

**PUBLIC SERVICE COMMISSION
OF WEST VIRGINIA
CHARLESTON**

CASE NO. 07-0508-E-CN

**TRANS-ALLEGHENY INTERSTATE
LINE COMPANY**

Application of Trans-Allegheny Interstate Line Company for a certificate of public convenience and necessity under W. Va. Code § 24-2-11a authorizing the construction and operation of the West Virginia segments of a 500kV electric transmission line and related facilities in Monongalia, Preston, Tucker, Grant, Hardy, and Hampshire Counties, and for related relief

DIRECT AND REBUTTAL TESTIMONY OF DUANE G. NICHOLS

Q. PLEASE STATE YOUR NAME AND ADDRESS.

A. My name is Duane G. Nichols. My address is 330 Dream Catcher Circle, Morgantown, WV 26508.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. I received my Bachelor's Degree in chemical engineering in 1959 from West Virginia University. My Master's and Ph.D. degrees in chemical engineering were earned at the University of Delaware in 1963 and 1968. I served as Head of the Physics Department at Delaware State College, Assistant Professor and Associate Professor of Chemical Engineering at West Virginia University, Head of the Fossil Energy Section at the Research Triangle Institute, Senior Research Engineer for the Conoco Coal Development Corporation, Group Leader for Special Projects for the and Group Leader for Systems Analysis of CONSOL R & D.

Q. PLEASE DESCRIBE YOUR EXPERIENCE IN THE METHODS AND APPLICATIONS OF ELECTRICITY, MAGNETISM, AND THEIR APPLICATIONS.

A. I completed course work in general physics and theoretical physics as well as the course entitled “Introduction to Electrical Engineering. I taught the course “Electricity and magnetism” as well as other courses in physics and engineering including “System Optimization”. I complete the course in “Process Analysis and Control” as taught by practicing engineers. Also, my work on the Clean Coal Technology Development at the Milliken Station of NYSEG in New York State involved actual field experiences in the electric power industry, including automatic data acquisition, monitoring and control. I testified before this West Virginia Public Service Commission regarding the 500 kV transmission lines proposed for the Longview power plant, particularly regarding the “congestion” problems that this proposed new plant would create on the existing grid system.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. I am testifying in this Case at the request of the WV Chapter of the Sierra Club, to bring my background knowledge and experiences into consideration. I testified regarding the proposed TrAIL line at public hearings in both Greensboro, Pennsylvania and Morgantown, WV on behalf of the MonValley Clean Air Coalition.

Q. HAVE YOU REVIEWED TRAILCO’S APPLICATION FOR A CERTIFICATE OF CONVENIENCE AND NECESSITY AND ITS SUPPORTING DOCUMENTS?

A. Yes. In addition, I have reviewed various discovery responses and other documents from TrAILCo, Allegheny Energy, PJM organization, and other related materials.

Q. WHAT OTHER RESOURCES DID YOU UTILIZE IN YOUR EVALUATION?

A. I have provided a RESUME of my professional background and experience. And, the sources of my testimony have been included in the text of this TESTIMONY for ready reference. The relevant EXHIBITS are appended or attached.

Q. HAVE YOU READ THE TESTIMONY OF DR. BAILEY AND OTHERS RELATIVE TO THE POTENTIAL HEALTH EFFECTS FROM HIGH VOLTAGE ELECTRIC TRANSMISSION LINES, AND WHAT ARE YOUR COMMENTS ON THESE ISSUES?

A. I have read the pre-filed testimony on health-effects from the perspective of my own association with health-effects research at the Research Triangle Institute. First, it must be concluded that there is no conclusion that health-effects are absent. One can conclude that there may well be health-effects that are difficult to detect and subtle in their impacts. Since there is no threshold below which influences of electro-magnetic fields are active, it is clear that human beings

living near high-voltage transmission lines will be affected even if modern instrumentation cannot measure actual damages.

Human brain function, spinal cord function, and whole body function of the nervous system will experience small, if imperceptible, interactions with electromagnetic fields that pervade the locality. Thought patterns, memory functions, muscular reflexes, and/or other bodily functions can experience incremental changes. Whether these changes could be documented or whether such changes could be cumulative are not now known. Until and unless research findings are to the contrary, a vigilance for the protection of the public interest is called for.

