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IN THE

SUPREME COURT OF VIRGINIA

Record Nos. 751084, 751085,
751086 and 751087

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

Appellants,

v.

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

Appellees.

JOINT APPENDIX II

(Exhibits)

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Ex CMS-2

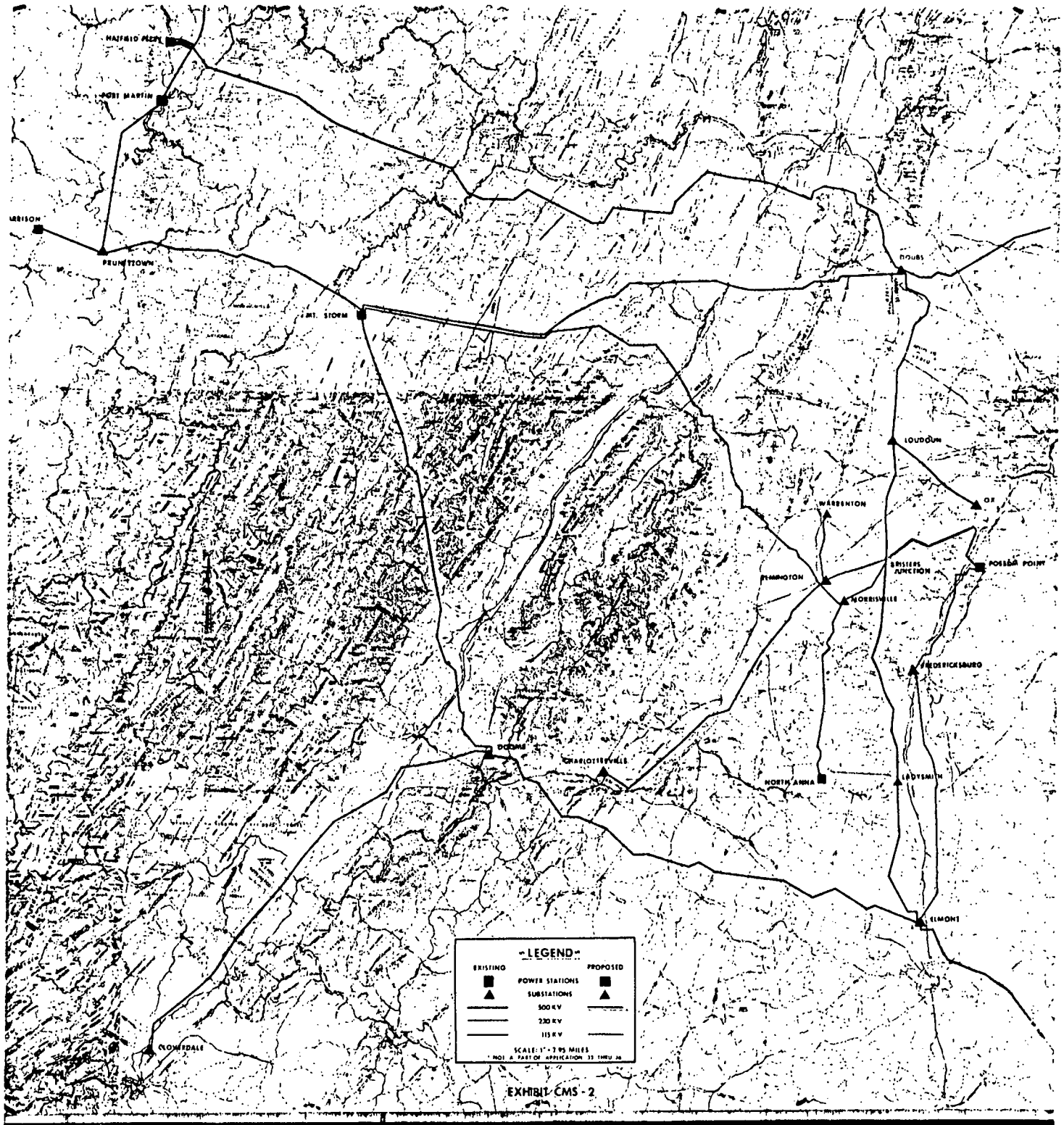


EXHIBIT CMS - 2

Ex Kay-1

Docket No. R-365 APPENDIX A

Federal Power Commission guidelines

Nov 27, 1970
(p 1 of 13)

Guidelines for the Protection of Natural, Historic, Scenic, and Recreational Values in the Design and Location of Rights-of-Way and Transmission Facilities

It is intended that these guidelines provide an indication of the basic principles and elements of good practice which, if applied in a reasonable manner to planning and design of particular facilities, will provide the most acceptable answers from an environmental standpoint taking account also of such factors as safety, reliability of service, land use planning, economics and technical feasibility.

The Selection and Clearing of Rights-of-Way Routes

1. To the extent permitted by the property interest involved rights-of-way should be selected with the purpose of minimizing conflict between the rights-of-way and present and prospective uses of the land on which they are to be located. To this end, existing rights-of-way should be given priority as the locations for additions to existing transmission facilities, and the joint use of existing rights-of-way by different kinds of utility services should be considered.

2. Where practical, rights-of-way should avoid the national historic places listed in the National Register of Historic Places and natural landmarks listed in the National Register of Natural Landmarks maintained by the Secretary of the Interior, and parks, scenic, wildlife and recreational lands, officially designated by duly constituted public authorities. If rights-of-way must be routed through such historic places, parks, wildlife or scenic areas, they should be located in areas or placed in a manner so as to be least visible from areas of public view and so far as possible in a manner designed to preserve the character of the area.

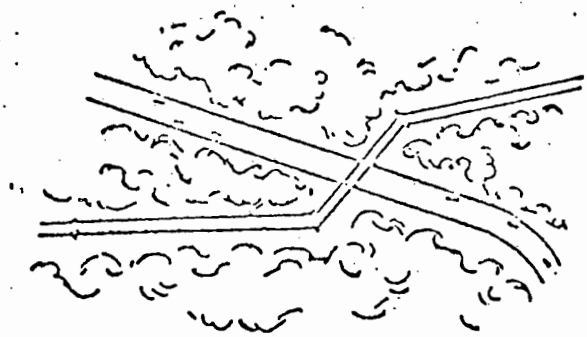
3. Rights-of-way should avoid prime or scenic timbered areas, steep slopes and proximity to main highways where practical. In some situations scenic values would emphasize locating rights-of-way remote from highways while in others where scenic values are less important rights-or-way along highways in timbered areas would achieve desirable conservation of existing forest lands.

4. Where the transmission rights-of-way cross areas of land managed by Government agencies, State agencies or private organizations, these agencies should be contacted early in the planning of the transmission project to coordinate the line location with their land-use planning and with other existing or proposed rights-of-way.

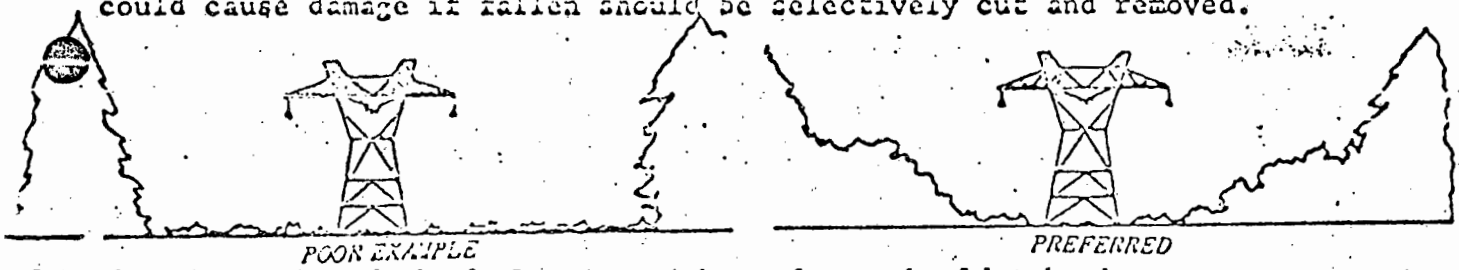
K-1
(1st page of 5)

. In scenic and residential areas clearing of natural vegetation should be limited to that material which poses a hazard to the transmission line. Determination of a hazard in critical areas such as park & forest lands should be a joint endeavor of the utility company and the land manager in keeping with the National Electric Safety Code, state or other electric safety and reliability requirements.

6. Long tunnel views of transmission lines crossing highways in wooded areas, down canyons and valleys or up ridges and hills should be avoided. This can be accomplished by having the lines change alignment in making the crossing, or in other situations by concealment of terrain or by judicious use of screen planting.



7. Rights-of-way clearings should be kept to the minimum width necessary to prevent interference of trees and other vegetation with the proposed transmission facilities. In scenic or urban areas trees which would interfere with the proposed transmission facilities and those which could cause damage if fallen should be selectively cut and removed.



8. The time and method of clearing rights-of-way should take into account matters of soil stability, the protection of natural vegetation and the protection of adjacent resources.

9. The use of helicopters for the construction and maintenance on rights-of-way should be considered in mountainous and scenic areas where consistent with reliability of service. This would permit rights-of-way to be located in more remote areas and would reduce disturbance of the ground and the number of access roads.

10. Trees and other vegetation cleared from rights-of-way in areas of public view should be disposed of without undue delay. If trees and other vegetation are burned, local fire and air pollution regulations should be observed. Unsightly tree stumps which are adjacent to roads and other areas of public view should be cut close to the ground or removed.

11. Trees, shrubs, grass and top soil which are not cleared should be protected from damage during construction.

12. Rights-of-way should not be cleared to the mineral soil where possible. Where this does occur in scattered areas of the rights-of-way, the top soil should be replaced and stabilized without undue delay by the planting of appropriate species of grass, shrubs and other vegetation which are properly fertilized.

13. Soil which has been excavated during construction and not used should be evenly filled back onto the cleared area or removed from the site. The soil should be graded to comport with the terrain and the adjacent land, and the top soil should then be replaced and appropriate vegetation should be planted and fertilized.

14. Scars on the surface of the ground should be repaired with top soil and replanted with appropriate vegetation or otherwise conformed to local, natural conditions. Grading generally should not be done on slopes where the scars cannot be repaired without creating an erosion problem.

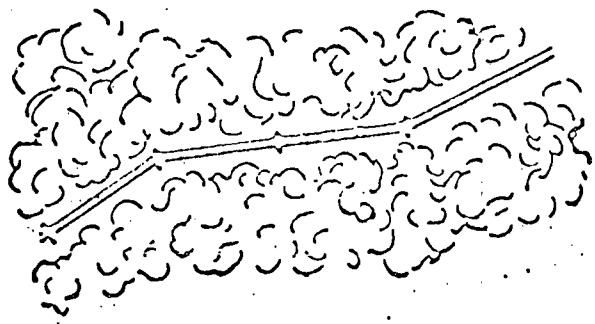
15. Terraces and other erosion control devices should be constructed where necessary to prevent soil erosion on slopes on which rights-of-way are located.

16. Where rights-of-way cross streams or other bodies of water, the banks should be stabilized to prevent erosion. Construction on rights-of-way should not damage shorelines, recreational areas or fish and wildlife habitats.

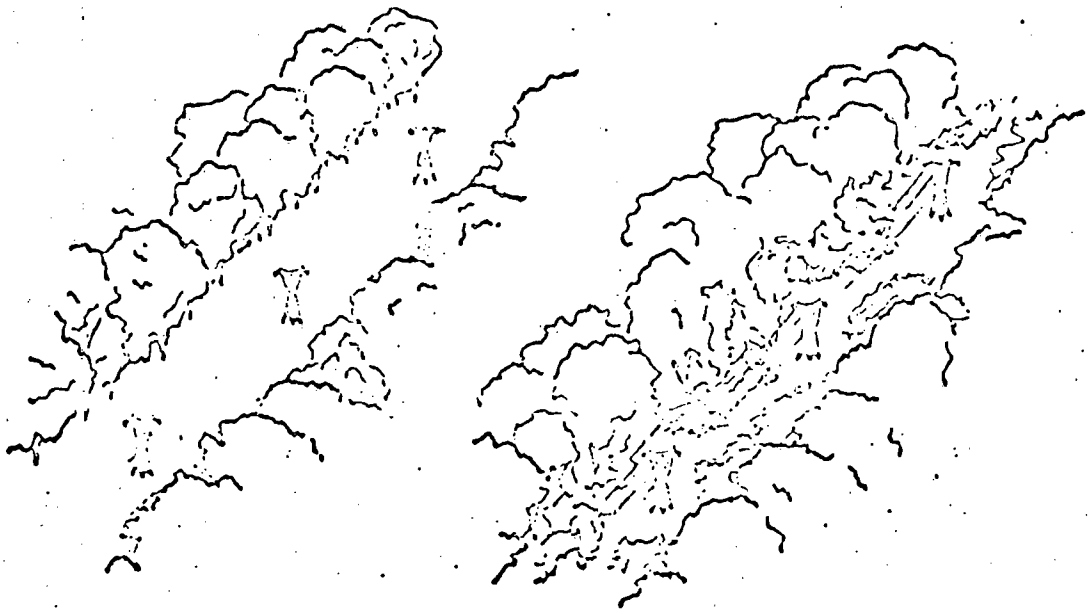
17. When necessary, cofferdam techniques to lay pipe or cable across streams should be used in order to permit full flow in one part of the stream while construction work is being performed in another part.

18. Care should be taken to avoid oil spills and other types of pollution while work is performed in streams.

19. In scenic areas visible to the public, rights-of-way strips through forest and timber areas should be deflected occasionally and should follow irregular patterns or be suitably screened to prevent the rights-of-way from appearing as tunnels cut through the timber.



20. At road crossings or other special locations of high visibility rights-of-way strips through forest and timber areas should be cleared with varying alignment to comport with the topography of the terrain. In such locations also where rights-of-way enter dense timber from a



POOR EXAMPLE *PREFERRED*

meadow or other clearing, trees should be feathered in at the entrance of the timber for a distance of 150-200 yards. Small trees and plants should be used for transition from natural ground cover to larger areas.

21. If underground transmission lines must be located near the crests of hills or other high points, trenching should be done with small equipment in order to minimize the width of the rights-of-way clearings.

22. Roads used during construction should be stabilized without undue delay by erosion control measures and the planting of appropriate grass and other vegetation. These roads should be designed for proper drainage, and water bars to control soil erosion should be installed.

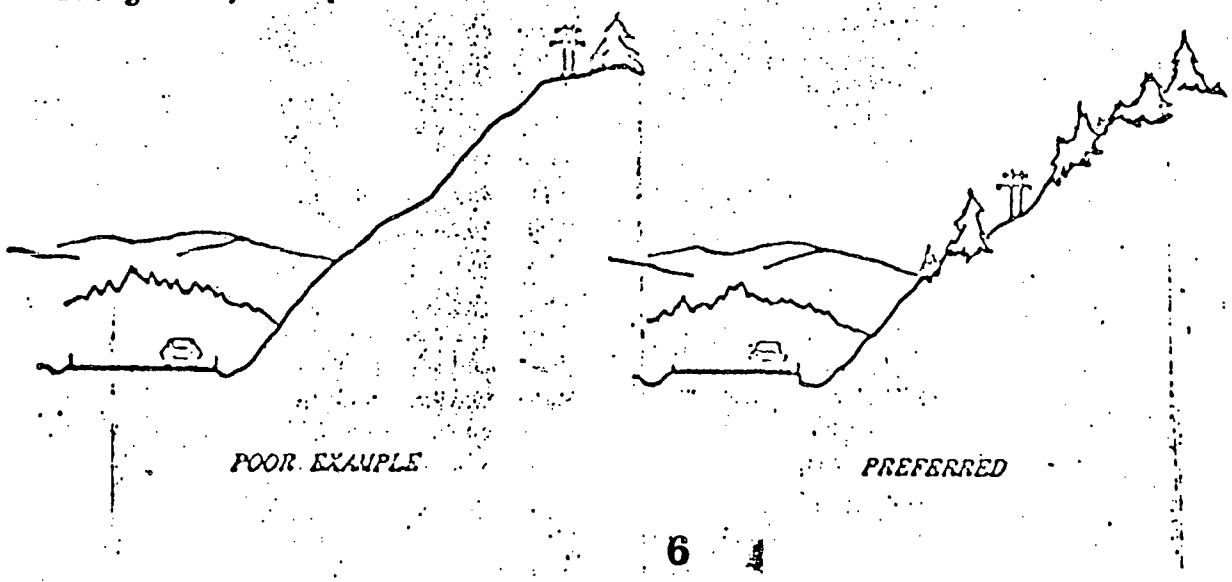
23. Access roads should not be constructed on unstable slopes. Where feasible, service and access roads should be used jointly.

The Location of Transmission Towers and Overhead Lines

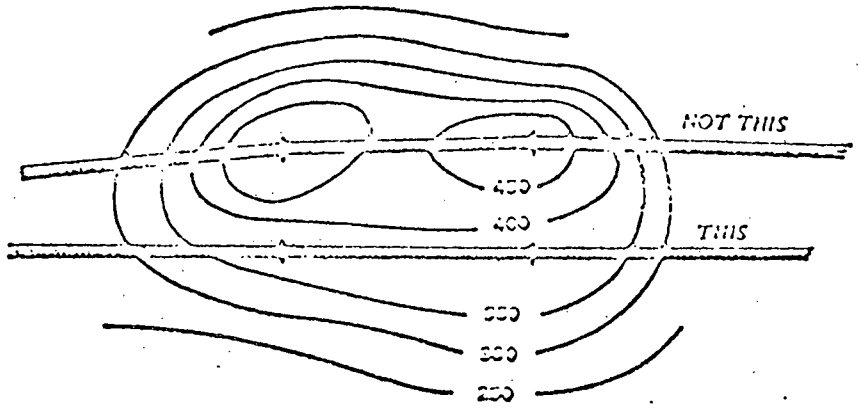
24. If an overhead line must be routed across uniquely scenic, recreational or historic areas or rivers, the feasibility of placing the lower voltage line underground should be considered. If the line must be placed overhead, it should be located on a right-of-way least visible from areas of public view.

25. Transmission facilities should be located with a background of topography and natural cover where possible. Vegetation and terrain should be used to screen these facilities from highways and other areas of public view.

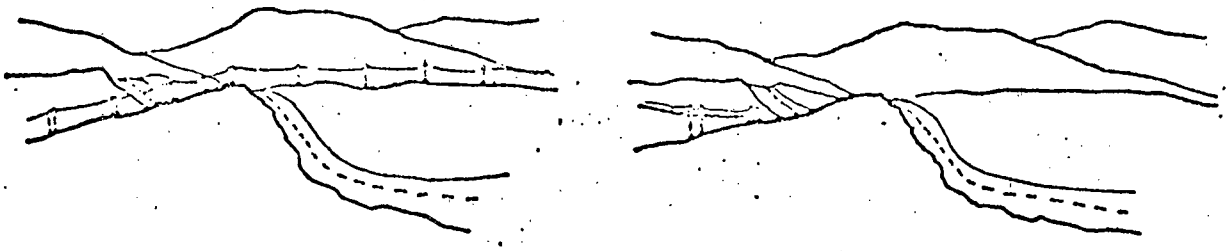
26. Where transmission facilities must be placed on slopes which parallel highways or other areas of public view, they should be located approximately two-thirds the distance up the slopes where feasible. With the slopes as background, the presence of the facilities would be less noticeable.



27. Transmission line rights-of-way should not cross hills and other high points at the crests and when possible should avoid placing a transmission tower at the crest of a ridge of hill. Towers should be spaced below the crest to carry the line over the ridge or hill, and the profile of the facilities should present a minimum silhouette against the sky.

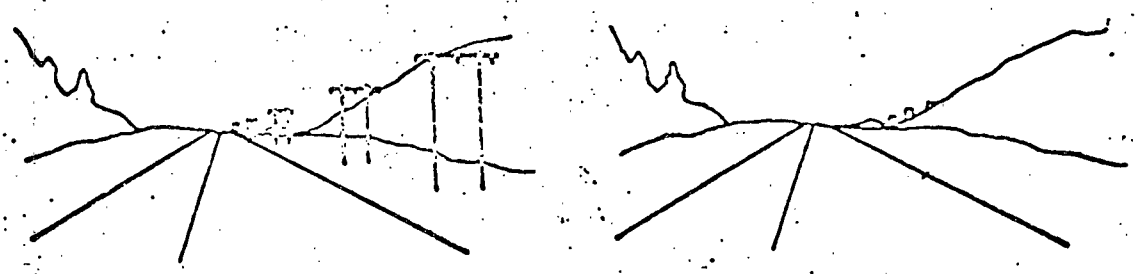


28. Transmission lines should not cross highways at the crest of a road.



POOR EXAMPLE PREFERRED

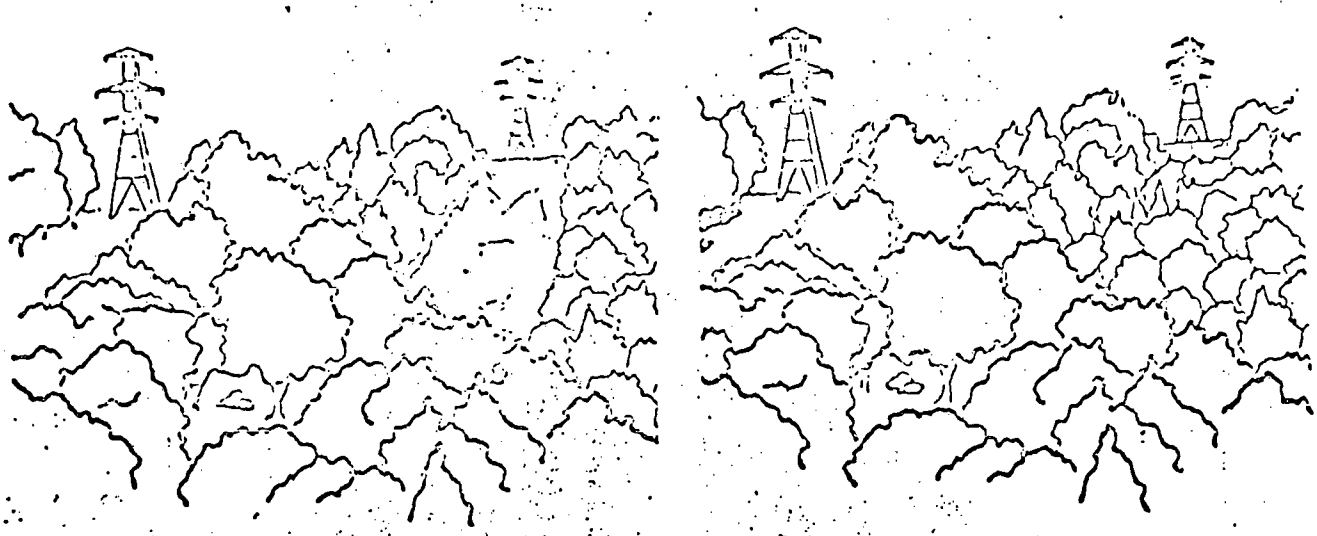
29. Long views of transmission lines parallel to highways should be avoided where possible. This may be accomplished by overhead lines being placed beyond ridges or timber areas.



POOR EXAMPLE PREFERRED

30. Transmission lines should cross canyons up slope from roads which traverse the canyon basins if the terrain permits.

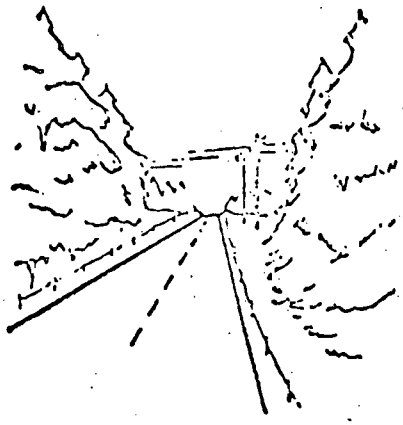
31. When crossing canyons in a forest, high, long-span towers should be used to keep the power lines above the trees and to eliminate the need to clear all vegetation from below the lines. Only as much vegetation as is necessary to string the line should be cut.



POOR EXAMPLE *PREFERRED*

32. Where ridges or timber areas are adjacent to highways or other areas of public view, overhead lines should be placed beyond the ridges or timber areas.

33. In forest or timber areas, high, long-span towers should be used to cross highways in order to retain much of the natural growth along the highways.



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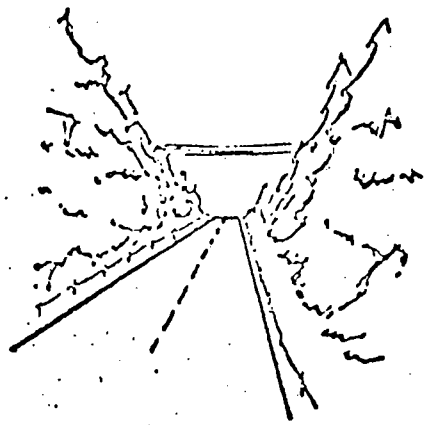

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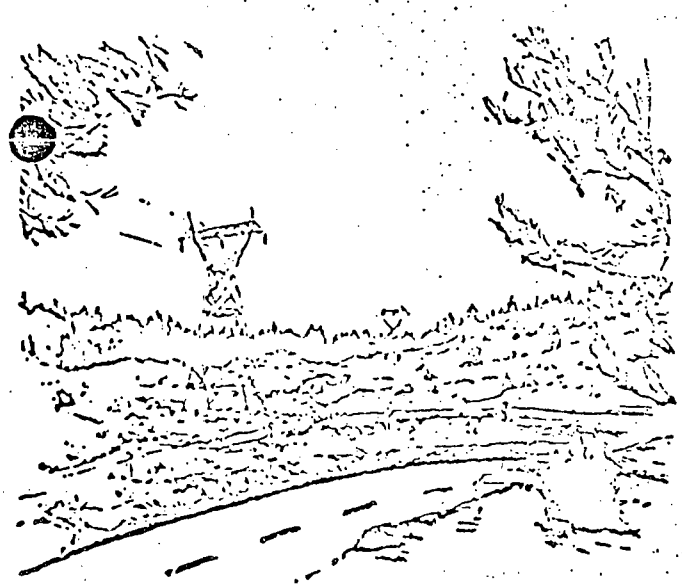
34. Native shrubs and trees should be left in place or planted at random, with the necessary allowance for safety, near the edges of rights-of-way adjacent to roads.



POOR EXAMPLE

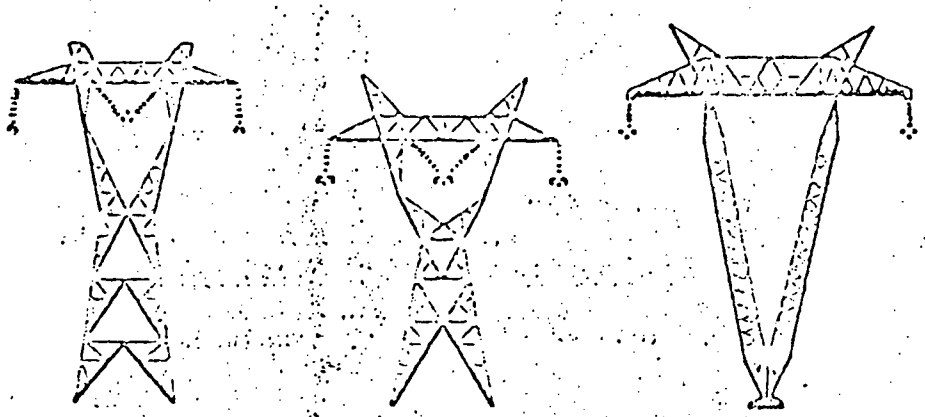
PREFERRED

35. Transmission lines should not be located or cross at road intersections or interchanges where possible.

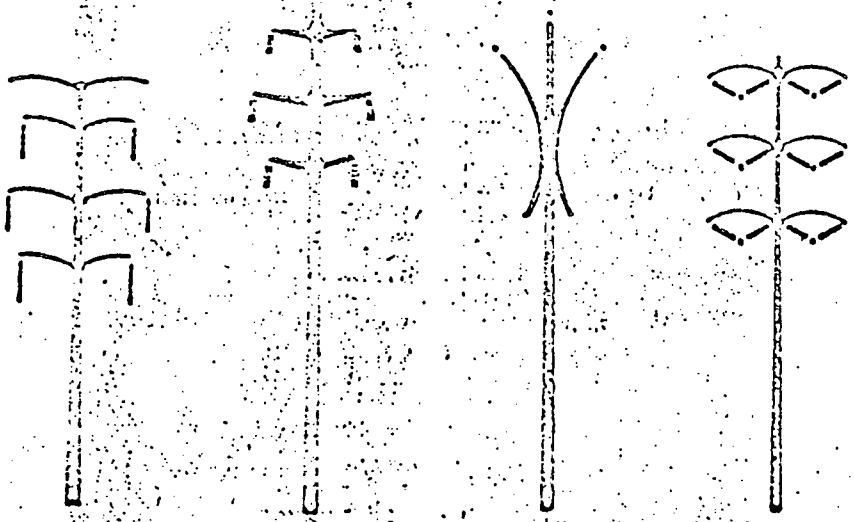
36. The Federal Highway Administration and the State Highway Department should be consulted with respect to any applicable guidelines or regulations that they might have to govern transmission lines which cross highways.

The Design of Transmission Towers

37. The size of transmission towers should be kept to the minimum feasible.

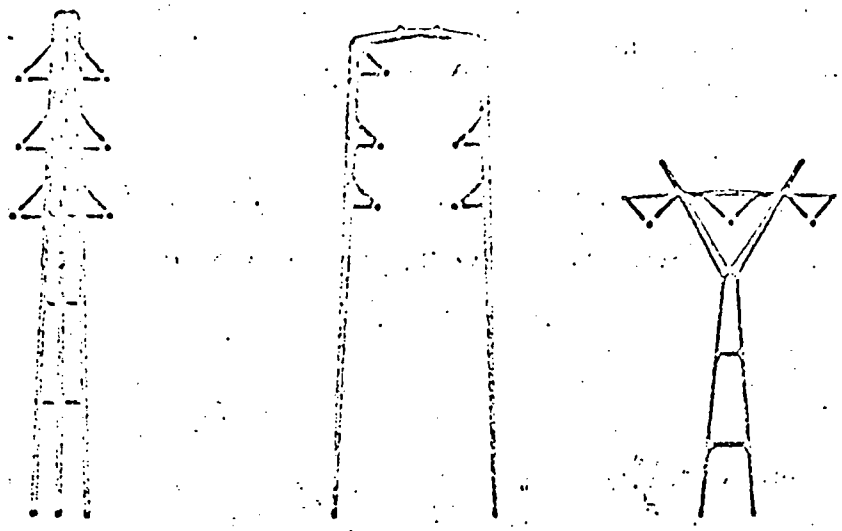


STANDARD TOWER DESIGNS

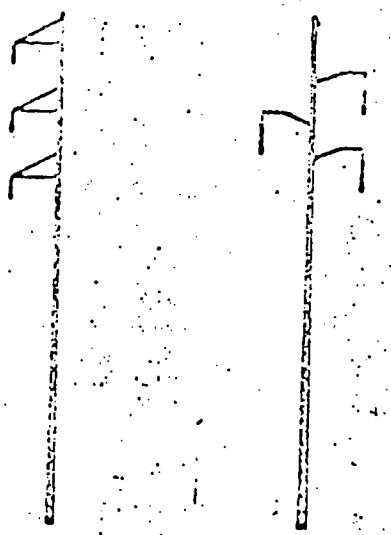


NEWER TOWER DESIGNS

38. Simple, but functional, designs of towers and poles should be used. Illustrations of these kinds of structures can be found in the book ELECTRIC TRANSMISSION STRUCTURES, sponsored by the Electric Research Council.



