large sum. But as Mr. Herling clarified in response to Discovery, as quoted above, the "congestion charges are rebated back to load customers in the form of FTR revenues." Exhibit HMM-3. Figure 1 and Figure 2 show that the Loudoun line will cause these FTR ratepayers' rebates to decrease even more than the gross payments decrease. Therefore, the ratepayers' net payments will go up if the line is built.

Q: WHY DOES PJM MOVE MONEY FROM ONE POCKET TO ANOTHER IN THIS WAY?

A: The effect of PJM's real-time pricing mechanism is to raise prices — dramatically — when congestion occurs. This is intended to send a price signal to encourage more generation and demand side savings in congested areas. However, to protect ratepayers from huge price increases due to congestion, PJM created a hedging mechanism. PJM captures a portion of the congestion-related price increase, which it calls "Congestion Costs." PJM then rebates these increased costs to the ratepayers through the FTR mechanism as Mr. Herling described. See Exhibit HMM-3. These are bookkeeping procedures carried out within the market accounting and billing system.

Q: DO YOU MEAN TO SAY THAT "CONGESTION COSTS" ARE SIMPLY A BOOKKEEPING ENTRY?

A: Yes. When Mr. Herling and others refer to congestion costs of $1.2 billion in a single year, for example, they are referring to ratepayer rebates, not to costs paid by ratepayers.

Q: THANK YOU, DR. MERRILL. PLEASE SUM UP WHAT YOU HAVE SAID ABOUT FIGURE 1.

A: The first conclusion I draw from Figure 1 is that the Loudoun line will make actual net ratepayer payments increase by $168,800,000 per year, and the generators will get all of this as increased income.

Q: DO YOU HAVE ANY FURTHER OBSERVATIONS TO MAKE CONCERNING FIGURE 1?

A: Yes, I have two further observations.

First, the table does not take into account the annualized cost of the Loudoun line itself, a sort of mortgage payment estimated by PJM to be about $200,000,000 per year for the lifetime of the line. The ratepayers will pay this amount too, in addition to the $168,800,000 per year in increased payments to generators. This means that the true cost to the ratepayers, if the Loudoun line is built, will be the increase in the net payment ($168,800,000 per year) (Figure 2) plus the $200,000,000 per year cost of the Loudoun line, for a total of $368,800,000 in increased payments per year, as shown in Figure 3.

Let me put this in context. J. Craig Baker, a Senior Vice President of American Electric Power (AEP), wrote a very strong letter to the PJM Board on October 15, 2007. Exhibit HMM-4. He vigorously attacked a PJM decision that would cost the ratepayers $31 million per year. The Loudoun line will cost the PJM ratepayers twelve times this amount.

Figure 3
The Loudoun line will make total customer costs increase
(2010 PJM test year)

$ 621,200,000	Decrease in gross ratepayer payments
790,100,000	Decrease in FTR rebates to ratepayers
168,900,000	Net increase in rate payer costs
$ 168,800,000	Corrected, probably rounding error
200,000,000	Annualized cost of the line itself
$ 368,800,000	Total increase in ratepayer costs

Q: IS THIS RATEPAYER COST INCREASE A TOTAL THAT IS SHARED OVER ALL OF PJM?

A: Yes, though not necessarily equally.

Q: DOES PJM CLAIM THAT RATEPAYER COSTS IN VIRGINIA WILL GO DOWN IF THE LOUDOUN LINE IS BUILT?

A: A table that appears in several PJM working reports can be so interpreted, but this interpretation would be incorrect. The table refers to gross ratepayer costs, not net ratepayer costs. It does not reflect ratepayer rebates through the FTR mechanism.

Q: WHAT IS YOUR SECOND FURTHER OBSERVATION, DR. MERRILL?

A: The PJM study that produced Figure 1 concluded that the Loudoun line would reduce congestion and, as a result, would reduce generation production costs (mainly fuel) by $140,400,000 per year. Exhibit HMM-2. I explained and showed earlier that the effect of the Loudoun line on the net amount paid by the customers equals the effect on generator revenues: both increase by $168,800,000. Aside from this amount, the generators will retain the $140,400,000 in production cost savings, as shown in Figure 4.

Figure 4
The Loudoun line will make generator income increase (2010 PJM test year)

$ 168,800,000	Increase in revenue
140,400,000	Decrease in production (fuel) cost
$ 309,200,000	Net increase in generator income

In sum, the Loudoun line will increase generator profits by $309,200,000.

Q: PLEASE RECAPITULATE THE EFFECT OF THE LOUDOUN LINE ON RATEPAYERS AND GENERATORS.

A: According to PJM's numbers in Figure 3 the Loudoun line — a single project — will enrich generators by $309,200,000 per year and will cause ratepayers as a whole throughout PJM

to pay $368,800,000 per year more for their electricity than would be the case without the Loudoun line.

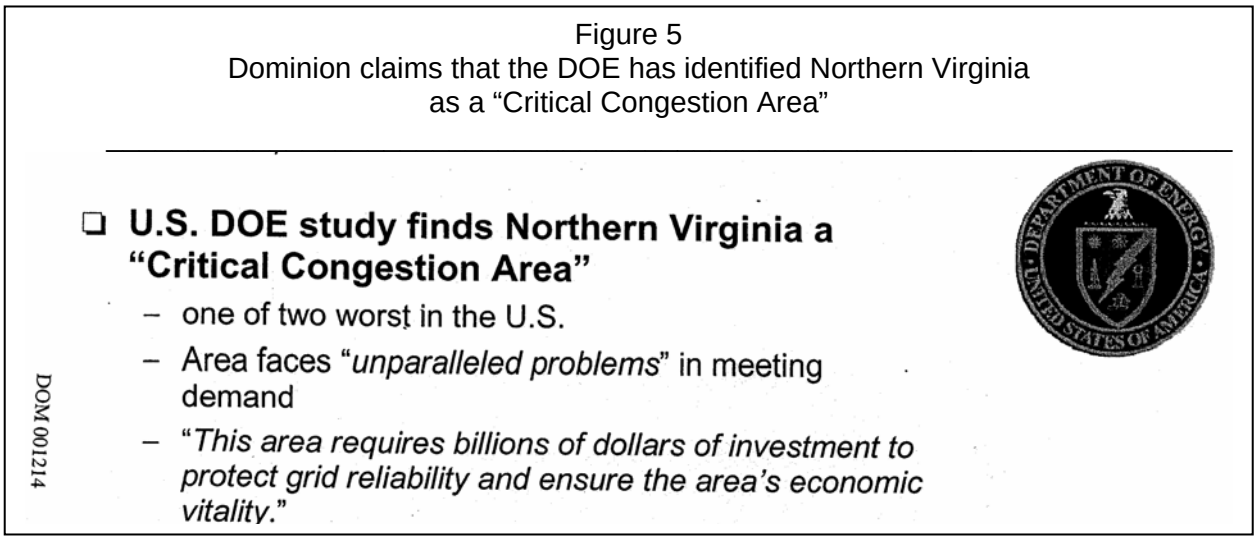
Q: REGARDING YOUR QUESTION 2, WHAT IS YOUR UNDERSTANDING OF THE APPLICANTS' TESTIMONY ON WHETHER THE LOUDOUN LINE IS NEEDED BECAUSE OF LOAD GROWTH IN NORTHERN VIRGINIA?

A: Mr. John D. Smatlak, on pp. 2 and 3 of his direct testimony on behalf of DVP, says: "As the testimony of several of our witnesses shows, there is a critical need for this line to maintain reliability of service in northern Virginia. . . . [T]he proposed project will need to be in operation by summer of 2011. The rapid growth, and the consequent increased demand for electricity in northern Virginia, is widely recognized, and the Company must act now to meet the needs of this vital region. Reliable service to hundreds of thousands of our customers is at stake in this proceeding."

In a set of Questions and Answers sent in response to letters to its Directors and provided to Piedmont in discovery, DVP asked rhetorically, "Who will get the energy flowing through the power line?" and answered that, "This energy is needed for the homes, hospitals, schools and businesses of Northern Virginia." Exhibit HMM-5. In another set of Questions and Answers, DVP said "To meet the growing demand for reliable electricity in Northern Virginia, Dominion Virginia Power and Allegheny have proposed . . . to build [the Loudoun line]." Exhibit HMM-6.

DVP has also claimed repeatedly that the US Department of Energy has identified Northern Virginia as a critical congestion area. Figure 5 is an example. The source for Figure 5 is Exhibit HMM-7.

Figure 5
Dominion claims that the DOE has identified Northern Virginia as a "Critical Congestion Area"



Q: DO YOU AGREE THAT THE LOUDOUN LINE IS NEEDED BECAUSE OF LOAD GROWTH IN NORTHERN VIRGINIA?

A: No. DVP projects that the summer peak load in Northern Virginia will grow from 6,368 MW in 2006 to 6,833 MW in 2011 – an increase of 465 MW. It is illogical to claim that a line capable of delivering 3,000 MW is needed to supply 465 MW of new load.

Equally illogical is the claim of KEMA, Inc., in a report sponsored by DVP witness P. Jeffrey Palermo, that Northern Virginia load would have to be reduced by 3,000 MW in 2011, using demand-side management, in order to avoid having to build the Loudoun line. KEMA does not explain why a Northern Virginia load increase of 465 MW must be offset by trimming 3,000 MW from Northern Virginia load.

Q: WHAT ABOUT DVP'S CONTENTION THAT THE DOE HAS DESIGNATED NORTHERN VIRGINIA AS ONE OF THE COUNTRY'S TWO CRITICAL CONGESTION AREAS?

A: DVP quotes the DOE out of context. The DOE's two critical congestion areas are Southern California and the Mid-Atlantic coastal area from north of New York City to Northern Virginia.

With regard to the latter, the DOE's August 2006 *National Electric Transmission Congestion Study* states at page 41: "[M]ajor transmission upgrades will be needed in parts of Delaware, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia, and perhaps Ohio to enable delivery of enough Midwestern generation to the Mid-Atlantic area to meet that area's growing reliability and economic needs. This area requires billions of dollars of investment in new transmission, generation, and demand-side resources over the next decade . . ." DOE's billions of dollars are for transmission, generation and demand-side resources -- not just transmission. Moreover, the billions of dollars are not confined to Northern Virginia.

Q: TO WHAT AREAS WAS THE DOE REFERRING?

A: The DOE study lists on pp. 41-42 specific areas where "congestion problems are worsening." The complete list in DOE's words is:

Southeastern New York	Transmission constraints in the Allegheny Mountains
As a whole, New York state	Retirements of generation [no area is specified]
New Jersey	The Delmarva Peninsula
The Delaware River Path [a conduit from Wilmington and Philadelphia to upper New Jersey]	The Baltimore-Washington, DC area

Northern Virginia is not separately listed. It is not a significant focus of the report. DVP is wrong when it attempts to apply to Northern Virginia something that the DOE said about a much larger region and not about Northern Virginia.

Q: HAS PJM SPECIFIED WHERE THE CAPACITY OF THE LOUDOUN LINE IS NEEDED, IF AT ALL?

A: Yes. DVP witnesses point to the PJM "Regional Transmission Expansion Plan" (RTEP) report dated February 27, 2007, which is sometimes referred to as "the 2007 RTEP." Exhibit HMM-8. The RTEP concedes that the Loudoun line will serve needs in Pennsylvania, Delaware, Maryland, the District of Columbia, and possibly other load centers, in addition to Northern Virginia.

Northern Virginia demand is only 19% of the load and increase in load that, according to PJM, the Loudoun line would serve. See Figure 6.

Northern Virginia's share of the regional load is even less than what Figure 6 shows. That exhibit excludes Allegheny Power customers in Northern Maryland who are served from the Doubs and Bedington substations and who would be served in part by the Loudoun line, according to PJM. The KEMA report indicates that the demand of the Allegheny Power customers in Northern Maryland might amount to about 2,200 MW. Using KEMA's numbers , Northern Virginia demand falls to 18% of the load to be served by the Loudoun line.

Figure 6
Northern Virginia accounts for a small fraction of the demand
(in megawatts, MW) that the Loudoun line is supposed to help serve.

	2006	2011 Forecast	Increase
Northern Virginia	6,368	6,833	465
PECO Energy Co. - PA	8,337	8,904	567
Delmarva Power & Light - DE, MD	3,994	4,403	409
Baltimore Gas & Electric - MD	7,212	7,703	491
PEPCO Holdings - DC	6,953	7,474	521
Totals	32,864	35,317	2,453

Sources:
Northern Virginia: Dominion filing, Attachment I.B.3
All others: RTEP report

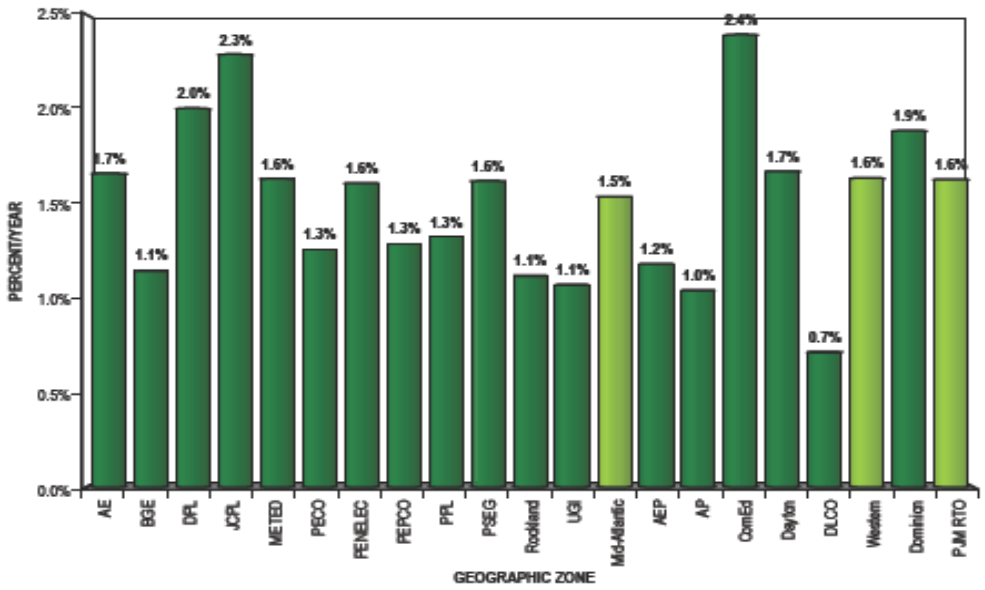
Q: WHAT IS YOUR UNDERSTANDING OF DOMINION'S VIEW ON HOW PROJECTED LOAD GROWTH IN NORTHERN VIRGINIA COMPARES TO LOAD GROWTH ELSEWHERE IN PJM?

