REPORT OF THE
JOINT SUBCOMMITTEE STUDYING

The Health and Safety Effects of High Voltage Transmission Lines

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

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Report of the Joint Subcommittee Studying the Health and Safety Effects of High Voltage Transmission Lines
January, 1985

To: Honorable Charles S. Robb, Governor
and

The General Assembly of Virginia

INTRODUCTION

In recent years there has been a significant increase in concern over the health and safety aspects of high voltage transmission lines as utilities have moved toward higher transmission line voltages in response to the nation's increasing demand for electricity. The recent interest in Virginia over the health and safety aspects of high voltage transmission lines was prompted by an application filed in 1974 by Appalachian Power Company with the State Corporation Commission to construct a 765 kV powerline from Jackson's Ferry near Wytheville to Axton in the Martinsville area. The application for this line was considered over a four-year period during which public hearings were held. In 1978, the Commission approved the construction of the 765 kV line yet the case was appealed by the Citizens for the Preservation of Floyd County to the Supreme Court of Virginia, where the Court upheld the Commission's decision. A more detailed description of the Commission's evaluation of the application and of the hearings which were held is attached to this report as Appendix I.

In an effort to determine if there is legitimate cause for concern over the health effects of high voltage transmission lines and to study the adequacy of the present State Corporation Commission oversight, the health and safety rules and regulations, and the statutes in the Code of Virginia in protecting the citizens from potential harm, a joint subcommittee was established pursuant to Senate Joint Resolution No. 26 of the 1984 Session of the General Assembly.

SENATE JOINT RESOLUTION NO. 26

Establishing a joint subcommittee to study the adequacy of present protections afforded the citizens of Virginia when high voltage electrical transmission lines are constructed and maintained.

WHEREAS, high voltage electrical tranmission lines have been constructed and are being constructed across various regions of the Commonwealth by electric utilities; and

WHEREAS, such transmission lines cause strong electromagnetic fields in nearby areas; and

WHEREAS, many doctors have attested that the residual effects of the electromagnetism are hazardous to human beings and may have long-term effects; and

WHEREAS, many citizens are concerned about the effects upon their health and safety of such transmission lines; and

WHEREAS, it is important that consumers are protected from hazardous conditions; and

WHEREAS, the protection could be ensured by adequate State Corporation Commission oversight, health and safety rules and regulations and statutes in the Code of Virginia; now, therefore, be it

RESOLVED by the Senate, the House of Delegates concurring, That a joint subcommittee be established to study the adequacy of the present State Corporation Commission oversight, the health and safety rules and regulations, and the statutes in the Code of Virginia in protecting the citizens of Virginia when high voltage electrical transmission lines are constructed and maintained. The joint subcommittee shall be composed of seven members: one appointed from the Senate Committee on Commerce and Labor, and one appointed from the Senate Committee on Rules, each to be appointed by the Senate Committee on Privileges and Elections and five appointed from the House Committee on Corporations, Insuranace and Banking by the Speaker of the House. The State Corporation Commission, the State Health Department, and all state - supported medical schools are requested to give whatever support that may be needed to this study. The joint subcommittee shall complete its work and make any recommendations that it deems appropriate prior to the 1985 Session.

All direct and indirect costs of this study are estimated to be $8,450.

Senator Madison E. Marye of Shawsville, chief patron of the resolution, served as Chairman of the joint subcommittee. One other member of the Senate who was appointed to serve was Virgil H. Goode, Jr. of Rocky Mount.

Delegate Lewis W. Parker, Jr. of South Hill served as Vice-Chairman of the joint subcommittee. Other members of the House of Delegates who were appointed to serve were: V. Thomas Forehand, Jr. of Chesapeake, Charles C. Lacy of Wytheville, Harvey B. Morgan of Gloucester, and Kenneth R. Plum of Reston.

C. William Cramme', III, Senior Attorney, and Terry Mapp, Research Associate, of the Division of Legislative Services served as legal and research staff to the joint subcommittee. The Senate Clerk's Office provided administrative and clerical duties for the joint subcommittee.

WORK OF THE SUBCOMMITTEE

In an effort to give all interested parties the opportunity to testify on the health and safety aspects and the adequacy of the State Corporation Commission oversight, the health and safety rules and regulations, and the statutes in the Code in protecting the citizens of Virginia when

high voltage transmission lines are constructed, the joint subcommittee held four meetings during 1984. These were held on June 8, August 9, October 12, and November 16.

Prior to the subcommittee's first meeting, its staff furnished each member with a copy of a staff report which provided a brief overview of transmission lines, their potential detrimental health and safety effects, and their regulation in other states as well as Virginia. A copy of this report minus its lengthy appendices is attached to this report as Appendix 2.

The joint subcommittee heard a large amount of oral testimony during their meetings and also received position papers and other written materials from a number of interested parties including: the State Corporation Commission, the Department of Health, the Taskforce Opposing the Powerline, Appalachian Power Company, American Electric Power Company, Virginia Electric and Power Company, Dr. K. R. Shah, Dr. Abraham Liboff, Mr. Max Goodwin, Dr. Ron Wilson, Dr. Dwight Merser, Dr. Sol Michaelson, Dr. Mort Miller, Dr. H. B. Graves, and the citizens of Floyd, Carroll and surrounding counties.

During the subcommittee's first meeting, which was organizational in nature, the study group elected its chairman and vice-chairman, discussed what the study should encompass, and heard from several groups. The State Corporation Commission testified that they have the final responsibility for the approval of applications for the construction of transmission lines. They explained that they are charged by statute to carefully review the applications, to evaluate the evidence presented to them, and to weigh environmental considerations prior to approving them. They informed the subcommittee that they have been monitoring the actions of other states and research regarding transmission lines, and that the majority of the information reviewed to date has not indicated with any certainty that detrimental health effects result from the exposure to electric and magnetic fields of high voltage transmission lines. They indicated that they will continue to monitor the research.

Richard Gutleber, Director of Transmission Distribution with Virginia Electric and Power Company, testified that their highest transmission line voltage is 500 kV which was put into service in 1964 to meet rapid growth in the demand for electricity. He explained that the 500 kV system is adequate for the forseeable future yet that they see no problems with operating a 765 kV system should one be necessary in the future. He informed the subcommittee that they have had no incidences of detrimental biological effects from the electrostatic and electromagnetic fields of such lines and that they support the current studies by the Department of Energy and the Electric Power Research Institute as such studies are needed to obtain a meaningful risk analysis.

The joint subcommittee learned that Appalachian Power Company has had 765 kV lines in service for fifteen years in Virginia during which they have never had a single documented case of detrimental biological or health effects to human beings, animals, or plants resulting from exposure to the fields from the 765 kV lines. C. A. Simmons, Vice President of Construction and Maintenance with APCo, explained that the use of higher voltages provides for better land use and that since they are more economical and efficient, they have a favorable impact on the cost of electricity to consumers.

Wayne Bradburn, Organizer of the Taskforce Opposing the Powerline, a group of Southwest Virginia citizens who are greatly concerned about the health and safety effects of transmission lines since APCo's proposed 765 kV line will run through their counties, testified that for ten years they have fought to prevent the construction of the Jackson Ferry-Axton 765 kV powerline. Mr. Bradburn stated that a number of studies have demonstrated adverse health effects as the result of exposure to electric and magnetic fields and although not all of these effects have been confirmed nearly half are awaiting replication. Mr. Bradburn explained that they have tried to raise health and safety issues with the State Corporation Commission, APCo, and American Electric Power Co., APCo's parent company, to no avail. He urged the joint subcommittee to hold a hearing in Floyd to hear from the people.

A representative from the Department of Health informed the subcommittee that they were collecting and reviewing the research conducted in this area and would submit a report to the subcommittee once it was completed.

The study group decided they would hold a public hearing in Floyd on August 9 in order to

afford the residents of the area affected by the construction of the 765 kV line an opportunity to express their concerns. They also decided that a third meeting would be held in Richmond during which they would hear from expert witnesses and that possibly a fourth meeting would be held for final testimony and discussion of the issues.

At the August 9 public hearing the subcommittee heard extensive testimony from the residents and elected officials of Floyd and its surrounding counties regarding their concerns about and experiences with the existing 765 kV line and the proposed line. Testimony revealed concerns over the following: health and safety issues, the psychological impact of the line, noise, radio and television interference, the devaluation of property, shocks, limited land use, the inadequate notice of hearings in the newspapers, the inefficient management by the utility, the methods used by APCo representatives to convince people to sign over their property, and the order in which the State Corporation Commission conducts its hearings. It was suggested many times during the hearing that a moratorium on the Jackson Ferry-Axton 765 kV powerline be declared until the health and safety issues could be thoroughly researched.

During the October 12 meeting the joint subcommittee heard from expert witnesses provided by the Taskforce Opposing the Powerline and VEPCO and APCo. Testifying on behalf of the Taskforce were Dr. K. R. Shah, President of Shah & Associates, an engineering consultant group, and who has an extensive background in the field of electrical power systems; Dr. Abraham Liboff, Professor of Physics and Director of Medical Physics at Oakland University in Michigan; Dr. Ron Wilson, a former Biology professor and resident of Floyd County; and Max Goodwin, an attorney from Indiana. Dr. Shah discussed the need for the Jackson Ferry-Axton 765 kV line, economical alternatives to the line, the safety and health-related effects, and recommendations of mitigation measures that should be required to assure acceptable electrical effects of the 765 kV line on the public. A copy of Dr. Shah's statement is attached to this report as Appendix 3.

Dr. Liboff reviewed some studies the results of which showed adverse effects from exposure to electromagnetic radiation and commented on the recent surge in the interest by the scientific community in this area. He stated that there is no direct, straightforward answer to the question of whether low-frequency electromagnetic radiation is hazardous to one's health, yet if he was forced to take a stand he would err on the side of those who claim it can be dangerous. He stressed that the results of recent studies should make one cautious when dealing with the health and safety issues.

Dr. Wilson testified that it is difficult to obtain accurate information from the studies yet they demonstrate there is a need for concern. He reminded the joint subcommittee that public policy should be formed on a concrete basis. Mr. Goodwin explained to the joint subcommittee the transmission line situation in Indiana and urged the members to protect the land and citizenry from abuses by electric utilities. Mr. Bradburn reiterated the citizens' concerns and strongly urged the subcommittee to accept their recommendations, two of which were declaring a moratorium on the 765 kV powerline construction until such lines are proven safe and requiring that all powerlines meet the standards set forth in the National Electrical Safety Code.

Testifying on behalf of VEPCO and APCo were Dr. Morton Miller, Senior Scientist and Associate Professor of Radiation Biology and Biophysics of the School of Medicine and Denistry at the University of Rochester; Dr. Sol Michaelson, Professor of Radiation Biology and Biophysics and Associate Professor of Medicine and Laboratory Animal Medicine of the School of Medicine and Denistry also of the University of Rochester, and Dr. Dwight Mercer, a veterinarian and Board Certified Veterinary Toxicologist with the College of Veterinary Medicine at Mississippi State University. Dr. Miller stated that to date no detrimental biological effects on people or animals have been demonstrated and that there is little reason to expect such effects to occur, yet, from a scientific point of view, no one can say that a 765 kV line is absolutely safe. Dr. Miller presented a brief synopsis of the literature which supported his earlier statement regarding no effects. Dr. Michaelson testified that he was convinced that there are no health hazards resulting from exposure to electric or magnetic fields of extra high voltage transmission lines and presented a critique of the literature which suggested harmful effects. Dr. Merser informed the subcommittee that existing literature and his own personal experiences have not revealed any solid scientific evidence that indicates that there are hazards to agricultural animals. He also referred to several studies which supported his opinion.

The joint subcommittee also heard from W. R. Roy, Manager of American Electric Power's

ultra high voltage transmission staff, who stated that AEP has conducted its own tests and reviewed the biological studies and found no health hazards resulting from exposure to high voltage transmission lines. He explained that a 1980 survey of landowners along the 765 kV powerline in Indiana revealed that approximately sixty-four percent of the respondents had had no problems with the line.

A final meeting was held on November 16 during which the subcommittee received written comments regarding the potential adverse effects of transmission line electric fields from Dr. H. B. Graves, a biological researcher at Pennsylvania State University and the chairman of a committee at The American Institute of Biological Sciences which is conducting a comprehensive review of bioeffects of low frequency electromagnetic fifelds. A copy of Dr. Graves' comments are attached to this report as Appendix 4.

The subcommittee heard further explanations of the New York noise ordinance which was discussed at the October 12 meeting. It was explained that New York has a noise ordinance for only one 765 kV line yet they intend to develop one for all lines based on the experience with this one. It was explained further that the utilities are required by this ordinance to take corrective action when they receive complaints from individuals living within 600 feet of the centerline who have noise levels in their homes greater than 35 db.

During the meeting Dr. Khizar Wasti, a toxicologist with the Department of Health, testified that they have been monitoring the health and safety effects of high voltage transmission lines since 1979 and that they had prepared a report which presented an overview of the reported human health effects from exposure to high voltage transmission lines and the regulations of other states. Dr. Wasti stated that from a review of the literature to date, it appears that there is no conclusive evidence to indicate that there are significant harmful effects on human health that can be attributed to exposure to the electric and magnetic fields produced by transmission lines. He explained that the only hazards known are electric shocks due to very high electric fields and currents. He explained further that contradictory studies which have suggested harmful effects should not be overlooked entirely but that their results should be interpreted with caution until more reliable and conclusive studies establishing a definite causal relationship become available. Dr. Wasti indicated that they would continue to monitor future studies and will inform the subcommittee members of any major departures in their opinion.

The joint subcommittee also heard final testimony from APCo and the Taskforce Opposing the Powerline, copies of which are attached to this report as Appendices 5 and 6.

After hearing from all interested parties present, the subcommittee discussed the recommendations it should make to the 1985 General Assembly.

RECOMMENDATIONS

The joint subcommittee offers the following recommendations to the General Assembly:

1 - THE APPROVAL OF APPLICATIONS OF 765 kV LINES SHOULD NOT BE PERMITTED UNTIL THE STATE CORPORATION COMMISSION HOLDS A HEARING ON THE HEALTH AND SAFETY ISSUES OF SUCH LINES.

It was pointed out during the last meeting of the joint subcommittee that the last time the health and safety issues of such lines were considered was in 1972. A substantial amount of research has been conducted since then which must be taken into consideration in order to protect the citizens of Virginia from any potential harm.

2 - HEALTH, SAFETY AND NEED ISSUES SHOULD BE PERMITTED TO BE RAISED UNTIL THIRTY DAYS AFTER THE FIXING OF THE ROUTE THE LINE WILL FOLLOW SO AS TO AFFORD LANDOWNERS OF RECORD ALONG THE ROUTE AND OTHER INTERESTED PERSONS THE OPPORTUNITY TO RAISE THESE ISSUES. DETERMINATION OF THE NEED,

HEALTH AND SAFETY ISSUES SHOULD NOT PRECEDE THE ISSUE OF THE ROUTE DETERMINATION; AND

- THE NOTICES IN THE LOCAL NEWSPAPERS AND TO THE LOCAL OFFICIALS OF THE PROPOSED ROUTE SHALL INCLUDE A MAP AND COMPLETE DESCRIPTION OF THE ROUTE THE LINE WILL FOLLOW. IF THE COMMISSION DETERMINES THAT A ROUTE DIFFERENT FROM THE ONE INCLUDED IN THE ORIGINAL NOTICE IS TO BE CONSIDERED, IT SHALL HAVE NEW NOTICES INCLUDING A MAP OF THE NEW ROUTE PRINTED.

Currently, the State Corporation Commission first holds a hearing on the need for the construction of the line and then determines the route the line will follow which will reasonably minimize the impact on the environmental assets on the area concerned. The joint subcommittee felt that the need for the line should not be determined prior to the fixing of the route the line will follow, taking into consideration the health and safety effects of the line on the citizens in the affected area and the environmental impact.

Many people testified during the hearings that they did not oppose the powerline until they found out that it would run through their county and property. They, however, were not allowed to raise any health or need issues before the Commission at that time because these issues had been considered in earlier hearings. Including the map of the proposed route and a complete description thereof in the notices would ensure that the people in the area affected by the construction know where the route is located.

Requiring additional notices and maps when changes are made in the route will ensure that the newly affected people will be aware of the new route. This will enable all people who are affected by the construction of the line to have the opportunity to raise the health, safety, and need issues. The joint subcommittee felt that those persons most affected by the route should have up to thirty days after the fixing of the route to raise any health, safety or need issues.

3 - PUBLIC COMMENT HEARINGS ON THE HEALTH AND SAFETY AND NEED ISSUES SHOULD BE HELD IN THE LOCALITY IN WHICH THE PROPOSED LINE IS TO BE BUILT.

Additional testimony revealed that many people who were most affected by the construction of the Jackson Ferry-Axton transmission line were unable to attend the hearings because such hearings were held in locations inaccessible to them. Holding public comment hearings in the locality in which the proposed line is to be built will enable those persons most affected by the construction of the line the opportunity to oppose the need for it and to raise health and safety issues. The joint subcommittee also felt that people testifying at the local hearings should have the benefit of reviewing testimony received by the Commission in previous hearings.

Enclosed as Appendix 7 of this report is the legislation recommended by the subcommittee to effect the first three changes.

4 - ELECTRICAL TRANSMISSION LINES SHOULD BE CONSTRUCTED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL SAFETY CODE.

The Taskforce Opposing the Power Line testified that APCo's 765 kV line does not meet the minimum design clearance standards set forth in the National Electrical Safety Code and therefore provides a potential health hazard. APCo testified that all of their transmission lines are built in accordance with the NESC which is a voluntary code which was developed by the industry. To ensure that all overhead electrical transmission lines are built in accordance with the NESC the joint subcommittee felt that compliance should be mandatory.

Enclosed as Appendix 8 of this report is the legislation recommended by the joint subcommittee which will affect this change.

5 - THE STATE CORPORATION COMMISSION AND THE DEPARTMENT OF HEALTH ARE REQUESTED TO MONITOR RESEARCH REGARDING THE HEALTH AND SAFETY ASPECTS OF HIGH VOLTAGE TRANSMISSION LINES AND THE DEPARTMENT OF HEALTH IS REQUESTED TO REPORT ITS FINDINGS ANNUALLY TO THE GENERAL ASSEMBLY.

Studies in this area should continue to be monitored so that if any replicated and conclusive effects are demonstrated, the General Assembly will be informed and will be able to take appropriate action to protect the citizens of the Commonwealth.

Enclosed as Appendix 9 of this report is the resolution recommended by the joint subcommittee.

CONCLUSION

The joint subcommittee expresses its appreciation to all parties who participated in its study, especially the citizens of Floyd, Carroll, and their surrounding counties. The study group's recommendations have been offered only after careful and thorough study of the information it received. The subcommittee believes that its recommendations are in the best interests of the Commonwealth, and it encourages the General Assembly to adopt its recommendations.

Respectfully submitted,

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Madison E. Marye, Chairman

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Lewis W. Parker, Jr., Vice-Chairman

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V. Thomas Forehand, Jr.

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Charles C. Lacy

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Harvey B. Morgan

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Kenneth R. Plum

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Virgil H. Goode, Jr.

and Virginia Beach, and with proper marketing as proposed by applicant, both applicant and protestant should run successful operations. It is felt that the two carriers offering different tour packages would attract different segments of the market. Bigger is not necessarily better in the minds of all people. Some groups can be expected to prefer a smaller boat, as testified to by Charles Nelson, a witness for Harbor Tours. The lower cost of a no-frills package would continue to be the choice of many. Several witnesses, not financially connected to either operation, testified that the market area could support both operations. Those witnesses, representing civic and governmental organizations, are interested in the development of tourism in the Norfolk area and we cannot suppose that they would support an application they believed would result in competition detrimental to the public interest.

The Commission also finds reason to conclude that, with the growth of the Norfolk waterfront, the new attractions would likely result in an increase in business for Harbor Tours. The growth of the Baltimore harbor tours would certainly suggest this.

Harbor Tours is the only certificated sight-seeing and charter party carrier in the Tidewater area, out of six such carriers, which is protesting this application. Despite additional competition approved by this Commission in the immediate past, the record reveals that Harbor Tours has enjoyed unabated growth in its income for each one of its 18 years of operation. The other carriers, despite the stated intention of Cruise Ventures to draw customers from all over the Tidewater area, apparently concluded that there is enough business to go around.