39. The use of poles designed without cross-arms for electric transmission lines of 138 kV and below and communications cables should be considered.



40. The materials used to construct transmission towers and the colors of the components of the towers should comport with the natural surroundings.

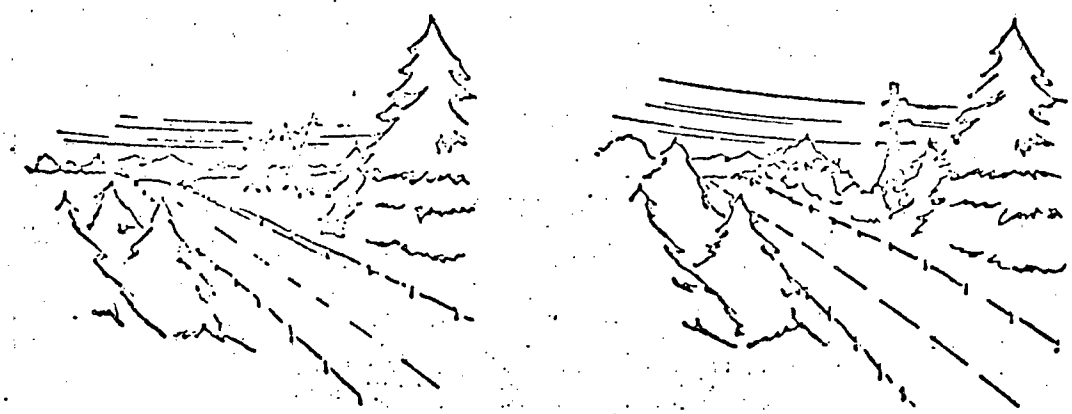
41. In addition to steel and aluminum transmission towers, the use of towers constructed of fiberglass, reinforced plastic, laminated wood, concrete, and other materials should be considered.

42. The use of treated single or double wood poles should be considered in forest or timber areas.

43. The use of weathered galvanized steel structures should be considered when transmission towers are to be silhouetted against the sky.

44. The design and color of the insulators should be compatible with the design of the tower.

45. Where two or more circuits are required at high crossings, the use of multiple circuit towers should be considered where it is consistent with adequate reliability.



POOR EXAMPLE *PREFERRED*

The Maintenance of Transmission Line Rights-of-Way

46. Once a cover of vegetation has been established on a right-of-way, it should be properly maintained.

47. Chemicals, when used, should be carefully selected to have a minimum effect on desirable indigenous plant life. Selective application should be used wherever appropriate to preserve the natural environment. In scenic areas, the impact of temporary discoloration of foliage should be considered; and where this factor is critical, either mechanical means of vegetative control should be used, or the work should be scheduled in early spring or late fall. It is essential that chemicals be applied in a manner fully consistent with the protection of the entire environment, particularly of the health of humans and wildlife.

48. Access roads and service roads should be maintained with suitable natural cover, water bars, and the proper slope in order to prevent soil erosion.

49. Aerial and ground maintenance inspection activities of the transmission line facility should include observations of soil erosion problems, fallen timber and conditions of the vegetation which require attention. The use of aircraft to inspect and maintain transmission facilities should be encouraged.

Possible Secondary Uses of Rights-of-Way

50. One of the potential benefits of transmission line routes is that clearings at safe distances adjacent to transmission facilities may be used for secondary purposes. Consistent with general safety factors the following should be considered as possible secondary uses of rights-of-way to the extent permitted by the property interest involved:

- Cultivation of Christmas trees, elderberry and huckleberry bushes, and other nursery stock
- Parks
- Golf courses
- Equestrian or bicycle paths
- Picnic areas
- Game refuges
- Hiking trail routes
- General agriculture
- Winter sports
- Orchards

The Location of Appurtenant Aboveground Facilities

51. The proposed designs and locations of electric substations, and other aboveground facilities, including communication towers, should be made available to local agencies which have jurisdiction over these matters sufficiently in advance of construction deadlines to permit adequate review.

52. Unobtrusive sites should be selected where possible for the location of substations and like facilities.

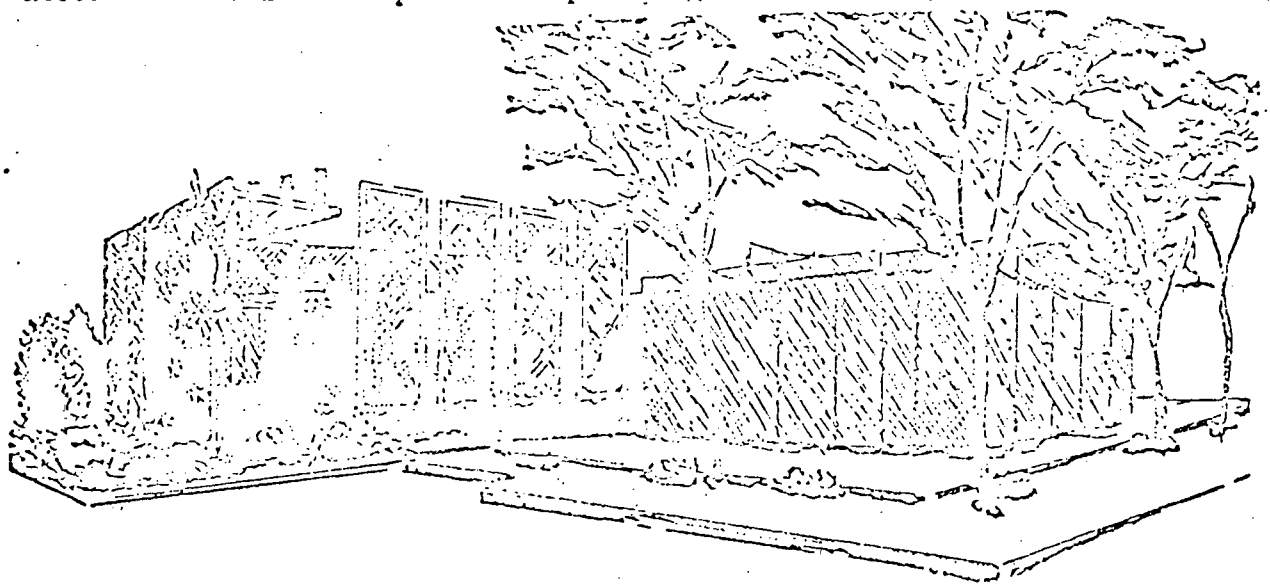
53. Potential noise should be considered when the locations for turbines, substations and like facilities are being determined. Such facilities should be located in areas where sound will not be resonated.

54. The size of substations and like facilities should be kept to the minimum feasible.

55. The designs of the exteriors of substations and like facilities should comport with the surroundings and other buildings in the area all in keeping with local control and applicable local zoning ordinance. For example, if a substation is to be located in a residential area, its design should comport with the designs of nearby residences.

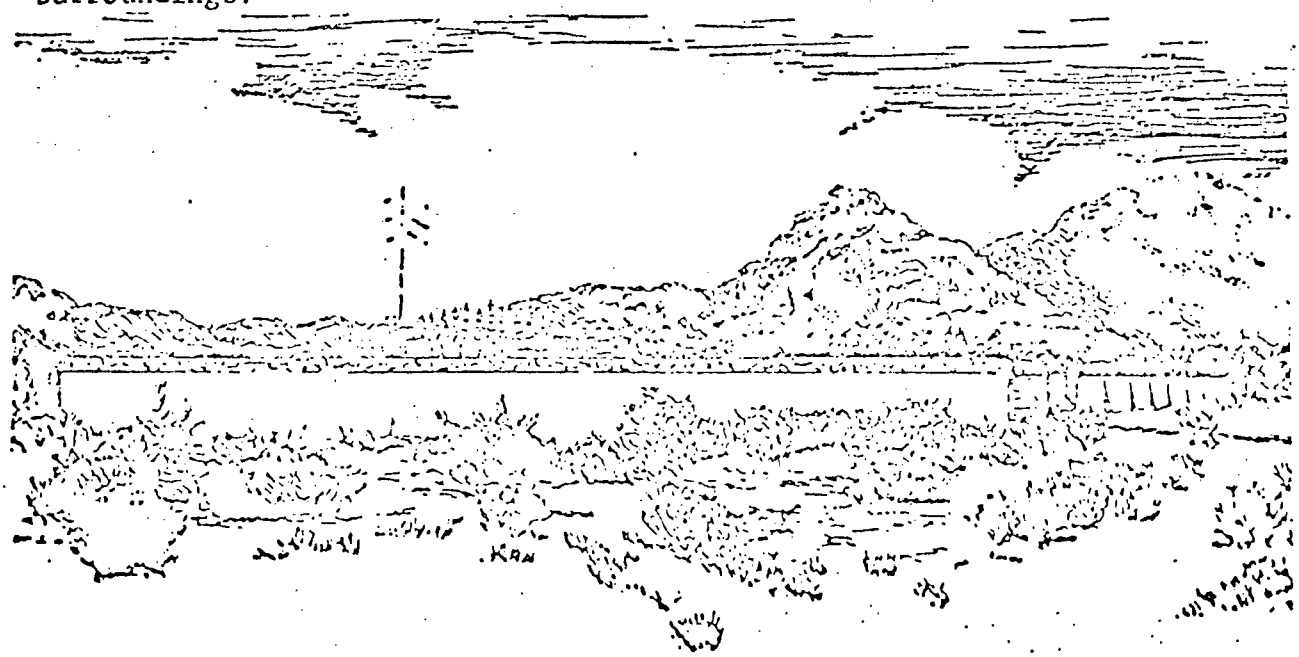
56. If substations are located in residential and/or scenic areas, the appurtenant transmission conductors and distribution conductors adjacent to the substations should be placed underground where economically and technically feasible.

57. Trees and other landscaping appropriate to the site should be placed around substations to present a pleasing view to the public.



58. Storage tanks in scenic areas should be placed below ground where feasible. If storage tanks must be placed above ground, they should be concealed in part by appropriate plantings of trees and shrubs.

59. The materials used to construct substations, storage tanks and like facilities and the colors of these materials should comport with the surroundings.



Ex Kay-2

NOTED OCT 13 1972 E.L.H.

Kay

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October 10, 1972

TO: MEMBERS SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL AND ASSOCIATE MEMBERS
MEMBERS TECHNICAL ADVISORY COMMITTEE AND ALTERNATES
REPRESENTATIVES PUBLIC SERVICE COMMISSIONS AND FEDERAL POWER COMMISSION
MEMBERS SERC JOINT TAC - S & F EXECUTIVE COMMITTEE

Guideline Number 3 - Criteria for Reliability in System Planning

Gentlemen:

Enclosed for your information and files is a copy of SERC's Guideline Number 3, Criteria for Reliability in System Planning. This Guideline was approved at the Executive Board meeting of October 4, 1972, following discussion of important reservations by certain member systems, which may ask further consideration by the Board following completion of certain studies of less credible incidents.

Sincerely,

Wm. R. Brownlee

Wm. R. Brownlee

WRB/llh

K-2

SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL

GUIDELINE NUMBER 3

CRITERIA FOR RELIABILITY IN SYSTEM PLANNING

By SERC Technical Advisory Committee

Approved - Executive Board - October, 1972

SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL

GUIDELINE NUMBER 3

CRITERIA FOR RELIABILITY IN SYSTEM PLANNING

The purpose of SERC "...is to augment further the reliability of bulk power supply in the areas served by the member systems." This can be best accomplished by promoting maximum coordination of planning, construction and utilization of generation and transmission facilities involved in interconnected operations.

To assist in achieving these objectives, the member organizations of SERC recognize the need for common criteria to be used in the planning of their systems for adequate and reliable bulk power supply.

LOCAL AREA CRITERIA

It is recognized that the reliability of power supply in local areas is the responsibility of the individual SERC members and that each system has internal criteria relating to the more common contingencies. It is further recognized that there are severe contingencies which are credible but of a low probability of occurrence, which may result in conditions such as islanding and/or loss of load. Such conditions are considered acceptable as long as they are controlled so as to limit the adverse impact of the disturbance and so as to leave the system or systems in such condition as to permit rapid load restoration and/or reconnection.

SERC REGIONAL CRITERIA

The objective of the regional criteria is to assure that the SERC bulk power systems are planned so that cascading outages will not result from any foreseeable contingencies. These criteria are, therefore, directed only at preventing cascading.

Cascading is defined as the uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in an uncontrolled, widespread collapse of system power which collapse cannot be restrained from sequentially spreading beyond an area predetermined by appropriate studies.

Each of the SERC member systems will be planned to avoid cascading upon the occurrence of the following contingencies:

1. Loss of Generation
   - A. Sudden loss of entire generating capability in any one plant.
2. Loss of Load
   - A. Sudden loss of a large load or major load center.
3. Loss of Transmission
   - A. The outage of the most critical transmission line caused by a three-phase fault during the outage of any other critical transmission line.
   - B. Sudden loss of all lines on a common right-of-way.
   - C. Sudden loss of a substation (limited to a single voltage level within the substation plus transformation from that voltage level), including any generating capacity connected thereto.
   - D. Delayed clearing of a three-phase fault at any point on the system due to failure of a breaker to open.

ECAR-MAAC-NPCC-VACAR
INTERREGIONAL SYSTEM APPRAISAL STUDIES
SCOPE AND CRITERIA

Scope of Study Activity

The MEN (MAAC-ECAR-NPCC) and VEM (VACAR-ECAR-MAAC) Study Committees are responsible for appraising, from an overall interregional standpoint, the effects of future system developments within the ECAR, MAAC, NPCC and VACAR regions. To obtain information for making these appraisals, the Study Committees will carry out appropriate analytical investigations. These investigations will include interregional load flow, inertial response, and transient stability studies as necessary to appraise the ability of the interregional network to withstand severe contingencies without experiencing widespread cascading outages and to exchange power sufficient for reliable operation. These investigations will provide the basis for assuring that developments within each region, which could affect other regions, are being properly coordinated and that the overall reliability of the interconnected network is maintained.

In carrying out their assignments, the Study Committees will:

1. Determine interregional transfer capabilities.
2. Determine transregional transfer capabilities as limited by ECAR, MAAC, NPCC, or VACAR facilities.
3. Examine the effects on interregional system performance of representative, very severe contingencies.
4. Examine the effects of other situations considered important to the reliability of the interconnected systems.

Whenever possible, the Study Committees will make use of investigations made by the regions or by individual systems within the regions to avoid duplication of effort.

Studies will be based on the most up-to-date plans of the individual systems. Changes in projected system developments that significantly affect interregional system performance will be included in the

appraisals.

Definitions and Criteria

To aid the Study Committees in their appraisals of interregional bulk power transmission system performance, the following definitions and criteria are established. The investigations will be conducted considering the load level most critical to system performance as well as appropriate power transfer schedules.

1. Transfer Capability

The ability of the interregional transmission system to exchange power sufficient for reliable operation will be appraised by evaluating interregional and transregional power transfer capabilities. These are defined as follows:

> Interregional power transfer capability is that amount of power that can be transferred via all paths between two adjacent regions in a reliable manner. This capability is affected by, among other factors, all transmission facilities through which significant amounts of this power flows.
>
> Transregional power transfer capability is that amount of power that can be transferred via all paths between two non-contiguous regions in a reliable manner. This capability is affected by, among other factors, all transmission facilities through which significant amounts of this power flows.

To evaluate interregional and transregional power transfer capabilities, the Capacity Emergency Transfer Limit (CETL) will, in general, be used. The CETL is the maximum amount of power that can be transferred from one area to another as follows:

a. With all transmission facilities in service system stability limits will be observed, facility loadings will be within appropriate long time ratings, and voltage levels will be within acceptable limits.

b. The interconnected system shall be capable of supporting the initial power swing resulting from the sudden loss of any one circuit, transformer, or generating unit.

c. After the loss of any one circuit, transformer or generating unit, the appropriate short time rating shall not be exceeded on any facility, and voltage levels will be within acceptable limits.

Facility ratings and acceptable voltage levels will be determined by practices being used within each of the councils.

Each council will consider other aspects of transfer capability according to its criteria. Sufficient investigation will be made to adequately analyze those aspects that are important to any council.

2. Very Severe Contingencies

To appraise the reliability of the interregional bulk power transmission system as measured by its ability to avoid cascading outages over a widespread area, the effects of the following types of very severe contingencies will be considered:

a. The sudden loss of all generating capacity at any generating plant.

b. The sudden loss of all transmission facilities at any station, including all generating units connected to that station.

c. The sudden loss of all transmission lines on a common right of way.

d. The sudden loss of a large load or a major load center.

e. The loss of the most critical transmission circuit on any one of the interconnected systems immediately following the loss of another critical circuit, before any readjustment of generation.

f. A three phase fault at critical locations, including the effect of delayed clearing by backup devices as a result of failure of a primary device to clear the fault.

3. Other Considerations

Each council will consider other aspects of interregional transmission system performance according to its criteria. Sufficient investigation will be made to adequately analyze interregional effects that are important to any council.

VACAR-SOUTHERN-TVA
RELIABILITY STUDIES

A. Scope

The inter-area performance of the systems as planned by Southern, TVA, and VACAR will be evaluated. The ability of these systems to exchange large blocks of power and to withstand very severe contingencies will be investigated.

B. Study Criteria

The following determinations will be made as required:

1. Transfer capabilities among the three subregions with all transmission facilities in service.

2. Transfer capabilities among the three subregions with the most critical transmission facility out of service.

3. Approximate transfer capabilities across the three subregions with all transmission facilities in service.

4. The effects of the sudden loss of all generation at critical power stations in each subregion.

5. The effects of circuit outages and power transfers among the subregions on the transient stability of critical power stations.

6. The loss of the most critical transmission circuit on any one of the interconnected systems immediately following the loss of another critical circuit, before any readjustment of generation.

7. The effects of the sudden loss of a substation (limited to a single voltage level within the substation plus transformation from that voltage level), including any generating capability or load connected thereto.

8. The effects of the sudden loss of all lines on a common right-of-way.

9. The effects of three-phase faults at critical locations, including the effects of delayed clearing by back up devices as a result of failure of a primary device to clear the fault.

10. The effects of other situations considered important to the reliability of the interconnected systems.

C. Methods

Joint Southern-TVA-VACAR studies will be made as necessary to evaluate the inter-area performance of the three subregions. Full use will

C. Methods - cont'd.

systems to minimize the joint studies required. The Steering Committee and the Study Group will coordinate the studies that are made.

The studies used in this work will include load flow studies, inertial response studies and transient stability studies. When necessary, alternate plans will be considered to obtain improvements in system performance.

The work will seek to assure that transfer capabilities are reasonable for the systems involved and that the systems can withstand extremely severe conditions without cascading outages or loss of major load area. The studies will be limited to performance evaluation only; economic studies will not be made on an overall joint basis, but will be left to the individual systems involved in a particular situation. The results of the work will be reported periodically.

LLW:fss
Jan. 10, 1973

DEP FILE

ENVIRONMENTAL CRITERIA

FOR ELECTRIC TRANSMISSION SYSTEMS

UNITED STATES DEPARTMENT OF THE INTERIOR, WASHINGTON, D.C. 20240
UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D.C. 20250

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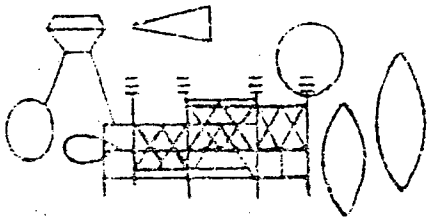
12-3
parker

Ex Kay-3

25

REF FILE



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ENVIRONMENTAL CRITERIA FOR ELECTRIC TRANSMISSION SYSTEMS

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price 65 cents

"...we in this century have too casually and too long abused our natural environment. The time has come when we can wait no longer to repair the damage already done, and to establish new criteria to guide us in the future."

RICHARD NIXON

Message on Environment
February 10, 1970

In his Message on Environment on February 10, 1970, President Nixon stated that "The task of cleaning up our environment calls for total mobilization by all of us. It involves Government at every level; it requires the help of every citizen." The issuance of Environmental Criteria for Electric Transmission Systems represents a step that can be taken now to help restore harmony between man and his surroundings.

This publication is intended to serve as a guide to the planning and accommodation of needed electric transmission systems. All agencies in the Department of the Interior and in the Department of Agriculture have been directed to use the criteria. We urge all governmental agencies, the electric utility industry and private organizations to adopt the criteria in an effort to assure adequate environmental planning. A common reference document will enable all affected interests to more intelligently review and discuss the environmental aspects of electric transmission systems.

Walter J. Hickel
Secretary of the Interior

Clifford M. Hardin
Secretary of Agriculture

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FOREWORD

Many publications have been written covering most aspects of the environmental impact of electric transmission systems. In May 1966 the Bonneville Power Administration issued "A Report on Appearance Planning for BPA". This report, and others in the referenced list, such as "Working Committee on Utilities–Report to the Vice President and to the President's Council on Recreation and Natural Beauty" dated December 1968––are the foundation for "Environment Criteria for Electric Transmission Systems". This publication is a compilation of pertinent criteria which have been updated and organized for easy reference, guidance and use.

While acknowledging past efforts, we would also like to express our appreciation for the cooperation received in preparing this publication. The review of the draft document and the preparation of detailed comments was a time consuming task. We appreciate the cooperation of and the contributions made by Federal agencies, a majority of the states, the electric utility industry and private organizations. All comments and suggestions were carefully considered and in most cases incorporated into the final document.

"Environmental Criteria for Electric Transmission Systems" is generally written for broad application. When applied to

specific circumstances, the criteria should be used as a guide only. It is intended that all criteria be considered; however, it is recognized that many will not be applicable to the specific system being reviewed. They should not be used to justify violations of existing safety regulations or the various codes applicable to the construction, operation, and maintenance of electric transmission systems.

The criteria were carefully written to serve as a reasonable guide to the review of transmission systems. It should be recognized that not all of the criteria may apply to a given set of circumstances, and where an application is questionable, interested parties should jointly seek a reasonable solution. Discussion and reasonable compromise between competing interests is the best mechanism for enforcement.

The electric utility industry is encouraged to make environmental costs known to the public so that unreasonable demands and excessive costs can be avoided. In most cases, these costs will be negligible. In some cases the costs will be so high that alternatives will have to be considered, or, it may be determined that no intrusion is tolerable regardless of the costs involved. While no attempt is made to outline cost guidelines, all additional costs should be fully justified. At the same time, management should consider as a part of their construction and their normal maintenance and operating budgets, the costs of these environmental considerations.

INTRODUCTION

The electric utility industry is faced with a complex challenge in the 70's. It must provide the generation and transmission facilities that are and will be needed to meet the ever growing demand for reliable electrical power, and it must do this in a decade dedicated to the restoration and protection of our environment.

There are approximately 3600 electric utilities in the United States. These utilities operate over 300,000 miles of overhead electric transmission lines, which preempt nearly 4 million acres of land for right-of-way. With the demand for electric power doubling each decade, it is estimated that approximately 100,000 miles of new transmission lines will be constructed on 1½ million acres of right-of-way each decade for the balance of this century. These projections become even more significant when viewed as "but a part" of the total right-of-way requirements for highways, railroads, pipelines, and other utilities.

On January 1, 1970, President Nixon signed into law the National Environmental Policy Act of 1969, which states that it is the policy of the Federal Government ". . .to create and maintain conditions under which man and nature can exist in productive harmony."

The publication of Environmental Criteria for Electric Transmission Systems is in accord with this policy.

The Federal Government is deeply involved with and can be properly considered a part of the electric utility industry. Federal agencies are engaged to varying degrees in the generation, transmission, and marketing of electrical power and in the regional planning required to meet this Nation's growing electrical demands. At the same time, these agencies are required to work with this industry in an effort to minimize its impact on our environment and specifically on the lands and programs that these agencies administer.

The electric utility industry faces an environmentally aroused general public. The questions being raised are difficult to answer to the satisfaction of this public and oftentimes adverse reactions cause delays that may create critical shortages. The industry must acknowledge by policy and deed the public's right to insist upon environmental protection. However, no less important is the general public's duty to acknowledge that the principal function of this industry is to supply energy at a reasonable cost where and when it is required. What remains to be defined then is the

balance between these two significant concerns. Energy must be supplied and the environment will be protected.

The purpose of this report is to provide broadly based criteria which can be applied with judgment by the Federal land managing agencies to design regulations and enforce contractual standards of performance in the construction and maintenance of transmission systems. It is patently impracticable to include in a single document standards of environmental protection which will contain sufficient detail to cover every situation. This document will permit Federal agencies and all electric utilities to enter into the design and planning of transmission lines—particularly lines which cross Federal lands—with an understanding of the frame-of-reference in which their work will be appraised by the Federal Government.

The land managing agencies have the responsibility to protect the natural resources affected by transmission systems. They must determine the degree of protection required, which varies with the use of the land and its environmental values.

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Environmental considerations and the aesthetic needs of land set aside for parks, historic sites, national monuments and recreational areas will differ significantly from those of lands used; for example, for grazing or forestry. The environmental values to be considered by the land managing agencies relate to visual aesthetics, multiple land use, proper drainage, protection of game cover and fishing and spawning areas, and safeguarding the land against the damage caused by burning and flooding.

The Nation no longer can afford the profligate use of its land resources. Improved long-range land use planning, the more extensive use of utility corridors and the upgrading of existing systems will help to alleviate this problem. New technological developments may permit the undergrounding of transmission lines, the use of superconductors and even the transmission of electric power without wires. But for now, at a time when planning and construction must proceed without tomorrow's technology, there is a need for improved design, construction and maintenance of overhead transmission lines to protect the natural environment and to preserve the aesthetics of the countryside. The development of these criteria is directed toward this objective.

This report represents an element of environmental planning. It establishes a frame-of-reference within which the land managing agencies will devise and implement regulations to protect and conserve the environment with respect to the construction of electric transmission facilities by the Federal Government or by non-federal entities on Federal land. It will also guide Federal agencies engaged in the construction of transmission systems on both public and private lands.

Environmental criteria for electric transmission systems are equally valid for construction of non-federal electric transmission systems which do not cross Federal lands. The electric utility industry is urged to adopt these criteria for their entire transmission systems.

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COORDINATION

The public interest is properly served when electric transmission facilities are planned, constructed and operated to provide the country with an adequate and reliable power supply that is compatible with our environment. The key to success in the efforts to minimize the impact and optimize the compatibility of electric transmission systems on the environment is coordination—involving the industry, all interested Federal, State and local governments (especially those with planning responsibilities) and the private sector. It is the responsibility of management to insure that this coordination takes place at the earliest possible time in the planning process.

The purpose of coordination is to identify all interests affected by the electric transmission facility, to explore alternatives and to resolve conflicts.

Environmental considerations must be placed in proper perspective with other vital issues such as reliability, cost and safety. The techniques for implementing environmental criteria are widely known in the electric utility industry. This industry is concerned with the environment and has demonstrated a willingness to incorporate environmental considerations into its plans.

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Just as reliability became a criterion against which plans and actions of the industry are measured, another criterion of equal importance must now be given comparable status—the environment.

There is a need for development of viable State and regional mechanisms to work with the electric utility industry to plan and review its future requirements. This type of mechanism does not now exist in most states and must be developed promptly if there is to be orderly growth and intelligent coordination of individual plans. Regional, overt, integrated planning will produce broad conceptual guidelines for future growth and will assist individual utilities to proceed with the design and construction of facilities required to meet their specific needs. Efforts are now being made to define and establish these mechanisms. Once established, "Environmental Criteria for Electric Transmission Systems" will be a useful document in their planning and review.

When a transmission system crosses lands administered by more than one Federal land-managing agency, it is in the public interest to have a coordinated review of this system. An uncoordinated, fragmented approach reduces the effectiveness of the Federal review and does not allow for an

overview of the entire transmission system. If all alternatives are to be considered, the review must encompass the entire system, with an understanding of the electrical problems and considerations that should be a part of this review.

Technical staff assistance on electrical, structural, landscape, and design alternatives is available upon request from the Department of the Interior's Office of the Assistant Secretary--Water and Power Development, and the Department of Agriculture's Office of the Assistant Secretary–Rural Development and Conservation. The use of these talents will provide an unbiased, reasonable and coordinated input into the decision making that would remain with the land-managing agencies or for Federal involvement in systems built on private lands.

Pre- and postconstruction conferences are key elements to local coordination. Once all affected interests have been identified and appropriate measures have been agreed upon to accommodate these interests, a preconstruction conference should be held to review and reaffirm the agreements. A similar postconstruction conference should also be held, following a physical inspection, to assure that these agreements have been implemented, and if not, what can be done. These conferences should be held between

representatives of the affected interests and the builder of the transmission system. Where possible, the agreements should be written into right-of-way permits or other documents of comparable stature. Where Federal lands are involved, this should become standard practice. Finally, periodic tours of the completed transmission system should be made to see to it that the system is properly maintained and that repairs are made with the same care with which the system was constructed.

SEN-F NO-SS-WSNAT 1

A. General Comments

Past experience has demonstrated that compliance with the following criteria will safeguard aesthetic and environmental values within the constraints imposed by the current state of high-voltage transmission technology. The development of an economically feasible underground transmission technology will require a redefinition of environmental transmission criteria.

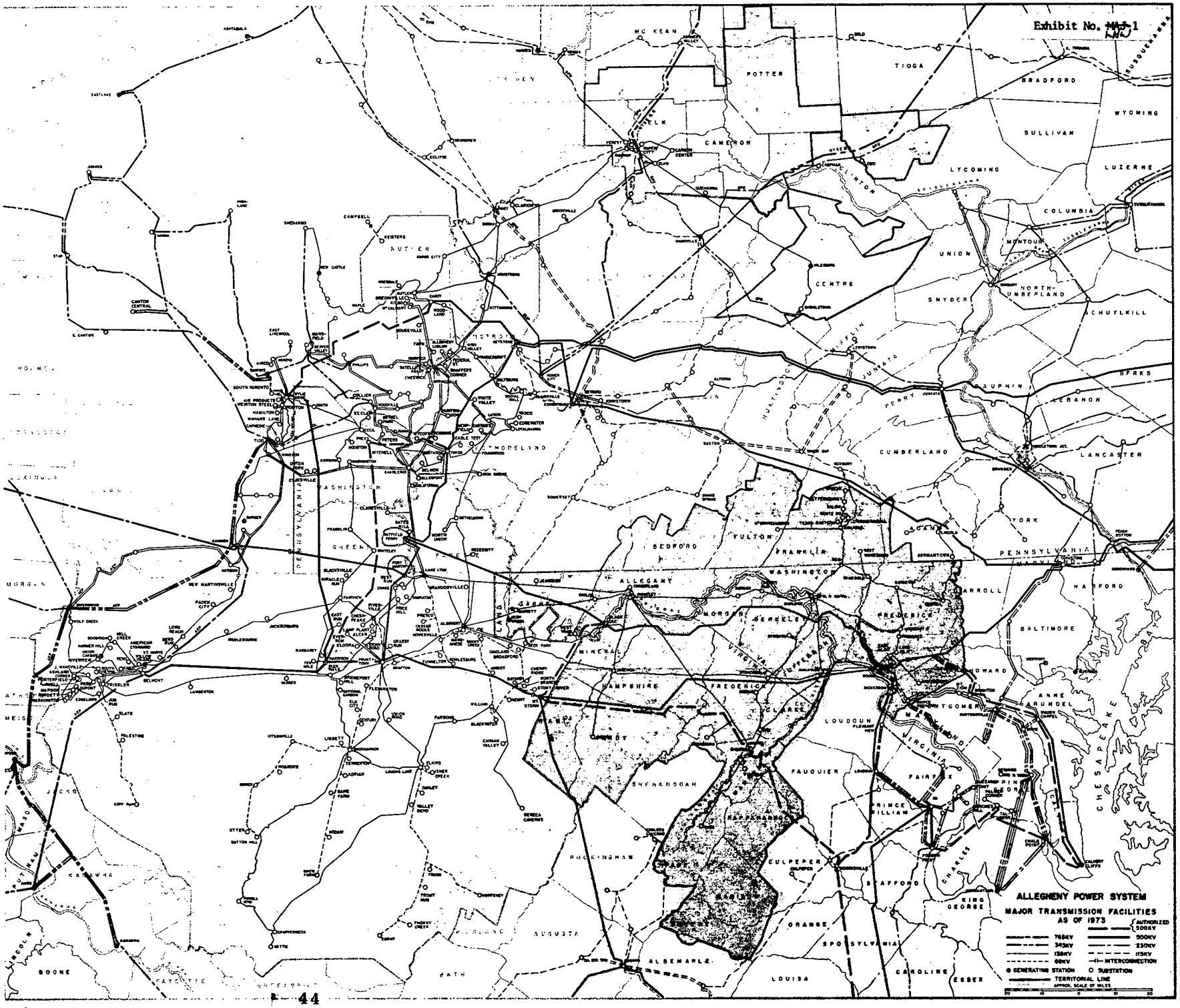
These criteria are intended for use in rural areas and may not apply specifically to urban areas.

