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IN THE

SUPREME COURT OF VIRGINIA

Record Nos. 751084, 751085,
751086 and 751087

RAPPAHANNOCK LEAGUE FOR
ENVIRONMENTAL PROTECTION, INC., Et Al.,

Appellants,

v.

VIRGINIA ELECTRIC AND POWER COMPANY And
POTOMAC EDISON COMPANY OF VIRGINIA,

Appellees.

JOINT APPENDIX IA

[TR. P. 944]

are already there; and we are talking about simply widening of the existing corridor as being less damaging to the environment than building a new corridor. This is all I am saying.

Q I take it then that you want to change your earlier answer to say that you now propose running an additional line across there; is that correct?

A No, I am not saying that. I am simply saying that if a line is through a particular area, running one alongside of it doesn't hurt very much more than the line that's already there.

This is all I am saying.

[TR. PP. 961-963]

Q Now, as far as the "save the river" point, you referred to the fact that you had been out to a certain place?

A Yes.

Q In the confluence of the Rappahannock and the Rapidan; is that correct?

A Well, there are about four pronunciations. I thought there were only three, but I found out there are four.

I know the place, yes, sir.

Q What exactly is a problem that you foresee with the proposed line right there?

A Well, the proposed line right there, to get to the lexicon of the young today, just about tears it as far as the scenic river qualifications of the Rappahannock is concerned.

Q You say you don't know this map?

A You'd have to point the confluence out.

MR. MASSIE: Is that it?

MR. BRASFIELD: They are the two rivers you are referring to; the Rappahannock and the Rapidan. The confluence is off the map.

THE WITNESS: The confluence is not there.

But, anyway, the point of confluence here is one of the things that is stipulated as part of the scenic properties of the Rappahannock and the attempt to qualify this as a wild and scenic river. It's that confluence, because it's a beautiful area, if you have been there; and it's one of the things that are stipulated as it runs down all the lists and all the merits to have this included in the scenic and wild river system. One of the things that is included is the undisturbed character of various places, and it mentions specifically this confluence, and now we are going to run a transmission line right through it, or

[TR. P. 963]

at least propose to.

This is what I am saying.

Q And you think that this is one of the most outstanding problems that you see in the line?

A Oh, I see the crossing of the Rappahannock River as a serious problem.

[TR. PP. 965-966]

Q Now, my next question is this: the map -- and I think this is CMS-2 that I am looking at that is behind you -- shows a black existing line from what they call the Ladysmith line going north to Loudoun that passes over to -- it's a 500 kV line that passes over just west of Fredericksburg at the approximate confluence of the Rapidan and Rappahannock Rivers, north to what is known as the Loudoun Station.

The proposed North Anna route is a red line that runs from the North Anna plant now -- Atomic Energy Plant now being constructed and goes north to Morrisville.

And if I may now switch your attention to BH-3 over here, that is the line that is going to, proposed to cross the Rapidan River here?

A Yes, sir.

Q And then the Rappahannock?

A Yes, sir.

Q Do you know that this is the proposed route and that there is an existing route that goes over the confluence already. Would it be your testimony as an environmentalist that the new route or the old would be preferred?

A Well, the old. The one in existence would be preferred, obviously.

Q It's your testimony that two lines immediately parallel and adjacent going over the confluence would in those circumstances have less environmental impact than a new line as proposed that would cross those rivers several miles west at two new junctions?

A That's correct.

TESTIMONY: BRUCE HOWLETT

[TR. P. 975]

I have some problem understanding the purpose of your testimony. I realize that the environmental bill was passed after the line was routed, and so forth, and your study was really a verification.

A I wouldn't call it a verification. I think my study really is a review, an appraisal, you might say, of the lines that VEPCO had proposed.

[TR. P. 981]

Q In your field, all engineering and economic considerations aside, do you recommend paralleling?

A We recommend paralleling where the circumstances would seem to be appropriate environmentally.

I don't think it's the kind of thing that you want to recommend without some understanding of the problems involved.

It sometimes is offered as a panacea. I don't happen to believe that it is. I think we have to look at the circumstances of each individual case.

[TR. PP. 982-983]

COMMISSIONER SHANNON: By adjacent, you mean occupy the same or an expanded right of way?

THE WITNESS: Yes. There are two ways of looking at it. One is if the right of way is already owned, or you can take down a structure and put another one up in its place without any electrical consequences. That is one very minimal impact, because you are using the same right of way; but in most cases you find that there is a need to expand, to parallel along the side, or this is what is proposed.

My view is that you shouldn't do that. It's a good concept in principle, but you shouldn't do it

without very clear examination of what the consequences are environmentally, because if you are alongside an existing route it doesn't make any difference to the trees. If you are concerned with vegetation, they can be immediately alongside an existing line, or they can be ten miles away; you are still going to have to take them down.

So you have to examine, I think, each case on its own merits. You may, in some cases, in a parallel alignment, have much more damage environmentally than you have in another location where you have more flexibility in finding a low environmental impact route.

[TR. PP. 987-988]

Q But am I correct that your employment by VEPCO did not include your involvement in any planning of the location of any of these routes which are subject to these proceedings; is that correct?

A That's correct.

Q The routes were fixed; you were merely asked what the impact of these routes would have on the environment; is that correct?

A That's correct.

Q Did you do any line level or detail level environmental studies on either side of the existing Mr. Storm to Doubs line?

A No.

Q None whatsoever?

A No. We have one underway, as I mentioned, for the future.

Q But in connection with these particular applications, you did not make it?

A No.

Q Then none of the transmission lines which is the subject of the applications now pending before this Commission, none of them were changed or relocated as a result of your system level or line level environmental studies; is that correct?

A I believe that's correct, yes.

[Tr. Pp. 988-990]

Q All right, my final question is -- possibly my final question -- wouldn't the overall environmental impact of proposed Mt. Storm-Morrisville 500 kV transmission line be tremendously reduced if that line were placed adjacent and prallel to the existing Mt. Storm-Doubs line?

A No, I will not agree with that.

Q All right, can you state it in such a way that you could agree with it?

A I don't see how I could.

Q Well, does the adverb, tremendously, bother you?

A No. As I indicated to the Commission earlier, I think you have to look at the circumstances of each particular alternative; and this is what we are in the process of doing.

Q You would certainly concede it would be considerably more acreage involved in a new line?

A Not necessarily. It depends on the length of the line.

Q Assuming the same length of line, of course.

A It depends on what the company would want for the right of way.

Q All right. Assume 150 foot right of way for a new line.

A Yes.

Q And assume you have to have an additional 100 feet to put it in the same corridor.

Now, that's a difference in acreage, isn't it, over a hundred mile length?

A Yes. If the parallel -- if the line can be paralleled with an existing line, and in so doing requires so

[TR. P. 990]

much less width of right of way, then naturally it would be less acreage.

Q And that would probably tend to reduce environmental impact; wouldn't it?

A Not necessarily.

Q It would depend on the area it's going through; is that what you are saying?

A It would depend exactly on the area that you are going through and the types of impact encountered.

Q But you didn't check on the area of existing Mt. Storm-Doubs line in your study?

A No.

Q You didn't do 2 1/2 miles on one side as you did on Mt. Storm to Morrisville?

A No. As I indicated to you, we are preparing such a study in connection with rebuttal testimony.

[TR. P. 1006-1007]

First one, Mr. Howlett, you stated in answer to a question from Mr. Rogers -- I took it that if asked you might state some points where you can't quite agree with the routing of the line?

A There may be places where I think I might study and perhaps find a small change.

Q Could you point those out?

A There's one area where it might be -- this area, I think, south of Front Royal is rather a difficult area to traverse.

* * *

A (Continuing) This particular area is quite hilly, as we have indicated. It's heavily vegetated. Therefore, as one approaches the vicinity of Front Royal the roads and a proposed interstate route which all mesh into the problem as it were, and the route which has been chosen goes over some relatively hilly terrain. What the company has obviously done is try to avoid affecting homes in this general area, and I would perhaps restudy that slightly to see if we might get this line down a little bit off the hillside.

This is obviously a trade-off going on here in trying to reconcile the impact on homes with the impact on this hilly terrain.

Hardly anyone will ever see this, because it's in the back, you might say; and it's heavily vegetated; but, nonetheless, there may be opportunities, perhaps for rounding out that a little more effectively. Perhaps we can remove our potential erosion problem, things of that type.

TESTIMONY OF DONALD N. RICE

[TR. PP. 1032-1075]

Q Please state your name, place of residence and place of employment.

A My name is Donald N. Rice and I reside in Chesterfield County, Virginia. I am employed by the Virginia Electric and Power Company as its Chief Electrical Engineer.

Q What are your responsibilities as Chief Electrical Engineer?

A As Chief Electrical Engineer, I am responsible for transmission line, distribution line and substation design.

My employment with Vepco started in January 1941. My first supervisory job was in 1953 as District Engineer in Newport News, Virginia.

In 1957, I was transferred to Norfolk as District Engineer and in May of 1961 I was transferred to

CONTINUED

Richmond as Assistant Transmission Engineer.

I was promoted to Transmission Engineer in July 1961. I became Chief Electrical Engineer in March 1968.

Q What is your professional background?

A I am a 1940 graduate of Purdue University with a BSEE and with a major in power. I have been certified as a Professional Engineer by the State of Virginia.

I have been a guest lecturer on AC and DC transmission lines at the U. S. Department of Agriculture Graduate School in Washington, D.C. since 1965.

I am a senior member of the Institute of Electrical and Electronic Engineers and participate as a member by invitation on the Transmission and Distribution Committee.

I am chairman of the Towers, Poles and Conductors Subcommittee which has seven task groups engaged primarily in transmission activities. One of these task groups is engaged in the environmental treatment of transmission lines.

I have been accepted as an expert witness in courts of Virginia, West Virginia, and Georgia concerning matters of transmission line design, operation and route selection.

Q In the course of your testimony you will offer certain exhibits. Have they been prepared under your

supervision and direction?

A Yes. In addition, the maps previously introduced and identified as Exhibits CMS-1 and CMS-2 were prepared under my supervision and direction. A map to be introduced later by another witness and to be identified as Exhibit BH-1 has been prepared under my supervision and direction.

Q In what manner do you receive assignments for the design of transmission lines and substations?

A The Vepco System Planning Department determines the need for new transmission lines. Its studies take into consideration load growth trends, planned new generation facilities to meet that load growth, the desired level of reliability and the feasibility of alternative plans to insure that level.

My department then considers the proposed facilities generally and provides informal recommendations regarding the feasibility of line routes and substation sites being considered. These studies result in a formal project request which is submitted to a budget team which meets annually.

The projects accepted by the budget team are submitted to management for further approval and then forwarded to the Board of Directors for authorization.

After the projects are authorized, responsibilities

for transmission design and substation design are assigned to respective engineering sections under my supervision.

Q What guidelines are used in determining the location of transmission lines?

A Once the project is authorized the route is selected insofar as practicable using the FPC guide entitled, "Electric Power Transmission and the Environment."

Routes are selected using coast and geological survey maps, aerial photographs, field reconnaissance by auto and by air.

After our engineers have selected a preliminary route, it is discussed with local governmental agencies and representatives. This is done to avoid conflicts with proposed projects contemplated by local governments and to provide feedback to Vepco engineers on possible areas of consideration overlooked by them in their initial route selection. Suggestions for relocations have generally involved proposed roads or reservoirs.

At the same time, we advise interested state agencies of our proposals so that we can have the benefit of their review.

After we have heard from all interested parties and fully considered their comments, the final route is selected.

Q To what extent are alternate routes considered?

A Our experience indicates that there is frequently one route that best meets applicable Federal Power Commission Guidelines. We investigate numerous alternatives in an effort to exercise sound economic and environmental judgment based on these guidelines, and thereby select the best route. This is one of the reasons we use private consultants to review our routes and why we consider suggestions made by others.

Q What consideration is given to expanding existing utility corridors or rebuilding existing transmission facilities?

A We have a long record of rebuilding transmission lines using existing rights of way where the transmission lines can be taken out of service for rebuilding without adversely affecting electric service to our customers.

For example, in Northern Virginia we have rebuilt 37.8 miles of 115 kV line for 230 kV. We have also expanded existing utility corridors wherever feasible.

We have built on railroad rights of way; this requires considerable expense to comply with railroad requirements.

We have expanded several pipeline rights of way in order to use these utility corridors.

We always consider such possibilities and we use existing rights of way and corridors wherever possible.

Q What does Vepco propose in Application No. 32, "APPLICATION FOR APPROVAL AND CERTIFICATION OF REMINGTON-WARRENTON TRANSMISSION LINE?"

A Vepco proposes to construct a single pole 115 kV transmission line between our existing Remington Substation and a proposed new substation near Warrenton. The length of the line between these two points is 11.3 miles, and the right of way required is 100 feet in width.

The line will be constructed to permit it to be uprated to 230 kV in the future when load growth requires such conversion.

Exhibit D to Vepco Application No. 32 shows the type of structure to be used: a single pole having an average height of 80 feet with the poles being spaced at an average interval of 600 feet.

Q What does this exhibit show?

A This exhibit is a drawing showing a typical pole and its location on the right of way. The drawing indicates that pole material is steel or concrete and also shows the location of crossarms and that the proposed conductor is aluminum.

Q What methods were used for selecting the route of the Remington-Warrenton transmission line?

A Extreme care was used to minimize environmental impact in selecting the route for this line, and I personally

reviewed the general route before it was assigned to our engineers.

Remington Substation near Remington was a logical point of origin because studies by our planning engineers indicate that this was a proper point for supporting the lengthy Charlottesville-Possum Point 115 kV line.

A cross-country route was selected in compliance with FPC guidelines so as to avoid paralleling major highways.

The land between Remington and Warrenton is gently rolling land having extensive open spaces devoted to agricultural activities; however, wooded areas were employed werever possible in our routing to take advantage of their screening capabilities.

The existence of farm ponds and residences influenced the routing; however, every effort was made to avoid routing theline over the crests of hills.

At Warrenton the line parallels an existing gas pipeline right of way for approximately 2,500 feet.

As I have indicated, we propose to construct the Remington-Warrenton line using single pole structures of concrete or steel. This is more expensive than conventional construction, but it will minimize environmental impact.

The proposed route of this line is shown as a solid green line on Vepco Exhibit CMS-2.

Q Were alternate routes considered for the

Remington-Warrenton transmission line?

A We investigated two alternate routes for this line.

Q What does this exhibit show?

A It is an overlay to Exhibit CMS-2 and shows the alternate routes as dashed green lines.

The dashed green line which is west of the solid green line on Exhibit CMS-2 involves the overbuilding of a distribution line along U.S. Route 17 and 29.

The environmental impact of such construction is much greater than the solid green route shown on Exhibit CMS-2 because the structures would have to be of sufficient height to accommodate the existing distribution circuits as well as the proposed transmission facilities.

There are many locations where buildings have been built adjacent to the existing distribution line and adequate clearance is not available for the proposed transmission line. At these same points of conflict, Vepco would have to negotiate for adequate rights; and if we were unable to negotiate on reasonable terms, we would have to make unsightly doglegs around those obstacles. This alternate route does not comply with FPC guidelines.

We explored a second alternate route which consisted of extending a line from Catlett to Warrenton Substation Site. This route is shown on Exhibit DNR-2 as a

dashed green line to the east of the solid green line on Exhibit CMS-2.

Vepco received a request to supply electric service to Colonial Pipeline Co. at Catlett, Virginia and located in Fauquier County. The magnitude of the load was such that a transmission line would be required. Serious consideration of this alternate route was abandoned after Fauquier County officials would not approve the route of the transmission facilities to serve Colonial Pipeline at Catlett.

Q Were alternate sites considered for the Warrenton Substation?

A Two sites were considered for the Warrenton Substation. The first site was adjacent to the Southern Railroad; however, it was in an area open to view for a considerable distance and did not lend itself to suitable screening techniques. We extended our line parallel to the gas pipeline right of way to a site which is wooded and enables Vepco to use native flora for screening.

Q What does Vepco propose in Application 33, "APPLICATION FOR APPROVAL AND CERTIFICATION OF MORRISVILLE-BRISTERS TRANSMISSION LINE AND MORRISVILLE SUBSTATION?"

A The transmission line associated with Application 33 is to be a 500 kV line 7.75 miles long. One terminal point for this line will be a location on Vepco's

existing Loudoun-Elmont transmission line south of Bristersburg, Virginia. We have called this point Bristers.

The other terminal point is a new substation site located near Morrisville, Virginia. These two terminal points are labeled and shown on Exhibit CMS-2. The route of the proposed transmission line is shown as a red line between these two points.

The right of way between these two locations is 235 feet in width; however, only 150 feet of right of way will be cleared for the construction and operation of the proposed Morrisville-Bristers transmission line. The remainder will be cleared only when needed in the future.

The structures to be erected for this line are shown on Exhibit D1 to Vepco's Application No. 33.

Q What does this exhibit show?

A This exhibit shows a typical 500 kV lattice type structure, brown in color, and averaging 116 feet in height. It also indicates that the average spacing of the towers will be 1100 feet and that the conductors will be made of aluminum. The towers will be spaced approximately 1100 feet apart.

Q What facilities will be installed at Morrisville Substation?

A The Morrisville Substation will provide switching equipment for the proper termination of the

Morrisville-Bristers line, the North Anna-Morrisville line (Application No. 35), the Mt. Storm-Morrisville line (Application No. 36) and equipment for transforming 500 kV to 230 kV for service to the 230 kV transmission line to Remington (Application No. 34.)

The substation will be a low profile substation and the trees surrounding the substation site will effectively screen the substation equipment.

Q What do these exhibits show?

A These exhibits are copies of Exhibits D2 and D3 to Vepco's Application No. 33 and show the arrangement of the Morrisville Substation together with the relative height of equipment.

Bus support stands will be made of galvanized steel and all electrical equipment will be painted a light gray color and will have gray insulators. The substation will be enclosed with a 6 foot high chain link fence which will be topped with 3 strands of barbed wire.

Q What factors influenced the location of the Morrisville Substation site and the point known as Bristers?

A This can be answered more clearly with the introduction of the next exhibit.

Q What does this exhibit show?

A This is an overlay to Exhibit CMS-2 and indicates by the dotted red line southward from Remington

the route along which Vepco initially planned to construct its proposed line to North Anna.

You will note that a substation site was proposed adjacent to Vepco's 115 kV line which extends between Charlottesville and our Possum Point Power Station.

At this location, we proposed to develop a 500 kV switching station and install transformers to provide a 115 kV supply to our transmission system. We also proposed to construct a 500 kV line eastward and parallel to the existing Charlottesville-Possum Point 115 kV line to a point beyond Bristersburg where we meet the existing Loudon to Elmont 500 kV line.

The route of this portion of line is indicated by a dashed red line eastwardly from Remington. This routing was selected in order to use an existing utility corridor from Remington eastward to an existing utility corridor for 500 kV construction to our Ox Substation located in the southwest corner of Fairfax County.

When the Federal Bureau of Investigation became aware of our activity, they informed us that our proposed 500 kV line would interfere with the operation of their extremely sensitive radio receiving equipment located near Midland, Virginia and cited applicable Federal Communications Commission regulations that would bar the construction of our 500 kV line parallel in this existing corridor.

At about the same time we learned of a similar sensitive radio receiving station operated near La Grange, Virginia by the Department of the Army, Warrenton Training Center, and known as Site D. We were informed that these government operations use sophisticated communication receivers for the purpose of receiving extremely weak signals, many times weaker than domestic radio and TV signals, and these operations have been located in areas having low ambient radio interference levels so they can achieve their purpose.

These concerns came as a great surprise to us because our 500 kV system is designed to avoid interference with radio and television reception and operating experience has proven this to be true.

We retained Westinghouse Electric Corporation to conduct a study of this problem. As a result of the study, Westinghouse confirmed that our proposed 500 kV line is designed so there will be no interference with domestic radio and television reception but to be in compliance with FCC regulations regarding these special installations, the line should not be closer than approximately five miles from each of the receiving stations.

These two receiving stations are at the center of the black circles, each of which has a radius of 5 miles. You will note that the dashed red line routing initially considered extends through both of these circles.

In order to move the necessary distance from the FBI receiving station, the proposed reconnection point on the Elmont-Ladysmith-Loudoun line had to be moved 1.8 miles south of its intersection with the Charlottesville-Breme 115 kV line; to the point we have called Bristers.

Our proposed route from North Anna to Remington intruded within 5 miles of Site D, and the relocation to get out of this area passed in the vicinity of Morrisville, Virginia.

The constraints associated with the two government receiving stations also influenced the Morrisville terminal point for a transmission line to be built from Vepco's Mt. Storm Station in West Virginia.

For all of these reasons, it became evident that the 500 kV substation for terminating the proposed lines should be located in the vicinity of Morrisville. The site that has been selected has existing trees that will be used for natural screening.

Q How was the line route selected between Morrisville Substation and Bristers?

A Coast and geological survey maps showed that the area between these two points was generally forested with very little land devoted to agricultural activities. These terrain features made it possible to comply with FPC guidelines of locating lines remote from roads and at the same time use

natural forest growth for screening.

Only one major highway is crossed, U.S. Route 17. Forested areas are on either side of the road at the crossing point thus permitting selective cutting to provide screening; or in the event that suitable species of native flora will not provide adequate screening, Vepco will provide planting so as to effectively screen the right of way from U.S. Route 17.

The line route shown as a solid red line on Exhibit CMS-2 swings south of the community of Ensor Shop and at the same time crowds the 5 mile circle around the FBI receiving station.

Q Were alternate routes considered between Morrisville and Bristers?

A Specific alternate routes were not, in this case, considered. The line route selected provides good screening because the majority of the route is over forested lands and we believe complies with the FPC guidelines to the extent practicable. Any alternate route would have been longer and would require more right of way.

Q What does Vepco propose in Application No. 34 entitled "APPLICATION FOR APPROVAL AND CERTIFICATION OF MORRISVILLE-REMINGTON TRANSMISSION LINE AND REMINGTON SUBSTATION?"

A Vepco proposes to construct a 230 kV

transmission line between Morrisville Substation and our existing Remington Substation site. The transmission line will be 4.9 miles long and will occupy the same utility corridor as the proposed Mt. Storm-Morrisville line (Vepco Application No. 36) for a distance of 4.2 miles.

The last 0.7 mile of line will be on a separate right of way having a width of 120 feet. The right of way which is common to the Mt. Storm-Morrisville line will be 235 feet wide.

The existing Remington Substation site will be expanded to accommodate the electrical equipment required for connecting the 230 kV line to the existing Charlottesville-Possum Point 115 kV line. This proposed transmission line is shown on Exhibit CMS-2 as a solid yellow line between Remington and Morrisville. The substation sites are shown as black triangles.

Q What type of transmission structures are proposed for this line?

A This can best be answered by the introduction of my next exhibit.

Q What does this exhibit show?

A This exhibit is a copy of Exhibit D to our Application No. 34 and shows a steel lattice type tower having a brown color. The average height of the tower is shown as 120 feet and the towers will be spaced at intervals of

approximately 1100 feet. The towers provide space for a second circuit. Aluminum conductors will be installed.

Q How do you plan to expand Remington Substation?

A This can be explained more clearly through the introduction of my next two exhibits.

Q What do these exhibits show?

A These are copies of our Exhibits D2 and D3 to Vepco Application No. 34 and show our proposed plans for expanding our existing Remington Substation.

The additional property is of sufficient size to permit the use of existing trees for screening from Route 782, and we plan to plant additional screening from Route 655.

Steel structures in the substation will be made of galvanized steel, and the electrical equipment will be painted a light gray color. The substation will be enclosed by a 6 foot high cyclone fence which will be topped with three strands of barbed wire.

Q How was the route selected for the Morrisville-Remington line?

A The transmission line route between Remington and Morrisville was restricted to a narrow corridor between two 5 mile radii originating at the FBI Midland Station and Site D. The 5 mile circles are shown on Exhibit No. DNR-6 and the 230 kV line is shown as a yellow line on Exhibit CMS-2.

FPC guidelines were applied within this limited corridor and the line route was selected to make maximum use of forested land for screening. The route was selected to stay at a reasonable distance from existing dwellings. No major highways are crossed by this proposed line. There were no existing utility corridors between these two points.

The route was selected so that a major portion could be used for the proposed Mt. Storm-Morrisville 500 kV line (Application No. 36).

Cultivation and the use of lands for pasture can continue after the transmission line is completed.

Coast and geological survey maps were used in determining the actual route to be surveyed.

Field trips were made to be sure that all buildings had been spotted and that the map route was feasible based on a review of the route in the field.

Q Were alternate routes considered for Morrisville-Remington line and the Remington Substation?

A The narrow corridor between the two government receiving stations did not leave much room for alternate routes for this relatively short line. We followed applicable FPC guidelines where possible.

We proposed to expand the existing Remington Substation which has been at this location since 1944 rather

than develop a second substation site in the Remington area and this will minimize our use of additional land.

Q What does Vepco propose in Application 35 entitled "APPLICATION FOR APPROVAL AND CERTIFICATION OF NORTH ANNA-MORRISVILLE TRANSMISSION LINE?"

A Vepco proposes to construct a 500 kV transmission line from its North Anna Power Station to the Morrisville Substation. The length of the line is 32.5 miles. The proposed right of way width is 235 feet of which 150 feet will be cleared. The remainder of the right of way will be cleared at a future date.

The route of this transmission line is shown on Exhibit CMS-2 as a solid red line between the red square labeled North Anna and the red triangle labeled Morrisville.

The structures to be erected for this transmission line are shown on my next exhibits.

Q What do these exhibits show?

A These are copies of our Exhibits D-1, D-2 and D-3 to Vepco Application No. 35. These three exhibits show the use of a steel lattice type of tower which is brown in color, and which will support aluminum power conductors.

Exhibit DNR-10 covers the majority of towers and indicates that the average height will be 116 feet and that the tower spacing will average 1100 feet.

Exhibits DNR-11 and 12 show similar towers for

crossing the Rappahannock and the Rapidan Rivers. The river crossing towers are 166 feet high for the Rappahannock crossing and 196 feet high for the Rapidan crossing.

Q How did you select the line route for the North Anna-Morrisville line?

A The location of the North Anna generating site in Louisa County automatically determined the terminal point of transmission lines associated with the plant.

The North Anna site is located in an area that is devoid of utility corridors that can be expanded for use as transmission corridors.

The area north and south of the North Anna Power Station is an area that will grow in population in the years to come, and we therefore have made plans to acquire sufficient right of way so that a lower voltage transmission line can be built in the future to meet local power requirements.

Our initial studies did not indicate any environmental problems of major consequence in routing lines northwardly from the North Anna site.

My testimony has already discussed the necessity of changing the terminal point of this and other lines from Remington to Morrisville. Once this change was made the line route was laid out using coast and geological survey maps to determine the routing that met environmental

guidelines.

We gave careful consideration to the crossings of the Rapidan and Rappahannock Rivers to have the shortest possible crossing and at the same time take into consideration the impoundment of waters due to the proposed construction of the Salem Church Reservoir. Our engineers were aware of the proximity of the Lake of Woods Subdivision and the Wilderness National Military Park. All of these factors were taken into consideration in the selection of the route. These factors are included in the FPC guide. The crossings of the Rappahannock and the Rapidan Rivers are located so as to be least visible from areas of public view and so located that these rivers can be crossed without placing structures in the riverbed.

Q Are you aware that the State of Virginia is now opposing the construction of the Salem Church dam?

A That is a very recent development, and obviously it makes the construction of the project less likely than was the case when it had the support of the state.

Our planning, however, has had to proceed on the basis of circumstances at the time, and we could not properly have planned this transmission line without taking the Salem Church reservoir into account.

Since there is still a possibility that the dam will be built, we believe that it must still be considered

and, in any event, we believe that the other factors that I discuss justify the proposed routing of the transmission line.

Q What alternate routes were considered for the North Anna-Morrisville line?

A Several alternate routes were considered for this line. I propose to discuss each of these alternates through the introduction of additional exhibits which are overlays to Exhibit CMS-2.

Q What does this exhibit show?

A It shows a dashed red line which is west of the proposed solid red 500 kV line.

We considered paralleling an existing 34.5 kV utility corridor established by the Virginia Electric Cooperative in the vicinity of the North Anna Station.

When we reviewed this proposed line route with the Virginia Commission of Outdoor Recreation, we learned that a regional park was planned in the vicinity of the North Anna reservoir and it encompassed the Virginia Electric Cooperative 34.5 kV right of way that we proposed to parallel.

When we learned of this planned park, our engineers consulted with the staff of the Commission of Outdoor Recreation and selected a route slightly to the east to eliminate any impact to the proposed park, and this route is shown as a solid red line.

My testimony has already indicated through the introduction of Exhibit DNR-6 that we had proposed to terminate the North Anna line at Remington and that route is shown as a dashed red line from Remington to a point just south of the Rapidan River.

Q What does this exhibit show?

A This is an overlay of Exhibit CMS-2. It shows a dashed red line west of the solid red line on Exhibit CMS-2.

This proposed alternate began 4,500 feet southeast of Germanna Bridge. A new community college was being erected between the bridge and the proposed transmission line. The heavy tree growth and the college provided adequate screening from the location marked by historical markers and met acceptable guidelines, insofar as we knew at that time.

It was only after on-the-ground surveys were made that we learned that our proposed route traversed the historical lands of the Germanna Colonies.

Q What does this exhibit show?

A This is an overlay of Exhibit CMS-2 and indicates by a dashed red line an alternate route to the west of the solid red line of Exhibit CMS-2 in the vicinity of the Germanna Colonies Site.

When we reviewed this route with the staff of the Virginia Outdoor Recreation Commission, they advised us

that this alternate conflicted with proposed parks on the Rapidan and the Rappahannock Rivers.

The solid red route shown on CMS-2 represents the best environmental routing in this area between the Rapidan and Rappahannock Rivers.

Q What does this exhibit show?

A This is an overlay to Exhibit CMS-2 and shows by means of a dotted red line a line route to the west of the North Anna Station.

The Atomic Energy Commission asked us to consider the environmental impact of constructing the North Anna-Morrisville line to avoid crossing Lake Anna.

This would require 9.3 miles of additional line and the purchase of 265 acres of additional right of way which would be a greater burden on the environment than crossing our lake.

Q What does this exhibit show?

A This also is an overlay to Exhibit CMS-2 and shows by dashed red lines two alternate routes that were investigated as a result of public hearings in Fauquier County.

The Planning Commission of Fauquier County requested us to study alternate line routings that would utilize a portion of the utility corridor formed by the existing Loudoun-Ladysmith-Elmont 500 kV line, and in addition, a Fauquier County citizen asked us to investigate a

route submitted to us at a public hearing in Warrenton shown as a dashed red line and running eastward from the solid red line on Exhibit CMS-2 between the Rapidan and Rappahannock Rivers.

A route was studied. It departed from the route of this Application in Culpeper County and extended eastwardly to the Elmont-Loudoun line in Stafford County at a point where Aleotti Run intersects with it.

A review of this route by the staff of the Commission of Outdoor Recreation indicated that this route conflicted with several potential park sites and that it would be in close proximity to an area of the Rappahannock River which is "replete with old canal locks and dams, white water rapids, rocks and forests, similar to the river below its confluence with the Rapidan." (Letter from Commission of Outdoor Recreation dated July 20, 1971.)

The alternate route suggested by a citizen in the Sumerduck area of Fauquier County is shown as a dashed red line which leaves the proposed Vepco route in the immediate vicinity of the Germanna Colonies site and extends eastward to the vicinity of Flat Run and then turns northward so as to miss Sumerduck.

This proposed routing involves several crossings of Flat Run which are not desirable if the Salem Dam is built, because these crossings would encompass a greater

expanse of water. The citizen's proposed route would extend east of Richardsville. The area east of Richardsville in Culpeper County is being considered as a major park area and the Commission of Outdoor Recreation recommended that it be avoided when Vepco was studying the alternate route I testified to previously and shown on Exhibit DNR-15.

The routing proposed by the Sumerduck resident would also call for crossing the Rappahannock at the confluence with Sumerduck Run, and would involve 5 spans of conductor over the waters at this confluence if the Salem Dam is built, whereas the Vepco route has a direct single span crossing the Rappahannock River.

North of the Rappahannock the line would cross the Southern Fauquier County Dump; however, the environmental impact to the Rappahannock River, Rapidan River and potential park east of Richardsville would greatly exceed the environmental impact of the Vepco route.

The Sumerduck citizen route cost $1,000,000 more than the North Anna-Morrisville line because this alternate route moves the Morrisville Substation approximately 4 miles east, and requires the construction of more miles of 500 kV and 230 kV lines.

Q What does this exhibit show.

A This exhibit is an overlay to Exhibit CMS-2 and shows by means of a dashed red line an alternate route

considered by our engineers in conjunction with our studies to meet the request of the Fauquier County Planning Commission.

This alternate route departed from the proposed line in our Application No. 35 at a point near Robertson Run and extended eastwardly in Spotsylvania County to the Loudoun-Elmont 500 kV line just south of Chancelor.

It would parallel the existing 500 kV line for a distance of 21 miles from a point south of Chancelor to its termination at Bristers (Indicate). At the same time the line from Mt. Storm would continue in its original route via Remington and Morrisville to Bristers (Indicate). The required substation would then be constructed at Bristers instead of at Morrisville as originally proposed.

This line routing was discarded because of its proximity to the Fredericksburg-Spotsylvania National Military Park and because of obstacles to the acquisition of right of way northward and parallel to the existing 500 kV line.

Also, as I have stated, the existing 115 kV line must be supported at Remington. This would require a 230 kV line between Bristers and Remington which would be 7.8 miles longer than the Morrisville-Remington line (Indicate).

This plan would result in the construction of 16.9 miles of additional 500 kV line in Spotsylvania County and 9.1 miles of additional 500 kV line in Stafford County

which is not crossed by the proposed North Anna-Morrisville line.

This plan would remove 8.7 miles of 500 kV line in Orange County and 6.75 miles of 500 kV line in Culpeper County. In Fauquier County 3.9 miles of 500 kV line would be removed and this would be replaced by 4.8 miles of 500 kV line and 7.8 miles of 230 kV line. However, a 230 kV right of way along the original North Anna-Morrisville route will be required in the late 70's or early 80's in Orange, Culpeper and Fauquier Counties.

Right of way requirements for the 500 kV North Anna-Bristers route and for a North Anna-Morrisville-Bristers 230 kV line would require approximately 232 acres more right of way than the proposed North Anna-Morrisville right of way.

Q What does Vepco propose in Application No. 36 entitled "APPLICATION FOR APPROVAL AND CERTIFICATION OF MT. STORM-MORRISVILLE TRANSMISSION LINE?"

A Vepco proposes to construct a portion of a 500 kV transmission line from our Mt. Storm Power Station to Morrisville Substation. This is a joint venture with the Allegheny Power System which is to construct the portion of line, beginning at the Mt. Storm Station and ending at a point in Warren County.

Vepco Application No. 36 is for the portion to

be built by Vepco which will include the line from Morrisville Substation to the interconnection point with APS in Warren County.

The proposed route of this line is shown as a solid red line on Exhibit CMS-2 which extends between the square in West Virginia labeled Mt. Storm and the triangle at Morrisville Substation. The interconnection point in Warren County is also labeled.

The line will be constructed on a right of way 150 feet wide for a distance of 41.8 miles. The remaining 4.2 miles of right of way will be 235 feet wide to accommodate a major portion of the Morrisville-Remington 230 kV line.

Q What does this exhibit show?

A This is a copy of Exhibit D1 to Vepco Application No. 36 and shows a lattice type steel structure having a brown color. The towers will be spaced at an average interval of 1100 feet and average 116 feet in height. Aluminum conductors will be installed.

Q How did you select the route of the Mt. Storm-Morrisville line?

A The line route selection was a joint effort by Vepco and Allegheny Power System engineers.

Vepco's major effort was directed towards its portion of the line which terminated at Morrisville.

The two engineering teams gave consideration

to using some rights of way purchased in the 60's and located in the George Washington National Forest. This right of way could have been used by APS for their portion of the line.

The recently issued FPC guide recommends that parks and recreational lands be avoided where possible. Our joint studies showed that recreational lands were being developed in the area of the original right of way. We concluded that a route should be selected to miss the George Washington National Forest and the recreational lands.

Q What does this exhibit show?

A This exhibit is an overlay to CMS-2 and shows a dashed red line which is along a route on which Vepco had purchased some parcels of right of way in the early 60's. This route goes through the George Washington National Forest and is in close proximity to Cedar Creek.

The line route shown in red on Exhibit CMS-2 resulted in moving the line route northwardly from Fall Run and Cedar Creek in Frederick County.

The staff of the Virginia Commission of Outdoor Recreation had suggested that our original route was too close to Cedar Creek. Our efforts resulted in adjoining an existing Allegheny Power System utility corridor in Frederick County.

That portion of the line to be owned and built by Vepco starts in Warren County and is a continuation of the

same utility corridor paralleled in Frederick County.

Our application begins at a point approximately 1.8 miles southeast of the boundary line between Frederick and Warren Counties and near the confluence of Sheep Run and West Run. This utility corridor is to be expanded all the way to the Riverton power plant of the Allegheny Power System and located on the Shenandoah River near Front Royal.

This line routing will permit the development of a 500 kV substation in the future for reinforcing the lower voltage transmission lines in the vicinity of Front Royal and this same substation will provide support for Vepco's transmission lines located in the northern end of the Shenandoah Valley.

The proposed line route continues south of the Riverton plant for approximately 1 mile and utilizes an existing distribution line utility corridor. At this point, a new route was required because there are no existing utility corridors that are suitable for expansion to permit the construction of a 500 kV line.

The line route extending southeastwardly from Front Royal was selected to avoid the crossing of mountaintops and to use existing terrain features to mask the line route.