Harbor Tours' argument that there is no room for a second tour operation out of Norfolk implies that no restriction on the Cruise Ventures operation short of denial of the application would protect the protestant's operation. However, there is nothing in the statute that prohibits reasonable competition, as proposed by Cruise Ventures. Finally, the Commission finds that restrictions on Cruise Ventures' proposed operation are not necessary to protect existing carriers.

It is readily apparent that Harbor Tours's major concern is that any new competition in the area would jeopardize its alleged fragile financial situation. It should be noted that the carrier's financial situation was not created by competition but rather by questionable, highly leveraged financing of a long-term asset with quick pay-back provisions. The statute makes it clear that the beneficiary of the sight-seeing and charter party carrier legislation is to be the public. While the Commission finds that any adverse economic impact on Harbor Tours from the proposed operation is not likely to be significant, absolute protection from the competition of existing carriers is not to be extended in this case at the cost of the public's opportunity to have a choice and variety of tours through which the Commonwealth's waterfront sights can be viewed.

CASE NO. 10848-A

Application of
Appalachian Power Company

For a Certificate of Public Convenience and Necessity authorizing construction of a proposed 765 kv transmission line from its present Jackson's Ferry Station to a proposed station to be located in the vicinity of Axton, Virginia.

ORDER OF JANUARY 4, 1978

OPINION AND INTERIM ORDER

In an application filed with the Commission on March 22, 1974, Appalachian Power Company (hereinafter referred to as "Applicant", "Company" or "Appalachian") requested a certificate of public convenience and necessity authorizing construction of a proposed 765 kv transmission line. The proposed line would extend from Company's present Jackson's Ferry substation near Wytheville, Virginia, to a proposed substation in the area of Axton, Virginia, a community located between the Cities of Martinsville, on the west, and Danville, on the east. [A map, attached as Appendix "A", is referenced for locations and various line

designations used in this opinion]. The application was considered under the requirements of §§ 56-46.1[1] and 56-265.2[2] *et seq.* of the Code of Virginia.

Appalachian requested consideration of its application in two stages. It first seeks Commission determination that there is a need to construct the proposed line from Jackson's Ferry to Axton. Following determination that there is a need for the proposed line, Company will then file data and information establishing a route for the line which, it believes, will reasonably minimize the adverse impact on the scenic and environmental assets of the area concerned — including the area of the proposed substation at Axton.

By order dated April 22, 1974, Company was directed to give public notice of its application and of a public hearing set for June 10, 1974, in Richmond to receive evidence of the need for the proposed transmission line. The notice further provided for the scheduling of additional investigation and public hearing to consider line location and substation site should the need for the line first be established. Witnesses for Appalachian and the Commission's Staff testified at the hearing, and at its conclusion the question of need for additional transmission facilities was taken under advisement.

On July 5, 1974, the Commission issued an order finding:

> . . . there is a need for a 765 kv transmission line extending from Appalachian's existing Jackson's Ferry substation to a substation to serve the electrical load in the Danville-Martinsville area;

The order of July 5, further provided:

> . . . that Appalachian Power Company shall be, and hereby is, granted leave to proceed with part 2 of its application under consideration herein by filing with the Commission the data and information pertinent to establishing a route for construction of a 765 kv transmission line extending from its existing Jackson's Ferry substation to the Danville-Martinsville area.

Thereafter, Appalachian filed with the Commission a proposed route for the 765 kv line and a proposed site for the substation at Axton. Hearings on the location of the proposed facilities were conducted in the Commission's Courtroom in Richmond and in local courtrooms in areas which would be affected. The hearing at Richmond occupied September 23, 1974, November 20, 1975, and July 27, 1976. Interested citizens and their representatives were also heard on March 22, 1976, in the Circuit Court of the City of Martinsville, on March 23, 1976, in the Circuit Court of Floyd County and on July 5, 1977, in the Circuit Court of Franklin County. For the convenience of citizens, hearings at the local courthouses were scheduled for afternoon and evening sessions in accordance with prior notice giving the time, location, and purpose of each hearing.

During the course of the proceedings the following counsel entered appearances for the parties indicated: John L. Walker, Thomas F. Lemons, Jr., and Ronald M. Ayers for Appalachian Power Company; Martin F. Clark and Mary Sue Terry for the Board of Supervisors of Patrick County; Robert W. Spessard, Jr., and Robert C. Boswell for Citizens for the Preservation of Floyd County; John S. Graham, III, for Joe B. Shumate, Jr.; A. L. Philpott, Dale McGhee, and David Worthy for Bassett Furniture Company, Inc., Anthony Brothers Lumber Company, Inc., and Charles G. Anthony; William Roscoe Reynolds for the Board of Supervisors of Henry County; Richard D. Rogers, Jr. and Patricia Schwarzschild for the Commission's Staff. Numerous citizens appeared and testified in their own behalf.

SCOPE OF THE COMMISSION'S INVESTIGATION

Construction of the 765 kv line from Jackson's Ferry to Axton, herein proposed, is not an isolated request to be approved or disapproved without regard to Appalachian's remaining construction program and existing facilities. The proposed Jackson's Ferry-Axton line is one segment of a continuous 765 kv circuit tying the generating facilities of Appalachian Power Company to the population centers needing electric power. In fact, the proposed line will tie together the American Electric Power Company System operating in several states. The American Electric System, of which Appalachian is one operating subsidiary, operates as an integrated system. In Case No. 10848, *Application of Appalachian Power Company For Certificate of Convenience and Necessity*, in an opinion and order issued on July 5, 1974, the Commission approved construction of another segment of the same 765 kv circuit. In its opinion the Commission then stated:

> Having determined that there is a need for additional power in the Lynchburg-Bedford area and that a 765 kv transmission line would be the most appropriate facility for supplying that power, the Commission must now determine the route for the line. The transmission line under investigation in this proceeding is actually a segment of a 765 kv line which originates outside this State. It enters Virginia across its border with the State of Kentucky and proceeds to a substation at Jackson's Ferry, which is situated some ten to fifteen miles west of Wytheville, Virginia. A 765 kv transmission line, or circuit, which is already constructed, proceeds from the Jackson's Ferry Substation in a north-easterly direction to a substation immediately north of Roanoke, Virginia, at Cloverdale. Appalachian plans extension of this line from Cloverdale to Lynchburg, from Lynchburg to the Danville-Martinsville area, and from the Danville-Martinsville area back to the Jackson's Ferry Substation, though construction of the segments will not necessarily be in the foregoing order. The ultimate purpose of this roundabout route is to form a closed loop serving the Virginia load centers of Roanoke, Lynchburg-Bedford, and Danville-Martinsville. Such a loop is described as greatly increasing electric system reliability by providing voltage support to each side of the load centers with a single line.

The purpose for constructing the 765 kv line, including the loop in Virginia, is to improve system ties between load centers and generation stations [illegible] American Electric System, to provide more power directly to load centers [illegible]ginia, a[illegible] to improve electric reliability within the State. The growth in [illegible]c den

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[1] *Commission to consider environmental factors in approving construction of electrical utility facilities; approval required for construction of certain electrical transmission lines; notice and hearings.* — Whenever under any provision of law whatsoever, applicable to the Commission, the Commission is required to approve the construction of any electrical utility facility, it shall give consideration to the effect of that facility on the environment and establish such conditions as may be desirable or necessary to minimize adverse environmental impact. In such proceedings it shall receive and give consideration to all reports that relate to the proposed facility by State agencies concerned with environmental protection.

No electrical transmission line of two hundred kilovolts or more shall be constructed unless the State Corporation Commission shall, after at least thirty days' advance notice by publication in a newspaper or newspapers of general circulation in the counties and municipalities through which the line is proposed to be built, approve such line. As a condition to such approval the Commission shall determine that the corridor or route the line is to follow will reasonably minimize adverse impact on the scenic and environmental assets of the area concerned. If, prior to such approval, any interested party shall request a public hearing the Commission shall, as soon as reasonably practicable after such request, hold such hearing or hearings at such place as may be designated by the Commission. This section shall apply to such transmission lines for which rights-of-way acquisitions have not been completed as of April eight, nineteen hundred seventy-two. In any such hearing the public service company shall provide adequate evidence that existing rights-of-way cannot adequately serve the needs of said company. For purposes of this section, "interested parties" shall include persons residing or owning property in each county or municipality through which the transmission line is proposed to be built, and "environmental" shall be deemed to include in meaning "historic."

[2] *Certificate of convenience and necessity required for acquisition, etc., of new facilities.* — It shall be unlawful for any public utility to construct, enlarge or acquire, by lease or otherwise, any facilities for use in public utility service, except ordinary extensions or improvements in the usual course of business within the territory in which it is lawfully authorized to operate, without first having obtained a c[illegible]cate from the Commission that the public convenience and necessity require t[illegible]cise of such right or privilege. Such certificate shall be issued by the Com[illegible]n only after formal or informal hearing and after due notice to interested parties.

of individual load centers necessitates building the line in Virginia, and Company's evidence is conclusive that such growth in the Danville-Martinsville center now requires completion of the Jackson's Ferry-Axton segment.

NEED FOR CONSTRUCTION OF THE 765 KV SEGMENT FROM JACKSON'S FERRY TO AXTON

Evidence of the need for the proposed segment of the line was introduced at the hearing commencing on June 10, 1974. Three Company witnesses generally concluded that the present transmission system serving Danville-Martinsville could become inadequate as early as 1977. They said that the threatened inability of present facilities to satisfy demand is due to increasing use of electricity by present customers, in addition to population growth and expansion of industrial facilities dependent upon electric energy. The same witnesses appeared convinced that the proposed line was essential to strengthen the facilities serving western Virginia and to improve ties with neighboring utilities.

Mr. John W. Vaughn, Executive Vice President of Appalachian, testified that electric demand in the Danville-Martinsville area grew at an average, annual compounded rate of 13.8 percent between 1964 and 1973. Evidence supporting a conclusion that growth in electric demand will continue was not disputed, and included data on population growth, employment, per capita income, housing starts, and saturation levels of major appliances. The record particularly emphasizes a transition of the Danville area population from heavy dependence on agriculture employment to industrial employment. This industrial growth is considered a primary factor in the growth in electric demand, which demand was projected by Mr. Vaughn as follows:

1973 — 315,000 kw (actual)
1977 — 460,000 kw
1980 — 610,000 kw
1985 — 940,000 kw

Mr. Raymond M. Maliszewski, Assistant Head of Bulk Power Planning Division of American Electric Power Service Corporation, said that the line is needed not only for the Danville-Martinsville area but also the "Eastern Area" comprising virtually all of Company's service territory in Virginia. Mr. Maliszewski explained the various electric failures which can occur in both of these areas unless the proposed 765 kv line is installed.

Mr. Ralph D. Mudgett, Jr., Superintendent of Civil Engineering for Appalachian, explained why Axton was chosen for the location of a termination substation for the proposed line. A number of reasons were given for the selection, but Company clearly requires a location compatible with its existing facilities. Mr. Mudgett said:

> The study area [to locate the substation] selected was primarily based on an analysis of the system electrical performance of the Danville-Martinsville sub-area as presented in Part V of this Application. In order to most effectively integrate a new 765/138 kv station into the existing 138 kv transmission facilities in the areas, the new station should be installed in a manner to supply the present 138 kv lines traveling between Martinsville and Danville. Thus, the station should ideally be located east of Martinsville and west of Danville and be accessible to the present 138 kv lines.

The Commission's Staff presented two witnesses who addressed the need for the proposed line. Mr. Sam G. Berry, Assistant Professor of Finance in the School of Business at Virginia Commonwealth University in Richmond, evaluated demographic and economic factors[3] providing a basis for a projection of load growth.

[3] These factors included Population Growth: 1960-70; Household Growth: 1960-70; Urban Population: 1960-70; Population Projections: 1980 and 1990; Net Migration; Natural Increase Rates; Labor Force Participation Rates; Mfg. Employment Growth Projections; Mfg. Employment Vulnerability to Bus. Cycle; Wages and Income Levels; Family Incomes, Income Distributions; Per Capita Income Growth; Kwh Usage Per Household; Industrial Development Potential, New Industry; Poor Availability of Substitute Energy; Reductions in kwh Usage Per Household; Increased Energy Needs, Existing Industry.

Based on his study Mr. Berry concluded:

> I have performed what I consider to be a rather comprehensive independent inquiry into the demographic and economic development of the Danville-Martinsville Sub-area. In my evaluation of the Company's filed testimony, I have identified certain errors of commission and omission which I suggest could be avoided in future testimony. In the final outcome, however, I feel that the Appalachian Power Company's projections of electric peak demand for the Danville-Martinsville Sub-area are reasonable and conservative.

James R. Wittine, a Staff Engineer, testified that:

> The proposed EHV line is a logical extension of the existing 765 KV transmission facilities and is the most desirable from an economic and environmental viewpoint. The capability of a transmission circuit increases approximately as the square of its rated voltage. Since the cost of EHV transmission facilities as compared to lower voltage lines, increases less than its transmission capabilities, then the higher voltage transmission become intrinsically more economical. EHV transmission also enables an improved utilization of a given right of way in terms of load carrying capability.

Mr. Wittine's present testimony iterates our earlier findings at the conclusion of our investigation of the Roanoke-Lynchburg segment of the 765 KV line, approved by order of July 5, 1974, in which we concluded:

> The requisite power needs of the Lynchburg-Bedford area can be met in one of two ways. The needs can be satisfied by construction of a 765 kv line or by construction of a number of lines having a lower voltage capacity. Generally, installation of higher voltage lines is more economical than installation of lower voltage lines. One 765 kv transmission line may serve the purpose of several lines of lower voltage. Except for limitations such as the thermal capacity of conductors, one 765 kv line has the equivalent load-carrying capability of five 345 kv lines or thirty 138 kv lines. It also follows that use of high voltage lines constitutes a more efficient utilization of a given right-of-way in terms of load-carrying capability. A 765 kv network gives maximum capacity with fewer lines at a lower unit cost to provide the voltage requirements for an area. Fewer transmission lines would appear to minimize adverse impact upon the environment.

During the investigation of the Roanoke-Lynchburg segment of the line, we received considerable evidence on the nature of 765 kv lines pertaining generally to their effect on property owners in the vicinity of the line. That evidence supported various findings by this Commission, for example, regarding radio and television interference, potential danger from electrical "shock", noise, and ozone production. In the immediate proceeding, while several witnesses alluded to some of these alleged undesirable "side-effects" of a 765 kv line, no expert witnesses were offered by any participating party, and no evidence was otherwise offered tending to impugn our earlier findings that a 765 kv line, as proposed, is safe within the determination of present technology.

This leaves unanswered, however, the second fundamental question raised by this application, namely, what is a proper route for the line to follow?

Evidence intended to establish an appropriate route for the line was presented by Company, the Commission's Staff, and interested citizens; in fact, separate routes were developed and proposed by all three. Opportunity was given for interested citizens during the hearings to express their views of the advantages and disadvantages of the several proposals. The Commission viewed from the air the routes proposed by Staff and Company.

On the basis of the evidence received from Company and the Commission's Staff, we issued an order on July 5, 1974, determining that a 765 kv transmission line from Jackson's Ferry to Axton was needed. The order further authorized Company to file its proposed route for the line, thus commencing the second phase of the investigation.

THE ROUTES STUDIED

Company filed with the Commission its "preferred route", and as a part of the proposal showed three alternatives which had been considered and rejected. (See Map, Appendix "A"). Company's preferred route leaves Jackson's Ferry in an easterly direction, crossing the Wythe-Carroll County line, thence through Carroll and Floyd counties and across the Floyd-Franklin County line. In Franklin County said route bears in a southeasterly direction, crossing the Franklin-Henry County line and continuing in a general southeasterly direction to the proposed substation near the community of Axton in Henry County. The "preferred route" is approximately 72 miles in length and was expected to cost approximately $25,128,000 (estimate at time of the hearing), excluding the cost of terminal equipment at Jackson's Ferry and Axton.

Appalachian's three rejected alternative routes were designated N-1, N-2, and S-1 (Map, Appendix "A"). N-1 is an alternative to the first 46 miles of Company's preferred route, beginning at Jackson's Ferry, and was estimated to have a total length of 52 miles (a net increase of 6 miles over the preferred route). The estimated cost of N-1 amounts to $18,497,000, as opposed to $16,054,000 for the 46 mile segment of the preferred route.

S-1 is an alternative to a 26 mile segment of the preferred route terminating at the proposed Axton substation site. S-1 was estimated to have a total length of 34 miles (a net increase of 9 miles over the preferred route). The cost was estimated at $11,866,000, compared to $9,074,000 for the 26 mile preferred segment.

N-2 is an alternate which would move the line in a northeasterly direction farther from Martinsville. It was estimated that N-2 would add two miles and approximately $700,000 over the preferred route.

Selection of the preferred route was said to have resulted from field surveys and studies by Company personnel, consultation with state and federal agencies,[4] and the findings of consultants who utilized a computer program. In seeking its proposed route, Company studied all, or portions, of the Counties of Carroll, Wythe, Pulaski, Montgomery, Floyd, Patrick, Franklin, Henry and Pittsylvania, and the municipalities of Martinsville, Ridgeway, Rocky Mount, Floyd, Stuart, Ferrum and Hillsville.

Mr. Mudgett, Company's Superintendent of Civil Engineering, identified two primary factors limiting the location of a route. First, its proposed crossing of the Blue Ridge Parkway must be acceptable to the Blue Ridge Parkway Administration. The latter indicates that it will not approve a crossing at, or south of, the Rocky Knob Recreation Area located on the Blue Ridge Park right-of-way. Company's preferred route is approximately five miles north of the proposed crossing. Second, Appalachian witnesses testified that it is necessary that the line pass near Henry, Virginia, which lies in the southeast corner of Franklin County and in the area of possible future substation sites and existing 138 kv lines which could b econnected to any station so located. The Company's preferred route satisfies this need.

Maps were introduced by Mr. Mudgett of Appalachian to demonstrate the consideration given, in the routing of the line, to such factors as housing density, critical environmental areas, scenic highways, both State and national historic landmarks, airport locations, together with projected land use through 1990 for residential, commercial, and industrial growth. Photographs were introduced illustrating the apparent visual impact on certain important environmental areas such

[4] Appalachian contacted 18 governmental agencies to obtain information on historic landmarks and critical environmental areas. Among these were various state and local planning commissions, eight County Boards of Supervisors, the National Park Service, Virginia Division of State Parks, Virginia Division of State Planning and Community Affairs, Virginia Division of Forestry, Virginia Commission of Game and Inland Fisheries, Virginia Historic Landmarks Commission, Virginia Outdoor Recreation Commission, Virginia State Highway Department, Virginia State Water Control Board, Virginia Department of Agriculture and Commerce, Governor's Council on the Environment, and Virginia Department of Conservation and Eco[illegible] Development.

as the Blue Ridge Parkway. Mr. Mudgett further testified that particular attention was given also to the Philpott Dam and Reservoir, Fairy Stone State Park, City of Martinsville Reservoirs, and the Turkeycock Mountain Critical Wildlife Habitat.

Mr. Mudgett explained the application of six criteria in selecting the proposed substation site. Company requires a site which is central to the Danville-Martinsville load area, which is close to existing 138 kv circuits, which offers suitable terrain for station construction, which is in close proximity to a railroad, which is removed from densely developed residential areas, and one upon which Company can build in an environmentally acceptable manner. Company's study of the Axton area yielded eight possible locations. With the aid of consultants the particular site now proposed was selected.

The consultants employed by Company are associated with Virginia Polytechnic Institute and State University (VPI). Under a grant from Appalachian, researchers from the school's Center for Urban and Regional Studies undertook studies to evaluate and select a station site at Axton and Henry, a suitable crossing of the Blue Ridge Parkway, and a transmission line corridor from Jackson's Ferry to Axton. Leonard J. Simutis, Associate Professor and Director of the Computer Applications Laboratory at the College of Architecture at VPI, appeared as a witness to explain the study and recommendations.