B. Selection of a Proposed Route or Corridor

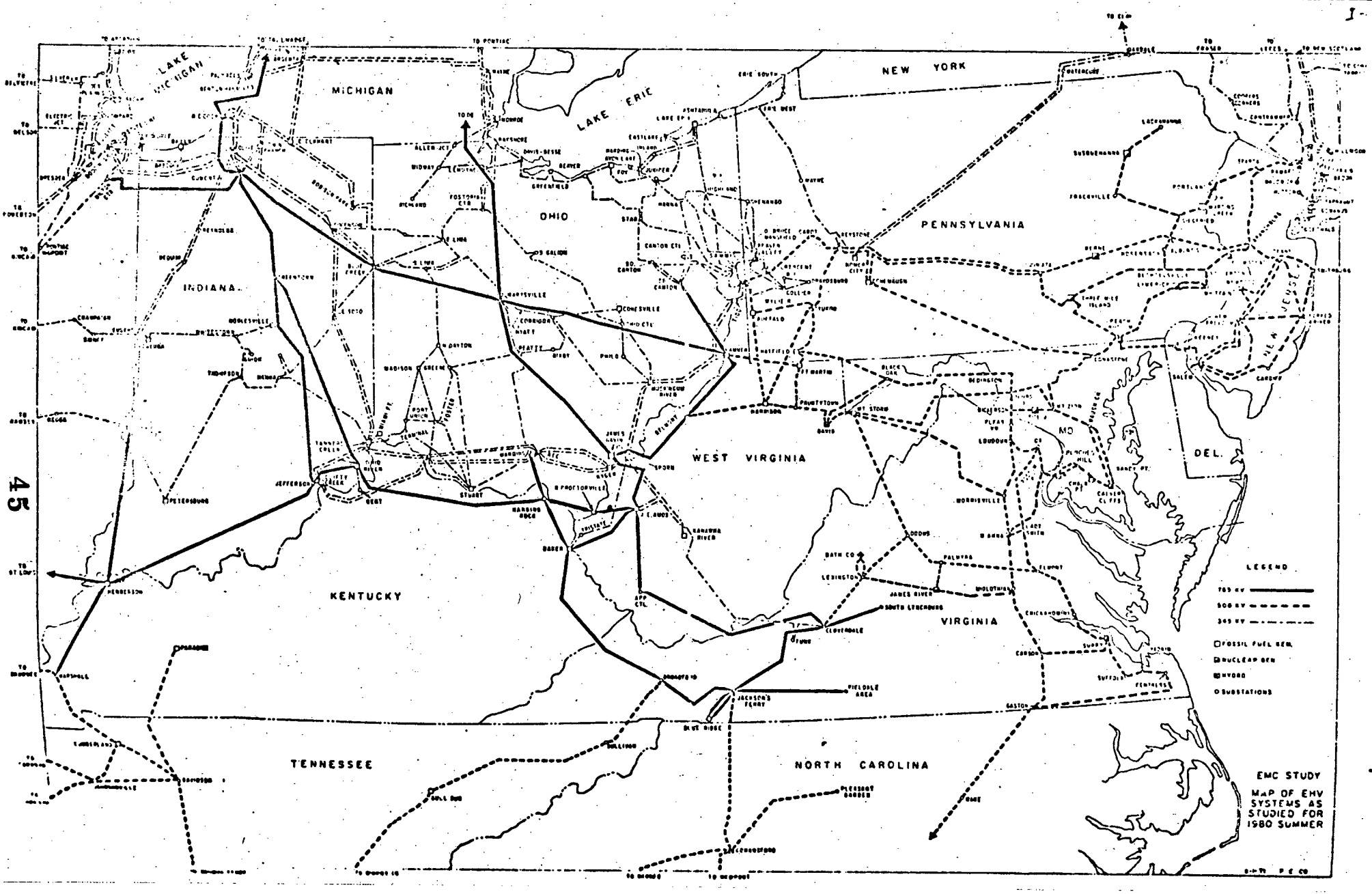
Concealment of transmission towers and lines is virtually impossible, but much can be done to make them less obtrusive and more attractive. Adherence to the following criteria will minimize the impact and optimize the compatibility of transmission facilities with the environment.

1. Rights-of-way should be selected to preserve the natural landscape and minimize conflict with present and planned uses of the land on which they are to be located.
2. Where possible, retirement or upgrading of existing lower voltage transmission circuits should be required to allow construction of higher voltage, higher capacity circuits on the existing right-of-way.
3. Properly sited established rights-of-way should be used where warranted for the location of additions to existing transmission facilities.
4. The joint use of electric transmission facilities by two or more utilities should be encouraged, when feasible, to reduce the total number of transmission lines constructed.

Exhibit No. MHJ-1



Ex MHJ-1


LAKE MICHIGAN
MICHIGAN
LAKE ERIE
NEW YORK
OHIO
PENNSYLVANIA
INDIANA
WEST VIRGINIA
KENTUCKY
VIRGINIA
TENNESSEE
NORTH CAROLINA
MD
DEL.
LEGEND
765 KV
500 KV
345 KV
FOSSIL FUEL GEN.
NUCLEAR GEN
HYDRO
SUBSTATIONS
EMC STUDY
MAP OF EHV SYSTEMS AS STUDIED FOR 1980 SUMMER

Ex Kay-6

Ex DNR-27

DNR-29

TOTAL COST	NOTES
23,540,000	* ALL LINES 500KV EXCEPT MORRISVILLE - BRISTERS*

$145,000/MILE FOR 500KV

BY: STT DATE: 3-7-73 SUBJECT: COST COMPARISON NEW LINES ALONG LOOP VS MORRISVILLE PANL SHEET NO. 1 OF 1 JOB NO.

566.22 CHKD. BY: DATE:

LINE NAME	MILES	LINE COST	ACREAGE	R/W COST	OBSTRUCTION COSTS	TOTAL COST
1. MT. STORM - LOUDOUN 100' R/W	130.4	18,910,000	1580	3,950,000	680,000	23,540,0
2. MT. STORM - DOOMS 100' R/W	82.1	11,900,000	995	2,490,000	430,000	14,820,0
3. DOOMS - ELMONT 100 R/W	82.4	11,950,000	999	2,500,000	490,000	14,940,0
4. ELMONT - LADYSMITH 100 R/W	26.2	3,800,000	318	790,000	500,000	5,090,0
5. NORTH ANNA - BRISTERS 37.2 mi 150' R/W 6.3 mi 100' R/W	43.5	6,310,000	753 (500 / 177)	1,540,000	200,000	8,050,0
6. MORRISVILLE - BRISTERS 120' R/W	7.8	980,000	113	230,000	-	1,210,0
						67,650,00
7. NORTH ANNA - MORRISVILLE 235' R/W	32.5	4,710,000	926	1,850,000	-	6,560,0
8. MT. STORM - MORRISVILLE 42 mi 235' R/W 41.8 mi 150' 55 mi 200	111	16,100,000	2455 (320 / 560 / 1575)	4,910,000	-	21,010,0
		*	* (2215)	* (4,430,000)	*	* (20,530,0)
9. MORRISVILLE - BRISTERS 235' R/W	7.8	1,130,000	222	440,000	-	1,570,00
						29,140,0
					*	* (28,660,0)
10. ELMONT - LOUDOUN 100' R/W	86.3	12,510,000	1046	2,610,000	1,370,000	16,490,0
						69,790,0
						4,200,0
						$73,990,0
						$52,980,0

TOTAL LOOP ACREAGE 4620
LESS MYSTIM 2455
2165

* Red was first study

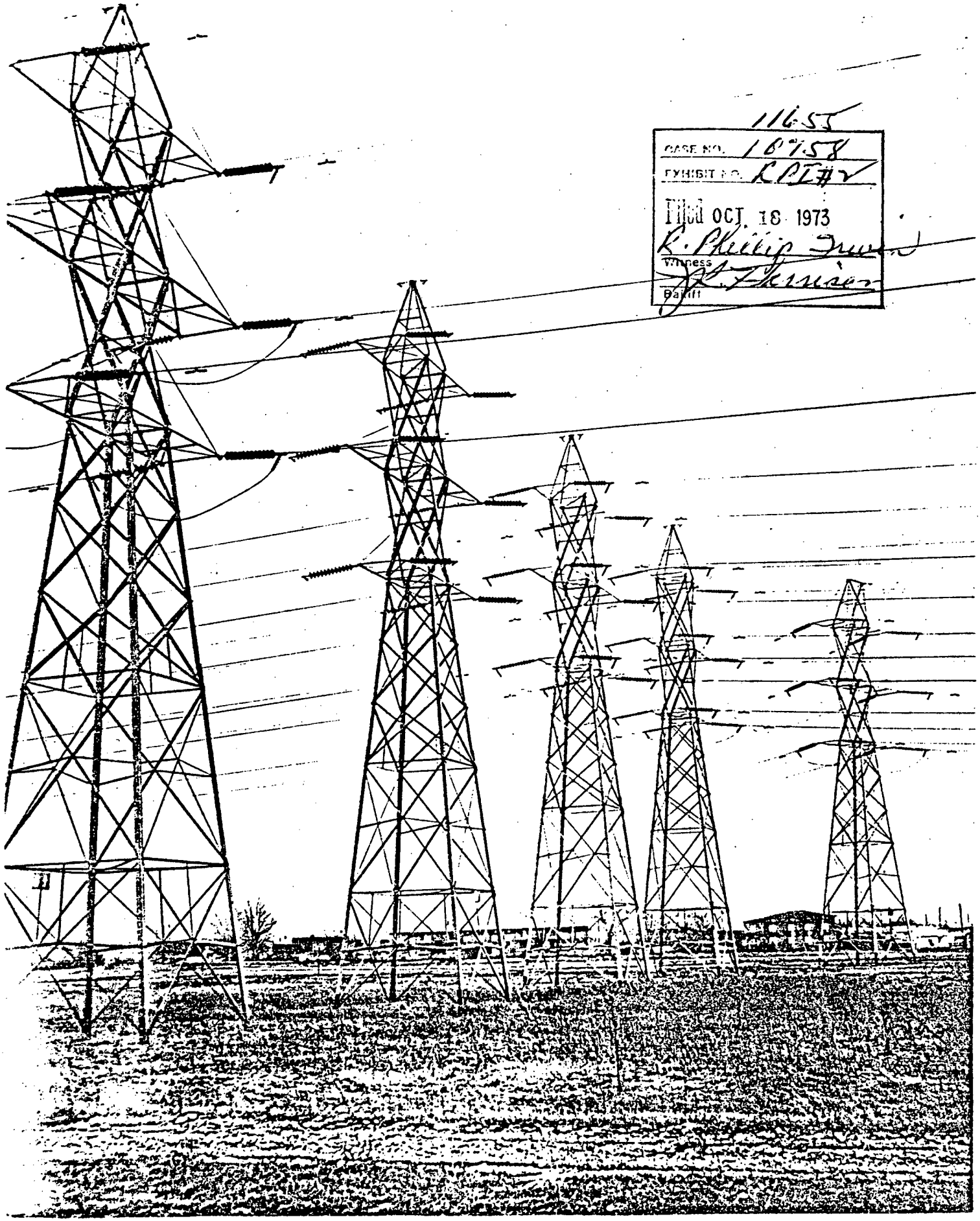
BY RTT DATE 3-7-73 SUBJECT COST COMPARISON SHEET NO. 1 OF 1
566.22 CHKD. BY _____ DATE _____ NEW LINES ALONG LOOP W/ JOB NO. _____
MORRISVILLE PANN

LINE NAME	MILES	LINE COST	ACREAGE	R/W COST	OBSTRUCTION COSTS
MT. STORM - LOUDOUN 100' R/W	130.4	18,910,000	1580	3,950,000	680,000
MT. STORM - DOOMS 100' R/W	82.1	11,900,000	995	2,490,000	430,000
DOOMS - ELMONT 100 R/W	82.4	11,950,000	999	2,500,000	490,000
ELMONT - LADYSMITH 100 R/W	26.2	3,800,000	318	790,000	500,000
NORTH ANNA - BRISTERS 7.2 mi 150' R/W 6.3 mi 100' R/W	43.5	6,310,000	753 (676 77)	1,540,000	200,000
MORRISVILLE - BRISTERS* 120' R/W	7.8	980,000	113	230,000	-
NORTH ANNA - MORRISVILLE 235' R/W	32.5	4,710,000	926	1,850,000	-
MT. STORM - MORRISVILLE 2 mi - 235' R/W 41.8 mi 150' 65 mi 200	111	16,100,000	2455 (320 560 1575)	4,910,000	-
		*	* (2213)	* (4,430,000)	* *
MORRISVILLE - BRISTERS 235' R/W	7.8	1,130,000	222	440,000	-
ELMONT - LOUDOUN 100' R/W	86.3	12,510,000	1046	2,610,000	1,370,000

TOTAL LOOP ACREAGE 4620
LESS MTST-ML 2455
2165

Red was first study

Ex RPI-2



11655
CASE NO. 16758
EXHIBIT NO. RPI #2
Filed OCT. 18 1973
R. Phillip Trund
Witness
J. R. Ekrusen
Bailiff

REVISED

COMPARISON OF ALTERNATE CORRIDORS, ADJUSTED COSTS,
COMBINED MT. STORM-BRISTERS STUDY AREA

Corridor	Total Grid Cells	Mt. Storm-Morrisville Total Cost Per Five Acre Basis	Morrisville-Bristers Total Cost Per Five Acre Basis	Combined Total Cost Five Acre Basis
VEPCO	528	$ 23,602,235	$ 2,340,165	$ 25,942,400
Ratepayer I	521	22,916,185	2,154,880 (R') 2,239,650 (R',•)	25,071,065 25,155,835
Ratepayer II	521	22,819,090	2,154,880 (R') 2,239,650 (R',•)	24,972,970 25,058,740
Intervenor (I-III)	558	n/a	n/a	28,718,505

n/a: not applicable.

Note: Paralleling options (I-III) and (R') do not include obstacle costs.

Ex KCS-44A
EXHIBIT
KCS-44A

Ex KCS-45A

EXHIBIT
KCS-45A

REVISED
TOTAL COST COMPARISONS OF
ALTERNATE CORRIDOR SYSTEM CONFIGURATIONS

		Total Present Value Cost
Ratepayer	Morrisville-Bristers (R',•)	$ 2,239,650
	North Anna-Morrisville	8,584,305
	Mt. Storm-Morrisville (I)	22,916,185
		$33,740,140
	Morrisville-Bristers (R',•)	2,239,650
	North Anna-Morrisville	8,584,305
	Mt. Storm-Morrisville (II)	22,819,090
		$33,643,045
VEPCO	Morrisville-Bristers	2,340,165
	North Anna-Morrisville	9,339,100
	Mt. Storm-Morrisville	23,602,235
		$35,281,500
Intervenors	North Anna-Bristers (I-I)	15,007,080
	Mt. Storm-Loudoun (I-III)	28,718,505
		$43,725,585
	North Anna-Bristers (I-II)	12,703,745
	Mt. Storm-Loudoun (I-III)	28,718,505
		$41,422,250

Ex W-6

Attachment I

SCC CASE NO. 11655
SCC CASE NO. 10758

Summary of Statement of

CARROLL J. SAVAGE

Before The

STATE CORPORATION COMMISSION

at Hearing Held at Warrenton, Virginia

March 28, 1973

Case Nos. 11655 and 10758

I am a resident of Alexandria, Virginia, a stockholder of Virginia Electric and Power Company, and am owner of property in northwestern Fauquier County in the Blue Ridge Mountains near the Warren County line.

I purchased this Fauquier property, known as "Hidden Valley", in the Spring of 1972, a few weeks before Vepco surveyors contacted property owners in the area in connection with preliminary surveys for the proposed 500 KV line from Mt. Storm to Morrisville, which is the subject of Application No. 36. The property, comprising 167 acres, consists almost entirely of a wooded valley surrounded by hills on either side, with a large stream called "Fiery Run" (a tributary of the Rappahannock River) located in the center of the valley.

Since the hillsides are steep, the only usable land is the 20 or 30 acres of relatively level bottom land. Vepco proposes to run its 500 KV line diagonally along and across the center of this valley, crossing Fiery Run twice on my property and a third time just to the north. Exhibit A is a copy of a topographical map showing the route of the proposed line through this area. Exhibit B is a plat showing Vepco's proposed right of way across my property.

The terrain traversed by the proposed right of way begins at an altitude of 1250 feet at the point where the line enters the property on the southern boundary, drops to about 1050 feet when it crosses Fiery Run, and then rises steadily again after leaving the property at the northern end until reaching an altitude of approximately 1750 feet on the side of High Knob, the highest mountain visible where the Blue Ridge crosses Route 55 at Manassas Gap. The proposed line crosses the Appalachian Trail at an altitude of 1500 feet about one-half mile from the northern boundary of my property at a point not far from the Appalachian Trail's Mosby Shelter, which is the first shelter on the trail after it leaves Shenandoah National Park. Throughout this area there are many springs and streams, deer and other wildlife, a wide variety of trees, shrubs and wildflowers, hiking and horseback riding trails,

and lovely mountain views. Exhibits C and D are pictures showing the present views from a point at which the proposed transmission line would dominate the scene with towers on each ridge. Exhibit E shows pictures of some of the actual area which would be clear-cut and treated with insecticides for vegetation control.

My purpose in purchasing Hidden Valley was to obtain a wooded mountain retreat which could be preserved in its natural state. My intention was to build a small lake and cottage along Fiery Run and to donate an open space easement over the remainder of the property to the Virginia Historic Landmarks Commission, the Commission of Outdoor Recreation, or the Virginia Outdoors Foundation, all of which have been authorized by the General Assembly to accept and administer such easements. At present, I find that the threat of the 500 KV line makes this impossible. I have plans to discuss with the Potomac Appalachian Trail Club the possibility of extending onto this property hiking trails under its jurisdiction, but again the threat of virtual destruction of the property by Vepco has forced a postponement.

In considering Vepco's claim as to the comparative cost of alternative routes, the Commission should bear in mind that the per acre value of the actual

required right of way is only a small part of the cost involved in a new corridor as compared to an existing corridor. In my case, and that of neighboring landowners for several miles on both sides, the severance damages representing the loss of value of substantial additional adjacent acreage must be considered. With respect to my property, since Vepco proposes to run its line down the middle of the valley, the steep hillsides overlooking it on each side are also rendered virtually worthless for any purpose that I can think of, and I expect that in eminent domain proceedings I would recover from Vepco substantially the entire value of almost 100 acres, whereas the actual area of the proposed right of way is less than 10 acres.

All of the governmental studies and publications on transmission line siting, including the Federal Power Commission guidelines incorporated into this Commission's procedures, have concluded that existing transmission corridors should be given priority for new transmission lines. The guidelines also state specifically that rights of way should avoid scenic, wildlife and recreational lands, steep slopes and prime or scenic timber areas, both because of the scenic values and to achieve desirable

conservation of existing forest lands. Virginia Code §56-46.1 charges the Commission with choosing a transmission route which reasonably minimizes the adverse impact on the scenic and environmental assets of this state, and it seems to me to place the burden on the utility to show that there are not acceptable alternatives which make use or partial use of existing rights of way. In view of the direct conflict between the proposed route and the basic environmental guidelines applicable to transmission line siting, the burden, in the case of Application No. 36, should be a heavy one.

It will not be sufficient for Vepco to show that greater reliability will be created by a maximum diversion of transmission lines, since the protection of the environment inevitably requires that additional corridors be limited. Historically, Vepco's service area has survived with <u>one</u>, and later <u>two</u> transmission corridors from Mount Storm. Now, even with additional flexibility becoming available with interconnections from North Anna and proliferation of additional interconnections with neighboring utilities, we are suddenly asked to believe that reliability requires <u>three</u> separate corridors. In order to justify the destruction of our dwindling rural

areas which Vepco proposes here, it should be necessary that Vepco clearly demonstrate a high probability that adequate service cannot be provided to its customers through a line paralleling one of the existing lines from Mr. Storm or through other alternatives which make use or partial use of existing rights of way.

As an attorney specializing in federal tax laws, I recently ran across a 1969 case in the U. S. Court of Claims in which Vepco, contending that it should be entitled to claim a depreciation tax allowance on the cost of its overhead transmission lines, produced expert testimony, accepted by the Court, to the effect that rights of way now being sought for extra-high voltage overhead transmission lines will be entirely obsolete within the next 27 years, after which all new transmission will be constructed underground. Once the scenic areas covered by Application No. 36 are destroyed, however, there will be no recovering the natural assets. As ecological changes are measured, 27 years is a very short time. Present expediency must not take priority over protection of our rapidly diminishing natural resources. See Virginia Electric and Power Company v. the United States, 188 Ct.Cl. 120 (1969).

In summary, as a resident of the Northern Virginia Urban Corridor who is concerned with the reliability and cost of Vepco's electrical service, as a stockholder of Vepco concerned with the return on my investment, and as a rural landowner, I ask that this Commission require that any additional transmission facilities from Mt. Storm be located, to the extent possible, in or adjacent to the present rights of way.

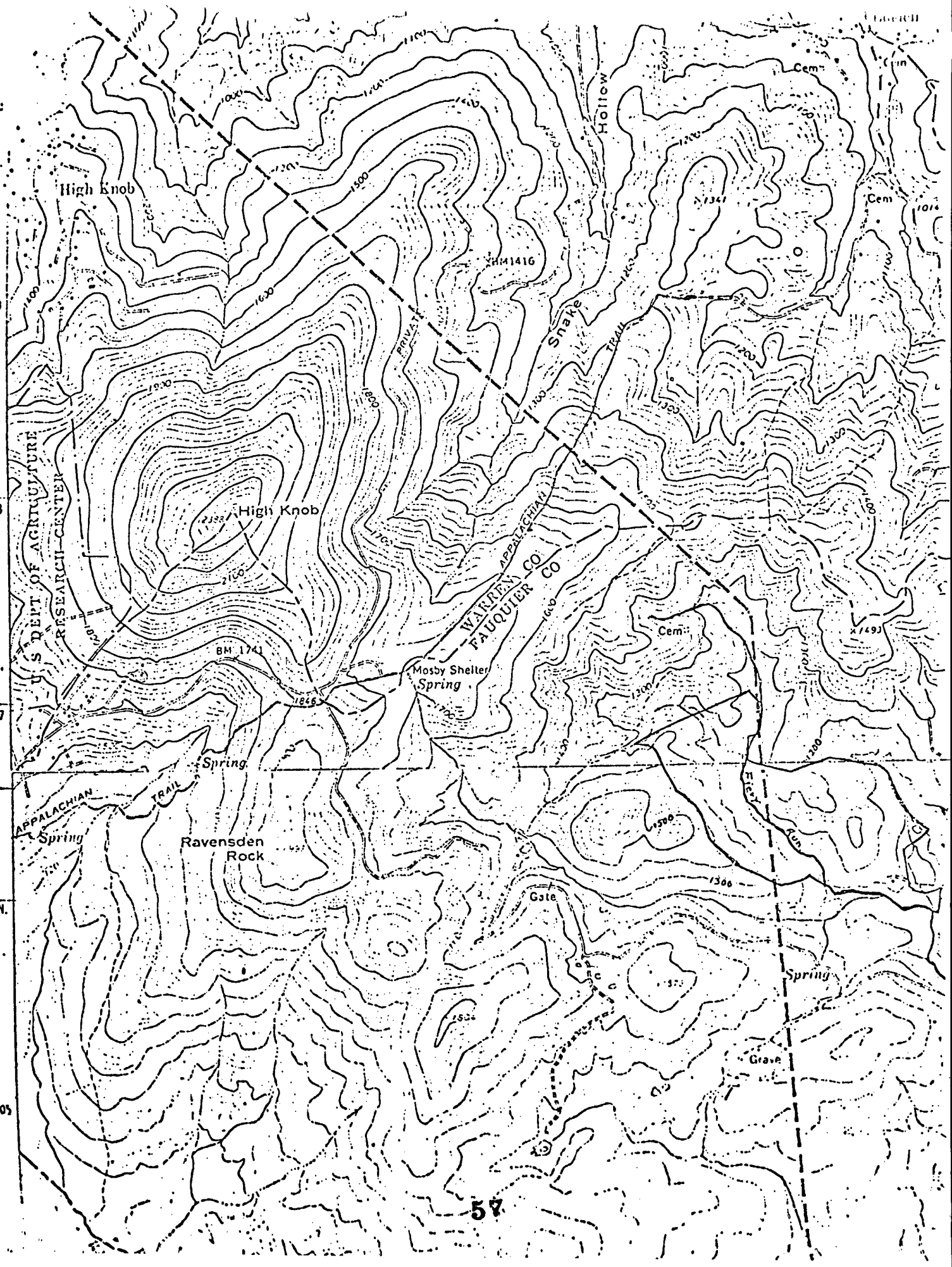

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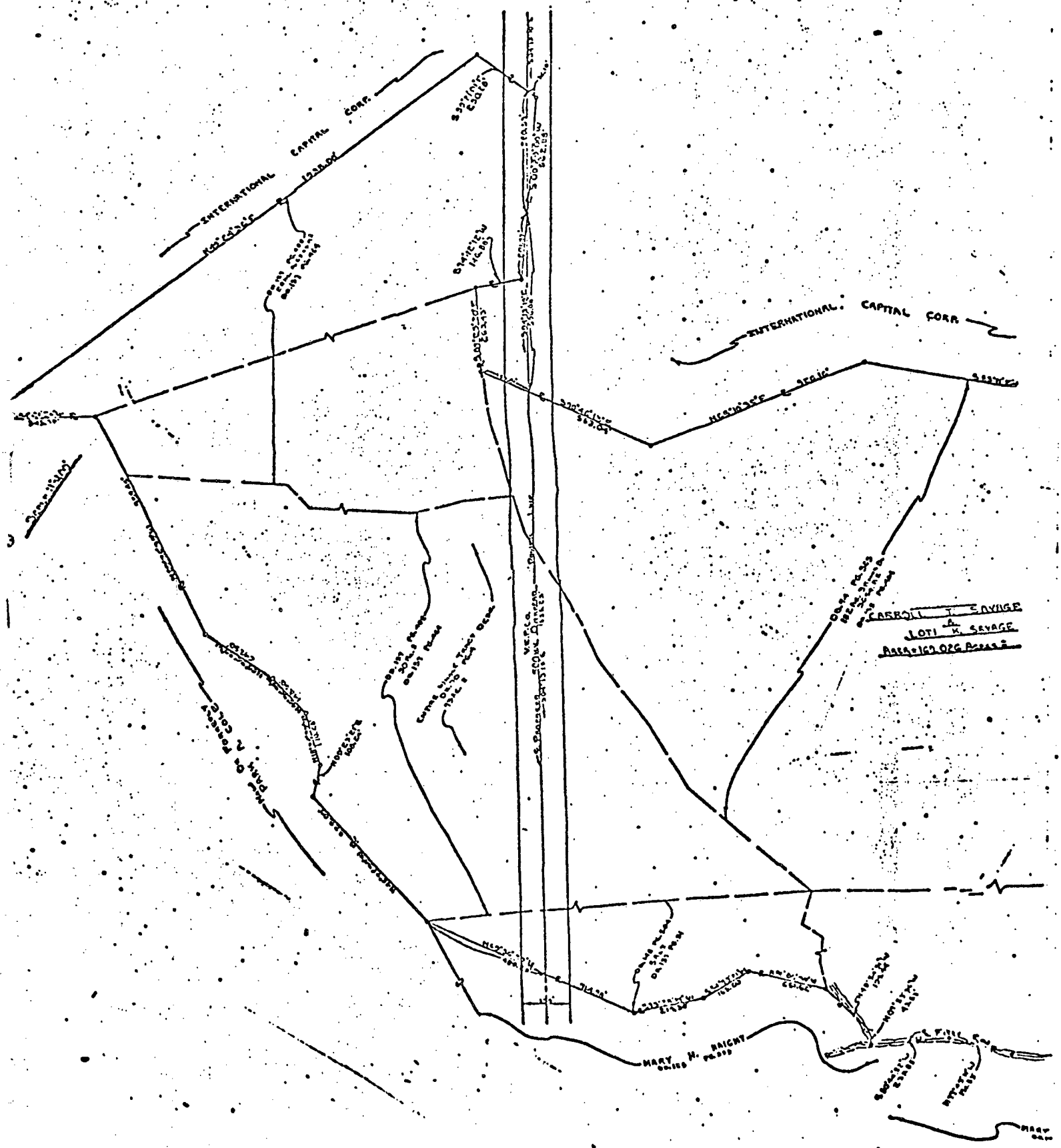
EXHIBIT B


INTERNATIONAL CAPITAL CORP.
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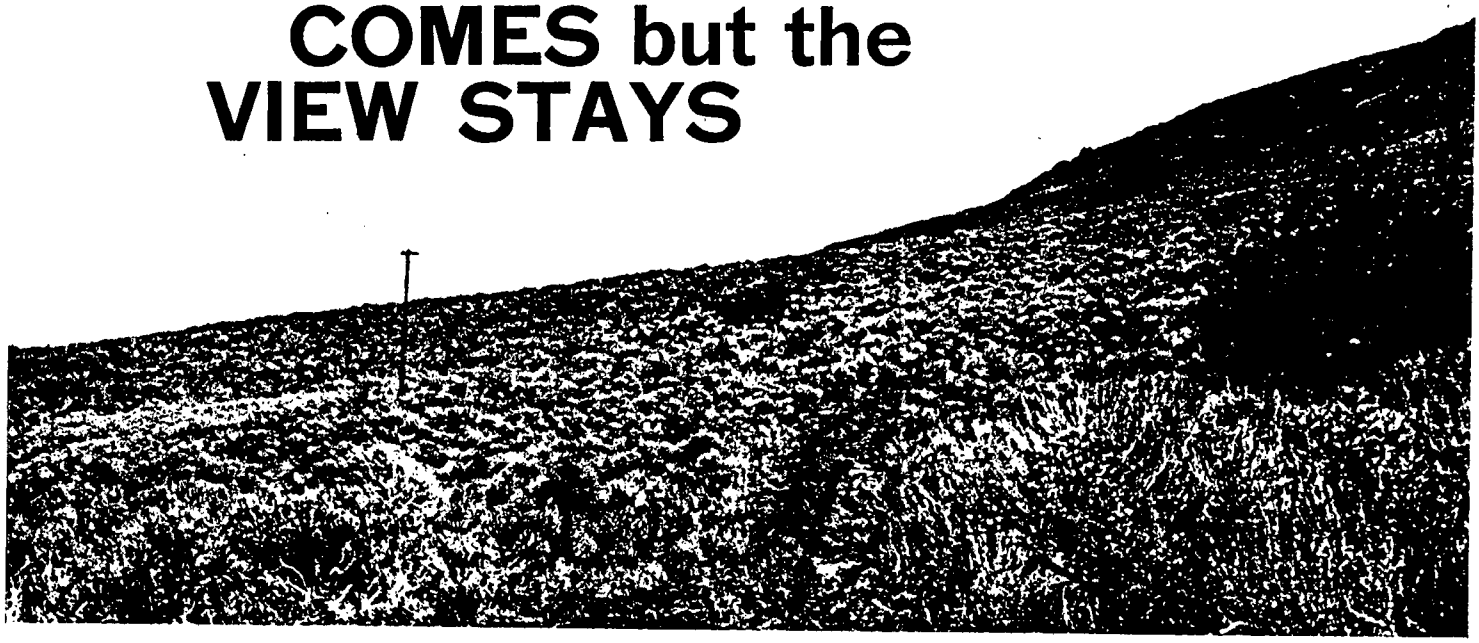
CARROLL H. SAVAGE
JOTI H. SAVAGE
MARY ANNE H. BRIGHT

Ex W-3

POWER COMES but the VIEW STAYS



Old power poles will be removed; trench scar will heal.