A: In a March 15, 2007, presentation to the Loudoun County Economic Development Commission, DVP claimed that "The highest growth rate [in PJM] during [the next ten years] is expected to be in . . . Dominion." On April 25, 2007, DVP's President, Paul D. Koonce, appeared before the US House of Representatives Subcommittee on Domestic Policy. He testified: "More load growth is expected to occur in our load area in the next five years than in any other PJM region." Exhibit HMM-9.

Q: WERE THESE REPRESENTATIONS ACCURATE, DR. MERRILL?

A: No. Indeed, PJM has apparently rejected them. Figure 7 shows PJM's forecast for PJM as a whole (labeled PJM RTO) and for its various member companies. It shows DVP's load growing over the next ten years at an annual rate of 1.9%. This is plainly not the highest growth rate in PJM. It is less than the 2.3% per year for Jersey Central Power and Light, 2% per year for Delmarva Power and Light, and 2.4% per year for Commonwealth Edison – each of which is within PJM. Exhibit HMM-8.

Figure 7
Projected Regional Load Growth in PJM



Furthermore, load growth in the District of Columbia and Maryland suburbs, including Baltimore, is projected to be 1.3% and 1.1% per year, respectively. If we average these load growths with DVP's, the projected load growth of the region most immediately served by the Loudoun line is close to PJM's average of 1.6% per year.

Q: DOES DOMINION SAY THE LOUDOUN LINE IS NEEDED TO PRESERVE RELIABILITY IN NORTHERN VIRGINIA?

A: Yes, it does. John D. Smatlak, on p. 2 of his direct testimony concludes that, "there is a critical need for this line to maintain reliability of service in northern Virginia." Similarly DVP witness James R. Bailey at p. 4 of his direct testimony cites the 2003 Northeast Blackout, warning about the significant impact that a transmission event can have. DVP also published statements to the effect that "The grid conditions that existed in Northeastern Ohio prior to the [2003] Northeast Blackout will exist in Northern Virginia in 2011, unless something is done." Exhibit HMM-10. DVP confirmed that by "unless something is done," DVP means, "unless the Loudoun line is built." Exhibit HMM-11.

Q: DO YOU AGREE WITH THESE CLAIMS, DR. MERRILL?

A: No. Even during peak hours, DVP's generation dispatched exceeds its load through 2012, according to PJM data. See Exhibit HMM-12. DVP is a net exporter.

Moreover, the Applicants' studies are seriously flawed because their data dramatically underestimate new generation in eastern PJM. In PJM's study databases only 19.8 MW of new generation are added between 2007 and 2011 in Virginia, Maryland, Delaware and the District of Columbia, according to PJM response to Discovery. None of this is in Virginia. Exhibit HMM-13. PJM later amended this discovery response, claiming, *inter alia*, that a new 640 MW generation project in Maryland was modeled in 2011 and 2012 studies. Exhibit HMM-14. But

an examination of three PJM load flow databases for 2011 and one for 2012 shows that, yes, the project is in the databases, but it is represented as turned off – not producing any power. The project is under construction as of 2007, with a 2009 in-service date. It should be modeled as producing power in 2011.

To assume only 19.8 MW of new generation in the area referred to, and none in Virginia, is unrealistic. If one makes more reasonable estimates of future generation additions, then DVP can continue to be a net exporter beyond 2012.

Under these conditions, the existing five 500-kV lines entering DVP's service territory are sufficient to make up for any generation contingency within DVP. That would cease to be the case only if those existing lines were heavily loaded with power flowing through DVP to supply loads that are not in Northern Virginia but rather to the east and north, in the District of Columbia, Maryland, Delaware, and Pennsylvania. Any reliability problem that may exist, then, is a regional problem, and not a problem either of DVP or Northern Virginia.

Q: WILL NORTHERN VIRGINIA BECOME VULNERABLE TO A 2003-STYLE BLACKOUT IF THE LOUDOUN LINE IS NOT BUILT?

A: No. DVP's repeated invocation of the 2003 blackout is a baseless and irresponsible scare tactic.

Q: HOW IS THAT, DR. MERRILL?

A: In discovery, Piedmont asked DVP to identify those transmission deficiencies that caused the 2003 Northeast Blackout, which will obtain in Northern Virginia in 2011, if the Loudoun line is not built. DVP declined to do so. Exhibit HMM-11.

In fact, a cabinet-level bi-national commission determined that operating errors, not deficiencies in the regional transmission system, caused the 2003 Northeast Blackout. Exhibit HMM-15. Piedmont asked if Applicants agreed with the conclusions of this commission. PJM and TrAILCo answered that they "do not take a position on these conclusions" regarding North America's largest blackout to date, one that spanned their systems on the watch of their current technical and institutional leaders. Exhibit HMM-16. DVP also declined to agree or disagree with the commission's conclusions. Exhibit HMM-17.

It is noteworthy that the Applicants disclaim understanding what caused the last major blackout and then in the testimony of DVP witness Edward V. Badolato describe in detail the next one.

Q: TURNING TO YOUR QUESTION 3, WHAT IS YOUR UNDERSTANDING OF THE APPLICANTS' TESTIMONY ON WHETHER THE LOUDOUN LINE IS NEEDED REGIONALLY FOR RELIABILITY?

A: The Applicants' advance reliability concerns under certain contingencies that could be characterized as regional:

1. The Mt. Storm-Doubs and Pruntytown-Mt. Storm 500-kV lines may overload in 2011 and 2014, respectively;
2. Low voltage may occur near the Meadow Brook substation in 2011;
3. Some lower voltage lines and transformers in western Virginia may overload; and
4. In 2016, many lines in eastern PJM could overload and voltage problems could occur throughout eastern PJM.

Q: PLEASE DISCUSS THE POTENTIAL OVERLOADS ON THE PRUNTYTOWN-MT. STORM-DOUBS LINES.

A: Certainly. The DVP/Allegheny/PJM projection of overloads on the Pruntytown-Mt. Storm-Doubs 500-kV lines is not supportable. These overloads show up in computer models as a direct result of an unrealistic and unreasonable assumption.

Q: WHAT IS THAT ASSUMPTION?

A: The assumption is that almost no new generation will be built in eastern PJM and that projected retirements will occur. PJM databases used for all reliability studies assume, for instance, that only 19.8 MW of new generation will be added in Virginia, Maryland, Delaware, and the District of Columbia between now and 2012 and only 664 MW more by 2016. Exhibit HMM-13. In contrast, the same databases assume that thousands of MW of new coal-fired generation will be built in western PJM.

With modest demand growth, but with essentially no new generation in eastern PJM in the next ten years, of course imports from western PJM into eastern PJM would grow. Of necessity the computer models using this unreasonable assumption will show overloading on west-to-east lines.

Q: HOW DO YOU KNOW THAT PJM MAKES THIS ASSUMPTION?

A: None of the utilities involved publicly acknowledges this assumption and its implications. The assumption is buried in the technical databases, which are not publicly available. I reviewed the databases and I added up the generation, year by year and company by company. In responses to Discovery, DVP confirmed my conclusions, as noted above.

Q: CAN PJM'S ASSUMPTION REGARDING THE AMOUNT AND LOCATION OF FUTURE GENERATION BE JUSTIFIED?

A: No. Figure 8 shows that thousands of MW of generation projects are currently proposed for eastern PJM. An examination of the PJM RTEP report on which Figure 8 is based shows that most of this is gas-fired generation with in-service dates of 2011 or earlier. And there is more. Figure 8 does not include many potential additions in the area, including the following. See Exhibit HMM-8.

Figure 8
New generation in local PJM interconnection queues
Source: PJM RTEP Report

Location	MW
Delmarva	980
MD + DC	5,170
Dominion	3,209

- The 600-MW CPV gas-fired Warren plant is to be built near Meadow Brook by 2010. The plant reportedly obtained all needed permits and signed an interconnection agreement with DVP several years ago. The developers put it on hold temporarily. However, the developers are on record as having informed DVP and PJM in 2006 that they have decided to go forward. This plant is not in any of the databases used or included in DVP's application.
- A similar 600 MW gas fired plant in Charles County, MD, near Washington, DC, is to be built by the same developers for service in 2011. This unit was announced in July 2007.
- DVP announced three new gas turbines, totaling 510 MW, to be built at the company's existing site at Ladysmith, two by 2008 and the third by 2009. The site already has two such units and has space for the additional three. Two of the three units entered the study queues in October 2006. While the third was not announced publicly until July 2007, after DVP filed for the Loudoun line, surely DVP has been studying these units for a long time and knew they were in the pipeline.

Mirant Mid-Atlantic is one of the largest independent power producers in PJM. It operates 5,000 MW of capacity in the Washington DC area. In a June 7, 2007 letter to Steve Herling, PJM's Vice President Planning and a DVP witness, Mirant CEO Robert E. Driscoll discussed the proposed Amos-Kemptown 765-kV line, which parallels the Loudoun line. He said that Mirant's analysis "shows that facility overloads are highly sensitive to . . . [generation] assumptions used in the model." Mirant says that this may amount to "perhaps 2 MW of transmission flow for every [1] MW of generation." Mr. Driscoll goes on to complain that PJM made independent and far-reaching assumptions about Mirant plants. Although these comments addressed the Amos-Kemptown 765-kV line, they apply at least qualitatively to the Loudoun line, as well. Mr. Driscoll's letter is attached as Exhibit HMM-18.

If in the neighborhood of 3,000 MW (depending on location) of the generation in Figure 8 materializes, not to mention other projects such as the CPV and Ladysmith units, major new transmission will not be needed in 2011, according to the report of DVP's consultant KEMA. The KEMA report (pp. 69-70) says that 3,000 MW of new generation at Loudoun, or dispersed throughout Northern Virginia, would displace the line. Moreover, as I explain below, nowhere does KEMA demonstrate that all of this new generation must be in Northern Virginia.

Q: DOES PJM AGREE THAT THE LOUDOUN LINE WILL RESOLVE THE OVERLOADS OF THE MT. STORM-DOUBS AND PRUNTYTOWN-MT. STORM LINES?

A: PJM once agreed, but apparently no longer does. PJM now says that the Loudoun line is merely a temporary one-year solution to the overload problems.

In July 2006 PJM said that the Mt. Storm-Doubs and Pruntytown-Mt. Storm lines would overload in 2011 and 2014, respectively, and that the Loudoun line would resolve all overloads on these and parallel lines in the Allegheny Power South (Allegheny Mountain) path through the end of the planning horizon, 2021. Exhibit HMM-2. PJM's RTEP report of February 2007 disavows these claims. Exhibit HMM-8 p. 214. In May 2007, PJM said that the Mt. Storm-Doubs and Pruntytown-Mt. Storm lines will overload in 2012 and 2015, respectively, even if the Loudoun line is built. PJM TEAC Reliability Analysis Update, May 9, 2007, http://www.pjm.com/committees/teac/downloads/20070509-interconnection-planning-study-update.pdf.

Q: DR. MERRILL, PLEASE NOW ADDRESS THE APPLICANTS' CLAIM THAT THE LOUDOUN LINE IS REQUIRED TO ADDRESS A SECOND RELIABILITY PROBLEM – LOW VOLTAGE NEAR MEADOW BROOK.

A: Voltage in an EHV system may drop below its normal level when a local area draws power from the grid, especially under certain contingencies. An excessive drop results in voltage collapse and a local blackout that may cascade. At Meadow Brook, the problem is said to occur under an extreme double contingency involving loss of both of the 500-kV lines feeding into Meadow Brook substation.

The low-voltage problem is well understood. In fact, future low voltage has been diagnosed in several places in PJM. In early 2006, PJM studied and recommended installing dynamic reactive devices (static volt-ampere-reactive (VAR) compensators (SVCs) or similar devices) at Meadow Brook, Doubs, and two locations in Pennsylvania to solve low-voltage problems at those locations. Exhibit HMM-19 (DOM 000218-219). The last three are now in PJM's RTEP as projects scheduled to be carried out. Despite the fact that PJM has studies using

such devices at Meadow Brook and elsewhere, an SVC at Meadow Brook has not (to my knowledge) been considered as a possible solution to low voltage near Meadow Brook.

Q: WOULD AN SVC AT MEADOW BROOK OBVIATE THE LOW-VOLTAGE-BASED JUSTIFICATION FOR THE LOUDOUN LINE?