For the corridor, a study area of approximately 2,800 square miles located in Carroll, Wythe, Pulaski, Montgomery, Floyd, Patrick, Franklin, Henry and Pittsylvania Counties was used. The area was divided into grids of one square kilometer. Information such as the physical, environmental, economic, social and aesthetic characteristics of the area was collected and coded for each grid. More particularly, this information included such items as land slope, streams, rivers and reservoirs, critical environmental areas, highways, urbanized areas, historic sites, public and private recreational facilities, and airport zones. According to Mr. Simutis, "25 data variables, with a range of up to 10 distinct data attributes for each variable, were collected and coded for the study."

Mr. Simutis explained that, "By use of computer mapping, displays of the data variables were used like traditional constraint maps, pointing to areas where locations of transmission facilities would be difficult because of social or aesthetic conflict." The VPI computer program was used to evaluate various routes in light of four general considerations, namely, (1) social disruption ti existing and proposed development; (2) environmental disruption during construction and maintenance; (3) costs of land acquisition, construction, and maintenance; and (4) the visibility of transmission facilities in areas of recreational, scenic, and historic importance. After explaining the route alternatives considered in the study, Mr. Simutis concluded that, "The corridor which we found to be most desirable was evaluated by the Company and accepted as its preferred route."

The VPI group also aided in the selection of the Axton site. Data was gathered relating to an area of 60,000 acres. Within this tract, Company selected eight optional sites considered suitable for station development. Of the site finally selected Mr. Simutis said:

> The site alternative number 7 [proposed by Appalachian] had above average suitability in six of the eight models; below average suitability was indicated in two of the environmental models. Specific characteristics of the site which contributed to these results include the proximity of the site to Cascade Creek and relatively steep slope conditions on the fringe of the station site location. With careful consideration of these environmental constraints during detailed site engineering studies, there is no question that potential environmental disruption can be avoided during the construction and operation of the station site proposed by Appalachian Power Company.
>
> While alternative number 7 was not judged as the most acceptable alternative based on the application of the site selection criteria developed in our studies, with careful handling of site development and construction, the objective of minimizing disruption to society and the environment can be achieved.

The VPI group also evaluated the proposed Blue Ridge Parkway crossing. Mr. Simutis testified that "Using both conventional techniques and computer-aided approaches, milepost 106 [proposed Appalachian crossing] is the most acceptable crossing point along the Blue Ridge Parkway in terms of minimizing the aesthetic and environmental disruption potentially associa[illegible]h the proposed

transmission line." Mr. Simutis further said that, while the VPI group collected data which would aid in the selection of a station site at Henry, Virginia, no specific sites were analyzed.

While Company witnesses testified that a number of alternatives were examined, evidence was introduced only on alternates N-1, N-2, and S-1. Any one of the three would add to the cost of construction. Although N-1 offers no major environmental problems, it runs through an area which is being considered for a major dam site and reservoir. It was estimated that N-1 would require the acquisition of approximately 170 additional acres of land compared to the preferred route.

Although N-2 would cost more and use approximately 49 more acres of land, it passes through a much less populated area than does the preferred route. The primary objection to the N-2 segment is its passage through the Turkeycock Mountain Critical Wildlife Area, a designated wildlife area lying to the northeast of the City of Martinsville.

The S-1 alternative not only would require considerably more land acquisition, with attending greater cost (adding 8 miles to the total length of line), but would pass through relatively densely populated areas and areas in which considerable population growth is projected.

A separate and independent study was undertaken by the Commission's Staff through the funding of a study by Dr. Robert H. Giles, a professor in VPI's Division of Forestry and Wildlife Resources, has extensive education and broad practical experience in fields relating to man and his environment. On behalf of the Staff, Dr. Giles previously evaluated transmission line locations in Case Nos. 11655 and 10758, considered jointly as *Application of Virginia Electric and Power Company and Application of Potomac Edison Company*. His methodology was generally explained in an opinion and order entered in those cases on May 15, 1975. 1975 *Report of the State Corporation Commission*, page 64.[5]

Dr. Giles and his staff used a computer-based system to evaluate the effects of a 765 kv line and to develop an alternative route. An area comprising approximately 2.5 million acres was studied. This area was divided into a grid of cells. Each cell forms a square with each side being one-third of a kilometer (approximately 1,100 feet) in length. The study area thus contained over 102,000 cells of about 25 acres each.

Data covering 12 acres of concern was collected and assigned to each cell. These areas consisted of: (1) construction cost to the ratepayer, (2) scenic and visual impacts, (3) vegetative change, (4) wildlife community impacts, (5) aquatic community impacts, (6) recreation utility, (7) historic impacts, (8) residential use impact, (9) agricultural use impact, (10) forestry impact, (11) institutional use impact (schools, etc.), and (12) industrial use impact. Data derived from 41 variables[6] was used to determine the significance of the 12 areas of impact upon each of the 102,000 cells. This data was obtained from a series of topographic maps, including maps maintained by the Virginia Historic Landmarks Commission and the Division of Outdoor Recreation.

[5] This decision was affirmed by the Virginia Supreme Court in *Rappahannock League v. Vepco*, 216 Va. 774 (1976).

[6] The 41 variables included: total depreciated likely construction costs (1973), cell observability, large streams, small streams, lakes and ponds, swamps, wooded marsh, submerged marsh, national forest, miscellaneous forest, state-owned natural resources, orchards, agricultural field, residential area, urban area, slope class 5-15 degrees, slope class greater than 15 degrees, registered historic sites, recommended historic sites, proposed historic sites, existing public parks, potential public parks, existing public natural areas, potential public natural areas, existing private non-commercial recreation areas, potential private non-commercial recreation areas, existing commercial recreation, potential commercial recreation, existing scenic easements, potential scenic easements, potential recreation resources, existing major hiking trails, proposed trails, existing boat landings, existing beaches, potential beaches, south — facing slopes, south-west facing slopes, ridge tops, national park, cell observability from roads and historic sites.

Dr. Giles assigned weights of importance to each of the above 12 areas of concern. As he testified, "These weights were assigned by me based on my best professional judgment." It is obvious from a review of Dr. Giles' credentials that he is qualified to weight environmental factors in their order of importance to society. He generally describes the weighting process as representing, "A society tending to value highly scenery, historic sites, and recreational opportunities while simultaneously protecting their homes, working areas, and food producing areas." The 41 variables, measures of the 12 areas of study, are applied within the mathematical ranking (weighting) assigned to the 12 areas.

Three features of Dr. Giles' study are of primary importance. First, he emphasized that the Staff's program was not necessarily intended to produce a final solution, but to serve as an aid in evaluating alternative corridors. Second, other factors being equal, the program possessed an inherent bias towards shorter routes requiring less land. Third, significant weight advantage was given to building the 765 kv line along existing rights-of-way, recognizing the legislative mandate in Code § 56-46.1, viz., "In any such hearing the public service company shall provide adequate evidence that existing rights-of-way cannot adequately serve the needs of said company."

The computer-based program, with weighted information ascribed to each of the 102,000 cells, was used to identify the route with the lowest probable long-term environmental and construction costs. The program favored constructing the 765 kv transmission line parallel to present facilities along existing rights-of-way (See Map, Appendix "A"). Dr. Giles stated that the computer-based program "specifies that paralleling, all environmental, cost, and aesthetic factors considered, is the least bad solution."

Dr. Giles used the computer-based program to evaluate the impact of Applicant's preferred route and various combinations of the preferred route with the alternate segments (N-1, N-2, and S-1). While this evaluation also shows paralleling to be preferable, Appalachian's preferred route is favored over its combination with any of the alternate segments.

In rebuttal to the above, an Appalachian witness testified that use of the Giles' route would add more than $10,000,000 to the total cost of the project. Part of this additional cost would arise from the need for special angle towers to accommodate the sharp turns in the Giles route. Further, according to Company, paralleling would require the acquisition of approximately 1,963 acres of additional right-of-way, compared with 1,745 acres needed for Company's preferred route. The additional land would be needed because the Giles route is longer than Company's preferred route, and because the existing right-of-way is adequate only for an 88 kv line, which is constructed on towers approximately 60 feet tall — requiring right-of-way width of approximately 60 feet. In contrast, a 765 kv line requires towers up to 190 feet in height and a right-of-way approximately 200 feet wide.

Company claims that the Giles route, further, would have a detrimental affect on rivers or streams and on critical environmental areas. Company explains that its preferred route crosses only three rivers,[7] or major streams, while the Giles route crosses seven, some more than once, and one as many as six times. Company says that the Giles route, in paralleling the existing 88 kv line, passes through five critical environmental areas, while the preferred route passes through only two.

Two areas crossed by the Giles route prompting the most significant local opposition were Claytor Lake and Stanleytown-Bassett. By paralleling the existing 88 kv line, the proposed location of the 765 kv line would impinge upon both that major recreational area with its several hundred permanent residences and upon the densely populated area comprising Stanleytown and neighboring Bassett.

The Citizens for the Preservation of Floyd County employed Mr. Richard Alan Whalen, a graduate of VPI with a degree in Civil Engineering, to develop a proposed corridor for the line to follow. Mr. Whalen applied the "concept of discontinuity of usage", a methodology intended to take advantage of changes in land use. Mr. Whalen describes it as follows:

[7] West Fork Little River, Big Reed Island Creek and Little Reed Island Creek; each of the three is crossed once by the Company's preferred route.

Discontinuity is a phase between areas of radically different land use generally defined in the study area by a change in the land form. Discontinuity lines are found between the upper rim of a steep river valley and the higher, flatter agricultural and residential areas. The discontinuity line can also be found along slopes of mountains where farmland gives way to woodland.

Mr. Whalen's thesis is that constructing a line to follow discontinuity lines will minimize the adverse impact upon the aesthetics of an area. The route he developed does not pass through Floyd County (See Map, Appendix "A"). Generally, it follows a southeasterly course from the Jackson's Ferry substation through Carroll County, turns and follows an easterly course through Patrick and Henry Counties, thence in a northeasterly direction in Henry County to the proposed Axton, Virginia subsite.

Appalachian opposed the Whalen route with rebuttal testimony. Mr. Mudgett described the route as having significant environmental disadvantages in comparison with Company's preferred route. A letter from the National Park Service, United States Department of the Interior, was introduced which stated that the crossing of the Blue Ridge Parkway by the Whalen route appeared unacceptable to the Park Service and compared unfavorably with the proposed crossing by Company's preferred route. Mr. Mudgett further testified that the Whalen route would adversely affect a number of important geographic areas, landmarks, and streams; for example: the proposed route crosses Periwinkle Mountain, in the vicinity of the Jackson's Ferry station, at a very high elevation that would be visible to motorists; it follows the Big Reed Island Creek Valley (a designated environmental area), paralleling the creek for a distance of approximately 12 miles while crossing it four times; the proposed route intersects the Blue Ridge Parkway south of Rocky Knob in the vicinity of Groundhog Mountain (golf course and resort community) and could be seen for miles from the Groundhog Mountain Parkway Overlook (artist's rendition of overlook introduced as exhibit); it would traverse very steep, bare, ragged terrain in the Pinnacles of Dan critical environmental area, and would cross the South Mayo River several times within a distance of a few miles where the route parallels the river.

Mr. Mudgett says the distances are inaccurate that were used by Mr. Whalen in explaining the proximity of his route to a number of sites. He contends that the Whalen route is well within ten miles from the Reynolds Homestead and the Jack's Creek Covered Bridge, while Mr. Whalen had said the distance to be more than ten. Company's rebuttal witness also says, "Mr. Whalen's mileages listed for proximity to airports are inaccurate because he apparently did not consider the influence zones surrounding the airports."

Company's testimony further shows the Whalen route passing to the south of Martinsville in a highly urbanized area, and to the southeast of Martinsville through an area designated for future heavy urbanization by the West Piedmont Planning District Commission. In summary, Company's evidence shows construction along the proposed Whalen route would be more costly than company's preferred route (18 miles longer), would have a greater adverse effect on the environment, and would pass through more densely populated areas and projected areas of intensive development.

In addition to a route proposal, Mr. Whalen urges that Appalachian abandon its plan to construct a 765 kv line from Jackson's Ferry to Axton and, instead, to construct a 765 kv circuit from Axton in a northwesterly direction to a station at Dixie Caverns (Funk Station) — west of Roanoke (See Map, Appendix "B"). Mr. Whalen expressed his views of the cost, environmental, and technical advantages of constructing the circuit to Dixie Caverns.

Rebutting the foregoing, Company says the construction of an Axton-Funk circuit would be more costly than its proposal, and would be inconsistent with its operation of present facilities and long-range plans. Mr. Maliszenski says that while a line from Axton to Dixie Caverns is 22 miles shorter than that between Jackson's Ferry and Axton, any savings would be more than offset by the absence of a 765 kv station at Funk. According to the witness, "Funk is a 345/138 kv stepdown station supporting the Roanoke 138 kv system." The Whalen proposal would necessitate constructing a new 765 kv station at Funk — at an estimated cost of $20,000,000, or approximately $4,000,000 more than the sum saved by the shorter route.

However, the Axton-Funk circuit, appears particularly objectionable to Company because of its incompatibility with Company's operational and planned facilities. Company contends that its 765 kv line originating north of Virginia and passing into Western Virginia, together with the loop planned for Virginia, is needed to strengthen ties with the generating and transmission facilities of the AEP system. According to Company, the Virginia territory is presently tied to that system by three Extra High Voltage supply circuits — the Jackson's Ferry-Cloverdale 765 kv, Amos-Funk-Cloverdale 345 kv, and the Cloverdale-Lexington-Dooms 500 kv interconnection with VEPCO, along with some lower voltage 138 kv facilities (See Map, Appendix "B"). Mr. Maliszewski said that the Whalen proposal does not help integrate the system and would not significantly increase electric reliability to Virginia; he concluded that "the Funk-Axton arrangement does not introduce a fourth independent channel into the Eastern Area since its beginning point is within the Eastern Area."

A modification to its preferred route was introduced by Company which would affect the crossing of U. S. Route 220 in Franklin County. As initially proposed, the preferred route would cross U. S. Route 220 approximately one mile north of the Franklin-Henry County line. The modification later filed would move the line southward to cross U. S. Route 220 just north of the Franklin-Henry County line.

A primary purpose of the public hearing on July 5, 1977, in the Franklin County Circuit Courtroom was to receive evidence and comments on the proposed modification of the crossing of Route 220. At this hearing A. L. Philpott and David Worthy appeared as counsel to citizens opposed to the foregoing change. Those citizens had employed counsel, together with an engineer, to develop and present an alternative plan. During the hearing a recess was taken to permit a discussion of the crossing between Company's counsel and counsel for the citizens. Through the efforts of counsel a satisfactory agreement was reached. Immediately after the hearing had reconvened, Company's counsel announced withdrawal of the proposed crossing of U. S. 220 just north of the Franklin-Henry County line.

LOCAL HEARINGS AND PUBLIC WITNESSES

The Commission conducted hearings in the City of Martinsville and in Franklin and Floyd Counties to give individuals affected by the proposed transmission line construction a reasonable opportunity to critique the proposed corridors. As one might expect, some witnesses opposed any construction of a line near their home or business. Some witnesses offered valuable insight into foreseeable effects the proposed construction and operation could have on a particular locality which was not revealed by expert witnesses or by maps received in evidence. Such testimony is a great aid to the Commission in this investigation.

The diverse interests of affected citizens were well represented. A number of persons identifying themselves as farmers appeared as interveners, including Mr. Charles Hall, President of the Floyd County Farm Bureau.

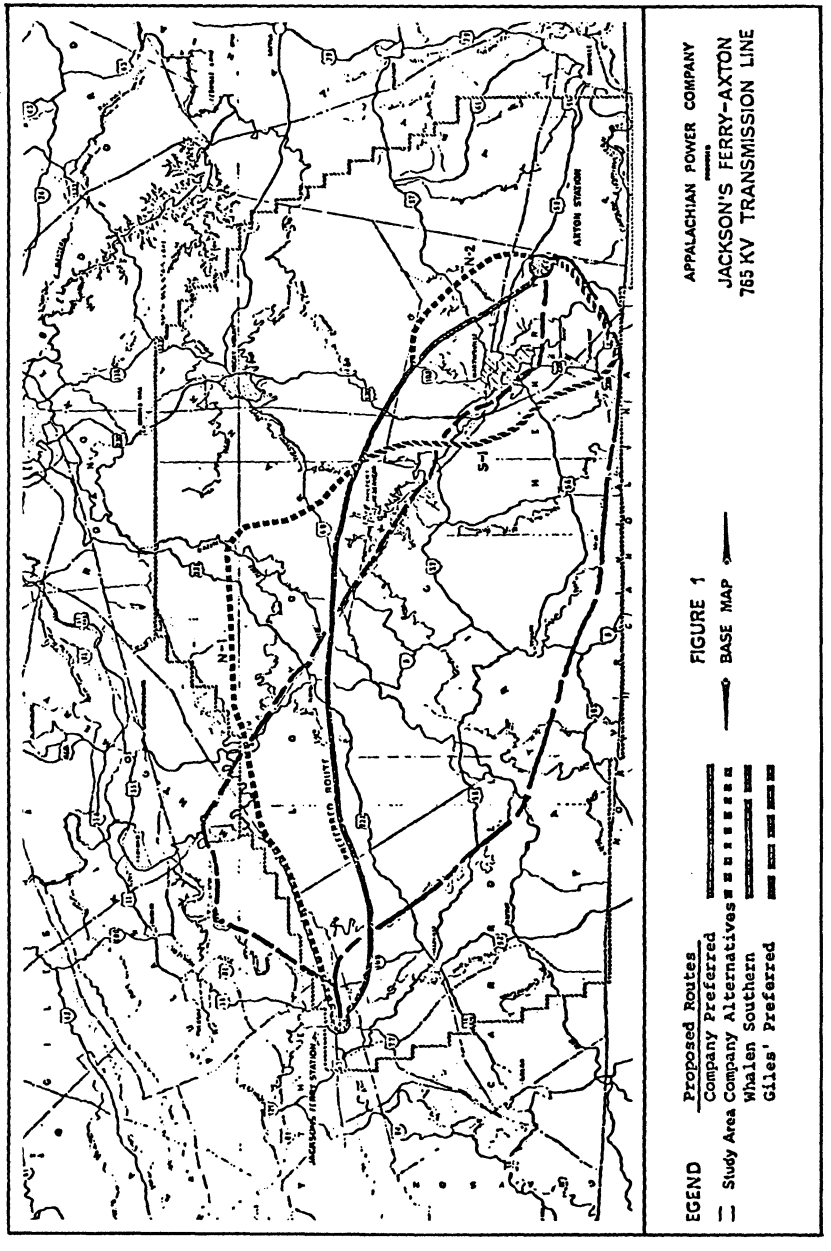
Representatives appeared on behalf of the Boards of Supervisors of Henry, Franklin, Patrick, Floyd, Pulaski, and Carroll Counties. In some instances, Counties were represented by both their members and their counsel.

Local industry, particularly in the Stanleytown-Bassett area, was represented, including Bassett Furniture Industries, Stanley Furniture Company, Anthony Brothers Lumber Supply Company, Coleman Furniture Company, Camp Branch Plantation, Frith Construction Company, Inc., E. I. DuPont de Nemours, First National Bank of Martinsville, and Hubbard Lumber Corporation.

Lawrence Barnett, Executive Director of the Piedmont Planning District Commission, appeared in its behalf. Representatives of local civic organizations spoke in behalf of their membership. Several members of the Virginia General Assembly appeared, as did many citizens, *pro se*.

While the public witnesses appeared fully aware of all the proposed routes, four particular segments seemed to draw intense opposition. This opposition focused upon: (1) that portion of the Giles route which would cross the Claytor Lake area, (2) the portion of the Giles route which would cross the Stanleytown-Bassett area, (3) that portion of Company's preferred route in the vicinity of Martinsville (most persons favored the N-2 segment as an acceptable alternative), and (4) Company's proposed crossing of U. S. Route 220 in Franklin County.