THE VIEW of the Snake River and the rugged Sawtooth Mountains beyond is beautiful from the public lands on the top of Cotterel Mountain. Cotterel Mountain is a small mountain range about 20 miles southeast of Burley, Idaho. For the first time in more than 10 years, no power poles or powerlines obstruct this view. The only evidence of the powerline that remains is the trace of a 6-inch-wide trench running down the mountain. In about 2 years, even the scar will be grassed over and no longer noticeable.

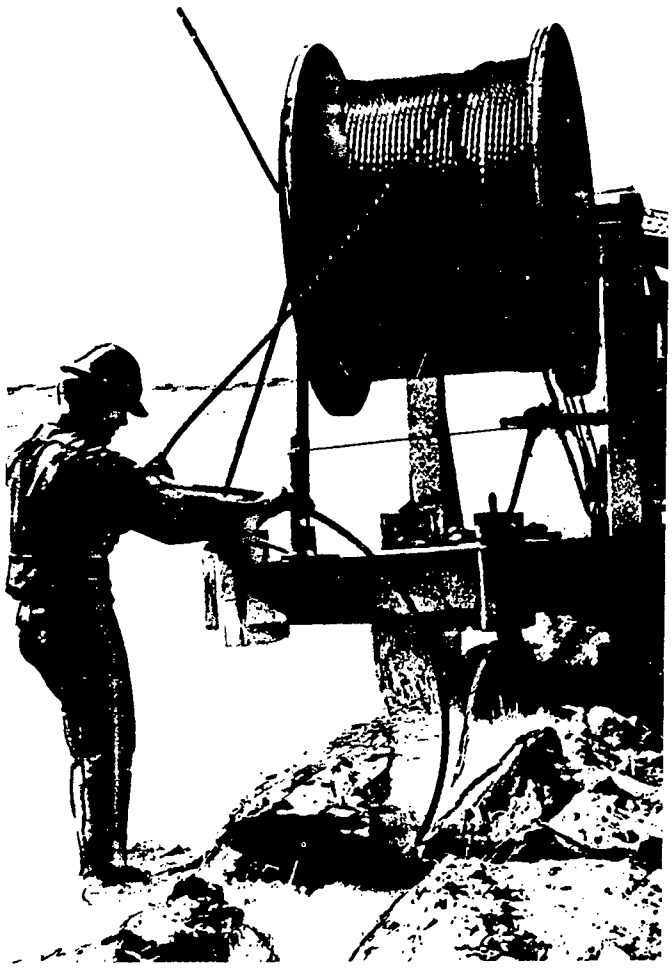
This improvement was made possible when Raft River Electric Co-Op Inc., of Malta, Idaho, decided to alter traditional overhead lines by going underground on an experimental basis.

Now, after five projects and more than 17 miles of underground line, the latest of which is the nearly 5 miles across the top of rugged Cotterel Mountain, Raft River Electric feels buried powerlines have a definite future.

As Boyd Booth, Line Foreman for Raft River Electric, says, "Although still experimental, the public likes

By LEWIS O. MARTINDALE
Raft River Resource Area Manager
and
ROBERT J. BROCK
Magic Resource Area Manager
BLM District Office, Burley, Idaho

Raft River Electric eliminated overhead by going underground



the idea of hidden lines and there are places where we find it difficult to keep overhead lines in service."

Raft River Electric had to take into account several considerations before a decision was made whether to transport power by overhead lines or underground cable:

- Amount of power to be wheeled.
- Installation cost.
- Future maintenance costs.
- Aesthetics and watershed damages.

The utility has buried both single-phase and 3-phase lines. The single-phase lines carry 7,200 volts and the 3-phase up to 24,900 volts. Neither line has lost any significant amount of voltage by going underground.

Material costs for overhead single-phase lines are about $840 per mile. To carry 3-phase power, only additional wire is needed with no additional poles or hardware. Material costs for underground cable are $1,343 per mile for single-phase power. For 3-phase power this figure is tripled because three lines are required.

While material costs can be predetermined, installation costs for overhead line vary greatly, however, depending upon terrain. An installed single-phase line, including material, will run from $1,800 per mile on flat ground with little rock to more than $2,200 per mile on steep, inaccessible terrain that is rocky.

One of the first underground projects undertaken by Raft River Electric was across flat, rocky ground. Due to rental equipment, lack of experience, breakdowns, and weather conditions, the project cost more than $3,000 per mile, including materials. However, in the most recent projects on Cotterel Mountain, using company equipment and with three other projects under their belt for experience the cost was $2,200 per mile, including materials. Raft River Electric feels that due to the extremely rocky conditions and steep terrain, this was actually less expensive than an overhead line would have been.

The trenches on all projects in rocky soils are preripped with a D–8 size tractor using a large ripper tooth before any line is laid. The next pass with the ripper opens the trench and the line is laid at least 30 inches deep. In rock free soils, no preripping is needed.

Engineer Golden Gardiner feels that now that Raft River Electric has gained experience and owns its equipment, a single-phase underground line will be no more expensive than overhead line.

Future maintenance costs for underground power lines appear to be the big selling factor as far as Raft River Electric is concerned. Although the underground lines have not been in use long enough for a real test, the utility feels that the maintenance will be nil if the lines are properly installed. The only problems to date have been some minor vandalism and a burnout due to improper installation.

This is not the case with overhead lines. Poles and crossarms require routine checking and continual maintenance. Summer lightning storms and winter icing create a constant maintenance problem in higher elevations. These two factors alone convinced Raft River Electric to convert its overhead line on Cotterel Mountain to an underground installation.

Of great importance was the consideration of aesthetics and watershed damages. Both of these factors affect not only the image portrayed by the power company but the goals set by the Environmental Policy Act as well. Raft River Electric believes underground lines maintain the aesthetic value of an area with no powerlines to obstruct the picturesque view of the otherwise open space areas. There are no steep maintenance roads scarring the landscape, which is subject to erosion.

The utility has invested more than $20,000 in specialized equipment and is proud of its work. At this point utility officials feel single-phase lines are good investments to go underground.

Bud Tracey, work order accountant for Raft River Electric, says, "We haven't solved all the problems of burying 3-phase power yet but, with improving technology and equipment, I'm sure it will only be a matter of time."

Raft River Electric, a small company servicing only 1,700 customers in south central Idaho and corners of Utah and Nevada, has pioneered underground powerlines and feels they are here to stay. □

Ex W-3

SOUTHERN ENGINEERING REPORT
ON
VIRGINIA ELECTRIC & POWER COMPANY

I. BACKGROUND ON SOUTHERN ENGINEERING COMPANY

Southern Engineering works primarily for rural electric cooperatives. The firm works east of the Mississippi River. Southern has testified before state commissions concerning the development of generation and transmission systems for cooperative supply and in many rate matters. The Company has been in business for approximately 25 years which is just about the span of time that the rural electric program has been in being. The Company has also worked for municipal electric cooperatives and provided general consulting work in engineering. Fauquier County has retained our services on a phase basis.

II. FAUQUIER COUNTY - SOUTHERN ENGINEERING AREA OF STUDY AND RESPONSIBILITY

Phase I requires that Southern Engineering look into the proposed transmission system development of Virginia Electric and Power Company and make an analysis of it and answer certain questions that were posed to Southern Engineering Company in a letter to Mr. D. A. Springs from Mr. Harry Morris dated October 4, 1971 (see copy of letter in office of Harry Morris).

That letter states in part: 1) Is it possible, practical, feasible, and within the range of good engineering and land use practices to place high voltage transmission lines within existing corridors already designated and being used. 2) Review VEPCO's

transmission corridor from a regional point of view which would include Fauquier County. 3) Could power source routes better be located in relation to consumer markets, even if it means going into other power company areas?

That's a series of questions that Southern Engineering has taken to mean: 'Does VEPCO make its planning on a regional basis and does the plan as presented by VEPCO meet the regional requirements for electric supply.' Southern Engineering is also required to examine the requirements for military and/or other government agencies' sending and receiving stations which tend to be of national strategic importance. In other conversations the same questions were stated in a different way 1) Can VEPCO more adequately use present corridors? 2) Is their planning on a regional basis? 3) How urgent is the need for facilities planned?

III. SUMMARY OF MR. EDWARD MARTIN'S INITIAL COMMENTS STEMING FROM PHASE I STUDY

My presentation is directed toward responding to the above series of questions, and I propose to go about it by discussing what we have found out about each of VEPCO's individual proposals and in so doing, show the regional impact of the proposals by VEPCO. I'm using VEPCO's exhibit S which shows the proposed lines through Fauquier County and connecting to other parts in the State. I've numbered them according to the series that Mr. Downs used, and possibly other people in a public hearing on this matter, as a matter of reference.

On November 4, 1971, I met for five hours with a Mr. Richard Carroll, District Manager of VEPCO, Rappahannock District, Mr. Earl L. McKay, Manager of Systems Planning at VEPCO, and Mr. Randolph McIver, Director of Transmission Engineering. I understand all three of those gentlemen have appeared before the Planning Commission before.

The first item we talked about was the Bristersburg-Colonial Pipeline site at Catlett, and it's shown on Item 1 on Exhibit S. It was my belief when I began examining the question on this particular line that Colonial Pipeline does have a right to electric service at that point, if it so desires, for operation of its facilities. By reading the transcript of the previous Commission hearings, I believe that the Planning Commission approved the site for the Colonial Pipeline Company.

I'm not trying to render a legal opinion, obviously, I cannot. But it is a question that should be answered, I believe, as to whether or not they have a right to electric service there. From a layman's standpoint, along those lines, I think they do.

From an engineering point of view the use of existing 34.5 kv distribution facilities to supply motors of the 5,000 hp range that are planned is not feasible. The electric lights, and probably even some motors, might well lose their contact and stop. As to whether they could use diesel power or not, as Commission records question, I thought Mr. Bagley answered just about everything that could be said along those lines. He certainly answered that question. If we assume that Colonial Pipeline does have a right to receive

electric service, and I have had to assume that, then there are three alternatives for supplying that power to that site, and all of them come from VEPCO's existing, what they call #2 line. The first alternative is to go south with the pumping station down the #2 line to the junction of the #2 line and the Colonial Pipeline right of way. Unfortunately, this approach places Colonial directly in one of the restricted radio areas and as far as I can determine, eliminates it as a possibility. I'll go into radio interference problems later.

The second alternative is to go Northeastward along the right of way of the #2 line to a point where the Colonial Pipeline right of way intersects VEPCO again. This is a possibility. There certainly is no radio interference problem along that direction. By going north a considerably greater amount of electrical line would be required. In addition to that, the Colonial Pipeline right of way is 50 feet across, as I understand it. VEPCO's transmission line would require 100 feet of right of way. Our engineering firm agrees that 100 feet of right of way would be required for such a line. Thus, 50 additional feet of right of way would be required for the use of the Colonial Pipeline right of way. Presently there is no transmission line down that right of way and if that route were used, obviously there would be a transmission line down that right of way.

So that brings us to the third alternative, which essentially is the one that VEPCO has proposed: to come north along the #2

line right of way and thence across country, approximately, 4.3 miles to the pumping station.

If this alternative is used there will be, overall, less new right of way required in Fauquier County for this supply. I think that's the only plus there is, and that one, of course, you might well say is a minus - it requires right of way too, and we come down to a choice of the lesser of evils, assuming that this pipeline station does have a right to electric supply. Therefore, I concur with VEPCO's proposal for supplying power to the Colonial Pipeline station at Catlett.

The second item is listed as Item II on Exhibit S with the overlay that we have provided, and that is the line from Remington to Warrenton. It is a 115 kv line that, as I understand it, brought up the initial questions to the Commission and precipitated VEPCO's presentation of its plans for the next several years. I also understand that this line has been disapproved by the Commission, and I believe, however, that a full airing of the impact and need for this line would be within the scope of the Phase I job which the Commission has given Southern Engineering Company to do.

The length of this line is approximately 11 miles, and that would be true regardless of which route was taken from the Remington point northward. It is incredulous that VEPCO would propose to spend funds for 11 miles of 115 kv line if additional power were not needed in the area to which it is building, particularly when such a line would probably cost $50,000 per mile as a minimum under today's construction standards.

You asked VEPCO to provide an alternative to the routing that they had proposed and they provided a routing along the existing 34.5 kv line that now goes from Remington to Warrenton. This line would require, in my engineering opinion, substantially more right of way clearance than the present 34.5 kv line provides. It's possible to build a 115 kv line down a roadway, but such construction still has to meet these requirements. First, it cannot go over a dwelling. No one wants, I suppose, any electric line going over his house. I certainly wouldn't build one over a house, or any type of structure for that matter. Second, any type of danger trees or any object which might fall across the line has to be cleared or the line isn't secure. It could be damaged and taken out of service by a storm. Third, to go along a roadway requires a substantial number of angle turns in almost every instance. An angle turn in a 115 kv line will increase the cost of the structure to at least two times the cost of an in-line structure, so that from a cost of facilities standpoint, construction along such a roadway would be substantially greater than construction in a straight line off of a roadway down open field cleared right of way.

VEPCO's proposal then is to build away from this roadway northward along cleared right of way which would go over no dwellings and would therefore not cause the condemnation of any such dwellings. As far as a choice of the two routes, from an engineering standpoint it is far better to take the one that VEPCO has proposed as opposed to the one that was presented as an alternate in the use of

existing right of way along the 34.5 kv line.

I would say if VEPCO used their existing right of way on Routes 15-17-29 it would require a clearance from any danger trees of 50 feet on each side, the same as their other line proposal, which should be about a 100 foot right of way. Houses should also be out of the corridor the transmission line goes through.

One of the conditions of the transmission line easement is that no building or structure should be erected on the right of way area. The existing 34.5 kv line, of course, is a distribution line and there's a totally different approach to it as far as security of the line is concerned. The transmission line, particularly a radial line, as proposed here, would be guarded as well as possible by the power company. A distribution line is allowed to flow more with the pluses and minuses of the route it has to go through; if there's a tree and the owner of that tree stands up and says, "I've got to have that tree," then he might well keep that tree. On the other hand, if a transmission line carrying supply for half a country were going through there, he probably would not keep his tree, regardless of how much he loved it.

To pursue this route further, a 115 kv line supplying the town of Warrenton and the area around it should not be left forevermore, or for that matter for any longer than necessary, as a radially supplied line. Electrically it should be tied back into VEPCO's system to provide loop-feed into the area, and that's a considered opinion.

It's possible, just from a cursory look, to come from Catlett to Warrenton as one alternative.

The logical connection point, or one logical point would be the Colonial extension over at the Colonial Pipeline and just bringing it up to Warrenton.

From a system design standpoint, such a tie-in for the loads of the magnitude that you have at the Warrenton area, and can expect in the future, you simply would have to firm that source up with another transmission line.

If it were to go down under an ice storm or some other natural disaster, or if an insulator were to be broken or someone should shoot the insulator and break it, you're talking about a major outage because you've got to get people into this area who are knowledgeable in the repair of such a line; you must also get equipment which isn't necessarily as readily available to a power company as a distribution line insulator is, which is probably on every truck that they've got.

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

Item #3 is the 500 kv line from Bristersburg to Prince William County, 3 1/2 miles. It is my understanding that the line has been approved and I have nothing more to say about it. It certainly is a part of their regional power plan.

Item #4, the 500 kv line from North Anna to Bristersburg, via Morrisville, 235 foot right of way, 13.4 miles in Fauquier County. At this juncture, we do go into the regional discussion. North Anna is a nuclear powered generation station. At such it has the advantage of not having smoke come out of it and not having to have coal yards and tremendous amounts of coal brought in to supply it. But it has certain disadvantages too. One of those disadvantages is that its economic operation practically demands, and from today's technology, does demand that it run full blast when it's running, and that when maintenance is required on it, it's completely shut down.

I'm not a nuclear engineer and I can't go into all of the reasons for this, and I don't intend to, but it is a fact that such stations simply have to run - - once they're turned on, they've got to run. (They're like these rock bands - they've got to go wide open or not at all.)

Well for such a condition to be met, power has to be able to be taken from this nuclear plant by more than one route, and the capacity of these routes must be enough to take the whole output if one or the other route is out of service.

That situation is what keyed the need for the line from North Anna to Bristersburg via Morrisville.

The line going south from North Anna will not be built for some time. The reason the line going north will be built as opposed to the one south is that the need for power lies in northern Virginia. The two lines that VEPCO proposed to build are the two that are

logically needed, one going to the east of North Anna to connect with an already existing 500 kv system which will provide the focal point for a series of loop transmission lines. The theory behind the need for these looped transmission lines is precisely the same as the theory behind the need for a looped transmission supply to Warrenton if you come right down to it, except that it's on a much, much larger scale.

VEPCO initially wanted to build this line not to Morrisville but to Remington and the reason for this is because it would have been a direct line as opposed to a "dog-leg" line or an angled line. It costs considerably more to make the angle than it does to not have it. It can be noted that the line to Morrisville provides what could be termined as an outer beltway or an outer loop transmission system, if the existing 500 kv is considered to be an inner loop.

This line met the second objective that VEPCO had. If you'll remember, the first was to have two routes out of North Anna. The second is to have an extended route into an area that, quite bluntly, is expected to grow in load as time goes by. The present line is to be broken near Sowego. Then there will be a connection from the North Anna line to the northern line and a connection from the existing 500 kv line into a new loop which is being constructed into Northern Virginia. There will then be a series of electrical loops. It becomes network after network of 500 kv loops that is made, quite simply, by using Morrisville as a focal point, which probably should be around Remington.

Why did VEPCO change from that location - they changed because they were afraid that they would build a line through a radio interference restricted area and would have millions of dollars invested in a line that they would have to turn off and move to another place.

I can say that with some authority, because I called the Federal Communications Commission and asked them what authority they had over the builders of transmission lines as far as radio interference was concerned. I was told, without any question, that the FCC is required to have the cause of radio interference removed. Well the cause of radio interference is this case would be the 500 kv line under bad weather conditions which can and usually do create a corona from this high voltage line. This corona does in many instances create a pulse that sounds like static on a radio. It can occur on lower voltage lines too. There is no way to seal the lines although I certainly believe that the power companies do everything they can to eliminate corona. At 500 kv, they have a substantial loss of power because of corona. It hits them in the pocketbook and power companies are going to try to avoid that, even if they might not see everything else that people might wish for them to see. Even though they try to avoid it, it still will exist where there is a kink in the line or where insulators have been contaminated by dust and grime and smog to such an extent that the electric field created on those insulators start to break down. That doesn't mean there's a big flashover or the line burns up, but it glows, it's visible to the naked eye. And this corona effect is

what VEPCO feared in building through these restricted radio areas. Their exhibit showed routing around the radio restricted area quite clearly I thought.

I think this is a good time to discuss why VEPCO's line comes to Morrisville. The reason it has to go to Morrisville is because of a series of events that has occurred in the past, according to all that I can understand, and obviously that's what I have to report to you.

Mount Storm is a mine-mouthed fossil generation plant. In addition to its location, there is the interconnection between, or the main interconnection between VEPCO and American Electric Power Company, the huge power company in the middle northeast. There are many large generation units sitting behind the Mount Storm location.

The reason that 500 kv lines are built is to connect huge generating stations together and to connect the huge generations station with load areas. Now VEPCO's faced with a problem in 1974. It has two 500 kv lines coming into its system from Mount Storm and backup generating facilities behind it. At that time, one 500 kv line will not be able to supply all the power which must go from Mount Storm to Northern Virginia. Therefore, some other 500 kv line must be built and that's the simple reason for the whole system's requirement of this other line. These two lines, the north and the south leg of the loop, that goes through the northern part of Virginia, part of Maryland, and the other one that goes south simply have to have

additional support to cause them to have additional capacity.

The answer should be a line from Mount Storm by the most direct route available, if you were just going to sit down and indiscriminately decide electrically how to solve it. Put down a ruler and draw a line from Mount Storm to Washington, D. C. or Alexandria. That goes through northern Fauquier County.

In the early 1960,s, as I understand it from Mr. McKay who is the System Planning Engineer for VEPCO, a line was proposed from Mount Storm to the Washington area. This line would have passed through northern Fauquier County and obviously some other area around it. The citizens of northern Fauquier County had enough power and influence to cause this line not to be built through their area, and instead the line was built to the north; and it is indeed the line that now goes from Mount Storm to what is called Dobbs from an electrical standpoint, and I understand Dickerson from a layman's standpoint.

The line going to Dobbs from Mount Storm is owned by more power companies than just VEPCO and a portion of the capacity of that line, supplies part of the northeast corridor and brings power from the mountains to the northeast corridor. The northeast corridor runs from Boston to Washington, D. C., and a little bit beyond there now. It might be here tomorrow.

Because the line was built to the north and because other power companies were involved and because their involvement required some of its capacity to go to the north, VEPCO in a sense was electrically short-changed. I'm not saying they lost anything financially, I really doubt that they did. They're probably as good bargainers as

any other big corporation around. But electrically they lost because it would have been far to their advantage to have a line go to their area for their use from their plant and from the support of their plant to their load area in northern Virginia.

Now the time has come that that question is back on us again. How do we get power from this area to northern Virginia. A part of the existing line capacity is taken up by the north, it's a fact of life. There's no way to get around it, by the way, VEPCO can't turn a switch off and cause the north not to get power. That power is going to flow because that's where the lower voltage or lower frequency requirements require that power to flow. It's not a matter of wishing, it's a matter of circumstance.

Now does VEPCO build back through northern Fauquier County? VEPCO said no, they are not going through that again. So in the alternative, they have going through existing rights of way in many instances; now from Mount Storm to Rock Oak, is not along the existing right of way. It is, according to VEPCO planners, or according to Mr. McIver, 4,000 feet apart. However, as it goes from Rock Oak on down north of the Skyline Drive, it does follow in general along existing right of way of 138 kv line; of course I'll tell you this much, by the time the people over there see this 500 line coming through, they won't believe it was the existing right of way because it'll take a huge right of way in addition to what's already there. VEPCO followed along existing routes as far as they could, at which time they took off and went down what they would consider to be a screened right of way for their transmission line. That is on the

side of a hill, not on top of a hill, as much screened from view as possible. It's reasonable to believe that VEPCO would have gone to this extreme carefulness because they're going to meet opposition wherever they go with their lines. VEPCO has a choice as they approach Fauquier County from the west, obviously. They can either go south or they can go north around Fauquier County or they can try to go through it again.

Well, the system planner simply said that he wasn't willing to try to go through it again. To go north around it is a possibility, but the reason they went south is quite simply because of the North Anna plant and the fact that if they go south they can provide the loops of transmission supply. And the third reason is that they are going to have to have additional bulk supply in the Fauquier County area, and that might sound like a local selling point but it's a fact of life that I-66 is going to spread the growth to you. Fauquier is projected to have substantially greater electrical requirements in the future than it has now and I mean more than just normal growth would require. So that's why the lines come to Morrisville to the switching station.

Now it should have been at Remington, electrically, but the radio sites forced them to the south, therefore it went to Morrisville.

The reason the switching station is at Morrisville and that lines merge at that point is a result of a combination of things that happened. The need to get power from Mount Storm to the northern area; the block in the north; the transmission route required

from North Anna to the north, and the fact that power is needed in Fauquier County. Plus channeling the Morrisville location by these radio sites.

If they move back to Culpeper there is going to be the same problems. I don't know what the requirements are in Culpeper, but I know VEPCO would have to build more lines to go to Culpeper; of course that wouldn't be an overwhelming point.

Different kinds of generating units perform different functions in electric systems. The Mount Storm type of unit is a mine-mouth generation facility that takes coal out of the ground to go directly in the furnace. It is an extremely economical way to produce electricity. The only thing that's not particularly economical about it, is that you have a substantial amount of loss in transmitting power from Mount Storm to where the electric users are.

Now, however, fossil fuel, coal is one of them, has increased in price tremendously over what it was in 1967 so that there is some question as to whether additional coal plants will be put into service. Because of the increase in fuel costs and certain other things that have come up, nuclear plants are now considered to be feasible and they are being placed in service. They will take the place of the Mount Storms but it will be a gradual thing. If you look at different types of generation as tiers on a ladder, the first rung would be occupied by the nuclear plant and the second rung would be occupied by the Mount Storms. Now the third part, or the third rung of the ladder, would be taken up by the old less efficient generating units. And then on top of that are cycling units or peaking units. Today the companies are building large

oil-fired peaking plants. These oil-fired peaking plants have a low start-up cost and a low shut-down cost, but on the other hand their energy cost is considerably higher than the Mount Storm type or certainly higher than the nuclear type. To put the types in a range of economics; the nuclear might cost 1.7 mils. per kilowatt hour, and the Mount Storm might cost 2 1/2 mils. per kilowatt hour. The oil-fired peaking plants might be in the 8 mil. range, you see, considerably higher; then on top of that are the gas turbins, or maybe oil-fired turbines, called combustion turbines, and they are quick start, quick stop. On and off, just for an hour or two during the heaviest load requirement for the day.

Now what happens when a nuclear unit comes on line is that oil-fired peaking plants and less efficient fossil-fired plants are cut back, or not used at all, but they're used for reserve capacity. If a Mount Storm were to go down, that is, if one of its units which is about 500,000 kv, were to become inoperative, then something must be placed into the system to take its place; that might be the oil-fired unit, it might be an old steam plant unit. But those are the things that North Anna would replace and certainly it does the electric consumer a great deal of good to have the North Annas come on to the system. It will reduce fuel costs.

We're going to swear to that before the Federal Power Commission in the Carolina Power and Light Company rate case where they come in with enormous costs of fuel. We've said 'No, Mr. Carolina Power and Light Company, that's not going to be what is going to happen. If you're going to have nuclear plants come on line, they're going to cut your fuel costs down. We're on record as being firm believers.

in nuclear plants reducing fuel costs. Nuclear plants will be run practically all year long, wide open, while the load requirements day by day, hour by hour are not such that they can use all the power that these nuclear plants will put out, particularly, say, at 2:00 A. M. If these plants must run, it is economical to use that energy generated to pump water back up the mountainside to hydro-electric locations, and that's what's now being planned in several locations in the mountains, and it has to be in the mountains. I think it's rather obvious that you would have to have a mountain to pump water up.

Now it takes three units of energy to get the water up and you get two units out when it comes back down. You're losing energy it seems but that's not too bad. That's not bad at all when you consider how cheap it is to run, and they run anyway. Since hydro-electric plants do have to be in the mountains, these vary, very high powered hydro-electric units would be running night water up and running daytime water down, and that power has to flow over these lines too and that's why this is not a lost cause, by any means, as far as the electric industry is concerned. They will use the lines to feed the power from the nuclear plants to the mountains and the power from the mountains back to the consumer areas.

Well, now to zero in on the Morrisville location. My opinion is that the Morrisville station was forced where it is, the actual pinpoint location, by these radio facilities of the F. B. I. and the Warrenton Training Center. I think that's just a fact of life. Morrisville can't be put in Culpeper County. I think VEPCO would have preferred to locate the station at Remington as I've said before.

I can only tell you why VEPCO didn't locate there because of the radio facilities; now as to whether the threat is real or not, I would guess that it is. I was totally lost when I saw that as one of the requirements of what we had to do was strictly a matter of research. I talked to VEPCO's system planners and they said they were also absolutely shocked when they ran into it the first time. It was a new phenomenon to them to have to skirt radio areas. They had had to do it nowhere else.

I can comment on the technical aspect of it - the radio facilities. I certainly would not build a 500 kv line where I felt that there was even a slight possibility that the Federal Government was going to tell me to move it.

Electrically it would be better to go to Remington. Electrically I think VEPCO would have preferred to go to Remington once upon a time. By going directly to Remington it would eliminate line #7 which is the 230 kv line from Morrisville to Remington proposed along the same route as it the 500 kv line. It would also have the effect of reducing that right of way requirement by 135 feet.

Item #6, the Morrisville to Bristersburg line route, is constructed in its sloping sort of fashion to avoid the F. B. I. station. If that line ran straight to Remington it would cut out one high power line from Morrisville to Remington. Except that one of the reasons that VEPCO didn't go there to start with, and I'll point this out again just to make sure it's clear, is because of this other radio site, It does go right through it. We haven't

grilled the Federal Government the way we have VEPCO. All we've gotten are the reports and the statements, but we really haven't gotten any top ranking member of the FBI or anybody else to tell us that VEPCO can't go through the F. B. I. station.

A report filed with the Commission stated the F. B. I. will not oppose the construction of the 500 kv line on which the studies were conducted in 1968 and 1969, as long as it is located no less than five miles from the Midland station as originally agreed. They've opposed to upgrading the 115 kv line to a higher voltage.

The line from Mount Storm to Morrisville was discussed in earlier hearings as having a possible alternative in following the present route which now goes from Mount Storm over to Dobbs and Dickerson. Well electrically, that route would in part answer the power requirement need of bringing power from the Mount Storm area to the northern Virginia rea. It would not provide the loop service that the Mount Storm to Morrisville route does provide. On top of that, to use the same routing would introduce an element of lack of line security. VEPCO went into some detail about sabbotage, now I really don't know about that, but certainly natural forces, particularly ice storms which might or might not affect the 500 kv lines do have localized effects. They will come into one area and right across the ridge there won't be any ice at all or very, very light ice whereas in the adjacent area there'd be such heavy ice that it would break the trees down. These things just happen, and I don't know why, I don't. But I do know it is a phenomenon. So the security of the lines would be hampered or diminished by using

the right of way to the north. As far as sabbotage is concerned, if I were a pilot, I could run that line and come down here and run another line, it wouldn't take ten minutes. There are 51 locations along this northern route that would require condemnation of dwellings or going through an impoundment. VEPCO flew the northern route after my discussions with them to determine what conflicts there would be in taking this northern route and they found 51 conflicts. And as opposed to, as I understand it, no conflicts as far as dwellings and obstacles, other than the Commission, they cannot overcome.

The chart that I've provided shows in yellow the lines that you're directly interested in and it's taken from the Southeastern Electric Reliability Council planning survey. On this map are shown essentially the same things that are shown on Exhibit S that VEPCO prepared. There's the Mount Storm plant, the 500 kv loop that exists, the line from Mount Storm to Morrisville, and the Morrisville line toward northern Virginia and south to North Anna. In addition to that information the dates, or the years, that these lines are to be in service are also included, in 1974 for the Mount Storm to Morrisville line; 1974 for the 500 kv line from Bristersburg to Morrisville; 1973 for the line from North Anna to Morrisville. I don't believe that 1974 is an accurate statement because certainly if the North Anna plant is to have two points of supply by the time it goes into operation, there must be some way to connect it with the north.