Q. DO YOU HAVE COMMENTS ON THE QUESTION OF “CONGESTION” ON THE EXISTING POWER LINES?

A. Yes. “Congestion” can be relieved immediately by instituting an active program of energy conservation and energy efficiency improvement in this region. This will not be as profitable to TrAILCo as the proposed TrAIL line. Secondly, “congestion” can be controlled by planning an electrical system based upon many different forms and locations of power generation, called “distributed power generation”, from both conventional and alternative power sources.

Q. WHAT IS THE ESSESTIAL NATURE OF THE RELIABILITY OF THE EXISTING TRANSMISSION LINES?

A. Let me briefly discuss the reliability of high voltage power transmission lines. The long distance transmission of electricity by electrical wires is not reliable compared with local generation and local distribution of power. The long distance lines are at risk from a wide variety of causes; and, when they do fail it is a major outage affecting many States and millions of electricity users.

As a society, we must work toward a sustainable future for power generation that involves alternative energy forms as well as distributed power from as many different locations as is feasible. The TrAIL transmission line proposal does not meet these criteria, and was not designed to help achieve this essential future scenario.

Q. IS THE STUDY OF THE SECURITY OF LARGE SCALE TRANSMISSION ACTIVE IN THE UNITED STATES, PROVIDING FOCUS ON THE MANY PROBLEMS INVOLVED AND THEIR DETAILED ANALSYIS?

A. Yes. Important work is on-going at West Virginia University in Morgantown. This work has a primary focus on advanced control systems to achieve continuous operation of a complex system. Also, the Center for the Security of Large Scale Systems (CSLSS) at Purdue University was established in 2004 to support fundamental and applied research focused on the assessment of the security of large-scale systems and the development of new devices and control/ operating methodologies for security enhancement. The first-year funding of \$1M, was used

to support ten projects involving twenty professors from six schools at Purdue University.

A key tool utilized by the center is a new method of Distributed Heterogeneous Simulation that enables us to connect together subsystem models to form end-to-end representations of very large-scale systems and study the interconnected dynamics. As part of the center-funded research, Distributed Heterogeneous Simulation is being used to develop detailed system-level simulations of the Indiana/Ohio Electric Grid. There is no indication that this level of study has been applied here in West Virginia, although such is essential if new lines are to be justified.

<http://center.e-enterprise.purdue.edu/wps/portal/.cmd/cs/.ce/155/.s/4913>

Q. IS A SMART GRID SYSTEM THAT INCLUDES A SUPERVISORY DIGITAL CONTROL SYSTEM(S) ESSENTIAL TO THE FUTURE OF ELECTRICITY TRANSMISSION IN THE UNITED STATES?

Yes, a “smart power grid” will be able to automatically respond to occurrences on the overall generation and transmission system that would compromise the reliability of the electric power supply to near, intermediate and long-distance users. Bruce Wollenberg, Massoud Amin, and Phillip Schewe have developed and described an essential strategy for preventing serious reliability problems. This work derives from projects at the Electric Power Research Institute of Palo Alto, CA, an industry-funded research institution. This work is presented as EXHIBIT-DGN-1. (See Scientific American, Volume 296, No. 6, pp. 60 – 67, May 2007. See also IEEE Power and Energy Magazine, Volume 3, No. 5, pp. 34 – 41, Sept./Oct. 2005.) The essential points are as follows:

1. Transmission lines can and will become overloaded if measures are not taken to control and prevent serious reliability problems.
2. Even if more transmission lines are added, a self-healing smart grid that can sense local problems early, and automatically fix or isolate them before they cause serious problems, is needed to prevent the cascading power failures that cause blackouts.
3. Digital controllers and real-time communications devices must be placed on every interconnected transmission line, substation, power-plant and utility operations center.
4. Modern digital control systems that include high speed digital computers and system software for automatic adaptive control are needed, so that problems can be anticipated by the control system with the capacity to enable and perform corrective control actions.
5. Better trained human controllers are also needed to take over from the computer-based automatic control system, if a blackout does somehow begin.

Q. WHAT IS THE COST IMPACT ON ELECTRIC POWER GENERATION, IF THE INFLUENCE OF CARBON DIOXIDE IS CONSIDERED?

- A. The recent report entitled “The Carbon Calculus” of Matthew L. Wald as reported in the Business Section of the New York Times on November 7, 2007, provides the essential and important answers to this question. See EXHIBIT-DGN-2 and 2A. With conventional electric power at 5.7 cents per kilowatt-hour, the cost of electricity would grow to perhaps 6.4 cents at \$10 per metric ton of carbon dioxide produced and this would grow to 10 cents at \$50 per metric ton of carbon dioxide. In this scenario, the cost of conventional pulverized coal-fired electricity from base-load power-stations would rise first above that for natural gas fired electricity and then above the cost for wind-turbine generated electricity. Nuclear power will only be indirectly affected by the influence of carbon dioxide emission, so nuclear power is taken at 6.3 cents per kilowatt-hours, below the cost of coal-fired electricity at the generation site for either level of “carbon tax” considered.

