

**REBUTTAL TESTIMONY
OF
EDWARD V. BADOLATO
ON BEHALF OF
VIRGINIA ELECTRIC AND POWER COMPANY
BEFORE THE
STATE CORPORATION COMMISSION OF VIRGINIA
CASE NO. PUE-2007-00031**

1 **Q. Please state your name, position, place of employment and business address.**

2 A. My name is Edward V. Badolato. I am the President and CEO of Integrated
3 Infrastructure Analytics, Inc. My business address is 1625 K Street, N.W., Suite 850,
4 Washington, D.C. 20006.

5 **Q. Have you previously filed testimony in this proceeding?**

6 A. Yes. I have filed direct testimony on behalf of Virginia Electric and Power Company
7 (“Dominion Virginia Power” or “the Company”).

8 **Q. Please describe the purpose of your rebuttal testimony.**

9 A. This rebuttal testimony addresses various assertions made by Piedmont Environmental
10 Council (“PEC”) witness, Benjamin K. Sovacool, before the State Corporation
11 Commission of Virginia (“SCC”) concerning the national security implications of
12 Dominion Virginia Power's project, a 500 kilovolt (kV) transmission line from the
13 Meadow Brook Substation to Loudoun Substation (“the Project”) in Northern Virginia.

14 **Q. Will the use of various terms in your rebuttal testimony be consistent with**
15 **definitions assigned to those terms used in your direct testimony?**

16 A. Yes. In addition, I may define additional terms in my rebuttal testimony.

1 Q. **Have you reviewed the testimony of Benjamin K. Sovacool on behalf of the PEC in**
2 **this case?**

3 A. Yes, I have.

4 Q. **According to PEC witness Sovacool's own statement at page 1, he was asked to**
5 **"address the Direct Testimony of Applicants' witness Col. Edward V. Badolato."**
6 **Mr. Badolato, what was the purpose of your previously submitted direct testimony?**

7 A. I was asked to discuss the importance of having and maintaining electric power reliability
8 in the northern Virginia, Washington, D.C. and suburban Maryland region from a
9 national security perspective.

10 Q. **Based on your analysis of PEC witness Sovacool's testimony do you believe he has**
11 **addressed the national security implications of having a reliable source of electric**
12 **power for the National Capital Region ("NCR")?**

13 A. Dr. Sovacool, indeed, has agreed that energy security is a critical part of our nation's
14 infrastructure and is therefore, key to our country's national security. And, he recognizes
15 that power losses in the National Capital Region could have a profound impact on our
16 national security operations as well as other, related critical infrastructures. However, he
17 has arrived at different conclusions regarding the need for the Project.

18 Q. **Would you please explain what you mean by this?**

19 A. Instead of focusing on the unique nature, national security significance, and power
20 requirements of the high concentration of national security facilities and related support
21 businesses and industry, along with the corresponding number of high ranking
22 government officials and staff, military and civilian personnel, and private sector
23 employees, all that would benefit from the Project, Dr. Sovacool has turned his attention
24 to responding to the technical nature of building the high voltage power line. He
25 contends that the Project would not enhance electric power reliability because it fails to

1 provide the reactive power necessary to promote grid stability, thereby jeopardizing the
2 electric power transmission to the NCR which could lead to voltage collapse and power
3 outages. Many examples of writings supporting this theory were included with his
4 testimony. Further, he states that broader considerations of electric power reliability and
5 energy security were not taken into account in planning the Project. These include
6 diversification alternatives and resilience, insulation and environmental issues. The
7 above points are carried as a theme throughout his entire testimony.

8 **Q. It seems PEC witness Sovacool's contention that the construction of the Project**
9 **would not help promote energy security in the National Capital Region. Do you**
10 **concur with his assessment?**

11 A. No, I do not. Several of the Company's expert witnesses have responded to Dr.
12 Sovacool's statements, exhibits and references to studies regarding power system
13 reliability. I would refer you to the rebuttal testimony of Mr. Jeffrey Palermo of KEMA,
14 who has found errors and misstatements in PEC witness Sovacool's justifications for
15 using the need for reactive power as the basis for comments in his testimony. Mr.
16 Palermo corrects several key factual errors found in Dr. Sovacool's argument.