I think the important part of this map is to show that VEPCO's proposal does fit in with a regional plan, or it is a part of a

regional plan, at least in the southern part. Now I must also report to you that we reviewed the Electric Reliability Council plans prior to 1971 and they did not have the Mount Storm to Morrisville line on them. In an analysis of what that means, it could be that the load growth has been faster than it had been anticipated in the late 1960's. The report I'm referring to was, I believe, the 1968-1969 report.

Northern Virginia is growing fast, even up to the edge of Fauquier County. It's running over into our county.

Since I'm in the public power bracket of the industry, I don't always offer anything good to say about power companies but in this case I have to because VEPCO has moved forward on its own initiative, just on a great deal of imagination and plain guts, I think. In developing their 34.5 kv distribution, they are the pioneers, period. There just isn't anybody else that's gone into the development as VEPCO but it's definitely a following, and from an environmental standpoint or from a land use standpoint, VEPCO has given to its Virginia service area and its North Carolina service area too a very substantial benefit. It has reduced the number of large transmission lines that it will have to have coming through Fauquier County area because these 34.5 kv systems cover a broader area and require fewer lines for substation sites. It's reduced the number of three-phase lines that have to criss-cross roads because 34.5 kv single phase carries substantially more power than lower voltage single phase lines which would otherwise have to be multi-phase. Certainly they have moved forward to minimize the environment effect of the electric power industry. Also, in reading through the

the transcript of Mr. Downs, it seems to me that VEPCO is following the latest guidelines on recognizing that power lines are not pretty to look at to most people, even if the power industry does think they are. And it has tried to take them off the mountainsides, where they're seen the most. They must get them down off the ridges and into the valleys where they blend into the background and put them behind trees whereever possible and thereby reduce the visual impact on the land that they go through, and from all that I can read from Mr. Downs' statement, VEPCO fully intends to do this, which, by the way, is to the credit of Commissions and to public bodies who have stood up and said change your ways, power company, don't just build it right over everything in creation and make it look unsightly.

IV. SUMMARY STATEMENT ON VEPCO

Virginia Electric and Power Company has not presented to Fauquier County the plan that I think they would have preferred in the development of their electric system. It's my opinion that they have been forced into the lesser of evils, in fact. It would have been to their advantage to build lines directly from Mount Storm into the northern Virginia area. It would have been to their advantage to build through some of these radio sites, or both of these radio sites, in fact, and even to use the existing corridors along the #2 line that they have. I don't know whether the Morrisville substation site is the best or not, I think they compromised and went there because of the radio interference at Remington. That's my conclusion. I do know that it has cost additional money because

they've had to build back from Morrisville to Remington in order to bring power into the #2 line which is critically needed, I might add, and also into the Warrenton area itself. So in conclusion, VEPCO has presented a plan to you which they don't particularly like, which they have been forced into, which does the job, and does, I believe, from all that I can understand from their statements from their testimony, that it minimizes the impact on your area and on adjacent areas as much as possible.

Edward Martin Statement
November 10, 1971

Ex CMS-4

9-25-73

Cmpt CMS 4

(Equivalent to Storm Doubs - Loudoun

1980 LOSS OF STORM-DOUBS + STORM-MORRISVILLE

WITH 5000 MW TRANSFER ECAR → PJM

CALCULATED FROM CASES

80S-100B3 1980 EPRC STUDY

80S-115B3 " " "

80S-30B1 " " "

80SP104 VEPCO SPECIAL 1980 STUDY

80SP104A " " " "

CASE NO. 11-IT-10703
EXHIBIT NO. CMS-4
Filed OCT 15 1973
Witness C. M. Allchurch
Reporter J. Tamacan

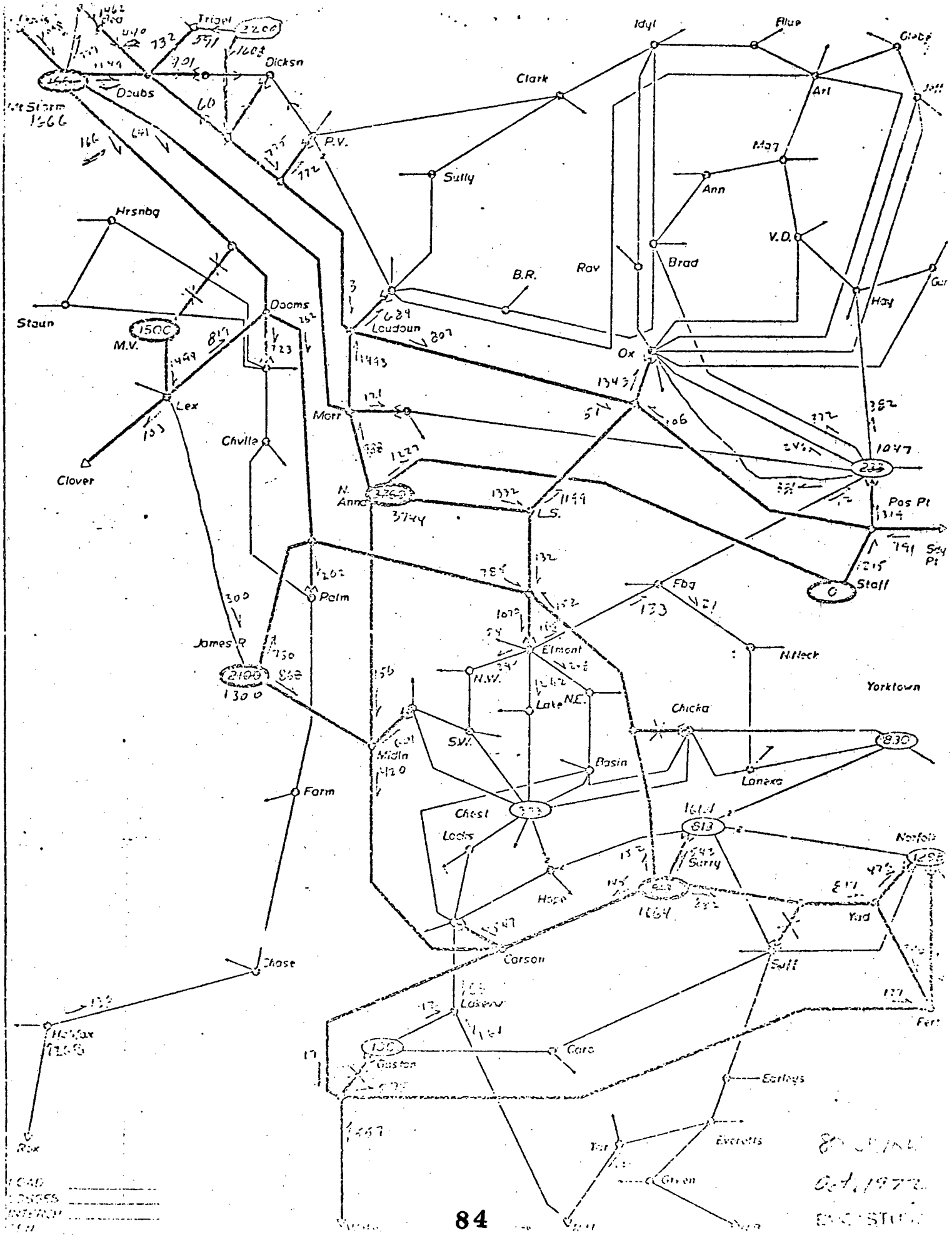
	Case	Holland-Doubs Black Oak-Beddington	Mt. Storm-Morrisville
Outage Case	80SP104A	1611	OUT
Base Case	80SP104	1462	641
		149	641

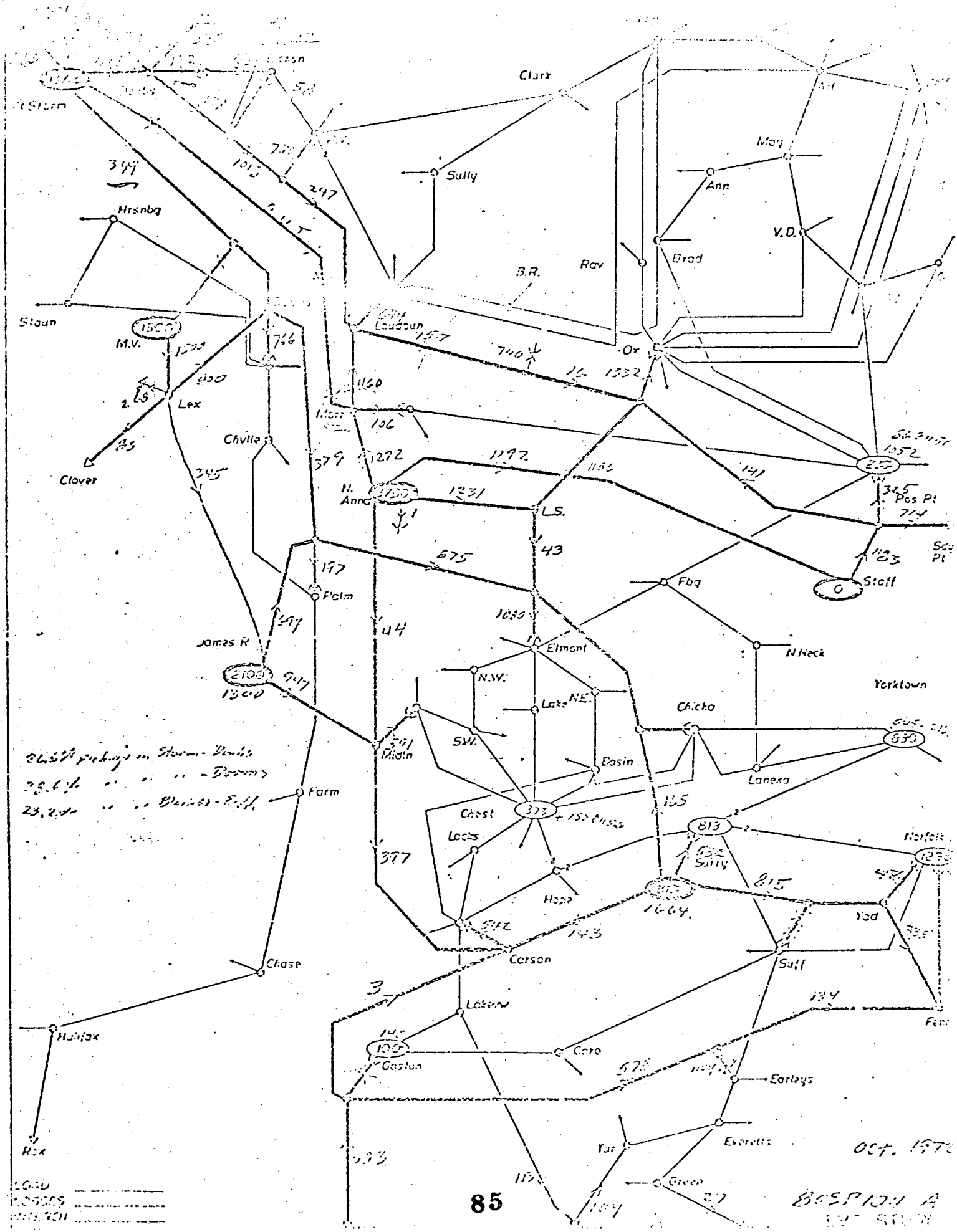
∴ Portion of flow in Mt. Storm-Morrisville that is picked up by Black Oak-Beddington is 149/641 = 23.3%

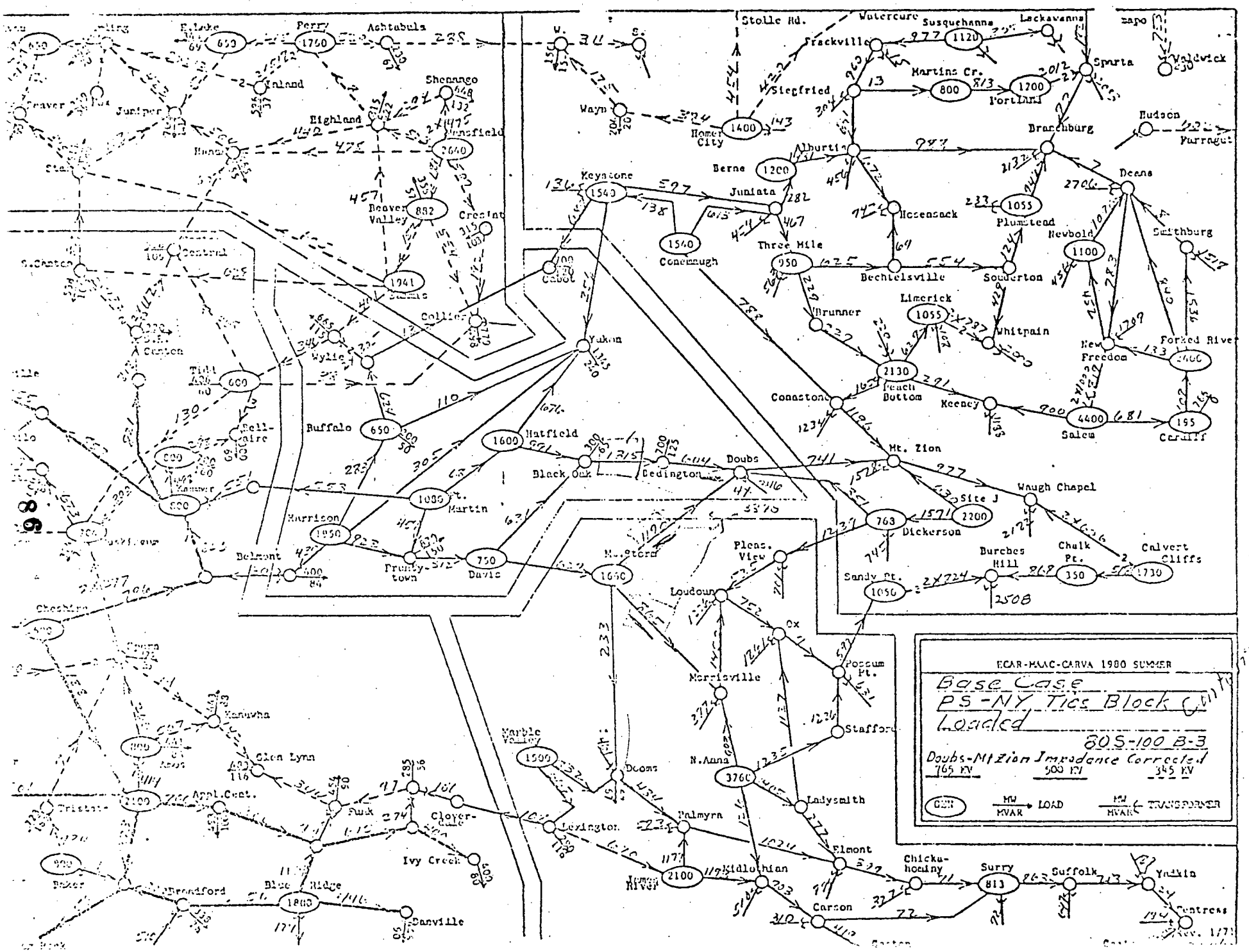
	Case	Black Oak-Beddington	Mt. Storm-Doubs
Outage Case	80S115B3	1677	OUT
Base Case	80S100B3	1315	1190
		362	1190

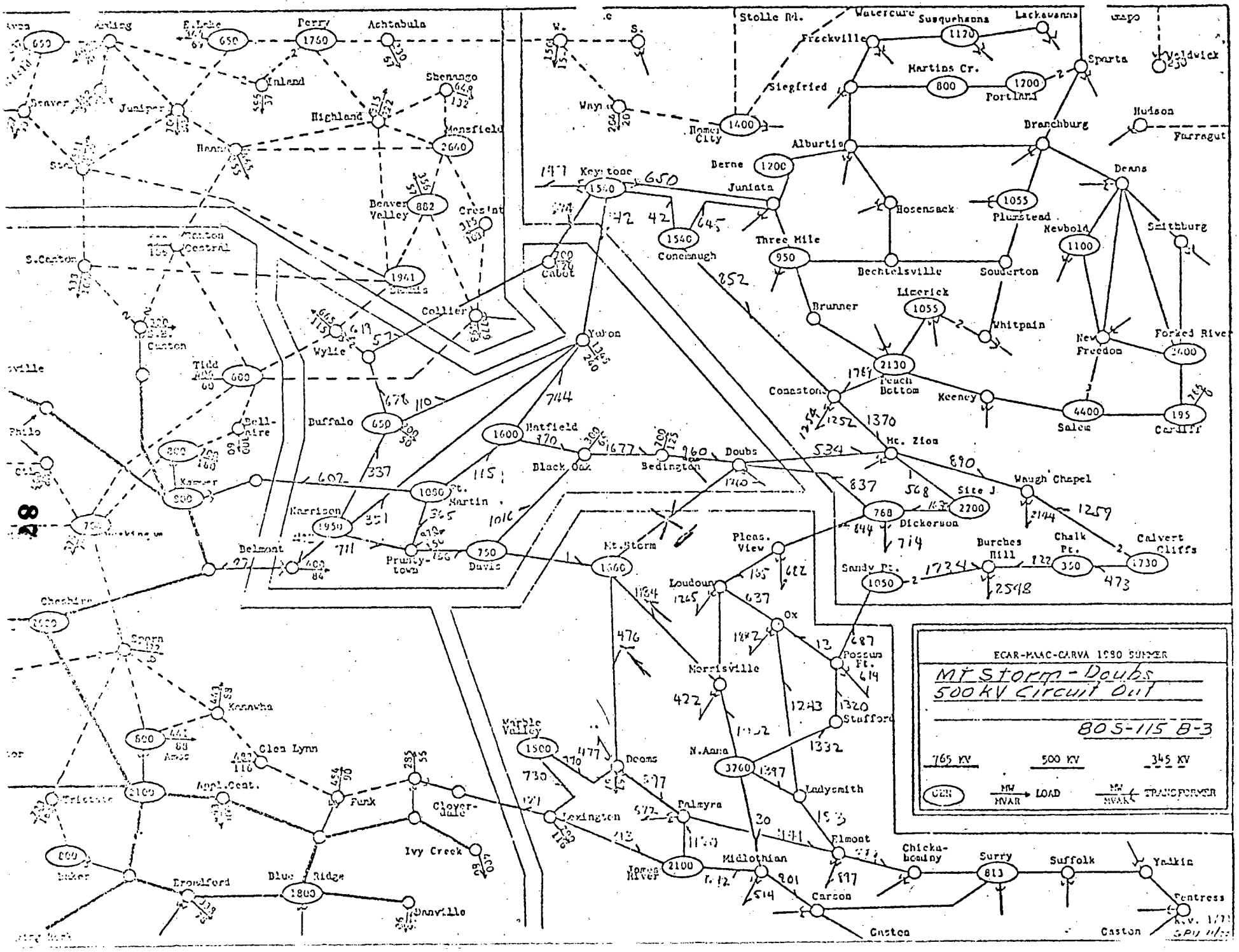
∴ Portion of flow in Mt. Storm-Doubs that is picked up by Black Oak-Beddington is 362/1190 = 30.5%

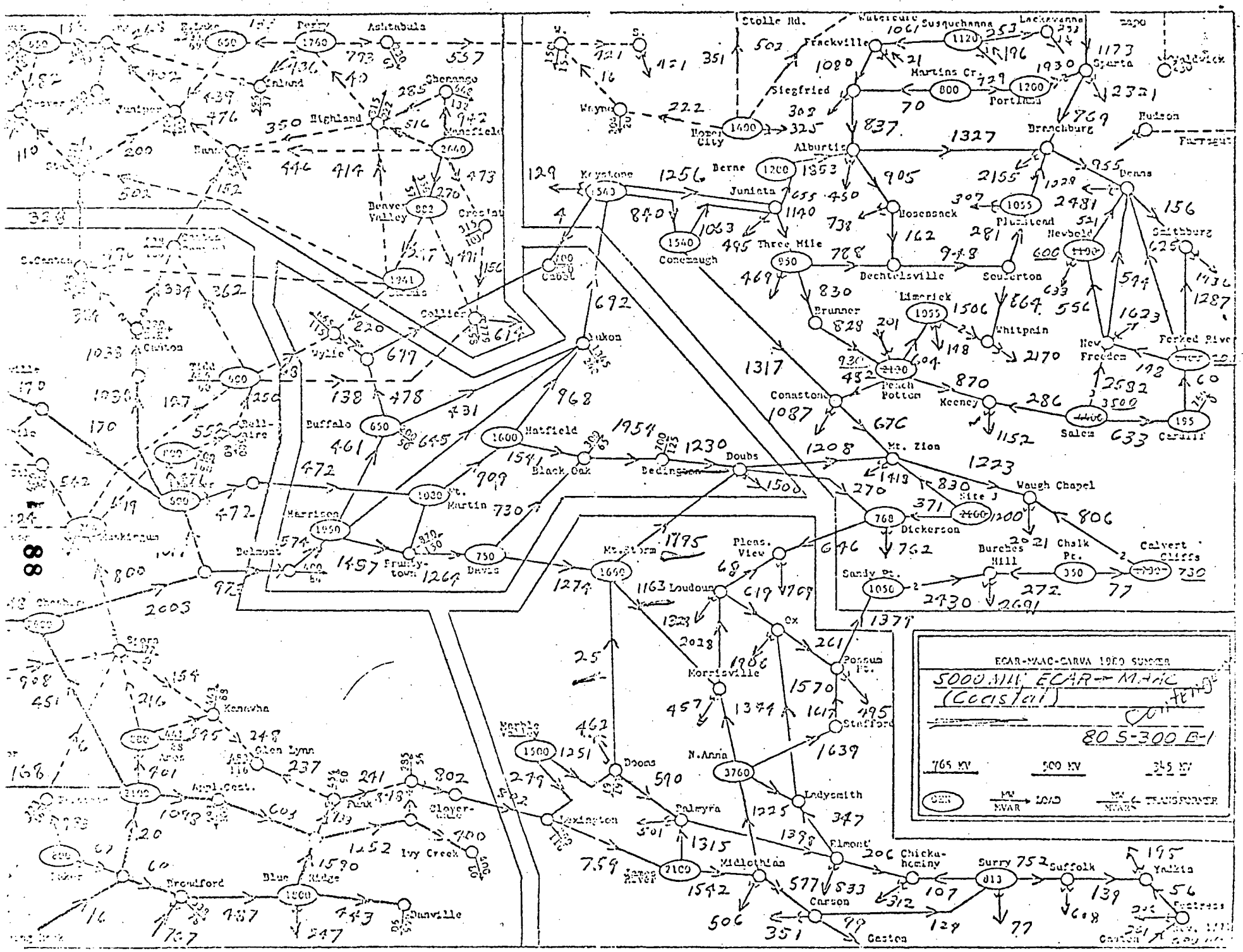
	Case	Black Oak-Beddington	Mt. Storm-Morrisville	Mt. Storm-Doubs
5000 MW Transfer ECAR to PJM	80S30B1	1954	1163	1192
		292	[illegible]	[illegible]


Trigel
Dicksn
Daubs
Mt Storm
P.V.
Sully
Clark
Idyl
Blue
Art
May
Ann
V.D.
Brad
Rav
B.R.
Hay
Hrsnbg
Staun
M.V.
Doams
Loudoun
Ox
Lex
Clover
Chville
Marr
N. Anna
L.S.
Pos Pt
Sky Pt
Staff
Palm
Fbg
James R
Elmont
N.W.
Lake
N.E.
N.Neck
Yorktown
Chicka
Midln
S.W.
Basin
Lanexa
Farm
Chest
Locks
Surry
Norfolk
Hope
Yard
Chase
Carson
Suff
Halifax
Gaston
Cara
Earleys
Rox
Everetts
Green

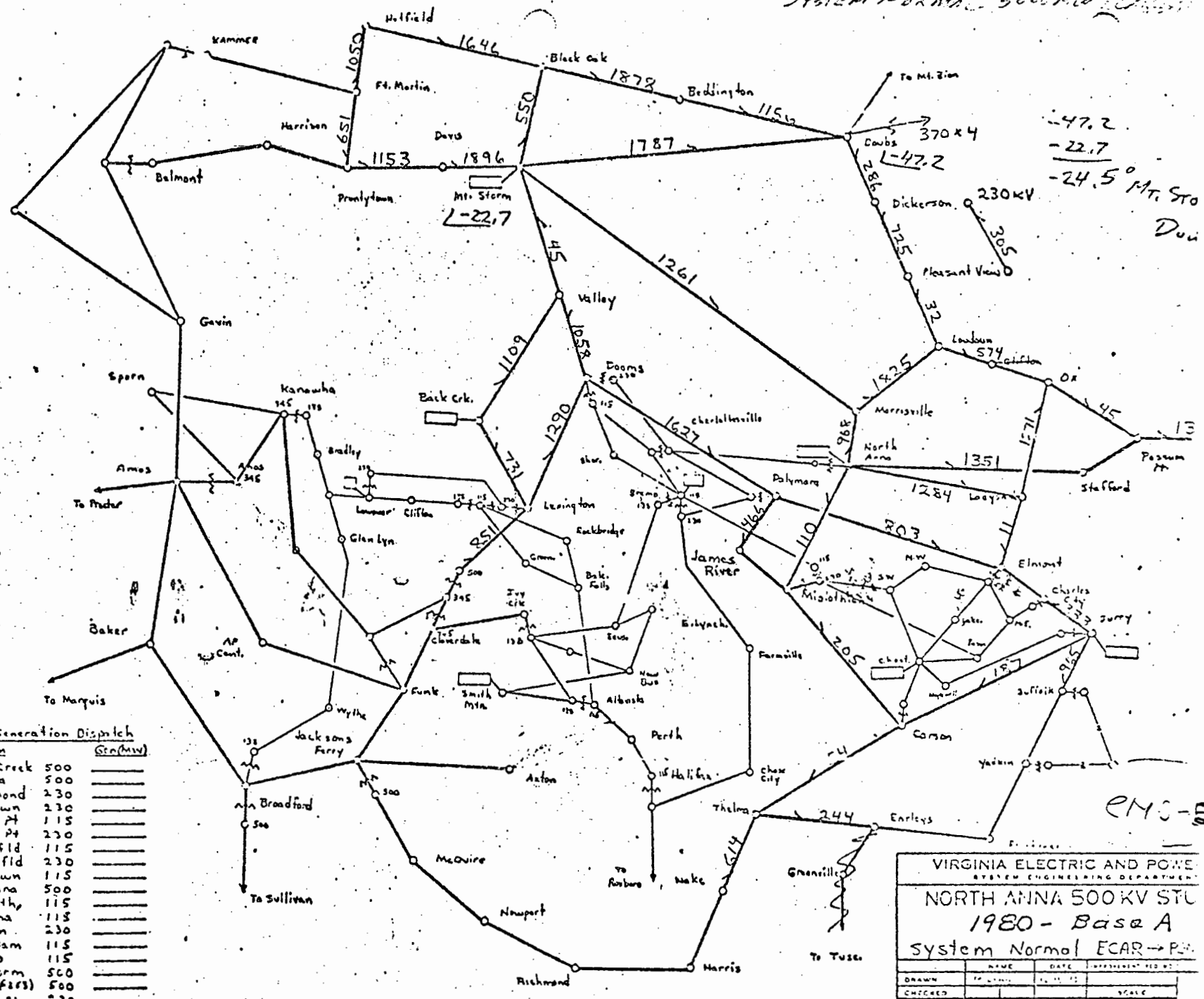

Clark
Sully
Ann
Mag
V.D.
Brad
Rav
B.R.
Hrsnbg
Staun
M.V.
Lex
Clover
Chville
Loudoun
Ox
Mort
N. Anna
L.S.
Pos Pt
Staff
Fbg
Palm
James R
Elmont
N Neck
N.W.
Yorktown
Chicka
Lake
N.E.
SW.
Midln
Dasin
Lanexa
Farm
Chest
Locks
Hopp
Norfolk
Suffy
Yad
Chase
Carson
Suff
Halifax
Lakeview
Gaston
Cara
Earleys
Rex
Tar
Everetts
Green
Oct. 1972
85


ECAR-MAAC-CARVA 1980 SUMMER
Base Case
PS-NY Ties Block C
Loaded
80S-100 B-3
Doubs-Mt Zion Impedance Corrected
765 KV
500 KV
345 KV
MW
MVAR
LOAD
TRANSFORMER
Stolle Rd.
Watercure
Susquehanna
Lackawanna
Sparta
Waldwick
Trackville
Siegfried
Martins Cr.
Portland
Branchburg
Hudson
Farragut
Perry
Ashtabula
Shenango
Highland
Mansfield
Beaver Valley
Crescent
Wayne
Homer City
Alburtis
Berne
Keystone
Juniata
Hosensack
Plumstead
Deans
Newbold
Smithburg
Conemaugh
Three Mile
Bechtelsville
Souderton
Limerick
Brunner
Whitpain
New Freedom
Forked River
Yukon
Cabot
Collier
Wylie
Buffalo
Hatfield
Black Oak
Bedington
Doubs
Mt. Zion
Site J
Waugh Chapel
Dickerson
Calvert Cliffs
Chalk Pt.
Burches Hill
Sandy Pt.
Connaston
Peach Bottom
Keeney
Salem
Cardiff
Harrison
Belmont
Frankstown
Davis
Mt. Martin
Pleas. View
Loudoun
Ox
Possum Pt.
Morrisville
Stafford
Marble Valley
Doomes
N. Anna
Ladysmith
Palmyra
Elmont
Lexington
Kidlothian
Chickahominy
Surry
Suffolk
Yadkin
Carson
Ivy Creek
Clover
Sunk
Glen Lynn
Kanawha
Appl. Cent.
Tristate
Baker
Bradford
Blue Ridge
Danville
Centress


ECAR-MAAC-CARVA 1980 SUMMER
Mt Storm - Doubs
500 kV Circuit Out
805-115 B-3
765 KV
500 KV
345 KV
GEN
MW
MVAR
LOAD
TRANSFORMER
Perry
Achtabula
Highland
Mansfield
Beaver Valley
Crescent
Collier
Wylie
Tidd
Buffalo
Bell-Aire
Kammer
Harrison
Belmont
Prunty-town
Davis
Mt. Martin
Yorton
Cabot
Keystone
Conemaugh
Juniata
Three Mile
Berne
Alburtis
Homer City
Siegfried
Freckville
Susquehanna
Lackawanna
Martins Cr.
Portland
Sparta
Branchburg
Hosensack
Plumstead
Deans
Newbold
Smithburg
Bechtelsville
Souderton
Brunner
Limerick
Whitpain
New Freedom
Forked River
Coatesville
Peach Bottom
Keeney
Salem
Cardiff
Hatfield
Black Oak
Bedington
Doubs
Mt. Zion
Site J
Dickerson
Waugh Chapel
Burches Hill
Chalk Pt.
Calvert Cliffs
Sandy Pt.
Mt. Storm
Pleas. View
Loudoun
Ox
Possum Pt.
Stafford
Morrisville
N. Anna
Ladysmith
Elmont
Chickahominy
Surry
Suffolk
Yadkin
Fentress
Caston
Carson
Midlothian
James River
Palmyra
Doorns
Lexington
Marble Valley
Ivy Creek
Clover-dale
Funk
Appl. Cent.
Clen Lynn
Kanawha
Amos
Tristate
Baker
Bronlford
Blue Ridge
Danville
Cheshire
Sporn
Philo
Zanesville
Muskingum
Stollo Rd.
Watercure
Hudson
Farragut
Wyldwick