A: Yes. SVCs are standard technology devices. The one needed at Meadow Brook is in the same size range as the other three mentioned above. According to PJM, this SVC would cost about $35 million — considerably less than the $1 billion cost of the Loudoun line. The SVC would be installed in the substation. Its only environmental impact would be a footprint measured in square feet.

Q: ARE THERE OTHER SOLUTIONS TO LOW VOLTAGE AT MEADOW BROOK?

A: Yes. In addition to SVCs and similar devices, power plants are important sources of VARs and voltage regulation. The CPV Warren plant that I discussed earlier at essentially zero cost could provide about a third of the VARs needed to prevent voltage collapse at Meadow Brook. A smaller SVC (around 350 MVA) could provide the rest. With a controllable VAR source (the Warren plant), the remaining VARs might be provided through switched capacitors, which are even cheaper than an SVC.

Q: WOULD THE LOUDOUN LINE SOLVE LOW VOLTAGE AT MEADOW BROOK UNDER THE IDENTIFIED CONTINGENCIES?

A: It might. Nevertheless, building the Loudoun line to solve the voltage problem at Meadow Brook is far more expensive and environmentally damaging than the standard methods I mentioned, which are known to the Applicants and are applied throughout PJM.

Q: PLEASE DISCUSS THE OVERLOADS OF LOWER-VOLTAGE LINES AND TRANSFORMERS IN WESTERN VIRGINIA, THAT APPLICANTS ADVANCE AS A THIRD RELIABILITY PROBLEM REQUIRING THE LOUDOUN LINE.

A: Such problems are everyday fare for planning engineers. Perhaps the Loudoun line would solve some of them without further action. But PJM and its member utilities are expert in solving these problems at much lower cost, and with much less environmental impact, than by building a new 500-kV transmission line.

Q: PLEASE DISCUSS THE OVERLOADS AND VOLTAGE PROBLEMS THROUGHOUT EASTERN PJM IN 2016 THAT THE APPLICANTS POSIT AS A FOURTH RELIABILITY CONCERN REQUIRING THE LOUDOUN LINE.

A: The applicants' description of these problems leads me to suspect that their power flow program would not converge or solve. This commonly occurs when the generation and demand are out of balance. PJM apparently got the program to converge by reducing VAR loads in the program's input data for eastern PJM by 1,000 MVAR, proportional to the projected nominal loads. Exhibit HMM-20. This artifice allows the software to function, but does not resolve any fundamental line overload or voltage problems.

These fundamental problems are simply further manifestations of the erroneous underlying assumption that essentially no new generation will be built in eastern PJM. Generators supply both VARs and MW. Making reasonable assumptions regarding future generation would likely resolve all or most of the 2016 problems. The rest could probably be fixed with minor projects appropriately located.

Q: DR. MERRILL, PLEASE PROVIDE EXAMPLES OF SUCH MINOR PROJECTS.

A: Power systems evolve continually. It would be uneconomical to size all of the equipment, today, to be adequate through the indefinite future. Instead, equipment is sized for a reasonable horizon, and then supplemented or replaced when it becomes necessary. PJM's RTEP is full of such projects. For example, PJM recently concluded that a request for 1,000 MW of west-to-east firm transmission service from First Energy into PJM could be granted on "completion of upgrades to the first 1/10th of a mile of the Pruntytown-Mt. Storm 500-kV circuit." See Exhibit HMM-8, p. 65. Other such projects include replacing or adding transformers, tapping transmission lines, adding VAR sources, reconfiguring substations, replacing wave traps and switches, etc. These projects are legitimate. Moreover, they are much cheaper than the 500 kV Loudoun transmission line.

Q: TURNING TO YOUR QUESTION 4, IS IT IMPORTANT THAT THE TRANSMISSION PLANNING PROCEDURES OF DOMINION, ALLEGHENY, AND PJM USE INDUSTRY-STANDARD METHODS AND CRITERIA?

A: Yes.

Q: WHY, DR. MERRILL?

A: DVP or PJM methods and criteria that are more stringent or weaker than industry-standards will result in a system that is more expensive (and hence more profitable to the utility) and more reliable, or alternatively cheaper and less reliable.

There is a trade off between cost and strictness of criteria. Adhering to a stricter criterion requires greater investment. It will cause greater cost to the ratepayer and will give greater profit to the utility insofar as rates are set proportional to investment. We don't make any system

100% reliable because it would require infinite cost. The Applicants understand this concept. Exhibit HMM-21.

When an organization adopts a criterion that is more or less strict than the collective wisdom of the industry, the organization ought to justify it by evaluating the implications, including the cost-reliability trade off. I have been unable to find evidence that PJM or DVP have done so.

There is also a risk in adopting methods and criteria that are merely different from industry standard methods and criteria, when it is not demonstrated that they are weaker or stricter. To do so may have unintended effects if, in some circumstances, they turn out to be weaker or stricter than the industry standards.

Q: CONTINUING WITH YOUR QUESTION 4, WHAT IS YOUR UNDERSTANDING OF THE APPLICANTS' TESTIMONY ON WHETHER THE TRANSMISSION PLANNING PROCEDURES OF DOMINION, ALLEGHENY, AND PJM USE INDUSTRY-STANDARD METHODS AND CRITERIA?

A: The Applicants claim repeatedly that the Loudoun line is needed to avoid violation of criteria established by the North American Reliability Council. They contend that these criteria are industry standard because they were approved by the FERC. Exhibit HMM-22.

DVP witness James R. Bailey claims that DVP and PJM found "NERC reliability violations that will directly impact northern Virginia load areas beginning in Summer 2011" (p. 13) and "Dominion Virginia Power will not be able to meet projected growth in a reliable manner consistent with NERC Reliability Standards" (p. 17).

DVP contractor KEMA purports to have used "national, regional and DVP planning criteria and standards" in its studies. KEMA emphasized that "Good utility planning practices require:

- Using reliable data and assumptions;
- Using industry-standard methods and computer tools; and
- Using accepted national and local reliability criteria."

Q: DID THE APPLICANTS USE INDUSTRY-STANDARD METHODS AND CRITERIA?

A: Only in part. In at least five significant respects the Applicants deviate from industry-standard methods and criteria.

Q: WHAT IS THE FIRST DEVIATION?

A: PJM's load deliverability and generation deliverability tests and their application are not industry-standard criteria or methods. This is significant because, as I discuss below, four of the eight deficiencies listed as justification for the Loudoun line on pp. 40-42 of the Appendix to DVP's Application involve these non-standard criteria. The other four involve minor problems on the lower voltage system. As I propose to discuss later, these last four are easily resolved without need for the Loudoun line.

In assessing the need for transmission reinforcements, and in particular in studies leading to the recommendation of the Loudoun line, PJM applies load deliverability and generation deliverability tests. The failure of these tests seems to imply a need to reinforce the grid.

In particular, failure of the generation deliverability test, according to PJM, "will result in denial of full capacity rights for the generator," creating a desire on the part of generator for the

network to be reinforced. Failure of the load deliverability test will lead to such actions as "enhancement to the transmission system." Exhibit HMM-23.

In discovery, Piedmont asked DVP to identify other industry bodies that use these tests. PJM responded that the Midwest ISO performs a test "similar to" PJM's load deliverability test, but identifies no one else who uses load or generation deliverability tests. Exhibit HMM-24.

Neither test is an industry standard method, and Exhibit HMM-24 confirms that DVP concedes that point. DVP also concedes that requiring that the system pass the tests is not an industry-standard criterion. Exhibit HMM-24. The tests depend on assumptions, calculations, and data that have apparently not been justified, made public, or subjected to independent peer review or regulatory approval. See Exhibit HMM-25.

Q: WHAT IS THE SECOND DEVIATION FROM INDUSTRY-STANDARD METHODS AND CRITERIA?

A: DVP seems to confuse the NERC criteria — which are industry-standard — with PJM's and DVP's own criteria, which by DVP's definition are not industry standard. See Exhibit HMM-24. DVP and PJM criteria are created and applied unilaterally. While the FERC has approved NERC's criteria, to my knowledge no external governmental or industry body has formally approved PJM's or DVP's. PJM accepts DVP's insofar as application to DVP is concerned, but this does not imply an endorsement. PJM claims that NERC, PJM, and DVP planning criteria have been accepted by FERC and the Commission but does not demonstrate this.

DVP simply claims that projects which DVP justified using DVP's local criteria have been approved by the Virginia State Corporate Commission – implying that this means Commission approval of the criteria. This logic is flawed; the Commission may have approved the projects for legitimate reasons independent of the application of DVP's local criteria.

Q: WHAT IS THE THIRD DEVIATION FROM INDUSTRY-STANDARD METHODS AND CRITERIA?

A: DVP requires that its system withstand the loss of two generators or of a generator and a transmission line without loss of demand. Exhibit HMM-24. This is more restrictive than NERC's criterion, which defines these as Category C events for which planned/controlled loss of demand is acceptable.

Note that all eight violations listed on pp. 40-42 of the Appendix to DVP's Application are overloads of a line DVP does not own and that does not pass through or terminate in DVP's service territory, diagnosed by applying DVP's private, more stringent, and unapproved criteria.

DVP appears to claim that the critical loads in Northern Virginia require higher levels of reliability than loads elsewhere. Exhibit HMM-21. But every state has vital loads such as hospitals, airports, military bases, data centers, etc., requiring higher levels of reliability.

Q: WHAT IS THE FOURTH DEVIATION FROM INDUSTRY-STANDARD METHODS AND CRITERIA?

A: DVP repeats warnings about "rolling blackouts." Rolling blackout is not a technical term and is not defined. As used by DVP, it implies unacceptable reliability failures.

I assume from the contexts that the term refers to planned/controlled loss of demand, the NERC term, which, according to NERC criteria, is an acceptable system operator response to improbable and extreme conditions. This acceptable response includes controlled interruption of electric supply to customers (load shedding), planned removal from service of certain generators, and curtailment of firm (non-recallable reserved) electric power transfers, or a combination of these, depending on circumstances. The key words are "controlled" and "planned," which mean that service is restored rapidly as soon as necessary adjustments are made. In uncontrolled blackouts, by contrast, it may take hours or days to restore service.

NERC's criteria implicitly recognize that multiple-contingency events are much less likely to occur than single contingencies, so there is much less exposure to them. In addition, the criteria implicitly recognize that it is much more expensive to build a system to withstand multiple contingencies than single contingencies. The industry judges that the additional reduction in exposure is not worth the additional investment required.

The Applicants appear to understand this but claim that "TrAILCo and PJM do not consider [planned/controlled loss of demand] an acceptable result for the vital customer loads in Virginia." Exhibit HMM-21.

Granted, there are vital customer loads in Virginia. But, as I noted above, every state has vital loads such as hospitals, airports, military bases, data centers, etc., requiring higher levels of reliability. DVP has not shown that all of the "homes, hospitals, schools and businesses" that DVP says will be fed from the Loudoun line are in this category.

In response to Discovery, DVP admitted that "Many, but not all, organizations with especially critical needs for electric power have made arrangements for alternative sources of generation including . . . backup power supplies." Exhibit HMM-27. Providing alternative

sources of generation for critical customers is cheaper than gold-plating the entire region and is more reliable than relying on remote generators two or three states away.

In fact, most interruptions of power experienced by customers are due to problems in the distribution system, which problems the Loudoun line would not address.

Q: WHAT IS THE FIFTH DEVIATION FROM INDUSTRY-STANDARD METHODS AND CRITERIA?

A: The NERC criteria require that systems be planned such that "the network can be operated to supply projected customer demands . . . under the contingency conditions as defined." Exhibit HMM-28. The operative words here are "can be." The criteria do not require that the network withstand the contingencies under all conceivable generation dispatch patterns.

PJM and the Applicants do not address this fundamental element of the NERC criteria. They have chosen a base-case dispatch for economic rather than reliability reasons. This dispatch creates flows that exceed the west-to-east transfer capability under the NERC n-1 criterion. By my calculations, changing the dispatch to increase the generation in PJM's Mid-Atlantic area by 61.9 MW, with a similar decrease in western PJM, would resolve the asserted NERC criteria violation in 2011. This is well within the capability even of the unreasonably low level of eastern generation modeled in the PJM databases.

In other words, the driver for the Loudoun line is not reliability (violation of the NERC criteria), but rather economic (the desire to provide coal-fired generation in the west with access to markets in eastern PJM). The dispatches in the PJM databases used in the studies done by PJM and Applicants reflect this objective of the owners of western coal-fired plants.

Q: WHAT ARE THE PRACTICAL RESULTS OF PJM AND DOMINION FAILING TO APPLY INDUSTRY-STANDARD METHODS AND CRITERIA?

A: If the local methods and criteria are more stringent than industry-standard, they will lead to investments that would not be made using standard methods and criteria. This will lead to higher rates for the customer and higher profits for the utility.

Q: CAN YOU PROVIDE AN EXAMPLE?

A: Specifically, failure of the generation deliverability test, which is more stringent than the NERC criteria, "will result in denial of full capacity rights for the generator," no doubt creating a desire on the part of the generators affected for the network to be reinforced (at ratepayer expense). Failure of the load deliverability test will lead to such actions as "enhancement to the transmission system." Exhibit HMM-23.

For example, the generation deliverability violations identified for the Mt. Storm-Doubs 500-kV line (Exhibit HMM-29) doubtless created economic incentives for the generators affected to have the violations removed. These generators are presumably to the west, and building the Loudoun line will ostensibly remove the violations. As I show elsewhere, the ratepayers will pay for this new line, and the generators will make more money.