We avoided crossing Green Hill and High Knob by selecting a line route considerably lower than the elevation of these two points. The coast and geological maps

list High Knob as having an elevation of 2388 feet and Green Hill as 1301 feet. Our line route is approximately 300 feet lower than Green Hill and 600 feet lower than High Knob. Both locations have forested slopes and the visual impact will be at a minimum.

Similar routing considerations were taken to use the slopes of foothills for screening rather than routing the line across the crest of hills and mountains. The line route lies east of Long Mountain in Rappahannock County. The remainder of the route traverses sparsely settled portions of the Rappahannock and Culpeper Counties. Particular care was given to routing the line at reasonable distances away from dwellings and settlements wherever possible.

Q What alternate routes were studied for the Mt. Storm-Morrisville line?

A Exhibit DNR-20 indicated an alternate route northwest of Front Royal which was considered and was abandoned after we had consulted with the Staff of the Virginia Commission of Outdoor Recreation.

This same exhibit shows a dashed red line indicating a realignment at our proposed crossing of the Rappahannock River near its confluence with Stony Branch at the Culpeper-Fauquier County line.

This realignment was also made upon advice from the staff of the Virginia Commission of Outdoor Recreation.

The realignment to the north placed the line in an area remote from existing dwellings.

Q What does this exhibit show?

A This is an overlay of Exhibit CMS-2 and shows two alternate routes studied in the vicinity of Front Royal. These two routes are shown as dashed red lines.

The dashed line southeast of Front Royal is an alternate route parallel to a proposed APS transmission line to Boston. We were obligated to study this in an effort to use common utility corridors.

There were several areas along this proposed right of way in Warren County where the close proximity of existing residences did not permit paralleling and a dogleg routing would be required to get around such obstacles, and this is not environmentally desirable.

The Allegheny Power System proposed right of way from the Riverton Plant crossed U.S. Route 522 near Bear Hollow and continued southward toward Boston. We studied the possibility of paralleling this proposed right of way to a point just north of Hittles Mill Stream in Rappahannock County. At this point the Vepco line was to turn eastward towards Morrisville.

The proposed APS 138 kV line route crossed near the Blue Ridge Mountain Estates and residential construction in this area prevented us from widening this

proposed corridor. Consideration was given to routing the line parallel to a distribution line which was adjacent to U.S. Route 522.

This route passed through Chester Gap and is not a desirable location for a transmission line due to the scenic impact and was not studied in detail. However, the problems outlined concerning our endeavors to use this proposed route were sufficient to cause us to make further studies which resulted in the route shown as a solid red line on Exhibit CMS-2.

Exhibit CMS-2 shows the proposed Mt. Storm-Morrisville line crossing ridges in the vicinity of Green Hill and High Knob. The route selected is lower in elevation than the background hill and complies with the FPC guide which suggests, "Transmission facilities should be located with a background of topography and natural cover where possible." (Page 7, paragraph 25).

However, we have explored an alternate route further east and generally parallel to Route 638 and 726 plus a longer parallel to proposed Interstate 66. This route is shown as a dashed red line and east of our proposed route in the Front Royal area.

This alternate is visible for a longer distance from Interstate 66 and is in closer proximity to existing residences on Route 726 and 638. It requires more right of

way because of increased line length and in our opinion has a greater environmental impact than does our route shown in red on Exhibit CMS-2.

Q What does this exhibit show?

A This shows by means of a dashed red line a line route which would result in the Mt. Storm line being terminated at our Loudoun Substation.

At the time studies were being made in conjunction with the third generating unit at Mt. Storm, we investigated a route that would terminate at Loudoun Substation. This route would cross the northern portion of Fauquier County and the southern portion of Loudoun County and would result in a maximum intrusion into an area having great scenic values and into an area which has been designated by Fauquier County as a conservation area.

When we applied to this Commission in 1963 (Case No. 11655) for a certificate of public convenience and necessity for this route, the Commission requested us to find another solution.

Since our original studies with respect to the third unit at Mt. Storm, we have learned that the Division of State Planning and Community Affairs is considering a recommendation to classify most of the area in the northern portion of Fauquier County and the southern portion of Loudoun County, through which this alternate route would pass,

as a critical environmental area.

All of these considerations which I have outlined made it advisable to abandon ideas of terminating our new Mt. Storm line at Loudoun Substation. The line route shown on Exhibit A to Application No. 36 is a route that results in the least adverse environmental impact.

Q As an alternative to building a 500 kV line over a new route from Mt. Storm to Morrisville, have you considered widening the existing utility corridor which was established in the early 60's and build a second 500 kV line parallel to your existing 500 kV loop?

A Yes. Such a duplicate loop system has a substantially greater impact on the environment than the proposed route and has greatly increased costs over our proposal in Application No. 36.

A duplicate loop system would involve the acquisition of more than twice as much right of way than is involved in the total length of the Mt. Storm-Morrisville line.

My calculations indicate that a minimum of 2,468 acres of additional right of way over and above the acreage of right of way required for the Mt. Storm-Morrisville line. This acquisition of 2,468 acres of additional right of way is, in our opinion, not environmentally sound and is not a proper application of environmental guides suggesting the use of existing utility corridors.

Engineers under my supervision have explored the possibility of expanding the right of way on the original 500 kV loop and they reported a total of 1,065 obstacles on both sides of the right of way. These obstacles are so close to the existing line that our negotiations would have to be done on the basis of 100 percent damage to these obstacles including possible demolition. Failure to negotiate for these rights could result in construction of the line around such obstacles which would result in them being set apart between two transmission lines.

These obstacles consist of 116 residences, 66 barns, 162 sheds, 3 commercial properties, 2 cemeteries and 716 subdivision lots. We estimate that the cost of negotiating for these obstacles on one side of the 500 kV loop would cost as much as $2,970,000. The cost of building around these obstacles would be more costly.

The existing 500 kV loop crosses the George Washington National Forest, The Shenandoah National Park and The Chesapeake and Ohio Canal National Monument. The electric requirements for the states of Virginia and Maryland made it necessary to cross these areas.

The FPC guide recognizes that these areas must be traversed on occasions provided such routes are located in areas having the least impact on the parks. We believe our original routing accomplished these objectives and permits

were granted by appropriate authorities.

However, to traverse these parks again by looping the existing 500 kV system is a violation of the FPC guide when the parks can be avoided by building the proposed Mt. Storm-Morrisville 500 kV line over the route shown in our Application No. 36.

In addition, the second 500 kV loop is estimated to cost $52,980,000 more than the proposed Mt. Storm-Morrisville 500 kV line.

Q Can these lines included in Vepco Applications Nos. 32, 33, 34, 35 and 36 be installed underground, and is it practical to do so?

A We have made several studies with respect to projects associated with the North Anna transmission lines and these studies indicate that it is not practical to install such lines underground in rural areas.

Our study for Fauquier County for the proposed 500 kV lines contemplated the installation of seven 230 kV pipe type cables in parallel as an equivalent to the overhead 500 kV line. The cost per mile for the cable system only was 16.5 times more expensive than the overhead line.

We used 230 kV cable in our study because it is commercially available and because Vepco has made two such cable installations, one in a congested metropolitan area and

another for a water crossing under a river subject to travel by oceangoing ships.

We made a later study for another county group using 345 kV cable which is the highest voltage underground cable used in the United States to date for transmission use. That study indicated that five 345 kV cables would have to be installed to be equivalent to our proposed overhead 500 kV line.

The 345 kV installation for cable only was estimated to be 15.6 times more expensive than the equivalent overhead 500 kV line.

Since both of these Vepco studies were made, the development of 500 kV cable has progressed to the point where it could be made commercially available in a short period of time for short lengths; however, it would require a minimum of four such cables in parallel to be equivalent to the two longest overhead 500 kV lines.

Multiple cables are required in order to have sufficient capability for supplying our customers' loads plus cable losses which are considerably higher than the losses in an overhead line. These cable losses also generate heat and current densities must be reduced for cable conductors so that the insulation is not damaged.

We anticipate that 500 kV cable installations would cost 16 to 18 times more than an equivalent overhead line.

Approximately 5,000,000 feet of 500 kV cable would be required in order to place Vepco's 500 kV lines underground.

We contacted the four major suppliers of high voltage cable in the United States in order to determine their capability of manufacturing 500 kV cable. Three of the manufacturers indicated that they would probably not take any orders for 500 kV cable before 1974. One manufacturer indicated that they would accept orders now. One manufacturer indicates that he has a manufacturing capability of 200,000 feet annually and a second manufacturer indicates that he will have the ability to manufacture 300,000 to 400,000 feet of 500 kV cable by 1974. The other two manufacturers would not give us any estimates of production capabilities.

It is obvious that the construction of these lines cannot be accomplished in time to meet load requirements by using 500 kV cable.

The number of cables required for equivalent overhead 230 kV lines is less because losses are reduced as the voltages are reduced. Our studies for Fauquier County indicated that the cost for 230 kV underground construction was 6.7 times greater than the equivalent overhead 230 kV line. It is cost ratios of this order that have restricted transmission cable systems to congested metropolitan areas where rights of way aboveground are unobtainable due to the

land being occupied by other structures.

Q The Vepco Applications Nos. 33, 34, 35 and 36 call for the installation of lattice type structures. Was any consideration given to the use of other types of structures?

A Our objective in the selection of structures is to obtain the most economic structure that will comport with the natural surroundings. To the extent possible, these line routes were selected through wooded areas. The russet color lattice structure blends into the natural surroundings.

Q You stated that the routes of these lines pass through forested lands. How do you propose to clear these lands?

A Extreme care will be exercised in clearing the full width of the right of way to provide adequate and safe operation of the Mt. Storm-Morrisville transmission line; however, only 150 feet of right of way will be cleared on the North Anna-Morrisville right of way and the Morrisville-Bristers right of way. The 0.7 mile separate right of way portion of the Morrisville-Remington right of way will also be completely cleared.

Naturally grown ornamental plants such as cedar, dogwood, holly, redbud and sourwood will be retained to the extent practicable in areas subject to general public view.

An exception to clearing the entire right of way will be provided where the proposed line crosses deep ravines and existing growth will not interfere with the construction and safe operation of the transmission line. Desirable plant

material will be preserved at road crossings in order to screen the transmission facility from the public view.

Brush trees and old stumps shall be cut at a maximum height of 3 inches above the ground for all right of way.

Rights of way in Vepco Applications Nos. 32, 33, 34, 35 and 36 are in predominantly wooded areas and it will be possible to log timber and pulpwood from most of the properties to conserve and utilize the natural resources. Merchantable timber and pulpwood will be sold to local sawmills for processing.

The remaining debris will be piled and disposed of by burning in order to leave the right of way in an acceptable condition and to have the maximum space available for use by the property owners. The disposal by burning shall conform with the rules of the State Air Pollution Control Board.

Q How do you propose to bring men and materials to the transmission routes?

A Conventional construction techniques will be involved utilizing line trucks, cranes, wire pulling equipment, concrete trucks, etc. Agreements with property owners provide for access along the route of a transmission line and over such other contiguous property owned by the grantors of easements as may be necessary.

The shortest distance between construction sites for the individual structures is along the right of way. When, because of terrain features, access along the right of

way become impractical, use is made to the maximum extent possible for existing trails and private roads through arrangements with property owners involved.

When contractors use private trails and roads, they are required to maintain them in a condition satisfactory to the property owners. This requires frequent dressing of road surfaces and the placement of crushed stone where necessary.

At the conclusion of the project the terrain will be restored as nearly as feasible to the original condition by the line contractors involved as part of their contractual obligation. This operation would include the smoothing of ground to its original contours, the removal of temporary bridges, and such other work as may be desirable and necessary.

Following the completion of work by line construction contractors, a separate contractor will be assigned to complete the restoration. Particular attention will be given to areas where erosion might start. Ground surface will be dressed up and grass seed will be planted appropriate to the season to stabilize the restored soil. Thus, access roads are obliterated to the maximum extent possible.

The disturbed areas will be restored after construction. These locations will be limed, fertilized and seeded to establish a ground cover. Such vegetation offers an

attractive situation for wildlife habitat. Birds and mammals use the products of the "edge" for food supplies and timber outside the right of way for shelter. The use of these transmission corridors for wildlife food will tend to increase game and wildlife habitat.

By measures such as are described above, we have been quite successful in practically eliminating property owner complaints.

Q How does Vepco propose to maintain this right of way?

A Property owners will be encouraged to utilize the area for agricultural purposes and Vepco will contribute a maximum of $100 an acre to convert woody brush areas to areas of permanent cultivation. Individual owners have the right to use this right of way area for farming, grazing, growth of ornamental plants or Christmas trees. The owners control public access to their lands.

The periodic maintenance treatments to control woody growth shall consist of hand cutting, machine mowing and chemical treatment. The first treatment would probably be made in 1976. Herbicides will be used to reduce the density of the fast growing hardwood species to an acceptable level.

Herbicides used to control woody vegetation are registered with the Environmental Protection Agency and

the Virginia Department of Agriculture.

The rates that will be used for these applications are recommended by the Agricultural Extension Service of Virginia Polytechnic Institute and State University. Herbicides will not be used where the right of way is devoted to agricultural use.

The purpose of the right of way maintenance program will be to prevent interruptions to electric service and to provide for access to the rights of way for patroling and to make emergency repairs. This program will be accomplished in an aesthetically acceptable manner.

The methods used to achieve these objectives will be consistent with the land use pattern for the area.

Q Mr. Rice, the prepared testimony of Mr. Bruce Howlett makes a number of recommendations that certain specific FPC guidelines be followed at certain locations. Would you comment on his recommendations?

A As my testimony indicates generally, we have followed and will continue to follow the FPC guidelines in routing, building and operating these facilities. More precisely, we will follow the exact guidelines referred to by Mr. Howlett in accordance with his recommendations.

Q Have there been any safety or operating problems associated with Vepco's existing 530.38 miles of 500 kV transmission line?

[TR. P. 1075]

A The existing 500 kV system has met with good success as a reliable transmission system, and no safety problems have been encountered.

Q To what do you attribute this success?

A A great deal of engineering study went into our original design and has been further improved with the 500 kV lines built since 1968. Particular attention has been given to conductor selection so as to maintain good radio and television reception along the routes of our lines.

We have received fewer than a half dozen complaints about radio or television interference and, upon investigation, none of them was substantiated.

Our transmission towers are designed to exceed the requirements of the National Electrical Safety Code (NESC), 6th Edition and the tower heights have been selected to provide conductor clearance to ground which exceeds the NESC requirements. As a result, our 500 kV system has been free from operating and safety problems.

[TR. P. 1100]

As a consequence, we felt obligated to review and consider the possibilities of utilizing some of the existing right of way that we had purchased in the early 60's when we had originally intended to construct a transmission line directly from Mt. Storm to Loudoun.

[Tr. Pp. 1103-1104]

A (Continuing) Mr. Howlett, in his testimony under cross-examination, was asked if he had any suggestions of alternate routes. One of his suggestions was in the Front Royal area which we felt obligated to study because we gave him the freedom to make any recommendations what he wanted to make with respect to our transmission line route; and if he had any serious objections to anything that we had done to let us know about them and we would take them into consideration.

One of those alternates that he suggested was in this Front Royal area, as he pointed out to you, that would involve a longer parallel of the proposed Interstate 66 in order to get down lower on the slopes where our present transmission line route is.

We looked at that transmission line route. As he indicated in his testimony, it becomes particularly closer to a number of buildings where we extend southward from Interstate 66. Also, in this same area, generally southward of Interstate 66, there are a handful of sites that have been cited by the Historic Landmark Commission as having historic significance.

For that reason, we did not elect to submit to this Commission for approval his alternate route.

We believe that the route that we have selected, it's true, is on the slopes; but it's down on the slopes. You will not be able to look up the hillside and see the towers above the slopes behind them because they have elected to stay down below the topmost part of the hills in this area, and we have done this purposely in an effort to abide by the FPC guidelines, and we believe that this is a preferable route to that route that Mr. Howlett indicated that he might give some consideration to as a result of direct cross-examination.

[TR. P. 1105]

A That transmission line is shown on Exhibit DNR-22, which is an overlay of Exhibit CMS-2. It's shown by a red dotted line extending eastward from the existing Mr. Storm-Doubs-Loudoun transmission line.

While this line is shorter, and I believe Mr. Stallings has said does electrically the same thing that a line from Mt. Storm to Morrisville would, it goes through an area that we believe is very scenic, large estate type farms, and is not a desirable route as this Commission found early in the 1960's when they refused to grant us a certificate, or an approval for the contruction of this line.

So that is a consequence of the previous action of this Commission, plus the fact that this is a much more scenic portion of the country, in our opinion, than the route that we have selected, we really never have given this any serious thought.

I might point out that we say that in spite of the fact that we still have some rights of way that we acquired originally in the early 60's. We don't think from an environmental standpoint that this is the way to construct our transmission line. We believe that this has the least environmental impact, and I say this, and I am talking about the Mt. Storm to Morrisville transmission line.

[TR. P. 1114]

Q Has it been a practice of the company to have consultants confirm routes in the past, or is this the first time?

A Yes. No. We have used Mr. Fred Arnold for a number of years as a consultant to review our transmission line routes.

Mr. Arnold was previously with the -- one of the federal agencies, one of the park agencies. He was concerned with public safety. He had had a lot of years of experience with the Forestry Department. We thought it well to use him to review the activity of our engineers, and this was done before this new environmental law was ever passed.

[TR. P. 1127]

Q What would the difference be equivalent to 50 million dollars if you were to loop to the north?

By that, I mean Mt. Storm to Black Oak to Doubs, back to Mt. Storm.

A I don't know. I never made an estimate of that.

Q How much greater distance would that be than the Mt. Storm to Morrisville?

A I don't know. I haven't studied that.

Q You had an idea I was going to ask that question, though, I presume?

A No. I had an idea that you were going to ask me what the cost of paralleling the Mt. Storm-Doubs-Loudoun line would be.

Q What is that?

A As against the Mt. Storm-Morrisville.

Q Okay, what would that be?

A Our original loop studies indicate that the cost of the Mt. Storm-Doubs-Loudoun line would be approximately $23,540,000.

Q $23,540,000.

Now, that's the cost. That's the cost to do that?

A Of the transmission line, as compared to a Mt. Storm-Morrisville line cost only of $21,010,000.

[TR. P. 1159]

Now, in connection with that line, is what you are saying that VEPCO has always had private consultants review the routes that they have selected?

A No.

Q Well, now, to what here do you reference? Are you referencing someone like Mr. Howlett?

A No. I am referencing primarily to the use of Mr. Fred Arnold, whom we have used for a number of years, even prior to the time of the enactment of the present laws under which this hearing is being held.

[TR. P 1181- 1182]

You have referred to the review of your routes by private consultants, and you have referred to Mr. Arnold.

* * *

Q I have in my hand a report dated April 22, 1971, entitled Mt. Storm to Morrisville 500 kV line alternate routes A and C.

Mr. Arnold says personal observations upon which the following recommendations and comments are based were limited to an aerial overview with Messrs. Senell and Marshall on April 21, 1971, the date preceding the report itself.

He indicates that no on-the-ground survey was made.

Now, what was the scope of his engagement with you, Mr. Rice; just to go out there and fly over it one day and give you his general ideas, or was he to give you detailed recommendations?

A His general instructions were to review the route of the transmission lines in any way in which he deemed advisable to do it.

In this particular case, he chose to do it by air, together with representatives of our company who were familiar with the line route.

[TR. PP. 1182-1183]

Q So it's this two page, one and a half page report, made the day after an aerial flight that you refer to in, I think, your application where you stated that your

[TR. P. 1183]

routes were reviewed by an independent consultant? This is the one you are referring to?

A Yes.

Q Are there any others?

A No. Not other than the one done by Mr. Bruce Howlett which was presented here.

Q And that was done after the fact; was it not, after the selection had been made?

A That's true.

***

Q I notice that Mr. Arnold made a recommendation in his report which he says involves a fairly major relocation and that was -- was it High Knob?

A Yes.

Q Where is High Knob?

A High Knob is generally this area immediately -- it's in the area immediately east of Front Royal.

[TR. P. 1184]

A I don't think we followed them specifically in this particular area. ~~We did follow them up here in the~~

[TR. PP. 1206-1207]

Q What would be the total cost from Mr. Storm to Doubs to Loudoun be to parallel on an adjacent right of way?

A I have got those from the loop study. I don't have the loop study in front of me. That loop study indicated that the cost of -- the estimated cost to parallel the Mt. Storm-Doubs-Loudoun line for 130.4 miles would cost approximately $23,540,000.

Q Does that include the terminal?

A No. There's no terminal equipment in there.

Q This is the figure you mentioned the other day, I believe, Friday, perhaps.

What's the cost of the terminal equipment?

A Based on the 25 million dollar figure I gave you for the total for the Mt. Storm-Morrisville, approximately 4 million dollars.

Q So it would be approximately 27 million dollars to compare with the 25 million dollars; is that right?

A That's correct.

COMMISSIONER SHANNON: Did I understand correctly the other day, I think when Mr. Massie was cross-examining you, Mr. Rice, that you indicated the cost of the construction of the Mt. Storm to Morrisville line was $21,010,000, plus $4,000,000 terminal cost?

THE WITNESS: That's right.

[TR. PP. 1216-1219]

BY MR. KAY:

Q Now, with respect to the obstacles we were discussing of these subdivision lots and barns and sheds and residences, could you tell me how many of these are on each side of the line?

For example, how many would be on the, say, the north and east side of the line, and how could you best do it?

A All right. All I have is a percentage figure that my engineers gave me, which said 55 per cent of the obstacles are located on the outside of the loop, which would mean that 45 per cent were located on the inside of the loop.

CHAIRMAN BRADSHAW: You could never build it

CONTINUED

north to east. It would either have to be north-south, east-west.

MR. KAY: All right, sir.

BY MR. KAY:

Q You don't know, of these percentages, you don't know which of the obstacles we are talking about then as to whether -- for example, you don't know whether all of the residences are on one side or on the other? You have lumped them together for these percentages?

A Lumped together for the purpose of making the loop experience. We lumped them together; then viewed them together; then made an opinion that 45 per cent of them were on the inside of the loop and 55 per cent were on the outside of the loop.

We have made a detailed study of the Mt. Storm-Doubs-Loudoun line.

Q You have made --

A Since then, yes, sir.

Q Well, what do they show?

A Now, going back and looking at a Mt. Storm to Doubs to Loudoun, and looking at paralleling on the south side of the right of way, and counting only the obstacles that were inside the right of way that were proposed to be taken, there are four dwellings, six barns, five large sheds, five small sheds, two chicken barns, six mobile homes and thirty-nine lots

at the Keys Ferry Acres, and West Bridge Hills Subdivision.

Q And that was for what segment, sir?

A For the Mt. Storm-Doubs-Loudoun.

Q And that's for the inside?

A Inside of the loop.

Q Which would be the south and the west?

A West. That's correct.

MR. KAY: Judge Bradshaw, that's what I meant by south and west. One part is south. On the other part it's west. It's south from Mt. Storm to Doubs and then it's west from Doubs to Loudoun.

CHAIRMAN BRADSHAW: Well, the way I understood the question you asked him how many obstacles on the north side and how many on the east side. I just didn't see how many on the north side and how many on the east side.

MR. KAY: It depends on which way you are talking about.

COMMISSIONER SHANNON: You are talking about a rectangle.

MR. KAY: The question was not clear, but it was clear in my mind.

BY MR. KAY:

Q Now, from the outside --

A We didn't make a study, a detailed study of that,

because we thought the inside loop has the least number of obstacles.

Q When was this analysis made that you have just given?

A 7/11/73.

Q Have you made any estimate as to the cost of those obstacles?

A Yes. Those obstacle costs were estimated at $326,000, as compared to $630,000 on the original loop study that was made in March, which included obstacles outside the right of way.

Q And $680,000 was for the entire loop?

A No. That was for the Mt. Storm-Doubs-Loudoun.

Our original estimate, the one that is dated 3/7/73 that I just handed you --

MR. BRASFIELD: That's DNR-27.

A DNR-27, the top line, item 1, you look across to the column entitled "Obstruction Costs," you will see a figure of $680,000.

Q Yes, sir. And that included --

A That included obstacles both outside the right of way and inside the right of way.

The figure I gave you on the study made and completed July 11, 1973 and had a figure of $326,000 were for those obstacles that are in the right of way to be taken.

[TR. P. 1242]

A No. What I said was that we considered a relocation Mr. Howlett made in the Front Royal area, which would get us further down slope from High Knob, and we rejected it primarily because it took us closer to a number of historical sites.

We thought that the route we had offered the best concealment.

* * *

We reviewed the major relocation that he had recommended, and I included it in one of my exhibits as an alternate route that we had studied.

[TR. P. 1248]

Q Would it be your opinion that the existence of an extra high voltage line through Windsor Farms would not affect the values of the residences in that area?

A Based on the information that I have seen developed by our appraisers over a number of years, I would say that you could take a raw acreage and went through a site that was to be developed with large estates such as you have in the Windsor Farms, with the proper promotion in sales, that that development would continue to grow and would grow

into a -- could grow into a development similar to what you have at Windsor Farms now without transmission lines there.

Q And without any depreciation in value?

A That's right.

[TR. P. 1249]

CHAIRMAN BRADSHAW: No question that would be considered, too, and I think almost everybody can take almost judicial notice that nobody wants any big poles in your back yard, and they do depreciate your land if you get ready to sell it.

TESTIMONY OF HAROLD D. KUBE

[TR. P 1290]

Q Please state your name, address and place and date of birth.

A My name is Harold D. Kube and I reside at R.F.D. #1, Broad Run, Fauquier County, Virginia 22014. I was born in Buffalo, Wyoming, on June 16, 1910.

[TR. P. 1292]

Q What association do you have with the Fauquier County government?

A I was appointed to the Fauquier County Industrial Committee (later known as the Economic Development Committee) on June 28, 1962, and remained on such Committee until it ceased to function in 1967. I was appointed to the Fauquier County Planning Commission in December, 1968, for a four-year term and served as its Chairman for the Years 1971-72.

[TR. P. 1296]

A First of all, I think we started out with the basic premise that we all agreed we needed the power. ~~The~~

[TR. PP. 1320-1321]

A "I think the best route to Warrenton is the one that does the least amount of damage overall + which would be the direct line through the countryside as opposed to down the road. It would be the one VEPCO has actually proposed."

Q All right, now, did you disagree with his conclusions with respect to that transmission line?

A No, I didn't.

Q All right, now, would you turn to page 9, where we are talking about the North Anna line to Bristersburg via Morrisville.

MR. BEAN: May we go back to one point, if I may?

When you asked the gentleman if he disagreed, was he speaking as an individual or as a Commission, for the Commission?

THE WITNESS: I was speaking as an individual

MR. BENA: Thank you.

COMMISSIONER SHANNON: And when you said "that line," you were talking about the Remington-Warrenton line?

THE WITNESS: Right. Exactly.

BY MR. CHURCH:

Q You were satisfied that the Remington -- you yourself were satisfied finally that the Remington-Warrenton line would be better cross country than it would be up the road?

[TR. PP. 1334]

BY MR. CHURCH:

Q During the recess, we placed DHR-22, I believe, on the board, Mr. Kube.

Have you had a chance to familiarize yourself with the route of the dotted dashed red line shown on that map?

A I have.

Q Would you comment on the desirability of that route; that is, the route shown in dashed red lines on DNR-22 as opposed to the route shown on the base map CMS-2 from Mt. Storm to Morrisville?

A Now, which is the route 2 map?

Q CMS-2 is the base map which is underneath.

A Oh, all right.

MR. BEAN: Mr. Commissioner, again I don't object to his answering this on an individual basis; but unless the Fauquier Planning Commission considered this as an alternate, I do not think it's relevant.

THE WITNESS: I would like to just state that the changing of this --

COMMISSIONER SHANNON: Just a minute.

Did the Fauquier County Planning Commission consider this as an alternative?

THE WITNESS: That's the question I was just going to answer.

COMMISSIONER SHANNON: Did it, yes or no?

THE WITNESS: No.

COMMISSIONER SHANNON: Well then, I don't see really what relevancy this would have, Mr. Church.

MR. CHURCH: Well, it's a route that's been suggested, Your Honor, and this route goes -- dashed red line goes through the upper Fauquier County, and

I would think the Commission would want to know what the former Chairman of the Planning Commission thought about that route.

COMMISSIONER SHANNON: He could only express a personal opinion.

MR. CHURCH: Well, he has some personal standing, I believe. He stated that he's the former --

COMMISSIONER SHANNON: But he can't speak for the Planning Commission.

MR. CHURCH: No. I am not asking him to speak for the Planning Commission.

COMMISSIONER SHANNON: Well, if he speaks his personal opinion, do you have any objection, Mr. Bean?

MR. BEAN: I have no objection to his personal opinion, no. I just think the relevancy is very minimal.

THE WITNESS: Well, I'd just like to state, as I started to, that this proposed line through here was considered and turned down and withdrawn by VEPCO before I ever became a member of the Planning Commission, so that I was a citizen of the County, of course, and aware of some of the implications of it, but --

BY MR. CHURCH:

Q That was about 1962; wasn't it?

A Right, and the alternate route up through here

[TR. P. 1337]

and down this way was then put into effect, so to stand -- for me to stand up here and comment on a proposed route through here now would have no meaning. I am just not in a position to make any judgment factor or anything else at this time.

Q You have no opinion as to whether this would be a desirable route?

A No, I haven't.

Q But you do have an opinion that the other line would?

A I would have an opinion that this goes through some of the nicest country in Fauquier County and Loudoun County.

Q That's all I was trying to get you to say.

A And one of the reasons it was withdrawn in the first place is because of that, is my understanding.

MR. BEAN: We will so stipulate.

TESTIMONY: DONALD N. RICE

CONTINUED

We have broken those line costs out of that project this morning, and I have orally to inform you that the line cost of the Ox - Bristers transmission line is $3,368,812.

Now, obviously we can't estimate that close, but that is a percentage figure of the total figure.

The right of way that was acquired for the Ox to Bristers transmission line is 332 acres.

That concludes everything I have been asked for except the outage experience on the Remington to Warrenton 34.5 KV line.

MR. KAY: I had asked, and perhaps you determined that it is not available, but I wanted a breakdown of cost figures of the Mt. Storm - Doubs - Loudoun line to show the Mt. Storm - Doubs segment and the Doubs - Loudoun segment.

THE WITNESS: We did not make such an estimate.

MR. KAY: In the same way that you broke out the Bristers to Ox portion or the Morrisville to Ox portion, you could come up with an estimate, couldn't you?

THE WITNESS: We could do that. You didn't ask me to do it. You asked me if we had, and my answer was, no, we had not.

MR. KAY: Well, I'll ask you now, if I may.

[TR. P. 1417]

I had the major responsibility in the routing of the transmission line. The final routes were reviewed by those people that I report to.

* * *

A The environmental report that was submitted to the AEC was prepared under my supervision.

I reviewed it before it was submitted to the AEC.

[TR. P. 1421]

Q Do these statements indicate that VEPCO endeavors to use the same rights of way for more than one 500 KV line when it can do so and still achieve reasonable reliability?

A It does.

Q Why does VEPCO do this?

A Economic reasons, and it also meets the environmental guidelines.

Q Would it generally be less costly from the standpoint of right of way acquisitions to put more than one 500 KV line on the same or contiguous right of way?

A Answering strictly from a right of way cost, yes, I would imagine so.

[TR. P. 1423]

BY MR. KIPPS:

Q Would it generally be less costly to expand an existing right of way rather than acquire new rights of way in a different area?

A Not necessarily.

[TR. P. 1424]

Q If you expanded the existing Ladysmith to Bristers right of way, how many feet in additional width would VEPCO need?

A A hundred feet.

[TR. P. 1425-1427]

Q All right. Would the overall cost of maintenance of the right of way, transmission towers and lines generally be less if two or more 500 KV lines share the same right of way rather than being separated by ten miles?

A I would expect that is probably true.

Q Would the construction costs of constructing a new 500 KV transmission line generally be less if done on an existing right of way or one contiguous therewith rather than a right of way ten miles distant?

A I can't answer that question. To build a 500 KV transmission line on existing right of way with existing towers to add to it would call for the dismantling of the existing line and replacing it with a double circuit line at a

considerably greater cost than adding to the right of way and building a new line parallel to the existing right of way.

Q Fine. Let's look at just paralleling.

A The only diminution in cost that I know of just offhand would be the right of way acquisitional cost.

Q What about the clearing costs?

A The clearing costs would be less because of the diminution of right of way.

Q You also would have access roads, would you not?

A Not necessarily.

Q You have access roads to the existing right of way, don't you?

A Not necessarily, no, sir.

Q Well, you can use the right of way as the access, can you not?

A That's right. I can on a new right of way across country, too.

Q But it costs money to build it, doesn't it?

A It costs money to build a transmission line anywhere.

Q Yes. But we are talking about the comparison between using your existing right of way with your existing roads?

A The existing right of way does not have existing roads, except those that the property owners have

[TR. P. 1427]

available or use.

Q But you have access to the existing right of way?

A That is included in our right of way, yes, sir.

Q Do you agree with me that from an environmental standpoint it is preferable to locate two 500 KV lines in the same corridor rather than in two separate corridors?

A No. I don't think you can answer a question like that in a general way.

You've got to look at the environmental consequences of paralleling, and the environmental consequences of a new right of way.

[TR. P. 1437]

In VEPCO's application to this Commission, Number 35, Sheet 2 of 3, VEPCO states: "An investigation was made of an alternate route from North Anna that would extend eastward to the existing Elmont - Loudoun 500 KV line and parallel that line to a point near Bristers, referred to in Application 33. Such a route would have to be separate from the North Anna - Ladysmith line in order to meet Atomic Energy Commission requirements."

Are these AEC requirements referred to in the Commission Application Number 35, the AEC General Design Criteria Number 17?

A My understanding is the Design Criteria 17 applies.

[TR. PP. 1438-1439]

A "Electric power from the transmission network to the onsite electric distribution system shall be supplied by two physically independent circuits, not necessarily on separate rights of way, designed and located so as to minimize to the extent practical the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions."

Q Now, would you read the rest of Criteria 17 to yourself and tell me whether you see anything in there that requires VEPCO to place the North Anna - Morrisville route separate from the North Anna - Ladysmith route?

A No, except there is no definition in this criteria as to what constitutes two physically independent circuits on an existing right of way.

I would point out to you, Mr. Kipps, that at the time the transmission line routes were under study, in conjunction with the North Anna power plant, that this criteria had not been established, and at that time the Atomic Energy Commission indicated to us that the safety requirements were

satisfied with two transmission lines on independent rights of way.

This was a criteria which they insisted upon when we developed our Surry Nuclear Power Plant.

[TR. PP. 1439-1440]

Q And General Design Criteria Number 17 specifically states that they do not have to be on separate right of way.

A That's right.

Q You do have to have two coming out for safety reasons, but they do not have to be on separate rights of way.

A What the thing says is, "Not necessarily on separate right of way."

And it does call for two physically independent circuits.

Q Don't you have planned two physically independent circuits coming out of the North Anna plant?

A The right of way from North Anna to Ladysmith is wide enough for the installation of two 500 KV transmission lines. A tower failure on one of the lines, if it is in the direction -- what causes the failure is in the direction of the other line, the other line will be taken out of service at the same time.

This would happen if you had an airplane through it, if you had a failure of the foundation, if you had a failure

of the structure, for any reason whatsoever, if you had a static wire burn down, due to lightning, and it causes a flash-over that would burn the conductors down, that width right of way does not meet this criteria.

[TR. Pp. 1442-1443]

Q Don't you propose, at the present time, to have two 500 KV lines paralleling each other going to Ladysmith?

A That is correct.

Q How do you square that with the answer that you couldn't make the Morrisville line also go in the same direction, or in lieu of the one that proceeds on up north to Ox, or wherever it goes?

A If you install three 500 KV transmission lines on that right of way from North Anna to Ladysmith, and you had a common right of way outage, which is a recognized criteria for studying the reliability of a transmission system, a common catastrophe on that right of way would then leave you with only one transmission line for four generating units, but in addition to that would have a much more serious impact on a loss of electric supply to the Northern Virginia area.

[TR. PP. 1450-1452]

COMMISSIONER SHANNON: I take it everybody is fairly oriented to the map.

You may proceed, Mr. Kipps.

BY MR. KIPPS:

Q Mr. Rice, directing your attention to this, the Fredericksburg - Spotsylvania National Military Park, at or about Route 3, McLaws Drive, could you tell me whether VEPCO's transmission line, existing transmission line, 500 KV line would be visible from that site?

* * *

Q Is the adverse environmental impact of VEPCO's existing 500 KV transmission line from Ladysmith to Bristers in this Fredericksburg National Military Park area minimal or substantial?

A Generally speaking, I would say it was minimal.

* * *

Q Directing your attention to the Salem Church quadrangle where VEPCO's existing Ladysmith - Bristers 500 KV line crosses Route 3, do you know who owns the land on which VEPCO's line is located just prior to its crossing Route 3?

A I understand that you have a joint interest in some property there.

[TR. P. 1459]

Q Would I be correct in saying that the only two changes made by VEPCO from the preliminary route staked by the end of 1969 were those around the Germanna Colonies and the Pigeon Run Park and the most recent one moving it still further from Pigeon Run Park? Are these the only three?

A That's right. ~~I think I pointed out, though,~~

[TR. P. 1465]

touch with you. You are undoubtedly aware that there have been further survey activities on behalf of Virginia Electric and Power Company in an effort to assure that the final route selected for this line will meet the highest engineering standards.

"I am now advised that the power company has concluded that it should adhere to its original route with one slight modification. This modification will take place in the vicinity of the property owned by the Memorial Foundation of Germanna Colonies, which is an historic site. No other changes will be made on the original route of the proposed line."