17 Further, there are references throughout much of the rebuttal testimony of James R.
18 Bailey regarding Dr. Sovacool's ruminations about load growth and distributed
19 generation alternatives, particularly as mentioned in the direct testimony of Dr. Hyde P.
20 Merrill. Mr. James R. Bailey, and other rebuttal witnesses, discuss at length, and both
21 clarify and correct the points asserted by Dr. Merrill (and which have been incorporated
22 by reference into Dr. Sovacool's own direct testimony).

1 **Q. Does Dr. Sovacool believe that the Project will satisfy reliability and security**
2 **standards in accordance with government definitions and current regulations?**

3 A. No, he does not. I am very familiar with both documents and authors he used to make his
4 case on this point. One particular study to which he refers, "Brittle Power: Energy
5 Strategy for National Security," was researched and written nearly 30 years ago. Today's
6 regulations and standards have been upgraded to meet modern need and elevated security
7 concerns. As spelled out in detail in the rebuttal testimony of James R. Bailey, among
8 others, based on data and modeling assumptions used by the Company and as reviewed in
9 the Report and Supplemental Report of Staff witness Bates White, LLC, the Project
10 would fully resolve any anticipated reliability violation in 2011.

11 **Q. Do you acknowledge any risks inherent in transmission lines such as the Project?**

12 A. Dr. Sovacool has referred to an answer I gave in response to Piedmont Environmental
13 Council's Eighth Set of Interrogatories ("PEC Set 8"), Question 237, where I was making
14 a point about how critical it is to have a reliable source of electric power "24/7," such as
15 would come from the Project, for many of our national security operations. He has made
16 a false assumption that by making the statement "in a matter of milliseconds, excessive
17 current can damage critical infrastructure which must be replaced or repaired at
18 significant cost, often with corresponding service outage," I am "acknowledging a risk
19 inherent in centralized generation systems dependent on long-distance transmission."
20 This excerpt from my response was a reference to a briefing of an Arizona Public Service
21 and Salt River Project that talked about a scenario in a report on the Computer Business
22 Equipment Manufacturers Association ("CBEMA") Curve which covered statistics on
23 responses to problems with operating grids. Dr. Sovacool's implication was made in

1 error as the quote was taken out of context and the facts I stated were taken from a
2 reliable source. In that same response, I had also added, "Most electronic systems have
3 some amount of capacitance built into the system to enable a ride-through of critical
4 voltage disturbances, but longer duration milliseconds voltage sags can seriously impact
5 the end-user systems, both operationally and economically." (Source: Information
6 Technology Industry Council CBEMA CURVE APPLICATION NOTE published by
7 Technical Committee 3 available at <http://www.itic.org/technical/iticurv.pdf>) Further, in
8 my direct testimony, relating to this, I was making the point that effective national
9 security activities and operations, including related support facilities and industry within
10 the NCR are almost totally dependent upon electric power systems such as that provided
11 by the Company and the Project. The reliability of that source of power is critical.

12 **Q. Are the assumptions made by PEC witness Sovacool regarding a paper on electric**
13 **power accurate? If not, please explain.**

14 A. Referring to a paper I drafted in April, 2001, entitled "Meeting the Challenge of the
15 Digital Age: Electric Power Shortfalls and New High Tech Solutions," Dr. Sovacool at
16 page 21 states that I recognize the vulnerability of transmission systems like that of the
17 Project. Because I have served in the government and am also currently involved in
18 many government and industry energy-related activities and working groups, I can state
19 with some authority that the government is working closely with industry to alleviate
20 shortfalls by a number of means. Through legislation, like the recently passed Energy
21 Bill, Presidential Directives and Executive Orders and other mandates, the United States
22 is taking steps to promote energy security in the country by building a more robust
23 energy infrastructure and advancing technological solutions. The paper to which Dr.