Similarly, the load deliverability violations identified for the Mt. Storm-Doubs 500-kV line (Exhibit HMM-29) will apparently require network reinforcements (or such other actions as demand-side management or new generation, which DVP and PJM acknowledge in general but eschew in this case).

DVP and KEMA don't even apply DVP's published criteria. Instead, they apply something even stricter, making the need for transmission reinforcement seem even more urgent. Specifically, DVP's criteria say that in the outage of a generator followed by outage of a line, other DVP generating sources are to be adjusted to make up the deficiency. Exhibit HMM-26. But in studying the outage of Possum Point Unit 5 followed by the outage of various key transmission lines, DVP and KEMA assume that the lost generation is made up by proportionally increasing the output of all generators throughout PJM. Exhibit HMM-20.

Most of PJM's generation is west of the critical Mt. Storm-Doubs line. Most of DVP's generation is east of this line.

If DVP and KEMA followed DVP's criteria, the outage of Possum Point Unit 5 would be made up mostly in the east. As a consequence, the unit outage should have a minor effect on flows on the Mt. Storm-Doubs line and on the parallel Hatfield-Black Oak-Bedington-Doubs line.

Making up the deficiency from PJM as a whole, however, would increase the loading on west-to-east lines, including the critical Mt. Storm-Doubs and Hatfield-Black Oak-Bedington-Doubs lines, more than would occur if the deficiency were made up from DVP. This would make them appear more likely to overload, which in turn would increase the apparent need for the Loudoun line.

Q: DR. MERRILL, ARE THE TRANSMISSION PLANNING PROCEDURES OF DOMINION, ALLEGHENY, AND PJM BASED ON RELIABLE DATA AND ASSUMPTIONS?

A: No. DVP's consultant KEMA correctly represented at page 11 of the KEMA Report that reliable data and assumptions are required by good utility practice. The software used in the power industry today is incredibly powerful. However, even with the world's best software, unreliable data and assumptions produce unreliable results.

Q: WHAT ARE "RELIABLE DATA" AND "RELIABLE ASSUMPTIONS" ACCORDING TO THE APPLICANTS?

A: DVP told Piedmont in response to Discovery that "Reliable data . . . is validated and reasonable at the time [it] was developed . . . [it] will have identified sources . . . Reliable assumptions will be consistent with . . . planning standards and criteria, and planning practices." Exhibit HMM-30.

Q: DO YOU AGREE WITH THIS DEFINITION OF RELIABLE DATA?

A: No. Absent from this definition is the concept that reliable data must be correct. If the data and assumptions are wrong, they aren't reliable regardless of whether they have been agreed upon, validated or documented.

Q: CAN YOU PROVIDE EXAMPLES OF PJM AND DOMINION USING UNRELIABLE DATA OR ASSUMPTIONS?

A: I have found instances where PJM and DVP have relied on incorrect data – that is, unreliable data — usually with serious results — in load forecasts, cost estimates, projections of new generation, demand-side management, and system studies and conclusions.

Q: PLEASE DESCRIBE UNRELIABLE LOAD FORECAST DATA YOU FOUND.

A: DVP claims that the Loudoun line is needed because of load growth in Northern Virginia. However, DVP's Northern Virginia load forecasts are not reliable. DVP witnesses presented two load-growth forecasts for Northern Virginia and a third for DVP as a whole. None of the three is reliable.

The first two were presented by DVP witness Phillip Powell. He forecasts 244 MW per year growth in Northern Virginia. He also says that Northern Virginia's share of PJM's forecasted growth is 131 MW per year. Both numbers are weather-normalized; they can legitimately be compared. But they differ by almost 100%. Mr. Powell indicates at pages 6-7 that attempts to reconcile them are "under review." The two load forecasts use entirely different methods and assumptions. If they agreed more or less, one could claim that they mutually validate each other. But they don't.

Q: WHAT DO YOU MEAN WHEN YOU SAY THEY DON'T VALIDATE EACH OTHER?

A: For instance, if I step on two scales and one says 180 lbs. and the other says 190 lbs., I consider them reasonably consistent and believe that my weight is probably about 185 lbs. But if one scale says 131 lbs. and the other says 244 lbs., then I know that at least one is broken, but without other information I don't know which it is. Perhaps both are broken.

Q: DR. MERRILL, WHAT IS THE THIRD FORECAST?

A: DVP witness Dr. Frank A. Montforte describes a third forecast. He divides DVP into four regions. None of the regions coincides with Northern Virginia — two or three of them in part overlap it — so his forecast cannot be compared to the Mr. Powell's two inconsistent

forecasts. He concludes that his work "suggests" that DVP's forecast is "conservative," whatever that means, but he does not provide a forecast of his own for Northern Virginia.

The fact that the forecasts cannot be compared or produce very different results means that DVP does not have a reliable Northern Virginia load forecast on which to justify a project that it claims is needed because of future Northern Virginia load growth.

Q: PLEASE DESCRIBE THE UNRELIABLE COST DATA YOU FOUND, DR. MERRILL.

A: One example is central to the decision by DVP and PJM to proceed with the Loudoun line. An AEP-proposed 765-kV alternative to the Loudoun line was discarded by DVP and PJM based on a cost estimate that was apparently high by about 100%. PJM now endorses this 765-kV line, using a much lower cost estimate than that initially used in rejecting the AEP proposal. If lower costs had been used in 2006, perhaps the Loudoun line would not have been endorsed by PJM. But PJM now considers the Loudoun line to be an irrevocable decision since it has already endorsed it. Therefore, PJM wants the 765-kV line in addition to the Loudoun line, which it now finds will be inadequate.

Had correct cost data been used initially, a very different conclusion could have resulted. Perhaps we would face one new line instead of two, as the 765-kV alternative has greater capacity. Its proposed routing differs from that of the Loudoun line, too. I emphasize that my purpose is not to endorse the 765-kV line. Rather, my point here is to explain that a key decision to approve and proceed with the Loudoun line was based on fundamentally unreliable cost data.

Q: DR. MERRILL, TO WHAT UNRELIABLE COST DATA ARE YOU REFERRING?

A: At page 53 of the Appendix to DVP's Application, DVP says, "the AEP 765-kV project" was "ruled out [as an alternative to the Loudoun line] by PJM mainly because of its $3 billion cost." DVP does not define exactly what it means by "the AEP 765-kV project." Several variations have been under study since at least early 2006.

It may be that "the AEP 765-kV project" referred to was a proposed line from Amos to Kemptown to Deans, which is much longer and penetrated much further east than the Loudoun line. The two are not comparable.

In response to West Virginia PSC staff questions, PJM witness Scott Gass revealed that a 765-kV Amos-Doubs line was estimated to cost about $1.5 billion. Exhibit HMM-31. Results of PJM analyses provided by Mr. Gass show that this line would provide significantly greater transfer capability than would the Loudoun line. Again, I am not endorsing the 765 kV line, merely noting that the analysis used by Applicants is faulty.

According to PJM witness Steven R. Herling, the "currently proposed cost" for the Amos-Kemptown 765-kV project is $1.8 billion. Exhibit HMM-32. This is apparently the project that PJM considers necessary to relieve violations in 2012.

Clearly $1.5 billion or $1.8 billion is very different from $3 billion. The $3 billion estimate, the basis for a key decision to endorse the Loudoun line, was not reliable.

Meanwhile, the estimated cost of the Loudoun line has gone up from the $850 million (Appendix to DVP's Application, p. 11) on which the decision to build the line was based. DVP said its current "proposed route" is $71 million more expensive than the original route (now "segment overhead route") assumed in computing the $850 million cost. (Appendix to DVP's

Application, pp. 1 and 53). This means the total cost of the Loudoun line is now $921 million, and the price differential between the Loudoun line and its alternatives is reduced.

Note that the $850 million and $921 million figures do not include the cost of the Prexy-502 Junction line, which DVP (but not Allegheny) deems a separate project. If the cost of this portion is added, the cost of the Loudoun line is about $1 billion. All of this is more evidence that the underlying data are unreliable. The Commission should not approve a project of this magnitude based on such unreliable data.

Q: PLEASE DESCRIBE THE UNRELIABLE "NEW GENERATION" DATA TO WHICH YOU REFERRED.

A: I have already discussed the unreliable assumptions regarding the amount and location of new generation that PJM made in putting together the databases that PJM and the Applicants used for their network studies. Here I make three additional points:

1. the databases and base-case dispatches are inconsistent with planning and modeling practices;
2. the number of proposed plants in eastern PJM is growing, not shrinking; and
3. PJM's filter for the plants it will model, while facially neutral, always under-represents eastern gas-fired development and over-represents western coal-fired development, creating badly exaggerated west-to-east transfers and overloads.

Q: HOW ARE THE DATABASES AND BASE-CASE DISPATCHES INCONSISTENT WITH PLANNING AND MODELING PRACTICES AND HISTORICAL PERFORMANCE?

A: System planning standards call for installed capacity reserve margins of about 15% or 20%, depending on the utility, to protect against forced generation outages and demand spikes and to allow planned maintenance of power plants.

The 2012 base case provided by PJM shows much less generation for the area that, according to PJM, needs the Loudoun line. See Figure 9 for a summary of that data.

To the extent that the region shown in Figure 9 depends on imports, the local load is greater than the local dispatch, and the reserve expressed as a percentage of load is lower than that shown.

Planning studies are supposed to be based on a representative generation dispatch. In such a dispatch, cheaper generators are dispatched at higher levels than more costly generators. The dispatch reflected in Figure 9 violates this practice: the generation in most of the systems is dispatched at essentially 94% across the board.

Figure 9
The planning assumptions in the 2012 case are inconsistent with reserve criteria.

	Generation (MW)		Reserve	
	Dispatched	Capacity	MW	percent
BG&E	3,389	3,576	187	6%
PEPCO	5,590	6,380	789	14%
Delmarva	3,744	3,961	217	6%
Dominion	21,163	22,334	1,171	6%
PhilaElectric	7,906	8,345	440	6%
	41,792	44,596	2,805	7%

Furthermore, the base-case dispatch should reflect the way the system will actually be dispatched. The base-case dispatches in the databases for 2011, 2012, and 2016 violate the NERC n-1 criterion; the operators would not choose such a dispatch.

The dispatches are unreasonable in part because the installed capacity represented in the databases is unreasonable. The reserves are unreasonable for the same reason.

Q: IS THE NUMBER OF PROPOSED PLANTS IN EASTERN PJM GROWING?

A: Yes, it is. See Figure 10 and Figure 11. See Exhibits HMM-8, HMM-33 and HMM-34.

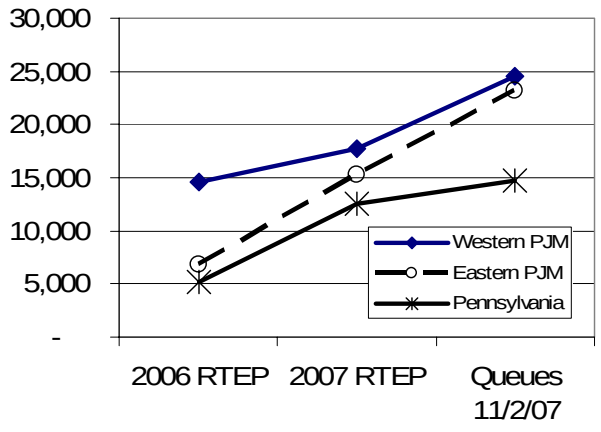
Most of the projects and most of the capacity in the queues in eastern PJM have in-service dates prior to 2011.

The proposed new MW in the eastern PJM queues more than doubled from early 2006 (when Applicants and PJM were doing the studies that lead to the development and endorsement of the Loudoun line) to early 2007 (when Applicants filed their applications with the Commission). And, since Applicants filed their application with the Commission, the capacity in the eastern PJM queues has increased even more, i.e., by another 50% between February and November 2007.

Figure 10
Generation interconnection study queues are growing, but especially dramatically in eastern PJM

	RTEP Feb. 2006	RTEP Feb. 2007	Queues 11/2/07
Ohio	3,170	3,538	6,560
West VA	3,571	4,397	3,572
Illinois	6,087	8,912	11,353
Indiana	84	203	3,003
Kentucky	1,735	745	
	14,647	17,795	24,488
Pennsylvania	5,231	12,547	14,781
Virginia	2,904	3,994	6,484
Maryland & DC	881	5,432	6,440
Delaware	14	2,393	1,860
New Jersey	2,920	3,451	8,291
North Carolina	62	62	78
	6,781	15,332	23,153

Figure 11
MW in interconnection queues



Pennsylvania is shown separately because the demarcation between certain of the western and eastern critical interfaces is not crisp.

Q: DO PJM'S PROCEDURES ACCURATELY REPRESENT NEW GENERATION IN EASTERN PJM COMPARED TO WESTERN PJM?

A: No, PJM's procedures systematically under-represent new eastern generation. This under-representation in the east compared to the west is the result of PJM's attempt to deal with uncertainty in future generation.

Q: WHAT IS THAT ATTEMPT TO DEAL WITH UNCERTAINTY, DR. MERRILL?

A: No one can project and know exactly which future generating units will be built and where. Nevertheless, the existence and location of new generation is a critical input to the transmission planning process. PJM deals with this uncertainty in a way that creates an unfortunate bias in their transmission plans. Specifically, for purposes of its transmission plans, PJM assumes that:

1. all generating plants that have applied for interconnection and completed a system impact study will be built; and
2. no other plants will be built.