Q Are those two paragraphs correct?

A To the best of my knowledge they are.

[TR. P. 1468]

How can you take those guidelines into account when they had not been published by that point in time?

A We took them into consideration in view of the fact that the guidelines as published followed previous reports to the President and to the Federal Power Commission on transmission line routings.

Much of that information was lifted verbatim and put into the FPC and the Agricultural Department Guidelines.

[TR. P. 1470]

MR. KIPPS: I would like to have marked as Kipps' Exhibit Number 5, United States Department of Interior, February, 1971, consolidated field report on the Salem Church Reservoir Project, made in cooperation with the Water Quality Office, Environmental Protection Agency and National Marine Fisheries Service, Department of Commerce.

[TR. P. 1474-1475]

BY MR. KIPPS:

Q I direct your attention to Page 18. Would you read the marked passages aloud?

A "The Rappahannock and Rapidan Rivers possess exceptional historic values. From the first colonial settlements until after the Civil War, the two rivers were avenues of American commerce, culture, and history."

Q Read the next sentence, would you?

A "Between 1608 and 1658, the Rappahannock and its tributary, the Rapidan, became a principal vehicle for discovery and settlement of Northern Virginia."

Q Okay. I direct your attention to Page 35 and 38 and ask you to read those marked passages.

A Starting with "alternative development"?

Q Yes, sir.

A All right. "Scenic river alternative: The portions of the Rappahannock and Rapidan Rivers affected by the reservoir project have been found to possess outstandingly remarkable qualities. These two free-flowing river areas, along with their immediate environments, meet the criteria for inclusion in the National Wild and Scenic Rivers System. The Virginia Commission of Outdoor Recreation has also identified portions of the Rappahannock and Rapidan Rivers as worthy of preservation in a natural condition in a Virginia Scenic Rivers System."

Q Would you continue to the next sentence?

A "These actions were the basis for the Secretaries of Agriculture and Interior to jointly identify under the provisions of Section 5(d) of the Wild and Scenic Rivers Act, the Rappahannock River from Tidewater to Remington and the Rapidan from its confluence with the Rappahannock to the community of Rapidan."

[TR. P. 1476]

A "Three major recreation areas are proposed. These would be complemented by 13 smaller satellite recreation areas. Special attention would be given to improving access to historical sites and restoring and maintaining these areas so as to maximize the rich historical values."

Q Let me just swiftly read a couple more points that I want here. "Extensive trail systems would be provided joining historical points and recreation areas. Comfort stations, family, primative, and group camping facilities, parking facilities, river and trail access, take-out points, visitor centers, picnic areas and pavilions, archeological and nature study trails, and trail rest shelters would be incorporated into the park and satellite areas."

[TR. PP. 1477-1479]

BY MR. KIPPS:

Q "These would be developed in the interest of providing a recreation experience in a natural setting within a market area where recreation demands are high, while at the same time maintaining and enhancing the natural and historical values of the rivers. Cost for establishing this area as a unit of the National Wild and Scenic Rivers Systems is estimated to be about $12.6 million."

***

Mr. Rice, I would like for you to read the marked passage on Page 66 and 67, commencing with "Virginia's free-flowing Rappahannock River."

A "Virginia's free-flowing Rappahannock River, from Fredericksburg 35 miles up to the mouth of the Hazel River

CONTINUED

near Remington, and 37 miles of the tributary Rapidan constitute a unique scenic and recreation resource of national stature close to large urban areas. There is no substitute or equivalent resource. None exists that can fulfill the special role of this reach of the Rappahannock - Rapidan in enhancing the quality of life in its region. The nearest alternative offering a somewhat similar experience and scene is beyond the Blue Ridge and is different in character. No other major urban centers along the mid-Atlantic Seaboard have, within an hour's drive, a river resource so beautiful and secluded, fraught with natural and historical values, the character of its flow delightfully varied and useable by anglers and boaters from novice to expert for a major part of the year. These values have been found by the Bureau of Outdoor Recreation to merit this river's inclusion in the National Wild and Scenic Rivers System."

Q Now, Mr. Rice, the designation of these two rivers for inclusion in the National Wild and Scenic Rivers System did arise after VEPCO had selected the route.

Do you think that VEPCO's proposed crossings of the Rapidan and Rappahannock Rivers require further study in light of the Federal Government's proposal to include these rivers in the National Wild and Scenic Rivers System?

A No, I don't think so.

We have worked very extensively with the Commission of Outdoor Recreation in the State of Virginia, in

[TR. P. 1479]

the location of our crossings of the Rappahannock and the Rapidan Rivers, particularly the crossing of the Rappahannock River was selected in order to have a crossing with a minimim length.

It has the least amount of interference with proposed park sites, proposed by Outdoor Recreation, and along the Rappahannock River.

I think we have been very sensitive to the fact that these are rivers of some significance.

[TR. PP. 1490-1491]

Except for the $3 million penalty, would this alternate that you considered have been acceptable to VEPCO?

Can't you state an opinion on that?

A Yes, except that we don't make those kind of exceptions. It is not prudent engineering.

To answer your question specifically, if the cost of construction of transmission facilities were not a consideration, this is an acceptable alternative route.

Q Except for the $3 million?

A That's right.

***

Q So you agree that the 500 KV adjacent to the existing Bristers 500 KV line would meet acceptable reliability?

A That's right.

[TR. PP. 1498-1499]

Q But could you also accomodate a line along the Robertson Run route which would not substantially adversely affect the national parks?

A In my opinion that route doesn't seriously affect those parks.

Q Thank you.

In VEPCO's Application Number 35, there is a reference, at Exhibit 3, Sheet 2 of 3, to obstacles, to the acquisition of right of way northward to Bristers parallel to the existing Ladysmith - Bristers 500 KV line.

Now, there has already been testimony, I think, covering that, and I don't want to belabor it.

Are those obstacles only a barn, two sheep sheds, and a maintenance building?

A That's correct.

[TR. P. 1501]

A Response: "If the North Anna - Morrisville were to parallel the Ladysmith - Bristers 500 KV, the applicant could tolerate the loss of both 500 KV lines simultaneously with an overload on the 230 KV Elmont - Possum Point line. This relocation would make it necessary to build a 230 KV line from Bristers to the Morrisville site for extension to Remington and then in the late 70's and early 80's it would be necessary for the applicant to extend 230 KV from the Morrisville location to the North Anna Power Station to supply local loads in that area as it develops. It should be pointed out that the loss of both 500 KV lines discussed under Item 1 above can be tolerated only if the Mt. Storm - Morrisville 500 KV circuit were in service."

Q And we could substitute Bristers there for Morrisville, could we not?

A That's right.

[TR. PP. 1502-1503]

BY MR. KIPPS:

Q Can VEPCO now justify a North Anna to Morrisville 230 KV line in addition to a 500 KV line to Bristers or Morrisville?

A You mean the actual construction of the transmission line as such?

Q Yes.

A No, sir.

Q Isn't it possible that the demand in the late 70's and early 80's would not justify a 230 KV line in that area?

A I suppose anything is possible. Based on the load growth figures that we have from the cooperative in this area, there is every indication that the load will grow in this area and require service from transmission facilities that aren't existing in the area.

Yes, it is entirely possible that this might not happen, but it would be a violation of all the load trends, historical load trends that we have over a good many period of years.

[TR. PP. 1505-1506]

BY MR. KIPPS:

Q Is Kipps' Exhibit Number 9 a copy of the calculations which you submitted -- did you submit Kipps' Exhibit Number 9 to the AEC?

A I think we submitted them to the AEC based on your request to the AEC for them, yes, sir. I didn't submit them. Our attorney did.

Q Do these five pages of calculations represent the entire set of work papers used by you to make the estimate?

A They do.

Q In developing your $2,854,500 additional line cost for the North Anna - Morrisville line, for the Robertson Run alternative, you used $150,000 a mile for line cost for a 500 KV line.

A That's correct.

Q Would you tell us what is included in that $150,000?

A Included conductor cost, tower cost, engineering cost, construction and labor, all materials, everything except right of way costs.

Q Everything except right of way costs?

A Yes.

Q And what was the source of your build-up of the $150,000 figure?

A Our general experience and detailed estimates that we have been using for preparing estimates for the cost of transmission facilities for submission to our Board of Directors.

[TR. P. 1509]

Q Does this mean that the $2,000 an acre assumed that the land contiguous with the existing Ladysmith - Bristers 500 KV right of way is the same value as that of the new right of way from North Anna to Morrisville?

A In the same general character of land and land values, in my opinion.

Q Do you think that is a reasonable assumption?

A That what is a reasonable assumption? That the lands are similar, or that that's a reasonable figure?

Q No. If the land value along the existing right of way from, say, Ladysmith to Bristers is $2,000 an acre, if you expanded, is the same as what land value would be if you went ten miles away and took a new right of way, per acre?

A In my opinion I think this is a reasonable approach to this type of estimating, yes, sir.

[TR. P. 1512]

Q But it is your considered opinion that the value of real estate contiguous to the existing Ladysmith - Bristers 500 KV line generally is equal to the land ten miles west and not contiguous to that line?

A I would expect to pay about the same amount of money in the same situations for right of way on both lines.

[TR. PP. 1515 - 1523]

I'm asking you did VEPCO consider using the existing 500 KV right of way from Ladysmith to Bristers for its north-south line which it now proposes from North Anna to Morrisville?

Yes or no.

A No.

* * *

COMMISSIONER SHANNON: Mr. Rice, do you understand it?

THE WITNESS: My answer is no.

BY MR. KIPPS:

Q You did not?

A No.

Q Did VEPCO consider running a parallel transmission line adjacent or contiguous to the Ladysmith - Bristers right of way for this 500 KV line that it now proposes to run to Morrisville?

A No.

Q Did VEPCO consider upgrading the existing 500 KV line from Ladysmith to Bristers as a substitute for the proposed North Anna - Morrisville line?

A No.

* * *

BY MR. KIPPS:

Q What I would like to take a few moments to do is just trace for a moment how much consideration you gave, or

VEPCO gave, to environmental factors in locating this line.

Now, I would like to start with the property that I own on the Rappahannock River, which is in the upper portion of Kipps' Exhibit 3, upper left-hand corner.

COMMISSIONER SHANNON: What county?

MR. KIPPS: In Culpeper County.

BY MR. KIPPS:

Q Are you familiar with that property?

A I know approximately where it is. I've flown over it. I have been close to it in our meeting in 1969.

Q The point at which VEPCO proposes to cross the river is a high point, is it not?

A That's correct.

Q Is it not one of the highest points in the entire area?

A It probably is.

Q And the entrance to my property, which is off Route 731, do you know approximately how much footage I have on Route 731?

A No. I remember it's a rather small footage.

Q It is rather small.

Do you recall where the line would cross my property?

A If I remember correctly, it crosses your

entrance road to your property.

Q So that I cannot get into it without driving under VEPCO's proposed line?

A That's true.

Q Do you agree that the point at which the proposed line crosses Route 731, and on to my property, is one of the highest points in that general area?

A I haven't addressed myself particularly to that particular location.

COMMISSIONER SHANNON: Now, by proposed line, Mr. Kipps, you are talking about the North Anna - Morrisville line?

MR. KIPPS: That is right, Your Honor.

BY MR. KIPPS:

Q I think if you accept the contour figures on the map as substantially correct -- would you examine it and see whether it isn't the highest point in that area, Route 731? Something in the area of about 300 feet above sea level?

A Yes. I see several areas in the vicinity of Route 731 of elevation 300.

Q How tall would your towers be at that point?

A At which point?

Q At the point where you cross my property off of Route 731, approximately?

[TR. P. 1519]

I'm not asking exactly.

A I would have to look specifically to find the height of the river crossing towers. The average height of the tangent towers in that area, if I remember, are in the order of 116 feet. The river crossing tower is considerably higher than this.

Q Would the river crossing tower, where it crosses the Rappahannock, be visible both upstream and downstream for, say, a mile or so or more?

A I suspect that they would be, yes, sir.

CONTINUED

Mr. Rice, at the point at which VEPCO's proposed line crosses Route 731, and enters onto my property, how far would the right of way be in back of Archie Martin's property?

Are you familiar with that?

A I know where the property is, and I don't have any measurements, and I can't answer that question.

Q It would be less than, say, 200 feet, though, wouldn't it?

A I don't know.

Q Are you familiar with the location of Mr. Allen's house? I think he's the gentleman whose home we met in.

A In a general manner, yes, I am familiar with the residences that are in this area.

Q How much in front of his house would the VEPCO proposed line go?

A I can't answer that question.

Q Again, do you think it would be within a couple hundred feet?

A I would think so.

Q Do you recall that one of the ladies in attendance at that meeting was Mrs. Frances Martin, I believe, who had a lot over which she -- over which VEPCO proposed to put the line? Do you remember that?

A I remember that.

Q Which is immediately north of Mr. Allen's house.

Do you recall Mr. Yager, Roland Yager, who was at that meeting, who has a home down below the proposed route?

A I remember Mr. Yager. I couldn't tell you where his residence is.

Q The exact location, but he does have a home in the general area?

A Yes.

Q Do you remember George Walker, who has a home in the Maston property, also in the general area?

A That is a name I do not remember.

Q It is true, unlike much of the rest of your property, is it not, that the route crossing 731 does impact on homes and residences more than most of the rest of your route does?

A Talking about a group of homes as a whole, yes, I think that is a valid statement.

Q Thank you. When VEPCO crosses Route 610 in Culpeper County, which is a mile or so from the river, it crosses near what is referred to as Kipps' Exhibit 3, Culpeper Lookout Tower.

That is a fire lookout tower, isn't it?

A That's correct.

Q What is the approximate height of that tower,

[TR. P. 1523]

do you recall, or do you know?

A I don't know.

Q Is it a hundred feet or thereabouts?

A I had the information at one time and I have misplaced it now. I don't know what it is.

Q Is that one of the highest points in that general area of Richardsville, or, for that matter, that general area of the county?

A I believe it is, yes.

Q What would be the approximate height -- 116 feet, is that the --

A Of the tangent towers in that area, yes, sir. That is a good, average tower height.

Q Do you know whether the existing lookout fire tower on Route 610 is visible from across the Rappahannock River over into the Summerduck area?

A I don't know that from my own personal observations.

Q Has someone made that allegation to VEPCO?

A Somebody has made that allegation, yes, sir.

[TR. PP. 1537-1539]

BY MR. SPIVEY:

Q Mr. Rice, referring to CMS2, if the companies were directed by the Commission to choose a route which would parallel the existing Mt. Storm to Doubs to Loudoun, what would be required to then serve the area in and around Front Royal?

CONTINUED

A What would be required in that event would be to take one of these lines, either the existing line or the new line, and break it in two, extend it down to the area of Front Royal and take it back up to the Front Royal area.

In effect, you would have to make the line approximately 30 miles longer, and I believe Mr. Weeks testified that that would result in a $9 million additional expenditure for serving this area, which wouldn't be required if the Mt. Storm - Morrisville line is built as we have requested.

Q Now, with respect to the 500 KV proposed from North Anna to Morrisville, is there not another facility proposed in there also?

A From North Anna to Morrisville?

Q Yes, sir.

A We anticipate the need to put a transmission facility, 230 KV, between North Anna and Morrisville in the late 70's or the early 80's to serve local load in this area, and also with the possibility of having to use those same facilities for reinforcing the Charlottesville - Possum Point line by extending transmission facilities from a point on the North Anna - Morrisville line over to an existing 115 KV delivery point known as Locust Grove, which I'm not sure what cooperative it is installed for, but I think it's Northern Virginia Electric Cooperative.

Q Is it anticipated that that line will be needed

irrespective of whether the proposed 500 facility goes via Ladysmith to Bristers or up the now proposed route, Robertson Run, and over to the Ladysmith - Bristers route?

A That is our contention, that we do need transmission facilities in this area between the Charlottesville Remington, 115 corridor, and generally the Richmond - Fredericksburg - Possum Point corridor, which has lower voltage, 115 and 230 KV transmission lines.

[TR. P. 1542-1543]

Q Mr. Rice, I would like to hand you Kipps' Exhibit 2, which apparently is an excerpt from Criterion 17, 10 CFR, and I believe Part 50, and ask you if you would read into the record the last paragraph of that Criterion 17, beginning "provisions."

A All right.

I'm reading from Page 278, starting with the fifth paragraph from the top on the left-hand column. "Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies."

Q Mr. Rice, are you familiar with the Final Environmental Statement filed by the AEC, particularly the part that commented on the routing of the transmission lines

out of the North Anna station?

A I am.

Q I refer you now to Kay Exhibit 5 and ask you if you would read into the record the comment by the AEC found in Paragraph 10.4.

A Paragraph 10.4 reads thusly: "Good practice dictates that the number and width of transmission corridors be minimized to reduce ecological impacts as well as costs. From the standpoint of reliability, however, two circuits which carry a substantial percentage of the power supply should be widely separated so that a falling tower, an airplane, or a lightning stroke will not disable both circuits. The Staff believes the Applicant has properly followed these concepts in choosing 500 KV rather than a lower voltage so as to minimize the number of circuits required to carry the power generated at the station, and in planning for three separate right of way for the four 500 KV lines."

TESTIMONY OF HARRY E. HUTCHINSON

[TR. P. 1560]

Q Please state your name, please of residence and occupation.

A My name is Harry E. Hutchinson, and I reside in Greensburg, Pa. I am the Senior Engineer, Survey Projects, for the Allegheny Power Service Corporation (APSC) which provides engineering, construction and management services

for the Allegheny Power System and its subsidiary companies, Monongahela Power Company, The Potomac Edison Company, and West Penn Power Company.

[TR. PP. 1561 - 1565]

Q What methods are used in the site selection of transmission line routes?

A The terminals of the line are defined by the Transmission Facilities Planning Department of APSC. The area between the terminals is studied, using U.S.C.S. topographic maps, aerial photos, taxation maps, zoning regulations and maps, and local or regional master development plans. Alternate preliminary routes are selected and an on-site reconnaissance is made. The routes are laid out to conform to guidelines issued by the Federal Power Commission (FPC) in its publication, "Electric Power Transmission and the Environment," and issued in the joint publication of the U. S. Departments of Agriculture and the Interior, "Environmental Criteria for Electric Transmission Systems." Local and state governmental agencies are consulted and are asked for information which has a bearing on the selection of a final route. Using the information from these sources, consideration is given to future and existing

land use, topography, aesthetics, transmission system reliability, safety, and economics of line construction and maintenance. The alternates are refined and evaluated, and a final route is selected.

Q What is the scope of Potomac Edison Application entitled "Application for Approval and Certification of Mt. Storm - Morrisville Transmission Line?"

A The Allegheny Power System proposes to construct

CONTINUED

a portion of a 500 KV line between VEPCO's Mt. Storm Power Station and their Morrisville Substation. Monongahela Power Company will build the section from Mt. Storm to the Virginia - West Virginia line, and Potomac Edison will construct 16.1 miles of line in Frederick County, Virginia, and 1.8 miles in Warren County, Virginia. The route of the line in Virginia is shown on Exhibit A to Potomac Edison's Application. It is also shown on Exhibit No. CHS-2 introduced by Mr. C. M. Stallings of VEPCO.

The line will be constructed on a right of way 175' wide for 1.8 miles in Warren County and for 9.1 miles in Frederick County where it will parallel the existing Potomac Edison Riverton - Cumberland 138 KV line. The remaining 7 miles in Frederick County, which are not parallel to an existing line, will be built on a right of way 200 feet in width.

Q How was the route selected for the Mt. Storm - Morrisville line?

A The route selection was accomplished using the method previously outlined. The selection was done jointly by VEPCO and APS engineers, with our emphasis on the section of line which we will construct. The route was sited to minimize impact on land use, to avoid parks and recreational land, to utilize existing utility corridors, to minimize visual impact by taking advantage of screening of the line offered by terrain and existing vegetation, and to provide the greatest possible distance

away from developed areas.

Q What alternate routes were considered for the Mt. Storm - Morrisville Line?

A. Several alternates were studied before final selection of the route. Some of the alternates were discarded without an in-depth consideration because of glaring aesthetic and land use problems.

One route, which was rejected without detailed study, was a direct route between Mt. Storm Power Station and Morrisville Substation. The line would have been located through the George Washington National Forest and the Shenandoah National Park. For obvious environmental considerations, the route was discarded.

Another route, which would have utilized rights of way previously purchased by VEPCO, was considered and rejected. This alternate route is shown on Exhibit DNR-20 and was referred to in earlier testimony by Mr. Donald N. Rice of VEPCO. The route would have crossed Warden Lake, a recreational and public fishing area in West Virginia, and would have been located in the George Washington National Forest. The route entered Frederick County, Virginia, in the Dry Gap area near Short Mountain and Eagle Rock. It continued in generally a southeast direction, crossing Cedar Creek several times, then intersected the existing Potomac Edison Riverton - Cumberland Line. We felt that this route would have serious adverse aesthetic and

land use impact on Warden Lake, on the National Forest, and on the scenic area near Cedar Creek. The Virginia Commission of Outdoor Recreation recommended that the line not be located in the Cedar Creek area, which later was tentatively designated a "Critical Environmental Area" by the Division of State Planning and Community Affairs.

The other alternate that was considered, with some refinement and minor modification, is the final proposed route. The route is shown on Exhibit DNR-20 and was referred to in earlier testimony. The route enters Frederick County south of the Pinnacle on Great North Mountain near Wilde Acres. It continues in a generally southeastern direction until it intersects the existing Riverton-Cumberland Line at a point northeast of Funkhouser Knob. The proposed route parallels the existing line, leading to the southeast toward Front Royal.

The selected route best suits the guidelines of the FPC and the Departments of Agriculture and the Interior. In the wooded mountainous areas of Frederick County, visual impact will be minimized because the line will be screened by existing vegetation and avoids, as much as possible, crossing over the higher terrain. The route avoids recreational and scenic areas such as the National Forest and Cedar Creek. Maximum use is made of an established utility corridor by paralleling the existing Riverton-Cumberland Line. The route avoids developed areas. By avoiding recreational, scenic and

developed areas, and by using the corridor concept, aesthetic and land use impact is minimized.

The proposed route includes minor modifications recommended by the Virginia Commission of Outdoor Recreation to move the line to lower elevations near the Pinnacle on Great North Mountain and near Funkhouser Knob. The Virginia Historic Landmarks Commission reported that the line did not conflict with any historic sites.

Q Are you familiar with the prepared testimony of Bruce Howlett as it relates to the Potomac Edison section of the Mt. Storm - Morrisville Transmission Line?

A Yes. I have reviewed this portion of Mr. Howlett's testimony.

Q In that testimony, Mr. Howlett has certain suggestions for compliance with specific criteria established by the Federal Power Commission for the routing and construction of transmission lines. Has Potomac Edison followed these suggestions in the routing of the proposed line?

A Yes. We are in agreement with Mr. Howlett's comments as to the applicable guidelines, and the routing of the line has been in accordance with the guidelines he enumerates.

TESTIMONY OF SAMMUEL CLUTS

[TR. P. 1593]

Q Please state your name, place of residence and place of employment.

A My name is Sammuel Cluts and I reside in McHenry County in the State of Illinois. I am employed by Sargent & Lundy as Head of the Electrical Substation and Transmission Line Division.

[TR. P. 1594-1599]

Q Please describe the design and construction of the proposed Potomac Edison Company transmission line.

A The line will be constructed on lattice type steel towers having a galvanized finish which results in a neutral gray color. These lattice towers have been carefully designed to fully make efficient use of a combination of both A572 steel and A36 steel. These towers will be spaced an average of 1150 feet apart and average 105 feet in height with a width

of 84 feet. The conductor will be aluminum with a steel core for added strength. The line will meet or exceed all applicable requirements of the National Electrical Safety Code. I have prepared an exhibit showing the appearance of a typical tower of the type that will be used.

Q What width of right-of-way will be required?

A The right-of-way consists of two specific requirements; namely, one requirement for the 500 KV line only, and a second requirement for a section where the 500 KV line parallels an existing 138 KV line. For the 500 KV line only, a distance of approximately 7.03 miles, a right-of-way 200 feet in width will be secured for this line; however, only 150 feet width will be cleared. This will, in general, be 75 feet on either side of the conterline of the transmission line. The 200 feet width of right-of-way allows for minor transverse shifts in the centerline of a transmission tower during the final design stages without having to renegotiate the right-of-way. Also, the uniform width of 200 feet width allows the use of long spans anywhere on the line route without reducing the clearances required under conditions of conductor blow-out. Lastly, the 200 feet right-of-way includes all trees which may fall into the category of "danger trees" which may have to be cut either during construction or later when doing right-of-way maintenance to provide adequate safe clearance to the conductors.

The section of the 500 KV line which parallels the existing "Riverton to Cumberland" 138 KV line, a distance of 10.85 miles, will have a right-of-way width of 175 feet, which is in addition to the existing right-of-way width of 100 feet. This will give a total right-of-way width of 275 feet for the two lines. The distance between centerlines of the two transmission lines is 125 feet consisting of 50 feet of existing right-of-way and 75 feet of new right-of-way. This provides the same 100 feet from the centerline of the 500 KV transmission line to the edge of the right-of-way. The reasons for this distance are the same as noted earlier.

Q How do you propose to clear the right-of-way?

A The right-of-way will be cleared to a width of 150 feet for normal terrain. Extreme care will be used in clearing to insure a minimum disruption of the right-of-way. Ornamental trees and shrubs will be maintained on the right-of-way wherever they do not interfere with the actual construction of the line. Also, natural screening will be maintained along the major highways to reduce the public view of the facilities. Where the terrain is such that the line crosses a ravine, the width of clearing will be reduced to only that which is necessary to maintain the safety of the line.

The right-of-way is in a predominantly wooded area where it will be possible to log timber and pulpwood from the properties to conserve and utilize the natural resources.

Any merchantable timber will be piled on the edge of the right-of-way for disposal by the grantor. The debris will be windrowed at the edge of the right-of-way or piled and compacted in selected locations to leave the right-of-way in an acceptable condition, and to have the maximum space available for use by the property owners. Any disposal by burning shall conform with the rules of the State Air Pollution Control Board.

Q What methods will be used to construct this line?

A The line will be constructed with conventional techniques, using line trucks, concrete trucks, cranes for tower erection, and wire pulling equipment. In general, a construction road will be built along the centerline of the transmission line route for the passage of the construction vehicles. This involves less distance and, therefore, less disturbance to the existing terrain than other methods of ingress to the structure sites. When it is impossible to continue along the right-of-way because of a terrain feature, then arrangements will be made with the property owners to use existing private roads and trails. The contractors are required to maintain these private roads and trails to the satisfaction of the property owners if they are used. At the conclusion of the construction, the terrain will be restored by removing and leveling all construction ruts, seeding areas where ground has been destroyed, installing water bars where they are required

to prevent erosion, and such other work as may be necessary.

The restored areas of the right-of-way will provide vegetation for wild life habitat, using the products of the edge of the clearing for food and the timber outside the right-of-way for shelter.

Q How will the right-of-way be maintained?

A The land owner will be encouraged to utilize the cleared land for agricultural purposes such as farming, grazing or growing of ornamental shrubs or trees.

The right-of-way maintenance will be consistent with land usage and will include machine mowing, necessary hand cutting of trees and chemical treatment. The machine mowing will be used in areas of residential or recreational uses. The hand cutting will be used to maintain adequate safe clearances on the right-of-way and chemical treatment will consist of herbicides applied to tall growing species where required. Herbicides used will be those registered with the Environmental Protection Agency and the Virginia Department of Agriculture. The applications that will be used are those recommended by the Agricultural Extension Service of Virginia Polytechnic Institute and State University. This right-of-way maintenance program is required to prevent interruptions to electric service and to provide for access to the right-of-way for patrol and emergency repairs. The maintenance program will be accomplished in an aesthetically acceptable manner.

[TR. P. 1599]

Q Are you familiar with the prepared testimony of Bruce Howlett as it relates to the Potomac Edison section of the Mt. Storm - Morrisville Transmission Line?

A Yes, I have reviewed this portion of Mr. Howlett's testimony.

Q In that testimony, Mr. Howlett has certain suggestions for compliance with specific criteria established by the Federal Power Commission for the routing and construction of transmission lines. Will Sargent & Lundy follow these suggestions in clearing the right-of-way and designing and constructing the transmission line?

A Yes.

Q Can this line be installed underground?

A Mr. Rice of Virginia Electric and Power Company has answered the question aptly, and I can only concur that our findings agree with his.

[TR. PP. 1959-1960]

Q Describe the number and nature of the members of RLEP.

A Since there is no set fee for membership in RLEP, there are more members than the 700 individuals who have contributed $1.00 or more. RLEP's members so far are all over 21 years of age and represent nearly all educational, economic, occupational, religious and ethnic groups.

Q Are all RLEP members in favor of its intervention in this proceeding?

A By unanimous decision of our Board of Directors and by show of hands at the last annual meeting, we believe our membership is 100% behind our efforts to require new transmission lines to be built in existing corridors, rather than sacrificing additional virgin landscape such as found in Rappahannock County.

Q Are there other organizations similar to RLEP supporting your efforts?

A Yes, there are now five leagues for environmental protection in the area around Rappahannock County, namely the Central Virginia Environmental League, the Warren, Fauquier, Frederick and Culpeper County Leagues

for Environmental Protection. Although transmission lines are only one interest of these groups, this subject forms a major common concern among them. The Warren League is a co-intervenor in this proceeding, and several other Leagues are assisting by collecting contributions to help with the expenses involved.

[TR. P. 1978]

Q How long have you and others of your organization been aware of VEPCO's plan to construct the proposed line from Mt. Storm to Morrisville?

A I believe it was in late 1971 that we first became aware of this proposed route.

Q Have you suggested the alternatives which you have enumerated earlier to VEPCO for its consideration?

A Yes, on several occasions, the first of which was in the Spring of 1972.

Q What response have you had from VEPCO?

A We have had no satisfactory answer given to us. They have responded only in very general terms, mentioning the question of reliability and obstacles along the existing right-of-way.

FRED CHAMBERS, a witness introduced on behalf of the Rappahannock League for Environmental Protection, being first duly sworn, testified as follows:

[TR. PP. 2015 - 2073]

BY MR. KAY:

Q Mr. Chambers, would you state your name and address and occupation, please, sir?

A I'm Fred Chambers. My occupation is electrical engineer. I'm associated with the State of New York Public Service Commission.

Q And where is your residence at this time, Mr. Chambers? In New York?

A New York, yes.

CONTINUED

Q Have you filed testimony consisting of 33 pages, and an exhibit marked FC1, which is bound with that testimony?

Have you filed such with the Commission?

A Yes.

Q Are there any corrections or additions to your prefiled testimony?

A Yes. I have a few.

On Page 1, Line 2, I would like to change it to read, "I was employed as a principal engineer."

The word "was" is replacing "am presently."

And then I would like to add a sentence saying, "until June 1, 1973."

Q That comes at the end of the first sentence, does it not?

A The end of that sentence.

Q On Line 4?

A Right.

And then add a sentence, "I am now with the State of New York Public Service Commission."

And then I have a correction on Line 7, which should be changed to read, "Willowridge Apartments."

That's like the tree.

"Rensselaer, New York."

The spelling is a little peculiar. It's

R-e-n-s-s-e-l-a-e-r, and the zip is 12144.

CHAIRMAN BRADSHAW: What is your capacity with the New York Public Commission?

THE WITNESS: Sir?

CHAIRMAN BRADSHAW: What is your job with the New York Public Commission?

THE WITNESS: I'm the Deputy Director of the Power Division.

A (Continuing.) On Page 5, I have a change, beginning with Line 8, which I would change to read, "In 1971 I retired from TVA and from that time until June 1, 1973, I was a principal engineer with Bovay Engineers, Inc., Houston, Texas."

And then I add a sentence saying, "I am now with the State of New York Public Service Commission."

CHAIRMAN BRADSHAW: Will they let you testify in New York now?

THE WITNESS: They would not let me testify in New York, no.

CHAIRMAN BRADSHAW: It's only because you were in this case prior to going to New York?

THE WITNESS: Yes. This was really a condition of my going to New York, that I had started this, and in fact I wouldn't have gone.

And then, also, there is a provision, I think, that simply prohibits any interest in a case that could

come to the New York Public Service Commission, and I take it this one never would.

MR. BRASFIELD: I hope not.

CHAIRMAN BRADSHAW: Not unless it cascades in New York.

A (Continuing.) Then on Page 16, there's an error in Line 19.

It should read, beginning with Line 18, "Generally speaking, 500 KV lines have over two times the capacity of 345 KV lines."

I'm not sure there are any more.

COMMISSIONER SHANNON: You say Page 16?

THE WITNESS: Yes.

COMMISSIONER SHANNON: And you say "two times capacity."

THE WITNESS: Page 16. I'm sorry. Line 9.

The word "two" should be removed from Line 19.

COMMISSIONER SHANNON: I see.

THE WITNESS: The way it is now, it says twice.

A (Continuing.) And then on Page 20, beginning on Line 12, I would put a period after the word "distance," and then add a sentence saying, "I understand that they are now planned to be parallel and adjacent for about four miles, and for a substantial added distance they will be parallel but separated by some 2,000 feet."

BY MR. KAY:

Q That's a period after the first "distance" used on that page?

A Right.

Q Strike the remaining part of the prefiled testimony on Line 12?

A Right.

MR. BRASFIELD: What do you strike?

MR. KAY: "Instead of about one-third of the distance" is struck.

COMMISSIONER SHANNON: Just strike the rest of that sentence, and add the addition in there?

THE WITNESS: Yes.

MR. KAY: Right.

THE WITNESS: I think that does it.

BY MR. KAY:

Q Mr. Chambers, if I were to ask you the questions contained in your prepared testimony, would you give the answers that you previously gave?

A Yes, except for these corrections.

Q Except for the corrections?

A Yes.

Q Now, sir, since the prefiling of the Applicants' direct testimony, have you heard some cross-examination of

Applicants' witnesses and seen certain new exhibits that were filed by the Applicants during the course of their examination?

A Yes. I've seen some. Not all, of course.

Q And you were not here for the entire cross-examination but only portions of it?

A Right.

Q Does any of the testimony that you did hear, or the exhibits that you have studied, change the conclusions that you stated in your prefiled testimony?

A No.

MR. KAY: If the Commission please, I move that the prefiled testimony of Mr. Chambers, as amended, be copied into the record and that the exhibit that is attached to that prefiled testimony be introduced into evidence.

COMMISSIONER SHANNON: Mr. Chambers' prefiled testimony as amended will be copied into the record and Exhibit FC1 will be received.

TESTIMONY OF FRED CHAMBERS

Q Please state your name and occupation.

A My name is Fred Chambers and I am presented employed as a Principal Engineer with Bovay Engineers, Inc. in Houston, Texas.

Q What is your present address?

A 13815 Britoak Lane, Houston, Texas 77024.

Q Would you please summarize your educational background and your previous professional experience?

A I was awarded a Bachelor of Science degree in Electrical Engineering from the Alabama Polytechnic Institute in 1930. I did graduate work at M.I.T. My professional career began with two years' experience on the General Electric Company's Test Program at Schenectady, New York and Lynn, Massachusetts. I was also with the Associated Gas and Electric Company in Elmira, New York, the Tennessee Electric Power Company and Electric Power Board of the City of Chattanooga. In 1939 I became associated with the Tennessee Valley Authority and, except for an interruption of several years during World War II, was with TVA until my retirement in 1971. Upon my retirement from TVA, I became associated with Bovay Engineers, Inc.

Q Please summarize the positions which you held with TVA and your professional responsibilities in each of those positions.

A In 1939, I became associated with the Tennessee Valley Authority in its electrical laboratory and test branch where I performed initial, routine and emergency field testing involving transformers, circuit breakers, meters, relays, control circuits, load and frequency controls, etc.

In 1941, I was made Operating Superintendent

for TVA's Tupelo, Mississippi, District, and was in charge of routine and emergency operation and maintenance of all transmission lines and substations and the direction of the necessary crews of men and equipment to carry out these duties.

From 1943 to 1946, I was on active duty with the U. S. Navy engaged principally in the various phases of mine-sweeping. After the war, I returned to TVA and from 1946 to 1950, was Assistant Division Engineer, Middle Tennessee Division, TVA, at Nashville, Tennessee. In that capacity, I assisted and acted for the Division Engineer in being responsible for the routine and emergency operation and maintenance of facilities in the Middle Tennessee Division of the TVA, which included over 2,000 miles of transmission lines up to 161 KV and some 75 substations of various sizes up to 180-MVA capacity.

From 1950 to 1960, I was Assistant to the Chief Power Engineer, TVA, and as such, I was responsible for the preparation of comprehensive studies, reports, and investigations related to the development of the TVA generation and transmission system. This included complex engineering studies that required some coordination with adjacent power systems with which TVA is interconnected. It also included overall review of the work performed by the design, construction, and operating activities in the Office of Power.

I also reviewed and coordinated project authorizations and prepared economic and engineering justifications

for projects submitted by the Manager of Power to the TVA Board. Reviews were conducted of engineering studies that were made by the distributors of TVA electricity to determine the soundness of engineering for long-range plans proposed by those systems to supply their growing loads and to be assured of the coordination of those plans with TVA's transmission system plans.

From 1960 to 1963, I was Assistant Director of Power Planning and Engineering and assisted in the formulation, direction, administration, and coordination of the policies, programs, and activities of the division. This division's responsibilities included appraising the adequacy of the capacity and energy available from existing and projected power sources to meet the long-range forecast of expected loads. It recommended the type and location of major new capacity to be installed in existing or in new plants. It performed planning and economic analyses for the overall development of TVA's power system. It conceived and developed plans and recommendations for additions to or changes in the power transmission and communication system along with the relaying and protective plans and the selection of power control equipment for application to TVA's power transmission facilities. This division developed specifications and determined characteristics of equipment and material used on the TVA power system. Some 400 employees in this division were associated with five branches;

namely, Transmission System Planning, Power Supply Planning, Electrical Engineering and Design, Civil Engineering and Design, and Communication Engineering and Design.