1 Sovacool refers specifically addresses a method of responding to a catastrophic
2 emergency situation, such as Hurricane Katrina, by the use of a high-powered system,
3 operated by a large capacity battery system that is able to maintain high quality reliable
4 power in the case of outages or fluctuations in power sources. These are backup systems
5 that would be used on a temporary basis until the restoration of all power was completed.

6 **Q. PEC witness Sovacool seems to feel that there are no technologies in place to lessen**
7 **the vulnerabilities of long distance transmission. Mr. Badolato, are you familiar**
8 **with facility, operational or security technologies used to safeguard such lines?**

9 A. I disagree with Dr. Sovacool on his point that modern trends have increased
10 vulnerabilities in high voltage transmission line systems. He blames reliance on
11 automation and cost-cutting measures by utility companies and excerpts a quote, taken
12 out of context, from the National Research Council's report, "Making the Nation Safer:
13 The Role of Science and Technology in Countering Terrorism." I served on the
14 Committee on Science and Technology for Countering Terrorism that researched and
15 published this report. National security and utility planners in the NCR understand that
16 electricity must be produced and delivered through highly complex technological
17 systems, at the instant of demand and cannot be easily stored. The electric power
18 industry has made investment in its facilities, has the technical knowledge and skills, and
19 has a proven record of providing reliable service to all of its customers, on demand.
20 Industry has met the reliability challenge under historic conditions of stress.

21 The electric systems are constructed and operated to withstand the stresses imposed upon
22 them by malevolent acts, nature, and by equipment failure. The utilities are prepared for
23 such emergencies and often pool their resources to aid each other in restoring service.

1 Major electric systems rely heavily on their primary system control centers where highly
2 trained dispatchers and operations engineers operate the system to satisfy the varying
3 needs of both the system and the load. Supervisory Control and Data Acquisition
4 systems with computers, telemetry, radio and dedicated telephone lines continually
5 monitor system elements and transmit information to the control center. Immediate
6 action, either by computer or manually, is taken to protect the system and serve load
7 demands. When routine faults occur, the system is designed to take certain remedial
8 measures instantly close to the point of fault and automatically report these conditions to
9 the control staff. Electric utility systems have an outstanding record of reliability due to
10 their maintenance policies and ability to restore or bypass most outages quickly.

11 Surveillance technologies developed for defense and intelligence purposes have also
12 brought new capabilities to further safeguard our nation's electric power systems.

13 Examples of new technologies include smart sensor cables and other intrusion detection
14 systems, satellite surveillance and other security equipment not normally employed prior
15 to September 2001.

16 **Q. Are the concerns expressed by Dr. Sovacool and others at public hearings that high-**
17 **voltage transmission lines are very vulnerable to sabotage warranted?**

18 A. Everyone is very aware of the United States government's elevated threat alert, especially
19 in the vicinity of the nation's capital. However, the vast majority of the cases of sabotage
20 of power transmission lines and facilities Dr. Sovacool cites, many of which are isolated,
21 politically or environmentally motivated, or are in foreign countries, including Iraq,
22 happened in areas that do not have the safety and security mechanisms, policies and
23 procedures that we have instituted here in the United States. He goes on to reiterate and

1 give further examples of the same alternatives that he believes are solutions such as
2 renewable and distributed power generation, all of which have been more than fully
3 addressed by the Company's expert witnesses in their respective rebuttal testimonies.

4 **Q. As an expert in this field, Mr. Badolato, do you feel the Company, TrRAILCo and**
5 **PJM are doing enough to ensure the future security of the 502 Junction Loudoun**
6 **Line? Will it still be vulnerable to sabotage?**