Both assumptions are unfounded. For instance, since a new gas-fired plant can be sited, permitted, and built in two to four years, its developers would rarely enter it in the interconnection study queue more than five years ahead of its expected in-service date. In contrast, key transmission planning starts five years into the future: planning for the Loudoun line started in 2005 and 2006 for 2011 service. Therefore, the databases used to analyze transmission requirements will be underpopulated with gas-fired plants because they have yet to enter the interconnection queue, or to complete a system impact study.

Coal-fired plants are another story. They may take seven or more years to permit and build. Most of them are identified early enough to enter the queues and complete system impact studies more than five years before the planning horizon. Consequently, the planning databases will be well populated with such plants.

Q: IS IT REASONABLE TO ASSUME THAT ALL PLANTS THAT HAVE ENTERED THE INTERCONNECTION QUEUE AND COMPLETED A SYSTEM IMPACT STUDY WILL GO INTO SERVICE?

A: No. Plants with completed system impact studies have been cancelled or postponed for a variety of reasons. Today, future coal-fired plants are particularly susceptible to cancellation or postponement for environmental reasons. This means that the databases used for transmission planning are overpopulated with plants vulnerable to cancellation. These are mainly coal-fired plants.

Q: HOW DO PJM'S TWO ASSUMPTIONS CREATE A BIAS, DR. MERRILL?

A: Coal-fired plants are predominately located in western PJM; while gas-fired plants are predominately located in eastern PJM. The western coal-fired plants take longer to build than do eastern gas-fired plants. Therefore, western coal-fired plants enter the interconnection study queues sooner and complete system impact studies sooner, than do eastern gas-fired plants. Since the databases are overpopulated with western coal-fired plants and underpopulated with eastern gas-fired plants, the system studies will show high west-to-east power flows and the need for massive new west-to-east transmission.

Q: DR. MERRILL, HAS THIS BIAS BEEN DOCUMENTED?

A: Dr. Ren Orans has analyzed the western coal versus eastern gas bias, as discussed in his concurrent testimony. He shows that of the coal capacity still listed in the "Active" queue on

PJM's website, 86% applied for interconnection at least 4 years ahead of projected in-service dates. In contrast, only 39% of natural gas generation projects applied 4 years or more in advance.

As of late 2007, new eastern gas-fired plants with in-service dates 2011 and earlier are still entering PJM's interconnection study queues. In addition, as I showed above, there are many such plants still awaiting completion of the system impact studies and therefore not included in PJM's study data.

Q: DOES DEMAND-SIDE MANAGEMENT (DMS) DATA AFFECT THE ANALYSIS?

A: Yes, it does. Moreover, I have found examples of unreliable DSM data. Neither the PJM nor the DVP econometric load forecast models described by DVP witnesses John M. Reynolds and Frank A. Montforte, nor the bottom-up area forecast described by DVP's Mr. Powell, include any but the most rudimentary forecasting of demand management. PJM's approach is described in a White Paper, Attachment JMR-1 to Mr. Reynolds' testimony. PJM corrects historic load data for active load management (ALM), as described on p. 18. It forecasts future load without ALM. It then estimates peak demand reduction due to ALM in the most recent year for which historical data is available. It then assumes that this level of ALM will continue into the future and subtracts it from its load forecast. See p. 39 of Mr. Reynolds' Attachment JMR-2. This is unreliable for two reasons:

1. Since demand is growing while future ALM projection is constant, this approach assumes that ALM as a percentage of peak load shrinks, with no justification for the assumption. For instance, the February 2006 PJM Load Forecast Report (Mr. Reynolds' Attachment JMR-2) projected active load management (e.g., under direct PJM control) in PJM's Mid-

Atlantic Region plus DVP (essentially, eastern PJM) to amount to a constant 890 MW from 2006-2016. The same report a year later (January 2007) projected 794 MW from 2007-2022. Both reports showed DVP with zero active load management.

2. This approach ignores possible increased contributions from DSM, which are likely due to the heightened prominence of DSM programs as evidenced by the DSM responses to 2007's RPM offerings in PJM (Figure 12) and in similar recent auctions in New England.

Figure 12
Cleared DSM in PJM's 2007 auctions, MW
(Mostly in eastern PJM)
[Sources: PJM and press]

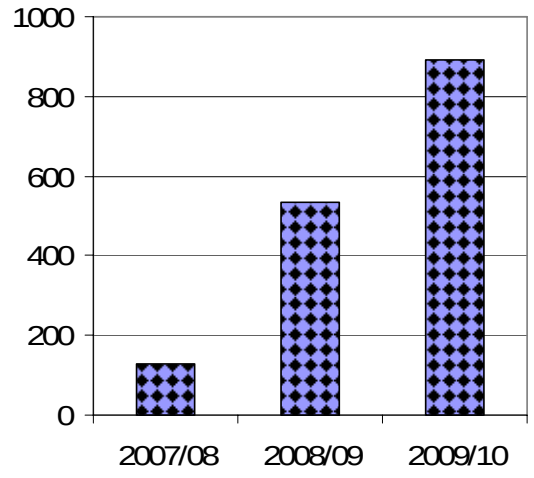
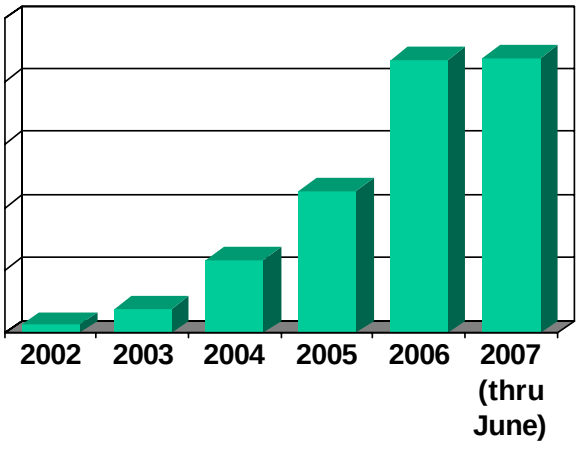


Figure 13 shows the growing penetration of one form of DSM in PJM. It doubled in 2005 and 2006 and seems on track to doubling again in 2007. See the concurrently filed testimony of Dr. Daniel M. Violette.

Q: PLEASE DESCRIBE THE UNRELIABLE ANALYSES AND CONCLUSIONS YOU FOUND.

A: Unreliable analyses and conclusions are not quite the same as unreliable data or assumptions. But they are unreliable because either the data or assumptions are unreliable or the analyses themselves are unreliable, or maybe all three. Let me offer three examples.

Figure 13
PJM Economic (price-responsive) Demand Side Response (vertical axis is MWh)
[Source: Susan Covin of PJM at SCC Workgroup mtg, Aug. 23, 2007]



Q: PLEASE DESCRIBE THE FIRST EXAMPLE.

A: In July 2006, PJM represented that if the Loudoun line were built and went into service in 2011, then it would resolve all overloads in the area through a 15-year horizon. But now PJM contends that in addition to the Loudoun line an even larger line is needed in the same area by 2012, one year later. Specifically, the July 11, 2006 PJM TEAC materials concluded that with the proposed Loudoun line built, "All [Allegheny Power] South overloads are resolved through 2021." Exhibit HMM-2 at pp. 2-3. Less than nine months later, in the February 27, 2007 RTEP report, PJM publicly repudiated this conclusion. According to this report, in 2012, just one year after the Loudoun line is to go into service, overloads of the Mt. Storm-Doubs 500-kV line will require another major backbone transmission line. The line proposed to the PJM TEAC on May 9, 2007, is a 765-kV line from Amos to Bedington, plus an extension to Kemptown that will be either 765-kV or, more recently, double-circuit 500-kV. For notational convenience, I refer to this as a 765-kV project. Exhibit HMM-35. This 765-kV project is larger than the proposed Loudoun line and will carry more power. The earlier conclusion that building the Loudoun line would resolve all major overloads in the area for at least a decade was erroneous and thus unreliable.

Q: PLEASE GIVE YOUR SECOND EXAMPLE OF UNRELIABLE ANALYSES OR CONCLUSIONS.

A: The conclusion that the Loudoun line is needed was based on the assumption that essentially no new generation will be built in the Northern Virginia-District of Columbia-Maryland-Delaware-Eastern Pennsylvania area. As discussed earlier, this assumption is untrue and thus unreliable. The conclusion of need therefore has no basis.

Specifically, KEMA reported that 3,000 MW of new generation would be needed at the Loudoun substation or maybe in Northern Virginia in lieu of the Loudoun line. Nothing in KEMA's report sustains its assertion that all of this has to be at the Loudoun substation, or even in Northern Virginia. Significantly more than 3,000 MW of new generation is in the PJM interconnection study queues for the relevant areas. Those queues are growing, not shrinking.

Q: PLEASE GIVE YOUR THIRD EXAMPLE OF UNRELIABLE ANALYSIS OR CONCLUSIONS.

A: My third example is more complex and fundamentally more unsettling than the first two. PJM's ability to analyze and diagnose its largest-scale problems seems highly unreliable.

Specifically, in early 2006 PJM diagnosed that the most serious limits on west-to-east transfers were overloads of lines feeding the Doubs substation and of lines farther to the south in Virginia. This diagnosis called forth the Loudoun line.

One year later, in 2007, PJM revised the diagnosis. Now the most serious limits are in Pennsylvania. The Loudoun line is no longer PJM's most urgent project. In fact, as of this testimony, the Loudoun line now is only a stopgap measure to bridge a perceived need for one year. Such a radical change in PJM's diagnosis from July 2006 to May 2007 is troubling. A transmission system diagnosis should not be so unstable. Something is wrong.

Q: WHAT WAS PJM'S ASSESSMENT OF FUTURE PROBLEMS IN 2006, DR. MERRILL?

A: In 2006 PJM said that potential overloads of lines from the west feeding the Doubs substation north of Washington, DC

Figure 14
Backbone transmission problems identified in 2006
[Source: PJM TEAC Presentation, July 11, 2006]

Year That Facility Loading Exceeds Conductor Rating	Overloaded Facility
2019	Airydale - Juniata 500 kV Circuit 1
2019	Airydale - Juniata 500 kV Circuit 2
2020	Keystone - Conemaugh 500 kV

constituted the most important and immediate constraint on west-to-east transfers. The Loudoun line would resolve these through 2021, according to PJM. PJM said that three 500-kV lines in central Pennsylvania would be the next to overload, near the horizon year of their studies, in 2019 and 2020, long after 2011. See Figure 14. See also Exhibit HHM-2.

The 2016 basecase PJM supplied was in fact the 2011 basecase with minimal modifications. My studies using PJM basecases for 2011 and 2016 were consistent with PJM's conclusions: the immediate and most serious west-to-east constraints were in the south, not in Pennsylvania.

I performed First Contingency Incremental Transfer Capability (FCITC) analyses using Siemens-PTI's MUST and PSS/E software. While there is no known single measure of the strength of a transmission system, FCITC is widely used and understood by power engineers. Loosely speaking, FCITC is the additional power, above a normal or base-case level, that can be transferred from one area to another, without violating NERC criteria. The specific test is reliable operation under the worst single (first) contingency. Transfer capability (FCITC, to be precise) cannot be measured directly. It is computed by doing simulation studies using powerful software.

My analyses using a 2011 PJM basecase revealed that the overloads all had to do with the lines feeding into the Doubs substation, or lines farther south, until incremental transfers exceeded 4,000 MW, at which point overloads began appearing in central Pennsylvania.

Q: HOW WOULD BUILDING THE LOUDOUN LINE AFFECT THIS DIAGNOSIS, USING THE 2011 BASE CASE?

A: In 2006 PJM concluded that, even with the Loudoun line in service, the west-to-east transfers would continue to be limited by the lines feeding the Doubs substation from the west as shown in Figure 15. See also Exhibit HMM-2. These would overload more than 1,000 MW before the first overload in Pennsylvania, on the Hosensack-Elroy 500-kV line.

Q: WHAT WAS PJM'S ASSESSMENT OF FUTURE PROBLEMS IN 2007?

A: In 2007, less than a year later, PJM identified a number of overloads in Pennsylvania in the much nearer future than those shown in Figure 14. In addition, as I explained earlier, in 2007 PJM says that even with the Loudoun line the 500-kV transmission lines will overload through Pruntytown, Mt. Storm, Meadow Brook, and Loudoun soon and throughout the planning horizon. See Figure 16.

PJM's 2012 basecase is one year newer than the 2011 and 2016 cases. It apparently differs significantly from the older basecases. My studies using PJM's

Figure 15
In 2006, PJM concluded that even with the Loudoun line built, the first limitations on west-to-east transfers would be the Pruntytown-Mt. Storm-Doubs lines
[Source: 7/11/06 PJM TEAC Presentation, p. 19]

Facility	FCITC (MW)
Mt. Storm - Doubs 500 kV	2454
Pruntytown - Mt. Storm 500 kV	2844
Hosensack - Elroy 500 kV	3490
Keystone - Airydale 500 kV	3519
Keystone - Conemaugh 500 kV	3604
Airydale - Juniata 500 kV #1	3706
Kammer 765/500 kV	3768
Airydale - Juniata 500 kV #2	3820
Lexington - Dooms 500 kV	4018
Harrison - Pruntytown 500 kV	4111

Figure 16
Overloads and year of overload identified in 2007.
(Loudoun line assumed built)
[Source: PJM TEAC Reliability Analysis Update, May 9, 2007]

Keystone - Airydale 500 kV	2012
Keystone - Conemaugh 500 kV	2012
Mt. Storm - Doubs 500 kV	2012
Airydale - Juniata 500 kV	2013
Airydale - Juniata 500 kV	2013
Pruntytown - Mt. Storm 500 kV	2015
Harrison - Pruntytown 500 kV	2016
Lexington - Dooms 500 kV	2017
Loudon - Pleasant View 500 kV	2017
Greenland Gap - Meadowbrook 500 kV	2020
Mt. Storm - Greenland Gap 500 kV	2020
Hosensack - Elroy 500 kV	2021
Bath County - Valley 500 kV	2022

Note: Keystone, Airydale, Conemaugh, Juniata, Hosensack, and Elroy are in Pennsylvania.