APPENDIX A



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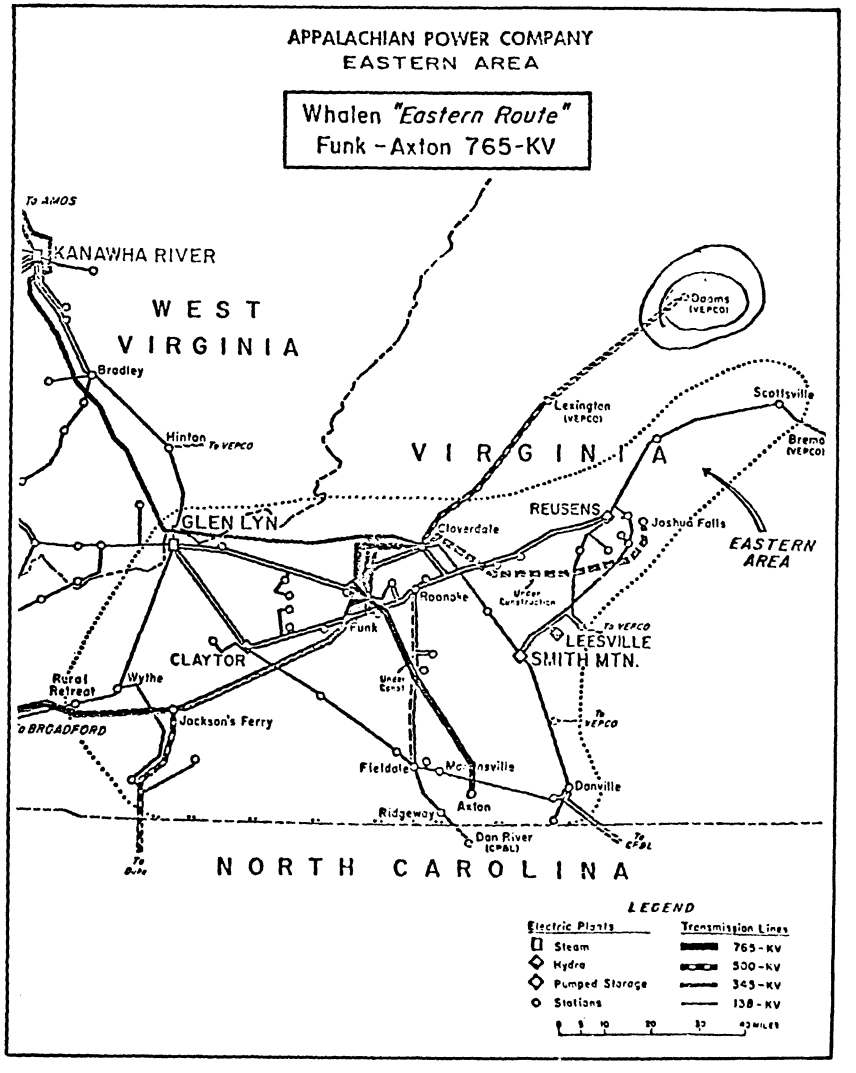
APPENDIX B



DECISION

The Commission's prior order herein, dated July 5, 1974, determined there to be ". . . a need for a 765 kv transmission line extending from Appalachian's existing Jackson's Ferry substation to serve the electrical load in the Danville-Martinsville area." The reasons for that decision appear hereinabove.

We are satisfied, and do so find, that existing rights-of-way cannot serve the needs of Company in constructing the proposed facilities. In fact, the Commission's Staff studied and proposed an alternative route which would have used the existing right-of-way of an 88 kv transmission line for much of the requisite route. Both Appalachian and affected citizens opposed this alternative. Company witnesses testified that the aforesaid Staff route would require the use of more land, would be longer, and would cost more. Citizens testified that its use would conflict with existing land uses in the Claytor Lake and Stanleytown-Bassett areas.

Citizens for the Preservation of Floyd County offered in evidence the Whalen Eastern Route after the Commission determined the need for a 765 kv line from Jackson's Ferry to Axton. Company objected to our consideration of that route, which would not terminate at Jackson's Ferry, but would run from Axton to the vicinity of Dixie Caverns to the west of Roanoke. The Commission did receive the evidence relating to the Whalen Eastern Route, but, having considered same, we conclude that the Whalen proposal would unnecessarily increase costs and would preclude optimum usage of existing facilities. Adoption of the Whalen proposal could necessitate the construction of facilities not otherwise needed.

Additional evidence negates against adoption of the Whalen Southern Route. Aside from land usage equal to, or exceeding, that required by Company preferred route, the evidence shows this route to have adverse impact on the environment greater than Company's preferred route. In seeking to avoid Floyd County, the Whalen route would pass through developing areas of Henry County.

We have analyzed all routes and we find the evidence supports adoption of the corridor proposed by Company, modified to follow the N-2 alternative. This route passes in the vicinity of Henry and will permit Company to make optimum use of existing facilities, in addition to minimizing the future construction of additional facilities. Further, we are confident that the preferred route, as modified, will reasonably minimize adverse impact on the environment of the State.

The N-2 modification of Company's preferred route was strongly supported by citizens who would be affected by the transmission line. Construction along the N-2 modification will avoid residential and business concentrations.

While the Commission herein approves construction along the aforesaid corridor, we shall retain jurisdiction to approve right-of-way location. The preferred route of Company, for the most part, is a corridor 9,000 feet wide. Company shall now define and present to the Commission the 200 foot wide right-of-way it proposes to acquire for construct of the 765 kv line.

In accordance with the above findings IT IS ORDERED:

(1) That Appalachian's proposed preferred corridor, with the N-2 modification, to terminate at the proposed substation site at Axton, Virginia, be, and same hereby is, approved for the construction of the 765 kv line from Jackson's Ferry;

(2) That Appalachian prepare and submit for the consideration of the Commission maps and plans establishing the 200 foot wide — more or less — right-of-way the 765 kv line will follow;

(3) That this proceeding be continued generally, subject to further order of the Commission.

ORDER OF FEBRUARY 14, 1978

BY ORDER dated January 4, 1978, the Commission found that the evidence in this proceeding supported adoption of the original corridor proposed by Appalachian Power Company (hereinafter referred to as "Appalachian" or "Company"), as modified to follow the N-2 alternative, for construction of a 765 kv transmission line from its present substation at Jackson's Ferry in Wythe County, Virginia, to a proposed substation site near Axton in Henry County, Virginia. Accordingly, the Commission approved the original corridor, as modified, for construction of the line, having determined that this corridor

minimizes adverse impact on the scenic and environmental assets of the area concerned. While it approved construction within this corridor, the Commission retained jurisdiction to approve the location of the 200-foot wide right of way the 765 kv line will follow from Jackson's Ferry to Axton and ordered Appalachian to prepare and submit for the consideration of the Commission maps and plans indicating the location of the right of way.

In accordance with the Order dated January 4, 1978, the Company has filed with the Clerk of the Commission a folio of topographic maps indicating the approximate location (no field survey having been performed) of the 200-foot right of way which the 765 kv line will follow within the approved corridor. Having examined and considered the map folio filed by the Company, the Commission finds that this folio complies with the directive of its Order dated January 4, 1978, that the Company prepare and submit maps and plans establishing the approximate location of the right of way. The Commission is further of the opinion that interested parties should have the opportunity to examine the folio and that two local hearings should be held for the purpose of giving interested parties the opportunity to comment on the proposed right of way location.

Accordingly, IT IS ORDERED:

(1) That the folio of topographic maps filed by the Company with the Clerk of the Commission, indicating the right of way's approximate location and having been found herein to be in compliance with the aforesaid directive set forth in the Commission's Order dated January 4, 1978, shall be filed in this proceeding.

(2) That, subject to the Commission's final approval of the right of way the 765 kv transmission line will follow, the Company shall construct the line on the right-of-way proposed by the Company in its map folio without deviation of more than 200 feet to either side of the proposed 200-foot right-of-way, and shall make such deviation only if it is deemed necessary by the Company for engineering reasons; but in no event shall the right-of-way on which the line is constructed be greater than 200 feet in width.

(3) That by February 27, 1978, the Company shall have the map folio available in each of its business offices located in Pulaski, Christiansburg, Rocky Mount and Fieldale for examination by interested parties, and on the dates indicated below shall also have a knowledgeable Company representative present in each of those four offices to explain the folio to interested parties and to answer inquiries, during the hours from 8:00 a.m. to 11:30 a.m., from 12:30 p.m. to 4:30 p.m., and from 7:00 p.m. to 9:00 p.m.:

a. March 13, 1978—Pulaski, Virginia.

b. March 14, 1978—Christiansburg, Virginia.

c. March 16, 1978—Rocky Mount, Virginia.

d. March 17, 1978—Fieldale, Virginia.

(4) That public hearings shall be held on March 29, 1978, in the Circuit Courtroom of the Montgomery County Courthouse in Christiansburg, Virginia, and on March 30, 1978, in the City Council Chambers in the City of Martinsville Municipal Building, Martinsville, Virginia, for the purpose of hearing comments from interested parties on the Company's proposed location of the right-of-way the 765 kv transmission line from Jackson's Ferry to Axton will follow. Each of these hearings shall be held in two sessions; the first session shall begin at 2:00 p.m. on the designated day and conclude at 4:30 p.m.; the second session shall begin at 7:00 p.m. and conclude at 9:00 p.m.

(5) That the Company shall give notice of the availability of the folio for examination by interested parties in its four business offices and shall also give notice of each of the aforesaid hearings, the location of each hearing, and a general description of the location of the 200-foot right of way proposed in the folio filed with the Commission, said notices to be given by publishing the following notice once a week for two successive weeks in the display advertising section of a newspaper or newspapers of general circulation in the counties through which the proposed right of way passes, with the first publication to be forthwith after receipt of this Order:

NOTICE TO THE PUBLIC THAT THE STATE CORPORATION COMMISSION WILL HOLD HEARINGS ON APPALACHIAN POWER COMPANY'S PROPOSED LOCATION OF THE 765 kv TRANSMISSION LINE RIGHT OF WAY FROM THE EXISTING JACKSON'S FERRY SUBSTATION TO A PROPOSED SUBSTATION SITE NEAR AXTON, VIRGINIA

Appalachian Power Company has obtained the approval of the Virginia State Corporation Commission for construction of a 765 kv transmission line from a substation at Jackson's Ferry in Wythe County to a substation which Appalachian proposes to construct near Axton in Henry County. The Commission has approved construction of the line within a corridor running from Jackson's Ferry through the Counties of Wythe, Carroll, Floyd, Franklin and Henry to the proposed substation site at Axton. The Commission has retained jurisdiction only to approve the location of the 200-foot wide right of way on which the 765 kv line will be constructed. Pursuant to the Commission's directive, Appalachian has filed with the Clerk of the Commission a folio of topographic maps indicating the proposed location of this 200-foot wide right of way.

[A general description of the proposed 200-foot wide right of way in each of the counties involved, as shown on the Company's map folio, shall be set forth at this point in the notice. The notice to be published in a particular county need set forth only a description of that portion of the proposed right of way located in that county.]

The Commission has determined that, subject to its final approval of the right of way the transmission line will follow, Appalachian shall construct the line on the right of way as proposed by the Company in its folio without deviation of more than 200 feet to either side of the proposed 200-foot right of way, and shall make such deviation only if it is deemed necessary by the Company for engineering reasons. In no event, however, shall the right of way on which the line is constructed be greater than 200 feet in width.

Appalachian shall have the map folio available by February 27, 1978, in each of its business offices located in Pulaski, Christiansburg, Rocky Mount and Fieldale for examination by interested parties and, in addition, on the dates indicated below, Appalachian will have a knowledgeable Company representative present in each of those four offices to explain the map folio and to answer inquiries, during the hours from 8:00 a.m. to 11:30 a.m., from 12:30 p.m. to 4:30 p.m., and from 7:00 p.m. to 9:00 p.m.:

a. March 13, 1978—Pulaski, Virginia.
b. March 14, 1978—Christiansburg, Virginia.
c. March 16, 1978—Rocky Mount, Virginia.
d. March 17, 1978—Fieldale, Virginia.

In addition to making available these map folios for examination by interested parties, the Commission has scheduled hearings in Christiansburg and Martinsville to give interested persons an opportunity to comment on Appalachian's proposed location of the right of way the line will follow. The hearing in Christiansburg is scheduled for March 29, 1978, in the Circuit Courtroom, Circuit Court of Montgomery County, Courthouse, Christiansburg, Virginia. The hearing in Martinsville is scheduled for March 30, 1978, in the City Council Chambers located on the second floor of the City of Martinsville Municipal Building, Church Street, Martinsville, Virginia. Each of these hearings will be held in two sessions; the first session will be from 2:00 p.m. to 4:30 p.m. and the second session will be from 7:00 p.m. to 9:00 p.m. Interested persons desiring to appear at either hearing to offer their comments on the location of the right of way should file on or before March 24, 1978, with the Commission, Attention: William C. Young, Clerk, State Corporation Commission, P. O. Box 1197, Richmond, Virginia 23209, a written statement setting forth name, address, and intention to appear. Each such interested person should indicate whether he or she prefers to appear in the afternoon or evening session. An approximate time for the appearance of each such person will then be scheduled. Appalachian will have at each of the hearings a map folio showing the location of the proposed right of way.

APPALACHIAN POWER COMPANY

(6) That a copy of this Order shall be served forthwith by the Company on the Commonwealth's Attorney, Chairman of the Board of Supervisors, and Attorney, or equivalent officers, of every county through which the Company's proposed right of way passes, such service to be made either (a) in person or by delivery to the customary place of business or to the residence of the person served, or (b) by certified mail, return receipt requested.

(7) That proof of the above publication and service shall be furnished to the Commission for filing in this proceeding at or before the local hearings on March 29 and 30, 1978.

ORDER OF MARCH 7, 1978

BY ORDER entered January 4, 1978, the Commission retained jurisdiction in this proceeding to approve the location of the 200-foot wide right of way for construction of a 765 kv line from Jackson's Ferry in Wythe County, Virginia, to a site near Axton in Henry County, Virginia, and ordered Appalachian to prepare and file maps and plans indicating the location of this right of way. In accordance with that order, the Company filed with the Clerk of the Commission a folio of topographic maps indicating the approximate location of the right of way, and on February 14, 1978, the Commission, having found after examination and consideration of the folio that it complied with its order of January 4, 1978, ordered the folio to be filed in this proceeding.

Having made further study of the folio filed by the Company, the Commission is of the opinion that the Company's proposed location of the right of way in the vicinity of the crossing of U.S. Route 220 in Franklin County, Virginia, deviates from the Company's original proposed route. The Company has thus prepared and filed with the Clerk of the Commission a revised cover and revised sheets nos. 17A, 18A and 19A to its folio to show the right of way it proposes to acquire along the original proposed route in the vicinity of the crossing of U.S. Route 220. Upon examination and study of these revised sheets, the Commission finds that they accurately display the Company's original proposed route in the vicinity of U.S. Route 220.

Accordingly, IT IS ORDERED:

(1) That the revised cover and revised sheets nos. 17A, 18A and 19A shall be filed in this proceeding and shall be substituted for the original cover and original sheets nos. 17, 18, and 19 of the map folio filed with the Commission Clerk on February 10, 1978, and ordered filed in this proceeding by the Commission order dated February 14, 1978.

(2) That, subject to the Commission's final approval of the right of way the 765 kv transmission line will follow, the Company shall construct the line on the right of way as shown on revised sheets nos. 17A, 18A and 19A without deviation of more than 200 feet to either side of the proposed 200-foot right of way, and shall make such deviation only if it is deemed necessary by the Company for engineering reasons; but in no event shall such right of way on which the line is constructed be greater than 200 feet in width.

(3) That on or before March 9, 1978, the Company shall substitute the aforesaid revised sheets in each of the map folios which, pursuant to the Commission's order of February 14, 1978, have been available since February 27, 1978, for inspection by interested parties in the Company's business offices located in Pulaski, Christiansburg, Rocky Mount and Fieldale, Virginia; the Company shall have its personnel explain the revised folios to interested parties requesting information at the sessions heretofore ordered to be held at the Company's offices in Pulaski, Christiansburg, Rocky Mount and Fieldale on March 13, 14, 16 and 17, 1978, respectively; and the Company shall further have the revised folios available for inspection by interested parties at the public hearings heretofore ordered to be held on March 29 and 30, 1978, in Christiansburg and Martinsville, Virginia, respectively.

(4) That the Company shall give supplemental notice of the filing of the revised cover and revised sheets nos. 17A, 18A and 19A and the substitution of

these sheets in the folios previously filed with the Commission and located in the Company's four business offices, as aforesaid, said supplemental notice to be given by publishing the following notice at least once in the display advertising section of a newspaper or newspapers of general circulation in Franklin County, Virginia, with the first publication to be forthwith after receipt of this order:

NOTICE TO THE PUBLIC OF REVISION OF PROPOSED TRANSMISSION LINE RIGHT OF WAY LOCATION FOR APPROXIMATELY 5.7 MILES IN FRANKLIN COUNTY

Pursuant to an order entered by the State Corporation Commission on January 4, 1978, Appalachian Power Company ("Appalachian") filed with the Commission a folio of topographic maps indicating the proposed location of the 200-foot wide right of way to be acquired for construction of a 765 kv line from Jackson's Ferry to Axton. The folio has been available since February 27, 1978, for inspection by interested parties in Appalachian's business offices located in Pulaski, Christiansburg, Rocky Mount and Fieldale.

The Commission, after further study of the map folio filed by Appalachian, has determined that the proposed right of way location from a point approximately 4.3 miles west of U.S. Route 220 to a point approximately 1.4 miles east of U.S. Route 220 in Franklin County, Virginia, deviates from Appalachian's original proposed route. Accordingly, Appalachian has filed, and the Commission has accepted for filing, a revised cover and revised sheets nos. 17A, 18A, and 19A to the folio to show the right of way Appalachian proposes to acquire along its original proposed route for this total distance of approximately 5.7 miles in the vicinity of the crossing of U.S. Route 220. Appalachian will construct the line on the right of way as shown on these revised sheets, subject to the Commission's final approval of the right of way the transmission line will follow and further subject to the engineering deviation of not more than 200 feet to either side of that right of way as is permissible under the Commission's February 14, 1978 order.

The original proposed route has been described in earlier public notices, was in part the subject of a public hearing held in Richmond on September 23, 1974, and was the subject of a public hearing held in Rocky Mount on July 5, 1977.

On or before March 9, 1978, the aforesaid revised sheets shall be available for inspection by interested parties as part of the map folios on file in Appalachian's business offices in Pulaski, Christiansburg, Rocky Mount and Fieldale, Virginia; shall be explained by Appalachian personnel to interested parties requesting information at each session heretofore ordered to be held during the hours of 8:00-11:30 a.m., 12:30-4:30 p.m., and 7:00-9:00 p.m. at the Company office located in Pulaski on March 13, in Christiansburg on March 14, in Rocky Mount on March 16, and in Fieldale on March 17; and shall be available for inspection by interested parties at the public hearings heretofore ordered to be held on March 29 and 30, 1978, in Christiansburg and Martinsville, Virginia, respectively.

APPALACHIAN POWER COMPANY

(5)That a copy of this order shall be served forthwith by the Company on the Commonwealth's Attorney, Chairman of the Board of Supervisors, and Attorney, or equivalent officers, of Franklin County, Virginia, such service to be made either (a) in person or by delivery to the customary place of business or to the residence of the person served, or (b) by certified mail, return receipt requested.

(6) That proof of the above publication and service shall be furnished to the Commission for filing in this proceeding at or before the local hearings on March 29 and 30, 1978.

ORDER OF APRIL 4, 1978

ORDER DENYING PETITIONS FOR RELOCATION OF HEARING

On March 29, 1978, Citizens for the Preservation of Floyd County ("CPFC") filed a petition and on March 30, 1978, filed a second petition. Both petitions regard the Commission's scheduling of two hearings — one in Christiansburg, Virginia, for March 29, 1978, and the second in Martinsville, Virginia, for March 30, 1978. These hearings were scheduled by Commission Order of February 14, 1978, to receive evidence on the 200 foot right-of-way which Appalachian Power Company proposes for the construction of a 765 kv transmission line extending from Jackson's Ferry to Axton, Virginia.

The first petition of CPFC, dated March 22, 1978, was not filed with the Commission until March 29, 1978, because, according to petitioner in a cover letter, "The Petition, which was sent to you by special delivery mail on March 22, 1978, was returned for insufficient postage. We immediately took it back to the Post Office and sent it again . . . ."

In the first petition, CPFC petitioned the Commission "to relocate the right-of-way hearings to a site in Floyd County." Among other reasons, for its request, CPFC cited the distance which residents of Floyd must travel to attend a hearing in Christiansburg.