From 1963 to 1970, I was Director of Power Planning and Engineering and administered the work of the division as outlined above except for the addition of a nuclear power staff.

From 1970 to 1971, I was Assistant Manager of Power and in that capacity I assisted in carrying out the electric power program of TVA. The Manager of Power's office included more than 9,000 employees who were located in the Division of Power Resource Planning, Transmission Planning and Engineering, Power Construction, Power Production, Power System Operations, and Power Marketing along with appropriate services stiffs which carry out the TVA's power program.

In 1971 I retired from TVA and since that time I have been a Principal Engineer with Bovay Engineers, Inc., Houston, Texas.

Q In what states are you a licensed professional engineer?

A Tennessee and Louisiana.

Q Please list the professional organizations to which you have belonged.

A I am a Fellow of the Institute of Electrical and Electronic Engineers, a past Chairman of the East Tennessee

Section, past Chairman of the IEEE Power Group Recognition Committee, a member of the Habirshaw Awards Committee, and was a member of the National Transmission and Distribution Committee. I am also a member of the INternational Conference on Large High-Tension Electric Systems (CIGRE - Conference Internationale des Grands Reseaux Electriques a Haute Tension) and was U. S. representative on one committee and advisor on three committees. I was a member of the National Electric Reliability Council's Technical Advisory Committee, the American National Standards Institute on Insulation Coordination and Preferred Voltage Ratings for AC Systems and Equipment, the Electric Research Council's Study Committee on Proposed Electric Power Research and Development Center, and the Atomic Industrial Forum. I was also a member of the Electric Research Council's R&D Goals Task Force. I was selected as Engineer of the Decade in 1970 by the Chattanooga Chapter of the Tennessee Society of Professional Engineers. I am listed in "Who's Who in America".

Q Have you authored any technical papers?

A Yes. I have authored or co-authored a number of papers, some of which relate to high voltage transmission lines.

Q What experience have you had in the planning of transmission lines with particular reference to the location of these lines and the effect of such location on the reliability of a system?

A For some 21 years of the time I spent with the Tennessee Valley Authority I was involved with the planning of generation and transmission facilities. Reliability criteria were established and the system was planned to meet these criteria. The performance of the facilities that were meaningful to meeting the criteria were under constant review in order to determine if and what changes should be made in the engineering and design or application of the facilities. The TVA system, at the time I retired, supplied a total load approaching 17 million KWs from generating facilities totaling about 20 million KWs and a transmission system including some 7,000 miles of 44-69 KV lines, some 8,000 miles of 161 KV lines, and some 1,000 miles of 500 KV lines. The system had about 500 substations, ranging in capacity up to some 1,350,000 KVA, and, generally, they were planned so that their capacity could be doubled.

TVA's power program was carried out with full regard for the environmental and aesthetic cost of each project.

Q By whom were you retained in this case?

A I was retained by the Rappahannock League for Environmental Protection and the Warren County League for Environmental Protection - intervenors in this case.

Q Describe generally the scope of your employment.

A I was employed to give my clients my opinion concerning whether the location of the 500 KV transmission line

proposed by VEPCO and Potomac Edison from Mt. Storm to Morrisville appeared to be based upon sound system planning in light of all relevant considerations or whether it appeared that these companies could feasibly utilize or parallel an existing transmission line corridor to accomplish the intended purposes. In this connection, I was to review all of the other applications as they might bear upon the question of the location of the proposed Mt. Storm to Morrisville line. Of course, I was also employed to testify before this Commission concerning my conclusions.

Q Generally, how did you proceed with your assignment?

A I examined the applications filed by VEPCO and Potomac Edison and initially reviewed pertinent data available to me relative to the VEPCO and Potomac Edison systems, including studies showing some of the future plans of these systems. I also studied and reviewed certain data furnished by the applicants in response to requests by the attorneys for the intervenors. This included certain documents which the applicants produced for inspection and certain facts which the applicants furnished in correspondence and other responses to the attorneys for the intervenors. I also studied the pre-filed testimony of the applicants' witnesses and the relevant exhibits filed with that testimony.

Q Did you attempt to recommend any definite

alternative location for any of the lines covered by the VEPCO or Potomac Edison applications?

A Certainly not. This was not my assignment and I would not have been able to do so without an exhaustive study which I would not have been able to make within the time permitted. Such a study by me would have been prohibitively expensive. In addition, I do not visualize this as being the responsibility of the intervenors.

My efforts were directed to an examination of the available data and information to see whether it adequately supports the conclusion of applicants that the new line should be built from Mt. Storm to Morrisville. Conversely, I examined the data and information available to me to see whether it supported the conclusion of the applicants that the alternative of paralleling the Mt. Storm to Doubs line was not feasible. Of course, in proceeding in this way I necessarily formed some tentative conclusions of my own concerning the feasibility of using the existing Mt. Storm to Doubs corridor as a superior alternative to the proposed plan. As I stated before, it was beyond the scope of my assignment to do the work necessary to reach firm conclusions as to whether the alternative is feasible or whether it could be made so with proper planning.

Q Do you have an opinion whether additional transmission capacity is needed from Mt. Storm to the east?

A Yes.

Q What is that opinion?

A It does appear that the data supports the conclusion of applicants that additional transmission capacity is needed from Mt. Storm to the load centers in Northern Virginia and the Washington, D.C. area.

Q Does your opinion apply to both VEPCO and Potomac Edison?

A Yes.

Q Do you have an opinion concerning the need for transmission capacity from North Anna to Morrisville and the proposed route as described in VEPCO application No. 35?

A Yes. Certainly provision must be made to transmit the power generated at North Anna to the load centers, and a large portion of the load has been described as being in Northern Virginia. As I stated before, an in depth study of all feasible alternatives would be required before I could give any definite conclusion concerning the route selected. In this instance, since North Anna is a nuclear plant, much coordination would be necessary with the Atomic Energy Commission and the Advisory Committee on Reactor Safety.

It should be noted that some of the reliability criteria for nuclear plants are much stricter than for conventionally powered plants. I really am not in a position to say whether the proposed route from North Anna to Morrisville

represents the best trade off of reliability, environmental and cost factors. However, I do point out that there is a big difference between the situation relating the North Anna to Morrisville line and the Mt. Storm to Morrisville line.

Q Do you have an opinion concerning the need for service to be provided by the lines described in VEPCO applications 32, 33 and 34?

A Yes, I do.

Q What is that opinion?

A Remington - Warrenton 115 KV Application No. 32 relates to the provision of added transmission capacity to the Warrenton area and seems essential to provide satisfactory service to the projected future loads. A review of the application, other material and testimony indicates that considerable studies were made to select the route for this line and I have no comment.

Morrisville - Bristers 500 KV Application No. 33, Morrisville - Remington 230 KV Application No. 34, and North Anna - Morrisville 500 KV Application No. 35, which I previously mentioned, all relate to the transmission of the power and energy to be supplied from North Anna to the VEPCO system and to the reinforcement of the underlying system in the general Remington area, including the 115 KV Charlottesville - Possum Point line. The stability and reliability criteria for the North Anna units must be met and the systems connections to

that location must be adequate for emergency requirements. As I said before, the connections proposed and their arrangement may represent the best trade off of the reliability, environmental impact and cost factors. Again, judgment concerning the best routing would require considerable in-depth study of all feasible alternatives and much coordination with AEC and ACRS to even determine which alternatives would be acceptable. It is my impression that considerable effort has been made to determine the location for these lines.

I do want to point out that, in my opinion, the location of the lines covered by VEPCO Applications 32, 33, 34, and 35 are not dependent upon the Mt. Storm to Morrisville line. No substantial change -- if any change at all -- would be required for the lines covered in VEPCO Applications 32, 33 and 34 if the North Anna to Morrisville line were built as planned, even if the Mt. Storm to Morrisville line were not built as proposed.

Q Before discussing the proposed line from Mt. Storm to Morrisville, please explain the history of the development of Extra High Voltage transmission lines, the trend in the utilization of such lines, and the future planning for EHV.

A Until the 1950's, the maximum voltage that had been used for transmission lines in the United States had been 287 KV for some decades. In 1952, the world's first EHV

was used in Sweden when 380 KV transmission facilities were placed in service. This designation later became 400 KV. In the United States, 315 KV facilities were placed in service in the 1950's, and this is now referred to as 345 KV. In about 1959 or 1960, the Russians began using 500 KV transmission facilities. This voltage was first employed for regular system operation in the United States in 1965. The initial use of transmission facilities in the 700-765 KV class in North America was by the Quebec Hydro Commission in 1966. This voltage is now being used by electric systems in the United States. The first use of 765 KV in the U. S. was by the American Electric Power System, whose engineers contributed greatly to its development.

The carrying capacity of transmission lines generally increases by a little more than the ratio of the voltage squared -- that is, a doubling of the voltage usually increases the carrying capacity by more than four-fold. The carrying capacity of a transmission line is limited by:

A. The ampere rating of the conductors (material and cross-section)

B. The permissible voltage drop, which is influenced greatly by its length, although there are means available to make a line's "electrical length" shorter than its physical length.

In recognition of these variables, it is

1 necessary to establish transmission line capability on a
2 uniform basis, and this is the accepted way to establish
3 comparisons. Accordingly, 500 KV lines can carry some 2100-
4 2700 MW and 765 KV lines can carry some 5000 MW. Due to the
5 capitalized value of losses, most systems plan for the everyday
6 normal loading of its lines to be some 50% to 60% of their
7 maximum capability. There are other system oriented factors
8 that also must be considered.

9 For EHV transmission lines (345 KV and above),
10 it is generally necessary to provide large conductors (usually
11 bundled), in order to meet audible noise and radio interference
12 criteria. The ampere capacity of 500 KV circuits is usually
13 3000 amperes or more, and this is true of the VEPCO circuits
14 of that voltage.

15 The need for higher capacity transmission
16 circuits is due to:

17 1. The rapidly increasing electric load which has
18 averaged doubling about every 10 years in the U. S., but of
19 course is growing at a greater rate in some areas. While the
20 individual circuit loading becomes greater, the relationship
21 to the total system loads may stay about the same.

22 2. Land use and comprehensive environmental considera-
23 tions are essential to be taken into consideration so that the
24 "total cost" of transmission facilities is properly recognized.
25 Land that is devoted to use for transmission lines must certainly

be utilized to the maximum practicable extent for that purpose before it will be permissible for additional land to be used.

For several years, it has been known that electric systems in the future will require transmission circuits in the 1000-1500 KV range which will be capable of carrying some 10,000-15,000 MW. Much work has been devoted to developing higher capacity transmission lines by the world's most competent engineers in that field, because the need for them is essential to provide reliable electric service in a manner that will be acceptable from an environmental and efficient use of land resources standpoint.

Q Would you compare generally the transmission capabilities of 345 KV lines with 500 KV lines and 500 KV lines with 765 KV lines?

A Generally speaking, 500 KV lines have over two times the capacity of two 345 KV lines. By the same token, one 765 KV line has over twice the capacity of one 500 KV line. For example, if compared on a common basis, a 345 KV line has approximately a 700 megawatt capacity, a 500 KV line has a 1750 megawatt capacity, and a 750 KV line has a 4400 megawatt capacity. All of these figures are for a distance of 100 miles and are set forth on page 62 of Volume 1 of the report of the Federal Power Commission to the President in 1967.

Q Is land use a factor in the utilization of EHV transmission lines?

1 A Yes, it is. For example, it is obvious that
2 much less right-of-way is required for one 765 KV line than
3 would be required for two plus 500 KV lines to carry the same
4 capacity as a 765 KV line.
5 Q Are EHV lines ever constructed which carry
6 more than one circuit?
7 A Yes, it is fairly common all over Europe for
8 two 400 KV circuits to be carried by the same structure. The
9 Japanese have plans for two 500 KV circuits to be carried by the
10 same structure; however, this has not been done very extensively
11 in the United States as yet. The United States preference to
12 date has been to go to higher voltage in order to transmit a
13 greater amount of electricity over one line of structures.
14 Q Returning now to the applications before the
15 Commission, please comment on the two applications covering
16 the proposed line from Mt. Storm to Morrisville.
17 A Mt. Storm - Morrisville 500 KV Application
18 No. 36 and the Potomac Edison application relate to an added
19 transmission connection for Mt. Storm 560 MW unit No. 3 and to
20 increase the interconnection capacity between VEPCO and the
21 Alleghany Power System. This added connection appears to be
22 needed; however, an examination of the data does not support
23 its proposed location and termination points. The base case
24 load flow plot for the 1977 VEPCO system, as filed with FPC,
25 indicates that the proposed line carries 534 MW to Morrisville

(Remington) where 511 MW is being received from North Anna, and most of this total flows north to Loudoun (VEPCO). At this time, 64 MW flows to Doubs (PECV) from Loudoun, and this is indeed a small load for a 500 KV line.

Here is a summary of facts:

1. Page 9 of Mr. Stallings' testimony beginning with line 3 states that the power transmitted from the coal fields via the Mt. Storm - Morrisville transmission line and from the new North Anna nuclear power station via the North Anna - Morrisville transmission line will in turn be transmitted from Morrisville to the Northern Virginia load center through switching facilities at the Morrisville Substation and the Morrisville to Bristers transmission line. At Bristers the transmission line connects with existing transmission facilities into Northern Virginia. Thus, one purpose for this line and substation is to complete the link between the new generating capacity and the demand for electricity in Northern Virginia. (Indicate on Exhibit No. CMS-2).

2. On page 14, line 23 of his testimony, Mr. Stallings notes that most of the output of North Anna will also flow to Northern Virginia.

3. On page 19, line 11 Mr. Stallings states that of lesser importance, but nevertheless worthy of consideration, is the fact that construction of the Mt. Storm - Morrisville transmission line will permit reinforcing the

1 supply to new loads that are developing in the Northern
2 Shenandoah Valley with a minimum of new transmission line
3 construction.
4 4. In response to interrogatory 14(b) it was
5 stated that "The North Anna - Morrisville - Loudoun 500 KV
6 circuit would supply Morrisville Substation, even if an alternate
7 route were used for the proposed circuit from Mt. Storm."
8 The situation is that the electricity is going
9 to Northern Virginia where the load is located (Doubs-Loudoun)
10 so why not simply transmit it directly there instead of the longer
11 route proposed to Morrisville and thence back north again.
12 A shorter distance from Mt. Storm to Doubs -
13 say 96 miles and lower cost, lower losses and located parallel
14 to the existing circuit was said to have been discarded by
15 Messrs. Stallings and Rice because "reliability is sacrificed by
16 placing two of the principal supply lines to Northern Virginia
17 on a common right-of-way; thereby exposing them to simultaneous
18 outages." This general statement is not valid unless supported
19 by results of studies.
20 There is no evidence that meaningful studies
21 were carried out for the plan of putting another Mt. Storm
22 500 KV line parallel to the existing one all of the distance
23 instead of about one-third of the distance. The results of
24 these detailed studies would have to be available before
25 conclusions could be drawn as to the adequacy of reliability.

A series of base cases would be required and then cases for different "contingencies" must be made for comparisons and this would certainly include loss of the two circuits simultaneously and noting the effect at the most critical location - probably Doubs or Loudoun. For the most severe case, the conditions will be assessed for the need for special operating procedures or added facilities such as condensors, capacitors or added transmission capacity and the most economical way to meet the needs.

The simultaneous outage of two 500 KV circuits from Mt. Storm to Doubs on separate structures on the same right-of-way at the most severe time could be judged in the category of credible but of a low probability of occurrence, which may result in conditions such as islanding and/or loss of load. Such conditions are considered acceptable as long as they are controlled so as to limit the adverse impact of the disturbance and so as to leave the system or systems in such condition as to permit rapid load restoration and/or reconnection.

The most severe condition for the loss of these two lines may occur when all three Mt. Storm units are running at full output, during peak hours and coinciding with a heavy schedule from ECAR to MAAC and the probability of this condition must be judged.

It is noted that ECAR-MAAC-CARVA studies have identified some limitations that would occur if the Loudoun -

Doubs 500 KV line is lost beginning in about 1976 so another 500 KV circuit between these two points may be required in all cases.

If studies show that two 500 KV lines from Mt. Storm to Doubs being lost simultaneously (a) would have such probability of occurrence during the most critical time and (b) the abnormalities are unacceptable during that period and (c) the requirements must be met with another transmission connection from the APS system or Mt. Storm to Doubs, then extensive studies should certainly be made before concluding the superior plan.

The alternative of increasing the capacity of the Mt. Storm - Doubs connection was rejected because ". . . it sacrificed reliability by placing two of the principal supply lines to Northern Virginia on a common right-of-way." This reasoning would limit the transmission capability of this right-of-way to a reduced capacity 500 KV circuit (1700 MW) which is not in accord with land use considerations. Today, there are transmission lines being used (765 KV) that have a capability greater than two full capacity 500 KV lines. Intensive effort is now being devoted to the development of even higher capacity transmission lines in the ultra-high voltage class of 1000-1500 KV. There have been a number of authoritative papers written on transmission system planning that illustrate this point. Among the better ones is "AEP

765 KV System: General Background Relating to its Development" by Howard C. Barnes and Theodore J. Nagel. A copy is attached. (Ex. FC 1)

Q Would you comment on the testimony of the applicants' witnesses that if two circuits were to occupy the same corridor from Mt. Storm to Doubs that reliability considerations would require the remainder of the entire Mt. Storm - Dooms - Elmont - Loudoun - Doubs loop to be parallel?

A I certainly do not agree with that conclusion based on the data available. From the information which I have seen, it is not at all clear that paralleling of the two 500 KV circuits from Mt. Storm to Doubs would not meet reasonable reliability criteria. Further, even if studies would indicate that these parallel lines would not satisfy reliability requirements without some additional back up, I do not believe that the data indicates that a paralleling of the entire loop would be necessary. It would be most surprising to me if the best plan turned out to be one to take power easterly from Mt. Storm by constructing facilities in a southerly direction, then easterly, and then northerly to get to the points where the power is needed. It is noted from the testimony that the fundamental function of the proposed Mt. Storm to Morrisville line is to provide reliable delivery of the output from the third unit at Mt. Storm to VEPCO load centers and from APS generation to Potomac Edison load centers. As I indicated earlier,

1 extensive studies would be required before a judgment could be
2 made and, to my knowledge, these studies have not yet been made.
3 Q What is your understanding of the primary
4 reason of applicants for not using existing rights-of-way?
5 A It is stated by their witnesses to be one of
6 reliability.
7 Q Would the construction of the new line on a
8 separate right-of-way be more reliable than constructing the
9 line in an existing corridor?
10 A Certainly. It is obvious that lines on
11 multiple, separated rights-of-way from generation points to
12 load centers would be more reliable than use of a single right-
13 of-way.
14 Q In your opinion, is that the determining factor
15 in the case at hand?
16 A No. The question is whether acceptable
17 reliability of a system can be achieved by use of existing
18 corridors. The determination of this question requires the
19 balancing of many factors some of which are: Where the power
20 is to be used, land use, and comprehensive system requirements.
21 Q Can you say whether the use of the existing
22 corridor from Mt. Storm to Doubs would provide acceptable
23 reliability?
24 A No. As I have repeatedly stated, no one can
25 answer this question without more study. But I cannot say that

1 such would not provide acceptable reliability -- it could well
2 do so. If it would not, there would be a number of ways to
3 make the use of existing corridors reliable depending upon
4 what the studies showed.
5 Q Would you please discuss the reliability of
6 parallel 500 KV lines as compared to a single 765 KV line and
7 two 500 KV lines on a single structure.
8 A A single 765 KV line is less reliable than two
9 500 KV lines on a single structure. In turn, two 500 KV lines
10 on parallel structures are more reliable than two 500 KV lines
11 on a single structure. What I am saying is this -- if parallel
12 500 KV lines are not feasible because of inadequate reliability,
13 then a 765 KV line on a single structure could never be used.
14 As this Commission well knows, this voltage is used extensively
15 in the United States, Canada and Russia.
16 Q Would you briefly discuss how utilities generally
17 approach this question of reliability?
18 A First, the utility establishes criteria for
19 reliability which appear to be reasonable with all factors
20 taken into account. Next, they attempt to plan the system to
21 meet these criteria. Next, studies are made to see if the system
22 will meet the criteria under various hypothetical conditions.
23 Computers are programmed to model the system and its performance
24 under various postulated system conditions to see if the criteria
25 will be met. I must emphasize that it is reliability of the

1 system rather than of individual lines or structures that is
2 the goal.
3 Q After the system is put into operation, how
4 do utilities determine whether the criteria are being met?
5 A Detailed records are maintained of the actual
6 experience of the system. These records are tabulated, studied
7 and constantly reviewed because it is only in this way that
8 necessary improvements or modifications can be made. Such
9 studies are essential for intelligent future planning.
10 Q Please discuss the significance of outages and
11 interruptions to the transmission system of a utility.
12 A It should be made clear that a transmission line
13 cannot be made interruption proof. Interruptions to transmission
14 lines do occur, and electric systems are planned to tolerate
15 their being interrupted. Most of the interruptions are caused
16 by lightning, and where the incidence of lightning is severe,
17 the structures supporting the transmission lines are equipped
18 with overhead ground wires to shield the power conductors and
19 reduce the trip-outs due to lightning. The effectiveness of
20 the shielding is not 100% and depends on a number of factors.
21 For important lines such as 500 KV lines, the shielding is
22 frequently applied in such manner as to reduce the probability
23 of trip-outs due to lightning to one per 100 miles per year,
24 and I believe this to be VEPCO's objective. There are also
25 means available to reduce the probability of trip-outs caused

by lightning to a much lower value.

Most interruptions to transmission lines are of virtually no significance. The greatest single cause is lightning. Typically, when a line flashes over due to lightning, there is a power arc established which is extinguished by the opening of the circuit breakers at each terminal within less than 1/10 of a second. Following a "dead time" of a small fraction of a second, the circuit breakers are re-closed automatically and normal conditions are restored to end the event. Automatic re-closing is successful about 95% of the time for temporary lightning faults. Excursions to the system posture are predictable and acceptable and of no particular concern.

When a fault which requires repairs occurs due to lightning or other causes, then the re-closing efforts are unsuccessful and the line must remain out of service until suitable repairs are made. During the period of a transmission line outage, the load must be supplied over alternate paths and sometimes the standards of service are not up to par during that time. This is particularly true if the effect of the outage is compounded because of abnormal conditions or other situations. However, the probability of such an occurrance is very low.

If the transmission outage results in some loss of generation, then the system will reconstitute the desired

resources either from its own system or sometimes from other systems who have surplus generating capacity available.

Q How are outages and interruptions handled by a utility?

A Very generally, a major interruption to either the power resources or the transmission system is handled by adjustments within the system itself or by support from neighboring utilities or some combination.

Q If the existing Mt. Storm to Doubs line were to be paralleled by another 500 KV line and if both lines were lost, would cascading be a problem?

A Again, without the studies which I have previously mentioned, it is not possible to give a definite answer. However, I can say that with adequate planning the problem could and should be avoided. The mere fact that there are two lines within one corridor does not give rise to a cascading problem any more than the existence of a single 765 KV line would. Attention is invited to Criteria for Reliability in Electric System Planning (October 1972) as developed by the Southeastern Electric Reliability Council and the ECAR-MAAC-NPCC-VACAR Interregional System Appraisal Studies (May 1972). Other Reliability Councils in the United States have similar documents.

Q If both lines would go out at the same time, what would be the probable effect?

A Again, without studies, I don't know, but VEPCO has not shown that it does either. The answer to this question would depend on the circumstances existing at the time. It would depend upon such things as whether the indicent occurred at a peak load period or at an off-peak period and the posture of the VEPCO system and the systems in ECAR and MAAC. Case studies would be needed to determine the effect of such an incident at any particular time. However, I can say if properly planned, the loss of both lines would not result in a catastrophe. The results could range from no significant effect, to low voltage for certain users, to localized outage for short periods to certain users. But if properly planned, there would certainly be no major disruption or system collapse.

Q Are there transmission lines presently in operation which would provide a potential back up to parallel lines from Mt. Storm to Doubs?

A Yes, there are. There is a line from Hatfield to Doubs, a line from the east coming into Doubs, and a line from Elmont to Doubs. These are potential sources of a back up supply of power.

Q Would you comment on the effect of EHV lines on radio and television reception?

A All energized lines have an effect on radio and television reception. In many cases, the effect is not at all noticeable but nonetheless exists. The higher the

voltage of the line, the more probable the interference. Transmission lines have a greater adverse effect upon radio and television reception in areas where the signals being received are weak. Generally, this is in areas remote from the transmitters.

Q What effect would the construction of an additional 500 KV line along the same route parallel to an existing 500 KV line have on radio and television reception in the area of those lines?

A It would not increase the problem. As a matter of fact, the addition of another line might well result in the reduction of interference.

Q Please cite to the Commission examples of where one transmission line corridor carries the number of megawatts that would be carried if another 500 KV line were built parallel to the existing Mt. Storm to Doubs line.

A Such examples are indicated on the ECAR map which shows the 765 KV lines that are now in use and planned for the future.

Q Please give the Commission your overall evaluation of the proposals put forth by VEPCO and Potomac Edison.

A As I stated earlier, I reviewed Applications Nos. 32, 33, 34 and 35 of VEPCO primarily for the purpose of determining whether they had any significant relationship to the

applications for the Mt. Storm to Morrisville line. From the available data and without the in-depth study necessary for a complete evaluation, it is my general opinion that the proposals contained in those applications do not have any significant relationship to the Mt. Storm to Morrisville proposal. I have no further comment on these applications.

So far as the Mt. Storm to Morrisville line is concerned, it is my opinion that while additional transmission capacity is needed from Mt. Storm to the Northern Virginia load centers, applicants have not justified the need for that line at the proposed location. Based on the consideration of the area where power is needed and of the impact on the environment, the location of the line from Mt. Storm to Morrisville is not logical. Considering these factors, the logical route of the line would be from the point of generation at Mt. Storm directly to the area of need at Doubs.

It is my further opinion that applicants have not shown sufficient grounds for rejecting the route which would parallel the existing 500 KV line from Mt. Storm to Doubs. They have not substantiated the generalization that reliability considerations will not permit a paralleling of the existing line.

It is my further opinion that applicants have not substantiated the conclusion that doubling the entire loop would be necessary to provide the necessary reliability. I

would be surprised -- at the least -- if this conclusion could be factually substantiated.

Lastly, it is my opinion that applicants could well devise a practical plan which would permit the needed line to parallel the existing Mt. Storm to Doubs line so that the power could be transmitted directly to the load centers and so that the major environmental intrusion, which would necessarily result from the construction of a line from Mt. Storm to Morrisville, could be avoided.

(Document received and marked as Exhibit FC1.)

BY MR. KAY:

Q Mr. Chambers, would you briefly summarize for the Commission the prefiled testimony to which we've just referred?

A Well, I think it is stated that I reviewed Application Numbers 32, 33, 34 and 35 primarily for the purpose of ascertaining any significant relationship with the application for the Mt. Storm to Morrisville line, and from the data that was available and is available now, and without the in-depth study necessary for complete evaluation, it is my general opinion that the proposals contained in these applications do not have a significant relationship to the Mt. Storm - Morrisville line, and I have no further comment on those applications.

As far as the Mt. Storm to Morrisville line

1 is concerned, it is my opinion that additional transmission
2 capacity is desirable from Mt. Storm to the Northern Virginia
3 load.
4 The Applicants simply haven't justified the
5 location proposed for this line.
6 Based on the consideration of the area where
7 power is needed, and of the impact on the environment, the
8 location to Morrisville as proposed is not logical.
9 Concerning these factors, the logical route
10 of the line would be from the source of electricity to the
11 area where the load is located.
12 It is my further opinion that Applicants have
13 not shown sufficient grounds for rejecting the route which
14 would parallel the existing 500 KV line from Mt. Storm to
15 Doubs.
16 They have not substantiated the generalization
17 that reliability considerations will not permit paralleling
18 the existing line.
19 It is my further opinion that Applicants have
20 not substantiated the conclusion that doubling the entire loop
21 would be necessary to provide the necessary reliability.
22 In fact, I would be real surprised if an
23 in-depth study would turn this kind of a thing out to be the
24 case, where electricity would go in a southerly direction for
25 a substantial distance and thence easterly, and then thence

northerly again, to get over to an area where the load really is, which is easterly.

Lastly, it is my opinion that Applicants could well devise a practical plan which would permit the needed line to parallel the existing Mt. Storm to Doubs line so that power could be transmitted directly to the load centers, and so that the major environmental intrusions which would necessarily result from the construction of a line from Mt. Storm to Morrisville would be avoided.

MR. KAY: Now, if the Commission please, because of the Commission's desire to move this case along, and because of our inability to bring Mr. Chambers back here too many times, we do have some additional questions that we would like to ask Mr. Chambers now relating to those new exhibits that came in through Mr. Stallings and Mr. Barthold and some of the testimony at that time, and I think if we can ask these questions now, we may eliminate the necessity of having to ask the Commission to permit us to bring Mr. Chambers back.

COMMISSIONER SHANNON: Go ahead.

BY MR. KAY:

Q Now, Mr. Chambers, when I was examining Mr. Stallings, I asked him to describe the general procedures

that are used in sound system planning.

Would you comment on that testimony and give the Commission your thoughts about sound system planning?

A Well, I think Mr. Stallings made a pretty good start and a pretty sound relating of how this is done.

The beginning input, the driving element of this is the load, the magnitude and the pattern of load.

This is established by the best means that are available today of projecting what future load and the characterization of the load is.

Some load is more difficult to serve than others.

Then it gets defined in terms of the load factor, the seasonal characteristic, and a very important thing is called a load duration curve, that a certain percent of the VEPCO load is existing every hour of the year. Not necessarily the same load, but some is base load, some is intermediate, some is peaking.

That peaking load might, depending on its definition, be something that would exist only a few hundred hours a year. Perhaps 25 or 30 percent of the load could require service for only 10 percent of the time.

That is what I'm really saying here.

Anyway, it has to be defined as best it can be done, and the sources of supply of electricity have to be planned, that that is base load, that that is intermediate,

that that is peaking, and to the extent of any of the sources being from neighboring systems, because of some favorable contractural terms, that might be arranged, and then the transmission system is planned to supply the system load.

That is the load on the VEPCO system or whatever system it is. And the initial studies -- superficial is not exactly the right word, but the initial studies are made to identify perhaps five or six feasible plans that deserve further study.

If a horse starts faltering, then it is discarded early, hopefully.

All the time there are joint studies that are going on with neighboring systems, with systems within the reliability council of the electric system, and the neighbors associated with it, and this leads to assessing the favorability of cooperative planning.

There can be large economies gained by working together, in the size and type of generators, the diversity of load among systems, firm sales are developed, there are so-called economy interchanges that are carried out, and coordination of maintenance is a very important thing; also, emergency assistance, in dealing with contingencies beyond which you design the system and these things.

The engineering studies to carry this out always have to be of the kind that are acceptable. They have

to have the reliability that is acceptable. The evaluation has to be carried out over a long term that takes account of what is spent, what cost is incurred, and the year in which they are incurred, and all these things.

I think I'm running too long on this, Jack.

Q Well, move on, if you would, then, Mr. Chambers, to the nature of these studies that the Commission has heard reference to, the base study, and just how they are done.

A Well, I just haven't seen any studies presented that are persuasive that -- you mean of the case that is here?

Q No, sir. Just generally, in making these studies, once you try to seek these things.

A Well, what you do is you simulate the system mathematically on a computer.

In earlier days it was done by simulating the actual system in a model form, but today it's done on a computer, and for each case that deserves in-depth study, you may run perhaps fifty what are called base load cases.

This is the kind of a thing in which you set up the summer peak and the summer off-peak, the winter peak, the winter off-peak, and the shoulders, the spring and fall, and you work in the requirements for maintenance.

Mr. Stallings might correct this, but I would speculate of the order of 10 or 12,000 megawatt months of maintenance that VEPCO has to work in somehow, and if they don't

do it this year they will be bitten next year.

It's part of the thing that has to be done.

And then you vary the pattern of generating schedules to allow this maintenance, and during the time this is being done you still are seeking the reliability that you have established that you want to do.

Different systems differ on this, but many, at any rate, in the United States, design on the basis of being unable to supply their load one day in ten years.

Now, this turns out to be about four nines in a row, if you consider that every day is not a peak day and these kind of things.

The question could very well be asked, why not five nines in a row, and why not three, and it's basically just money. It is how much reliability. You are not going to get a hundred percent, but how much reliability are you willing to pay for.

Well, so you establish the reliability that has to be met in all of these studies, and then you may have found yourself with perhaps forty or fifty base load cases.

Then you start some base load cases that postulate different arrangements with neighbors. You say that a certain amount will be received from and what interchange capability is available with your neighbor, and if it isn't as much as is favorable for you to have, economically, then you

adjust the transmission to meet this.

Well, I think I've left one of the more meaningful things now until the last, and that is the environmental impact study, and some of those factors are the most meaningful there are.

For example, you couldn't build a transmission line across a certain historical area regardless of how favorably it might be, economically or reliability-wise.

As a matter of fact, these three concerns are not at all compatible; economy, reliability and the environment, and really there is a trade-off in all of these things.

I think I've run too far again.

Q Well, which one of those factors that you just mentioned predominates? The economy, the reliability, or the environmental impact?

A Well, none of them do.

On the other hand, each does in its own way. As I mentioned, the environmental factor will override anything else if it's strong enough.

For this reason, the studies generally point toward the transmission facilities being located in areas that are not useful for higher purposes, you might say, or that are just simply unacceptable.

Then there are also interrelated things. There can be an environmental factor in a certain area that can be made

acceptable by the design of the line, or by some particular treatment that is done. But there's always -- it's always a trade-off, and the reliability is essential.

VEPCO couldn't plan its system for reliability that is unacceptable.

VEPCO should and, I know a lot of the people involved, and I think they do very good planning on the economy basis.

Q Well, in this particular case you've read Mr. Stallings' testimony and you heard him while he was being cross-examined, and on the basis of that, would you state whether or not you believe that serious consideration was given to the plan to parallel the existing 500 line from Mt. Storm to Doubs to Loudoun?

A No, I don't think it was.

Q Well, would you explain that conclusion, please, sir?

A Well, I haven't seen any data, studies, even those that Mr. Barthold just submitted earlier in his testimony, that demonstrates this.

You see, to make studies comparative, you have to make true comparisons of what is being viewed.

This just doesn't appear in these studies at all.

Q Now, sir, do you agree with Mr. Stallings'

statement that two 500 KV lines that are serving the same basic purpose should not occupy the same right of way because of reliability considerations?

A No.

Q And why not?

A Well, the use of one right of way for high capacity transmission is not really on trial I don't think.

It's pretty well established.

The 735 KV lines in Canada, and the 765 in the United States have a carrying capability that has already been testified by others of more than twice, two 500 KV lines.

Two 500 KV lines occupying the same right of way are much more reliable than one 765 or 735, and they are more reliable than two 500 KV lines built as double circuit on the same tower line on the right of way.

But in any case, it's possible to plan the transmission system so as to accept the tripping of all the line on the same right of way.

Q Now, sir, was that done here from what you can tell?

A Well, of course, I don't really know, but I haven't seen anything to show this.

Q Now, Mr. Stallings, in his exhibits, I think, CMS4 and 5, submitted some cases that, as I understand it, purported to show that the system, electric systems, in the

eastern United States, or at least a part of the eastern United States, would collapse if the two 500 KV lines were built on a common right of way and if they were both tripped out.

Do you think those studies in CMS4 and 5 proved that?

A No.

Q And why not?

A Well, first the studies were based on a base case of the line being from Mt. Storm to Morrisville and the line existing, of course, from Mt. Storm to Doubs.

The behavior of the system would be different from tripping two lines in separate directions than they would two on the same right of way.

The case that was presented by Mr. Stallings seems to me to be based on a postulation of about as severe a condition as you can cook up for this kind of an arrangement. That is, they base this on 5,000 megawatts being supplied from ECAR to MAAC, and I understand VEPCO is not a part of either one of those, and if 5,000 megawatts is transmitted, and if two of VEPCO's lines trip out, then there can be a critical condition appear on the Allegheny system between Black Oak and Doubs if they don't do anything at all to mitigate this, and there are means of doing it available, used regularly.

Mr. Barthold uses them all the time. But even

under that condition, the case that was shown indicated that the two lines to Juniata in Pennsylvania are still not overloaded. They are carrying a little over 3,000 megawatts, as I recall, and the two lines carrying that are doing all right.

This is a postulation of something that demonstrates reasons why something can't be done.

You might say, if you can do this, okay, we will have 10,000 to go from ECAR to MAAC. Well, that will do it. I mean, it's like a bug crawling. If you pull a leg off, trip out a line, he doesn't crawl as well, and if you trip out another line and then trip another, after a while the bug can't crawl, and the bug just has so many legs. And this is in the planning of reliability for electric systems.

If you want to go far enough, you can certainly demonstrate that you can't do it. What I have not seen is any effort as to how it could be done, and it can.

Q Now, sir, do you have any other observations on this point that you are testifying to now?

A Well, every system has to have a spinning reserve and a non-spinning reserve available to meet its reliability criteria.

In the cases that I have seen, the spinning reserve that would be available in MAAC have not been patterned to help this condition.