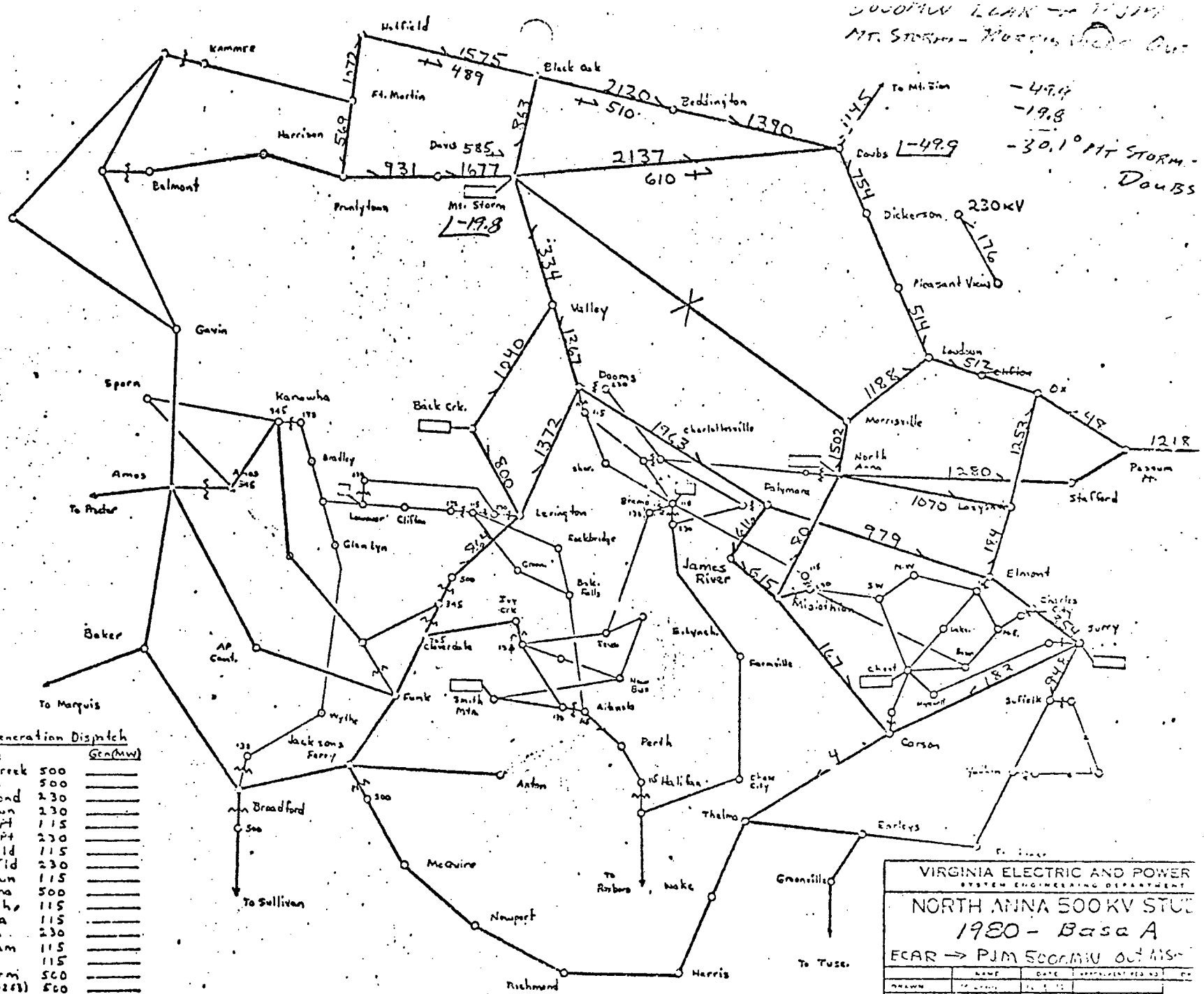

ECAR-MAAC-CARVA 1980 SUMMER
5000 MW ECAR-MAAC
(Coastal)
80 S-300 E-1
765 KV
500 KV
345 KV
GEN
MW
MVAR
LOAD
TRANSFORMER
Ashtabula
Perry
Highland
Chenango
Mansfield
Denver Valley
Collier
Wylie
Lukon
Buffalo
Hatfield
Black Oak
Bedington
Doubs
Mt. Zion
Site J
Dickerson
Waugh Chapel
Burches Hill
Chalk Pt.
Calvert Cliffs
Sandy Pt.
Pleas. View
Mt. Storm
Loudoun
Ox
Possum Pt.
Morrisville
Stafford
Doons
N. Anna
Palmyra
Lexington
Lady Smith
Elmont
Chickahominy
Surry
Suffolk
Yadkin
Fentress
Carson
Gaston
Midlothian
Marble Valley
Kanawha
Glen Lynn
Appl. Cent.
Slaverville
Ivy Creek
Bradford
Blue Ridge
Danville
Harrison
Belmont
Frankstown
Davis
Keystone
Conemaugh
Junieta
Berne
Three Mile
Deckelsville
Brunner
Limerick
Peach Bottom
Connastone
Keeney
Salem
Cardiff
Whitpain
Souderton
Plumstead
Newbold
New Freedom
Forked River
Saltsburg
Denis
Brenchburg
Alburtis
Rosenback
Siegfried
Frackville
Susquehanna
Lackawanna
Sterta
Portland
Martins Cr.
Stolle Rd.
Hudson
Farragut
Zapo
Hornell City
Waynesburg
Cresson
Clinton
Sellersville
Sunbury
Clarion
Dunkirkgum
Storm

System Normal 500 KV Power



[redacted]

500KV LEAR → PJM
MT. STORM - MORRIS [illegible] OUT



Vepco Generation Dispatch

Station	Gen(MW)
Back Creek	500
Arvonia	500
Nansemond	230
Yorktown	230
Pleasm Pt	115
Pleasm Pt	230
Chestfld	115
Chestfld	230
Yorktown	115
Nor Anna	500
Portsmith	115
Carolina	115
Gaston	230
Kerr Dam	115
Smmo	115
Mt Storm	500
Surry (2&3)	500
Surry #1	230

VIRGINIA ELECTRIC AND POWER
SYSTEM ENGINEERING DEPARTMENT

NORTH ANNA 500 KV STU
1980 - Base A

ECAR → PJM 500MW OUT MISC

	NAME	DATE	APPROVAL REQ'D	
DRAWN				
CHECKED			SCALE	
INSPECTED				
CORRECT			REVISIONS	
APPROVED				

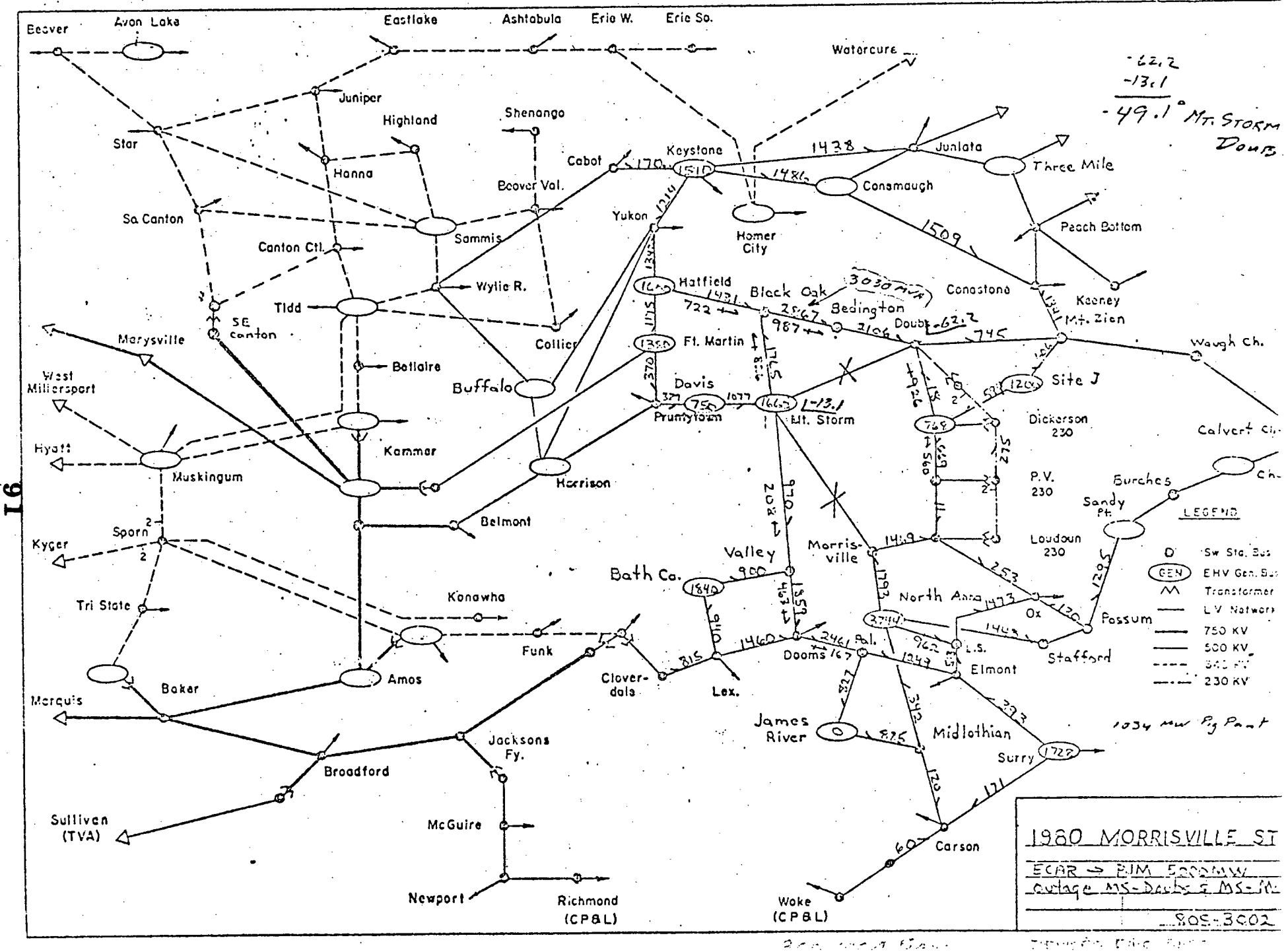
TITLE | ELECTRICAL | STEEL ASSEMBLY | STEEL DETAILS | FOUNDATIONS | LOCATION PLAN | BILL OF MATERIAL

865-3001

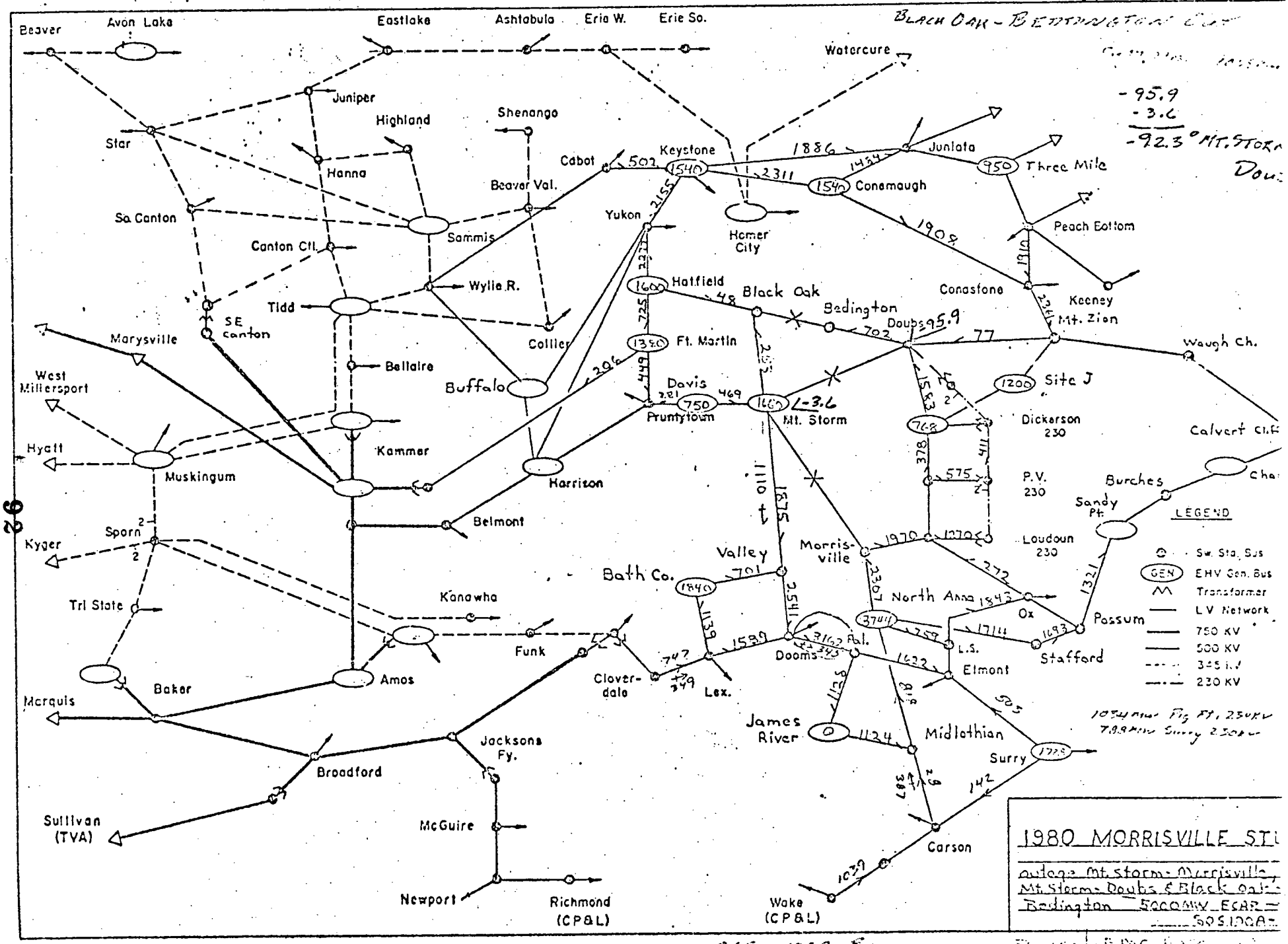
06

REVISIONS

500 MW ECAR → PJM
Mt. Storm-Morrisville Out
Mt. Storm-Doubs Out



5000 MW ESAR → MOT
MT. STORM - MORRISVILLE OUT
MT. STORM - DOUBS OUT
BLACK OAK - BEDINGTON OUT



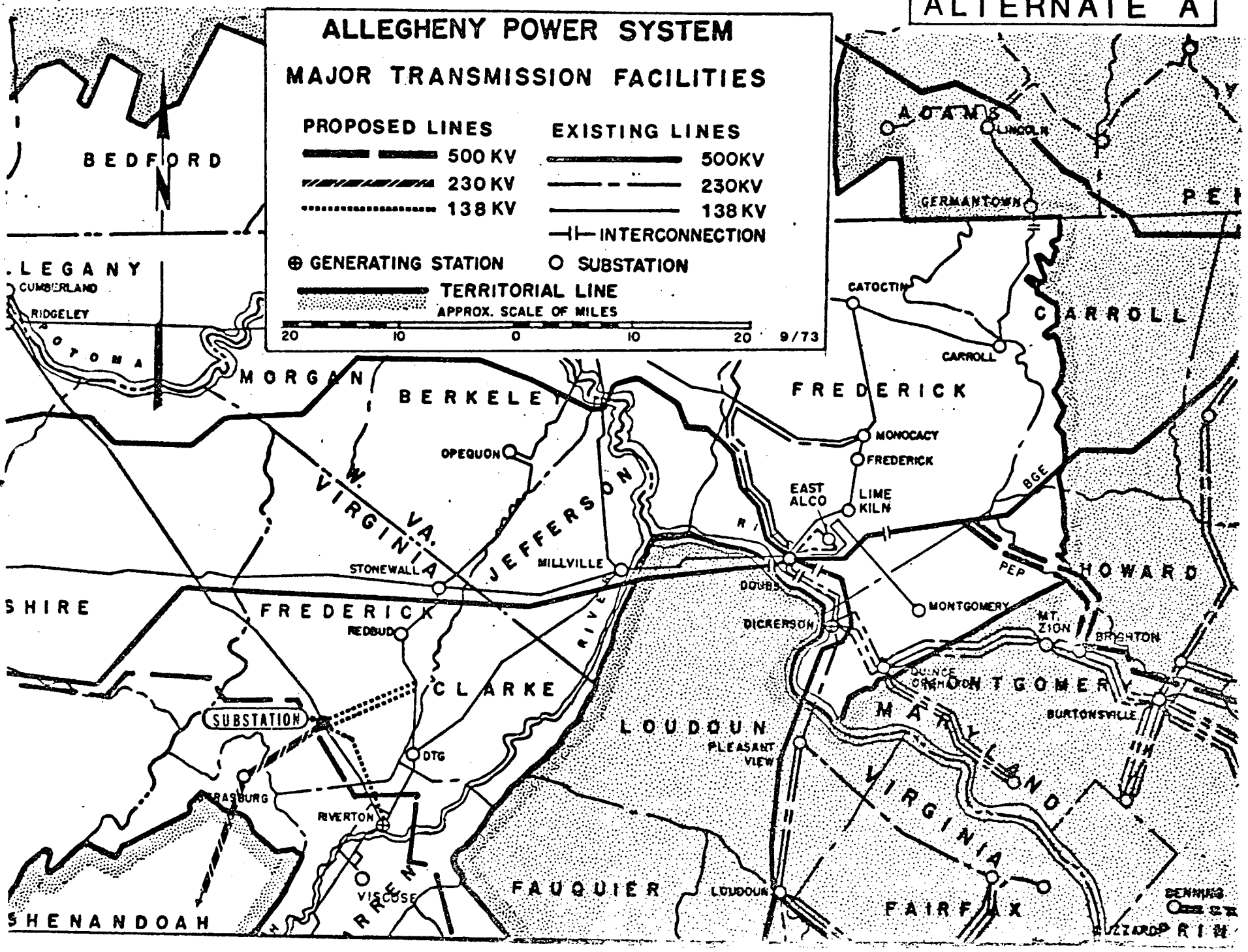
-95.9
-3.6
-92.3 MT. STORM
DOUBS

1980 MORRISVILLE STUDY
outage Mt. Storm - Morrisville,
Mt. Storm - Doubs & Black Oak -
Bedington 5000MW ESAR
505.100A

based on PH 3-4 line

LH6) - 2

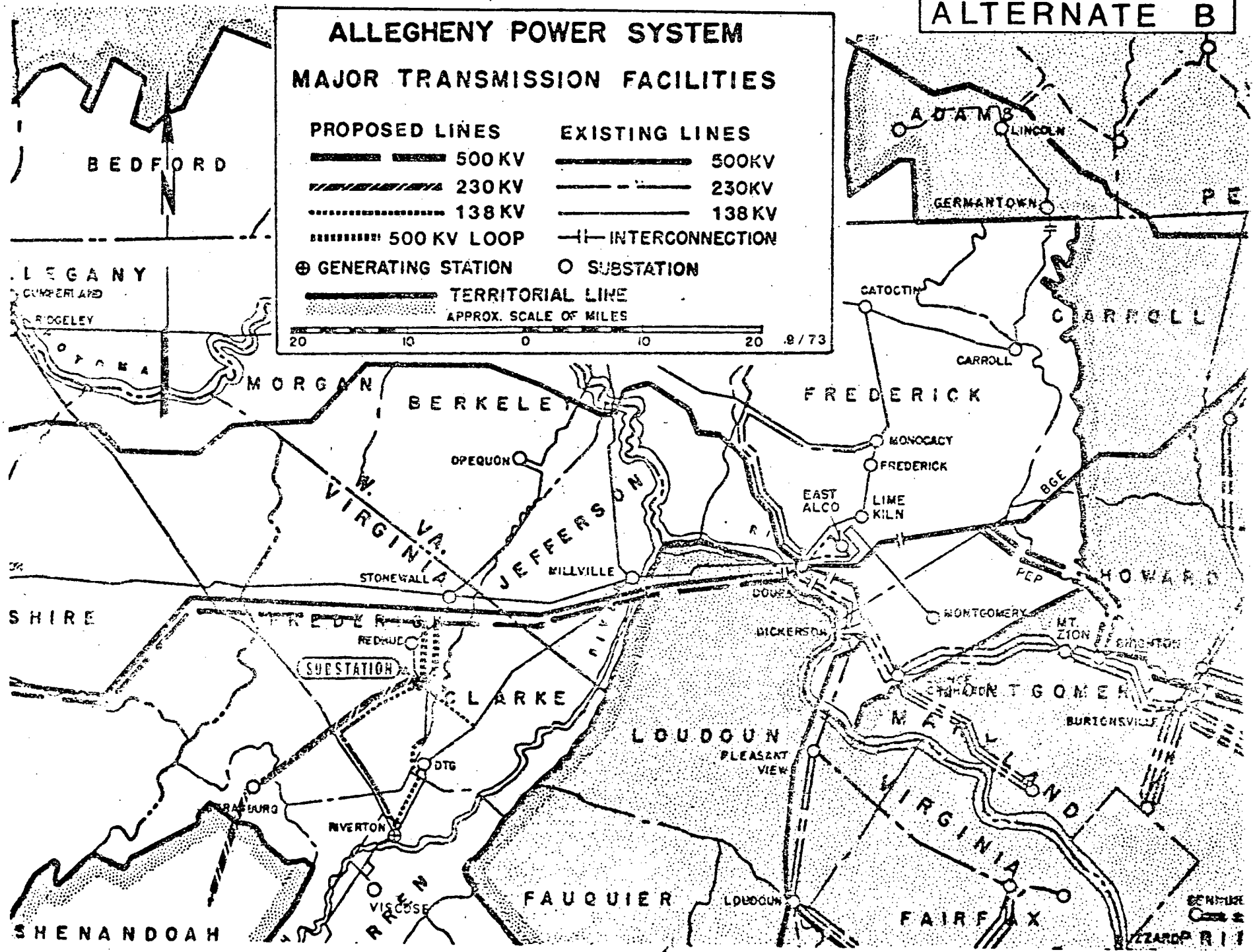
ALTERNATE A



Ex LHW-2

LHW-2

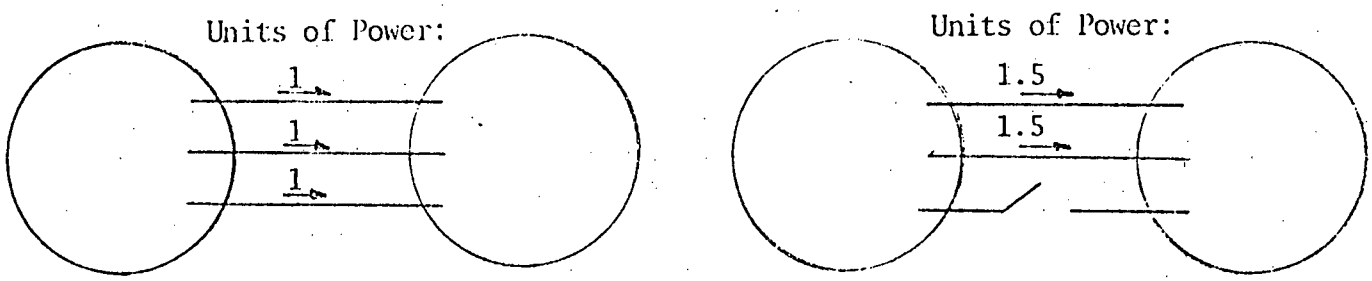
ALTERNATE B



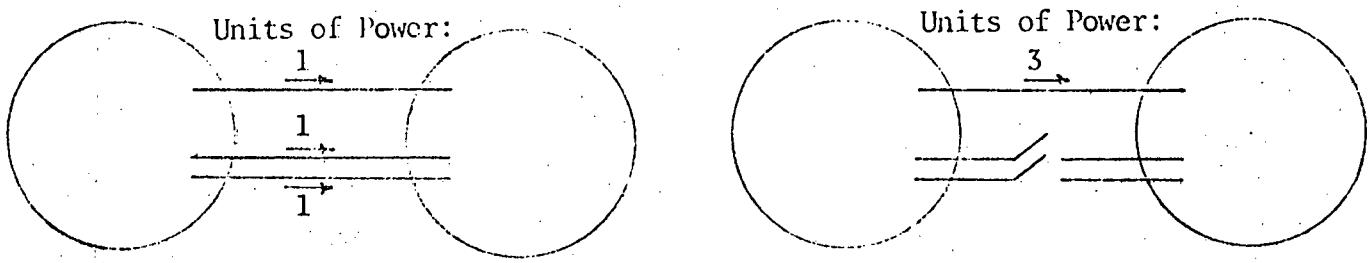
Ex LOB-1

Power
Technologies,
Inc.

EMERGENCY LOADING OF PARALLEL LINES



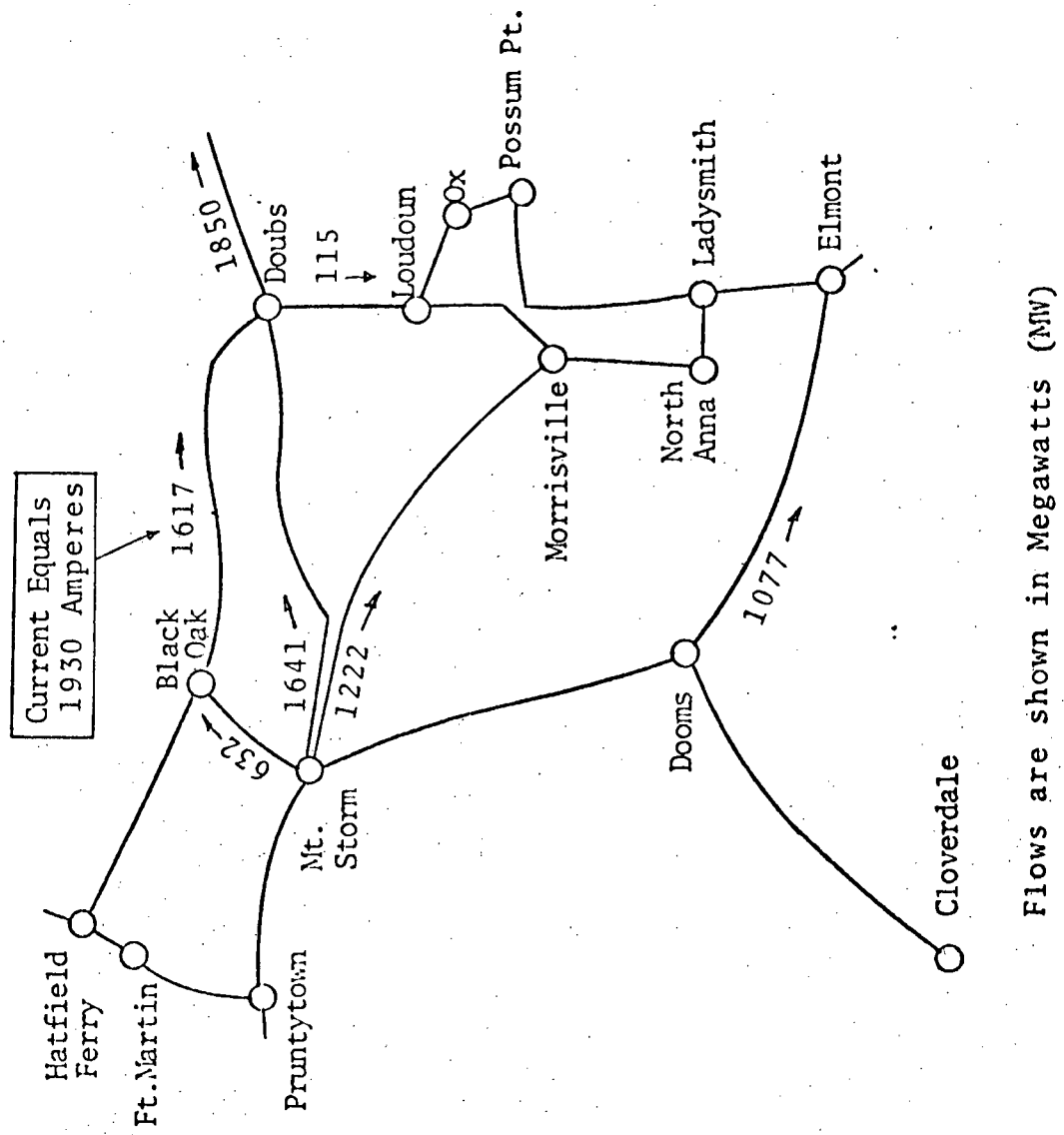
A - OUTAGE OF A SINGLE-CIRCUIT RIGHT-OF-WAY



B - OUTAGE OF A DOUBLE-CIRCUIT RIGHT-OF-WAY

Power
Technologies,
Inc.

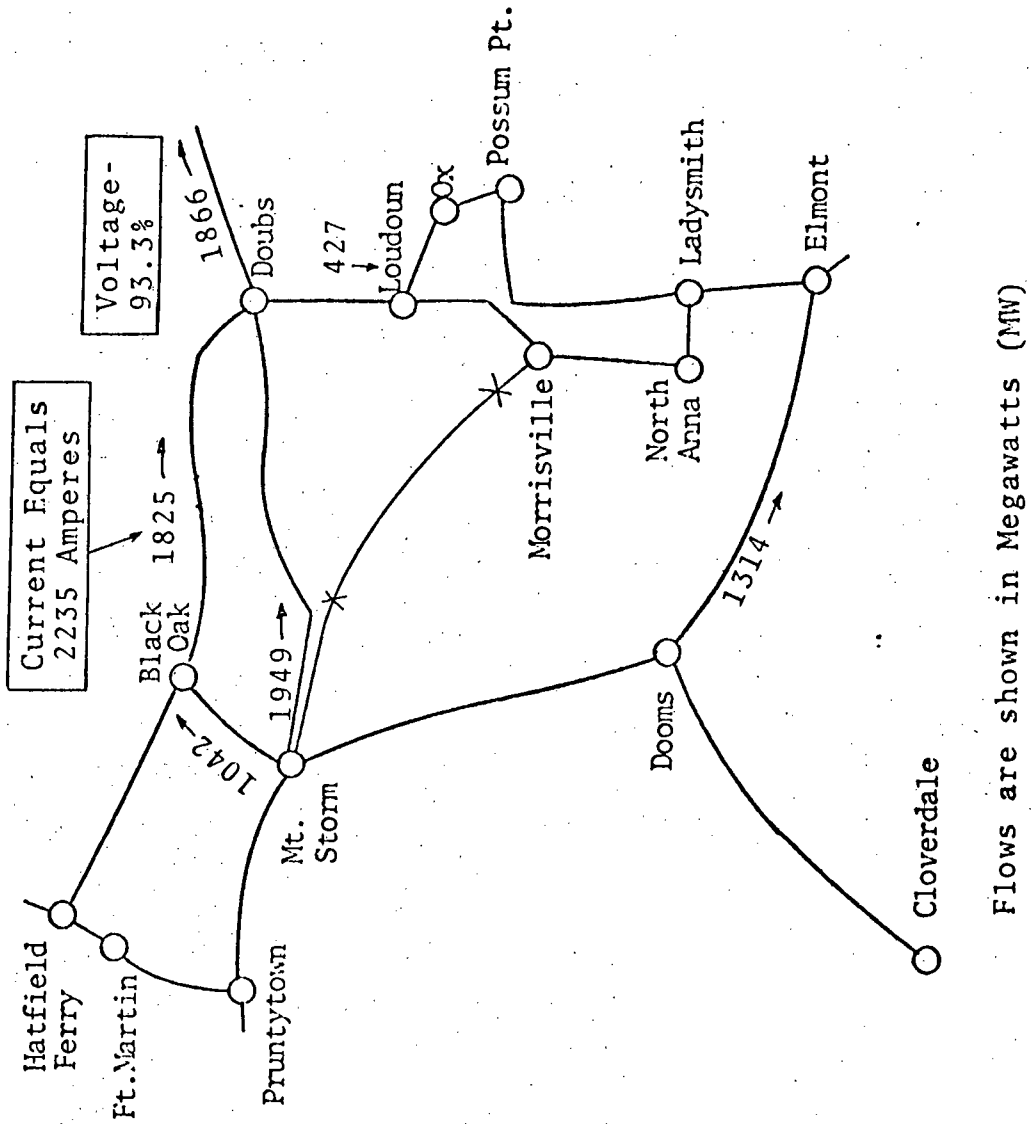
CASE A
1980 Loads
5000 MW Transfer
From ECAR to PJM



Flows are shown in Megawatts (MW)

Power
Technologies,
Inc.