On March 30, 1978, the second petition was filed with the Commission. The second petition was a supplement to the first petition. In this petition CPFC requested that;

> Because the hearings are presently scheduled for March 29th and 30th, it may not be possible for the Commission to relocate those hearings. Therefore, CPFC hereby petitions the Commission, in the alternative, to schedule an additional hearing at the Commission's convenience in Floyd County. As reasons therefore, CPFC incorporates all other reasons given in its Petition for Relocation of Right-of-Way Hearing dated March 22, 1978.
>
> THEREFORE, CPFC respectfully petitions this Commission to schedule an additional hearing for Floyd County or, in the alternative, to relocate the right-of-way hearings to a site in Floyd County.

AND, NOW, THE COMMISSION, after consideration of CPFC's request, and reasons given therefor, is of the opinion that the petition should be denied. The Commission has held a series of hearings on Appalachian Power Company's proposal to construct a 765 kv transmission line. Hearings have been conducted both in Richmond and in local courts in the area which would be affected by the proposed line. In addition to the hearings in Richmond, hearings have been held in the municipalities of Martinsville, Floyd, and Rocky Mount, for the purpose of receiving the comment of interested parties on the corridor proposed for the route of the transmission line.

After aproval of a corridor for the transmission line to follow, the Commission determined that two additional hearings would be held on the 200 foot right-of-way proposed by the Company within that corridor. The corridor which the line is to follow runs through a number of counties, including Wythe, Carroll, Floyd, Franklin, Henry, and Pittsylvania. The locations of the two hearings were based on, among other factors, proximity to the areas that would be affected, access by highways, and an effort to avoid preference of one county over the others. Accordingly, the Commission decided to have one hearing in Martinsville, Virginia, and the second in Christiansburg, Virginia.

IT IS ORDERED that the petitions of CPFC shall be, and they hereby are, denied.

ORDER OF DECEMBER 12, 1978

The following order of affirmation having been received, it is ordered that the same be here recorded, and is in the following words and figures:

VIRGINIA:

In the Supreme Court of Virginia held at the Supreme Court Building in the City of Richmond on Wednesday the 22nd day of November, 197

Citizens for the Preservation of

Appellant

Floyd County, Inc.,
against Record No. 780600
S.C.C. No. 10848-A
Appalachian Power Company and Appellees.
State Corporation Commission

Upon an appeal of right from a judgment rendered by the State Corporation Commission on the 4th day of January, 1978.

For reasons stated in writing and filed with the record, the court is of opinion that there is no error in the judgment appealed from. Accordingly, the judgment is affirmed. The appellant shall pay to the appellees thirty dollars damages and the costs expended herein.

This order shall be certified to the State Corporation Commission.

A Copy,
Teste: /s/ Allen L. Lucy
Clerk

Appellees' costs:

Attorney's fee	$50.00
Cost of printing brief — not to exceed $200 for each appellee — Code § 14.1-182	?

Teste: /s/ Allen L. Lucy
Clerk

CASE NO. 19010

Application of
Stoney Creek Utilities Corporation

21

To amend certificates of public convenience and necessity previously issued in this proceeding.

ORDER OF JANUARY 31, 1978

By earlier Order in this case, Stoney Creek Utilities Corporation ("Applicant" or "Stoney Creek") was issued Certificate No. W-205 which authorizes it to provide water service in a specific geographic area and Certificate No. S-60 which authorizes it to provide sewerage disposal service in a specific geographic area. Applicant now proposes to amend both of these certificates as a result of developments in a public hearing on Applicant's request for an increase in rates and charges.

In Case No. 19853, Stoney Creek filed with the Commission an application for an increase in rates and charges for water and sewerage disposal service; a public hearing was held on that application on October 3, 1977. Subsequent to that hearing it was brought to the Commission's attention that the testimony of Applicant was based, in part, on providing service to customers in territory which Applicant is not authorized to serve. Applicant then requested that it be authorized an interim increase in rates until it could be heard on a request to amend Certificates Nos. W-205 and S-60.

On January 6, 1978, Stoney Creek filed in this proceeding an application requesting authority to amend both Certificates W-205 and S-60. Stoney Creek proposes to reduce the geographic area in which it provides water service by eliminating from its service area territory lying to the southwest of Basye and a small area lying to the west of Stoney Creek Church.

Stoney Creek proposes to increase the geographic area in which it provides sewer service by adding to its service area four sections shown on maps filed with its application. Additionally, Stoney Creek proposes to remove from its sewer service territory a small area lying to the west of Stoney Creek Church.

By Order dated January 30, 1978, entered in Case No. 19853, Company was authorized to put into effect on a temporary basis increased rates for water and sewerage disposal service. A hearing is scheduled in Case No. 19853 for 10:00 a.m., March 1, 1978, to further consider the Company's request in that case for an increase in rates and charges.

APPENDIX 2

INITIAL STAFF REPORT FOR THE JOINT SUBCOMMITTEE STUDYING THE ADEQUACY OF PRESENT PROTECTIONS AFFORDED THE CITIZENS OF VIRGINIA WHEN HIGH VOLTAGE TRANSMISSION LINES ARE CONSTRUCTED AND MAINTAINED

Prepared by

Terry Mapp

Division of Legislative Services

CONTENTS

AUTHORITY FOR STUDY

Pursuant to Senate Joint Resolution No. 26 of the 1984 General Assembly a joint subcommittee was established "to study the adequacy of present protections afforded the citizens of Virginia when high voltage electrical transmission lines are constructed and maintained." A copy of this resolution appears as Appendix 1 of this report.

The resolution states that the study will include an evaluation of "the adequacy of the present State Corporation Commission oversight, the health and safety rules and regulations, and the statutes in the Code of Virginia in protecting the citizens..."

OBJECTIVES

It would appear that the joint subcommittee should strive to achieve the following objectives:

(1) A clear understanding of the potential safety hazards and health effects of high voltage electrical transmission lines;

(2) An understanding of the extent of State Corporation Commission oversight and rules and regulations;

(3) An understanding of Virginia laws which relate to electrical transmission lines;

(4) Identification of possible problems with those laws and consideration of changes to the statutes; and

(5) The drafting of appropriate legislation to effect any changes in the law which the joint subcommittee deems appropriate.

SCHEDULE

The subcommittee will hold its first meeting at 10:30 a.m. on June 8, 1984 in Senate Room 4 of the General Assembly Building. It is respectfully requested to complete its work by November 15.

Senate Joint Resolution No. 26 states "the joint subcommittee shall complete its work and make any recommendations it deems appropriate to the 1985 Session of the General Assembly." If the subcommittee concludes its deliberations by November 15, its staff will have ample time, prior to the beginning of the 1985 Session, to draft any legislation or reports desired by the subcommittee, and its members will have more time to devote to other matters.

GENERAL OVERVIEW

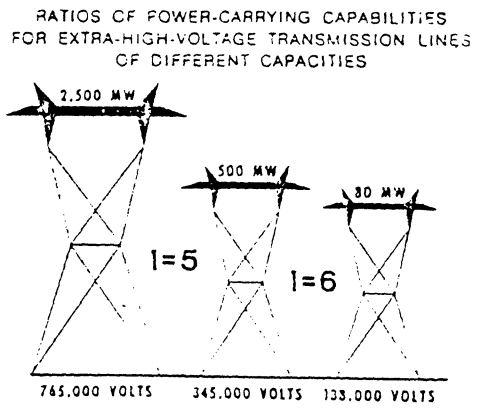
In recent years the move toward higher transmission line voltages has escalated in response to the nation's increasing demand for electric power. Concerns over the environmental and health and safety effects of such lines have grown considerably.

In 1916 when 138-kv was initiated, the average residential customer used only 250 kilowatt hours of electricity a year. Today, the average household uses more than 8,000 kilowatt hours a year.

Transmission line voltage has increased from 138-kv in 1916 to 345-kv in 1953 to 500-kv in 1964 to 765-kv in 1969. Research is underway today on ultra-high-voltage in the range of 1,000-1,500-kv. Each move to a higher voltage has served to minimize the costs of transmitting electricity and to improve transmission efficiency.[1] One 765-kv has the carrying capability of five 345-kv or thirty 138-kv lines.[2] See Figure 1. The 765-kv line makes more productive use of land than its 138-kv equivalent as it requires only 1/15 of the land area per kilowatt of carrying capacity. Also, construction cost per kilowatt for 765-kv is approximately 1/10 the cost for 138-kv.[3] Higher voltages, therefore, can transmit larger amounts of electricity over greater distances, and are able to do it more cheaply.[4]

FIGURE 1

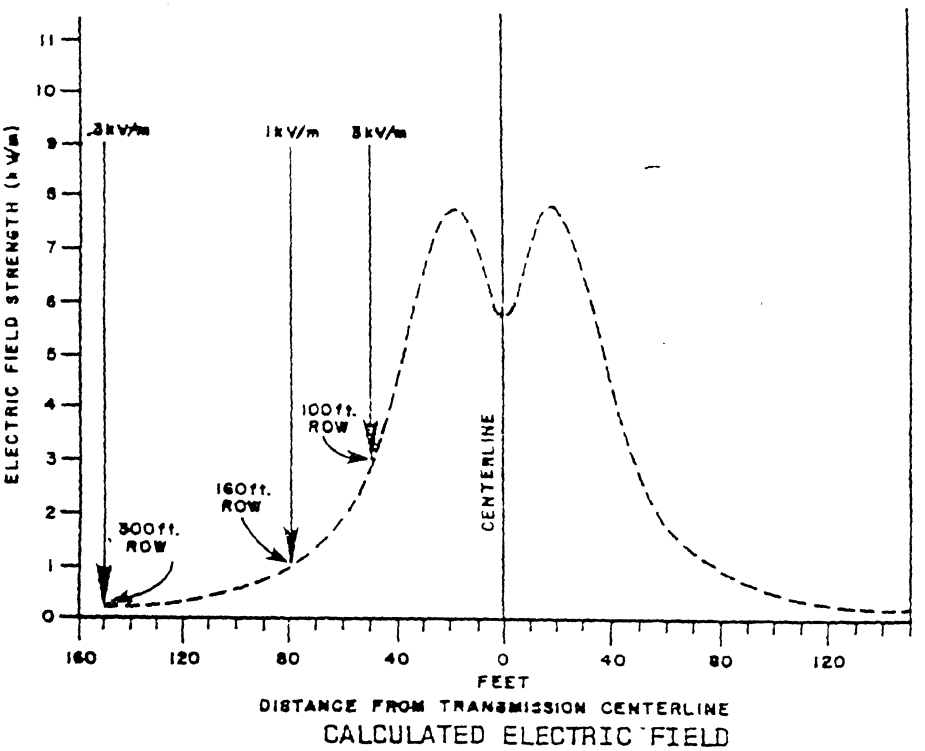
Extra-high-voltage transmission systems are the 'super-tankers' of the electric industry. In comparison to systems of equal capacity constructed from smaller sized equipment, EHV systems require fewer tower installations, deliver power more efficiently, take up less land area, and offer economy-of-size.[5]



The most noticeable environmental effects of transmission lines of 230-kv and below are related to the physical presence of the lines. With voltages of 345-kv and

greater effects from corona discharge and electric and magnetic fields become important factors.[6] When corona, the ionization of air at the surface of a high voltage conductor, occurs it creates audible, crackling noises and some radio and television interference. The corona effects are intensified during wet weather. During dry weather, the corona noise is covered up by general background noise and during wet weather it may be heard by only those individuals near the right-of-way. Studies on another corona effect, the production of ozone, have shown that the amount of ozone associated with power lines is insignificant.[7]

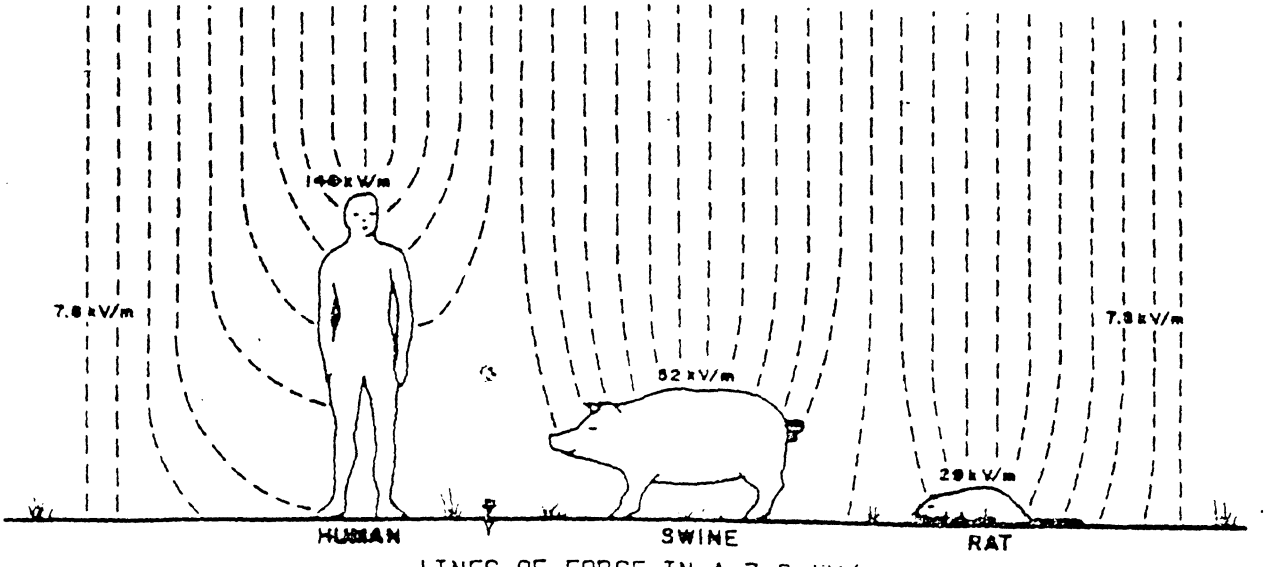
Most of the interest in transmission line effects has focused on electric rather than magnetic and corona effects. An electric field is produced by any energized wire, including the wiring found in households. The size of the fields, both electric and magnetic, depends upon the line operating voltage and current, and the size and configuration of the conductors.[8] Although the field strength dissipates as one moves away from the line, it does not reach its natural level until approximately one-half mile from the line. However, normal household wiring and appliances produce electrical fields equivalent to transmission line field effects found 300 to 400 feet from the line.[9] Figure 2 shows the magnitude of an electric field calculated for a typical double circuit 500-kv transmission line.



CALCULATED ELECTRIC FIELD STRENGTH IN kV/m AT 1 METER ABOVE GROUND AT MIDSPAN FOR A TYPICAL DOUBLE CIRCUIT 500-kV BPA TRANSMISSION LINE OPERATING AT 550-kV.

Electric fields are intensified near projections such as people or animals.[10] Figure 3 shows the electric fields at the body surface.

FIGURE 3



LINES OF FORCE IN A 7.8 kV/m FIELD ARE CONCENTRATED ON UPPER BODY PARTS WHICH INTENSIFIES THE ELECTRIC FIELD AT THE BODY SURFACE (VALUES ABOVE EACH FIGURE).

HEALTH AND SAFETY EFFECTS

As mentioned earlier, in recent years there has been increasing concern over the health and safety effects of high voltage transmission lines. A report reviewing the issues concerning the possible effects on human health from exposure to electric and magnetic fields of a high voltage transmission line which was submitted to the Montana Department of Natural Resources and Conservation in February 1983 is an excellent source of information on the biological effects of transmission lines. A copy of this report is attached as Appendix 2.

A recent study conducted by researchers at the University of Texas Health Center at San Antonio has indicated that "exposure to electromagnetic fields such as those associated with high voltage power transmission lines may not be totally harmless." In their laboratory tests they found that when subjected to living cells, electromagnetic fields "stimulated the growth rate of human cancer cells and induced changes in white blood cells from dogs." They noted however, that no conclusions concerning the health effects of electromagnetic fields may be drawn from their tests. Microbiologist Wendell Winter called the tests "the first steps in identifying a chain reaction of events which ultimately may affect cellular growth and functions in both humans and animals."[11]

Utility operating experience as well as overall results of extensive research programs indicate that it is not

likely transmission line electric fields have harmful effects on people and animals.[12] Many researchers, however claim there are significant health problems resulting from exposure to magnetiac and electric fields. Further study of the possibility of subtle long-term effects resulting from such exposure, therefore, is needed.

In addition to the possible direct effects of transmission lines on health, the use of dangerous herbicides to clear the lines of plant growth may cause serious health problems. In the past, utilities commonly used Tordon, also known as Agent White, which spreads into the water systems and affects the soil permanently. Boston Edison used Silvex, which contains dioxin, and Tordon in fourteen times the recommended dosage to clear some lines. Cattle in Michigan were destroyed as the result of dioxin contamination. The Environmental Protection Agency is currently trying to make a temporary ban on Silvex and Agent Orange permanent. Prior to the temporary ban on Agent Orange, Appalachian Power Company sprayed Agent Orange over homes, streams, and at least one school while clearing an area for 765-kv lines. Utility officials say that the ban could cost them $22 million.[13]

The recent interest in Virginia over the health effects and safety hazards of high voltage transmission lines was prompted by an application filed in 1974 by Appalachian Power Co. with the State Corporation Commission to construct a 765-kv powerline from Jackson's Ferry, near Wytheville, to Axton in the Martinsville area. The application was

considered over a four-year period during which public hearings were held. In 1978 the Commission approved the construction of the 765-kv line. The case was appealed by the Citizens for the Preservation of Floyd County to the Supreme Court of Virginia. The Supreme Court upheld the Commission's decision.

Since then, Appalachian Power has acquired rights-of-way and spent $46 million in the construction of the power line. The citizens of the counties through which the line passes are still unhappy about the Supreme Court's decision and, through the Hillsville Board of Supervisors, have petitioned the Commission to halt construction on the line.[14]

FEDERAL RESPONSIBILITIES

Currently, there is no single federal agency which is responsible for assuring public safety in the proximity of overhead transmission lines. No federal standards or guidelines limiting high voltage transmission line field exposure have been established. The federal government, however, is currently researching the bioeffects of transmission lines.

In 1976 the Interagency Advisory Committee on Electric Field Effects from High Voltage Lines, comprised of representatives of over a dozen federal agencies, was formed to review ongoing research and to exchange other information related to powerline field bioeffects. Also in 1976, a Task Force for Research Planning in Environmental Health Sciences

was established to coordinate research on the bioeffects of high voltage transmission line fields. Although the Environmental Protection Agency has the oversight responsibility for transmission lines health and environmental regulations it has not been funded to carry out that responsibility.[15] Most of the research conducted at the federal level on health and environmental effects is supported by the Department of Energy.

STATE REGULATIONS

All states have adopted the National Electrical Safety Case or some modification thereof, which limits body current resulting from possible electrostatic affects of high voltage lines.[16] Forty-one states have some sort of procedures they follow in determining the location of transmission lines. Attached as Appendix 3 is a state by state review of the siting procedures. Although these procedures vary considerably from state to state, a common thread exists - "the regulation of the location of facilities in order to meet the demand for energy and ensuring that environmental safeguards are met."[17]

Most of the forty-one states are limited in their jurisdiction by the size of the facility:

. "Twenty-two states are limited in jurisdiction by the capacity of generating plants and the voltage of transmission lines;

. seven states have unlimited jurisdiction over facilities in terms of facility capacity or site size;

. four other states have unlimited jurisdiction over transmission lines;

. three states are just the opposite on jurisdiction; unlimited as to transmission lines, but limited in jurisdiction over power plants;

. one state has no jurisdiction over power plants and only limited jurisdiction over transmission lines;

. in four other states jurisdiction limits are not clear; and

some states have jurisdiction not only over power plants and transmission lines, but also petroleum production and storage facilities, coal gasification and liquification plants, hydro and thermal facilities and other related energy facilities."[18]

. In each state, there are exemptions to the jurisdiction of the siting agencies which include municipalities, co-generation facilities and modifications or additions to existing facilities.

Thirty-one of the states having siting procedures make provisions for hearings on the facility siting. Again, the nature of the hearings vary widely:

. Two states have a very limited hearing process;

. one state holds hearings only when a demonstrated environmental impact is involved;

. one state holds hearings only when residential areas will be affected

. another allows the hearing process to be suspended when emergencies are involved; and

. yet another provides that the utilities hold the hearings.[19]

The environmental impact of the siting of the facility and its actual need are assessed by every state. Often the potential health hazards are considered in the environmental impact assessment. Of the forty-one states with siting processes, thirty-five issue permits or certificates of public need and convenience.