All of the systems have an enertia, sometimes

1 called WR square. It's rotating masses of generators and
2 turbines that if an event happens the initial response is taken
3 up by some stored energy, and then there is an adjustment in
4 the tie lines.
5 The reserve, the location of reserve and the
6 posture of the systems are never identical in -- I don't know
7 if any cases have been shown here to show how that could be done.
8 The reserve could very well be made up of MAAC,
9 and it doesn't make any difference what contracts are in
10 existence.
11 The kilowatts can't read them. When there is
12 a deficiency someplace, it's going there from that system
13 that has it available.
14 It was testified that the VEPCO system reserve
15 amounted to 15 to 18 percent.
16 Was that it?
17 That sounds reasonable, because VEPCO does not
18 have such very large units. They have units that are pretty
19 reliable and mature and predictable, and if you have larger
20 units that are not sold, then you may need a larger reserve.
21 Then, the spinning part generally will be
22 based on some kind of a formula, but will not be less generally
23 then the capacity of the largest unit, which in the case we
24 are talking about here would be North Anna -- North Anna would
25 be 835 or something like that.

1 I think that would likely be there.

2 Q Now, sir, Mr. Stallings testified that if the

3 chances -- at least, this is my recollection of his testimony --

4 that if the chances of both lines on a common right of way going

5 out were five million to one, or ten million to one, that that

6 chance should not be taken.

7 Do you agree with that conclusion?

8 A Oh, no, no. You can't provide service that

9 reliable.

10 Then, also, it is not the transmission line

11 itself or the transmission lines on the right of way.

12 It's the system that you are talking about,

13 and so you arrange the system with the probabilities of event

14 that all of them put together, on the Gaussian technique, of

15 saying that you will be unable to supply the load, or you will

16 have some deficiency or abnormality, low voltage or something,

17 once in so many years or once in a certain period of time. But

18 you can't get to five million. That's too many nines in a row,

19 or ten million.

20 Q We've heard a lot about reliability criteria.

21 Are there any reliability criteria for transmission lines

22 themselves that are put out by the reliability councils?

23 A Oh, no. Sometimes you have a transmission line

24 that you would like to have very reliable because the reliance

25 on the performance of that line is very great and you can

design lines for high reliability or lesser reliability, and it's just money, and so you don't design -- you don't seek to design the system for a performance greater, I suppose, basically, than the people are willing to pay for.

Q Now, Mr. Chambers, have you had an opportunity to look at the case plottings that were presented by Mr. Barthold, and I think they were LOB1, 2, and 3?

Have you had a chance to look at those?

A Yes, I've looked at those.

Q Do you think that any sound conclusions can be drawn from those studies?

A No, no.

Q And would you tell the Commission why you are of that opinion?

A Well, they are pretty well the same character as the ones that I referred to earlier. First, the base case doesn't start out with two lines. See, this is the reason I don't believe studies have been made. There are not a lot of cases showing two lines from Mt. Storm to Doubs, or one going on through to Loudoun.

This is not appearing in any material that I've seen anywhere, and when we have pursued this, as we have, we've gotten this stuff that is showing the Morrisville and the Doubs line being tripped out, and it's not the same response.

Now, I have a whole lot of comments about

Mr. Barthold's exhibits here. I don't know about taking up the Commission's time in this.

Q Well, I think this is an importance feature, and if you could run over at least briefly the reasons that these studies you don't think prove the conclusion.

A Well, if you look at LOB1, if we start at the beginning, this postulates something that just simply is not true at all. It shows three transmission lines from A to B, or one from a source to a load, that they are identical in character.

That is not the case at Mt. Storm. What is there are five lines, not three, and for purposes of going toward Virginia, or Northern Virginia, I think there would be four.

What I'm saying is that one goes down to Valley, and thence to Dooms, and one will go north to Black Oak, and then one goes to Doubs, and one would go to Morrisville to Loudoun.

Now, there's a fifth line which, for this postulation, would not be an out-flow line. It's the one from Pruntytown. This thing would lead somebody to believe that there are three lines, each identical, each sharing the load equally, and so you would ship some out, and this is true if you can say that this is what the real life girl is at that point, but it isn't.

One is a whole lot longer than the other, and if they were identical in character, and one is fifty miles long, and one is a hundred miles long, then one would carry one-third of the load, and one would carry two-thirds. The shorter one would carry two-thirds.

So, there is a difference here, and as long as it is recognized that this LOB1 is simply to illustrate a principle, it's all right, but if you think that this is illustrating what is true at Mt. Storm to Northern Virginia, that isn't right.

The other cases, that is, that follow this LOB1 here, Case A, B and C, so forth, all show some plottings that are very fragmental, and the first one, Case A, which is called the base load, you see it there, and it shows a line from Mt. Storm to Doubs.

Does the Commission have this?

COMMISSIONER SHANNON: Yes, we have it right here.

A (Continuing.) And Mt. Storm to Morrisville. It doesn't show but a few numbers in here.

You turn to Case B, and you find that you trip out the Morrisville line and there are a few numbers that are shown.

This is pulling the legs off the bug, and that leg didn't hurt the bug too much.

1 Let me see. There's Case C, which is the one
2 that the main point is made of here, and the plotting is so
3 fragmented that I would like to comment on it a little bit.
4 It shows, for example, 2250 as a number of
5 megawatts from Black Oak to Doubs.
6 It says that that would represent 3400 amperes
7 at 500 KV.
8 Well, that would be based on the voltage having
9 gone down to 382 KV. So, this is the reason we asked for the
10 back-up material, and we find the reason.
11 I pretty well knew what the reason was anyway.
12 When you load a line that heavily, the kilovar load, the
13 reactive load gets very high, and reactive power, the Commission
14 probably knows, is much more vicious than real power for voltage
15 drop.
16 In this case it perhaps is twenty times or
17 twenty-two times as vicious, the kilovars.
18 The principle is you just can't transmit
19 kilovars.
20 So, the remedy for that is to put in capacitors
21 or sychronous condensers, which are relatively inexpensive, and
22 you put them in at the load point such as Doubs and Mt. Zion,
23 or where the load is.
24 If you truly took care of the vars, and that
25 means is available, then the 2250 megawatts could be it period,

and then the voltage would be such that you would have a current within the capability of the Black Oak - Doubs line.

Another thing that is not shown is how much goes down from Mt. Storm to Dooms.

Well, I looked it up, and there's 724. That isn't much for a 500 KV line. So, if you really had an event, such as Mt. Storm - Doubs, double circuit being tripped simultaneously, you certainly could arrange for automatic switching to be performed at Mt. Storm to push one or two units of Mt. Storm this way, and you can take several hundred megawatts off of this part that goes from Mt. Storm to Black Oak, 1968, and correspondingly reduce Black Oak - Doubs.

If you are seeking to do something, you can do it.

Well, I don't know how much this going on that I ought to do.

BY MR. KAY:

Q Well, have you --

A The probability of this is very low.

Q Through any of these studies, have you seen any studies which show the kind of things that you are talking about as an effort to make this possible?

A No, I haven't. I haven't seen any of the techniques used that are available, and these people know all

about that.

To my mind they are among the better in the business.

Q Now, sir, in LOB4, the first page is entitled "Simultaneous Outage of Transmission Lines Resulting from Their Location on a Common Right of Way."

Is the definition of system practices as set forth in there the SERC council definition?

A I've got to find four, sir.

Q All right.

A Oh, no, no.

It says, "To require an accomodation by the rest of the system" --

Q Where are you reading?

A It's Line 2, 4, 6. Line 6.

This is not SERC at all, and I don't know of any others.

Two or more circuits on a common right of way, many times will result in abnormalities and some loss of load. Not every time. You see, this thing that we have been looking at here is the worst thing. It's a large amount, 5,000 megawatts. That's 70 percent as much as the VEPCO load is right now.

Go from one system to another, both of whom are neighbors of VEPCO, and VEPCO is not in this. This thing is piled up here to show this thing.

1 Q Now, sir, in the context that we're talking
2 about here, would you discuss, in your opinion, the advantages
3 of interconnections, and discuss the magnitude of interchange
4 potential?
5 A Well, that is a favorite subject of mine.
6 Q Briefly, please.
7 A I'm for it.
8 Q A little broader.
9 A Well, every kilowatt of load today is going
10 to represent an investment in my opinion of seven or eight
11 hundred dollars, as we view 1980.
12 I think generating capacity is going to cost
13 five or six hundred dollars a kilowatt. I think transmission
14 is going to cost a hundred to a hundred and fifty. I think
15 distribution will cost a hundred fifty to two hundred.
16 When you add these things up, the distribution
17 they can do nothing about. They have to do it, and that's
18 it.
19 The transmission and the generation, though,
20 they can find ways to work with neighbors to achieve economies,
21 and for every kilowatt that can be identified as delayed or
22 perpetually delayed, if it is a seasonal thing, it's a very
23 large amount of money. So, there is diversity, reserve sharing,
24 emergency assistance, you can buy and sell, you can achieve
25 reliability.

Basically, I'm very much in favor of it.

The National Electric Reliability Council has devoted a lot of study to that question, and they've come up with a little report which I've seen copies of, but this is a report that was made, I think, in response to two or three pieces of legislation, national legislation, based on interconnection over the United States, a national grid, which I don't really feel is economic.

I know it is engineeringly attainable, and if it has got a value that exceeds its cost, then that is something else.

But, anyway, they made a study on this, and I want to read from this study the paragraph on Page 5 -- would you want this to be an exhibit?

Q Yes, sir. Why don't we hand out copies of this.

COMMISSIONER SHANNON: All right. We will identify this as FC2.

MR. KAY: I guess we've got two sets of copies.

(Document received and marked as Exhibit FC2.)

THE WITNESS: Do I still need to read this?

BY MR. KAY:

Q Show the Commission the paragraph and maybe highlight it.

A Page 5, the large paragraph in the middle of the page, starting, "Each of the reliability regions tends to be well integrated with transmission. Consequently, the greater part of the delay, seasonal and annual diversity is presently being utilized within these regions of the United States. From an analysis of the hourly loads of the individual systems within the region, this integration permits seven percent of the eleven percent annual diversity to be utilized within the individual regions for scheduled maintenance of equipment and for capacity and emergency power transfer between systems. Load diversity of just four percent then remains, which possibly could be utilized between the regions. However, part of the latter" -- I don't think I'll read the whole thing.

The point I'm making is that while I'm very strong in my feeling for transmission between regions, I recognize that transmission lines never generate a kilowatt, and certainly you don't want to make monuments and spend money to the extent that they are not needed, and this pretty well establishes a pattern of possible advantages.

Now, there are certain systems that do indeed complement each other with summer peak, winter peak and these things, where there is a greater number.

Q Mr. Chambers, there was some testimony, again, as I recall it, from the Applicants that the paralleling of the Elmont - Loudoun line to get power from North Anna to the

1 load centers, that the paralleling of that line would provide
2 sufficient reliability.
3 Would you comment, please, sir, on that
4 conclusion as compared to the conclusion of the Applicants
5 that the paralleling of the Mt. Storm to Doubs to Loudoun line
6 would not be reliable?
7 A Well, the lines from North Anna have a purpose
8 of taking the quantities generated at that location out to
9 where the loads are.
10 Another significant requirement from AEC is
11 that the lines be prepared to transmit electricity to North
12 Anna to supply the emergency core cooling system for certain
13 events that they postulate can happen, and they go out farther
14 really than four nines in a row.
15 So, those lines, if they are acceptable to be
16 parallel to carry the load, and also acceptable to be parallel
17 for this emergency back feed, then their requirement is a little
18 more severe, I think, then going from Mt. Storm to Doubs which
19 is just load, and in earlier days AEC would not have approved,
20 I think, two lines on one right of way, but now they do.
21 Q Now, sir, if that paralleling would provide
22 sufficient reliability, would you tell the Commission in your
23 opinion whether if VEPCO were told to try to do it, could
24 VEPCO in your opinion plan its system in a practical way so
25 as to provide sufficient reliability for the paralleling of the

[TR. P. 2073]

existing Mt. Storm - Doubs - Loudoun line?

A Well, the answer is yes. It would be indeed unusual if Virginia were to be the only place that couldn't allow that much transmission capability on one right of way.

The systems in the United States are indeed looking forward to even higher voltages, and the reason is simply the economies and land use.

The right of ways have to be more intensively used, the acres that are allowed to be devoted for that.

As a matter of fact, the Pennsylvania systems, who now have 500 KV, have made a report in which they are viewing the possible alternatives that they will study in depth for their system, beginning in the 80's, and they brought it down to three. One is a continuation of the 500 KV, which they now use, which would occupy more and more acres of right of way with parallel 500 KV lines.

The second is a 1200 KV, or I think it's 1200, AC system, and about a 1200 DC system.

So, to the north there will be rights of way planned for carrying much more, and VEPCO can do it, Mr. Barthold can do it, and the answer is yes.

MR. KAY: Thank you, sir.

[TR. PP. 2074-2075]

BY MR. BRASFIELD:

Q Mr. Chambers, I believe you agree with a number of positions VEPCO has taken in this case, haven't you?

A Yes, I'm sure I do.

Q You don't disagree with everything?

A No.

Q I believe you are in agreement that there is an electric need for all of the facilities that VEPCO proposes?

A Yes.

Q And on that, I refer you to Page 10, 11 and 12 of your testimony.

A You know, the word need and the word desirability is --

Q You are not changing your testimony on that, are you?

A Oh, no, no, no, no.

Q So, there is, in your judgment, based on your review, a need?

A Yes. But you have to recognize that even since this has started there have been some things now that have come about that permits some relocation, and I don't want to get into that.

Q Has anything happened that eliminates the need,

the electrical need?

A No.

Q Right. Now, you also say, I believe, that the Remington - Warrenton facility seems essential to provide satisfactory service to projected future loads, and there I'm quoting from Page 12.

A Yes.

Q Now, another area, if not you are in agreement, at least non-disagreement, you haven't questioned the routing of any of the lines except the Mt. Storm to Morrisville line, have you?

A No. I didn't really study that.

Q And you have stated, and I think restated in your summary, that the Mt. Storm to Morrisville line is really independent of the others?

A Yes.

Q And so the Commission could grant the approval in all of the others and withhold the approval in that, or it could do the other way around, grant the approval from Mt. Storm to Morrisville?

A Yes.

[TR. PP. 2077-2075]

Q Now, you also agree that lines on separate rights of way are more reliable; that a system having lines on separate rights of way is more reliable than a system having those lines on the same right of way, or some of those lines on the same right of way?

A Sure.

Q And that the loss of all lines on a single right of way must be considered in system planning.

You agree with that?

A Yes.

Q Now, you were with the Tennessee Valley Authority for many years, were you not?

A Yes.

Q On Page 7, Line 20, you indicate that TVA's power program was carried out with full regard to the environmental and aesthetic costs of each project.

Now, you took the environment into account, did you not?

A Yes. TVA as a regional agency had the power

1 program as only one part of its objective, so it did.

2 Q Did you find that taking the environment into

3 account eliminated all citizen opposition to your plans?

4 A No, no.

5 Q Even the most carefully planned transmission

6 line, whether environmental considerations predominate, or

7 economic or reliability considerations predominate, will stir

8 up public opposition, will it not?

9 A Yes.

10 Q Particularly in the area affected?

11 A Yes.

12 Q The landowners and the citizens nearby.

13 A Yes.

14 Q And on the basis of that, if a proposed line

15 through one area were relocated to another area, you could

16 expect opposition from the second area, could you not?

17 A Right.

18 Q In recent years has the opposition from citizens

19 and landowners been greater than it was in the earlier years of

20 the electric industry?

21 A Yes.

22 Q It used to be that transmission towers coming

23 across the horizon were a great sign of progress.

24 A I remember that very well.

25 Q People were glad to have the power in those days,

[TR. P. 2079]

weren't they?

A Right.

[TR. P. 2081]

Q Well, can we agree on this: That a voltage reduction of greater than ten percent at the customer, where he uses it, might very well damage his equipment?

A Well, I would say it is undesirable. Equipment varies, so I'm not going to say that it would. It is undesirable.

CONTINUED

Q You would agree, would you not, that VEPCO ought by whatever means that may be available to try to avoid voltage fluctuations at the customer level beyond ten percent?

A Yes. No question.

Q Now, throughout your prefiled testimony, and with one exception in your supplemental testimony, you referred to an alternate of building a line from Mt. Storm to Doubs as an alternate to the Mt. Storm to Morrisville line.

A Yes.

Q Now, Doubs is in Maryland, is it not?

A Yes.

Q It's outside of the VEPCO system, is it not?

A Yes.

Q Now, if my notes reflect what you said correctly, you said Mt. Storm to Morrisville didn't make much sense because what was logical was to transmit direct to where the load was, is that right, rather than to Morrisville?

A Yes. The load is in the Doubs - Loudoun area.

Q VEPCO's load is not served from the Doubs Substation, is it?

A No.

Q Okay. So, how are you going to take care of VEPCO's load by going to Doubs?

A Well, there is a transmission line that goes from Doubs to Loudoun. It's a 500 KV line. It was built to

carry electricity, I think, both ways, and in parallel with it is a 230 KV, which I believe some earlier studies that I reviewed indicated that in the latter 70's, or 1980, if the 500 overlying line tripped out that the underlying would be overloaded, so it therefore must have a second line between the two.

The distance from -- let me finish this.

Q Okay.

A The distance from Mt. Storm to Doubs is 96 miles.

And then down to Loudoun it is 34 miles.

One hundred thirty miles altogether.

Q That's right.

A That is a much lesser distance, much lesser loss than to come down from Mt. Storm to Morrisville and join the quantities from North Anna, coming into that point, and then transmitting thence north to Loudoun.

Q Well, you are now talking about going all the way to Loudoun at this point. Your alternate proposal, however, does not consider going all the way to Loudoun, does it? It stops at Doubs?

A Well, this gets back, I think, to saying that the line between Doubs and Loudoun is almost a floater for normal conditions.

Q It's a what?

[TR. P. 2084]

A It isn't carrying much. It carries just a few kilowatts. It just kind of floats. It's not carrying much either way. Maybe, oh, a hundred or so megawatts or something like that. It's not loaded.

So, I would say -- and I'm not planning this. I'm not presuming to do this. But one alternative would certainly be to build the line to Doubs and then taking advantage of the time and value of money, I would wait the number of years that I could and extend it on down to Loudoun, and somebody else in testimony did say, well, that alternative then ought to be to go on and build all the way from Mt. Storm to Doubs and down to Loudoun, 130 miles, to start with, and that would be longer than the 110 to Morrisville, but it would still be only an advanced expenditure of something that is needed anyway into area eight, from Doubs to Loudoun.

Q Well, if the Mt. Storm to Morrisville is built, is your testimony that another line between Doubs and Loudoun will be needed then?

A It's my testimony that I reviewed a study that was made that indicated that that would be required.

Q Well, let me ask you this, Mr. Chambers: Forgetting that, but let's take next year, the year after next. You pick a year. But you tell me how, if Mt. Storm to Morrisville is not built, and Mt. Storm to Doubs is built, and the line terminates at Doubs Substation, how the power is going to get to VEPCO's Northern Virginia service area when it is needed, if the existing Doubs - Loudoun line is out of service for any reason?

A It depends on the load at the time that this trip out occurs.

Q Peak load.

A Peak load. You have to make some studies to find out.

Q So you can't say that no Doubs - Loudoun -- no second Doubs - Loudoun line is needed if you were to build from Mt. Storm to Doubs, can you?

A I never did say that.

Q You suggested that a comparable solution to Mt. Storm to Morrisville was building Mt. Storm to Doubs only, though, didn't you?

A I think I'm suggesting that studies have not been made to assess the question of building direct from Mt. Storm to where the load is instead of building down to where the load isn't and then going back north again.

Q Now, to get --

1 A Now, let me finish.

2 To accomplish this you could build a transmission

3 line from Mt. Storm to Doubs and thence to Loudoun.

4 If you studied it sufficiently, you might

5 find that the Loudoun - Doubs section could be delayed a year

6 or so. You might find that it's going to be needed anyway, as

7 is suggested before, and so that section would really amount

8 to expenditures advanced to some degree. But I didn't say

9 that -- I don't think I said it -- I hope I didn't -- in my

10 direct testimony, anywhere, that I was prepared to lay out

11 the transmission system.

12 Q But you did confine your comparison to

13 Mt. Storm to Doubs, did you not? You did not consider a

14 line from Doubs to Loudoun as a necessary part of this solution,

15 did you?

16 A That is not correct.

17 Q Point out to me in your direct testimony where

18 you referred to a line going from Mt. Storm to Doubs to Loudoun

19 as a part of this particular project?

20 Page 21 is where you refer to future need.

21 A Well, I think we've debated --

22 Q Well, let's forget that for the time being.

23 A I don't want to forget it. I want to get to

24 this thing.

25 Q Okay.

A What I am looking for is where I said in here that I did not presume to study and plan the system. That is the kind of a thing that I made a point.

Q But you did presume to limit your comparison to a line ending at Doubs, did you not?

You said a 96-mile line. Everywhere you're talking about the alternate of paralleling, you referred to a parallel from Mt. Storm to Doubs only.

Now, isn't that true?

A I think that I referred to building a line to Doubs with the expectation that the added lines to Loudoun would be required. I think we are playing on words here.

Q Well, let me ask you this: Do you concede that a line from Doubs to Loudoun will be needed to get the power into the VEPCO system if the alternate, the parallel alternate is adopted?

A I concede that, and I say that it may also be needed anyway.

Q So having conceded that, you would then say that the proper comparison would be to compare the line from Mt. Storm to Doubs to Loudoun rather than from Mt. Storm to Doubs with the VEPCO proposal?

A If you will take account of what I said, that you would study the question and you would determine if one or two years' delay can be achieved, and if you would present worth

[TR. PP. 2104-2105]

what you spend, and if you will also present worth the annual cost of losses associated with each, then you come up with it.

* * *

Q Now, I believe, as has been mentioned before on Page 10 of your testimony, you indicate that available data support the contention of VEPCO and Potomac Edison that additional transmission capacity is needed from Mt. Storm to the Washington, D.C. - Northern Virginia area?

A Yes.

Q You say it supports the conclusion of the Applicants.

Now, that conclusion has two parts to it, does it not? One, that power is needed; and two, when it will be needed.

Now, do you also agree with the conclusion of the Applicants as to when that need arises?

A I think so. I think by adding 540 megawatts at Mt. Storm, and with the Davis and with the other things that are going on in Pennsylvania, that it is needed.

I don't think I debate that.

Q Now, given your acceptance of those projected dates of need, can you tell the Commission how long the studies of the type you think are necessary to take, if they were to be performed starting today?

A Well, it could be a few months. You have to remember that the base setup in a large part of the southeastern United States is already set up on tape, and if intentive effort went after this, it could be done in a fairly short period of time.

Q I don't suppose you could give us any estimate of how long it would take to get approval from the State of Maryland to go in there, could you, after the studies were completed?

A I'm going to duck that.

[TR. P.2108]

BY MR. BRASFIELD:

Q Let's assume that the line from Mt. Storm to Northern Virginia is delayed by three or four years beyond its required in service date.

Is that something that represents good utility management?

A Well, I don't know what the basis for the delay would be, but it would not --

Q To comply with the National Environmental Policy Act.

A It does not represent good utility management to plan for some facilities to be available and then find that they are delayed.

[TR. P. 2110]

BY MR. BRASFIELD:

Q Have you built any lines across national parks in recent years?

A I don't know what you mean recent years.

Q The last five years.

A Yes.

Q Did you have any trouble getting approval to do that?

A (Witness nodding head affirmatively.)

Q Is that an affirmative answer?

A Yes.

Q Did you have to comply with the National Environmental Policy Act of 1969 when you did that?

A Yes. Across a national park you always had nothing but problems.

Q Two crossings of a national park would be twice as many problems, mighten it?

A Yes, it would. We generally just contracted with the park service to maintain the right of way, and we would pay them for it.

[TR PP. 2117-2118]

BY MR. BRASFIELD:

Q Now, we've already established, I believe, that you agree that lines on separate right of way tend to increase reliability of a system over lines on a single right of way?

A Yes.

Q And I believe on Page 24 you also admit that you don't know in this case whether parallel or adjacent construction would provide acceptable reliability?

A Right.

Q That is the object of the studies you've referred to?

A Yes.

Q You agree, however, do you not, that in making studies the company must consider the loss of all lines on a single right of way?

A Oh, yes, sure.

Q You say that on Page 20, I believe.

A Yes.

Q So you're really saying, are you not, that each situation as to whether it is appropriate to have a parallel or not must be judged on its own peculiar facts and circumstances?

A Yes.

[TR. PP. 2123 - 2124]

BY MR. BRASFIELD:

Q Mr. Chambers, before lunch and before I went to the map before lunch, I believe you had agreed that the question of whether a common right of way could be used for multiple transmission lines had to be determined on a case by case basis, based on the particular facts of each case.

A Yes.

Q Now, if that is true, the fact that other companies or even this company have or plan to have some 500 KV transmission lines on a common right of way, or that some of them have a 765 KV line which carries about double the power of a 500, this can't be controlling, can it? That can't be determined as to whether VEPCO should put these lines together?

A That's right, yes.

Q And so a company such as American Electric Power, when it builds a 765 KV line, it ought to study that and see if the loss of that line can be sustained, just like the loss of two lines on a common right of way would have to be sustained, isn't that right?

A Yes. The assessment is a completely different thing.

Q And isn't it fair to assume that a company building a 765 KV line plans to have that backed up with other 765 KV lines?

A It plans to tolerate the tripping of that line, and accept that on its system.

Q Through some sort of back-up?

A Or acceptance of abnormal --

Q Yes. Normally at least for the long term, they would plan to back that up with the same voltage until they moved on up to an even higher voltage, would they not?

A Yes.

[TR. PP. 2127-2128]

Q Now, do you know what cascading is?

A Yes.

Q What is it?

A Cascading is an uncontrolled collapse of the electric system in the area involved.

Q Does that mean going beyond system boundaries or confined within a single system, or both?

A Both.

Q Both. Now, was the northeast blackout the result of cascading?

A Yes. It was a cascading behavior that was not recognized as such, and it was permitted to go to the extent that it did.

[TR. PP. 2132-2134]

Q The reliability councils do suggest that steps be taken to avoid the likelihood of cascading, do they not?

A Oh, sure. That is one of the main objectives.

Q That is one of the big objectives, cascading is something to be avoided?

A Right. Absolutely.

Q Now, do not the reliability councils, in setting up what you do to avoid cascading, do they not require the companies, or certainly establish as a criterion that the companies should assume the loss of all lines in a single right of way and determine if that will produce cascading?

A Yes.

Q That is a sensible requirement, is it not?

A Sure. It doesn't mean they don't lose any load. It doesn't mean the system is completely intact.

It doesn't mean that they don't accept some substandard system conditions.

This is the thing that goes on. More likely things you accept with no problems. The less likelihood you can accept with some, and then you go on to other points.

Q But it does mean, does it not, that you do not build a system or design a system and build it where your studies show that cascading would result if you lost all lines?

A Correct. Right, right.

Q What reliability council is TVA a member of?

A SERC.

Q And it has to meet this criteria, does it not?

A No.

Q Why not?

A Because the reliability council as such is not an authoritative thing. The reliability councils do not boss the systems. They rather work cooperatingly to achieve it. But the SERC would not tell TVA to build a line from A to B, or to put in a generator with fast governor response or something.

Q I don't mean that. SERC has established criterion that the members of SERC by agreement comply with; is that not correct?

A Right.

Q So when I say they are bound to do it, they are bound by their agreement with the other members of the reliability council?

A This is correct.

Q I did not intend to suggest a regulatory sort of requirement.

A Well, that was a tender point with some of the systems, so I thought I shouldn't answer it yes unqualifiedly.

Q Now, I take it from all of this that if studies were to show that a loss of all transmission lines on a single

[TR. P. 2134]

right of way would produce cascading, then the company or companies involved would have to take steps to avoid that result?

A That's just simply not exactly right.

There are companies who have some vulnerable situations that they almost have no recourse.

Look at Con Ed. How do you get lines into Manhattan Island.

You know, there is some land that is used for that purpose, but there isn't any more, and they have got to make them. But I'm in general agreement with what you are saying. I'm not saying it happens in every case.

Q Well, do you have Kay Exhibit Number 2, which is a copy of the SERC criteria?

A I was just looking for it, because I thought you might want to read it.

[TR. PP. 2135-2138]

Q I just ask you to look at Page 2. I don't think there will be any argument about this.

A I wouldn't think there would.

Q The second paragraph says, "Each of the SERC member systems will be planned to avoid cascading upon the occurrence of the following contingencies," and one of those contingencies, 3B, is sudden loss of all lines in a common right of way.

A I said that earlier.

Q Yes. But you seemed to say later that TVA or VEPCO could, if studies showed that there would be cascading, if lines were lost, you seemed to suggest that VEPCO or TVA, as the case may be, would be free to go ahead and build that way without regard to those study results.

A I'm saying that the members of the councils are not bound by obligations to do what a council may tell them to do, and I'm also saying -- I'm saying this is a cooperative thing, is what I'm really saying.

Q Yes.

A And I'm also saying that some systems may indeed have a situation that would be a big problem, but if you read the words at the top, it says, "planned to avoid cascading upon the occurrence."

CONTINUED

1 Q Well, that was what I postulated, that studies
2 show cascading, that shouldn't the companies involved do
3 whatever is necessary to avoid that cascading.
4 A Correct. Right.
5 Q And if studies were to be made that showed
6 the loss of all lines on a Mt. Storm - Doubs, or Doubs -
7 Loudoun right of way, would result in cascading, then something
8 should be done to eliminate that problem; is that not true?
9 A Right.
10 Q And you've suggested in your summary this
11 morning, I believe, the installation of certain pieces of
12 equipment, some switching practices that you think ought to be
13 looked at in this regard; is that right?
14 A Yes. That is not all that could be looked at.
15 Q Okay. But suppose they were looked at and
16 everything else that you can think of were looked at, and we
17 still had a study that showed cascading when all lines are
18 lost; then you would either have to provide a back-up to that
19 system or achieve separation, would you not, in order to stay
20 within the criteria?
21 A Correct.
22 Q Now, by back-up, I suppose you would agree
23 that we're talking about a line into the Northern Virginia
24 area from some other location or generating station in that
25 area?

1 A Well, both of those things are in the future
2 picture, of course. There is a plan J or something in there.
3 But what you have here is ECAR and MAAC set
4 up to carry 5,000 megawatts from ECAR to MAAC, and VEPCO is
5 in parallel with them, and if VEPCO trips out certain elements
6 of its system, it results in overloading a piece of the MAAC
7 system that is carrying that load because of the large transfer
8 between the two.
9 Doesn't that suggest to you that two systems
10 who are neighbors, one here and one here, if they agree to
11 a transfer of a certain quantity from one to the other -- it's
12 only in this direction that this problem occurs, by the way --
13 then that they ought to deal with that problem themselves?
14 First, I'm not sure the problem is there,
15 because the studies that have been presented are not persuasive
16 at all. They do not show cascading. They show abnormalities.
17 Q Well, let me ask you this: Referring to the
18 Barthold study, you say they do not show cascading.
19 A No.
20 Q They do show the loss of two lines followed
21 by overloading and loss of another line, do they not?
22 A Yes. And this is sort of what I got at. I
23 mean, it's pulling those legs again.
24 I mean, how often is this going to happen?
25 But they show this, and even at that, if you look at the

[TR. P. 2138]

Conemaugh - Connostone line loading, if you look at the lines going into Juniata, there's no overloading. There is no cascading there. There is a big angle between them. But you really don't have to have all this. It's a negative thing. It's proving why you can't do something.

Maybe you can, but you got to prove that you are trying more than I've seen so far.

That circuit loading doesn't have to be 3300 amperes.

Q My question was really a hypothetical question.

A It sure was.

[TR. P. 2139]

Q Well, I asked you to assume that none of these equipment changes that you suggested would solve the problem, and after all of those studies of those changes have been made, you would still have a cascading situation. Then your only choices are either two lines or separate the one that is proposed; is that not true?

A I don't think so. What I would do, I would be negotiating with neighbors to see what they can do on their system.

[TR. PP. 2141-2152]

Q Please answer my question. The question is, studies show uncontrolled system collapse. Now, under those circumstances, if the studies show uncontrolled system collapse, is there anything in the SERC criteria that says you don't have to worry about it if it's not very probable?

A No.

Q No. The SERC criteria requires, or at least to the extent they have been accepted by agreement by all the members, require that you test for a sudden loss of all transmission lines on a single right of way.

A Right.

Q And if cascading is shown by those tests, then you've got to do something to solve that problem, don't you?

CONTINUED

A Yes. But it's not building more transmission lines. It can be load shedding, and it is.

Q Dropping Northern Virginia?

A Parts of it, yes.

Q But it is true that if it were to be done by transmission lines, you could do it by separation, so this criterion would no longer apply?

A Mr. Brasfield, you couldn't cover every square foot in Virginia with transmission lines and still have a hundred percent reliable system. The time would come when it would --

Q I've let you answer the questions. Please let me finish the questions.

A Okay.

Q If you were to solve this problem with east - west transmission, or west - east transmission I guess it is, one way of doing it would be to separate and eliminate the parallel, and another would be to build an entirely separate west to east line, and you would have two facilities there instead of just one? Isn't that correct?

A That's one way.

Q All right. Do you know if this criterion that we have been talking about is adopted by all reliability councils?

A Substantially so. They are not identical in

their provisions, but they are very similar.

I don't know of any that deviate considerably.

Q Now, you talked, I believe, about the size of the transfer from ECAR to MAAC that has been shown in the studies that have been produced.

Now, on Page 21 of your testimony, Lines 10 to 14, you state that in running the tests that have to be run, you would have to consider the most severe condition for the loss of these two lines.

A Sure.

Q And you said that would be during peak hours and coinciding with a heavy schedule from ECAR to MAAC.

A I said it may be, and that is correct.

You see, the flows from west to east would join in with the generation at Mt. Storm to some degree.

It depends on where the quantity available from the west is coming in, and that would be the most severe, and that is what you would study.

Q Well, hasn't VEPCO done what you said it has to do, study that condition?

A Sure. You have to study all conditions to determine the meaningfulness of different parts.

Q And if the company had failed to study the most severe condition, it would not have been doing its job?

A Correct.

Q Right. Now, are you challenging the size of the transfer as being unreasonable for 1980?

A No. I think what I'm doing is saying that of all of the 40 or 50 possible base case patterns, there is one here that is seized upon as being the one to submit, and to say that if we have this much transferred from ECAP to MAAC, and if both of these lines trip out, and if all three units are running at Mt. Storm, and if the spinning reserve is located most unfavorably, and if it occurs on the summer peak, and if this, and if this, and if the underlying subtransmission trips out, then there is a little piece of the Allegheny system that is overloaded, and so therefore VEPCO must do something about this.

Q Well, let me ask you this.

A It's a most severe condition, and you postulate everything in there.

Q These studies that have been done by the environmental councils getting together, and the location of the reserve, is based on the information of the companies as to where it's going to be, is it not?

A It is based on the information that the companies give. You see, each company supplies what they call a generating schedule. Each company has to provide a generating schedule to supply its load and its reserve and its other commitments.

Q We're not free to assume that ECAR is going to have -- I mean, MAAC is going to have more spinning reserve or not spinning reserve than it says it's going to have in these questions, are we?

A Well, I don't know what is assumed by MAAC, and I don't believe anybody else does.

Q Well, I believe you said in running down your list of assumptions that the location of the spinning reserves selected was the most unfavorable one?

A I didn't say that. I said that it seems to me that with these lines trading out, it is assumed that the quantities there carried has to still come from the west over other routes, which is a way of saying that there is little, if any, spinning reserve in the east to make this up.

Q But we have to take the generating facilities as they are projected by the individual companies, do we not?

A This is right.

Q Now, similarly, from the transfer from ECAR to MAAC, don't we have to take what MAAC projects as its need for imports during 1980?

A That is right.

Q And that is what was done in this case, was it not?

A Yes.

Q Well, we've established that VEPCO should have

studied the most severe conditions, and I think we have now established that we have here a condition based on information furnished by all of these participating companies that is entirely credible and probable in 1980.

Now, why shouldn't VEPCO design its system on the basis of those studies?

A What is wrong with the studies that are shown here, that Barthold submitted.

You are saying it has to be corrected by an added transmission line.

I'm saying this is not necessarily so, and if it is, why don't you put it -- you have this new plant at Davis and you have almost 2000 megawatts that are going north from Mt. Storm up to Black Oak, and then down into Doubs.

If that is the problem, maybe you ought to build another circuit from Black Oak to Doubs.

I don't know. I said in the beginning here that I'm not attempting to recommend a solution here at all, but I am saying that there is nothing persuasive that this is not acceptable.

Q Well, you have said on Page 21 that the companies must test for the most severe conditions.

A Sure. Yes.

Q And then after they set up that most severe condition, which you agree, I think, that the tests that you have

seen, including the Barthold test, do not go beyond that most severe condition.

A And they should avoid cascading resulting from that occurrence.

Q Okay.

A Now, if cascading would result -- that isn't established, but if it would, then its solution, its remedy -- there are several alternatives, and the only one that showed in anything that I've seen has been to rebuild a whole loop for 55 million dollars.

Q We've talked about separation, have we not, here of the existing line?

A Well, that got into probability again.

When you say separate, that doesn't mean they both won't trip out. It just means there is less likelihood.

Q Okay. So we must test for the most severe condition?

A Right.

Q We have tests that don't go beyond the most severe condition.

Now, you say they don't show cascading. Mr. Barthold says they do show cascading. But forgetting the ultimate resolution of that, if they do show cascading, then the SERC criteria necessarily require that you not build those lines together without providing some remedy for the situation

that these studies show; isn't that correct?

A Right.

Q And that requirement exists without regard to the precise probability of both lines being taken out, does it not?

A Right. But the key there is cascading.

Q Double circuit outages do happen on occasion, don't they?

A Are you talking about two on the same right of way, or double circuit?

Q Yes, sir. Two on the same right of way.

A Yes.

