AEP OHIO EX. NO._____

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application Seeking Approval of Ohio Power Company's Proposal to Enter into an Affiliate Power Purchase Agreement for Inclusion in the Power Purchase Agreement Rider	)	Case No. 14-1693-EL-RDR
In the Matter of the Application of Ohio Power Company for Approval of Certain Accounting Authority	)	Case No. 14-1694-EL-AAM

DIRECT TESTIMONY OF ROBERT W. BRADISH IN SUPPORT OF AEP OHIO'S AMENDED APPLICATION

Filed: May 15, 2015

INDEX TO DIRECT TESTIMONY OF

ROBERT W. BRADISH

TESTIMONY INDEX

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO
DIRECT TESTIMONY OF
ROBERT W. BRADISH
ON BEHALF OF
OHIO POWER COMPANY

I. PERSONAL DATA

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Robert W. Bradish. I am employed by American Electric Power Service Corporation (AEPSC), one of several subsidiaries of American Electric Power Company, Inc. (AEP). I am currently Vice President - Grid Development for AEPSC. My business address is 700 Morrison Road, Gahanna, Ohio 43230-6642.

Q. PLEASE BRIEFLY DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND?

A. I received a Bachelor of Science – Electrical Engineering degree in May 1985, and a Master of Science – Electrical Engineering degree in December 1986, both from Clarkson University. I also received a Master of Business Administration degree from The Ohio State University in May 2001. I was employed by AEPSC in 1987 as an assistant engineer and progressed through several engineering grades to the senior engineer level. In 2001, I was promoted to Manager – Power and Transmission Market Analysis. In 2002, I became Director of the same group. In 2003, I was promoted to Vice President – Transmission and Market Analysis. From 2005 to 2010, I was Vice President – Market Operations in AEPSC's Commercial Operations group. In May 2010, I assumed the position of Managing Director, Transmission Planning and Business

Development, where I was responsible for transmission planning and the origination, evaluation, and execution of strategic transmission investment opportunities in support of AEP's transmission business strategy. In January 2012, I assumed my current position. I am also president of Pioneer Transmission, LLC.

Q. WHAT ARE YOUR PRIMARY AREAS OF RESPONSIBILITY?

A. As Vice President - Grid Development, I am responsible for AEP transmission system planning and operations, which includes organizing and managing all activities related to: 1) assessing the adequacy of AEP's transmission network to meet the needs of its customers in a reliable, cost effective and environmentally compatible manner; 2) the real-time operation of AEP's transmission assets in compliance with all applicable safety and reliability standards, contractual and tariff obligations and all federal, state and local regulations and laws; and 3) advanced technical/analytical studies in support of planning, engineering, design and operation of the AEP transmission system. I am also responsible for managing/coordinating AEP's Transmission Technology/Research and Development Program.

Q. HAVE YOU PREVIOUSLY SUBMITTED TESTIMONY IN ANY REGULATORY PROCEEDINGS?

A. Yes, I have testified before the Arkansas, Indiana, Michigan, Oklahoma and Virginia regulatory commissions.

II. PURPOSE OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to describe the results of a transmission planning impact study, which estimates the required transmission upgrades and related costs that would be

necessary if certain generating units (PPA Units) owned by AEP Generation Resources (AEPGR) are retired. I will also describe how this study is related to the Purchase Power Agreement (Affiliated PPA) and its relevance to AEP Ohio customers.

III. GENERATION UNIT RETIREMENTS IMPACT ON AEP OHIO TRANSMISSION

Q. HOW DOES THE RETIREMENT OF GENERATING UNITS IMPACT THE TRANSMISSION SYSTEM?

A. The retirement of large, baseload generating resources can significantly change the magnitude and direction of power flows on the transmission system. The major impacts from the retirement of the PPA Units include transmission constraints; loss of spinning reserves; and loss of reactive power to provide voltage support to the transmission grid.

Specifically, areas that have been historically net exporters of power may now be forced to import power from other areas of the system. These changes in power flows can result in constraints.

Additionally, these units provide grid support in the form of spinning reserves and reactive power. The momentum created by the spinning generating units creates resistance to sudden changes caused by system disturbances. The spinning units can quickly react to adjust system voltage, frequency and power factor, which are also ancillary services provided by the generating units to PJM to support system reliability.