In order to determine the actual need for the facility, thirty-five states require some type of energy forecasting procedures and reports. However, only eight include public hearings as part of the forecasting process. The forecasting and reporting requirements again vary from state to state:

.. In twenty-three states forecast reports are prepared only by the utilities;

.. by the utilities and at least one state agency in eleven states; and

.. only by the state agency in one.[20]

Two other states, not included in the thirty-five mentioned above, prepare or accept forecasting reports on an informal basis. In one of these states the agency prepares the report and in the other, the utilities prepare reports at their own discretion.[21]

As of June 1978, twenty-five states require the preparation of environmental impact statements which address electrical effects specifically for proposed overhead power lines. The remaining States assess the health and safety

effects on a case-by-case basis.[22]

The staff has received legislation and rules and regulations from various states, yet because of their volume, they have not been included. Judging from the information received thus far, Minnesota appears to have one of the most comprehensive siting laws. Attached as Appendix 4 is a pamphet describing their routing and siting process.

In Virginia, the State Corporation Commission has jurisdiction over the facilities of electric utilities. Such jurisdiction appears in §§ 56-265.2 and 56-46.1 of the Code. Section 56-265.2 makes it unlawful for public utilities to construct, enlarge or acquire any facilities, other than ordinary extensions or improvements within its service territory, without first obtaining a certificate of public convenience and necessity from the Commission. For many years the section was interpreted as requiring approval for construction outside of the service territory. Latter facilities were considered "ordinary extensions".[23] In 1972, § 56-46.1 which requires the Commission to consider environmental factors in the approval of the construction of electrical utility facilities, including certain electrical transmission lines, was enacted. A copy of this section is attached as Appendix 5.

Legislation passed by the 1984 General Assembly, House Bills 88 and 511, amended this section so that it applies only to overhead transmission lines of 150 kilovolts or more.

Although the statute requires the Commission to

establish conditions to minimize the environmental impact of the lines, it discharged this obligation by adopting guidelines promulgated by the Federal Power Commission (today, the Federal Energy Regulatory Commission).[24] The purpose of these guidelines is to "provide the most acceptable answers from an environmental standpoint for the design and location of rights-of-way and transmission facilities".[25] A memorandum, a copy of which is attached as Appendix 6, was sent to all electric utilities in July of 1972 explaining the procedures under the Utility Facilities Act and § 56-46.1. The guidelines promulgated by the Federal Power Commission were also included in the memo.

RESOURCES

For the purposes of this study, the following appear to be excellent sources for testimony, data or other materials which the subcommittee may desire:

State Corporation Commission, Department of Health; electric utilities including VEPCO, Appalachian Power Co., Potomac Electric Power Co., Washington Gas Light Co.; consumer groups including the Citizens for the Preservation of Floyd County, the Virginia Citizens Consumer Counsel; the Virginia Municipal League; the Virginia Association of Counties.

PRESENTATION BY DR. K. R. SHAH

BEFORE

THE JOINT LEGISLATIVE SUBCOMMITTEE

STUDYING THE SAFETY OF HIGH VOLTAGE LINES

OCTOBER 12, 1984

Shah & Associates, Inc.
4 Professional Drive, Suite 148
Gaithersburg, Maryland 20879

My name is Kanu R. Shah. I am the President of Shah & Associates, Inc., of Gaithersburg, Maryland. I have either designed or investigated more than 5,000 miles of overhead high voltage lines throughout the free world. A copy of my resume describing my qualifications is attached.

In my testimony today, I will discuss:

(1) the need of the proposed 765 kV line from Jackson's Ferry to Axton, and

(2) economical alternates to 765 kV line.

I will prove to this subcommittee that the proposed 765 kV line alternate will transfer about 10 times more power than required in the Danville-Martinsville area and will cost customers of the Appalachian Power Company (APCo) more than $8 million per year than other comparable 345 kV line alternate. In the event that this subcommittee would decide to affirm construction and operation of the Jackson's Ferry-Axton 765 kV line because it was approved by the State Corporation Commission, I will discuss:

(3) safety and health related effects of the 765 kV line, and

(4) recommendations of mitigation measures required to assure acceptable electrical effects of the 765 kV line on the public living or working in close proximity of the 765 kV line.

I. <u>THE PROPOSED 765 kV TRANSMISSION LINE HAS THE CAPACITY TO TRANSPORT 10 TIMES MORE POWER THAN REQUIRED BY DANVILLE-MARTINSVILLE AREA</u>.

The proposed 765 kV transmission line from Jackson's Ferry to Axton has the capacity to transport 5,170 MW. Neither the report written by the APCo titled "Jackson's Ferry-Axton-Part I" nor the recent testimony by Mr. Simmons of APCo before this subcommittee gives any data about the required power transfer capability of the line between Jackson's Ferry to Axton. Because of this, I have based my analysis on the report titled "Forecast of Electricity Demand in the Appalachian Power Company Service Territory" by Energy Systems Research Group, Inc. The forecast of electrical load demand in the Danville-Martinsville area is to 547 MW by 1990. Thus, the proposed line is capable of carrying about 10 times more power than required in the Danville-Martinsville area.

2. THE PROPOSED 765 kV TRANSMISSION LINE DOES NOT MEET THE REQUIREMENT OF "PUBLIC CONVENIENCE AND NECESSITY."

In order to keep utility charges "just and reasonable," electric utility facilities must be "adequate, efficient, just and reasonable." The report I cited earlier, namely, "Jackson's Ferry-Axton 765 kV Transmission Line - Part I" was written by APCo in 1974 using the load data and distribution of power between various load centers for years prior to 1974. Today, i.e., October 12, 1984, electrical peak load demand on which transmission planning is done is quite different than in 1974. Some of the available and acceptable options to reduce peak load demand such as load management, dispersed generation, and energy conservation were not available and "laughed at"

in 1974. In 1974, the word of the electric transmission system planner was almost "gospel" regarding future transmission developments. He was never intelligently questioned about the economics and viable options by the electric utility regulators who were supposed to represent the interest and welfare of the public who, as you know, is ultimately responsible for payment for the decisions made by the electric transmission system planners. In this environment, the proposed 765 kV line was planned as a continuation of the 765 kV transmission network that American Electric Power Corporation (AEP), parent company of APCo, was building in other states. This power company, AEP, was saying in Indiana during Rockport to Sullivan 765 kV hearings, in which I participated from 1978 to 1984, that other states including your state, Virginia, have approvals for constructing 765 kV transmission lines and they want to complete the 765 interconnections even though they did not have need to transport as much power on 765 kV for which it was originally designed when some of the power plants they were building were not cancelled. They could have used other cheaper transmission options but since they were already building a 765 kV transmission network in Virginia, Ohio and West Virginia, they argued that if they would build one line - Rockport to Sullivan - at a different voltage, it would provide a "bottle neck." You know that the same story is being told to you by Mr. Simmons, a representative of APCo.

I want to give you one technically and economically viable option to the proposed 765 kV line. This option is to build single

circuit 345 kV line. This line has the capacity to transport 940 MW power while, as you know, peak load power of 547 MW is forecasted for the Danville-Martinsville area. The annual cost of constructing, using 20 per cent carrying charges, this 345 kV line is estimated at $5,840,000. The annual cost of losses--Joule heat and corona--is estimated at $6,194,600. Thus, the total annual cost of the 345 kV is only $12,034,600. Now, I want you to compare it with the annual cost of constructing and operating the proposed 765 kV transmission line. The annual cost of constructing a 765 kV line, using 20 per cent carrying charges, is estimated at $11,680,000. The annual cost of losses--Joule heat and corona--is estimated at $8,980,000 or about $8 million per year more than the 345 kV transmission line. It is true, as I discussed before and APCo representative, Mr. Simmons, discussed before you, that 765 kV can carry about 10 times more power than required by 1990 but it will cost to the customers of APCo, every year, about $8 million more than the alternate that I proposed. Simply put, when one needs to carry a small load, he buys a mule and not an elephant which can carry much more load than a mule but will cost much more to buy, feed, and maintain. To conclude, I have shown you that the proposed 765 kV alternate is much more expensive than the other technical and viable options and does not meet the requirements of the utility law which states that the utility facilities must be "adequate, efficient, just and reasonable"

to keep utility charges "just and reasonable." Because of this, I recommend to this subcommittee to reexamine the approval of the Jackson's Ferry-Axton 765 kV line until it is conclusively shown that the proposed 765 kV is the only technically and economically viable option and will result in reduced electric rates to the customers of APCo.

3. MAXIMUM ELECTRIC FIELD LEVELS PRODUCED BY THE PROPOSED 765 kV LINE DESIGN ARE NOT IN COMPLIANCE WITH THE NATIONAL ELECTRICAL SAFETY CODE.

All overhead transmission lines produce electric and magnetic fields. However, when the voltage level increases at a faster rate than the increase in minimum conductor to ground clearance, the electric field levels increase. These electric fields induce charges on metallic objects. When a person contacts these metallic objects, these electric charges are transferred to the person and he receives electric shock. To protect the person from possible electrocution, for the first time in 1977, the National Electrical Safety Code (NESC) established, under Rule 232B, a maximum limit of electric shock current of 5 milliamperes which corresponds to the electric field level of about 7.0 kV per meter for a large tractor trailer used in the state of Virginia.

The proposed 765 kV line design is the same as used by AEP in the other states. It will prodice for a 40 foot minimum design clearance, the maximum electric field level of about

12.5 kV per meter when the line is operating at 765 kV and 13.12 kV per meter when the line is operating at 5 per cent overvoltage or 805 kV for which it is designed. Thus, it is clear that this 765 kV line does not meet NESC requirements.

The parent company of APCo, AEP, argues that the 765 kV is never going to be loaded to its capacity and hence the clearance will be higher than the design clearance and hence the electric fields will be lower and hence the line will be in compliance with the National Electrical Safety Code. (Please note that the power company is now admitting that the 765 kV line will not be loaded to its capacity!)

Recently, we surveyed permissible electric fields under the overhead power lines in various states. Table III of the report titled, "Electrical Environmental Regulations of Overhead Transmission Lines" gives recommended electric field levels which is reproduced here as Exhibit I. Please note that not a single state has recommended 13.12 kV per meter electric field level that this line will produce.

After the 765 kV is constructed, assuming of course that the inquiry into the need issue is in the affirmative the public will not have any control on the maximum amount of power transfer over this 765 kV line. Because of this, to assure compliance with the NESC for protecting the public from electrocution, I recommend to this subcommittee (1) to mandate APCo to maintain minimum conductor-to-clearance under all electrical

loading conditions so as to comply with the NESC, and (2) if, in future years, clearances do not comply with NESC, then the cost of modifications should not be permitted in the rate base. If APCo does not accept my recommendation (2) above, then mandate them to maintain a maximum electric field level of 7.0 kV/m.

4. ELECTRIC FIELD LEVELS PRODUCED BY THE PROPOSED 765 kV LINE ARE EXCESSIVE AND HENCE MUST BE REDUCED.

We need overhead power transmission lines to transport power economically. These lines, as discussed earlier, produce electric fields. Hence, the lines are generally designed to produce acceptable electric fields, not only within the right-of-way, but also at the edge of the right-of-way where the responsibility and authority of the power company legally end and authority and responsibility of the land owner legally begin. Electric fields within the right-of-way are brought into compliance with NESC by adjusting clearances as I discussed earlier, and the electric fields at the edge of the right-of way are brought into acceptable levels economically by acquiring adequate right-of-way width, and in a few isolated cases by devising additional mitigation measures.

Three questions arise:

1. What is the magnitude of electric field produced at the edge of the proposed 765 kV line?
2. Why do we want to limit electric fields at the edge of the right-of-way?

3. What is the range of acceptable electric field levels?

4.1 Electric field level produced by the proposed 765kV line:
At the edge of the right-of-way, i.e., at 100 feet from the center line of the right-pf-way, the electric field produced by the proposed 765 kV line is 4 kV per meter when the line is operating at 765 kV and 4.2 kV per meter when the same line is operating at 5 per cent overvoltage, i.e., at 805 kV. These are the highest levels of electric fields produced at the edge of the right-of-way by any transmission line operating in this country.

4.2 Electric field levels at the edge of the right-of-way must be reduced to acceptable levels to reduce electric shock hazards and to reduce personal liability of the property owners.
The electric field levels that will be produced by this line will result in shocks to persons when they walk on grass, touch metallic objects such as motor vehicles, tractors, fences, rain gutters, work in the garden, ride bicycles, etc. In a 1980 survey made by Indiana & Michigan Electric Co., sister company of APCo, out of 114 property owners living or working in proximity of 765 kV lines (some lines operating for more than 10 years) 52 property owners complained about electric shocks. It is understandable if one receives shock or gets hurt if he trespasses on someone else's property, but it does not make sense when he is getting shocks while he is on his property. It does not make sense when he has to protect

himself against receiving shocks on his property and spend time every day to ground the vehicle that he is operating. Who is liable if any one gets hurt due to electric shock outside the right-of-way?

These shock hazards are reduced when electric field levels are reduced. The most economical way is to acquire additional right-of-way to limit the electric field and hence the shock hazards.

It is ironic that the property owners, whose property is condemned against their will, are made "guinea pigs" by subjecting them to electric shocks every day on their properties without adequately compensating them for the "convenience and necessity" of the public.

4.3 Acceptable range of electric field levels at the edge of the right-of-way.

There are no Federal regulations pertaining to electric field levels at the edge of the right-of-way. Some states, as given in Exhibit I, mandate electric utilities to limit electric field levels at the edge of the right-of-way. This range is between 1 to 3 kV per meter, which is significantly less than 4.2 kV per meter electric field produced by the proposed 765 kV line.

As discussed earlier, the electric field can be reduced by widening the right-of-way. Mr. Simmons of APCo has stated before this subcommittee that, "Appalachian has voluntarily followed a policy for many years of offering to purchase any

residence within 200 feet of center line of a 765 kV line to effectively create a 400 foot right of way..."
This is a remarkable change from the position that the parent company of APCo, AEP, has taken in regard to 765 kV line in Indiana. What would APCo do if a real estate developer builds a house adjoining the right-of-way, i.e., at 100 feet from the center line, and after a few months, a family purchases that house and finds out that he is constantly exposed to shocks and other electrical effects and complains to the power company? Would APCo buy his house?

To avoid these uncertainties and changes in company policies from one management to the other, I recommend to this sub-committee to mandate APCo to (i) purchase additional right-of-way to limit electric field level to about 2 kV per meter, (ii) provide an avenue for registering complaints from the public. and (iii) mitigate, at APCo's expense, any shock complaint from the present and future owners of the properties adjoining the power line and if APCo or its successor is unable to satisfactorily mitigate the complaint, the Virginia Corporation Commission or a special panel must independently evaluate the complaint and provide appropriate compensation to the property owner.

5. CORONA GENERATED AUDIBLE NOISE FROM THE PROPOSED 765 kV LINE IS EXCESSIVE.

The proposed 765 kV line produces at 100 feet from the center

line of the right-of-way, audible noise of 58 dB(A) during wet conductor condition. The audible noise, as you know, produces speech and sleep interference. The health effects of audible noise are well recognized by many states. These states have developed permissible audible noise limits in residential areas. Generally, audible noise level of 50 dB(A) on residential properties is an acceptable value. In the 1980 survey that I mentioned to you earlier, out of 114 property owners living near the 765 kV line, 104 property owners complained about excessive noise from the 765 kV line! I also want to emphasize to this subcommittee that corona noise is about 8 dB more aversive than noise due to air conditioners because of the high frequency energy content in the 765 kV audible noise spectrum.

To protect the property owners from audible noise of 765 kV, the state of New York mandated the power company, PASNY, to acquire easements of 350 feet and mitigate the complaints from residents living up to 600 feet from the center line of the right-of-way at the power company's expense. If the complaint is not resolved, power company will report to the commission and purchase the house (if it is located within 600 feet from the center line of the right-of-way) involved or move it to another location unless proved to the commission that the complaint is unfounded or wholly unreasonable. I recommend that this subcommittee make similar mandatory requirements to the power company to protect the health of the property owners living near the proposed 765 kV line.

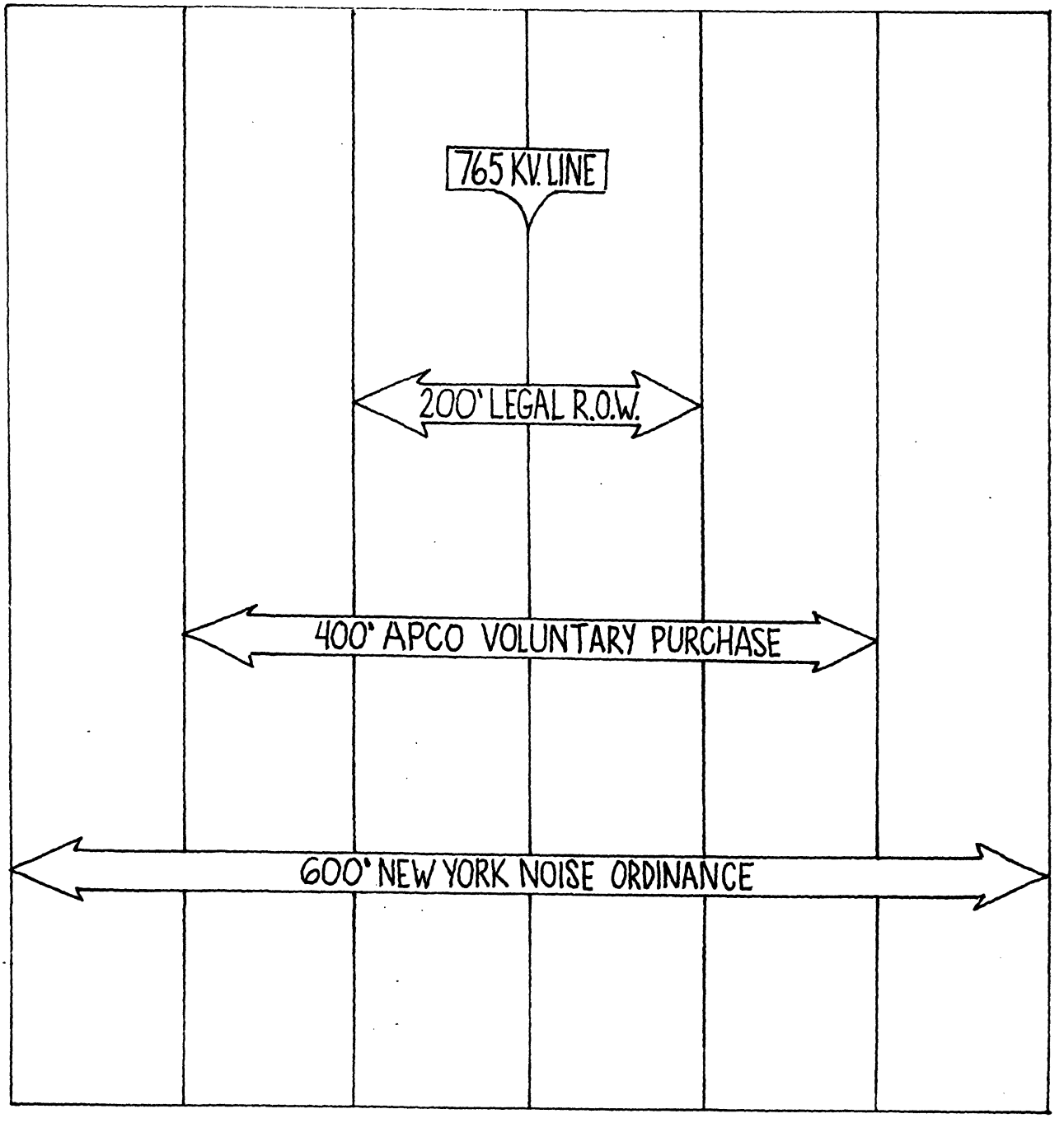
TABLE III

STATE RECOMMENDED ELECTRIC FIELD LEVELS

STATE	RECOMMENDING REGULATORY AGENCY	MAXIMUM ELECTRIC FIELD WITHIN THE ROW (kV/m)	MAXIMUM SHORT CIRCUIT CURRENT (mA)	ELECTRIC FIELD AT EDGE OF ROW (kV/m)
California	California Energy Commission/ Public Utility Commission			1.0 (See text)
Montana	DNR			1.0
Minnesota	Environmental Quality Board	8 (ac) 12 (HVdc, steady state)	5 (ac)	-
New Jersey	Department of Environmental Protection	(no requirement)		3*
New York	Public Service Commission	7.0 - public roads 11.0 - private roads 11.8 - over other terrain	4.5 (ac)	1.6 or less
North Dakota	Public Service Commission	8 (ac) 33 (HVdc)	5 (ac) 34 (HVdc)	-
Oregon	Energy Facility Siting Council	9	5 (ac)	
South Dakota	Public Utilities Commission	7.1 at ground level	5(ac)	1.4

HVdc = High voltage direct current transmission
ac = Alternating current
* From "Guidelines for High Voltage Lines Adopted", Resolution by New Jersey Commission on Radiation Pritection, June 4, 1981

COMPARATIVE RIGHT OF WAY WIDTHS



COMPARISON OF

ANNUAL COSTS BETWEEN 765 kV AND 345 kV LINES

Cost Component	765 kv ($)	345 kV ($)
Capitol cost of installation	11,680,000	5,840,000
Cost of losses	8,960,000	6,194,000
Total Cost:	20,660,000	12,034,000

APPENDIX 4

DATE: November 14, 1984

FROM: Dr. H. B. Graves
The Pennsylvania State University
204 Henning Building
University Park, PA 16802
(814-865-4481)

TO: Senator Madison Marye
c/o Teri Map
Division of Legislative Services
910 Capitol Street
P.O. Box 3-AG
Richmond, VA 23208

RE: Potential Adverse Health Effects of Power Transmission Line Electric Fields - November 16, 1984 Virginia House-Senate Joint Sub-Committee Hearing

I regret being unable to accept your invitation to testify before your group on November 16, 1984. As per your request, the purpose of this memo is to very briefly present your group with some comments based on my experience as a researcher in the area of biological effects of 60 Hz electromagnetic fields. As you may know, I have led a team of biological researchers at The Pennsylvania State University for over a decade. We have exposed thousands of laboratory birds and mammals to electric fields ranging from 0 to 100 kV/m (maximum electric fields under a 500 kV transmission line such as that proposed in Floyd County, Virginia are less than 10 kV/m). We have monitored growth, development, and behavior of over 20,000 avian embryos continuously exposed to 60 Hz electric fields ranging from 0.1 kV/m to 100 kV/m.