Q If you did parallel, and the conclusion were reached that you had to do something to avoid cascading, one way of doing that would be to parallel the entire loop, would it not?

A Yes. I guess that's one way you can do it. It would be like building another road from here to Washington by way of Charleston, I guess.

Q Another way of doing it would be to build a line along the proposed Mt. Storm to Morrisville route, wouldn't it? That would achieve the required back-up, would it not?

A It sure would, if that is the most favorable alternative.

Q Now, Mr. Chambers, on these studies that are

referred to, when you start off with a base case, you put into that for, say, 1980, the projections of the various participating companies in what they will have in service at the time of the peak in 1980; is that right?

A Yes.

Q And, so, the base case really assumes almost an ideal situation, does it not?

A Yes. Everything is normal for the condition that you have said, which I believe here was being considered the summer peak.

Q And then you start with that base case, and you've got everything working, and everything new has come into service by that time, and you then start figuring the contingencies that could happen to see if the system -- to see what the problems on the system are?

A Well, generally you run a whole series of base cases, you know. Summer peak, winter peak, off peak, and seasonal peak.

And with that you then trip out certain elements of the system for maintenance, certain generating units, and you run a base case for flows.

This is a base case right here, this back-up stuff that Lionel had. That is just one.

Q That was furnished you by Mr. Barthold; is that correct?

A Right. It was furnished to Mr. Kay, I suppose.

And then you get variations from this. After you've gotten all the family of base cases, then you start the contingency things that you talk about, and you trip things out. You pull those bug legs off, really, one by one to see what comes.

Q You take out this line, this substation or this station, or all of these lines on this one right of way, do you not?

A Right. Yes, you do.

Q So for the particular contingency that you are postulating, the base case may really not be a true picture because at the time that thing happens, if it happens, you may very well have another line out of service or a station out of service or something of that kind?

A Right.

Q So, conditions might be worse than they are, but because you have to draw the line somewhere, these guidelines, these contingencies have been developed by the reliability council, and this is what you test for; is that correct?

A Right. Some of the things are even helpful. You can have units off at Mt. Storm. There's some probability of all three units being off at Mt. Storm.

Q And there is some probability of everything being off at Possum Point, too, I suppose, is there not?

A Yes. They could coincide.

Q So you can't consider every combination of contingencies?

A No. You do those that are reasonable.

Q So you start with the perfect system and you postulate those particular ones?

A Yeah. A, B, C and D here are the reasonable ones, and if you will turn the page over to somewhere, you'll see where there is a substantial scope of things that are considered that would be even beyond things that we are talking about.

It says sudden loss of all generating capacity at any plant, sudden loss of all transmission lines at any station, sudden loss of a common right of way, major load center.

The likelihood of a substation loss is substantial. You have to assume all these things, and then somewhere you put a probability on it.

Q Well, let me ask you this: If you're looking forward to 1980, and you are imposing contingencies on a base case that has everything in service and in operation, to the extent there are delays getting those in service, conditions will actually be worse than the study shows?

A Yes, they will.

Q Now, from your experience and knowledge of the

[TR. P. 2152]

industry, would you say that most new generating units and transmission lines have been placed in service on schedule within the last several years?

A Well, generating facilities have been pretty notorious for being delayed, and transmission lines not nearly so much so.

Q But these studies are based on both generation and transmission being in service when scheduled, are they not?

A Yes, they are.

Q Do you know of anything that is going to change this trend in the next several years?

A No. I really think that the environmental questions may be tempered somewhat by the present fuel crisis.

I think that as a national we overreact, we always have. But I don't see any substantial improvement in schedule.

I think generating planning now is of the order of eight to ten years in the future.

Q So any studies that were run for 1980 probably show really a rosier picture than is actually likely to be the case because of the scheduling problem?

A Yes. The same thing could happen to the load. The load could not reach its projection.

[TR. PP. 2157-2165]

Q On Page 20, Line 25, you state the simultaneous outage of two 500 KV circuits, et cetera, could be judged in the

category of credible but of a low probability of occurrence.

Now, that language, "credible but of a low probability of occurrence," appears in the SERC criteria, does it not?

A Well, I think so. I was involved in writing the criteria.

Q Look on Page 1 of Exhibit Kay 2.

CHAIRMAN BRADSHAW: You say you were the author of the criteria?

THE WITNESS: No, sir. Nobody really was. It's a camel that was a horse designed by a committee, and that's what this criteria is. There was a lot of input to it, give and take.

BY MR. BRASFIELD:

Q Look at the second sentence under the heading "Local Area Criteria" there and see if that isn't essentially the sentence that appears at the top of Page 21 on your testimony.

A It probably is. I didn't mean to copy it, if I did.

Q Well, I'm not criticizing any failure to give credit to SERC. I do want to ask this: You seem at that point to be saying that the loss of all lines on this particular right of way is within this type of contingency. It is a severe contingency which is credible, but of a low probability

of occurrence, and then it goes on to say they are considered acceptable.

Is that what you are saying?

A Yes.

Q Well, now, isn't it true that that description in the SERC criteria appears under the heading, "Local Area Criteria," and under the separate heading of SERC Regional Criteria, beginning at the bottom of that page, and you get this contingency, the loss of all lines on a common right of way.

A Yes.

Q So, doesn't that suggest that the loss of all lines on a common right of way is to be treated differently from the local area of criteria being discussed here?

A Well, we are having still problems with this word "cascading." Cascading is an uncontrolled system collapse.

Now, that is something that is to be avoided, no matter what happens.

Q Well, forgetting the outcome, I'm just talking now about the probability of a multiple circuit outage, and you, using language from the SERC criteria, have indicated that it is acceptable, or may be acceptable, and I'm asking you if the criteria, the SERC document does not spell out that it is only the local area severe contingencies that are acceptable, and the regional contingencies -- to determine the regional effect

[TR. P. 2160]

you must test for the loss of all of them.

A Sure, and you must be assured that cascading doesn't result.

* * *

BY MR. BRASFIELD:

Q This morning, in your supplemental testimony, I believe you tended to distribute the studies that had been introduced during Mr. Stallings' cross-examination, because they showed the two lines that were taken out were not lines on the same right of way.

A Yes.

Q In both cases one of them was the Mt. Storm to Morrisville line.

A Yes.

Q And you said that that produced a different what?

A I just said the system would not respond

identically with tripping those two lines as with tripping two lines from Mt. Storm to Doubs or one of them being extended on to Loudoun.

Q Well, without regard to how it responded, would not the ultimate result in both cases be the same?

A No. I don't think so.

This gets back to the spinning enertia of the system, and the governor responses, and a lot of other things. I don't think that it would, because in one case the line goes down to Morrisville with six or seven hundred megawatts, and it joins, and then it comes from North Anna and then it goes from there up to Loudoun and the other way, with the Loudoun - Doubs line carrying a little, and I don't think the response would be --

Q Well, let me ask you this: Whichever way it is done, after the outage takes place, do you not have in both instances the same generation, the same load and the same remaining facilities?

A Yes. But you have an initial reaction that I'm not sure would be exactly the same for stability purposes.

Q But aside from that, the ultimate result you would get ought to be the same, oughten it?

A Well, stability, if you lose stability some-place you've lost something.

In other words, one of the measures of

stability is the generating plant that has certain transmission connections with a certain impedance, and this event happens, and then it's left with a different impedance, and it may swing out and it may not, and the impedances are different in this case.

Q If you can divorce stability from your consideration for a moment, and just consider the loading of the facilities, the transmission facilities, would not the ultimate result be the same?

A I think it would be reasonably close, anyway.

Q Now, referring to Mr. Barthold's testimony, you were critical of the first page of his Exhibit LOB1 as being not representative of what we've got here.

You don't really think Mr. Barthold put this in as a representation of the facilities we've got here. It was to illustrate the principle, wasn't it, Mr. Chambers?

A Yeah, to illustrate the principle. It could have been said, of course, that this simplified an idealized version, or whatever, but it was to illustrate.

But in real life, in this case it would have been considerably different because these things all have different impedances, and that could have been explained, but I withdraw.

Q Were you here when he testified, when Mr. Barthold testified?

A No, I was not.

Q So you don't know whether he explained it that way or not, do you?

A No.

Q Turning to Case A and Case B and Case C. Just looking at those three together -- well, strike that, and let's just look at Case B and Case C together.

They are representations of the principle alternatives that we have been talking about here, are they not? Case B being the Mt. Storm to Morrisville line and Case A being the northern parallel -- I mean Case C being the northern parallel?

A Yes.

Q So you don't have the same trouble with Mr. Barthold's configuration of the study that you had with Mr. Stallings? He has taken out the parallel lines, has he not?

A No. Mr. Barthold has not shown two lines in parallel as shown in Case C with the two circuits being in service, and the amounts of load that they are carrying.

He hasn't shown that.

Q You mean he hasn't shown a base case with the --

A Base Case A is not the same as Base Case C, with those X's in it.

As a matter of fact, one of the illusive things

about this is none of the cases will precisely agree. Some of them show the new line from the Davis plant direct to Black Oak and not to Mt. Storm.

This Case A of Mr. Barthold's shows power going from Doubs to Loudoun, 115 megawatts. Others show a little bit in the other direction.

But the main thing, I think, is that there is not a base case shown in C showing the flows associated with it.

Q Well, since the objective of this study is to determine what happens when you have an outage of the two lines, it's really not necessary to have a base case without the two lines out, a drawing of the base case, is it?

A There is neither a drawing nor a print out. This print out stuff that back this up is the same as is shown here, and for a base case you really ought to have what it was and what it was doing, and then you trip or you do something.

I won't argue that these things are not reasonably representative. I think it does illustrate that nowhere has a base case, a sincere consideration been given to this thing.

There has been no study of it that we've seen, anyway.

This Case C, I said in the beginning, I criticized it because it is real fragmented. It is consistent with Mr. Stallings' earlier case, which showed an overload between

Black Oak and Bennington.

Q You say it's fragmented. This is a simplified representation of a more complicated study, is it not?

A Well, when you put a simplified version down, a summary brief, whatever you call it, it ought to be complete enough to show just what is shown here.

For example, the numbers are not at all complete, and I've put in the numbers from this plotting, and I've been able to see some possibilities of dealing with this thing.

Q But the underlying study does have a number of facilities of both lines and substations and that sort of thing that are not shown on this particular drawing?

A Yes. I'm not for sure but what this underlying ought not to be introduced, because, for example, what is in here that I picked out of the underlying is the Conemaugh - Connostone line even under this severe condition, which is carrying only 1604 megawatts.

That doesn't show cascading at all. If you put in the Juniata lines, you will find that they are carrying reasonable amounts.

There can be abnormalities in here, but cascading, as we've discussed earlier, of the two lines lost on the same right of way, there is no cascading.

TESTIMONY OF ALLAN E. TURNER

[TR. PP. 2184-2185]

Q Would simply adding to one side of an existing 500 KV transmission line be less severe economically than the creation of a new transmission swath through the countryside?

A Unequivocably, yes. While the extent of damages would still be keyed to line of sight, it would be to an already damaged area. New damages would be limited to the effect of the additions' influence upon the land. It would be a very limited effect. Demand generally is greatest at the greater distance from the right-of-way. Utilization of land most proximate to the line is deferred into the far distant future, i.e., utilization for higher than timbering or dormant use. Interim uses are not significant to otherwise interim true use value. Further, uses not otherwise compatible with the area could be introduced by virtue of the right-of-way. Most significantly, trends favor unafflicted land. Land most proximate to pole line rights-of-way become dormant as regards higher use or higher rezoned use. As a general rule of thumb, any estimate of a right-of-way acquired for a 500 KV line should take into consideration the total value of the proposed right-of-way, then double it for damages, and then add special effect damages on a property by property basis.

It is obvious that less land would be required for a line placed in or parallel to an existing transmission corridor; further, the effects of an existing corridor would have already been imbedded in the thinking of the market, and damages would have already measurably occurred. Thus, costs of the right-of-way for these reasons should be substantially less.

Q How does a transmission line affect a rural developing area or neighborhood?

A A transmission line is like an unwelcome neighbor; one unwelcome for all time. Natural beauty and related value are compromised by the presence of a high pole right-of-way. Common sense will always correctly argue, "Don't do it to virgin land -- don't spoil so many, many miles of Virginia."

TESTIMONY OF R. PHILIP IRWIN

[TR. P. 2286]

Q So you say, then, that there are no existing corridors in Rappahannock County that could be utilized for the Mt. Storm - Morrisville line; is that correct?

A At the present time there are no transmission corridors in Rappahannock County.

Q And so for the power to get from Mt. Storm to Morrisville it would necessarily have to be rerouted out of Rappahannock County; is that correct?

A As we have contended many times, the use of existing transmission corridors for new facilities is the only way to go.

Q And the motivating factors in using the existing corridors is the fear that you people in Rappahannock County will be damaged in your property values; is that not correct?

A Unnecessarily, yes, sir.

[TR. PP. 2314-2315]

A It is our hope that the decision that the Commission will reach in this case will establish the precedent of using existing corridors to provide whatever transmission capacity is felt to be necessary by the utility.

[TR. P. 2334]

CHAIRMAN BRADSHAW: Can you visualize a situation where you would build a transmission line through virgin territory at any point in the state?

THE WITNESS: Yes, sir, there is. For instance, if there were to be constructed in the State of Virginia some significant load, some factory -- let's say we were going to enrich uranium in Virginia,

for instance; then there would have to be a transmission line built from a source of power, whether it is a generating station or whether it is a substation on an existing line, to the point of load. When a new facility is going to be constructed -- for instance, VEPCO has applied to the Federal Power Commission for the Bath County pump storage project. They will be generating 2100 megawatts of power.

That power has got to be connected to its grid by transmission lines.

Yes. New transmission lines will have to be built alone on their corridor, from time to time, but not when you have an existing loop already there.

TESTIMONY OF MICHAEL J. ILEO

[TR. P. 2377]

Q Dr. Ileo, what was the overall objective of the study?

A We were charged with the responsibility of analyzing the need for the proposed facilities, establishing alternative routes for the transmission lines and evaluating VEPCO's proposed routing. Our study focuses on just three of the five applications in issue in these proceedings: Application 33, a 500 KV transmission line from Morrisville to

Bristers; Application 35, a 500 KV transmission line from North Anna to Morrisville; and Application 36, a 500 KV transmission line from Mt. Storm to Morrisville. The results of the study, corresponding to each of these lines, are presented in three separate parts of mine and Mr. Strobl's testimony. The results of our study of the Morrisville-Bristers line are included in this part of the testimony.

Q Did you analyze the location of facilities other than the transmission lines?

A No, we did not. Our concern was limited to the routing of the proposed transmission lines and, therefore, accepted the origination and termination points as fixed.

[TR. P. 2385 - 2391]

Q In addition to the Commission's ratemaking and environmental obligations, doesn't it also have the responsibility of helping insure that the electrical needs of the community are met?

A Yes. Part of our assignment from the Commission was to analyze the need for the proposed transmission facilities. At this juncture, I think one can see very clearly the tripartite responsibility of the Commission. On the one hand, it must make an assessment of the need for new utility facilities.

On another, it must consider the environmental impact of proposed facilities. Yet on a third, the Commission must recognize the cost to the ratepayer of any project undertaken. It is because of this important 3-dimensional trade-off, that I do not believe it would be wise to impose binding constraints on the decision-making process.

Q What did you conclude from your analysis of the need for the proposed facilities?

A VEPCO witnesses, particularly Mr. Stallings, have indicated that the new facilities are primarily needed to adequately fulfill the growing electrical demands in the Northern Virginia area, particularly in the Company's Potomac District and generally in its Northern Division. My analysis leads me to concur in that conclusion.

Exhibit MII-1 shows some power supply statistics for VEPCO over the period 1968 to 1972. The Exhibit indicates that VEPCO has typically been a net purchaser of power at times of peak load over the period since internal excess capacity was negative in four of the five years. Total system peak load grew by 46.5 percent in comparison to a growth in internal capacity at peak load of only 27.9 percent.

Page 2 of Exhibit MII-1 presents VEPCO's gross capacity, after net purchases are added to internal capacity. The relationship between gross capacity and peak load are presented in the final column.

In Page 3 of the Exhibit the relationship between internal capacity at peak load and average load is depicted. The ratio indicates that VEPCO's reserve capability has decreased since 1968 despite the substantial increase in purchases of power.

In general, the data indicates that VEPCO has added generating capacity at a considerable rate over the last five years. However, it appears that demand continues to outstrip additional internal capacity so that an increasing level of net purchases has been necessary. In effect, internal generating capacity has dwindled relative to the growth in demand. This implies that VEPCO's internal reserve capability to meet unforeseen contingencies has continually fallen.

Q Dr. Ileo, what are the implications of VEPCO's increasing reliance on purchases of power?

A If a utility is able to continually meet growing demand within its service area by increasing its reliance on purchases of power relative to internal capability, an improvement in efficiency is realized. This follows since company owned resources are utilized more intensively and idle capacity is minimized. Consequently, ratepayers benefit since the rate based which would have been necessary to generate the required power is reduced as is the corresponding revenue requirements. In other words, required rates will tend to be lower as efficiency improves.

A utility, however, cannot indefinitely meet

growing demand by continually increasing its reliance on outside sources. If all utilities behaved in this manner, there obviously will be a shortage of power since each utility will seak to be a net purchaser. Increased reliance on purchases of power must be viewed, therefore, as a temporary source of improved efficiency and a temporary way of meeting power requirements. Eventually, additional internal capacity must be added. I believe this is the situation which presently confronts VEPCO.

Q Have you determined which part of VEPCO's service area is primary responsible for the growing demand for power?

A Demand in all parts of VEPCO's service area appears to be growing at a considerable pace as indicated in Exhibit MJI-2. Between 1968 and 1972, megawatt hours sold rose by 42.3 percent. Demand in VEPCO's Northern Division, which includes the Northern Virginia area, grew by 51.2 percent which is considerably more than total system growth. On a yearly basis, megawatt hours sold in the Northern District increased at an average rate of 11 percent. This is substantially higher than the average yearly rate of growth for VEPCO's total system or any of the remaining Divisions. Based on this data, it is reasonable to conclude that demand growth in Northern Virginia is the primary reason for the widening divergence between internal capacity and load requirements.

Q Dr. Ileo, how do the load characteristics of the Northern Division compare with other divisions?

A Exhibit MJI-3 presents data outlining the distribution of electric sales within customer classes by Division for the years 1962-1972. The customer class designated as "other" includes sales to public authorities and other electrics. Abbreviations for the service area Division are used in the Exhibit. For example, W.D. indicates the Western Division.

From the distribution data, we see that the load in the Northern Division is heavily oriented toward residential and commercial customers. This is not unexpected for the suburbs of Washington, D.C. However, it does point to the fact that power curtailments may have a greater impact on customers in the Northern Division than customers generally throughout the system. Moreover, because of the unusually small relative amount of industrial sales, the load is probably less predictable than in other Divisions since there are probably few large customers. In fact, of the 20 largest VEPCO customers listed in 1970, only one, Fort Belvoir, was in the Potomac District part of the Northern Division.

Q What does the absence of large customers imply?

A Large customers tend to have relatively large load factors which improves total system efficiency and, thereby, reduces production costs. Typically, the greater are the

number of large customers and the larger are these customers, the more efficient will be the utility. Since VEPCO's has a noticeable lack of large customers in the Northern Division, this implies that it is probably more expensive to provide power there than in areas which have many large customers.

Q Why do you say that a power curtailment may have a greater relative impact in Northern Division?

A Because of the relatively large number of residential sales and because of the absence of large customers in the Division. Large customers sometimes have alternative or reserve sources of supply and, therefore, may be able to cope with power interruptions more readily than residential customers. If the distribution of elderly, retired, and sick individuals is the same for all Divisions, then a power curtailment will tend to affect more of these people in the Northern Division than elsewhere.

Q The major portion of VEPCO's Northern Division is its Potomac Division. Have you analyzed load growth there also?

A Yes. Exhibit MJI-4 shows load growth and customers distribution for the Potomac District. The data present a similar picture to that described earlier for the entire Northern Division. The Potomac District accounted for over 91 percent of total sales in the Northern Division and grew by 50.5 percent in sales over the 1968-1972 period.

Exhibit MJI-5 depicts the contribution to VEPCO's total system peak load by load area. The Potomac District has continually been responsible for approximately one-quarter of the system's summer peak followed in ranking by the Norfolk-Portsmouth area and Richmond.

Q Is it your judgment that load demand will continue to grow rapidly in the Northern Virginia area?

A I don't think there is any question about it. I have reached this conclusion not only on the basis of the load data previously discussed, but equally on my continuing experience in analyzing the need for new financial institutions in the area. Generally, all data point to the fact that Northern Virginia should continue to grow at a rate not unlike that which occurred in the post decade.

Exhibit MJI-6 develops several comparative measures of economic growth in geographical areas which are comparable to VEPCO's Divisions for the 1960-1970 period. Four measures are considered: population, households, household median income, and bank deposits. A perusal of the Exhibit indicates that in many categories, the growth in the Northern Virginia area was unequaled. I feel reasonably confident in saying that the decade of the 1970's will present a similar picture.

[TR. P. 2425]

Q Have you considered the question that the corridor should not parallel an existing corridor because of reliability?

A Yes, we are. By instructing the computer not to pick cells which already contain transmission lines, we hope to secure an alternative corridor which avoids paralleling. This is discussed in the second part of my testimony.

[TR. PP. 2443-2444]

We found, one, that the Northern Virginia area, the load demand there is growing faster than in any other division. It is not the largest sector, but it is second largest.

The eastern sector takes up more total energy demand, but it is growing much faster than any other sectors, particularly around the Northern Virginia area or the Potomac District.

We found that the second factor was that VEPCO's internal capacity has been dwindling, and what I mean by internal capacity is its own generating ability. It has increasingly required to purchase power at an increasing rate.

We believe that the primary cause of this factor is the increasing load out of the Northern Virginia area.

The fourth thing that we found is that the Northern Virginia area has far more residential customers and far fewer industrial or heavy commercial customers. Hence, we drew the implication of two factors there: One, that it is probably more expensive to provide power to the Northern Virginia area because of the load characteristics, and, too, that in the event of an outage, the consequences would be more severe in the Northern Virginia area because of the heavy reliance on residential customers.

We drew that analogy by assuming that suppose the distribution of elderly, handicapped and sick people is the same throughout the state, and you have more residential customers in the Northern Virginia area than if you have an outage, because more of those people are going to be affected by an outage, so, we believe that the consequences in that area would be more severe.

Moreover, since there are very few large industrial customers, except, I believe, for Fort Belvoir, we drew the conclusion that the consequences would be more severe there, since industrial customers may have alternative sources of power where residential customers obviously do not.

So, essentially our conclusion was that the need for the facility is very definite and very keen, and we don't think there is any question about the fact that additional power is going to have to get into that area in the very near future particularly in view of the tremendous increase in demand there.

[TR. P. 2462]

MR. KAY: Am I correct that you have assumed at the outset Morrisville to be a fixed terminal point?

[TR. P. 2463]

MR. KAY: But I guess my question is, and I think this may be helpful at the beginning, you did not ask the computer the cheapest way to get from Mt. Storm to Loudoun?

THE WITNESS: No, we did not.

TESTIMONY OF KENNETH C. STROBL

[TR. PP. 2605-2606]

MR. MACAULAY: But it seems to me if you are going to mow a field, it is cheaper to mow one large field than two fields equal in size that are separated geographically?

I mean, if you have parallel lines, and you are going out to cut or put down pesticide or what-have-you, wouldn't the manhour and the vehicle cost and everything be less when the lands were parallel?

THE WITNESS: You mean because of the possibility of maintenance roads already existing, and things like that?

MR. MACAULAY: All sorts of things.

THE WITNESS: That is perhaps true, but we didn't take that into consideration right now.

MR. MACAULAY: A simple example would be a kid who is going to mow one small lawn and two small lawns equal in size. If he has to go from one side of town to another to mow the two separate lawns, it is going to take longer.

THE WITNESS: I don't quite understand that comparison. It would be cheaper to mow one big lawn than two smaller lawns equal in size?

MR. MACAULAY: If they are geographically separated it would be more expensive to maintain properties which are separated than it would be to maintain them in the same location?

THE WITNESS: I see what you mean. We did not taken into consideration that there is an existing corridor there and maintaining that corridor and the new contiguous corridor would in fact be cheaper.

I cannot say whether it would be cheaper.

TESTIMONY OF ROBERT H. GILES, JR.

[TR. PP. 2639-2640]

Another important factor relating to data is

the selection of variables and the question of how many factors should be included. A very large list is possible. It is at this point I must assert that in my professional judgement, the factors we have employed are, while being subject to the time constraints for developing information on a particular line, the best possible. The system is not complete; several other major factors will be incorporated in later developments. The factors selected generally have the following characteristics: (1) laws and practices for their preservation, (2) influence large number of people, (3) have well known ecological interactions, (4) have several large effects within large systems, (5) are subject to slight ecological system changes. The system we have developed is conceptually robust. We have selected factors, which if properly "accounted", will encompass or will have integrated within them many other ecological and environmental factors. The point I desire to make is that while the system we have developed may have some limitations, it is far more comprehensive and interactive than any used before to my knowledge. Just as importantly, it is in a form which can be updated and improved.

[TR. P. 2641]

Third, our system assumes the origin and destination of a particular transmission line as given and needed.

[TR. P. 2672]

If those routes are wrong, that is -- I beg your pardon -- if those points, or the origin and destination is wrong, then surely the answer will be wrong. But it seems to me that what we have developed

[TR. PP. 2695-2696]

What has happened is -- and it could not have been predicted -- it is almost unbelievable -- that is that the lowest cost lines for the Morrisville-Bristers do not touch any of the environmental cells. That is, there is no conflict between the lowest environmental cost -- I beg your pardon -- the least cost solution to the route and to any environmental impact questions that we are able to fit into the computer at the present time.

So, the line as now suggested by Dr. Ileo in his testimony this morning has no environmental problems that we can see at the present.

MR. BRASFIELD: Has the VEPCO line been evaluated in the same fashion?

THE WITNESS: Yes, it has.

MR. BRASFIELD: The same result?

THE WITNESS: With the same result. It does not, either.

TESTIMONY OF ERNEST M. JORDAN, JR.

[TR. PP. 2712-2713]

Q Please state your name and position with the Commission.

A My name is Ernest M. Jordan, Jr., and I am Director of the Division of Public Utilities.

Q Will you briefly summarize your qualifications and background?

A I hold a Degree of Bachelor of Science in Electrical Engineering from Duke University. I have been employed by this Commission for fifteen years. I am a Registered Professional Engineer and a senior member of the Institute of Electrical and Electronics Engineers and past chairman of the Richmond section of that organization.

Q What are the duties of the Division of Public Utilities?

A The Division of Public Utilities is primarily concerned with the rates and service of utilities. The tariffs of all utilities under the jurisdiction of the Commission are filed in the Division of Public Utilities. The Division is responsible for seeing that the rates, rules and regulations are properly applied. The Division is also responsible for monitoring the adequacy and reliability of the service rendered by utilities under the Commission's jurisdiction. Staff

members of the Division of Public Utilities make such inspections, tests and investigations as may be necessary to properly advise the Commission on matters pertaining to the service of utilities.

Q The question of reliability of electric utility systems has been discussed at some length in this proceeding. Has the Staff of this Commission concerned itself with this question?

A Yes. This Commission and its Staff have always been concerned about the adequacy and reliability of service offered by electric utilities. A considerable amount of attention has been paid to this subject since the northeast blackout of November 9, 1965.

[TR. PP. 2715-2723]

Q Since the Commission Staff has been quite active in questions of reliability, do you believe that in the routing of transmission lines the question of reliability is paramount?

A There are three basic criteria which I believe must be met in the selection of an appropriate route for a transmission line. First, it goes without saying that the line must be economically feasible; that is, the benefits to be derived must be greater than the cost of the proposed facility. Next, I believe that the line and its design must make minimum impact on the environment. Article XI of the State Constitution and Section 56-46.1 of the Code of Virginia clearly indicate the policy of the State concerning environ-

mental impact. The third criteria which must be met is that of technical adequacy. This would include the ability of the line to supply the load and the reliability of the line.

These three criteria are not necessarily incompatible. While it may be necessary to make a cost-benefits weighting in some cases, I do not believe that any one of the criteria is paramount. Consideration of any proposed route could certainly be eliminated by failure to meet any one of the criteria.

Q You stated that the State Constitution and Section 56-46.1 of the Code of Virginia set forth a State

CONTINUED

policy on the environmental impact of transmission lines. Is there such a State policy concerning reliability of electric systems?

A Yes. It is set forth in Section 56-509 of the Code of Virginia. This section of the Code declares the continued, uninterrupted and proper functioning and operation of electric utilities to be essential to the welfare, health and safety of the people of Virginia. It further indicates that it is contrary to the public policy of the State to permit any substantial impairment or suspension of the operation of any utility and it is the duty of the government of the State to exercise all available means and every power at its command to prevent such interruption.

Q Are you familiar with Guideline No. 3 of the Southeastern Electric Reliability Council which indicates that the SERC member companies should plan their transmission systems to avoid cascading upon the sudden loss of all lines on a common right-of-way?

A Yes. I am familiar with this criteria.

Q Do you know when this criteria was adopted?

A Yes. It was approved at the SERC Executive Board Meeting on October 4, 1972.

Q Was that after the applications in this proceeding were filed?

A Yes.

Q Do you attach any significance to the fact that the applicants in this case indicate that this SERC criteria prevents the paralleling of the existing Mt. Storm-Doubs line on the same right-of-way when this criteria was not adopted until after the application was made in this proceeding?

A No. I do not attach any significance whatsoever to that fact. The SERC criteria merely formalized what has been good engineering practice for many years. On July 19, 1967 the Federal Power Commission presented a report to the President of the United States on the northeast power failure of November 9, 1965 and its recommendations for improving power system reliability in the United States. On page 45 of this report, the FPC states:

"Analyzing the stability of large networks under possible abnormal conditions is an essential part of transmission system planning....

"The report of the Commission's Advisory Committee on Reliability of Electric Bulk Power Supply recommends the following abnormal conditions as criteria for examining the stability of networks:

"The outage of all transmission circuits on any one common right-of-way....,"

This is the first written reference I have been able to locate setting forth this criteria, however, the

concept was not new in 1967.

Q What is cascading?

A Cascading is the uncontrolled successive loss or outage of electric utility facilities triggered by a single incident.

Q What is islanding?

A Islanding is the isolation of a generating unit or station and some or all of the load it serves without electrical connection to other areas. For example, if all the transmission lines into the Richmond area were out of service and the Chesterfield Power Station was able to supply the Richmond area load, this area would be an island with electric service while the surrounding areas would be without service.

Q Is cascading a more serious condition than islanding or loss of load?

A Yes. Good system planning demands that cascading be avoided under all foreseeable contingencies. It is not reasonably possible to design an electric system which will be infallible, but, the probability of interruption can be greatly minimized by following sound practices in planning and operating power systems.

Q I take it then, that you believe the SERC guideline is prudent and not overly restrictive or conservative.

A That is correct. SERC was one of the last reliability councils to adopt such a guideline. All councils

now have similar guidelines. I believe that system planning to avoid cascading upon the sudden loss of all lines on a common right-of-way is completely reasonable.

Q Since the probability of the simultaneous loss of both lines on a common right-of-way is extremely low, do you believe that putting two lines on the same right-of-way would be a reasonable calculated risk?

A Not if the loss of both lines would result in a cascading outage under any anticipated operating conditions. This is a risk that I don't believe any prudent engineer would take, no matter what the odds.

Q Do you believe that existing rights-of-way should be used to the extent possible when new transmission lines are built?

A Yes. I believe in the use of rights-of-way for multiple circuits whenever it is possible to do so without jeopardizing the regional power supply reliability.

Q Does VEPCO use transmission rights-of-way for multiple circuits?

A Yes. I have reviewed the Certificates of Convenience and Necessity which are on file in my office and in addition have observed multi-circuit use of rights-of-way in the field.

Q Would you please give some examples of these?

A In Chesterfield County, VEPCO has a Certificate

of Convenience and Necessity for two lines of structures holding three circuits from the Chesterfield Power Station to Petersburg. Between Williamsburg and Newport News, there are three circuits on a common right-of-way parallel to I-64 for several miles. In Fairfax County, there are many examples of transmission corridors. Several of these have as many as four circuits on one right-of-way. In Henrico County, there are four lines crossing Interstate 64 at the Laburnum Avenue interchange east of Richmond.

Q Were you concerned about the possibility of locating the Mt. Storm-Morrisville line on the same right-of-way as existing lines out of Mt. Storm prior to the hearings in this proceeding?

A Yes. I have been concerned about this since I first heard these suggestions.

Q When did you first hear such suggestions?

A When I attended a meeting of the Fauquier County Planning Commission on October 28, 1970.

Q Did you express your concern at that time?

A No. I attended that meeting as an observer at Judge Hooker's request.

Q Have you previously expressed concern about the desirability of locating the Mt. Storm-Morrisville lines on the right-of-way adjacent to the existing lines from Mt. Storm?

A Yes. On February 17, 1972 I wrote a letter to Senator William L. Scott who was, at that time, a member of Congress. In this letter I stated:

"I cannot agree with RLEP's suggestion that additional 500 KV lines be put on the same right-of-way with existing 500 KV lines. This would make a great deal of VEPCO's capacity vulnerable to a disaster such as a tornado, airplane crash or sabotage. Such a disaster could not only knock out electric power to Virginia, but to neighboring states as well."

On November 10, 1972 I met with Mr. Lee Bean in my office, and at that time I indicated to him that I had some concern about the possibility of cascading power failure.

Q Why did the Staff accept the Morrisville Substation site as proposed by VEPCO instead of studying some other sites?

A First, let me say that we were aware that the Morrisville site was not fully acceptable to all parties. In trying to make a decision as to whether other sites should be studied, there are several things which must be taken into consideration, not the least of which is time and money. Studying other sites solely because there are known objectors to the proposed site brings up the question of what other sites to study and what action should be taken if someone objects to the alternate site. I would like to point out that there are at least seven State agencies concerned with matters

pertaining to the environment, and to my knowledge, none of these agencies has objected to the Morrisville site.

In January, 1970 the Federal Power Commission established a special task force on the environment to assist in the preparation of the National Power Survey of 1970. The report of this task force, entitled Managing the Power Supply and the Environment contains the following language (p. 14-15) which expresses the Staff's position on the location of transmission lines and associated facilities:

"The visual impact of large structures where the local populace does not want them is a matter in each case demanding individual resolution: there is little possibility of creating fixed standards that will be universally applicable .... As a result, it is sometimes difficult to decide whether there is in fact an unanticipated serious environmental problem whether to fault the utility for bad judgment, or to accuse the neighbors of unabashed self-interest: it could be any of these, or some of each.

"Power lines, long the center of some of our most celebrated conflicts, are unpopular everywhere, and particularly with those who must look at them, or make way for them in their own neighborhoods. There is always the conviction that they should 'go somewhere else' but the unfortunate fact is that transmission lines are as vital to the supplying of society with power as energy generation. Lines can be shifted

[TR. P. 2723]

from one location to another, sometimes at additional cost, but in principle locations should be determined by the broad public interest rather than by which route is cheapest, or which party can garner enough force to shift the burden to his neighbors." (emphasis added)

[TR. PP. 2724-2725]

Q Does the present energy crisis have any significance on the facilities under consideration at this time?

A Yes. A substantial part of VEPCO's generation is by oil. Most of this oil is imported. While VEPCO has no immediate problem, the worldwide shortage of oil will likely pose some problem in the future. The North Anna-Bristers line is to bring energy from VEPCO's North Anna Nuclear Station into northern Virginia. The line from Mt. Storm is to bring power generated in the coal fields to the Washington Metropolitan Area. Expeditious approval of these facilities would enable VEPCO to bring additional power into the northern Virginia-Washington Metropolitan Area which is not dependent upon oil or rail transportation of coal. The existence of the proposed facilities could become a very important factor in alleviating the energy shortage in Virginia in future years.

Q Does this conclude your testimony?

A Yes.

[TR. PP. 2727-2728]

My testimony also points out that multiple circuit use of rights-of-way is very desirable, and that VEPCO does this in many instances, and I give several examples where VEPCO does presently have several circuits on the same right-of-way.

I have attempted to indicate that I have had concern about the possibility of putting this additional 500 KV line from Mt. Storm into Northern Virginia on the same right-of-way with the present Mt. Storm-Doubs line for quite some time, and since I first originally heard of the plans.

I believe that any two lines that have this much capacity which could result in a cascading outage, it should never be put on the same right-of-way, and I discuss reasons for the Staff acceptance of the Morrisville Substation site rather than studying other substation sites.

[TR. PP. 2739-2745]

BY MR. KAY:

Q Now, sir, as I understand your testimony, it is intended primarily to be a general statement of principle to which you think this Commission should adhere; is that basically correct?

A A general set of principles which I believe should be followed in line design.

Q Right.

A I point this out for the Commission's consideration.

Q But you yourself or your Staff has made no detailed study upon which to make a recommendation as to the routing of these particular lines, have you?

A The routing?

Q Right.

A Yes. The Staff has made this through the Technical Associates.

Q But your Staff, you personally, and the people working directly under you on your Staff, have made no such study?

A No. This was done for the Commission Staff by Technical Associates as consultants to the Staff.

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Q And you were not working on a day-to-day basis with these consultants, were you?

A Not on a day-to-day basis. However, they do come under my department, and it is in the budget of my department.

Q But the concepts that they have testified to were their concepts rather than yours?

A They speak for their own judgment and their own opinions, yes, sir.

Q So you yourself really make no recommendation to this Commission as to any specific routes for these lines?

A None.

Q And you have made no study yourself, nor has your Staff made a study, of the effect of constructing the new Mt. Storm line on or adjacent to the existing right-of-way from Mt. Storm to Doubs to Loudoun, have you?