The transmission grid requires reactive power sources to maintain voltage levels and stability. Since baseload coal generation serves as the primary source of reactive power today, the loss of the PPA Units will also require replacement sources of reactive power. The coal-fired PPA Units can store a substantial amount of fuel on site, which helps maintain transmission grid reliability during adverse weather conditions, such as

the Polar Vortex experienced in PJM in January of 2014 and similar frigid temperatures that occurred in early 2015.

Q. DOES THE GEOGRAPHIC LOCATION OF A PLANT IMPACT RELIABILITY AND WHY?

A. Yes. The geographic location of a plant determines how power flows across the system from generation to load. When a plant is removed from the system, the specific location that was historically an exporter of power now must import power from other parts of the system to maintain the balance of supply and demand. Additionally, the reactive power the generator supplied that supports voltage is no longer available, leading to voltage stability concerns. The abrupt change brought on by retiring major baseload generating plants can cause serious swings in power flows and reactive power deficiencies that must be mitigated.

Central Ohio is particularly sensitive to this imbalance, as most generation in Ohio is located along Lake Erie or the Ohio River. A major exception is Conesville, which was designed to supply power to much of Central Ohio including Columbus. The retirement of Conesville would eliminate the last remaining major baseload generating plant in Central Ohio, leaving a major population susceptible to reliability risks.

Q. DO THE PPA UNITS HAVE ANY USE IN MAINTAINING RELIABILITY?

A. Yes. These plants provide necessary services, such as dynamic voltage and frequency regulation, which are essential to the transmission system's functionality. While the transmission upgrades would mitigate identified NERC reliability standard violations, they would not necessarily cover all potential scenarios where the plants may be required to maintain system stability. As more renewable and resources are added to the grid, the

ability of plants to re-dispatch in real-time is key to maintaining reliability while allowing these variable resources to operate. The fewer options available, the more the grid is susceptible to swings in power flows, voltage, and frequency that can lead to system instability.

Q. WOULD THE PJM PROCESS FOR EVALUATING GENERATOR DEACTIVATIONS PREVENT RELIABILITY ISSUES?

A. No, the PJM process does not prevent reliability issues, but provides a mechanism for evaluating the impacts, determining what reliability issues are anticipated, and assessing what transmission upgrades are required as mitigation. While the PJM process does allow for generator owners to enter into a Reliability Must Run (RMR) contract to mitigate short-term reliability issues, this contract is only necessary when mitigation cannot be completed by the date the unit is scheduled to retire. In other words, an RMR designation demonstrates the significant role a generator plays in maintaining reliability and only reinforces the need for the transmission upgrades. Additionally, since there is no obligation for a generator owner to accept an RMR designation, the reliability of the grid is still at risk if the transmission upgrades are not pursued in a timely manner.

Q. IS IT POSSIBLE TO IDENTIFY AND IMPLEMENT TRANSMISSION UPGRADES RESULTING FROM GENERATION RETIREMENT IN A TIMELY MANNER?

A. Yes, the improvements can be identified. However, one can never be certain that the transmission improvements can be implemented. Required regulatory approvals and permits, rights-of-way acquisition, long lead times for the purchase and installation of major equipment, environmental considerations, and scheduling equipment outages to

facilitate safe construction all impact project time lines. Major system upgrades often take several years to plan, design, and construct and may be challenging to complete prior to the time plants are scheduled to shut down.

Q. ARE THERE TRANSMISSION SOLUTIONS TO MITIGATE THE EXPECTED IMPACTS FROM THE RETIREMENT OF THE PPA UNITS?

A. Yes. Upgrading the transmission system can be used to mitigate the impacts from the retirement of the PPA units. By upgrading the transmission system, remaining available generation from within and outside the state of Ohio can serve AEP Ohio's customers. The purpose of the Affiliated PPA is to avoid the possible closure of certain generating units, and thereby, maintain sufficient generation within Ohio to meet the forecasted load needed to serve AEP Ohio's customers. The focus of my testimony will be to provide an analysis of the transmission upgrades and the associated costs that will be incurred if the PPA Units are retired.