I have also acted as reviewer of most of the laboratory research on 60 Hz electric fields in the United States. Although I have repeatedly refused to appear as an expert witness for utilities, I have welcomed involvement in the issues so long as I answer to Departments of Health, Departments of Environmental Resources, The Department of Energy, Legislative Committees, etc. I am currently chairman of a very large committee at The American Institute of Biological Sciences (AIBS) in Washington, D.C. which is reviewing bioeffects of extremely low frequency electromagnetic fields, including 60 Hz, and I am also Chairman of a multidisciplinary committee in Florida designed to provide advice and guidance to the Florida Department of Environmental

Resources. I have acted as a reviewer and advisor on electric field health programs for several foreign countries, The Department of Defense, The Electric Power Research Institute, The Aerospace Corporation, and other agencies and groups. In summary, I am emphatically not identified as a utility representative or expert witness, nor can I become one and maintain my role as an unbiased researcher/reviewer/advisor. I value my reputation as a researcher and as a coordinator and leader of workshops, seminars, and committees active in the health effects arena.

Attached is a thumbnail sketch of the background of power transmission and the associated health issues. I also advance several recommendations for your consideration.

HBG:ds

Attachment

Title: Power Transmission: Some Notes on Adverse Biological Effects

Submitted by: Dr. H. B. Graves
The Pennsylvania State University
204 Henning Building
University Park, PA 16802
(814-865-4481)

The Pearl Street electric power station began to provide power to the Wall Street district of New York City in 1882. Edison's brainchild was short-lived. Within a few years, his direct-current (DC) system was replaced by alternating current (AC) stations utilizing innovations such as the ste-up transformer to efficiently transmit power, possible only at high voltages, and then utilizing step-down transformers to reduce the voltage to usable levels. The incandescent light bulb quickly ceased to be a novelty. Although legend has it that some individuals feared the electric light bulb and regarded electrical devices as works of the Devil (The Pennsylvania Amish still rourinely strip a newly-purchased home of all electrical and plumbing devices!), relatively few of us wish to curtail the flow of electricity to homes, industries and farms.

The late 1960's and 1970's were associated with a strong ecology, or environmental, movement in the United Staes. Public interest in health in general and in the quality of life was, and still remains, very strong. Among the many issues which have generated questions is the nature of biological health effects, if any, caused by electric and magnetic fields such as those

generated by radio, TV and microwave communication systems, high voltage power transmission lines, a variety of industrial equipment, home appliances, and convenience items such as electric blankets and heat water beds. These issues have gained momentum from several sources, not the least of which is geniune concern, but issues other than public health are at stake.

Aesthetics and property values are often paramont issues, and it is a small wonder that biological findings relating to 60 Hz electric field research can suddenly become "hot" (and valuable!) news items rather than one more dry report written by one of us ivory-tower types. The temptation to seize opportunities to further individual notoriety, and occasionally to significantly augment earnings and/or research grants is very large indeed, and, to a degree, does not hinder scientific progress. It does create a level of chaos, however, as planners and legislators, Departments of Health, Public Service Commissions, etc. attempt to sift through the evidence while utility groups as well as their opposition assemble their respective experts.

With respect to biological effects of high voltage power transmission lines, the utilities have found themselves in a particularly frustrating position. A long history of operating experience, they say, has never suggested that individuals who live adjacent to transmission lines or who have electrical appliances in their homes experience an excess of adverse health

events. Further, the benefits of relatively cheap electricity for heating, cooking, lighting, and for the operation of all sorts of labor-saving (and life-saving) equipment is obvious. "Show us even one single death or illness definitely attributable to electric field exposure, other than shock from contact with the conductors", they cry.

Yet the opposition continues to suggest that cancer, heart disease, "stress" and a host of other maladies stem from "electrification" of our environment.

Who is right?

In Virginia, as in several other states, voters and legislators, scientists and laymen, utility spokesmen and their opposition alike are engaged in a minor (?) war of words. Yet a very great deal is at stake. Decisions made in Virginia can and will affect decisions made in other states and in other countries, and, in Virginia alone, the impact of decisions made by your Joint Sub-Committee can have very major consequences.

Unfortunately, the current atmosphere of emotionalism may make decisions much more difficult than would otherwise be the case. Spokesmen for the utilities have, no doubt, attempted to calm the waters, but such spokemen are, rightly or wrongly, often perceived as biased. Spokesmen for the opposition have, no doubt, attempted to counter utility claims and to foster concern about 60 Hz electric field health effects. Such is predictable and inevitable. So what is one to do and to believe?

I strongly recommend the following:

1. The emotionalism accompanying the Floyd County 500 kV transmission line case is not the proper environment within which a decision to change the status quo should be made.

2. Should a serious interest exist in Virginia to seek advice concerning the issue of health related effects of 60 Hz power transmission lines, a distinguished, multidisciplinary panel of scientists should be commissioned to provide recommendations to the appropriate agency or legislative committee. This panel should consist of individuals who are neither electric utility spokesmen nor their opponents and should involve independent representatives as "watchdogs" for the appropriate Virginia agency to which the panels report is directed. The utilities, the House-Senate Joint Sub-Committee and/or the VA Department of Health or other such agencies should assist the Chairman of this Science Commission in selecting member scientists in order to insure an impartial panel.

3. Funding for the Science Commission and their general scope of work should be the joint responsibility of the State of Virginia, and the Virginia electric utilities.

4. The Chairman of the Science Commission mst be knowledgeable in the biological effects area, have

administrative and leadership abilities and be capable of motivating his committee to produce a comprehensive and timely report. He must be able to devote the time and energy required to accomplish the task. He must know the actors and their perceived biases, if any, and, as previously emphasized, should in any case be monitored by a totally independent but knowledgeable "outsider" such as Dr. William Wisecup, leader of the Health Effects Section of The Aerospace Corporation. Dr. Wisecup maintains a constant quality control monitoring program on all 60 Hz research in the United States (Dr. Wisecup can be reached at his Washington, D.C. office, phone # 202-488-6328).

Finally, it is far beyond the scope of this very brief memo to even begin to summarize the biological effects of 60 Hz electric fields. Nevertheless, should your Committee decide to forego any further input from the science community, perhaps the following statements will prove useful:

1. The National Electric Safety Code (NESC) indirectly limits the magnitude of exposure to electric fields associated with power transmission lines by suggesting design features which do not allow a "let-go" current of 5 mA to be exceeded. Virginia utilities utilize, or should utilize, the NESC t design their power transmission lines.

2. None of the existing standards, neither in the United States nor elsewhere, are based on any scientifically recognized demonstration of harm from exposure to electric fields.

3. There is not presently available any definitive evidence of death, illness/malaise or other indication of health deterioration in laboratory animals exposed for any period of time, including several generations, to 60 Hz electric fields an order of magnitude higher than those present at ground level under a 500 kV transmission line. However, evidence of "EFFECTS", defined as any reliable change at any level of biological organization, including cell, tissue, organ or organism, is abundant. Effects which scientists agree are "real", i.e. reliably occur as a result of exposure to electric fields, are very subtle. Many such effects are typically caused by common, everyday events such as artificial lighting, noise, and moving about in routine activities. Areas of uncertainty are plentiful and any meaningful statement about such areas would require considerably greater input than warranted by this memo.

I hope these comments may be useful to your Committee in its deliberations. I regret being unable to be present in person for the November 16, 1984 hearing but remain most interested in

working with your group toward a better resolution of the uncertainties associated with this very important area of consideration. Should you be interested in persuing the issues expressed here in more detail, please feel free to contact me.

APPENDIX 5

SUMMARY POSITION OF APPALACHIAN POWER COMPANY IN REGARD TO SJR 26 AND THE ASSOCIATED HEARINGS PREPARED FOR THE NOVEMBER 16, 1984 HEARING

I. Purpose of the Subcommittee Hearings

A. SJR 26 established this joint subcommittee for the stated purpose of studying:

1. The adequacy of State Corporation Commission (S.C.C.) oversight;
2. The health and safety rules and regulations;
3. The statutes in the Code of Virginia; in protecting the citizens of Virginia when high voltage electrical transmission lines are constructed and maintained.

B. The Chairman of the Subcommitee has further stated that the Subcommittee intended:

1. To achieve "a clear understanding of the potential hazards and health effects" of such lines; and
2. "To determine if there is legitimate cause for concern over health effects of high voltage utility lines."

II. Record Before this Subcommittee

APCo feels strongly that the record before this Subcommittee has established that there is no legitimate cause for concern over any health and safety effects of High Voltage Transmission Lines. We base that opinion on:

A. Actual Operating Experience - As outlined in considerable detail to this Subcommittee in the June 8, 1984, Hearing, 765 KV (the highest transmission line voltage in commercial use) is not a new technology but rather one that has been proven over many years of actual operating experience.

The AEP System, of which APCo is a part, presently has approximately 1,800 miles of 765 KV transmission in service (approximately 200 miles have been placed in service since the June 8, 1984, Hearing). Over 1,000 miles have been operating at 765 KV for over ten years.

APCo has approximately 550 miles of 765 KV transmission lines in service with over 200 miles of this in Virginia. A significant portion of the 765 KV transmission line mileage in Virginia has been in operation

WITH THESE MANY YEARS OF ACTUAL OPERATING EXPERIENCE IN AEP AND APCo, AS WELL AS THE EXTENSIVE USE BY OTHER UTILITIES, PARTICULARLY IN CANADA AND THE USSR; THERE HAS NEVER BEEN, TO OUR KNOWLEDGE, A SINGLE DOCUMENTED CASE OF AN ADVERSE BIOLOGICAL OR HEALTH EFFECT TO MAN, ANIMALS OR PLANTS FROM 765 KV TRANSMISSION LINES.

B. OPERATING EXPERIENCE WITH LOWER VOLTAGE TRANSMISSION LINES

ALTHOUGH THE APPROXIMATE 15 YEARS OF SUCCESSFUL OPERATION OF 765 KV TRANSMISSION LINES SHOULD, IN ITSELF, SUBSTANTIATE THE ABSENCE OF ANY ADVERSE EFFECT; THE SUBCOMMITTEE CAN LOOK TO A MUCH GREATER BODY OF OPERATING EXPERIENCE. ALL TRANSMISSION LINES PRODUCE AN ELECTRIC FIELD WHICH CAN BE MEASURED AT ANY DISTANCE FROM THE LINE AND EXPRESSED IN TERMS OF KILOVOLTS PER METER (KV/M). THIS PERMITS A COMPARISON OF ANY LONG TERM EXPOSURE TO HUMANS WHICH FURTHER REINFORCES THE LACK OF EXPECTED ADVERSE EFFECT FROM 765 KV LINES SINCE:

1. THE FIELD STRENGTH AT 200 FEET FROM THE CENTERLINE OF A 765 KV LINE WHICH IS THE NEAREST EXPECTED RESIDENCE LOCATION (APCo OFFERS TO PURCHASE ANY RESIDENCE CLOSER THAN 200 FEET FROM SUCH A LINE) IS .6 KV/M COMPARED TO 1 KV/M AT THE EDGE OF RIGHT-OF-WAY (NEAREST EXPECTED RESIDENCE LOCATION) FOR A 138 KV LINE.
2. A SIMILAR COMPARISON WOULD SHOW A .6 KV/M AT THE NEAREST EXPECTED RESIDENCE FOR 765 KV COMPARED TO 2 KV/M FOR 345 KV AT THE EDGE OF RIGHT-OF-WAY OR THE NEAREST EXPECTED RESIDENCE LOCATION.

THE COMPARISON WITH 138 KV IS PARTICULARLY SIGNIFICANT SINCE 138 KV LINES HAVE BEEN IN USE IN APCo FOR OVER 65 YEARS WITH APPROXIMATELY 2,000 MILES IN SERVICE IN APCo AT PRESENT. MUCH OF THE 138 KV SYSTEM IN APCo, AS WELL AS OTHER UTILITIES, IS IN URBAN AREAS WITH RESIDENCES CONSTRUCTED AT THE EDGE OF RIGHT-OF-WAY. IN FACT, IT IS RELATIVELY COMMON FOR MANY UTILITIES TO CONSTRUCT 138 KV TRANSMISSION LINES ALONG CITY STREETS.

C. Research and Testing

We would again refer to our comments at the June 8, 1984 Hearing on this subject but would repeat the summary of the research in this area as expressed by the World Health Organization (WHO) in its report published in 1982 which stated "experimental studies show that E fields of intensity up to 20 KV/m and H fields of intensity up to 240 A/m; i.e., 0.3 mT whether individually or in combination, do not constitute a danger to health." 765 KV transmission lines as now operated have fields of intensity well below the values referred to in the WHO Report.

D. Expert Testimony at the October 12, 1984, Hearing

1. APCo and VEPCo sponsored appearances by three of the leading experts in the field of research into possible biological effects of high voltage transmission lines. The qualifications, positions and experience of these experts were furnished to the Subcommittee in the course of their presentations at the

October 12, 1984 Hearing. It is worth noting that all three of these experts are associated with major universities with substantial research programs. The work of Dr. Michaelson and Dr. Miller, in particular, has been supported by such organizations as the Department of Energy (DOE) and the National Institute of Health.

The degree to which Dr. Michaelson and Dr. Miller are considered to be the leading experts in the field of biological effects is illustrated by: (1) The extensive publishing of their work (approximately 300 publications) and (2) Their selection to serve as members or advisors to such organizations as The National Academy of Science. Dr. Michaelson has served on the Service Advisory Board of the Environmental Protection Agency (EPA) and as a consultant to the World Health Organization (WHO).

DR. MERCER, IN ADDITION TO DIRECTING THE RESEARCH PROGRAM OF A MAJOR UNIVERSITY, SERVES AS A CONSULTANT TO ANIMAL PRODUCERS AND VETERINARY COLLEAGUES. PRIOR TO ASSUMING HIS PRESENT POSITION, DR. MERCER DIRECTED RESEARCH FOR THE FOOD AND DRUG ADMINISTRATION DEALING WITH THE SAFETY OF DRUGS AND CHEMICALS TO ANIMALS AS WELL AS ENVIRONMENTAL TOXICOLOGY. APCO AND VEPCO SPONSORED THE APPEARANCE OF DR. MERCER WHO IS A VETERINARIAN BECAUSE OF PREVIOUSLY EXPRESSED CONCERN BY WITNESSES IN THIS PROCEEDING ABOUT POSSIBLE EFFECTS ON FARM ANIMALS. DR. MERCER CONCLUDED THAT ELECTRICAL FIELDS OF 10 KV/M DO NOT PRODUCE DETRIMENTAL BIOLOGICAL EFFECTS TO LIVESTOCK.

THE CONCLUSIONS OF BOTH DR. MICHAELSON AND DR. MILLER, AS PRESENTED TO THIS SUBCOMMITTEE, WERE THAT THERE HAVE BEEN NO DEMONSTRATED ADVERSE EFFECTS FROM EXPOSURE TO HIGH VOLTAGE TRANSMISSION LINES AND FURTHER, THAT THERE IS LITTLE REASON TO EXPECT ANY SUCH EFF

2. THE QUALIFICATIONS OF THE EXPERT WITNESSES SPONSORED BY APCO AND VEPCO AS WELL AS THE DIRECT APPLICABILITY OF THEIR TESTIMONY TO THE SUBJECT MATTER UNDER CONSIDERATION BY THE SUBCOMMITTEE IS EVIDENT FROM THE RECORD. IN CONTRAST THE TESTIMONY OF THE EXPERT WITNESSES SPONSORED BY TOPPL HAD LIMITED RELEVANCY TO THE ISSUE OF HEALTH AND SAFETY AND WAS BASED, IN MANY INSTANCES, ON INCORRECT ASSUMPTIONS. FOR EXAMPLE:

   A. A MAJOR PORTION OF DR. SHAH'S TESTIMONY DEALT WITH THE CAPACITY AND COST OF 765 KV VS. 345 KV LINES. AS DETAILED IN OUR REBUTTAL, DR. SHAH APPARENTLY INCORRECTLY ASSUMED A GENERATING SOURCE AT JACKSON'S FERRY IN ARRIVING AT HIS CAPACITY FIGURES. HIS TESTIMONY AS TO THE COST OF BUILDING 765 KV VS. 345 KV IGNORED BOTH THE COST OF TRANSFORMATION AND THE ADDITIONAL 345 KV CIRCUITS THAT WOULD BE REQUIRED.

DR. SHAH'S COMMENTS ON APCO COMPLIANCE WITH THE NATIONAL ELECTRIC SAFETY CODE (NESC) WERE APPARENTLY BASED ON HIS UNDERSTANDING OF A 40-FOOT DESIGN CLEARANCE. AGAIN, AS OUTLINED IN THE REBUTTAL, DR. SHAH'S ASSUMPTION IS TOTALLY INCORRECT. APCO'S MINIMUM DESIGN STANDARDS ARE: 45 FEET IN AREAS ACCESSIBLE ONLY TO PEDESTRIANS; 57 FEET OVER PUBLIC ROADS; AND 66 FEET OVER LIMITED ACCESS HIGHWAYS.

DR. SHAH RECOMMENDED A 2 KV/M FIELD STRENGTH AT THE EDGE OF RIGHT OF WAY. AS WE HAVE PREVIOUSLY ADVISED THIS SUBCOMMITTEE, APCO'S PRACTICE OF PURCHASING ANY EXISTING RESIDENCE WITHIN 200 FEET OF THE CENTERLINE RESULTS IN A FIELD STRENGTH OF .6 KV/M AT SUCH A RESIDENCE. THIS IS LESS THAN 1/3 OF THE VALUE RECOMMENDED BY DR. SHAH.