2012 basecase confirm that 2012 overloads in central Pennsylvania are more limiting than the overloads farther to the south.

I then went a step beyond what PJM apparently did by analyzing the 2012 system without the Loudoun line. See Figure 17. As west-to-east transfers increase in 2012, lines overload in Pennsylvania by as much as 400 MW before the Mt. Storm-Doubs line overloads. In fact, the first two overloads (at FCITC = -1,743 MW and -1,321 MW) would be in central Pennsylvania, as would six of the first ten.

The number and relative immediacy of overloads, and the shifting of the problem to Pennsylvania from the south, represent remarkable and significant changes from the diagnoses on which DVP, Allegheny and PJM justified the Loudoun line in their applications to the VSCC.

Figure 17
The Loudoun line shows much lower benefit analyzed with PJM's 2012 database than with its older 2011 database.
(Transfer capability - FCITC - in MW)

	2011 Case	2012 Case
FCITC without Loudoun line	-62	-1743
FCITC with Loudoun line	2998	-996
Increase due to Loudoun line	3060	747

Q: PLEASE COMPARE THE EFFECTS OF THE LOUDOUN LINE, USING THE 2011 AND 2012 PJM BASE CASES, DR. MERRILL.

A: Using the 2011 PJM database, my studies show that the Loudoun line would increase the west-to-east transfer capability by 3,060 MW. Re-analysis using the more current 2012 PJM database shows that the Loudoun line would increase the transfer capability by a mere 747 MW. The reduction to 747 MW is because the 2012 database implicates problems in Pennsylvania, which are only weakly addressed by the Loudoun line.

Spending close to $1 billion for a 747-MW increase in transfer capability is an unreasonable waste of money.

Q: ARE THE TRANSMISSION PLANNING PROCEDURES OF DOMINION, ALLEGHENY, AND PJM LIKELY TO YIELD OPTIMAL RESULTS?

A: No.

Q: WHY, DR. MERRILL?

A: This is because they are asking the wrong questions and are looking in the wrong places for answers.

Q: WHAT DO YOU MEAN THEY ARE ASKING THE WRONG QUESTIONS?

A: "Optimum" means "best according to some criterion." The DVP, Allegheny and PJM criteria are too narrow. In addition, they do not attempt to optimize even in accordance with their own narrow criteria.

Q: WHAT DO YOU UNDERSTAND THE BASIC CRITERION OF DOMINION AND PJM TO BE, DR. MERRILL?

A: On page 5 of his testimony, Mr. Steven R. Herling says PJM's planning objective is to "enable the transmission needs in the PJM Region to be met on a reliable, economic and environmentally acceptable basis."

Q: DOES THE PJM PLANNING PROCESS ACHIEVE THIS OBJECTIVE?

A: No, it does not. Let me focus on "reliable, economic, and environmentally acceptable." PJM does not address what these words imply, and that they and other important objectives are inadequately addressed or ignored.

Q: PLEASE START WITH "ENVIRONMENTALLY ACCEPTABLE."

A: Environmental protection plays no role in PJM's transmission planning. It is nothing more than an afterthought. Figure 18 summarizes word searches of PJM's 330-page 2007 RTEP report. On average, forms of the words "reliable," "economic," and "cost" appear more than twice per page.

Figure 18
Word occurrences in the RTEP report reflect PJM's priorities

Various forms of	Occurrences
reliable	444
economic	141
cost	131
environment	12
cultural	1
historic*	0
scenic	0

*"Historic" was never used in the context "historic site." It was used ten times in the context "past and continuing operation of the power system."

Ten of the twelve uses of the word "environment" referred to power plants, mostly in the context of retiring older plants for environmental reasons. Only one use of "environment" referred specifically to transmission. It did so only to bemoan the difficulty of siting transmission lines due to environmental concerns.

By contrast, the Commonwealth of Virginia places a great deal of importance on the environment. The State Code reflects this in § 56-46.1, which directs: "As a condition to approval the Commission shall determine that the [transmission] line is needed and that the corridor or route the line is to follow will reasonably minimize adverse impact on the scenic assets, historic districts and environment of the area concerned." This evaluation should be done when the planners are evaluating the various alternatives. It should not be an afterthought, done after one course has been adopted and others rejected.

DVP and Allegheny similarly failed to consider the relative environmental impacts of alternatives. A line with towers as high as a 16-story building could be seen for miles. The 270-mile Loudoun line could visually mar over 1,000 square miles. Wildlife, vegetation, and other land-use damage would be substantial.

The routing of the Loudoun line as first proposed was essentially a straight line from Meadow Brook to Loudoun across some of the country's most beautiful, cultural and historic landscape – an area that is a national treasure. Only after a strong public outcry did DVP modify the routing to reduce (but not to eliminate) this environmental damage.

Nowhere did the planning address air quality and strip-mining issues, obvious concerns of a new line allowing greater western PJM coal-fired capacity to come on line.

Q: DO PLANNING PROCEDURES OF PJM AND THE APPLICANTS ADEQUATELY ADDRESS ECONOMICS, DR. MERRILL?

A: No, they fail to do so in at least three critical respects. The first has been tersely analyzed and subsequently ignored by the Applicants. The second and third have apparently not been addressed at all.

1. As I explained earlier, PJM's own studies show that the cost of the Loudoun line, which came out of these planning procedures, would exceed its economic benefit. Further, the line would economically benefit certain generators (mainly in the west) and the line's owners, Allegheny and DVP. It would not be an economic benefit to ratepayers, who would pay for the line.
2. These planning procedures are inducing investment in massive, expensive interregional transmission projects that will connect with remote generation, existing and new, instead of generation accessible without requiring a massive and expensive new transmission system. The Applicants have not demonstrated the economic benefits to the ratepayers of this strategy.
3. The creation of these massive interregional projects will bias the energy markets against local power plants and in favor of remote plants, with concomitant interregional shifts of

economic benefit. Understanding these shifts should be central to any economic criterion. Yet, the Applicants have not analyzed this.

Q: DO THE PLANNING PROCEDURES FAIL TO ADDRESS RELIABILITY, DR. MERRILL?

A: Yes, they do. NERC's planning criteria and the criteria of PJM and the Applicants, fail to recognize explicitly that reliance on long-distance interregional transmission is inherently less reliable, all else being equal, than siting power plants near the load.

Specifically, if the Loudoun line is built — leading to increased dependence on remote power plants — then PJM actually will become more vulnerable to cascading blackouts, rather than increasing reliability. The province of Quebec epitomizes this. Hydro-Québec, the provincial power company, gets much of its power from huge, remote hydroelectric plants. As a result, the system has been so highly prone to blackouts that all of Hydro-Québec's interconnections are expensive direct-current links that effectively quarantine the province from its neighbors to prevent cascading failures.

Every major blackout — including the northeast blackout of 2003 that DVP regularly invokes to justify the Loudoun line — has occurred when interregional transfers were high. The triggering events of every blackout were failures of policies or procedures or of control or protective systems. Vulnerability to such failures increases as large systems become more tightly coupled. But power industry evaluative criteria, for examples, NERC's, do not capture these effects. The software and planning procedures available do not model them.

Q: HOW DO APPLICANTS MISAPPLY PLANNING CRITERIA?

A: I have already described several ways. I will now describe two more ways to misapply a set of criteria in choosing among alternatives:

1. the analyses of alternatives can be defective; and
2. the wrong alternatives can be considered.

One PJM statement illustrates both errors. On page 3 of the May 9, 2007 Christian Science Monitor, reporter Mark Clayton in his article *Cheap Power to Northeast US: a Mixed Blessing* quotes a PJM spokesman: "We can order transmission owners to build lines, but we cannot order generation to be built . . . So if we are seeing overloads developing, the only thing we can order is power lines." Exhibit HMM-36.

This crabbed perspective allows PJM to conclude at page 121 of the 2007 PJM RTEP report, "When PJM proposes a transmission upgrade . . . to resolve a reliability issue or transmission constraint, by virtue of the market's inaction regarding other potential solutions, the . . . transmission solution becomes the most economical option." Exhibit HMM-8. In other words, PJM is saying *our decision is optimal because we are doing it*. A non sequitur such as this should not be the basis of transmission system planning, least of all the basis for authorizing and siting a major new transmission project such as the Loudoun line.

Q: WHAT IS YOUR EVALUATION OF THE APPLICANTS' ANALYSIS OF ALTERNATIVES IN THEIR TRANSMISSION PLANNING, DR. MERRILL?

A: It is defective in three major ways:

1. Some analyses are not done at all, are too limited, or are done after-the-fact merely to justify a decision that has already been made. I have cited several examples. The Applicants' environmental analyses stand out in this regard.

2. Analyses may ignore or inadequately model uncertainty. I have pointed out the severely inadequate modeling of new generation and its location. With regard to this and to load growth, future potential fuel restrictions, and other key uncertainties, the Applicants follow the same inadequate procedure. In just one set of studies, the analysis of the economic effects of the Loudoun and other lines, PJM considered three generation scenarios for the remote future and price, load growth, and regulatory uncertainties for the near-term. The analysis was imperfect. Not even rudimentary analysis was done in the reliability studies which form the justification for the Loudoun line.

   Despite the fact that thousands of MW of generation projects were and are pursuing the PJM interconnection process in good faith, PJM nevertheless concludes that (a) because generators have failed to act, (b) PJM must build the Loudoun line, and (c) PJM's decision is optimal.

3. Decision-making may deal improperly with the conflicts among the various objectives implied by the criteria. Conflicts exist, for example, between PJM's announced objectives of reliability, economy (cost), and environmental protection. Balancing these objectives to resolve conflict is particularly the province of strategic planning, which I discuss later.

Q: DID PJM LATER DO SENSITIVITY STUDIES TO MEASURE THE POSSIBLE EFFECT OF NEW GENERATION ON OVERLOADS OF THE MT. STORM-DOUBS LINE?

A: Yes. An August, 2007 PJM TEAC report concluded that the putative 2012 overloading of the critical Mt. Storm-Doubs 500-kV line will be pushed back to 2019 if 11 projects in PJM interconnection study queues O, P, and Q materialize. August 2007 PJM TEAC report,

http://www.pjm.com/committees/teac/downloads/20070822-teac-reliability-interconnection-analysis-update.pdf.

These projects have in-service dates as early as 2008. All but two of them have completed Generation Interconnection Feasibility Studies or System Impact Studies, according to the list of PJM's interconnection study queues as of November 2, 2007. Exhibit HMM-34. The sensitivity analysis apparently ignored projects in queues R, S, and T, some of which have in-service dates as early as 2007 and some of which have completed System Impact Studies.

The sensitivity study also included the effects of the possible deactivation of the Benning and Buzzard units and other possible events which would make the loading on the Mt. Storm-Doubs line worse.

Q: HAS THIS STUDY CAUSED PJM OR APPLICANTS TO RECONSIDER THE NEED FOR THE LOUDOUN LINE?

A: No, though it should have. In fact, this study should have been done before deciding on the Loudoun line.

PJM takes the position that once it has approved a project, it considers the topic closed. Only if forced to do so, for instance, by action of this Commission, will it reconsider an approved project.

Applicants have their own reasons for pressing forward, as I describe later.

Q: CAN YOU NOW SUMMARIZE YOUR TESTIMONY WITH REGARD TO TRANSMISSION PLANNING BY PJM AND THE APPLICANTS?

A: The planning procedures of PJM and the Applicants are not likely to lead to optimal plans — which answers the fourth major question I posed at the beginning of my testimony. I have shown that PJM's announced planning criteria do not adequately address reliability,

economics, and environmental impact. I then pointed out three systematic ways in which any set of planning criteria can be misapplied. I showed how PJM and the Applicants err in the first two ways. Next, I show how bad decisions have resulted from the failure to consider alternatives.

Q: DOES PJM CONSIDER THE MOST IMPORTANT ALTERNATIVES?

A: No. This is illustrated by the PJM comment that, "the only thing we can order is power lines." Exhibit HMM-36. This illustrates the old saw that, "If you are a hammer, every problem looks like a nail." In fact, important planning options were ignored in selecting the Loudoun line.

Q: WHAT ARE THOSE ALTERNATIVES?

A: Let me divide them into two groups: (a) generation and demand-side alternatives, and (b) transmission alternatives.

Q: WHAT GENERATION AND DEMAND-SIDE ALTERNATIVES DID APPLICANTS FAIL TO CONSIDER?

A: First, changes in the structure and operation of the PJM power market should have been but were not, considered in connection with the decision to build the Loudoun line. PJM manages the power market. It can and should consider market changes and other initiatives as alternatives to new power lines.

Specifically, it should manage the PJM market so that it induces desired actions, such as maintaining and refurbishing existing generation and attracting investment in new, clean generation and demand management where they are needed in eastern PJM. It also should model the effects of these alternatives in its planning studies. That is, studies should recognize that more generation and demand management would or could appear beyond the very limited new power plants presently recognized in PJM's planning databases.