IV. TRANSMISSION PLANNING IMPACT STUDY

Q. WHAT AEPGR OHIO GENERATING UNITS ARE EXPECTED TO RETIRE FOR THE PURPOSE OF YOUR STUDY?

A. AEP Transmission Planning performed a preliminary analysis of the scenario in which Cardinal 1, Conesville 4, 5, and 6, Stuart 1, 2, 3, and 4, and Zimmer 1 generating units are assumed retired. Equivalent generation, with signed interconnection or facility study agreements, needed to make up for the loss of the retired units was modeled based on the PJM interconnection queue. The analysis was performed on PJM RTEP Cases using Siemens PTI PSS/E and PowerGem TARA software. PJM Interconnection, LLC (PJM) is the regional transmission organization (RTO) with operational control of the eastern

AEP transmission system. It should be noted that all PJM generating units proposed to retire in mid-2015 have also been retired in the case, and the related transmission system upgrades approved by PJM in 2012 are modeled in-service.

Q. WHAT ASSUMPTIONS WERE USED TO ASSESS THE IMPACT OF THE GENERATION RETIREMENTS ON THE TRANSMISSION SYSTEM?

A. The same power flow models, assumptions, and methodology utilized by PJM to evaluate the reliability performance of the regional transmission system were utilized in the AEP study. Load flow analysis to determine potential overloads included single and common mode contingencies (N-1), Generation Deliverability, and N-1-1 assessments on the 2019 PJM Regional Transmission Expansion Plan summer peak case and similar analyses on the 2017 PJM light load case. The 2019 summer peak case was also used to evaluate voltage performance under the same conditions. AEP and PJM planning criteria, which are based on NERC planning standards, were the basis for determining reliability violations that would require mitigation.

Q. PLEASE DESCRIBE THE PRELIMINARY ASSESSMENT AS A RESULT OF THE STUDY.

A. AEP's preliminary assessment has determined that both thermal overloads and low voltage conditions result following the retirement of the generating units. In some cases, the power flow models did not converge, which is an indication of severe system reliability concerns. Since the AEP transmission system serves as a thoroughfare for PJM, power flows change significantly in magnitude and direction, depending on the conditions modeled. For example, under peak conditions, the AEP transmission system is typically utilized to transport power from areas in the west to areas north and east of

the AEP system. Under light load conditions, power flows primarily from west to east and south of the AEP system as a result of increased wind generation, pump loads at hydro storage facilities, and reduced natural gas generation during off-peak hours. The variability of these factors, combined with the loss of centrally-located baseload generation sources, create vastly different stresses that must be accounted for in maintaining a reliable transmission system.

The results are indicative of the thermal overloads and voltage issues that are anticipated in the PJM analyses. Thermal overloads were found in different areas across the transmission system, demonstrating the broad impact of these units to regional reliability. The low voltage conditions that persisted indicate the resulting impact of the loss of major reactive power sources. The most serious conditions are in Ohio, as would be expected given the location of the generating units. Multiple facilities at 765 kV, 345 kV, 138 kV, and lower voltages are affected. Additionally, facilities on neighboring utilities' transmission systems were similarly impacted.

V. AEP OHIO TRANSMISSION MITIGATION REQUIREMENTS

Q. WHAT TRANSMISSION UPGRADES WOULD BE NECESSARY TO MITIGATE THE IMPACT OF THE GENERATION UNIT RETIREMENTS?

A. To mitigate these impacts, AEP would need to modify and upgrade its transmission system in Ohio and surrounding states. While some additional rigor is required to determine what solutions would ultimately be developed, AEP tested several upgrades that would mitigate the reliability issues. The upgrades include a new 765 kV line, several 765 kV and 345 kV substations, rebuild of existing 138 kV lines, and addition of

new reactive power sources such as capacitor banks and Static Var Compensators (SVCs).

Q. WHAT IS THE ESTIMATED COST OF THE TRANSMISSION UPGRADES?

A. The estimated cost for the minimum upgrades required is $1.6 billion. This cost does not include any upgrades to neighboring utilities' transmission systems, so it can be expected that the eventual cost for all required upgrades will be higher. Approximately $850 million of the upgrades are expected to be at voltages 345 kV and below, the cost of which will be borne directly by customers in the AEP zone. Fifty percent of the remaining $750 million may be shared with other PJM members if 765 kV options are approved as baseline upgrades.

Q. WHAT IMPACT WOULD THE TRANSMISSION UPGRADES HAVE ON RELIABILITY DURING CONSTRUCTION?

A. Scheduling outages of existing facilities is required to allow for safe construction, particularly if the lines or substation equipment are being replaced in the same location. While these facilities are out-of-service, the overall system is less reliable.