Clearly, the “carbon tax” cost for the generation of electricity is unknown at this time. However, there indeed is a real cost that must be born by the electricity generation and transmission system, given the facts that (a) carbon dioxide is legally known as a pollutant, (b) carbon dioxide is scientifically known to be responsible for irreversible damages due to global climate change, and (c) the industrial sector needs to have the costs or charges for a “carbon tax” to be quantified so that rational planning for the future can take place.

In the fact of the current uncertainty world-wide, in the United States and in West Virginia, the requisite determinations of reliable values for a “carbon tax” have not yet been made. Hence, it is premature to regard future plans for electricity generation to be reliable. The proposed TrRAIL transmission line needs to be set aside until reliable plans are made at the State and federal level to take into account of the “environmental costs” for coal-fired power generation.

Q. WHAT CAN WE LEARN FROM AN UNDERSTANDING OF THE CARBON CYCLE TRANSITIONS OVER GEOLOGIC TIME?

- A. The Earth and the Sun have an essential relationship to each other. Sun light has been used by earth processes to capture carbon dioxide from the atmosphere and store it underground as coal, as petroleum, as natural gas and in some other forms. These are called fossil fuels because they can be rather easily burned, as we all know. But, what was don’t always appreciate is that over geological time, the atmospheric level of carbon dioxide became about 280 parts per million, until the industrial age initiated an unnatural progression up to almost 400 parts per million. This is unnatural because it cannot be readily reversed by natural processes, nor can it be reversed by mankind.

Q. HAVE PROPOSED NEW GENERATION STATIONS IN THE EASTERN UNITED STATES BEEN GIVEN FULL AND PROPER CONSIDERATION BY TRILCO IN THESE PROCEEDINGS?

A. No. The natural gas peaking plants being planned by CPV-Warren and CPV-St. Charles have not been taken into account. Other power-stations are also likely in the eastern United States. Consideration should be given to the three proposed nuclear units that are at various stages of being advanced through the permitting process. These are:

1. "UniStar Nuclear Energy Seeks Maryland Public Service Commission Approval for Nesw Nuclear Facility at Calvert Cliffs". This report from CNN Money.com on November 15, 2007 describes planning for a new (advanced-design) nuclear power plant at the Calvert Cliffs site of Constellation Energy in Southern Maryland. UniStar, a joint venture between Constellation and the EDF Group, has submitted an application to the Maryland Public Service Commission for a Certificate of Public Convenience and Necessity for the construction of this new nuclear power plant. See EXHIBIT-DGN-3.

<http://money.cnn.com/news/newsfeeds/articles/prnewswire/NETH10815112007-1.htm>

2. "NRC Approves Site Permit For New Dominion Nuclear Reactor (Virginia)". As reported by CNN Money.com, November 20, 2007, the U. S. Nuclear Regulatory Commission approved an early site permit for up to two new nuclear reactors for Dominion Resources at their North Anna plant in Virginia.

See EXHIBIT-DGN-4.

http://money.cnn.com/news/newsfeeds/articles/djf500/200711201200DOWJONESDIONLINE000505_FORTUNE5.htm

3. "More Cheers Than Protests In Area That Could Get 4th Nuke Reactor". This report, from the Associated Press on November 25, 2007, describes planning that is underway to add a 4th nuclear reactor unit to the Salem (New Jersey) facility of the Public Service Energy Group. See EXHIBIT-DGN-5.

www.newsday.com/news/local/wire/newjersey/ny-bc-nj--nuclearcommunity1125nov25,0,6408955.story?page=1

Q. DO YOU AGREE WITH AMY ABEL, SPECIALIST IN ENERGY POLICY FOR THE CONGRESSIONAL RESEARCH SERVICE, IN HER STATEMENT THAT "THE ELECTRIC UTILITY SYSTEM IS VULNERABLE TO OUTAGES CAUSED BY A RANGE OF ACTIVITIES, INCLUDING SYSTEM OPERATOR ERRORS, WEATHER-RELATED DAMAGE, AND TERRORIST

ATTACKS [Congressional Research Service Report for Congress, Order Code RS21958, Updated February 4, 2005]?