A I don't think a study is necessary for this, Mr. Kay.

Q I asked you first whether you made the study?

A Whether we made the study on the effect?

Q Right.

A No.

Q Now you can elaborate if you want as to why a study isn't necessary.

A I don't feel that a study is necessary because

I think that the studies which have been produced as exhibits in this case indicate that cascading would be the effect of a common outage.

Q When did you see those studies for the first time?

A In this proceeding, after it was begun. I had no knowledge of the study prior to that, although I had publicly expressed my concern about putting this much of VEPCO's capacity on a single right-of-way. This is a very, very dangerous practice.

Q Well, we will get to that in a minute, because I do want to ask you a little bit more about that, too. But I think what I am basically trying to establish here is that you have set forth in your testimony certain accepted principles, the principles that you think are accepted?

A Accepted general principles which I wish to point out to the Commission, and I certainly concur in these principles.

Q And you concur in the criteria of the Southeastern Reliability Council, the reliability criteria guidelines?

A Right.

Q Based on your own studies, the studies made by you or your Staff, you are not in a position to testify, are you, that paralleling of that existing line would violate the Southeastern Reliability Council guidelines?

[TR P. 2742]

A No. We have not made such studies, as I indicated.

* * *

BY MR. KAY:

Q Now, sir, on page 8, Question 16, you say that you believe it is an unreasonable risk to put two lines on the same right-of-way if a loss could result in cascading

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under any anticipated operating conditions; is that right?

A That is right.

Q Well, isn't it true that there are always some operating conditions that could be anticipated that would result in cascading if two lines are put on the same right-of-way?

A No, sir. I wouldn't agree with that.

Q Well, you heard Mr. Chambers testify, did you not?

A Yes.

Q So, to use his example, if you pull enough legs off the bug, the bug isn't going to be able to walk. So, what I am suggesting to you is that you can always postulate conditions for even a single line that would result in cascading if it went out, if enough other things happened at the same time?

A No. The criteria is based on one single incident, and the one single incident is the simultaneous loss of both circuits on the same right-of-way. You don't postulate for a double contingency. This is a single contingency only.

Q That is not what your testimony says here, as I understand it, Mr. Jordan?

A Well, please let me clarify it if I misled you.

Q Question 16, and the answer to Question 16 might be a little broad, and that is what I wanted to explore.

A The design is for a single contingency, and the single contingency is a simultaneous loss of both circuits on a common right-of-way.

Q Sir?

A I said the design criteria for cascading is a single contingency, and that contingency being the simultaneous loss of both circuits on a single right-of-way.

Now, if you assume that that happens and a power plant is lost at the same time, yes, you could have cascading, you could postulate this sort of condition.

Q That is why I just thought perhaps your answer to Question 16 might be a little broad.

As I read that answer you did not limit it as you have just limited it.

A Well, I didn't postulate what else might happen, but I was only speaking of the simultaneous loss of two lines, if it would result in cascading under any -- what did I say?

Respective conditions. Under any anticipated operating conditions.

Q Well, I think we are clear, but I think this answer could be read to be broader than you have now limited it.

A I don't think that an anticipated operating condition would be a double contingency or a double catastrophe.

Q So there are situations in which systems can be

planned where the loss of two lines on the same right-of-way can be tolerated without resulting in cascading?

A Definitely. I think one example, in the VEPCO system -- of course, they have numerous multiple circuit corridors, but they are putting two 500 KV lines from North Anna to Ladysmith on the same right-of-way.

Q And there are lines all over the country that are high voltage lines that are parallel, are there not?

A Oh, yes.

Q And there are 765 KV lines which we have referred adnauseam to that carried more power than 500 KV lines on a single right-of-way?

A Yes.

Q Now, sir, on page 10, Question 23, you refer to your letter in February of 1972 to Senator Scott, in which you express concern about the paralleling of these lines?

A Yes.

Q In that letter, were you referring to a cascading situation?

A Yes.

Q And you said that such a disaster could not only knock out electric power to Virginia but to neighboring states as well? That was in that letter, I believe?

A Yes.

[TR. P. 2759]

BY MR. ROGERS:

Q In recommending against paralleling, Mr. Jordan, were you concerned with the probability of an outage occurring or the consequences of an outage, no matter how small the probability?

A The consequences. It is an outage. I started to say it is not. It is cascading that I am concerned about. The criteria, it is different from just as outage of a local area alone. The consequences are just too great to run the risk.

Q In other words, no matter how small the probability, you design against an outage in this situation?

A Yes.

Q And the purpose of your recommendation or your conclusion that you had no objection to the Morrisville site, you were not making a siting location; you were talking about the load centers and the path of distribution of transmission?

A Right. That is correct.

REBUTTAL TESTIMONY OF N. McKENZIE DOWNS

[TR. P. 2777]

Q Please state your name and residence.

A My name is N. McKenzie Downs and I reside in Fairfax, Virginia.

Q What is your profession?

A I have been a licensed real estate broker since 1948, and have been engaged in the listing, sale, management and appraisal of residential, commercial and industrial real estate from that date.

[TR. P. 2779]

Q Mr. Downs, what is your assignment in this case?

A I have been employed by Virginia Electric and Power Company to study the effect of extra high voltage electric power transmission lines on property values and to give rebuttal testimony based on that subject.

[TR. PP. 2798-2799]

Q What, in general, do you conclude from these studies?

A It is concluded that high voltage electric power transmission lines are compatible with single family residential or agricultural uses and that the orderly subdivision and development of land for residential purposes can and does take place adjacent to such easements. The effect of a particular easement on property will unquestionably vary with respect to its location and size but it would appear that adequate compensation is being obtained by landowners for such easements and that the market value of such properties which

are traversed by right-of-way restores very quickly to normal and the sales of such properties compares favorably to similar properties which are not traversed by such rights-of-way. The effect of electric transmission line easements is in many cases extremely difficult to measure because the effect in terms of market value is so slight. The real estate assessor's offices appears to recognize that there is no substantial adverse effect in the market created by the existence of the transmission lines and, therefore, assessments of land crossed by such lines appears to be very similar to assessments on similar land not crossed by such lines. I find absolutely no evidence that transmission lines have adversely affected the tax base of any political subdivision. In fact, it can be demonstrated that, on balance, 500 KV transmission lines tend to increase the tax base.

REBUTTAL TESTIMONY OF CARROLL WRIGHT

[TR. P. 28817]

Q Please state your name, residence and occupation.

A My name is Carroll Wright. I live in Charlottesville, Virginia, and I am a member of the firm of Wright & Nunnally, real estate consultants and appraisers.

[TR. PP. 282-286]

Q What is your assignment in this case?

A I have been employed by Virginia Electric and Power Company to make a study of the effect of its 500 KV Mt. Storm-Dooms-Elmont transmission line on land values, tax base and real estate development along the route of that line, and to give testimony based on that study in rebuttal to

Continued

testimony on behalf of landowners and intervenors to the effect that the proposed Mt. Storm-Morrisville transmission line will have a substantial adverse effect on land values in Frederick, Warren, Rappahannock and Fauquier Counties.

Q Have you made such a study?

A Yes.

Q What counties were involved in your study?

A I have considered the effect of the existing 500 KV Mt. Storm-Dooms-Elmont line in the counties of Rockingham, Augusta, Albemarle and Fluvanna. These are the counties most comparable to those involved in the proposed Mt. Storm-Morrisville routing. Rockingham and Augusta Counties, like Frederick and Warren Counties, run from the Allegheny Mountains to the Blue Ridge Mountains through the Shenandoah Valley, and the topography, scenery and land use in all of these counties are quite similar. Albemarle County, like Rappahannock County, runs from the crest of the Blue Ridge on the west well into the Piedmont, and Fluvanna, like lower Fauquier, is a further extension into the Piedmont. The topography, scenery and land use again are quite comparable in both instances, although it should be pointed out that Albemarle County is more highly developed with estate-type farms than is Rappahannock and generally has higher land values.

Q What did you do in making your study?

A I am very familiar with the existing 500 KV

transmission line and have been for a number of years, but I again examined it physically and observed the development that has taken place under it, adjacent to it and in close proximity to it. In addition I have examined sales of property in the area, discussed the effect of the line with property owners whose land is crossed by it, examined tax records of the counties and analyzed the history of tax assessments and land values since the line was built. I also made an examination in the field of the proposed route of Mt. Storm-Morrisville line.

Q What are your conclusions as a result of this study?

A I have concluded that the fears of landowners and citizens when the line was planned and being built that property values would suffer as a result of the line have not been realized. From my analysis of sales, I am convinced that properties involved have not suffered loss in the market due to the power line. Increase in value has been the general rule; in no case has deterioration in value over and above that compensated for at the time of taking been noted. Many of the affected properties have been purchased by discriminating people sensitive to factors considered detrimental to a property.

From my investigation of the power line through the four counties, I am convinced that after fair compensation for land taken was paid to property owners at the time of acquisition the values of the remainder of the parcels have not

diminished but have remained in line with other properties in the area. Properties crossed by the line, and in close proximity to the line, have sold without difficulty at increasing prices.

Similarly, my investigation shows that the construction of the transmission line has not had any adverse effect on the tax base within the counties along its route. Tax assessors have not generally changed their assessments as a result of the line. In a few instances some minor adjustments in tax assessments were made in response to requests from property owners, but in every case this differential in assessment was eliminated at the time of the next reassessment.

Q Are you intending to suggest that property owners have no objection to the presence of the Mt. Storm-Dooms-Elmont transmission line on their property?

A No. I believe that most of them would prefer not to have the line on their property. My testimony is, however, that I can find no evidence whatsoever that any property values have been adversely affected beyond the amount of compensation paid for the acquisition; that new homes and other structures are being built next to the right-of-way; that new purchasers buy with knowledge of the line and pay prices comparable to those paid for properties not crossed by the line; and that new people coming into the area accept the line and are not disturbed by it.

Q You stated earlier that Albemarle County is more

[TR. P. 2886]

highly developed than Rappahannock County. How does this affect your conclusions?

A The type of development to which I referred, that is large estate-type farms, is a direct result of the topographic and scenic features of the area; Albemarle County has great natural beauty and for that reason has attracted this type of development with the resulting increase in land values. It is my opinion that if a transmission line were to have an adverse effect on property values, that effect would be greater in a county like Albemarle with higher land values than in a county with similar scenic assets but with less estate-type development and lower land values. Since my study does not show any evidence of depreciation of land values in Albemarle, I believe that a similar transmission line would not cause depreciation of land values in Rappahannock County.

TESTIMONY OF LIONEL O. BARTHOLD

[TR. PP. 2988-3004]

Q Mr. Barthold, were you present at the State Corporation Commission hearings on November 5, at which time Mr. Fred Chambers testified?

A Yes, I was.

Q Do you agree with his interpretation of the first page of your Exhibit LOB-1?

A No. I believe that when this exhibit was introduced under cross-examination, I qualified it as merely illustrating a basic principle. Furthermore, the fact that two lines are shown supplemented by a third rather than a greater number was not by accident. The bulk of the energy being transported from west for supply to the Northern Virginia load area is now by those two existing lines, and the basic need at this point is for a third one. Therefore, I believe the figure aptly illustrates the problem.

Q Mr. Chambers has claimed that LOB-1 does not show a cascading condition. Do you agree with this?

A There is no question in my mind that the system option represented by my Case C will under conditions anticipated in 1980 lead to cascading under the outage conditions

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stipulated by SERC criteria. Furthermore, I believe that the data presented in LOB-1 adequately demonstrates this.

Case C of LOB-1, of course, simply illustrates the flow conditions with the loss of a two circuit right of way. As shown, the current on the Black Oak-Doubs circuit is already 45% over its emergency rating of 2460 amperes. The underlying 138kV is also overloaded and would undoubtedly trip out. In fact, the 138kV even now could be overloaded during certain contingencies and would be taken out intentionally to prevent risk of short circuits or damage to the line.

Case D shows the inevitable consequence of the double-circuit outage, either as a result of the 138kV trip-out, or as a result of the double-circuit 500 kV trip-out with the 138 kV system taken out of service to prevent its overload under normal conditions. Under these circumstances, the current on the Black Oak Doubs line is 3800 amperes, 64% above the 1/2 hr. current rating. The heat generated within the conductors under these conditions will be almost three times as great as the heat generated when the conductor is at its 1/2 hr. limit and represents a far greater percentage overload than the overload which caused the P-J-M 1967 black out which caused a loss of service to 13 million people for as long as 10 hours.

Case E shows that if it were somehow possible to drop 40% of the northern Virginia load quickly enough, the load on the limiting line could be cut down to 1/2 hr. rating. With

a 3800 ampere current in the Black Oak Doubs line, however, it is very questionable that sufficient load could be dropped soon enough to keep the line within its allowable current rating.

Case F of LOB-1 shows the result of the Black Oak Doubs line tripping. When this line comes out, the electrical angle between Mt. Storm and Doubs increases suddenly from 37 degrees to 74 degrees. If this were a shift of 5 to 10 degrees, one would be tempted to make a stability study to determine whether the system would break up dynamically. But when the removal of a line causes the phase angle to increase by 37 degrees, even a moderately experienced system planner would recognize that the system could not survive a dynamic shock of this magnitude. It should be obvious to Mr. Chambers that an outage would result.

Q Do you agree with Mr. Chambers' allegation that a number of unlikely circumstances have been compounded to illustrate the cascading conditions shown in your LOB-1?

A This statement, by Mr. Chambers, is quite puzzling. To begin with, the base case is in itself optimistic in that it assumes that all planned facilities will be in place. He has admitted the unlikeliness of this. Unfortunately, the only trend which seems to keep on schedule is the increase in electrical load.

Also, contrary to Mr. Chambers' inference, the

suppositions made for this case are not indepdent of one another. To begin with, the transfers are postulated at a time of summer peak load. That is, of course, when all systems are taxed to their capacity, when transfers are most likely, and, incidentally, when the thermal rating of conductors is minimum. Chambers also questioned the fact that spinning or fixed reserve are not brought into play. It should certainly be apparent that the defined import requirements of P-J-M are above and beyond their available reserves.

I have already indicated, too, that the 138 kV system underlying the Black Oak Beddington line may already be overloaded during some contingencies and would more likely than not be disconnected if an outage occurred. I do not, therefore, feel the circumstances postulated for this outage test to be the least unlikely.

Q In his cross-examination, Mr. Chambers stated that the studies you made of the northern parallel were done with the object of showing it would not work rather than trying to make it work. A similar inference was made during your own cross-examination by Mr. Kay. Was this indeed the intention of these studies?

A I think the testimony I have already presented has shown that this is not the case. Mr. Chambers' original testimony suggested that the alternative to the Mt. Storm-Morrisville line was simply a parallel line from Mr. Storm

to Doubs. I suppose the most effective rebuttal to this suggestion would be to confine studies to exactly that alternative. However, in the VEPCO studies of this alternative, the line from Mt. Storm to Doubs was studied together with another line from Doubs to Loudoun in order to make the alternative more viable. Furthermore, Mr. Chambers, referring to the VEPCO version of this route seems quite positive that the Mt. Storm-Doubs-Loudoun line would work better if tied to the bus at Doubs. In this matter, he seems to be arguing against his own point. VEPCO, in an attempt to make the case for the northern parallel as effective as possible, found that it would be better to take the line past Doubs without connecting it to the Doubs bus there. This lessens the 230 kV overload in the event of a two-circuit 500 kV outage between Doubs and Loudoun, and also reduces the vulnerability of the system to an outage of the substation at Doubs, a contingency which also must be considered in preventing cascading.

My basic point is that it was VEPCO, not Mr. Chambers, that introduced these two points, i. e. the need for a continuing line to Loudoun, and the advantage in by-passing the Doubs substation, in making the best possible case for the parallel route.

Q I believe Mr. Chambers was critical of the exhibit LOE-1 studies in that they represented no "base case" for the northern parallel; i. e., a case similar to Case C,

but with all lines in service. Did you perform such a case?

A Yes. This case was included in the detailed information supplied to Mr. Fay. It was identified as item 5 of the load flow data. We did not prepare a case map for it since it did not appear germane to the result of right of way loss.

Q In Mr. Chambers' pre-trial testimony and during his cross-examination, he implied there were many other recourses which might make parallel from Mt. Storm to Doubs satisfactory. Would you comment on this point.

A Yes, but in doing so, let me give Mr. Chambers the benefit of starting with what we feel to be the most optimistic parallel alternative; i. e., the one shown in my exhibit LOB-1, Case C.

Let me also comment generally on recourses which are considered or not considered in such studies. It is very difficult for experienced planners to reconstruct their decision processes in a form interpretable by even the most experienced of commissions.

Experience in a field such as power system planning causes one to set aside literally thousands of solutions based on past experience showing them not worthy of detailed study. Just looking at the VEPCO system, for example, I would estimate there are something in the order of 100,000 individual equipment items, the failure of any one of which would cause a

transmission outage. It would be absurd for a planner to try to study the effects of each of them. He would instead go to representative cases -- cases which tended to be moderately severe, and which represented a whole class of events.

Experience in the design and operation of large bulk power systems has also led experienced system designers to be very wary of unusual or extraneous equipment, or solutions which depend on equipment being called on to operate either automatically or manually, only when a special situation exists on the system. It is very easy to decide, in the comfort of a conference room or courtroom, that the answer to a problem is to perform a certain switching operation under some special contingency conditions. Such a decision was reached for the P-J-M system in the early 1960's. But 4 or 5 years later, system operators in a control center, not having been present at the conference, lost sight of the importance of what to them appeared as fairly arbitrary instruction. The result was the 1967 P-J-M black out. This sequence of events is documented in the Federal Power Commission report entitled "Power Interruption, Pennsylvania-Maryland-New Jersey Interconnection, June 5, 1967" - issued March, 1968.

Q Mr. Barthold, will you comment specifically on some of the options suggested by Mr. Chambers which he claims might make the northern parallel operate in conformance with SERC criteria without additional transmission capacity for

backup?

A Yes. Let me begin by discussing series capacitor compensation. A series capacitor is a device which can be connected in a line at one or more of its terminals to make the line appear shorter, as far as the flow of electricity is concerned, than its actual milage would indicate.

Q On what type of system are series capacitors usually used?

A They are usually applied on very long transmission lines, say, 200 miles or more, and in circumstances where the transfer of power is limited by dynamic stability -- as opposed to voltage drop and current carrying limits which apply in the VEPCO and APS case.

Q Have series capacitors worked satisfactorily?

A On some systems they have, on others they have not. The most recent application in the U.S., on the West Coast 500 kV interconnection extending from Washington state down to Los Angeles, have had a great deal of difficulty. Even before this trouble, many utilities simply regard the insertion of another series device in the system as being poor practice wherever it can be avoided. Hydro-Quebec, for example, in the planning of a system to transmit 16,000 MW of power from a hydro development at James Bay to Montreal, a distance of about 600 miles and under circumstances which might be considered a ideal application for series capacitors, ruled them out on the

basis that they were simply poor system design practice.

Q If they are usually used for solution of dynamic problems, and that is not VEPCO's problem, how could they be considered a recourse to make the northern parallel satisfactory?

A Series capacitors are sometimes also inserted in selected lines to cause a different division of power flow than would occur naturally. In other words, one might consider series capacitors in the southern loop through Dooms and Elmont in order to cause this loop to carry a greater portion of the current which flows from west to east.

Q Is there any reason one would not expect series capacitors to be effective in doing just that?

A There are two reasons. The first is fundamental to all of the alternatives suggested by Mr. Chambers and is based on the configuration of the system itself. With the two circuits lost, the bulk of the overload will fall on the Black Oak-Doubs line since it is electrically closest to the function displaced by the last line. Even if one were, by some device or other, to get the Black Oak Doubs line to pick up only one-half of the lost tie, diverting the balance on the other circuits, the Black Oak circuit would still be overloaded.

Q What is the other reason which discourages series compensation in this case?

A Compensation of individual circuits in a

system made up of multiple loops like this one, is fundamentally poor practice in my opinion. To begin with, you will certainly find an operating circumstances either on the presently planned system or in some future year where the distorted flow pattern will be the cause of an overload (this time on the Dooms Elmont circuit) rather than the correction of one. This might occur for other outage contingencies in the southern system, addition of other generating plants, maintenance outage conditions on the northern circuits, etc. Furthermore, any artificial distortion of the flow pattern will inherently increase the loss of energy in the transmission system. The importance of this is apparent nowadays.

Q Despite these objections, did you actually investigate whether series compensation in the southern loop could cause it to take load off the Black Oak Doubs line?

A Yes, we ran a case of that kind, which is shown in Exhibit LOB-6, Case J attached. In this case, we simply estimated roughly what level of compensation on the southern circuits would be required to cause it to go to its thermal limit of 3000 amperes. As you can see, we estimated a little high and wound up with a slight overload on the southern circuit. But, even with that, we failed to relieve the problem on the Black Oak-Doubs line. The current in this line is still 3100 amperes, a 25% overload referring to its 1/2 hr. rating. Incidentally, you will note that in this exhibit, I have

corrected the 500 kV system configuration between Loudoun and Ladysmith. It was incorrectly drawn in the diagrams for Cases A through I, though correctly represented in the solution. I have not reissued these earlier exhibits since flows in the affected areas were not germane to the argument.

Q Would the series capacitor equipment shown in your Case J be an unreasonable investment?

A The series capacitor installations shown in Case J represented about 910 MVAR, with an installed cost of approximately $9 million. However, as I have previously pointed out, I do not feel that the cost in itself is the most difficult problem. Compensation of this magnitude could, in itself, degrade system reliability. As I also explained, they would probably cause operating problems in other parts of the system which we did not take the time to examine.

Q I believe Mr. Chambers also mentioned the possibility of shunt capacitors being used to improve the voltage problem and the current level resultant in your case LOB-1, Case D. Do you have any comments on this possibility?

A Yes. I might first explain that "shunt" capacitors, applied between the conductors and ground, are a relatively inexpensive way to supply reactive power and increased voltage levels. In making the best case for this approach in the present study, however, we chose to consider synchronous condensers rather than capacitors. The synchronous

condenser is similar to shunt capacitors but may be controlled in magnitude and would avoid the risk of very high over-voltages during other system operating contingencies. In other words, it would have all of the advantages of the shunt capacitors, but in addition be controllable.

Q Did you have reason to believe that synchronous condensers would not solve the problem which shows up in Case D of LOB-1?

A Yes. It is apparent from the reactive power flow into the Black Oak-Doubs line from the Doubs station in Case D, that a synchronous condenser at the Doubs station would have to be very large indeed to have any effect at all. Item 8 of the load flow data supplied to Mr. Kay shows the reactive power input to this line to be 882 MVAR. Furthermore, most experienced planners realize that the addition of reactive power at the receiving end of a line like this will tend to improve voltage, but have only moderate leverage on power flow.

Q Did you actually run a simulation to confirm this judgment?

A Yes, we did. This is shown in LOB-6, Case K. In this case, we specified a synchronous condenser of any size required to keep the bus voltage at Doubs to 95% of its rated value. The case demonstrates that the synchronous condenser rating required to hold this level is 616 MVAR about the largest rating ever built. Such a unit would cost

about $12 million. Furthermore, Case K shows that the effect of the synchronous condenser is marginal. It merely drops the Black Oak-Doubs power flow to 2854 MW, which, in this case, corresponds to a current level of 3590 amperes, still a 46% overload referred to the emergency 1/2 hr. rating.

Q Mr. Chambers also suggested that one could make your Case D work if some of the Mt. Storm generators were switched on to the Dooms line when the two circuits tripped out. Would you explain this and comment on whether this would work or not?

A Yes. It is correct that one might devise a switching scheme which would isolate two of the Mt. Storm generators and connect them to the Dooms line, in the event that the two circuits to Doubs were lost simultaneously. There are several reasons why this scheme would be unacceptable, and would not in my judgment warrant serious study. To begin with, one would not expect that the isolation of Mt. Storm generators on the Dooms circuit would have sufficiently great effect on the flow on the Black Oak line, since the transfer of such generation would not have a major influence on those electrical characteristics of a system which cause power flow in the overloaded line. Secondly, I would recommend very stronly against a special switching scheme of this kind, just on the basis of its intricacy and consequent susceptibility to malfunction. Where schemes like this are applied, they are as

often the source of system disturbances as they are the prevention of them. Thirdly, the sudden isolation of two generators on a long 500 kV line of this type could cause dynamic shock which would result in the loss of the Dooms circuit and perhaps initiate the cascading sequence itself. Our studies indicated that there would probably be such a dynamic problem present.

Q Did you make confirming studies of this point subsequent to Mr. Chambers' cross-examination?

A Yes, we did -- again, simply to verify what we feel to be obvious to experienced planners. Case L shows a reproduction of our LOB-1 Case D, except with two Mt. Storm generators isolated on the circuit to Dooms. You will note that the Black Oak-Doubs flow is reduced only to 2533 MW despite the other hazards introduced by this scheme and still there are 3770 amperes on the line.

Q What about the idea of load shedding suggested by Mr. Chambers as a means of preventing cascading?

A I am somewhat confused by Mr. Chambers' suggestion of load shedding in this application. As presently applied, automatic load shedding occurs <u>after</u> a system has broken up to the point where the remaining "islands" may be left with deficiencies in generation. The generators on such a segment will begin to slow down, causing a drop in frequency. It is at this point that automatic load shedding comes into

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play, and, if properly designed, will automatically cut off enough load to balance things up so that within the region, selected areas remain operative and provide a basis by which the recovery can be started. In other words, it is regarded as a disaster plan to minimize the extent of the blackout and make for more rapid recovery of service.

Q But your Exhibit LOB-1, Case E shows, does it not, some corrective effect of dropping a large segment of northern Virginia, at least giving a chance to contain the cascading effect?

A As I mentioned, this load dropping would have to be done manually. That assumes the condition is recognized soon enough and action can be taken quickly enough. At the period of time represented by LOB-1 Case D, prior to system breakup, there is not yet any significant decay in frequency and, therefore, no basis for automatic load shedding equipment to operate.

Q Could not such equipment be made to operate on low voltage?

A To my knowledge, no system planner has seriously proposed that a scheme of that sort be used. It would, in most people's opinion, including mine, result in an intolerable reduction in the quality of electric service. This is because there is simply no way for automatic equipment to distinguish reliably between a voltage drop of several percent

which may result from a normal switching operation, (a very temporary problem), or a voltage drop of the same magnitude affecting only a small area, and the same voltage drop which could accompany the beginning of a cascading situation. In other words, voltage level is a completely insufficient measurement to diagnose whether loads should be shed or not. The only way such a scheme could possibly be useful in preventing a cascading situation would be to give it such a "hair trigger" that very frequent and completely unnecessary interruptions to service would be commonplace.

Q Have you any other comments on the application of special equipment to make the northern parallel a satisfactory solution?

A Apart from the individual assessments I have just made, I am of the general opinion that in a moderately highly developed region, such as VEPCO serves, there is simply no substitute for adequate transmission facilities. The application of novel schemes alluded to by Chambers is entirely appropriate in very long distance transmission, in systems serving extremely sparsely populated areas, and in other very unusual circumstances. They would, in my opinion, be very poor applications on the VEPCO systems, and could be regarded only as a temporary "fix" pending more fundamental solutions.

I should also point out that the cases run by our firm to illustrate the inadequacy of these "fixes" ignore what

[TR. P. 3004]

might be the greatest negative points. One learnes, often from sad experience, that when equipment is applied to satisfy a very specific system problem, that same equipment is present during completely different circumstances, and may conflict drastically with requirements not visualized in the initial study. In other words, our assessment of these options has ignored completely their compatibility with other system development. I would expect, for example, that the presence of series capacitors in the southern loop would have a major effect on contingencies not even considered in this study.

[TR. PP. 3021-3025]

Q Now, sir, do you agree with the definition of cascading as contained in the SERC reliability council guidelines which were introduced as Kay Exhibit 2?

COMMISSIONER SHANNON: Do you have that before you, Mr. Barthold?

THE WITNESS: If it is the --

COMMISSIONER SHANNON: Maybe your counsel can supply it.

BY MR. KAY:

Q Here is a copy of it. The definitions I am referring to are at the top of page 2.

MR. BRASFIELD: Why don't you read it into the record.

BY MR. KAY:

Q All right.

A Yes. "Cascading is defined as the uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in an uncontrolled

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widespread collapse of system power which collapse cannot be restrained from sequentially spreading beyond an area predetermined by appropriate studies."

Q All right, sir.

A I agree with it.

Q You agree with that?

A Yes.

Q All right. And your studies, I believe, show those that are to which you testified and those that are contained in LOB-1 and the cases attached to it, that the problem from any simultaneous outage of these parallel and adjacent lines would be manifested at the Black Oak-Bennington consegments of the Black Oak-Doubs circuit?

MR. BRASFIELD: Objection. This has nothing to do with rebuttal testimony.

COMMISSIONER SHANNON: Mr. Kay, do you want to --

MR. KAY: Yes, sir. Mr. Chambers says that the studies did not in his judgment show cascading. Mr. Barthold comes back on rebuttal and says in his judgment they do. Now, if this isn't proper cross-examination of the rebuttal, I just as well go home.

COMMISSIONER SHANNON: All right. Proceed. Objection overruled.

BY MR. KAY:

Q Would you answer the question, please, sir?

A I think the right answer is, yes, but I have forgotten the question.

COMMISSIONER SHANNON: Read the question back. I don't want the witness to guess at the question.

(The court reporter complied.)

BY MR. KAY:

Q All right.

A The answer is yes.

Q And that is the APS system in Pennsylvania?

A Yes.

Q And that is as far as your studies in LOB-1 go? That is as far as you took your studies was to that segment of that line?

A I don't think that is correct. I don't think that is a correct statement because as far as the values were specifically recorded, the sudden angle shift -- electrical angle shift that took place on that makes it virtually certain that other parallel lines would have to trip, so I think in at least in my judgment there is no doubt whatsoever that we have shown a separation of other circuits.

Q But the exhibits show only the wide electrical

angle at that point, do they not?

A That is right.

Q And that is as far as you felt that it was necessary to go to reach the conclusions to which you testified?

A That is right.

Q Now, sir, the criteria which you read into the record a minute ago refer to -- and I will read it again, "Cascading results in an uncontrolled widespread collapse of system power which collapse cannot be restrained from sequentially spreading beyond an area predetermined by appropriate studies."

Now, what area was here predetermined as being involved in your determination of whether cascading would result from this outage?

A The area, of course, the outer bounds to this area were not established by this study. They may have and probably would, in my judgment, extend up to the PGM, New York area. It is obvious that the problem would spread out of the VEPCO-APS area. It is obvious to me with an angle shift of that nature that the area, whichever area it is, would be greater than the service area involved with VEPCO and APS and I think from -- it is the intention of criteria like this that each company or operating group assure that trouble in their system does not spread outside of that boundary and that is what our studies demonstrated would

[TR. P. 3025]

happen.

Q All right, sir. So back to my question and if you would answer it. What area was predetermined as being the area involved in making the determination of whether cascading would result? So I take it that no area was predetermined?

MR. BRASFIELD: I think he has answered your question.

THE WITNESS: I thought I did. The greatest possible area for this in answer to your question --

BY MR. KAY:

Q Well, who made that predetermination?

A For my studies I did.

Q But as far as you went was Black Oak-Bennington?

A Of course, I could have carried this -- we could have carried this to have shown precisely the additional lines. It would have been a very substantial amount of work. I suppose that you then might then ask that we study system light bulbs and I would have --

[TR. PP. 3069-3071]

Q On page 12, lines 17 and 18, "PJM is not meeting its own responsibilities for generating enough for their load and reserves." What does that statement mean?

A I suppose it is fair to say they are unable in their view to be self-sustaining during 1980 in their opinion. Why that is and so forth, that is another question.

Q And to that extent they haven't met the obligation that sound planning imposes upon them, have they?

A They have been unable to, as has VEPCO in the last, I think, two summers because they themselves have had reserves down to close or near zero during both summers. Often the case systems depends on one another when they can't make the reserve level they should have.

Q So, then, I take it my answer is correct, that they are not meeting that responsibility that sound planning imposes upon them?

A I don't like the question because it implies that they have any control over their ability, they forecast their inability to meet it.

Q Well, unfortunately or fortunately, as the case may be, it is not up to you to decide whether you like my questions or not. You are supposed to try and answer them.

COMMISSIONER SHANNON: I don't think he was finding fault with your questions. I think he was having difficulty giving you an answer, as I understand it.

BY MR. KAY:

Q If PJM were to provide the reserves that sound planning imposes upon them, then would that reduce the necessity for this 5000 watt megawatt transfer?

A Yes, it would. If they were self-sustaining in their requirements.

Q And that in turn would reduce the chances of cascading?

A Yes, it would.

Q It seems to me that the substance of your testimony is that the VEPCO system could handle this simultaneous outage, but PJM could not, is that correct?

A No, that is not correct. The simultaneous outage would affect VEPCO, APS and all of the eastern seaboard system that would be the result of their cascading. They are all affected by the outage.

Q Because of the weakness in the PJM system?

A Because of the transfer. Yes, because of the --

Q And yet it appears that the responsibility for these PJM deficiencies are being imposed upon VEPCO.

A VEPCO is a party to the consequences just as several systems remote from VEPCO were consequences of VEPCO's inability to meet their reserve commitment for the last two years.

[TR. PP. 3076-3078]

BY MR. KAY:

Q You comment in your testimony on each of the suggestions made by Mr. Chambers and you conclude that each of them are without merit.

A That is correct.

Q Would you agree that Mr. Chambers is an experienced system planner?

A Yes. I think his activities primarily -- I don't think in the most recent years he has been active in that capacity.

Q How recent?

A I think the last four or five.

Q And you would agree, I take it, that he enjoys an excellent reputation in the industry?

A He does.

Q And he is a man of ability?

A Yes.

Q And yet you disagree with every single suggestion that he has made?

A That is correct.

Q And would you not agree that suggestions that he has made for these various corrective measures, the series capacitors and so forth are used all over the country?

A Not in applications of this type.

Q So you think he is absolutely wrong?

A I think he is absolutely wrong. I will modify my other response, if I may, in that as far as the fundamental or functions that are being cited, the needs that are being cited in this case, Mr. Chambers' testimony is correct and I think perceptive in agreeing with the needs that are being addressed here.

It is these specific recourses that I do not think are applicable in this type of system.

COMMISSIONER SHANNON: Did you know of Mr. Chambers before this hearing?

THE WITNESS: Yes, I have known him for many years.

BY MR. KAY:

Q But on the basis of the one test for each of these suggestions that you show as exhibits to your rebuttal testimony, you reject the usefulness of those suggestions?

A That is correct. Each of these has been an honest attempt on my part to -- you say one test. They have been an attempt on my part to create the most favorable circumstances for that recourse working, even though I would not have considered them good alternatives, fundamentally good alternatives.

Q But you have taken each of these separately and studied them, have you not, Mr. Barthold? You have not taken them in combination with those or perhaps other methods that are used by utilities?

A As a consultant I would just dismiss out of hand any combination of fixtures like this, much less taking one at a time to achieve transfer.

[TTR. PP. 3079-3082]

BY MR. KAY:

Q Mr. Barthold, I refer you to, I think it is Kay Exhibit Number 8 which is the backup material to the result of your pocket survey that you concluded as LOB-4. Do you have a copy of that exhibit in front of you?

A Yes.

MR. BRASFIELD: 8 is extra high voltage line.

MR. KAY: I don't think it is.

MR. BRASFIELD: I have your's as being Kay-9, but either way.

MR. KAY: Kay-9? All right.

BY MR. KAY:

Q You indicated, I think, that -- or at least your survey indicates, your exhibit indicated that you contacted twenty-two utilities and had responses from sixteen.

A Yes.

Q And yet only eight were included in your tabulation.

A Well, some had no double circuit experience.

Some had no outages.

Q All right, sir. If you would turn to the letter from Pennsylvania Electric.

A I have.

Q You have it in front of you?

A Yes.

Q It seems to me that that letter says that in response to your inquiry, "It has been our contention right along that the probabilities of simultaneous outages are almost nil and our experience confirms this." That is, they are saying they couldn't find any instance from '54 to '72 where two circuits sharing a common right-of-way were tripped out.

Then there is a response from Mr. Pliker (phonetic) of Texas Electric. It doesn't show on my exhibit, but it shows on your letter to him that he was from Texas Electric and he responds to your inquiry. He said, "We haven't had any. See attached note. Try Houston Lighting and Power." Is that correct?

A Yes.

Q Now, sir, I refer you to page 682 of the transcript and at that point Mr. Massie was cross-examining you as to this LOB-4 and he inquired, "Did anyone respond saying we have never had the problem, we don't feel it is a problem?" And you answered, "No." Is that correct?

A Absolutely what I said, yes.

[TR. P. 3081]

Q Can you explain that apparent inconsistency?

A As I recall that question, and I think Mister -- I did not have in front of me Mr. Lumnitzer's (phonetic) letter at the time and I recall that Mr. Lumnitzer at that time -- my recollection was that he had responded saying that they had events of this type, but did not consider them a problem.

You asked whether anyone had not had the problem and not had it happen and didn't feel it was a problem. So it was, perhaps, a technicality of my interpretation of your question.

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BY MR. KAY:

Q Well, isn't it more than a technicality, Mr. Barthold? Just plain wrong, your answer was?

A No. I guess when you interpret this as an and/or Penn Electric has had the problem, has had the event and doesn't feel that it is a problem. It says -- well, in that period of time, but then later on he says that the probability of simultaneous outages are almost nil. He doesn't

[TR. P. 3082]

say it never happened.

Q He said it never happened on his system?

A During that period of time.

Q You still stand by your answer to Mr. Massie?

A Having read this I would not give you a simple no.