Long duration outages will be required to complete transmission upgrades resulting from potential generation retirements. Overlapping outages affecting multiple companies/areas is also a challenge, as AEP, First Energy, and other neighboring utilities often must upgrade their respective systems during the same time frames. PJM and AEP Transmission Operations work closely to ensure the grid remains reliable at all times, and often this means delay or cancellation of construction outages if warranted by system conditions. Thus, there are reliability risks during construction outages, but also future

risks if these outages are delayed or cancelled and the upgrades are not able to be completed in time.

Q. ARE THERE OTHER FACTORS THAT COULD IMPACT THE TRANSMISSION UPGRADE REQUIREMENTS?

A. Yes. This analysis only considered the impacts resulting from the specific units listed above. As studies showed from the last round of generation retirements in 2012, the combined impact of retiring AEPGR generating plants and neighboring utilities' plants creates a more severe scenario. The impact of the combined retirements in the PJM region announced to date has required nearly $3 billion in upgrades. Similarly, it is expected that the collective impact of additional at-risk generation would require upgrades beyond those considered in an analysis that considers the specific AEP units in isolation.

Q. PLEASE SUMMARIZE HOW THE GENERATION UNIT RETIREMENTS IN THIS STUDY WILL IMPACT AEP OHIO'S CUSTOMERS.

A. The primary impact to AEP Ohio's customers from the continued retirement of generating units in Ohio is the future cost and reliability of electric service. Without the Affiliated PPA, the retirements of the PPA Units identified in the aforementioned transmission upgrade study could occur, in addition to the generation units already scheduled for retirement in mid-2015. The Affiliated PPA would keep the PPA Units operating to hedge the potential cost volatility of market-based electricity. In addition, the continued retirement of generating units in Ohio would necessitate construction of costly transmission upgrades to maintain transmission system reliability and enable importation of replacement power to serve AEP Ohio's customers.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes it does.

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of Ohio Power Company's *Pre-Filed Direct Testimony of Robert W. Bradish* have been served upon the below-named counsel and Attorney Examiners by electronic mail to all Parties this 15th day of May, 2015.

/s/ Steven T. Nourse
Steven T. Nourse

EMAIL SERVICE LIST

Allison@carpenterlipps.com	mhpetricoff@vorys.com
Bojko@carpenterlipps.com	myurick@taftlaw.com
callwein@wamenergylaw.com	mpritchard@mwncmh.com
Christopher.Miller@icemiller.com	mjsatterwhite@aep.com
cmooney@ohiopartners.org	msmckenzie@aep.com
dboehm@BKLlawfirm.com	mswhite@igsenergy.com
dconway@porterwright.com	mkurtz@BKLlawfirm.com
dwilliamson@spilmanlaw.com	Michael.schuler@occ.ohio.gov
fdarr@mwncmh.com	mjsettineri@vorys.com
ghull@eckertseamans.com	msmalz@ohiopovertylaw.org
glpetrucci@vorys.com	talexander@calfee.com
haydenm@firstenergycorp.com	nmoser@wamenergylaw.com
hussey@carpenterlipps.com	ricks@ohanet.org
jmcdermott@firstenergycorp.com	sam@mwncmh.com
jlang@calfee.com	Scott.Campbell@ThompsonHine.com
jeffrey.mayes@monitoringanalytics.com	scasto@firstenergycorp.com
jkylercohn@BKLlawfirm.com	schmidt@sppgrp.com
jfinnigan@edf.org	sasloan@aep.com
joseph.clark@directenergy.com	Stephanie.Chmiel@ThompsonHine.com
joliker@igsenergy.com	stnourse@aep.com
Katie.johnson@puc.state.oh.us	todonnell@dickinsonwright.com
Kurt.Helfrich@ThompsonHine.com	tobrien@bricker.com
Kyle.kern@occ.ohio.gov	toddm@wamenergylaw.com
Larry.sauer@occ.ohio.gov	tony.mendoza@sierraclub.org
lhawrot@spilmanlaw.com	tdougherty@theOEC.org
mdortch@kravitzllc.com	william.wright@puc.state.oh.us
mfleisher@elpc.org	

Summary: Testimony -Direct Testimony of Robert W. Bradish electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company