- A. Yes. This Specialist from the Resources, Science and Industry Division of the CRS reported to the U. S. Congress that “The main risk from weather-related damage or a terrorist attack against the electric power industry is a widespread outage that lasts for an extended period of time.” This could well be months rather than weeks or days. See EXHIBIT-DGN-6.

This Report states that “Of the transmission system’s physical infrastructure, high-voltage (HV) transformers are arguably the most critical component.” While such occurrences have been rare in the past, typically spare transformers of this type require months for their replacement. The Protective Security Division of the Department of Homeland Security has been working in this area although there has not been any planning to evaluate or enforce internal security programs relative to the critical assets of transmission owners, to my knowledge.

The Protective Security Division has also reported the importance of a grid monitoring capability, although no specific information was specified. Clearly, grid monitoring is consistent with the modern adaptive control concept for the electric transmission grid system that must be required by regulatory bodies if large, complex systems are to be constructed across many state boundaries. However, an interconnected transmission line system, that is “the grid”, is much more vulnerable than isolated individual lines even if a modern adaptive control system were in place.

- Q. HAVE YOU STUDIED THE CONGRESSIONAL TESTIMONY OF JOHN KAPPENMAN, MANAGER, APPLIED POWER SYSTEMS FOR THE METATECH CORPORATION, AS PRESENTED ON OCTOBER 30, 2003 BEFORE THE U. S. HOUSE OF REPRESENTATIVES COMMITTEE ON THE ENVIRONMENT?

- A. Yes, the testimony of John Kappenman was in response to the issue “What is Space Weather and who should forecast it?” See the Internet web site:

www.solarstorms.org/Spower.html

Space Weather refers to geomagnetic storms that are caused by the irregular behavior of the Sun. Tornados, hurricanes, lightning and other threats to long distance transmission lines derive for Earth-based phenomena.

According to Mr. Kappenman, “Space Weather differs from ordinary weather in that it has a big footprint and attacks the system across many points simultaneously, causing (at times of severe events) multi-point failures on the network that can threaten the integrity of the network. Therefore, geomagnetic

storms may be one of the most important hazards and is certainly the least understood threat that could be posed to the reliable operation of these networks.”

Quoting Mr. Kappenman further, “There were several noteworthy cases of transformer internal heating associated with the March 12, 1989 storm in the U. S. mid-Atlantic Region. In one case at the Salem nuclear plant in New Jersey, the internal heating was so severe that complete failure of the transformer resulted.” The 500 kV transformer had to be replaced. Such transformers are typically of custom design, and replacement can take a number of months. The foot-print for geomagnetic storms is quite large and such storms can threaten an entire multi-state area in their effects.

Q. DO ICE AND FREEZING RAIN POSE RISKS AND PROBLEMS FOR LONG DISTANCE TRANSMISSION LINES?

A. Yes. This is true in Canada where considerable research has gone into evaluating this problem and predicting extreme loads on power lines from freezing rainstorms. Some 96,000 customers were without power from the 1996 outage in the Portsmouth -- Norfolk area of Virginia. [Power Company Battles Worst Enemy: Freezing Rain, The Virginian-Pilot, February 3, 1996.]
<http://scholar.lib.vt.edu/VA-news/VA-Pilot/issues/1996/vp960203/02030328.htm>.

Twenty miles of 345 kV transmission line was rebuilt in five month in Poweskiek County in Iowa as a result of the February 2007 storm affecting Interstate Power and Light Company’s line. More than 2,200 IPL employees, mutual assistance and contract workers from utilities across the country were deployed to assist in the restoration of the transmission and distribution infrastructure damages resulting from this storm. [“Interstate Power Successfully Completes Rebuild of 345 kV Transmission Line –Transmission line destroyed during February 2007 storms, rebuild completed in less than five months.”]
www.alliantenergy.com/docs/groups/public/documents/pub/p016069.hcsp

The mountains between central West Virginia and the eastern counties of WV and Virginia are quite steep and high. Here it is well known that freezing rain and ice frequently form adding significant weight to trees and other structures. Breakage and damage are common, as I have observed during my frequent driving trips through this mountainous region. These mountains must be crossed by the proposed transmission line, which will be vulnerable as are the trees and other exposed structures.

Q. DO HIGH VOLTAGE POWER LINES AFFECT RESIDENTIAL PROPERTY VALUES?