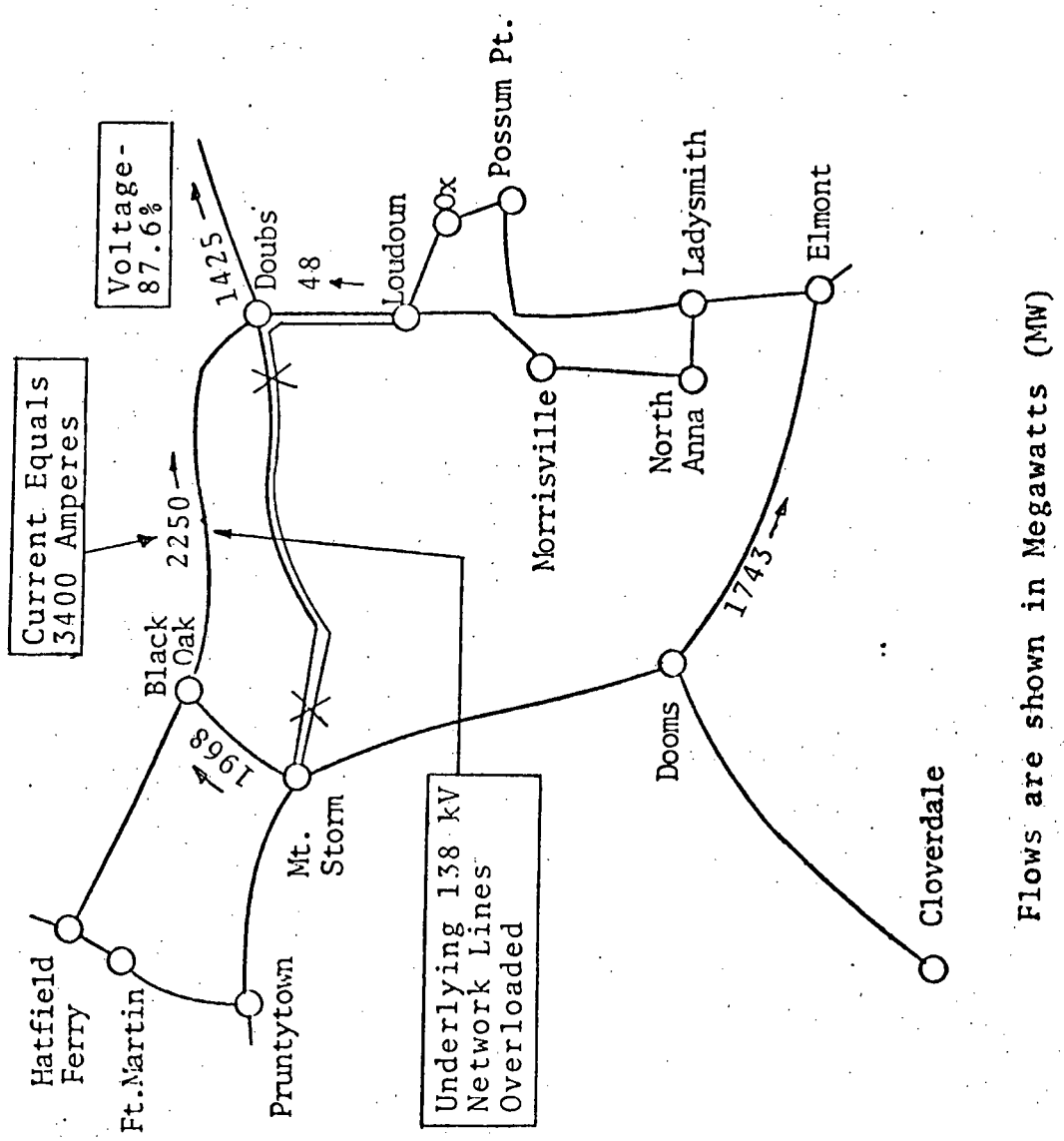
CASE B
1980 Loads
5000 MW Transfer
From ECAR to PJM



Flows are shown in Megawatts (MW)

Power
Technologies,
Inc.

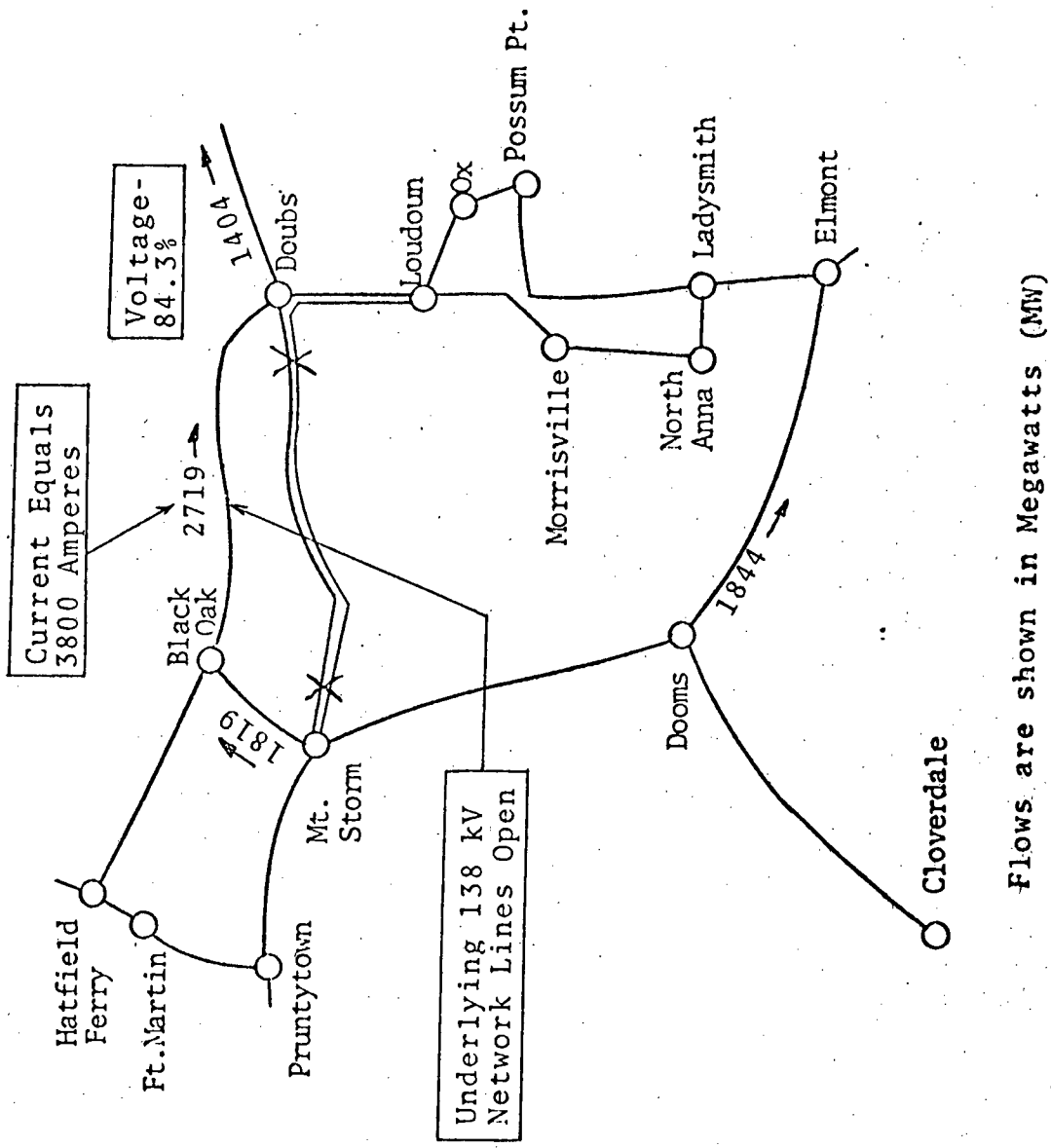
CASE C
1980 Loads
5000 MW Transfer
From ECAR to PJM



Flows are shown in Megawatts (MW)

Power
Technologies,
Inc.

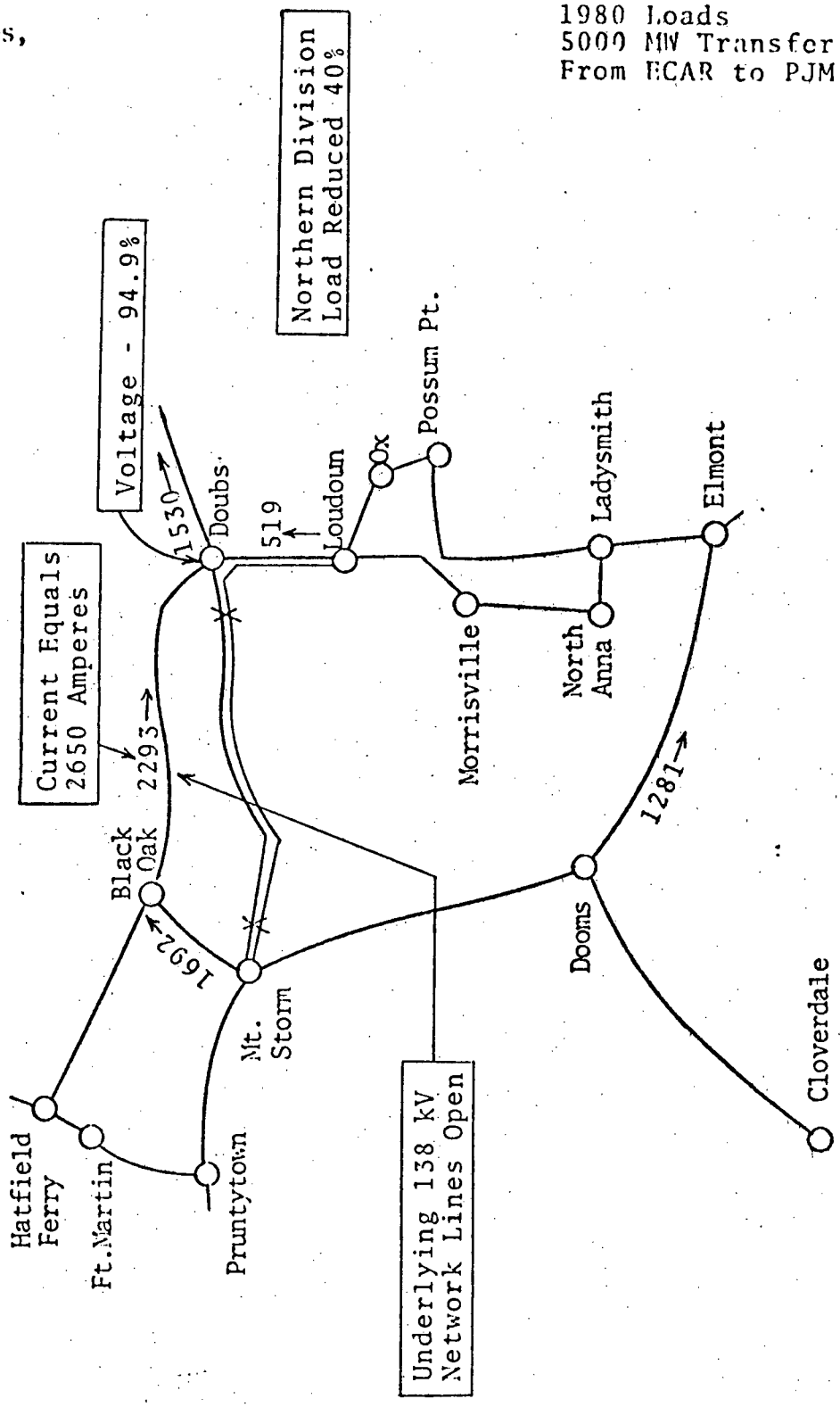
CASE D
1980 Loads
5000 MW Transfer
From ECAR to PJM



Flows are shown in Megawatts (MW)

Power
Technologies,
Inc.

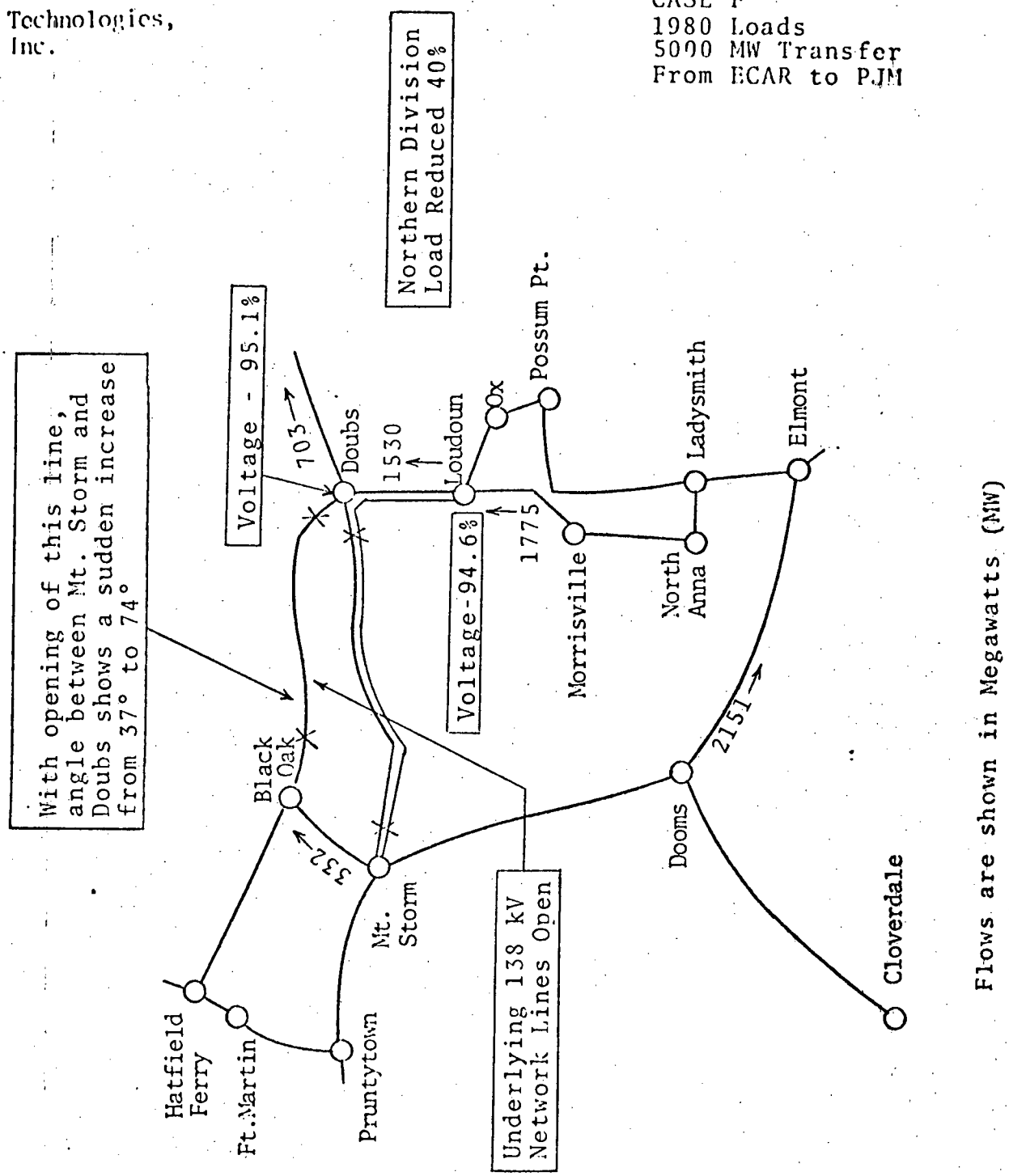
CASE E
1980 Loads
5000 MW Transfer
From ECAR to PJM



Flows are shown in Megawatts (MW)

Power
Technologies,
Inc.

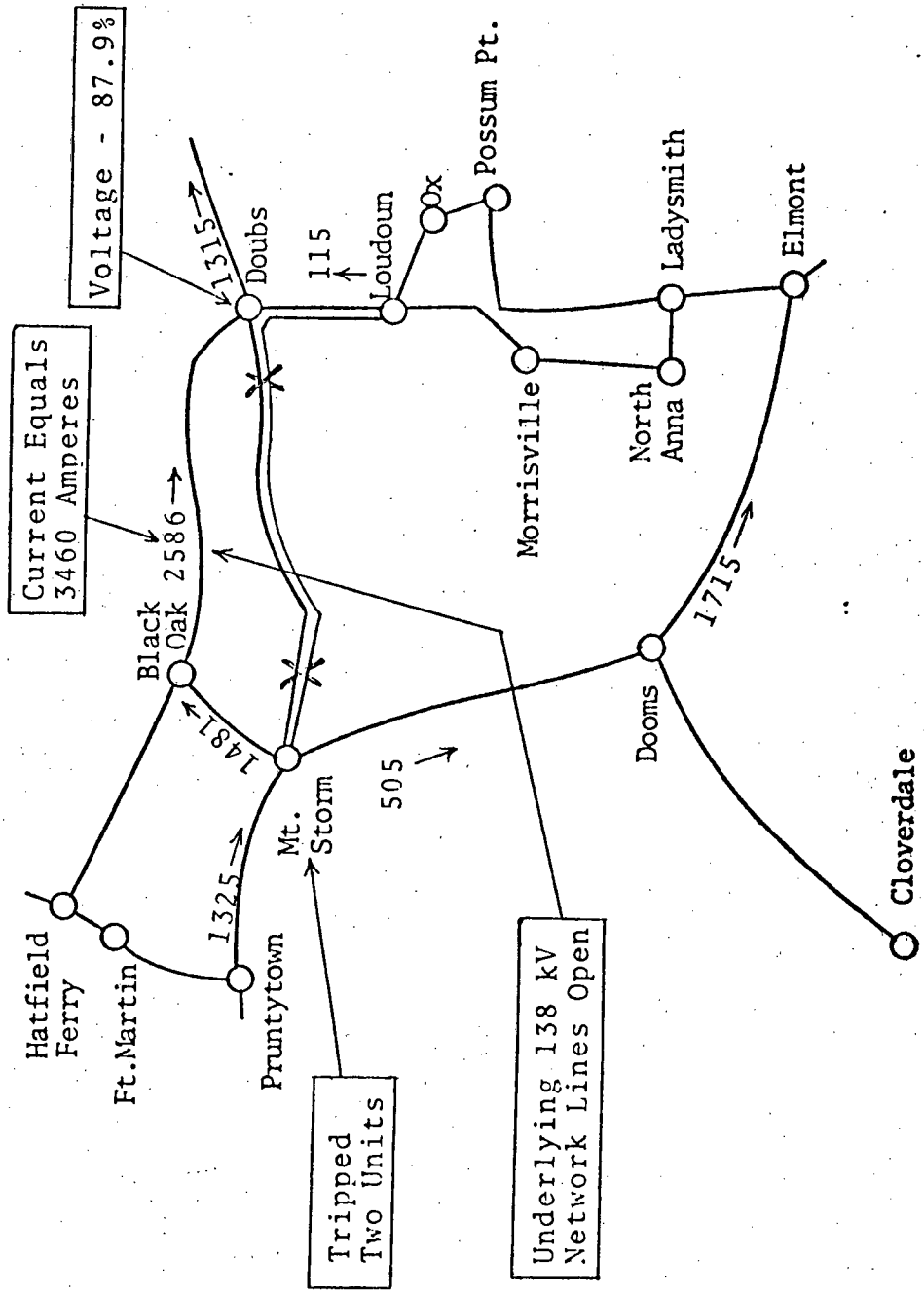
CASE F
1980 Loads
5000 MW Transfer
From ECAR to PJM



Flows are shown in Megawatts (MW)

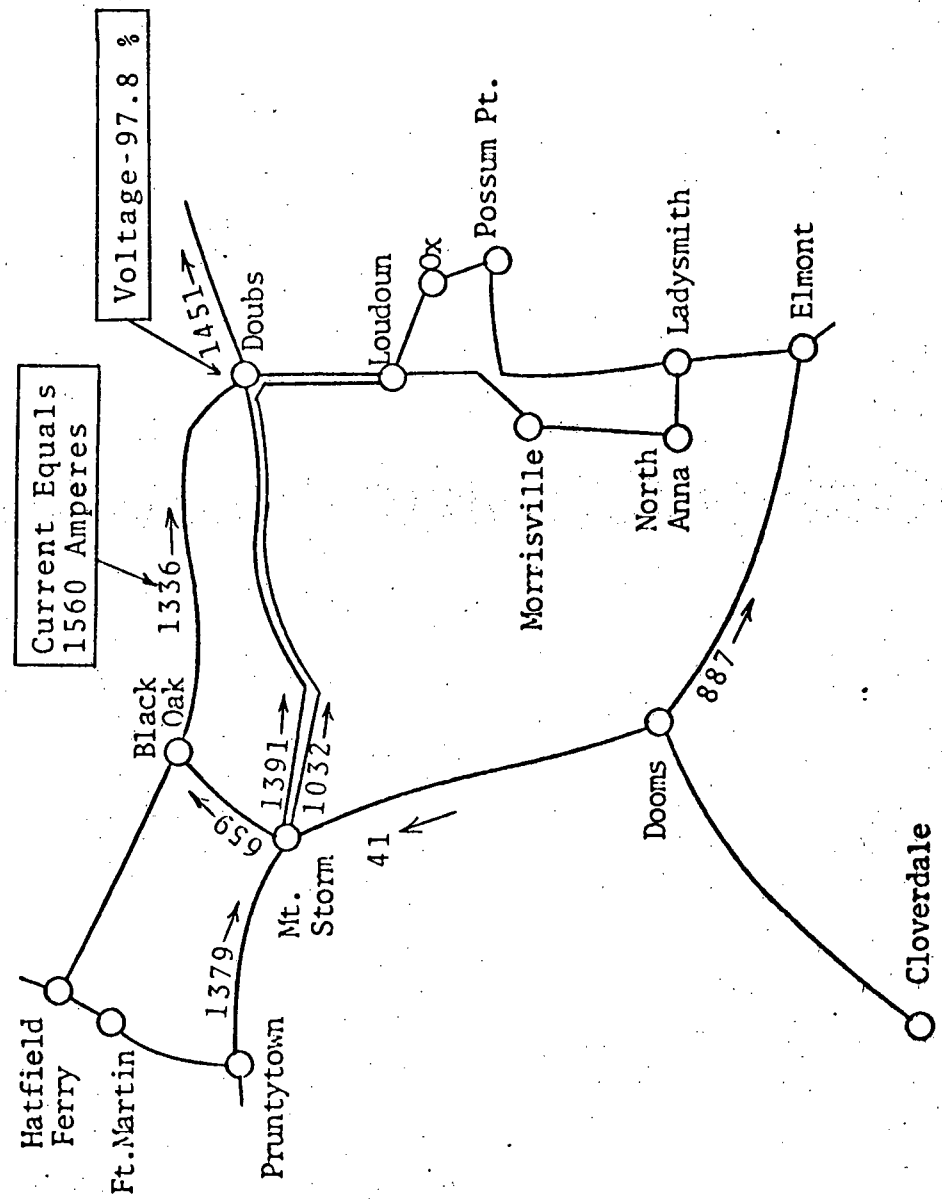
Power
Technologies,
Inc.

CASE G
1980 Loads
5000 MW Transfer
From ECAR to PJM



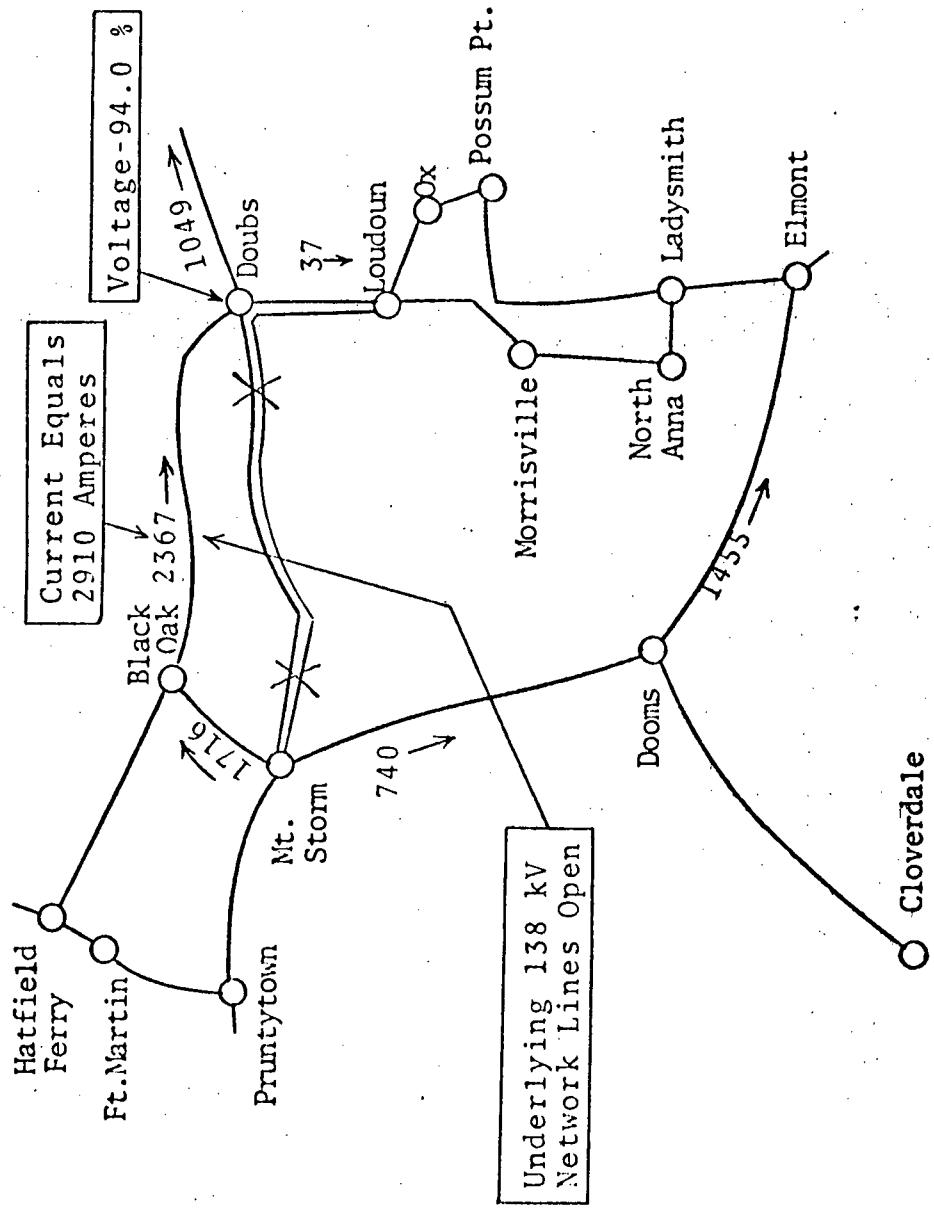
Power
Technologies,
Inc.

CASE H
1980 Loads
3000 MW Transfer
From ECAR to PJM



Power
Technologies,
Inc.

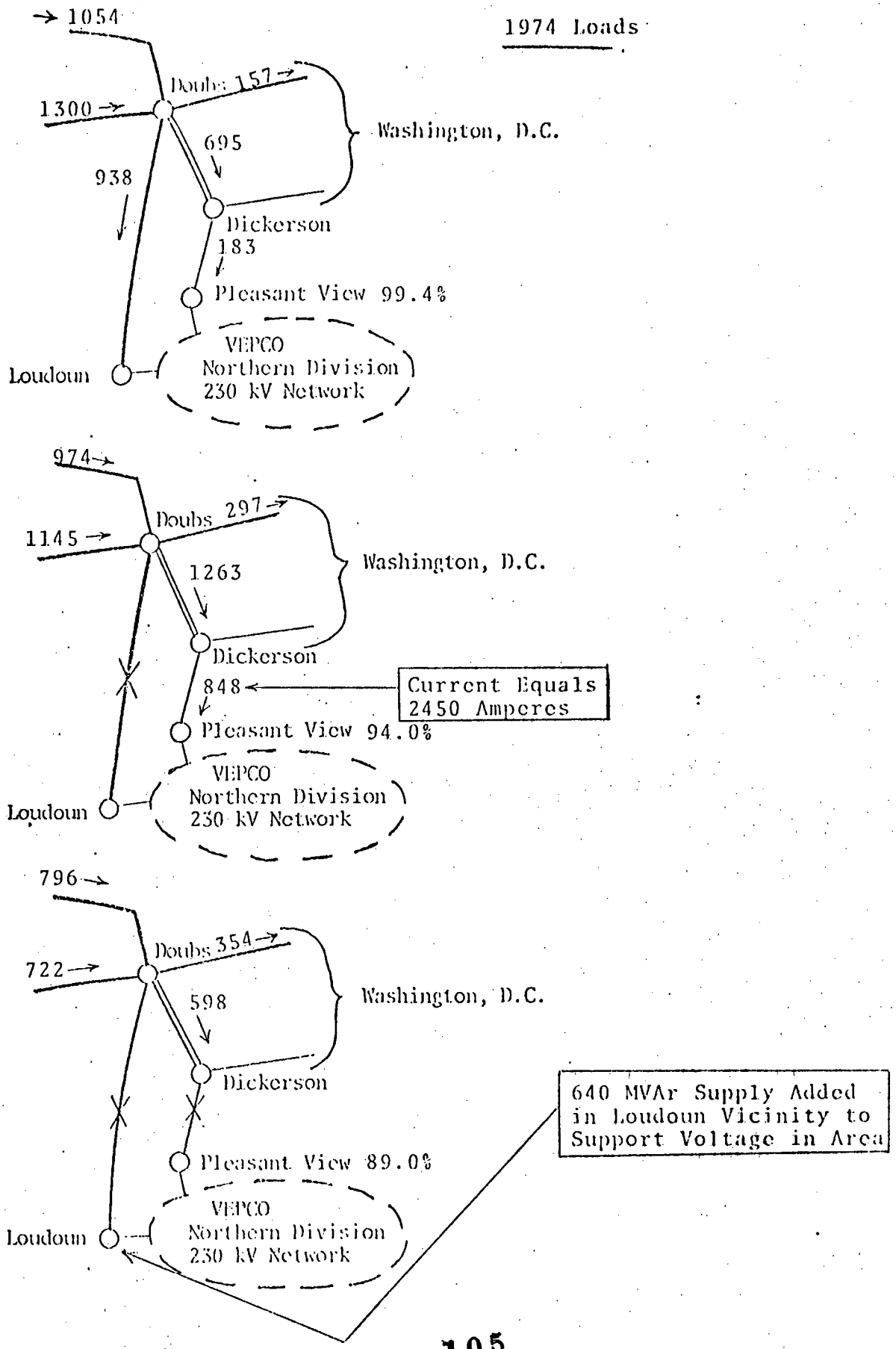
CASE I
1980 Loads
3000 MW Transfer
From ECAR to PJM



Ex LOB-2

Power
Technologies,
Inc.

1974 Loads



Ex LOB-3

Power
Technologies,
Inc.