7 A. The Energy Policy Act of 2005 directed the Secretary of Energy to conduct a nationwide
8 study of electric transmission congestion. The Department of Energy published its first
9 National Electric Transmission Congestion Study in August 2006. Based on this
10 congestion study and other considerations such as economics, reliability, fuel diversity,
11 national energy policy and national security, the Secretary designated geographic areas
12 experiencing electric energy transmission capacity constraints or congestion that
13 adversely affect customers as national interest electric transmission corridors ("NIETC").
14 Further, he went on to classify the Atlantic coastal area from metropolitan New York
15 southward through Maryland, Washington D.C. and Northern Virginia as one of the
16 nation's two most critically congested based on vital economic, dense population and in
17 the case of the National Capital Region, national security concerns, all of which I
18 discussed in detail in my previous direct testimony. This designation certainly increases
19 the visibility of the NCR, which is already a highly publicized area that has some
20 vulnerability to terrorist attack. It is for these reasons that the Washington Metropolitan
21 Area is one of the most protected regions in the country. The very nature of having a
22 concentration of national security-related agencies and facilities only serves to enhance
23 security on the local, state and federal levels.

1 Particularly since September 2001, the United States government has made a concerted
2 effort to more effectively address the issue of critical infrastructure, which includes
3 electric power, in national planning scenarios, Department of Homeland Security
4 advisories like “The National Strategy for Physical Protection of Critical Infrastructures”
5 and training documents, White House Presidential Directives and Executive Orders and
6 numerous others, as itemized in my response to PEC Set 8, Question 232. I personally
7 have addressed these issues by authoring articles and presentations and participating in
8 government sponsored and private sector group studies, as seen in my response to PEC
9 Set 8, Question 235. Dr. Sovacool refers to the same United States Department of
10 Homeland Security Homeland Security Advisory Council directive as I have in previous
11 statements. The Council established the Critical Infrastructure Task Force. Collectively,
12 this is one of the most senior working groups in the government that works directly with
13 the electric power industry in an effort to integrate national security into electrical system
14 reliability. Government and industry are looking at ways to integrate cost-effective
15 security measures into cooperative operations that would strengthen bulk power supply
16 systems, particularly those which serve key national defense or infrastructure assets. An
17 objective is to develop plans designed to ensure key asset protection and continued
18 functioning. A new dimension of national security reliability is being used in the
19 planning for overall electric power reliability. New protocols are being developed and
20 adopted to provide preparedness and mitigation measures designed to meet the current
21 terrorist threat. The electric power industry is qualified and staffed to address these
22 issues that serve the broader national security requirements identified by those in
23 government charged with national security preparedness.

1 To reinforce my point, I would like to refer to the rebuttal testimony of Mr. Steven R.
2 Herling. As a response to public concerns regarding possible terrorist attack on the
3 Project, he talks about the seriousness with which PJM takes its role in the area of
4 security. He goes on to say that PJM participates in a cooperative and also advisory
5 capacity with ongoing work, training sessions and safety and cyber-security exercises
6 with the government offices of homeland security in charge of the safety and protection
7 of our country's electric transmission grids. PJM is a member of the Critical
8 Infrastructure Protection Committee formed within the North American Electric
9 Reliability Corporation ("NERC") and therefore, works closely with industry and
10 government experts at the highest levels to protect and secure electric power
11 transmission.

12 Most recently, I served as a member of the Committee for the National Research
13 Council's three-year study on "Enhancing the Robustness and Reliance of Electrical
14 Transmission and Distribution in the United States to Terrorist Attack." The draft study
15 will be published this spring. But I can state with certainty that this study provides
16 measures that could make the power delivery system less vulnerable to attacks, restore
17 power faster after an attack, and make critical services less vulnerable while the delivery
18 of conventional electric power has been disrupted. The study describes in detail the
19 structure and operation of the transmission and distribution system, its current status, and
20 the vulnerabilities that it faces. Because electric power transmission and distribution
21 systems are spread across various regions, often in remote locations, they are vulnerable
22 to attack and natural disasters that could adversely affect our national security. This
23 vulnerability is exacerbated by years of underinvestment and the fact that these systems

1 are already under stress and facing growing demands for increased power transmission.
2 The NRC study addresses specific research and funding needs to alleviate these
3 problems, as well as recommended tasks for energy-related industry and government
4 organizations.

5 **Q. Does that conclude your rebuttal testimony?**

6 **A. Yes, it does.**