FERC Chairman Joseph Kelliher in an April 20, 2006 statement on PJM's reliability pricing model (RPM) blamed apparent generation shortages on a broken PJM market. He called on PJM in very strong terms to fix the market, giving notice that if PJM didn't, the Commission would. Exhibit HMM-37. The RPM auctions that PJM has implemented in 2007 appear to be succeeding in calling forth the generation and demand-side resources needed in eastern PJM. This market change was not incorporated into PJM's planning studies and played no part in the decision to endorse the Loudoun line.

Response to the first three RPM auctions is merely an indicator of significantly more generation and demand-side resources that RPM will call forth in the future, according to recent testimony by PJM's Michael Kormos in Maryland Public Service Commission Case No. CN-9117. Exhibit HMM-38. Mr. Kormos points out that 2007's "compressed, transitional schedule does not allow sufficient time for a generation project to enter the queue and advance to the stage of a completed System Impact Study or an executed Interconnection Service Agreement." (He noted that one or both of these milestones were required for a planned resource to participate in the three 2007 auctions.)

DVP's demand-side management (DSM) efforts to date have been minimal. Even moderate development of DSM resources could make a significant contribution to power supply in Virginia and eastern PJM, as discussed in the testimony of Piedmont witness Dr. Daniel M. Violette.

Q: WHAT TRANSMISSION ALTERNATIVES DID APPLICANTS FAIL TO CONSIDER?

A: The Applicants ignore at least three conventional transmission alternatives. There are others I do not include, some conventional, some innovative. First, let me emphasize that

transmission alternatives really means remote generation plus transmission, which should be contrasted against local generation and demand management, without major transmission.

1. A 525-MVAR static VAR compensator (SVC) or other controllable VAR source at the Meadow Brook substation should have been but was not considered as a solution to projected voltage drops. SVCs are widely-used devices that control voltage by supplying or absorbing reactive power, or VARs. They are controlled by solid-state valves, which have no moving parts. They are used in place of older, larger rotating devices whose footprint was as large as a house. A local VAR source would fix the only real problem that DVP advances as justification for the Loudoun line, namely the low voltage near Meadow Brook discussed earlier in this testimony.
2. A phase-angle regulator (PAR) on the Pruntytown-Mt. Storm line should have been but was not considered. PARs are special-purpose adjustable transformers. They change the apparent impedance of a line and hence encourage power to flow elsewhere. A number of these have been in service in eastern PJM for many years. This device would direct some power flows away from the Pruntytown-Mt. Storm-Doubs lines onto lines that are less heavily loaded.
3. The proposed Amos-Bedington-Kemptown 765-kV line, discussed earlier in this testimony. Again, I am not recommending this 765-kV line, merely observing that Applicants failed to consider it.

Other options, conventional as well as innovative, exist for meeting needs in 2011, 2016, and beyond. Nevertheless, DVP's, Allegheny's, and PJM's considerations of these alternatives thus far have been very shallow.

Q: DID DOMINION'S CONSULTANT KEMA LOOK AT THESE ALTERNATIVES?

A: At pages 69-70 of its report, KEMA purports to have evaluated demand-side, generation, and transmission options for DVP. However, KEMA was not part of the planning process. KEMA's evaluation was initiated months after the Applicants had already decided on the Loudoun line. KEMA was hired *post hoc* to bolster DVP's filing with the SCC. Moreover, KEMA did not consider viable demand and generation options, and KEMA never analyzed transmission, generation, and demand management options that could in combination displace any need for the Loudoun line.

Q: WHAT ARE YOUR SPECIFIC CRITICISMS OF THE KEMA REPORT?

A: KEMA presented and rejected two generation alternatives:

1. a new 3,000 MW plant to be built at Loudoun substation (KEMA said that this would be one of the largest power plants in North America, and by far the largest in Virginia. KEMA argued that it would be nearly impossible to license and build by 2011);
2. "[s]mall dispersed generating units throughout Northern Virginia." (KEMA concluded that more than 31,000 such units would be needed by 2011 and that this is "beyond reasonable expectations.")

These two "options" are straw men. They are not real, but rather set up to be knocked down. No one has proposed building anything like either of these options. At the same time it set up these straw men, KEMA never addressed thousands of MW of genuine, feasible generation projects pending in PJM's interconnection study queues for the areas of Pennsylvania, Delaware, Maryland, the District of Columbia, and Northern Virginia that the Loudoun line allegedly would serve.

Q: WHY DO YOU FEEL THAT A STUDY OF JUST THESE TWO GENERATION OPTIONS IS UNACCEPTABLE?

A: Both options are based on a presumed need for 3,000 MW of generation to offset a new line that would carry about 3,000 MW.

KEMA itself acknowledged that the 30,000 distributed generation units option was unreasonable and the 3,000 MW unit at Loudoun was impractical. A planner who knows an option is either unreasonable or impractical should discard it and proceed to study options that are reasonable and practical.

Furthermore, nowhere did KEMA show that all 3,000 MW have to be installed at Loudoun (in the case of the single large plant) or that they all have to be in Northern Virginia (in the case of distributed generation). In fact, there is no need for all 3,000 MW to be built at Loudoun or in Northern Virginia. PJM has said that the Loudoun line is needed to meet the needs of a region that includes Northern Virginia, the District of Columbia, Maryland, Delaware, and Pennsylvania. Generation to displace the need for this line could be in this larger area.

Q: DIDN'T KEMA ANALYZE BUILDING SEVERAL SMALLER PLANTS AS AN ALTERNATIVE TO ONE LARGE PLANT OR DISPERSED GENERATION?

A: No. KEMA mentioned but did "not specifically stud[y]" the possibility of several new power plants in Northern Virginia instead of a huge one at Loudoun. KEMA did not address this much more reasonable alternative and argued (without studying it) that injecting 3,000 MW from several new power plants would "almost certainly require" improvements in the local 230-kV and 500-kV transmission systems. KEMA therefore dismissed this option without further analysis.

And yet KEMA also found that the Loudoun line would cause or would not resolve problems on the Mt. Storm-Doubs 500-kV line; the 500/230-kV transformers at Doubs, Pleasant View, Ox, and Loudoun; and overloads of two 230-kV, three 138-kV, and seven 115-kV transmission lines. KEMA did not find that these were grounds for rejecting the Loudoun line.

KEMA does not explain why injecting a total of 3,000 MW from several power plants at different locations would be more stressful to the system than injecting all 3,000 MW at one point. Generally the opposite is true.

The 3,000-MW generation and demand-side numbers developed by KEMA are for 2011. KEMA claims that the corresponding numbers for 2016 would be higher. PJM's generation interconnection study queues for 2016 won't open until 2009, and KEMA does not give a projection of what generation and demand-side resources might be forthcoming through the normal mechanisms by 2016.

Q: DID KEMA CONSIDER DEMAND-SIDE MANAGEMENT AS AN ALTERNATIVE TO THE LOUDOUN LINE?

A: Yes, but KEMA's analysis of demand options was as incomplete as its analysis of generation options. KEMA analyzed "how much northern Virginia load would have to be reduced so as to avoid the need to build" the Loudoun line (p. 4). KEMA concluded that Northern Virginia load would have to be reduced by 2,850 MW in 2011 in order to eliminate the need for the Loudoun line. KEMA further concluded that this much reduction — amounting to nearly half of Northern Virginia's 2006 peak load — would be unreasonable. Nowhere does KEMA explain why 465 MW of load growth between 2006 and 2011 in Northern Virginia requires 2,850 MW of load reduction in Northern Virginia.

In fact, the load growth that drives the perceived need for the Loudoun line is regional and not confined to Northern Virginia, according to PJM. Nowhere does KEMA explain why this regional load growth must be met by load reduction in Northern Virginia only, but that is all KEMA considered.

Nowhere does KEMA analyze a reasonable level of demand management for Northern Virginia or for the broader region. Instead, KEMA dismisses demand management altogether because an unreasonable level of demand management is unreasonable.

Q: DID KEMA ANALYZE TRANSMISSION OPTIONS, DR. MERRILL?

A: Yes, but again the analysis was deficient. First, KEMA accepted without comment or analysis the assumptions about future generation that are contained in PJM's databases. I explained earlier that those assumptions that form the basis for the perceived need for new transmission in the first instance are unreasonable and unsupported.

Second, the alternatives analyzed were too limited. It was becoming clear in 2006 that the Loudoun line would not solve all the problems claimed. KEMA acknowledged more problems between 2011 and 2016, in their view calling for more transmission. But KEMA did not compare the Loudoun line to any of the higher-capacity Amos-Kemptown 765-kV options. (Again, I am not endorsing the 765 kV option, merely observing that KEMA's failure to address it shows the failures of KEMA's analysis). KEMA tacitly accepted my analysis of a flow-limiting alternative, as presented in testimony before the Department of Energy, but rejected the option because it would not satisfy *all* of the perceived needs. In contrast, Michael Kormos, a PJM senior vice president, recently acknowledged in testimony before the Maryland Public Service Commission, attached as Exhibit HMM-38, that such flow-limiting devices are legitimate and potentially useful options.

KEMA did not consider a controllable VAR source for preventing voltage collapse in the Meadow Brook area. Yet, as I discussed above, these devices are widely used and should be in every transmission planner's tool kit.

Q: SHOULD KEMA HAVE CONSIDERED OPTIONS THAT INDIVIDUALLY DO NOT SATISFY ALL SYSTEM NEEDS, BUT DO SO IN COMBINATION?

A: Absolutely. In Exhibit HMM-39, Matt LaRocque, a senior PJM official with responsibility for PJM's Maryland, Virginia, and North Carolina area, said, "PJM believes we need new transmission, generation and [demand response] all working together to meet the future needs of VA." While PJM recognizes that a combination of options is vital, KEMA refused to consider the possibility of a combination of more demand management (which will surely occur, as I have discussed earlier), new generation, and modest transmission additions (if necessary, which may not be the case). In sum, KEMA's conclusion that a massive new transmission line is the best solution is neither supported nor justified.

Q: TURNING TO YOUR QUESTION 5, WHAT IS YOUR UNDERSTANDING OF THE APPLICANTS' TESTIMONY ON THE PROPOSED AMOS-BEDINGTON-KEMPTOWN 765-KV LINE. IF IT IS BUILT, WILL THERE BE ANY NEED FOR THE LOUDOUN LINE?

A: DVP's testimony on this issue is contradictory. According to DVP, "PJM considered . . . an Amos-Kemptown 765 kV alternative [to the Loudoun line]." Exhibit HMM-40. This could mean that PJM did technical studies of the 765-kV line as an alternative to the Loudoun line before endorsing the Loudoun line. The 765-kV line apparently would provide a greater increase in transfer capability. DVP nevertheless says that the 765-kV line would not resolve some of the violations noted in the Loudoun line application, but DVP does not identify those violations.

Exhibit HMM-41. "The 2007 RTEP includes both the [Amos line] and the [Loudoun line] and demonstrates that both lines are now required . . ." Exhibit HMM-42.

Q: WHAT IS CONTRADICTORY ABOUT THIS?

A: PJM has no basis for claiming need for both lines unless they have found the system to be inadequate with only one line. PJM has never found the system to be inadequate with only the 765-kV line. PJM apparently has not studied this case, except before July 2006, when the 765-kV line was apparently rejected in favor of the Loudoun line for the erroneous cost reasons that I discussed earlier.

When PJM does system planning studies, it assumes that all projects it has previously approved have been built. Herling testimony, p. 22. Nothing in the 2007 RTEP report indicates that PJM departed from this protocol to study the system behavior with the 765-kV line, but without the already-approved Loudoun line, using the updated data and assumptions with which the inadequacy of the Loudoun line was diagnosed. To the contrary, DVP admits that "[t]he 502 Junction – Loudoun line was not studied assuming that an Amos – Kemptown line would already be built." Exhibit HMM-43.

In other words, PJM recently studied how system behavior would improve if the 765-kV line were added to the Loudoun line, but not the other way around. They may have a basis for claiming that the 765-kV line is needed if the Loudoun line were already built. But they never studied whether the Loudoun line would be needed if the 765-kV line were built.

Q: DID YOU DO SUCH A STUDY, DR. MERRILL?

A: Yes, I did. Figure 19 is a summary. My conclusions are:

1. Building either the Loudoun line or the Amos-Kemptown 765-kV line will increase west-to-east transfer capability. The 765-kV line yields 750 MW more west-to-east transfer capability than the Loudoun line.
2. Building both lines gives only a modest increase over building just one.
3. In particular, assuming the 765-kV line is built, then adding the Loudoun line increases the transfer capability by only an additional 755 MW.

Figure 19
First contingency incremental transfer capability (FCITC), ignoring overloads in Pennsylvania.
Year 2012

Case	FCITC (MW)
No new lines	-1,318
Loudoun line only	3,231
Amos-Kemptown 765-kV line only	3,984
Both new lines	4,739

Even if we suppose that PJM is right in saying that the Loudoun line will be inadequate and that the 765-kV line is needed, building the Loudoun line in addition to the 765-kV line at a cost of close to $1 billion to gain only 755 MW in transfer capability would be uneconomical.

Q: IN YOUR STUDIES, DR. MERRILL, DID YOU MAKE ANY ASSUMPTIONS THAT SHOULD BE DISCLOSED?

A: Yes, my analysis ignored all overloads except those on the Allegheny Power South interface. In particular, I ignored many overloads in central and eastern Pennsylvania. Problems in Pennsylvania would prevent attaining the levels of FCITC shown in Figure 19. I did this to show the 765-kV line and the Loudoun line in the most favorable light.

Q: PLEASE EXPLAIN HOW YOU STUDIED THE 765-KV AND LOUDOUN LINES.