B. DR. LIBOFF'S TESTIMONY WAS TOTALLY DIRECTED AT ELECTROMAGNETIC FIELDS AND REACHED NO CONCLUSIONS. AS WE HAVE DISCUSSED WITH THIS SUBCOMMITTEE,

ELECTROMAGNETIC FIELDS ARE NOT RELATED TO VOLTAGE BUT RATHER TO CURRENT. TO THE EXTENT THAT DR. LIBOFF OR OTHERS PERCEIVE A POSSIBLE PROBLEM IN THIS AREA, THE PROPER CONCLUSION WOULD BE TO SUPPORT HIGHER VOLTAGE LINES THEREBY REDUCING CURRENT AND THE RESULTANT ELECTRO-MAGNETIC FIELDS.

C. DR. WILSON, WHO QUALIFIED HIS TESTIMONY BY STATING HE WAS NOT AN EXPERT NOR HAD HE BEEN INVOLVED WITH RESEARCH, ALSO TESTIFIED TOTALLY IN REGARD TO ELECTROMAGNETIC FIELDS. DR. WILSON MADE REFERENCE TO A STUDY BY WERTHEIMER AS SUPPORTING HIS POSITION. THE FACTS ARE THAT THE WERTHEIMER STUDY INVOLVED DISTRIBUTION LINES (LOW VOLTAGE) AND NOT TRANSMISSION LINES. THIS ILLUSTRATES THE LACK OF RELEVANCY OF SUCH CONCERN ABOUT ELECTROMAGNETIC FIELDS TO THE ISSUE OF SAFETY OF TRANSMISSION LINES.

D. THE TESTIMONY OF MR. GOODWIN HAS NO RELEVANCY TO THE SUBJECT BEING CONSIDERED BY THIS SUBCOMMITTEE OR OTHERWISE. MR. GOODWIN ADVOCATED, IN ESSENCE, THAT THE COMMONWEALTH OF VIRGINIA CONSIDER ENACTING SITING LEGISLATION FOR TRANSMISSION LINES AND ESTABLISH A REQUIREMENT FOR TRANSMISSION LINE LOCATIONS TO BE DEFINED IN THE EASEMENTS. THE FACTS ARE THAT A COMPREHENSIVE TRANSMISSION SITING LAW WAS ENACTED IN VIRGINIA TWELVE YEARS AGO. IN REGARD TO RIGHT-OF-WAY DEFINITION, APCO HAS FOR MANY YEARS INCLUDED A DEFINITION OF CENTER-LINE AND DESIGNATION OF RIGHT-OF-WAY WIDTH IN ITS EASEMENTS FOR TRANSMISSION LINES. IN ADDITION, THE S.C.C. HAS, IN THE CASE OF JACKSON'S FERRY TO AXTON, PRESCRIBED THE RIGHT-OF-WAY LOCATION TO BE UTILIZED AND REQUIRED PUBLIC NOTICE OF SUCH RIGHT-OF-WAY LOCATION.

3. ACTION OF OTHER JURISDICTIONS

AS WE POINTED OUT IN THE JUNE 8, 1984 HEARING, THE ISSUE PRESENTED TO THIS SUBCOMMITTEE HAS BEEN REVIEWED IN HEARINGS IN A NUMBER

OF STATES AND IN ALL CASES, THE DECISION HAS BEEN TO PROCEED WITH CONSTRUCTION OF EHV TRANSMISSION LINES.

OF PARTICULAR INTEREST TO THIS SUBCOMMITTEE MAY BE A 1979 DECISION IN WEST VIRGINIA BY THE PUBIC SERVICE COMMISSION (PSC) OF THAT STATE FOLLOWING EXTENSIVE HEARINGS ON A 765 KV LINE SEGMENT. THE P.S.C. STATED: "IN OUR OPINION, THE OVERWHELMING BODY OF SCIENTIFIC EVIDENCE COMPELS THE CONCLUSION THAT THERE IS NO KNOWN ADVERSE BIOLOGICAL EFFECTS ASSOCIATED WITH ELF FIELDS OF THE MAGNITUDE ASSOCIATED WITH THE PROPOSED CULLODEN-GAVIN TRANSMISSION LINE."

THE MOST RECENT RULING IN REGARD TO 765 KV OF WHICH WE ARE AWARE WAS MADE ON DECEMBER 2, 1983, BY THE KENTUCKY PUBLIC SERVICE COMMISSION (P.S.C.). THE KENTUCKY P.S.C. DENIED A MOTION TO INITIATE AN INVESTIGATION OF THE HEALTH AND SAFETY CONSEQUENCES OF THE HANGING ROCK-JEFFERSON 765 KV LINE. THEY FOUND THAT THE MOTION FAILED TO ALLEGE SUFFICIENT GROUNDS TO SUPPORT SUCH AN INVESTIGATION.

III. Adequacy of Present Regulation

Section 56-46.1 of the Code of Virginia requires the State Coroporation Commission to determine all issues concerning the construction and location of EHV transmission lines. The fact that the S.C.C. has taken this mandate and implemented it fully is evident from the record.

APCo has applied for a certificate for two line segments since the enactment of the siting legislation -- Cloverdale to Ivy Creek and Jackson's Ferry to Axton. In the case of Cloverdale to Ivy Creek the S.C.C., after extensive hearings, rejected APCo's preferred route and adopted an alternate route. This alternate route was considerably longer and used an eastern terminal point that was considerably removed from APCo's preferred terminal.

In the case of Jackson's Ferry to Axton, this line has been under consideration in various forums for over ten years. During the course of the hearings, the S.C.C. considered need for the line as well as a number of routes submitted by the company, intervenors and a route prepared

for the S.C.C. by a consultant. The S.C.C. ultimately approved a portion of APCo's preferred route but required the use of an alternate segment for the eastern portion of the line. The S.C.C. further required APCo to submit its actual proposed 200-foot right-of-way for review and public hearings. Following such hearings, the S.C.C. directed APCo to make additional changes in the actual right-of-way to be utilized.

It is clear from the above that the position of the S.C.C. has not been a passive one but one of active involvement in carrying out the mandate of the legislation.

The procedures for notice, public hearings and the standards for the S.C.C. to consider in arriving at its decisions have been established by the legislature. Such procedures, coupled with the aforementioned active role demonstrated by the S.C.C., would appear to negate any need for further legislation in this regard.

C. A. Simmons

APPENDIX 6

PRESENTATION BEFORE JOINT LEGISLATIVE SUBCOMMITTEE

STUDYING THE HEALTH AND SAFETY EFFECTS OF HIGH VOLTAGE POWER LINES

A. No fewer than 11 recent scientific studies have suggested that exposure to electromagnetic fields can be linked to an increased rate of cancer or birth defects. Regardless of the criticism of these studies, the fact remains that these independent researchers found differences in groups of people regularly exposed to more electromagnetic radiation than the general public experiences.

In 1974 few people questioned the safety of power line radiation. By 1981, the U.S. Department of Energy admitted that, yes, electric fields do have effects, but more research was necessary to determine if these effects might be hazardous. Magnetic fields, per se, weren't being examined. In 1984 the Department of Energy requested a 25% funding increase to study magnetic fields because of growing public and scientific concern. What we are seeing is a disturbing trend. Rather than calming fears, more research has only raised more concern.

Mr. Simmons would have you believe that a power line does not increase the level of magnetic fields to which an individual would be exposed. In his letter of October 10, he equates the magnetic fields

in two homes close to power lines to the field generated by a fluorescent light. Although he doesn't provide the figures, it is established that the average fluorescent light produces a maximum field of about 50 milligauss. So we know that the fields in the two homes equals 50 mg. It is also known that the magnetic field inside a typical home, with normal appliances functioning, is between .5 and 1 milligauss. So, the people in those two houses are constantly being exposed to a magnetic field 50 to 100 times that to which a person would be exposed in a home not in proximity to a power line.

This clearly demonstrates the magnetic field from an appliance drops off very quickly, as witnessed by the relatively low fields inside a typical home. Due to the amperage, power line fields are greater and extend greater distances. In fact, at 1000 feet from the centerline of a 765Kv, the magnetic field equals about 1 milligauss. Increases in cancer rates have been noted at 3 milligauss, which equates to 600 feet from center. Obviously, the 765Kv right-of-way is too narrow.

The objectivity of testimony provided by APCo and VEPCo witnesses is questionable. Most of their research has been utility sponsored, as has the majority of research to date on the problem. Most of the research supporting their position was done prior to 1980 and prior to the recent increase in research which has produced studies linking EMR to cancer and birth defects.

Dr. Michaelson's testimony has been questioned before and found wanting. This document is FDA analysis of his testimony in 1976

indicating no significant risk of injury would be expected from exposure to a leaking microwave oven. The analysis concluded that "The testimony does not provide the evidence necessary to draw the conclusion that Dr. Michaelson makes regarding the lack of significant risk of injury at microwave exposures. In fact, the data indicate significant effects are possible." Dr. Ross Adey, is a prominent researcher and was recently named (MW news) by the NCRP, to head its new study panel on the bioeffects of ELF radiation. He stated in November, 1983, that the conclusions of a study by Dr. Michaelson, which he (Michaelson) offered in support of the less stringent safety standards for RF/MW exposure, were "misleading." It would seem that Dr. Michaelson's objectivity in these two instances is clearly questionable. Therefore, his objectivity in these proceedings is also suspect.

Utilities have failed to prove that long term exposure to power line electromagnetic fields is safe. In the 10 years since the JF-A 765Kv line was certified, their position has become less and less certain. An increasing number of scientists are taking Dr. Liboff's position, i.e. that the fields may be a health hazard and that caution should be exercised in building more such lines.

B. Both the existing and proposed 765 Kv transmission lines fail to comply with the National Electrical Safety Code (NES) and other safety standards. Rule 232B of the NESC limits the possible shock current under a 765 Kv line to 5 milliamperes. Compliance with the code is dependent upon adequate conductor to ground clearance to limit the intensity of electric fields and hence the possible induced shock current.

The Electric Power Research Institute reported in 1975 that the minimum clearance for a 765 Kv line would need to be 61 feet to meet the standard. Documents from the New York Public Service Commission hearings in 1978 clearly show that even at 50 foot ground clearance the shock current equals 5.8 ma. With a minimum clearance of 40-45 feet, possible currents under APCo's 765 Kv lines are even greater.

The 5ma standard is the "let-go" level for .5% of children. In other words, at higher current levels it could be expected that a child grasping a metal object might be unable to release the object, thereby receiving harmful and possibly fatal shocks. The standard also provides protection against accidents caused by "startle reaction."

Pacemakers have been the focus of considerable attention during these hearings. Dr. Michaelson stated that power lines pose no hazard to pacemaker patients. Yet in recent tests, exposing patients to electric fields of various intensities, one patient's pacemaker <u>failed to pace</u> and he became dizzy and presyncopal and the electric field was immediately switched off. The field to which the patient was being exposed was 5 Kv/m, roughly 1/2 the maximum field strength under a 765 Kv line.

I would remind the committee of the testimony of Mr. Perry Parnell, a pacemaker patient, at the August 9th hearing in Floyd. Mr. Parnell testified that he experienced similar symptoms when he walked under the 765 Kv line on his property. Luckily his companions quickly moved him from under the line. When he reported the incident to APCo, he was assured that they would check which his doctor. His doctor reports that he was never contacted.

"Nuisance" shocks cease to be a mere nuisance when they become so strong and unpleasant that persons effected will no longer tolerate the shocks. EPA tests found a threshold of 6-8 Kv/m, below which individuals would accept repeated shocks, and beyond which shocks were clearly disturbing and not desirable. Again this threshold is well below the 13.12 Kv/m maximum possible electric field under a 765 Kv line. While this may not represent a health hazard per se, is it appropriate to subject people to shocks above acceptable levels?

In recent proceedings in several states, regulatory agencies have consistently limited the electric fields generated by high voltage power lines. Montana, in the most recent of such proceedings, limited the field at the edge of the right-of-way to 1 Kv/m. Virginia should do no less, and we urge adoption of these standards (maximum electric field = 7 Kv/m; at edge of right-of-way = 1 Kv/m).

C. There is no proven need for the construction of a 765 Kv transmission line into the Martinsville-Danville area. Other alternatives exist which can provide all the electrical power needed in the area. One alternative is a 345 Kv line, running either from Jackson's Ferry or from Cloverdale near Roanoke. Another is to upgrade (double circuit existing 138 Kv lines into the area. According to Dr. Shah, both alternatives are technically viable. Either would be far less costly to APCo customers and would reduce the health hazards to effected residents.

Cost comparisons between the 765 Kv and 345 Kv line were presented to this committee by Dr. Shah. He pointed out that the annual cost of

operating a 765 Kv would be about $20 million, while a 345 would cost about $12 million annually. In a letter to Ms. Terry Mapp dated 11/6/84, Mr. Simmons of APCo stated that Dr. Shah's comparison failed to account for the "cost of transformation" from 765 Kv to 345 Kv. I discussed this matter with Dr. Shah at length via telephone, and he has indicated that he will prepare a written response for this committee. However, he did ask that I inform the committee that the "transformation" cost is not significant, and would change his comparison only slightly. According to Dr. Shah what we are talking about here is merely transforms which step voltage down from 765 Kv to 345 Kv and which have a relatively long life.

Using Dr. Shah's calculations the 765 Kv line will cost APCo customers over 1/2 billion dollars in 25 years. By building a 345 Kv line APCo customers could realize a savings of more than $200 million over that 25 years. While specific cost estimates are not available, common sense tells one that reinforcing the existing transmission system would realize an even greater savings for APCo customers. Again, Dr. Shah has confirmed this alternative as viable for meeting the needs of the Martinsville-Danville area.

The evidence we have presented to this committee regarding both the need for the Jackson's Ferry-Axton line and its failure to comply with the National Electrical Safety Code point out the necessity to investigate the line. We strongly urge this committee to recommend that the State Corporation Commission reopen the record in regard to this line.

We further urge this subcommittee to recommend legislation declaring a moratorium on 765 Kv construction until further research has been completed.

We also urge that you recommend legislation limiting electric under high voltage lines to a maximum of 7 Kv/m and limiting the field to 1 Kv/m at the edge of the right-of-way.

We urge recommendation of legislation that would provide further protection to effected residents from intrusive and abusive behavior on the part of utility land agents.

Finally we ask that you recommend legislation which provides for greater citizen input into SCC processes.

APPENDIX 7

SENATE BILL NO. ..... HOUSE BILL NO. .....

A BILL to amend and reenact §§ 56-46.1 and 56-265.2 of the Code of Virginia, relating to the approval of the construction of certain electrical transmission lines.

Be it enacted by the General Assembly of Virginia:

1. That §§ 56-46.1 and 56-265.2 of the Code of Virginia are amended and reenacted as follows:

§ 56-46.1. Commission to consider environmental factors in approving construction of electrical utility facilities; approval required for construction of certain electrical transmission lines; notice and hearings.– *A.* Whenever ~~under any provision of law whatsoever, applicable to the Commission,~~ the Commission is required to approve the construction of any electrical utility facility, it shall give consideration to the effect of that facility on the environment and establish such conditions as may be desirable or necessary to minimize adverse environmental impact. In such proceedings it shall receive and give consideration to all reports that relate to the proposed facility by state agencies concerned with environmental protection; and if requested by any county or municipality in which the facility is proposed to be built, to local comprehensive plans that have been adopted pursuant to Article 4 (§ 15.1-446.1 et seq.) of Chapter 11 of Title 15.1 of the Code of Virginia.

B. No overhead electrical transmission line of 150 kilovolts or more shall be constructed unless the State Corporation Commission shall, after at least ~~30~~ *thirty* days' advance notice by publication in a newspaper or newspapers of general circulation in the counties and municipalities through which the line is proposed to be built, and written notice to the governing body of each such county and municipality, approve such line. *Such notices shall include a written description of the proposed route the line is to follow, as well as a map of the route.* As a condition to approval the Commission shall determine that *the line is needed and that* the corridor or route the line is to follow will reasonably minimize adverse impact on the scenic *assets* and ~~environmental assets~~ *environment* of the area concerned .

C. If, prior to such approval, any interested party shall request a public hearing, the Commission shall, as soon as reasonably practicable after such request, hold such hearing or hearings at such place as may be designated by the Commission. Such approval shall not be required for transmission lines constructed prior to January 1, 1983, for which the Commission has issued a certificate of convenience and necessity. In ~~the~~ *any* hearing the public service company shall provide adequate evidence that existing rights-of-way cannot adequately serve the needs of the company.

If, prior to such approval, written requests therefor are received from twenty or more interested parties, the Commission shall hold at least one hearing in the area which would be affected by construction of the line, for the purpose of receiving public comment on the proposal. If any hearing is to be held in the area affected, the Commission shall direct that a copy of the transcripts of any previous hearings held in the case be made available for public inspection at a convenient location in the area for a reasonable time before such local hearing.

D. For purposes of this section, "interested parties" shall include the governing bodies of any counties or municipalities through which the line is proposed to be built, and persons residing or owning property in each such county or municipality and *"environment" or* "environmental" shall be deemed to include in meaning "historic ;" *, as well as a consideration of the probable effects of the line on the health and safety of the persons in the area concerned.*

E. In the event that, at any time after the giving of the notice required in susbsection B of this section, it appears to the Commission that consideration of the route or routes different from the route described in the notice is desirable, the Commission shall cause notice of the new route or routes to be published in accordance with subsection B of this section. The Commission shall thereafter comply with the provisions of this section with respect to the new route or routes to the full extent necessary to give interested parties in the newly affected areas the same protection afforded interested parties affected by the route described in the original notice.

F. Approval of a transmission line pursuant to this section shall be deemed to satisfy the

requirements of § 15.1-456 and local zoning ordinances with respect to such transmission line.

§ 56-265.2. Certificate of convenience and necessity required for acquisition, etc., of new facilities.–It shall be unlawful for any public utility to construct, enlarge or acquire, by lease or otherwise, any facilities for use in public utility service, except ordinary extensions or improvements in the usual course of business within the territory in which it is lawfully authorized to operate, without first having obtained a certificate from the Commission that the public convenience and necessity require the exercise of such right or privilege. ~~Such~~ *The* certificate shall be issued by the Commission only after formal or informal hearing and after due notice to interested parties. *The certificate for overhead electrical transmission lines of 150 kilovolts or more shall be issued by the Commission only after compliance with the provisions of § 56-46.1.*

APPENDIX 8

SENATE BILL NO. ..... HOUSE BILL NO. ..... of Chapter 1 of Title 56 a section numbered 56-46.2, relating to the construction of overhead electrical transmission lines.

Be it enacted by the General Assembly of Virginia:

1. That the Code of Virginia is amended by adding in Article 6 of Chapter 1 of Title 56 a section numbered 56-46.2 as follows:

§ 56-46.2. Construction of electrical transmission lines.–The construction of all overhead electrical transmission lines shall adhere to the standards set forth in the National Electrical Safety Code. The Commission shall, upon receipt of a written complaint concerning the lack of compliance with these standards in the construction of a particular transmission line, investigate the situation and, if appropriate, exercise its powers granted under § 12.1-12 to enforce adherence to the standards.

APPENDIX 9

SENATE JOINT RESOLUTION NO.....

Requesting the State Corporation Commission and the Department of Health to monitor ongoing research on the health and safty effects of high voltage transmission lines.

WHEREAS, in recent years there has been a significant increase in the concern over the health and safety aspects of high voltage transmission lines; and

WHEREAS, a joint subcommittee established pursuant to Senate Joint Resolution No. 26 of the 1984 Session of the General Assembly carefully studied the health and safety aspects and heard from a number of experts who were not in agreement over whether harmful effects exist; and

WHEREAS, currently there are a large number of studies on the health and safety of such lines, the results of which the joint subcommittee feels should be continuously monitored so that if any causal relationships develop the General Assembly will be informed and will be able to take appropriate action to protect the citizens of Virginia; and

WHEREAS, it is the sense of the joint subcommittee that this monitoring could best be done by the State Corporation Commission, which by statute has oversight over the construction of transmission lines, and the Department of Health; now, therefore, be it

RESOLVED by the Senate, the House of Delegates concurring, That the State Corporation Commission and the Department of Health are requested to monitor the ongoing research on the health and safety effects of high voltage transmission lines; and, be it

RESOLVED FURTHER, That the Department of Health, after consultation with the State Corporation Commission, is requested to report its findings annually to the General Assembly.