WITH MT. STORM-MORRISVILLE LINE

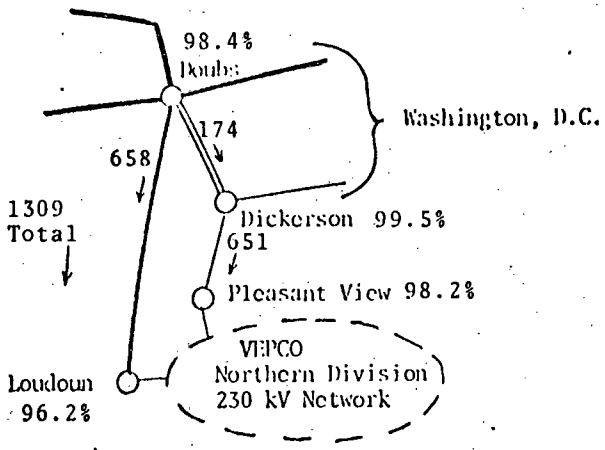


FIGURE A

NORMAL

WITH MT. STORM-DOUBS-LOUDOUN LINE

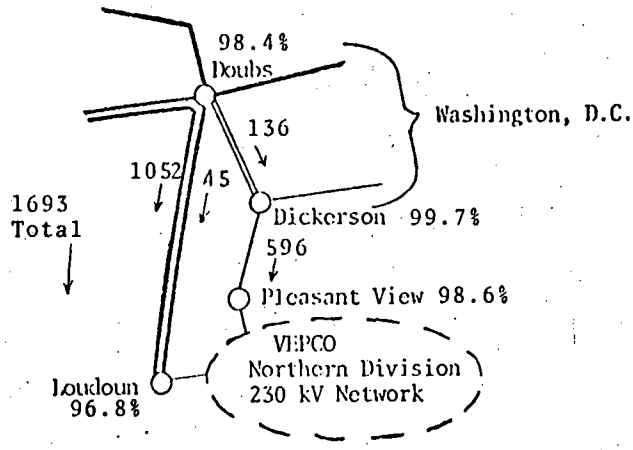


FIGURE D

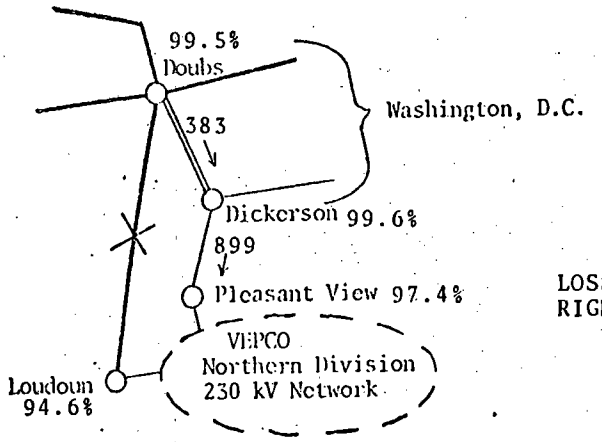


FIGURE B

LOSS OF 500 kV
RIGHT-OF-WAY

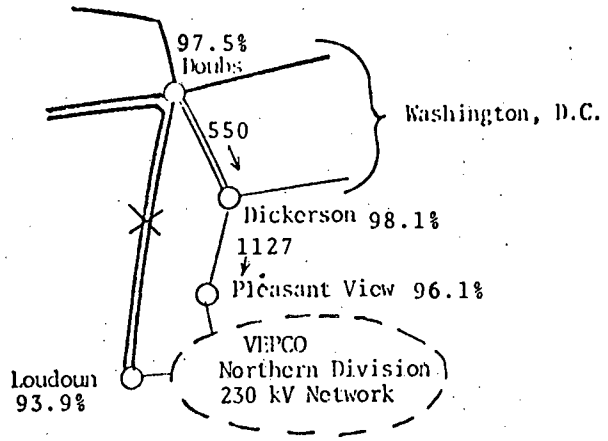


FIGURE E

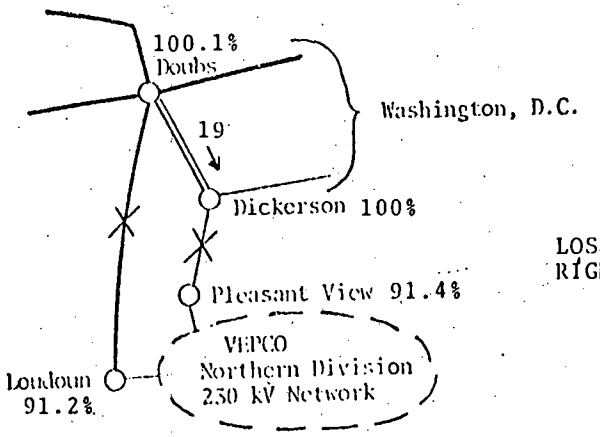


FIGURE C

LOSS OF ENTIRE
RIGHT-OF-WAY

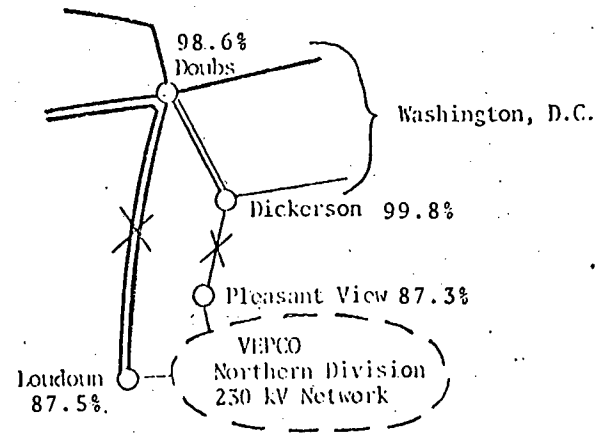


FIGURE F

LEGEND

500 kV
230 kV
Flows in MW
Voltages in %

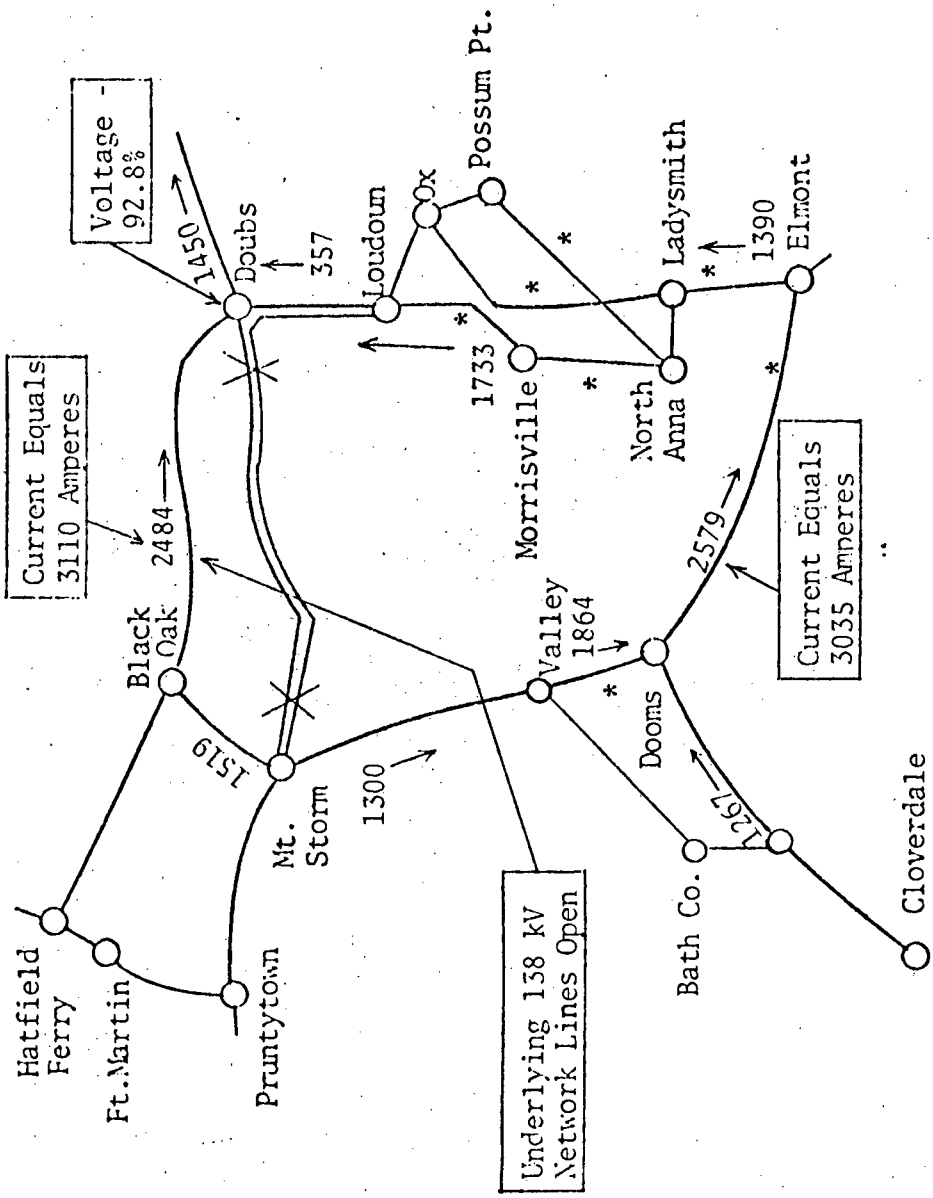
VEPCO IMPORT LIMIT FROM ECAR - 1980

Ex LOB-6

~~EXHIBIT LOB-6~~

Power
Technologies,
Inc.

CASE J
1980 Loads
5000 MW Transfer from ECAR to PJM
Series Compensation of Southern Loop

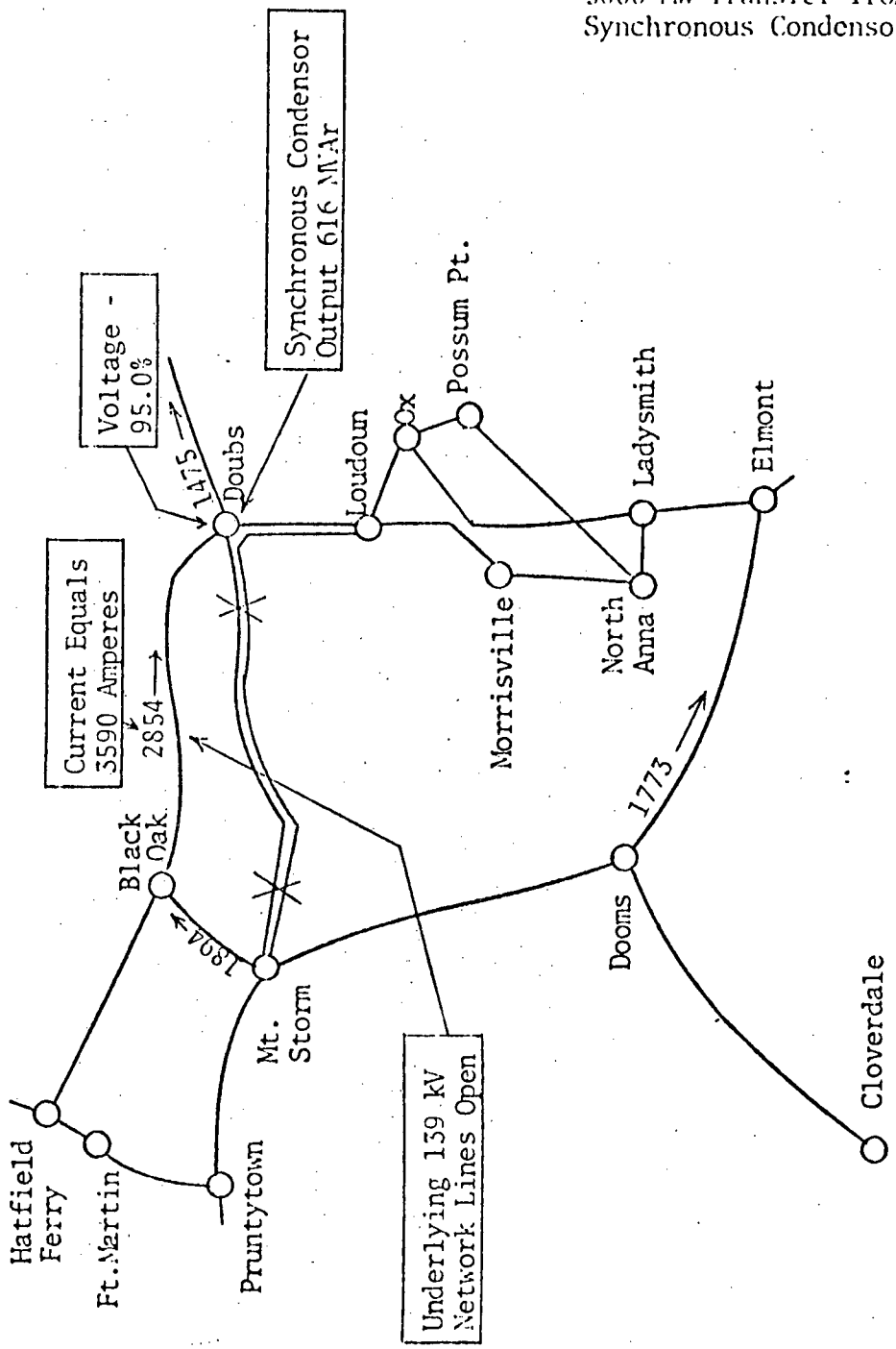


Flows are shown in Megawatts (MW)

* Line Reactance Compensated 50% by series capacitor.

Power
Technologies,
Inc.

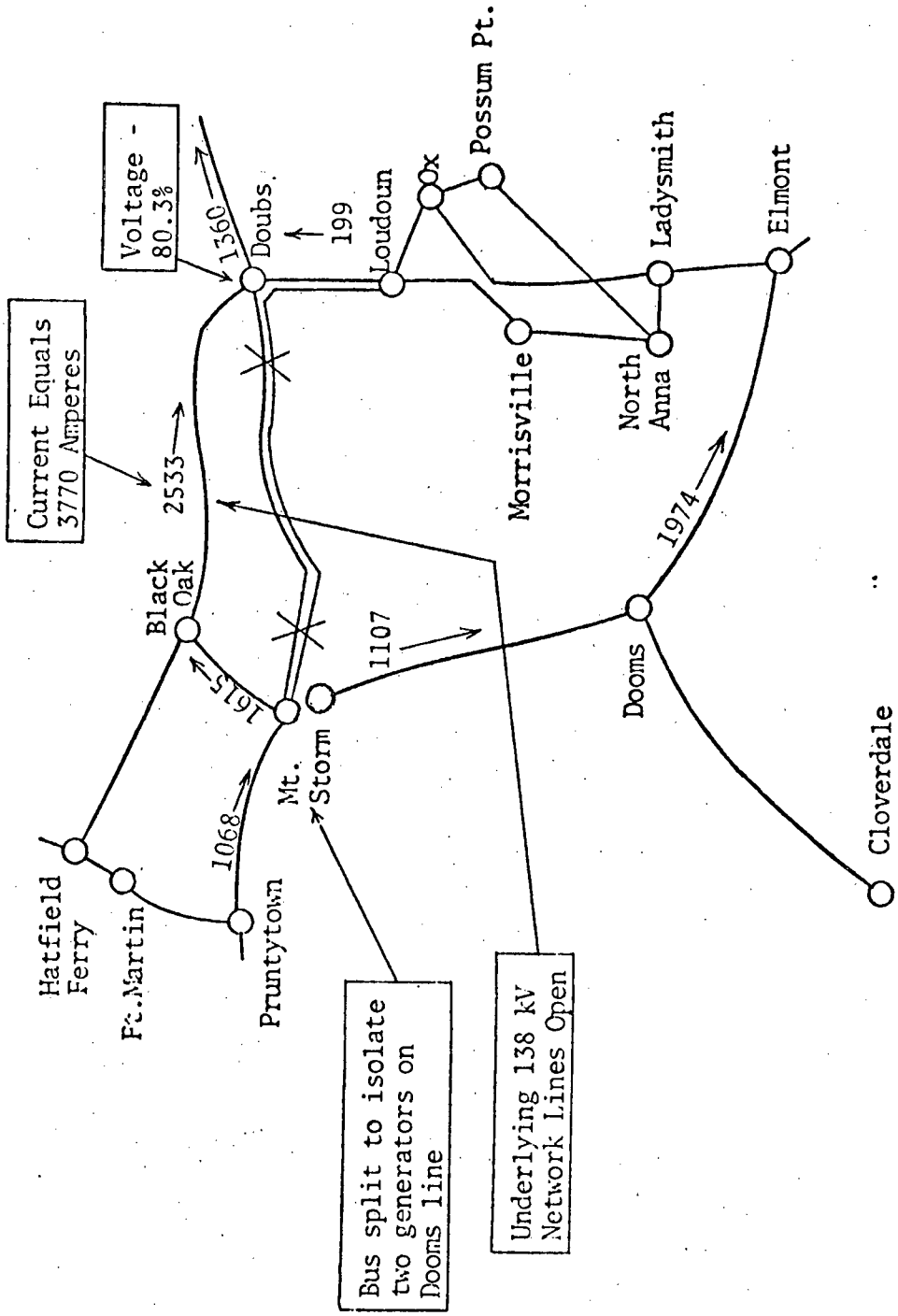
CASE K
1980 Load
5000 MW Transfer from ECAR to PJM
Synchronous Condensor at Doubs



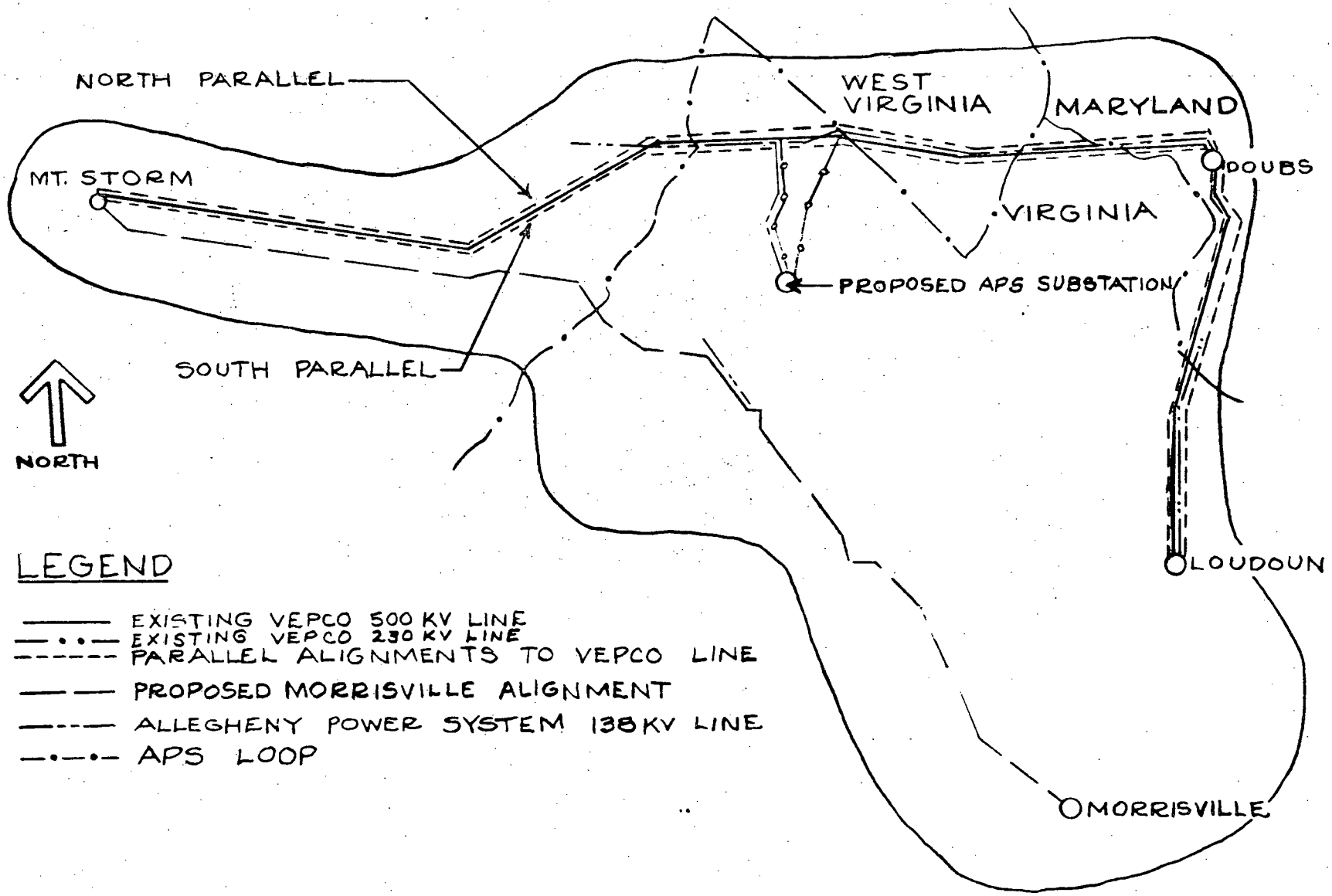
Flows are shown in Megawatts (MW)

Power
Technologies,
Inc.

CASE L
1980 Loads
5000 MW Transfer from ECAR to PJM
Mt. Storm Bus Split



Flows are shown in Megawatts (MW)



SCHEMATIC OF 500 KV TRANSMISSION LINE ALIGNMENTS IN REGIONAL STUDY AREA

Ex BH-9

~~EXHIBIT BH-9~~

Ex BH-10

~~EXHIBIT BH-10~~

	NORTH PARALLEL LINE		SOUTH PARALLEL LINE		MT. STORM-MSVL.		APS LOOP INTER-CON.	
	No.	Length	No.	Length	No.	Length	No.	Length
TRANSPORTATION								
* Major Highways	8	-	8	-	5	-	4	-
* Railroads	11	1	11	1	6	1	5	1.5
* Pipelines	2	2.3	2	2.3	5	-	1	-
* Existing Transmission Lines	(complete parallel)		(complete parallel)		4	11.4	1	14 ±
EXISTING LAND USE								
Urban	1	0.1	1	0.2	0	0	0	0
Developed Clusters	4	0.9	9	2.5	3	0.7	3	0.2
Commercial	1	-	0	0	0	0	0	0
Institutional	4	0.1	1	-	0	0	0	0
* Industrial	1	0.1	0	0	0	0	1	0.1
* Extractive Industry	2	0.5	1	0.3	1	0.4	1	0.1
Parks, Recreation & National Forests	4	2.1	5	4.5	1	0.2	2	0.5
* Wildlife Management Areas	0	0	0	0	0	0	0	0
* Natural Areas	0	0	0	0	0	0	0	0
Trails	1	-	1	-	1	-	0	0
Orchards	8	1.7	11	1.8	3	0.2	2	0.6
State Historic Sites	1	-	2	-	2	-	0	0
* Proposed National Historic Sites	0	0	0	0	0	0	0	0
* National Historic Sites	0	0	0	0	0	0	0	0
* Communications Zones	0	0	0	0	0	0	0	0
* Radio Towers	0	0	0	0	0	0	0	0
* Airfields	0	0	0	0	0	0	0	0
Structures	27	-	29	-	0	0	4	-
PROPOSED LAND USE								
High & medium density residential	5	3.3	5	3.2	4	7.6	11	6.8
Low density residential	6	6.9	6	6.6	2	1.2	2	0.6
Rural density residential	5	24.5	5	24.5	3	19.7	1	0.5
* Commercial	0	0	0	0	0	0	0	0
* Institutional	0	0	0	0	0	0	0	0
* Industrial	0	0	0	0	2	1.1	1	0.5
* Airport Oriented	0	0	0	0	0	0	0	0
* Extractive Industry	0	0	0	0	0	0	1	0.3
* Parks & Recreation	0	0	0	0	0	0	0	0
Potential Parks	0	0	0	0	1	0.2	0	0
Conservation & Open Space	8	4.3	8	5.3	1	0.2	0	0
Parkways	10	-	10	-	4	-	0	0
Highways	1	-	1	-	4	-	0	0
* Airports	0	0	0	0	0	0	0	0

NOTE: Lengths shown in table are in miles. Lengths shown for Transportation items indicate distances existing facilities are paralleled.

* Indicates features excluded from comparisons

EXHIBIT BH-10 Continued

	NORTH PARALLEL LINE		SOUTH PARALLEL LINE		MT. STORM-MSVL.		APS LOOP INTER-CON.	
	No.	Length	No.	Length	No.	Length	No.	Length
NATURAL FEATURES								
Steep Hills	13	15.7	12	15.2	13	16.1	0	0
Steep River Slopes	15	2.9	16	2.6	17	1.9	23	3.1
Rolling Hills	11	10.7	11	10.3	10	10.1	0	0
Gorges	1	0.6	1	0.8	1	1.0	0	0
Ridge Lines	9	-	9	-	8	-	0	0
* Summit Points	0	0	0	0	0	0	0	0
Forested Land	-	61.4	-	55.3	-	70.5	-	10.0
* Lakes	0	0	0	0	0	0	0	0
* Proposed Reservoirs	0	0	0	0	0	0	0	0
Potential Reservoirs	1	0.5	1	0.5	0	0	0	0
Rivers	3	0.6	3	0.6	1	0.2	0	0
Primary Streams	8	0.3	8	0.3	4	0.2	1	0.1
Secondary Streams	49	-	49	-	46	-	12	-
* Marshes & Wetlands	0	0	0	0	0	0	0	0
Sensitive Ecological Areas	33	5.8	44	9.4	24	3.6	15	1.7
SCENIC FEATURES								
Critical Environmental Areas	3	12.4	3	12.4	5	10.7	0	0
Scenic Rivers	3	-	3	-	1	-	0	0
Scenic Roads	0	0	0	0	1	-	0	0
* Scenic Areas	0	0	0	0	0	0	0	0
Gorges	0	0	1	0.3	1	1.2	0	0
VISUAL EXPOSURE								
Scenic Highways	0	0	0	0	1	1.9	0	0
Major Highways	9	13.5	9	13.5	6	7.8	4	13.3
Minor Highways	3	5.5	3	5.5	3	3.9	0	0
Scenic Rivers	2	1.8	1	2.0	3	2.9	0	0
Major Waterbodies	11	10.8	9	11.2	1	1.1	0	0
Steep Hill Zones	11	4.6	10	4.2	16	5.9	0	0
ZONING								
Medium & high density residential	4	4.8	5	5.9	7	8.0	3	1.5
Low density residential	7	26.6	7	26.6	2	0.3	0	0
Rural density residential	6	41.6	6	40.5	5	47.3	5	24.8
Conservation & Open Space	5	2.9	5	3.9	1	4.5	0	0
Commercial	0	0	0	0	0	0	1	0.2
* Institutional	0	0	0	0	0	0	0	0
Parks & Recreation	3	2.6	3	2.6	0	0	0	0
* Industrial	0	0	1	0.2	1	0.4	2	0.9
* Extractive Industry	1	0.5	0	0	0	0	0	0
* Airports	0	0	0	0	0	0	0	0

Ex BH-11

~~EXHIBIT BH-11~~

SUMMARY OF ENVIRONMENTAL IMPACTS

Line	Approximate Total Line Lengths in Miles	Number of Points of Impact	Total Length in Miles of all Impacts
North Parallel Alignment	130	297	269.5
South Parallel Alignment	130	313	275.4
Mt. Storm-Morrisville	111	206	229.1
APS Loop Interconnection	28	89	63.9
North Parallel plus APS Loop	158	386	333.4
South Parallel plus APS Loop	158	402	339.3

Ex BH-12

~~EXHIBIT BH-12~~

ADJUSTED IMPACT LENGTHS*

	Coefficient	North Parallel Line	South Parallel Line	Mt. Storm-Morrisville
EXISTING LAND USE				
Urban	1	0.1	0.2	0
Developed Clusters	1	1.1	2.7	0.7
Institutional	1	0.1	-	0
Parks, Recreation & National Forests	0.67	1.7	3.4	0.2
Orchards	0.67	1.5	1.6	0.1
PROPOSED LAND USE				
High & medium density residential	0.67	7.3	7.3	7.6
Low density residential	0.33	2.5	2.4	1.2
Rural density residential	0.33	8.6	8.6	19.7
Potential Parks	0.50	-	-	0.1
Conservation & Open Space	0.50	2.2	2.7	0.2
NATURAL FEATURES				
Steep Hills	0.67	10.5	10.2	16.1
Steep River Slopes	0.67	4.4	4.2	1.3
Rolling Hills	0.67	7.1	6.9	10.1
Gorges	0.67	0.4	0.5	1.0
Forested Land	1	71.4	65.3	70.5
Potential Reservoirs	0.33	0.2	0.2	0
Rivers	0.50	0.3	0.3	0.2
Primary Streams	0.50	0.2	0.2	0.2
Sensitive Ecological Areas	1	7.5	11.1	3.6
SCENIC FEATURES				
Critical Environmental Areas	0.67	8.3	8.3	10.7
Scenic Rivers	0.67	-	-	-
Scenic Roads	0.67	-	-	-
Gorges	0.67	-	0.2	1.2
VISUAL EXPOSURE				
Scenic Highways	0.67	-	-	1.9
Major Highways	0.50	15.0	15.0	6.4
Minor Highways	0.33	1.8	1.8	3.9
Scenic Rivers	0.67	1.2	1.3	2.9
Major Waterbodies	0.50	5.4	5.6	1.1
Steep Hill Zones	0.67	3.1	2.8	5.9

* Adjusted lengths include APS loop. Coefficients have been applied to the parallel of the Mt. Storm-Loudoun line, the parallel link of the loop, and to the 11.4 mile section of the Mt. Storm-Morrisville alignment which parallels an existing transmission line north of Front Royal.

	Coefficient	North Parallel Line	South Parallel Line	Mt. Storm-Morrisville
ZONING				
Medium & high density residential	0.67	4.2	5.0	8.0
Low density residential	0.33	8.8	8.8	0.3
Rural density residential	0.33	31.2	30.9	42.0
Conservation & Open Space	0.50	1.5	2.0	4.5
Commercial	0.33	0.1	0.1	0
Parks & Recreation	0.50	1.3	1.3	0

Ex BH-13

~~EXHIBIT BH-13~~

TRANSMISSION LINE SITING CRITERIA

AVOID	MINIMIZE IMPACT OR CROSSINGS OF	DESIRED LOCATION
TRANSPORTATION		
	Major Highways	Railroads Pipelines Existing Transmission Lines
EXISTING LAND USE		
Urban Developed Clusters Parks, Recreation & National Forest State Historic Sites Proposed Nat. Historic Sites National Historic Sites Communications Zones Airfields Structures Radio Towers	Commercial Institutional Trails Orchards	Industrial Extractive Industry Wildlife Management Areas
PROPOSED LAND USE		
High & Med. Den. Res. Parks & Recreation Potential Parks Airports	Low Density Residential Rural Density Residential Commercial Institutional Conservation and Open Space Parkways Highways	Industrial Airport Oriented Extrac. Industry
NATURAL FEATURES		
Gorges Summit Points Lakes Marshes & Wetlands Sensitive Ecological Areas	Steep Hills Steep River Slopes Rolling Hills Ridge Lines Forested Land Proposed Reservoirs Potential Reservoirs Rivers Primary Streams Secondary Streams	

AVOID	MINIMIZE IMPACT OR CROSSINGS OF	DESIRED LOCATION
SCENIC FEATURES		
Scenic Rivers Scenic Roads Scenic Areas Gorges	Critical Environmental Areas	
VISUAL EXPOSURE		
Scenic Highways Scenic River	Major Highways Minor Highways Major Waterbodies Steep Hill Zones	
ZONING		
High & Med. Den. Res. Parks and Recreation Airports	Low Density Residential Rural Density Residential Conservation & Open Space Commercial Institutional	Industrial Extractive Industry