A: Certainly. My study used PJM's year 2012 PSS/E base case together with the same software (PSS/E and MUST) that PJM and the Applicants apparently used. PJM studied several variations of the 765-kV line (as did I). I understand that the current version is 756 kV for most of its length, changing to two parallel 500-kV circuits for the last link from Bedington to Kemptown. As I explained earlier, for notational convenience, I refer to this entire project as a 765-kV line.

The first row in Figure 19 shows that the system modeled in 2012 cannot withstand a first contingency with the nominal west-to-east transfers. Indeed, the transfers would have to be reduced by 1,318 MW in order to satisfy the NERC n-1 criterion.

Adding only the Loudoun line would increase FCITC to 3,231 MW. This is a 4,549 MW improvement over the negative 1,318 MW of the base case.

Adding only the 765-kV line would increase FCITC to 3,984 MW. This is a 5,302 MW improvement over the negative 1,318 MW of the base case.

Either line by itself would give the approximately 5,000 MW increase in transfer capability called for by PJM's Karl Pfirrmann, then president of PJM's Western Region. Exhibit HMM-44. As I note elsewhere, Mr. Pfirrmann's number seems to be a broad approximation, not supported by a rigorous strategic analysis.

Figure 19 shows diminishing returns as more transmission is added. Adding the Loudoun line to the base system increases the transfer capability by 4,549 MW. However, if the Loudoun line is added to the base system plus the 765-kV line, the Loudoun line only gives 755 MW of additional transfer capability.

Q: WHY DID YOU PICK A BASE SYSTEM STARTING POINT THAT VIOLATED NERC CRITERIA?

A: I used the nominal west-to-east transfers from the dispatch that PJM selected. The nominal west-to-east flows are due to the generation dispatch in the base case PJM provided. As I discussed earlier, this base case has a fatal flaw. It assumes that load grows year by year, but that essentially no new generation is built in eastern PJM between now and 2012. In order to satisfy the demand with the dispatch selected, the computer model has no choice but to import large amounts of power from west to east, overloading the transmission lines.

I do not think this flaw invalidates my conclusions about the relative merits of the two lines. The system is somewhat linear, so the relative differences in FCITC would probably not change much if we had a more reasonable starting point, ignoring the violations in Pennsylvania.

However, we cannot increase transfer capability indefinitely by strengthening just one region of the network. I pointed out elsewhere that problems in Pennsylvania may limit west-to-east flows to levels far below where the Loudoun or 765-kV lines make their full contributions. In fact, my studies using PJM's 2012 base case, without the Loudoun line, show that a 500-kV line in Pennsylvania overloads more than 400 MW before the Mt. Storm-Doubs 500-kV line does. The Mt. Storm-Doubs line is no longer the weakest or most constraining west-east link. I did not analyze these Pennsylvania problems in developing Figure 19.

Q: WOULD THE AMOS-KEMPTOWN 765-KV LINE RESOLVE ALL THE PROBLEMS THE LOUDOUN LINE WOULD RESOLVE?

A: No. The 765-kV line would not resolve the voltage problems at Meadow Brook or overloads in the lower-voltage grid in western Virginia — both problems that DVP alleges that

the Loudoun line would resolve. However, as I noted earlier, these problems can be fixed at a much lower cost than the price tag for the Loudoun line.

Q: IS THE LOUDOUN LINE NEEDED TO BRIDGE A GAP BEFORE 2012, WHEN THE AMOS-KEMPTOWN 765-KV LINE IS PROJECTED FOR SERVICE?

A: Leaving aside whether massive new transmission is needed at all, there are several ways to defer the need for a new transmission line for a year or a few years. PJM's Michael J. Kormos described some of them in his recent testimony before the Maryland Public Service Commission attached as Exhibit HMM-38.

The perceived need for the Loudoun line in 2011 should automatically recede into the future as generation materializes that was not considered in the studies done by PJM and the Applicants. Furthermore, even if new transmission is needed, I doubt whether the need changes from zero MW to thousands of MW of transfer capability in one fell swoop in one year from 2010 to 2011.

Studies that I performed, and which the KEMA report tacitly acknowledges and does not challenge, show that a considerable increase in transfer capability can be attained by locating a phase-angle regulator on the Pruntytown-Mt. Storm 500-kV line. This increase in transfer capability would not be as much as the Loudoun line would provide, but alone could allow the system to operate reliably until the 765-kV line was built, whether this was one year or a few years later.

Some combination of even modest amounts of new generation, a phase-angle regulator, some demand-side management, and other actions identified by Mr. Kormos, should easily bridge the gap until the 765-kV line is built, if major new transmission is needed at all.

Q: TURNING TO YOUR QUESTION 6, WILL CONSTRUCTION OF MAJOR NEW WEST-EAST TRANSMISSION, BEGINNING WITH THE LOUDOUN LINE, LEAD TO AN OPTIMAL, BALANCED, AND ROBUST REGIONAL POWER SYSTEM?

A: No, it will not. This is a strategic question whose importance cannot be overstated for the following reasons.

1. The Loudoun line is a huge, long-lived investment with important direct and consequential economic impacts.
2. It will dramatically affect the future development of the power system in eastern PJM. In particular, it will discourage new generation and demand-side resources in the east and will lead to increased dependence on western coal-fired generation and additional major transmission.
3. It will increase the dependence on a single fuel, coal. There are important risks here, due to uncertainties related to environmental effects of coal, including production and future control of greenhouse gas emissions.
4. A power system that depends on remote sources of generation is less robust and is more vulnerable to cascading blackouts than a system not so dependent, all else being equal.
5. The tradeoffs between cost, reliability, environmental impacts, security and robustness are important. These include the effects on regional economies and development.

Q: WHAT IS YOUR UNDERSTANDING OF HOW THE APPLICANTS DEVELOPED THE LOUDOUN LINE PROJECT?

A: To my knowledge, the applicants did not undertake any strategic analysis of the issues outlined in my preceding answer. The project apparently evolved step by step over a short period without these issues being addressed.

Q: WHAT STEPS WERE INVOLVED, DR. MERRILL?

A: In May 2005, the FERC sponsored a conference in Docket Nos. AD05-000, PL03-1-000. As explained in the February 27, 2007 PJM RTEP at page 119, the purpose of the conference was to determine how to meet an objective whose validity was apparently assumed: How can coal-fired electricity from West Virginia, Kentucky, and Ohio be delivered to eastern load centers? See Exhibit HMM-8.

Karl Pfirrmann, then President of PJM's Western Region, responded with "Project Mountaineer." He sketched four conceptual transmission paths not including the Loudoun line and suggested that some combination of two of them could transmit an additional 5,000 MW of power from western PJM. Exhibit HMM-44. Mr. Pfirrmann did not identify the source of the 5,000-MW figure, nor did he justify the need for this amount.

On March 6, 2006, Allegheny Energy asked the Department of Energy for early designation of a national interest electric transmission (NIET) corridor for its proposed TrAIL 500-kV line from Wylie Ridge (near Pittsburgh) to Mt. Storm to Kemptown. This project would fulfill in part the goals of the FERC conference and the Project Mountaineer concept.

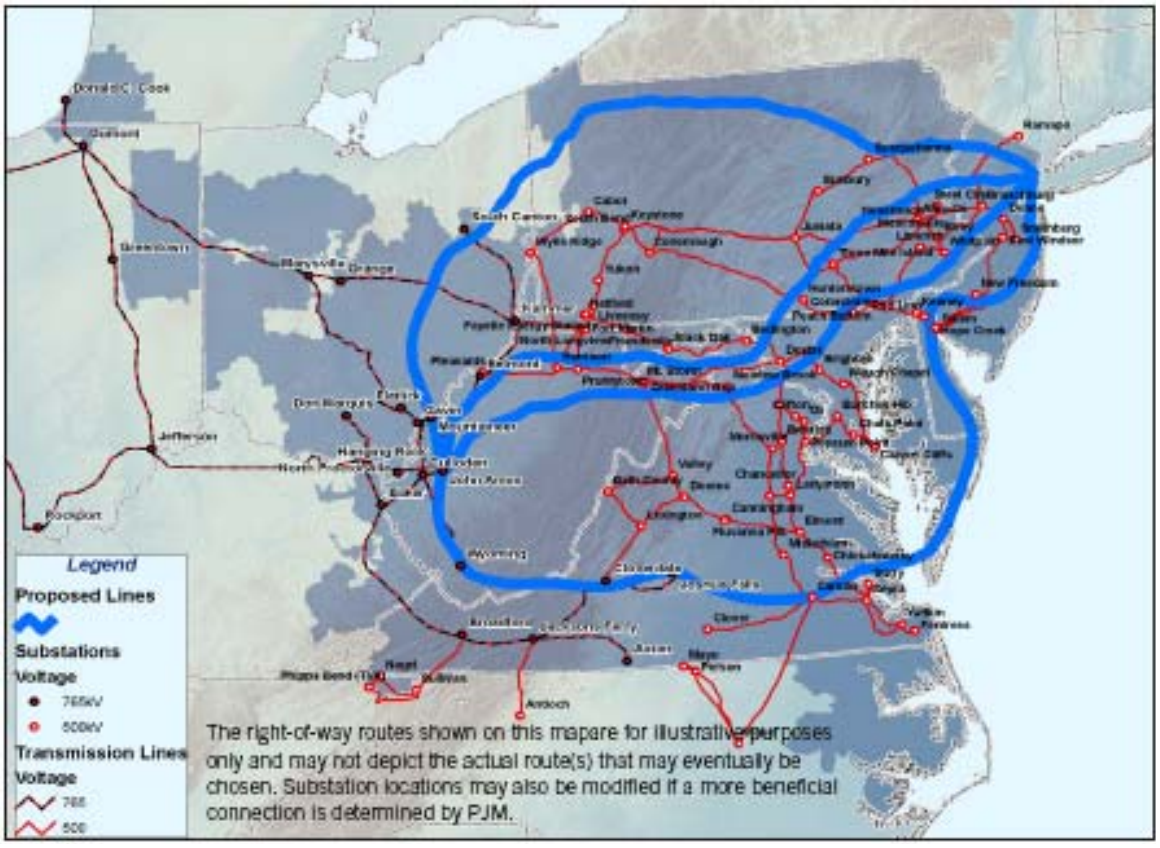
Allegheny emphasized that the project was needed because "PJM has been unable to timely implement market devices that mitigate the high-cost of electric energy in [eastern PJM] and merchant generation has not stepped forward to construct generation plants." Allegheny's explanation of the TrAIL project is in the excerpt from its Comments and Request attached as Exhibit HMM-45.

Figure 20

The blue lines are the "Project Mountaineer" concept from the 2005 Pfirrmann presentation. The Loudoun line is essentially the western half of one of the two central lines. The Amos-Kemptown 765-kV project, announced in 2007, is half of the other. PJM also has announced plans to build a portion of the southern blue line that crosses the Chesapeake Bay and runs north through Delaware into New Jersey.

> This is all being done unilaterally and piecemeal, without anyone except PJM accepting or endorsing PJM's overall strategic plan.

[Source: 2007 PJM RTEP, p. 119]



Allegheny was right: the PJM market at that time didn't work. As I explained earlier, FERC Chairman Kelliher confirmed this in April 2006. Exhibit HMM-37. Chairman Kelliher's solution, however, was to fix the market. The 2007 RPM auctions and the growth of the generation interconnection queues in 2006 and 2007 show that the market is already beginning to function significantly better than it was functioning when Allegheny conceived the TrAIL

project. It appears that plenty of new generation and demand-side resources are being called forth, probably eliminating outright the need for the TrAIL project.

DVP and Allegheny later modified the TrAIL proposal. In June 2006 the PJM board endorsed part of the modified proposal, what we know as the Loudoun line in this proceeding. The modified proposal differs from the original TrAIL project in three significant ways: (1) the eastern terminus is Loudoun, not Kemptown; (2) it has a step-down transformer at Meadow Brook; and (3) a new version of the line from the Ft. Martin area (502 Junction) north into Pennsylvania is treated as a separate project. Allegheny (but not DVP or PJM) continues to use the name TrAIL for this modified proposal, which Allegheny assumes includes the Pennsylvania segments.

Q: WHAT ARE THE INCENTIVES DRIVING THE LOUDOUN LINE?

A: Western coal-burning utilities like DVP and Allegheny can make money selling western generation to eastern PJM and can grow their respective markets, if the Loudoun line and other west-to-east transmission lines are built. These beneficiaries, however, will not even have to pay for these transmission lines; rather, all of PJM's ratepayers will pay the lines' costs.

DVP owns a fleet of western coal-fired plants. Recently it agreed to pay Exelon (the utility serving the Chicago area) $233 million to cancel a long-term contract that committed a DVP-owned coal-fired plant in Indiana to sell power to Chicago. This is more than DVP paid to buy the plant.

Q: WHY DID DOMINION PAY SO MUCH TO GET RID OF A CUSTOMER?

A: It did so because it concluded it could make more than $233 million by selling the power into eastern PJM. The October 17, 2007 Foster Electric Report No. 528 at page 16 quotes DVP's CEO, Thomas Farrell, as saying "There is enormous value trapped in our Midwest generation

fleet." He reportedly said that getting out of this contract allowed DVP to realize more than $30 million per year of after-tax earnings and to raise its current 2008 operating earnings per share outlook of $6.00 or more per share to $6.10 to $6.25 per share. Exhibit HMM-46.

DVP would not only recover its investment in the Loudoun line (a regulated cost-recovery asset), it would also make huge profits from its unregulated western merchant power plants if it could ship power into eastern PJM.

Q: THANK YOU, DR. MERRILL. NO FURTHER QUESTIONS.