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[TR. PP. 3085 - 3086]

CHAIRMAN BRADSHAW: Mr. Kay, just for the record, I thought my memory served me correctly. your witness, Mr. Chambers said on page 10 of his testimony that there was a need.

MR. KAY: Mr. Chambers did, yes, sir. We did not.

CHAIRMAN BRADSHAW: Wasn't he your man?

MR. KAY: He is our man, but we had other witnesses, too. As I said before, we did not concede the need, but we weren't making any big point out of it except in the context of the transfer.

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REBUTTAL TESTIMONY OF BRUCE HOWLETT

Q Mr. Howlett, since your direct testimony was filed with the Commission, it has been suggested that the 500 kV transmission facilities proposed by Vepco should not be built at the locations proposed by Vepco, but rather should be built along "existing corridors" presently used by Vepco's existing 500 kV facilities. Are you familiar with this suggestion?

A Yes. I heard the suggestion made at the hearing in Washington, Virginia, on March 29, and I understand the same suggestion was made the previous day in Warrenton. Also, I have reviewed the testimony on behalf of the intervenors on this point. The thrust of the testimony is that from an environmental point of view the use of existing corridors is preferable to the creation of a new corridor, and for this reason the Vepco proposal should be rejected in favor of one using existing corridors.

Q Would you please comment on this?

A Yes. While it is possible that the construction of a transmission line adjacent to an existing transmission line would produce less adverse environmental impact than would the construction of an identical line through new territory, this generalization cannot automatically be applied. In each such case, a study must be made of the

environmental factors that would be affected by each of the alternatives before it can be determined which route is preferable from an environmental point of view.

This point can be most imply illustrated by reference to just one factor, line length. Obviously, if the "corridor" route and the new route are of equal length, and everything else is equal as well, the corridor route would have less environmental impact. But if the corridor route were of greater length, crossing more parcels of land, an analysis would have to be made to determine which route involved the lesser environmental impact. And, of course, all other factors are rearely, if ever equal, so an analysis of the specific proposals clearly is required.

Q Were you requested by Vepco to make an analysis of a "corridor" route as compared with an alternative alignment?

A Yes.

Q Please explain how you went about doing so.

A My analysis was confined to an evaluation of the proposed alternative route from Mt. Storm to Morrisville as described in the regional study and the detailed line study testified to previously versus an evaluation of a "corridor" route paralleling the existing 500 kV facility from Mt. Storm to Doubs to Loudoun.

As I indicated in my earlier testimony, the regional

study involved an inventory of environmental features, shown on the base map and overlays, throughout the broad region through which the proposed facilities and the proposed alternate routes would pass. In that earlier testimony I described in detail the environmental features that would be encountered along the route proposed by Vepco.

In my analysis of the proposed alternate and the use of the existing 500 kV corridor, I have similarly determined the environmental features along the existing line and have made an evaluation of the impact of crossing these features in lieu of those referred to in my earlier testimony. Using these data I have made several different comparisons of the impact of the proposed line and the suggested alternate and from these I have reached a conclusion.

Q Please describe the features that you have found and evaluated.

A In making this evaluation I have separated certain segments of the existing 500 kV facilities in order to simplify that evaluation. I believe a preliminary explanation of that will be helpful, before I review the environmental features found on each segment.

As I understand the proposals of the intervenors, they believe Vepco should build a new line immediately adjacent to the existing Mt. Storm-Doubs transmission line in lieu of the proposed Mt. Storm-Morgnaville line.

[TR. P. 3092]

The Vepco and Potomac Edison engineers have advised, however, that the corridor route must extend from Doubs to Loudoun in order to provide the power where it is needed. Accordingly, a new study area was established and a base map and overlays prepared which included the "corridor" route as well as the proposed route from Mt. Storm to Morrisville. I have identified this map and the overlays as Exhibit EM-8.

COUNSEL OFFERS EXHIBIT EM-8

Q. What does this exhibit show?

A. The maps were similar to those used previously in the Mt. Storm-Moulstville study as described in my previous testimony and marked Exhibit EM-5. The base map depicts Transportation facilities within the study area and the five overlays present Existing Land Use, Zoning and Proposed Land Use, Natural Features, Scenic Features and Visual Exposure.

A determination of the environmental features was made along both the north and south sides of the existing 500 kV line from Mt. Storm to Loudoun. However, except for the number of structures which differs on either side, the "corridor" line generally impacts the same environmental features through which the existing line now passes.

[TR. PP. 3097-3110]

Q Have you prepared a statistical summary of the environmental features which would be impacted in the event that either the north or south Mt. Storm-Loudoun parallel line or the Mt. Storm-Morgansville line were to be built?

A Yes. As described previously, environmental features were mapped on the base map and the 3 overlay maps. A total of 72 items was plotted. For each of the three lines, ___

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a count was made of the number of features with which the line comes in contact and the length of the impact. Exhibit BH-10 is a tabulation of these data.

COUNSEL OFFERS EXHIBIT BH-10

Q What is the purpose of this table?

A The table is an accumulation of data produced by the process of mapping and evaluation, and it is the starting point for comparison of the alternate proposals. You will note that I have separately inventoried the impacts for a parallel running adjacent to and north of the existing Mt. Storm-Doubs-Loudoun line, for a similar parallel running south of that line, for the proposed Mt. Storm-Morrisville line and for the APS loop needed to serve the Northern Shenandoah Valley. As I understand from other witnesses, if either of the parallel alternates is built, it will be necessary to bring power to a new substation at the approximate location shown on Exhibit BH-8 and Exhibit BH-9, but that if the Mt. Storm-Morrisville line is built, the substation will be adjacent to the line and no additional facilities to serve that substation will be required. Under these circumstances, the facilities to serve the substation from the parallel alterate should be included in the environmental evaluation, since otherwise the total environmental impact of the parallel alternate would not be considered.

In making the data comparisons, it should be noted

at the outset that of the 72 features mapped, all three alternatives (with the necessary interconnections) avoid 19 features and these therefore do not enter into the comparison. Environmentally, the crossings of pipelines, railroads, major highways, and existing transmission lines are not considered to be a significant impact and therefore wherever crossing occur they have not been included in the summary. Industrial and extractive industry areas, both those existing and those proposed or zoned, will not be significantly affected by a new transmission line and these features are also excluded from the data comparisons which follow. All excluded items are identified on the exhibit by an asterisk.

Q Are there other features or measurements shown in the table marked Exhibit BH-10 which are not included in the data comparison?

A Yes. With reference to those sections of the lines which parallel existing pipelines, transmission lines and railroad grades, the parallel distances are recorded in the table, but discussed separately. Furthermore, because of the extreme irregularity of borders of the forested land along both the existing line and the Mt. Storm-Morrisville rights-of-way, the numbers of impact points are not included in the summary although the total lengths of this feature, of which the Mt. Storm-Morrisville line has the most extensive, are tabulated and included for each of the three alternate lines.

Q Please review these comparisons in detail and state what you conclude from them.

A Exhibit BH-11 is a summary of the data contained in Exhibit BH-10.

COUNSEL OFFERS EXHIBIT BH-11

Direct comparisons of the numbers of impact points and the lengths of impacts without regard to individual quality or significance of the features indicates that the south parallel alignment is somewhat more environmentally damaging than the north parallel. However, as compared with corresponding totals for the Mt. Storm-Morrisville line, the exhibit shows that without any adjustment by reason of the existing line and without inclusion of the APS loop, both parallels have significantly greater total environmental impacts than those along the route proposed by the applicants. When the APS loop is included, the parallel alternate has even a greater relative environmental impact.

This exhibit does not, however, give a final answer, for two reasons. First, as I have indicated, no adjustment is made for the existence of the present Mt. Storm-Doubs-Loudoun line. Secondly, the figures represent the sums of various environmental impacts and their lengths; those impacts are not qualitatively identical and, therefore, the sums are not a fair representation of total environmental impact. For example, the environmental impact of crossing five miles of rural density

residential land would be substantially less than the impact of crossing five miles of National Park land, and yet this distinction is not made in these totals.

Q What were some of the major differences between the impacts of the alternate proposals?

A Major individual features for which the impact would be more severe for the parallel alignments include urban clusters, parks, recreational and national forest areas, orchards, all categories of proposed and zoned residential areas, proposed conservation and open space areas, proposed parkways, sensitive ecological areas and major waterbodies. The numbers of points of contact of critical environmental areas and steep hill areas would be greater along the Mt. Storm-Morrisville alignment although the length through the critical environmental area is less than for the parallel lines.

With reference to residences and other structures, the exhibit indicates that it would be necessary to acquire 27 if the north parallel line were to be built between Mt. Storm and Loudoun and 29 if the choice were the south parallel. In siting the Mt. Storm-Morrisville line, it is anticipated that all structures would be avoided and consequently the total impact along this alignment would be zero in terms of this impact.

The north and south parallel alignments obviously involve more paralleling of existing utilities than does the

Mt. Storm-Morrisville alignment, and the effect of this is discussed below. In addition, these alterates would parallel railroad grades for a distance of 4.8 miles and pipelines for a distance of 2.3 miles, which the Mt. Storm-Morrisville route parallels a railroad for 1 mile and a transmission line for 11.4 miles.

Q Mr. Howlett, will you discuss the evaluation of the use of a parallel corridor versus a new alignment for a transmission line?

A In evaluating the suggested paralleling of the Mt. Storm-Loudoun line, the environmental data shown in Exhibit BH-10 reflect the impacts encountered on either side of the existing line. Except for structures, if the proposed line were to parallel the existing line, it would encounter much the same impacts on either side, but with some small variations in the numbers and impact lengths depending on which side the new line is placed.

However, the sum total of impact of a parallel line and an existing line together would not be twice that which already exists. In my judgment, two transmission lines sited alongside one another in the same right-of-way will have, in most cases, more impact than one line alone but generally less than two, as would be the case with two rights-of-way separated by considerable distances. For example, in general, the visual impact of two lines crossing a scenic river side by side would

be less than the impact of the same lines crossing the same river some distance apart, assuming the scenic values of the river to be similar at both locations.

With this in mind, the numerical quantities in the table are not strictly comparable. While the impacts of the proposed parallel would represent new impacts, they are in addition to those already in existence.

The degree of additional impact caused by placing a new transmission line alongside one already in existence is a matter of judgment. In some cases, the additional impact of a parallel line would have very little significance, such as a crossing of an industrial property, for example, or passing near an airport, while in others the impact would be greater, as when additional structures and vegetative cover would have to be cleared for the new line. In other instances, where sensitive ecological areas are encountered for example, the impact could well approach a doubling of that already existing, depending on the righ-of-way treatment practices that are followed.

Q Mr. Howlett, in light of the opinions you have expressed concerning parallel corridor alignments, have you made a tabulation of environmental impacts adjusted to take these judgments into consideration?

A Yes. As explained previously, 43 of the environmental factors have been used in making the straight

data comparisons. As Exhibit BH-11 indicates, the results show that on a numerical basis, without adjustment, both the north and south parallel routes to the existing Mt. Storm-Loudoun line are significantly more damaging environmentally than the Mt. Storm-Morrisville alignment, although the north parallel has slightly fewer adverse effects than the south parallel. In order to obtain a more comparable basis for judging the impact of paralleling versus a new alignment, adjustments have been made to the data shown in Exhibit BH-10. First, a coefficient which represents my judgment relationship to the existing line was determined. For example, an alignment in a parallel configuration adjacent to the present line has been estimated to have double the affect in an urban area and on forested land because of the direct impact. Structures would likely require removal in a built up urban zone and trees would have to be cut in forested areas. In other instances the impact would be less, such as in a scenic road zone where, because a visual impact has already occurred, an additional line would cause an increment less than double that which already exists. In this fashion, each of the environmental features was evaluated and a coefficient assigned which represents the new impact. The results of these computations with the assumed coefficients are shown in Exhibit BH-12.

COUNSEL OFFERS EXHIBIT BH-12

Q What conclusions can you draw from this

analysis?

A This exhibit permits the principal environmental impacts of the Mt. Storm-Morrisville line on one hand and the parallel alternate (including the APS loop) on the other hand to be compared, after adjustment has been made for the existence of the present Mt. Storm-Doubs-Loudoun line. If one were to add up these impacts, it would appear that the Mt. Storm-Morrisville line has about 5% more impact than either of the parallel alternates, but as I have indicated earlier, one cannot get a sufficiently meningful comparison by adding together the lengths of impacts of different types. Further analysis must be made.

Q Have you made such further analysis?

A Yes. In comparing the various categories shown in Exhibit BH-12, it must be kept in mind that there are qualitative differences in impact among the categories. For example, existing land uses would receive a higher impact because they exist, in comparison with proposed land uses which have not yet been developed. Similarly, some natural features, such as steep river slopes and sensitive ecological areas would be more significantly affected than rolling hills or potential reservois. In comparing these data, the Mt. Storm-Morrisville line qualitatively has a lower impact in terms of all categories of existing land uses, all of which are much more significant environmentally than proposed land uses.

Similarly, the Mt. Storm-Morrisville line has considerably less impact on most environmentally significant sensitive ecological sites such as woodlots and ponds than does either of the parallel routes. Also, as I have stated earlier, the parallel alternate would require the removal of a number of existing structures, including some residences, none of which would be affected by the Mt. Storm-Morrisville route. The primary reason for these advantages occurs because of the flexibility in routing the Mt. Storm-Morrisville line to avoid many significant features.

Q Mr. Howlett, have you approached comparisons among the alternatives in any other way?

A Yes. In the siting procedures which I used in selecting a low impact corridor for a new transmission line, after all environmental data are mapped, criteria are established at the outset to assist in locating the lowest impact routing. Application of this approach to the Mt. Storm-Loudoun north side and south side parallels and the Mt. Storm-Morrisville alignment provides another method of comparing the environmental impacts of these lines.

Initially in this process, each of the features encountered is judged to determine whether or not it is one which the route should try to avoid, one which should be traversed so as to minimize the length of impact of the transmission line, or one which is a desirable location for a

new line. Exhibit BH-13 lists the category to which each of the features was allocated.

COUNSEL OFFERS EXHIBIT BH-13

Of the 43 items compared previously, 16 are listed under the avoid category and 27 are those for which the impact should be minimized.

While it is not always possible to by-pass all features listed in the "avoid"category, nor restrict crossings of minimum impact features in all cases, a comparison of alternative routes does help determine which come closest in achieving the lowest impact alignment. The results of comparing the parallel routes with the Mt. Storm-Morrisville route are set forth in the following table.

3107A

	Number of Impacts in the Avoid Category	Number of Impacts in the Minimization Category
North Parallel Alignment *	126	259
South Parallel Alignment *	147	247
Mt. Storm-Morrisville Alignment	50	156

* Including APS Loop Interconnection

It will be noted that in all cases, the Mt. Storm-Morrisville line has significantly less adverse impact on the environment in the numbers of impacts on features that should be avoided or minimized.

Q Do you have any other comments about paralleling the existing lines as compared to the new routing Vepco proposes from Mt. Storm to Morrisville?

A Yes. First, considering the jurisdictional aspects, the parallel alignment would traverse the State of West Virginia twice, the State of Maryland once and the State of Virginia twice. The Mt. Storm-Morrisville line proceeds directly from West Virginia to Virginia.

With the parallel alignment, not only would a large number of homes be taken (which would not be the case for the Mt. Storm-Morrisville line), but the route also necessitates two crossings of National Park lands including two crossings of the Potomac River, which in my view are more significant to the nation as a whole than local, county or State facilities.

In addition, the parallel alignment proceeds through areas of rapid suburbanization in the greater Washington metropolitan area. As such, there will be a comparatively greater qualitative impact than would be the case where rural

activities will predominate for many years in the future.

While there are advantages to paralleling existing transmission facilities in many cases, these advantages must be carefully weighed against the disadvantages. To proceed willy-nilly along a route that may not have been located in an environmentally sound manner because past practices did not require strict attention to these features, would be tantamount to repeating the original error. And when, over the years, houses and other forms of urban growth have sprung up around an existing line, significant disruptions will occur when these homes must be purchased and people relocated. These aspects of the problem must be carefully considered and weighed before deciding on the best course of action.

In summary, a qualitative analysis of the environmental impacts of the proposed Mt. Storm-Morrisville line and the proposed Mt. Storm-Doubs-Loudoun parallel alternate (including the APS loop) shows that the Mt. Storm-Morrisville alignment will have less environmental impact, even taking into account the impact that has already been caused by the existing Mt. Storm-Doubs-Loudoun line. For this reason, it is my opinion that the Mt. Storm-Morrisville alignment is environmentally preferable to the Mt. Storm-Doubs-Loudoun parallel alignment.

Q Mr. Howlett, did you make a similar study of the proposed alternate to the North Anna-Morrisville line

that would involve paralleling a portion of the existing 500 kV line between Elmont and Loudoun?

A I have not made a detailed study, but I am sufficiently familiar with the matter to make some general comments.

As I understand the alternate proposal, it would involve running a new line on a new corridor in a west to east direction some distance north of the existing North Anna-Ladysmith line to the existing Elmont-Loudoun line and from that point paralleling the Elmont-Loudoun line to Bristers.

I have been advised that if this alternate is built, it will nevertheless be necessary to build a 230 kV transmission line along the entire route of the North Anna-Morrisville-Bristers 500 kV line in the early 1980's.

Under these circumstances, whichever route is selected, there will eventually be an impact along the North Anna-Morrisville route. Either way, there will ultimately be two transmission lines along one route, and one transmission line along the other and, for this reason, a comparison of the two alternatives would necessarily show less of a difference than would be the case if one of the routes were to be left free of facilities.

Without a detailed comparison I cannot state positively whether the environmental impact would be less if two lines were to follow the North Anna-Morrisville route and

[TR. P. 3110]

one the alternate route or vice versa. There are, however, two factors that suggest that the North Anna-Morrisville route would be less environmentally damaging, everything else being equal.

The first of these factors is that I am advised that if the alternate route is used it would be necessary to cut a new corridor from a point north of the North Anna power station east to the existing line and this is a corridor that will not have to be used if the North Anna-Morrisville alignment is approved.

Secondly, the parallel of the existing line would require a second crossing of the confluence of the Rappahannock and Rapidan Rivers, while the Mt. Storm-Morrisville route would cross both rivers farther upstream at narrower points. It would be preferable for there to be double circuit crossings at these upstream locations than at the confluence of the rivers. This will be particularly true if the Salem Church Reservoir is built, since the crossing at the confluence would involve a much broader expanse of water.

Because of these factors it would appear, to the extent that can be determined without detailed study, that the North Anna-Morrisville alignment is preferable environmentally.

[TR. PP. 3126-2127]

Q Mr. Howlett, did you undertake to evaluate the impact of the proposed North Anna-Morrisville line versus parallel from North Anna and along the existing 500 route?

A Yes. In very general terms this map doesn't cover that area and what we did was to give, in a sense, a judgment of what the impact would be of paralleling one particular route from North Anna north versus the other.

Q And what was your conclusion with respect to that particular line?

A Well, it is proposed that a 230 kV line would be located north of North Anna up to Morrisville area and that there is an existing 500 kV line existing to the east of that location. It was my feeling that the Mt. Storm -- I should say North Anna to Morrisville parallel would have, perhaps, a little bit less impact than the other one because it was upstream from the Rappahannock and Rapidan where the other one would cross an area where these two and where if the Salem Church Dam rose it would be created -- it would be a rather wide expanse of water and I feel that crossing in such a location is not particularly desirable compared to a location further upstream where it wouldn't be as long.

[TR. PP. 3148-3149]

BY MR. MACAULEY:

Q Now, in your Exhibits BU-11 and 12 did you include as a factor the width of the rights-of-way that would be involved in one case where you are paralleling and the other case where you are building a new transmission line?

A No.

Q Didn't take into consideration width at all?

A No.

Q Isn't that important?

A I think that in most cases it is not that significant. In some of these particular factors we are dealing with visual impact and other things and the width is not all that significant.

Q All right. How do you define impact?

A What kind of impact do you want me to try and define?

Q Well, talk about any kind that you want to.

A If we are talking about environmental impact, I think --

Q That is a good one.

A The way we endeavored to define impact in this case is to outline the factors which we think could be affected by the line, new line, parallel line, whatever it might be, and then to simply measure or count the number of times that these factors are affected. Now, that to me gives some measure of impact. It is quantitative. It does not, perhaps give us much weight to factor, say, the relative importance of the Potomac versus the Rappahannock. Some of these kinds of comparisons, the data will show in numbers of river crossings or the length or whatever.

Q Let me ask you this: you were completely quantitative on impact until you started putting your little coefficients in, weren't you? We will get to that. Don't answer the question.

Now, let me ask you this: what impact do you assign with respect to a new separate right-of-way two additional access roads that are required where you have a new right-of-way? What impact do you assign to that? Do you put that into the computer?

A No. The impact roads are not -- I don't have --

Q Access roads?

A Yes. Access roads are not included in this particular data.

[TR. PP. 3153 - 3154]

Q Now, do you not classify as equal the following features in the avoid category: urban, developed clusters, structures, land zoned high and medium density residential?

A Yes.

Q Now, considering those, is it not true that you take the following list and assign them no higher classification: parks, recreation and national forests? They are in the avoid, aren't they?

A Yes.

Q In other words, they are treated no better than the group I just mentioned, is that correct?

A I think I follow you.

Q All right. Well, you have got them in the same category as avoid. In other words, you should avoid a structure just as much as you should avoid a State Historic site under your routine, isn't that correct?

A Uh-huh.

Q A National Historic site?

A Uh-huh.

Q Potential park?

A Uh-huh.

Q Marsh and wetlands and to top it off, a structure rates just as high as a sensitive ecological area, is that right?

A Yes.

Q Both are avoid?

A Yes.

Q All right. Now, don't you classify equal the following features in the minimized category: commercial, institutions, proposed low density residential? They are all treated the same, aren't they?

A Uh-huh.

Q And treated the same as those three categories are the following categories: the proposed conservation, open space steep hills, steep river slopes and critical environment are treated the same as commercial, institutions and proposed low density residential?

A Uh-huh.

[TR. PP. 3176-3178]

This goes straight across the country. You can see it for miles. And if we follow this, we are perpetuating the practices which the law is intended to prevent, it would seem to me. And, so, I think this line on that basis is somewhat better.

BY MR. MACAULAY:

Q You keep talking about this line and that line.

We are talking about a new line paralleling an existing line, and you still maintain that paralleling an existing line has less harm to the environment than building a new one?

A I said the new line in this particular area would have somewhat less environmental impact than this one would have, than the parallel line.

Q Than the two of them?

A Beg your pardon?

Q Than the two of them up there, parallel?

A No. There is just one parallel here.

Q What are the two options? Paralleling and a single line in a new corridor?

Now, you still maintain that two separated lines have less impact on the environment than two in a single corridor overall?

A No. I have indicated that the impact of the paralleling would be in numerical terms. I have applied coefficients to bring it down.

All right?

That is what those coefficients are for, to give credit to this paralleling. And what I am saying is, even when that is done, this one, the Mt. Storm to Morrisville, appears to be better than the parallel. That is my point.

And also what I am trying to point out is that the law is the thing we are trying to comply with, and the law

[TR. P. 3178]

has been created to prevent this kind of thing.

These lines which were located in the past were located for reasons other than environmental reasons.

For that reason, it seems to me that this would perpetuate bad practice, in addition to the factors which I have already mentioned.

So, numerically it seems to be better.

Looking at the quality of this area, these rivers are very significant. They are nationally significant. Harper's Ferry is here. There is a federal park through here. None of these things exist down here.

Again, I didn't say this was perfect.

[TR. PP. 3179-3182]

Now, what is the distance of the Mt. Storm to Morrisville line, in miles?

A Let me look at my data.

Q Will you accept 111?

A Yes. I have got it here somewhere.

Q You've got it on Exhibit BH-11.

A Yes.

Q Now, are you aware that that line doesn't stop at Morrisville; that it goes on to Bristers?

A Yes.

Q And that is about nine miles. Would you agree with that?

A Yes.

Q So that would be about a total of 120 miles, right?

A Yes.

Q All right. Look at your Exhibit BH-11, and tell me how long you say the paralleling line would be?

A Well, we have the parallel plus the loop.

Q No. I don't want any loop. Just tell me about the parallel line.

A It says 130.

Q All right. Now, do you know what the width of the corridor is going to be on the Mt. Storm to Morrisville line?

A Mt. Storm to Morrisville?

Q Yes. The corridor width.

A I think it is on the order of between 100 and 150 feet.

Q Would you disagree that it runs from 235 feet to 150 feet?

A I am not aware of that.

Q Well, I think the record will show that of about 120 miles, nine miles are 235-foot right-of-ways, 54.3 miles of 200-foot right-of-ways, 10.9 miles of 175-foot right-of-ways, and the remainder, which is 45.8 miles, is 150-foot right-of-ways, and that is primarily the VEPCO segment.

Now, do you have any idea what the total acreage involved is, using those mileages and those widths?

A No, I am afraid I wouldn't.

Q Well, subject to the correctness of the VEPCO computer, which they kindly lent us, I think, if computed, it will amount to 2,636 acres.

You wouldn't dispute that, would you?

A I have no way of knowing.

Q All right. Now, if we are widening the 138-mile existing corridor by 100 feet, do you have any idea how much acreage is involved there?

A I don't know. I am not sure if you are making a true comparison.

Q I am just talking about acreage now.

A No, I don't. You would have to multiply 100 feet by the length.

Q That is right. When you do that, and you divide it to determine the number of acres, I think it will be clear that the amount of acreage involved is 1,576 acres.

[TR. P. 3182]

Now, subtracting 1,576 from 2,636, I get an answer of 1,060 acres' difference, meaning that 1,060 more acres are taken with this new line than by paralleling in spite of the difference in length.

MR. SPIVEY: Your Honor, I am going to object to this. I am not at all sure that Mr. Macaulay's figures are correct. I believe in his first figure he has included rights-of-way that are already existing here.

Is that correct, Mr. Macaulay?

MR. MACAULAY: It is subject to correction of the record. If you want to correct me, I will be glad to listen to you.

COMMISSIONER SHANNON: He is putting it in subject to check.

MR. MACAULAY: I am going primarily on the Allegheny witness as far as the corridor widths in West Virginia.

As I recall, VEPCO had -- well, anyway, it is subject to correction.

[TR. P. 3184]

Q I see. Well, you assign a higher value, though, to a structure than you do to a critical environmental area, don't you?

A Yes, because it is a man's home which may be taken. I think that is more important.

Q It may be a pigpen, too, may it not?

A It may be. It is a barn or something of this order. And I think also structures are important to this Commission.

[TTR. PP. 3214 - 3216]

BY MR. SPIVEY:

Q There seems to be some confusion from the questions being asked about the use of these coefficients, and I would like to ask you, Mr. Howlett, if you could take BH-12 and go to the board and explain how these coefficients are used.

The questions indicate that the examiners believe that some relationship among the various land uses exists in the coefficients, one to the other, as opposed to the coefficient relating to a parallel line versus a new line.

Now, Mr. Howlett, if you would go to the map and just by specific example explain that.

A All right. You will recall that we began our comparison by measuring the length of impact on the proposed Mt. Storm to Morrisville line, and what we said, when we add these up, this is clearly the better line, the Mt. Storm to Morrisville line. In numerical terms it comes out much, much better.

What we said, because this is parallel is we are going to apply a coefficient to each one of those factors.

Q And that is only on the parallel route?

A Only on the parallel route; and we will reduce the length of impacts that we find on this route by a factor to

make them comparable with what we would have on Mt. Storm to Morrisville.

So, for example, if we have a stream crossing on the parallel route, we multiply that by .50, which means we cut it in half.

So, the lengths of the streams along the parallel are multiplied, are cut in half, and all the other factors are similarly reduced in terms of their total length, because we are trying to give credit to the fact that the line would be parallel.

Then we compared the numbers on here with the numbers on here. These are all full, 100 percent in every case.

Q That is on the Mt. Storm to Morrisville line?

A On Mt. Storm to Morrisville. These are reduced by factors, .67, .33 to try and give them some weight, some weight to the fact that this is parallel, and still this particular alignment comes out better in most cases than the parallel does.

That was our point; that on the raw data alone, Mt. Storm to Morrisville looks very, very good in just about every factor you care to inventory, but let's give some credit to paralleling, and this is what we did, and I think these are conservative. Some people will say these are too low or say that we have given too much credit to paralleling. I don't believe we have. Even then, when you multiply them out,

it is clear that this route is still somewhat better than that route, even when you factor everything down.

COMMISSIONER SHANNON: But you didn't take into account the acreage involved?

THE WITNESS: No. I did not take acreage into account.

BY MR. SPIVEY:

Q Looking at BH-12, just for example, you have a coefficient there under steep hills, under natural features, of .67.

A Yes.

Q Then further down you have a coefficient of .50 for rivers.

Now, that doesn't mean, does it, that rivers are less important than steep hills?

A No, no.

Q What does it mean?

A It means that our view of the impact that would occur in a parallel situation, where a line already exists, that the addition of a new line will not have a hundred percent impact but will have .67, or .66 percent impact. Less than a full impact.

Do you follow me?

So, everything is reduced by that amount.

TESTIMONY OF MICHAEL J. ILEO

[TR. P. 3477]

Q Let me ask you a hypothetical question: If your given origin was Mt. Storm, and your given destination was the Northern Virginia load centers, be it Doubs or Loudoun, and based upon your familiarity with these cells which we have discussed at some length, where would the most cost beneficial line probably run?

A It probably would be the corridor that VEPCO originally proposed, or similar to that, back in 1973.

[TR. P. 3482]

Q Well, on the economic aspect, when you were studying the parallel line possibility, did you take into consideration from an economical standpoint the fact where you have existing right-of-way you have an existing access road?

A No, we did not.

Q You did not?

A In fact, we did not take into account access roads at all, and that is probably a weakness in the model.

Surely the costs are going to be a little more if there are no access roads than if there were access roads.

Q Well, don't you think there would be some cost benefit from the fact that where you have an existing right-of-way already surveyed, your cost of acquiring an additional 100 feet would be a lot less?

A Yes. I think that is also true.

TESTIMONY: KENNETH C. STROBL

[TR. PP. 3559-3560]

Q Yes. This is the supplementary testimony.

You were asked to compute the cost of paralleling the -- wait a minute. I got the wrong thing.

Well, in any event, KCS-46 is a computation of cost of paralleling an existing corridor from Mt. Storm to Doubs.

What did you compute that to be as shown on that exhibit?

A The total cost, five-acre basis?

Q From the kink to Doubs, right.

A It was $18,264,800.

Q Now, do you recall what you computed the cost of the parallel line was, the entire line from the kink to Loudoun?

A Are you referring to KCS-44A, then, combined total cost, five-acre basis, Intervenor I-III?

Q That is right.

A $28,718,505.

Q All right. Would you subtract the Mt. Storm

to Doubs from the Mt. Storm to Loudoun and tell us what the difference is?

COMMISSIONER SHANNON: Which exhibit is this, Mr. Macaulay?

MR. MACAULAY: This is subtracting the figure as shown, Judge Shannon, on KCS-46 from the figure for I-III shown on MJI-9, which was the total cost. I am just trying to determine the portion of the cost attributable to the line between Doubs and Loudoun.

BY MR. MACAULAY:

Q What is the portion of the cost as you compute it for the Doubs-Loudoun segment if paralleling is accomplished?

A $10,453,705.

[TR. P. 3592-3593]

SUPPLEMENTAL TESTIMONY OF ROBERT H. GILES, JR.

Q Why do you make that statement?

A The visual impact of power lines is well recognized. A line paralleling another within the same or similar right-of-way produces little additional visual impact. As previously reported, we do not yet have fully operational the visual analysis component of our system. When available, it will enable us to evaluate the relative conspicuousness of

alternative routes. Right-of-way changes, particularly swathes through woodlands and disruptions of horizons seem more important visually than the actual structures. Thus it seems desirable to reduce right-of-way width. Reducing such widths probably is not as significant to the public as reducing right-of-way presence.

There are other aspects to the question of parallel lines which should be mentioned. One is the question of reliability. I have no expertise to answer that question. The others are site-impacts, road building, and maintenance efficiency. Several lines within one right-of-way reduce the acreages involved and thus modify all "density" or area - specific computations throughout our models. These include erosion, sedimentation, soil water storage, wildlife, and foregone forest benefits. Over many miles, a few feet of width can amount to substantial acreages. In general, site disturbance is less and road construction less when existing lines are employed. Construction site disturbance is a consideration but should be dealt with as a time problem. Relative to the life of a project, soil disturbance is minimum, assuming our previous assumptions of high-quality corridor management.

[TR. PP. 3594-3595]

Q Have you evaluated the Intervenor line?

A We have manually plotted the line and visually inspected the route. In addition to the higher present valuation of that line than that derived for the staff line, the intervenor line crosses the C and O canal twice and comes within 1000 feet of it once. At this point there is a high slope area. The line also crosses a new residential area south of "Blue Ridge Acres" shown on the Charles Town quadrangle. Both are undesirable and violate major constraints previously suggested.

[TR. PP. 3596-3599]

BY MR. BRASFIELD:

Q Dr. Giles, I believe you ran environmental evaluations of routes for three lines; the Morrisville-Bristers, the North Anna-Morrisville, and Mt. Storm-Morrisville; is that correct?

A Yes, sir.

Q Now, with respect to the two other lines in this case, the Remington -- the Morrisville to Remington line, you didn't run a separate evaluation of that, but since that is on a common corridor with a portion of the Mt. Storm-Morrisville line I assume your findings would be essentially

the same?

A Essentially the same, that is correct.

Q And on Remington to Warrenton, you didn't run any evaluation at all?

A No, sir.

Q All right. Now, on Morrisville to Bristers I believe you found that neither the ratepayer route or any of the several ratepayer routes nor the VEPCO route affected or touched any cells that involved any of the 27 environmental constraints that you mentioned in your testimony?

A Yes. That is right.

Q Okay. Now, on the line from North Anna to Morrisville, on December 18th, when you testified earlier, and I refer to page 2696 of the transcript, I believe you said "There is only, you might say, one conflict that exists in the VEPCO proposal with the North Anna to Morrisville line, which is a proposed public park and recreational area which we discovered on the maps of the Virginia Commission of Outdoor Recreation."

Now, I asked Mr. Strobl on Wednesday whether the correction in the plotting of the VEPCO line had eliminated that conflict, and he said he thought so but he wasn't sure, and I want to see if you know the answer to that.

A In looking at the maps that I have seen, the so-called dog leg that was just displayed here, it eliminates

that environmental problem as I now see it.

Q Fine. So, if that be the case, there is no environmental problem on the VEPCO route from North Anna to Morrisville?

A Of those constraints we are now using, that is correct.

Q Now, on Mt. Storm to Morrisville your prepared testimony states -- let me see if I can find it.

This is in the January 21st data that was just introduced today.

This is from page 3: "Thus, in summary, the minimum present value line is also the minimum environmental impact line."

You are there referring to the computer selected ratepayer line as the minimum line?

A That is correct.

Q Now, you point out, I believe, that the ratepayer route touches the boundary of Greenfield Estates, but you didn't attach a great deal of significance to this because it is right on the edge and could probably within the cell be off the property?

A Within the cell it could easily be adjusted so that it would be off the property, and therefore it does not seem to be a significant problem there.

Q And it is only a proposal for restoration,

anyway?

A That is correct.

Q Now, the VEPCO route and the ratepayer route at this location are substantially identical, are they not?

A As far as I could tell, they are.

Q So, would your comments that relate to the fact that it is not much of a problem with the ratepayer route be equally applicable to the ratepayer route at that location?

A That is correct.

Q Now, except for this one minimal contact that exists on both VEPCO and the ratepayer routes, did you find that the VEPCO route impacted any of the cells with your environmental constraints in them?

A With that exception, none.

Q So, in the case of both the VEPCO route and the ratepayer route the only environmental constraint of those you are using in this case are that boundary of Greenfield, and they both touch that, so it could be said, could it not, that based on these constraints the VEPCO route and the ratepayer route are environmental equals?

A That would be my conclusion.

Q And if that is the case, your statement that the ratepayer route "is also the minimum environmental impact line" could also be said about the VEPCO route, couldn't it?

A That is correct.

Q So what you are saying is, considering that line, the only environmentally bad aspects about it is that it crosses the C&O Canal twice and it crosses a new residential area? Is that the summation of it?

A And the steep slopes at one point on the river, yes.

Q And all of those three points, even considering the line already there, already crossing the canal, counter-balances more than a thousand acres in new land with sedimentation, new roads, erosion and so on?

A Yes. I think that would be my conclusion.

Q I think I asked this question of a previous witness.

Suppose the additional 500 KV line were put on the same tower, just as it crossed that sacred canal.

Would that alter your conclusion any?

In other words, you still had only one tower as the line crossed the canal.

We have one 500 KV line crossing the canal which VEPCO put in place sometime back, right?

A And if it went in the same identical spot?

Q If where it crossed the C&O Canal the tower was made to accommodate -- the same tower was made to accommodate the second 500 KV line. Would that change your mind?

A I think it would, yes.

[TR. P. 3625]

Q It would?

A Yes.

Q Would that make the parallel line environmentally more acceptable in the Mt. Storm-Morrisville?

A It would certainly eliminate that one constraint which we have reported as being --

Q Well, if at one point where this great development of the Charles Town quadrangle is located, the second line did a little zig or a dog leg to avoid that, that would eliminate that problem, wouldn't it?

A Yes.

Q So, then, if those two steps were taken, the parallel line, the tremendous amounts of much less acreage, it would be much more acceptable than running a new 150-foot corridor?

A If those exceptions were made, I think that would be a good statement.

L. LEE BEAN (COUNSEL)

[TR. P. 3781]

MR. BEAN: I would like to say that at the commencement of this hearing, I think I stipulated that there was a need, and there has been nothing that has come to my attention in the interim that I think would change my opinion.