STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION

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AMEREN ILLINOIS COMPANY	)	
d/b/a Ameren Illinois	)	
	)	**ICC Docket No. 13-0498**
Approval of the Energy Efficiency and	)	
Demand-Response Plan Pursuant to)	)	
220ILCS 5/8-103 and 220 ILCS 5/8-104	)	
	)	

Direct Testimony of

CURT VOLKMANN

ON BEHALF OF

ENVIRONMENTAL LAW AND POLICY CENTER

October 18, 2013

Q. Please state your name and business address.

A. My name is Curt Volkmann, Environmental Law and Policy Center ("ELPC"), 35 East Wacker Drive, Suite 1600, Chicago IL, 60601.

Q. By whom are you employed and in what capacity?

A. I'm employed by ELPC as a Senior Clean Energy Finance Specialist. I currently provide technical and financial advice on a variety of clean energy, water, transportation and natural resource protection issues. I have experience as an electric distribution planning engineer in the U.S. and have advised utilities in many countries on performance improvements for their electric transmission and distribution operations. My full Statement of Qualifications is attached as an Appendix to this testimony.

Q. What are the purposes of your direct testimony?

A. My direct testimony includes recommendations for Ameren Illinois Company ("Ameren") to better integrate their Advanced Metering Infrastructure ("AMI") and Energy Efficiency/Demand Response ("EE/DR") programs to achieve more customer energy efficiency and peak demand reductions.

Q. Please describe your understanding of Ameren's AMI program.

A. The Illinois Energy Infrastructure Modernization Act ("Act") requires Ameren to invest over $625 million on advanced meter deployment and grid modernization over the next 10 years. Among other investments, Ameren expects to deploy 397,000 smart meters and the associated two-way communications by the end of PY9 under Plan 3, and 780,000 meters by the end of 2019.

Q. Why is it important to integrate Ameren's AMI and EE/DR programs?

A. The expected benefits of the significant investments under the Act include expanded energy efficiency offerings, dynamic pricing, and other innovations to help customers reduce their energy use and peak demand. Given the magnitude of the expenditures under the Act and the proposed expenditures for EE/DR under Plan 3, I believe it is important for these expected customer benefits to begin to be realized as soon as possible.

Q. Please explain how Ameren's AMI program can be used to enhance their EE/DR programs.

A. I believe there are two key areas: 1) Voltage Optimization and 2) Smart Device enablement for homes and businesses.

Q. What do you mean by Voltage Optimization (VO)?

A. I consider Voltage Optimization (VO) to be a combination of Conservation Voltage Reduction (CVR) and Volt/VAR Optimization (VVO), intended to primarily reduce end-use customer energy consumption and peak demand, and secondarily to reduce utility line losses. CVR and VVO are often used interchangeably but I will distinguish between the two concepts.

Q. What is Conservation Voltage Reduction (CVR)?

A. In the U.S., electricity is supplied to residential and small commercial customers at a nominal voltage of 120 volts. However, the American National Standards Institute (ANSI) defines an acceptable range of voltage delivery at the meter to be 114-126 volts at all times and between 106-127 volts for brief periods.

Utilities have historically found it easier and more profitable to operate at the high end of the ANSI voltage range. Voltage decreases as the distance from the substation increases, so operating at the high end of the range at the substation insures that minimal voltages are maintained at all points of a feeder. Utilities are also incented to maintain higher voltages since this increases energy consumption and associated revenues.

CVR refers to maintaining voltages as close as possible to the lower end of the ANSI thresholds at all points on a feeder to reduce feeder line losses, reduce peak demand, and reduce customer energy consumption. This is typically achieved using load tap changers at the substation and line voltage regulators at various points on a feeder.

Q. How does CVR reduce customer energy consumption?

A. Most electrical equipment works equally well and uses less energy at lower voltages, with the amount of savings dependent on the load type. Inductive loads such as motors in fans, refrigerators, air conditioners and other appliances offer the most savings. They typically operate at a lower mechanical load than they are rated to handle and higher voltages generate stronger magnetic fields and wasted energy. Resistive loads, such as lighting, also use less energy at lower voltages.

Q. What is Volt/VAR Optimization?

A. The electricity delivered by utilities consists of usable real power (measured in Watts) and unusable reactive power (measured in Volt-Amperes Reactive or VARs). VARs occur when there is a phase shift between the voltage and the current in an alternating current system. A higher phase shift means more VARs, a less efficient system, and degraded power quality. By reducing the amount of VARs flowing on a feeder, utilities reduce line losses and improve the voltage profile along the feeder. Managing VARs is often accomplished by installing capacitors or reactors at strategic points along the feeder.

Volt/VAR Optimization (VVO) refers to the active management of reactive power at all points of a feeder to minimize losses and improve the voltage. When VVO is combined with Conservation Voltage Reduction (CVR), acceptable levels of power quality are maintained, distribution system losses are minimized, and customer energy savings and peak demand reductions are maximized.

Q. How much does VO reduce energy and peak demand?

A. The Department of Energy's Pacific Northwest National Laboratory (PNNL) published a report in 2010 in which they estimate a peak load reduction and annual energy reduction of 0.5 to 4% from CVR. As part of the Electric Power Research Institute (EPRI) Green

Circuits project, Alabama Power and Duke Energy recently conducted field trials of VO. Results suggest they could achieve energy reductions between 1.2 and 2.4% just on the utility side of the meter. Customer end-use efficiency savings would be in addition to these savings.

Q. Does VO save energy for the utility, end-use customers, or both?

A. Both. However end-use customers realize most of the energy savings from VO. In the PNNL study and report, they concluded that 98-99% of the change in energy consumption from CVR occurs in the end-use loads, while only 1-2% of the reduction in energy consumed can be attributed to line losses. Other studies have attributed at least 80% of the energy savings from VO to end-use customers.

Q. Are there other customer benefits of VO?

A. Yes. Optimizing voltage also substantially lessens equipment maintenance costs and extends equipment life. This is because unnecessarily high voltage levels increase the operating temperatures of equipment and shorten their service life.

Q. Will all utility feeders benefit from VO?

A. No, not all feeders benefit equally. VO experts indicate that feeders that are primarily residential tend to see the biggest impact, followed by feeders with many small commercial customers. The 2010 PNNL study I mentioned earlier determined that 80% of the potential benefit from VO can likely be realized by implementing it on only 40% of a utility’s feeders.

Q. Is this a new idea?

A. No. The California Public Utilities Commission initiated a Conservation Voltage Reduction Program in 1977. The program required California utilities to reduce service voltages to the lower half of the ANSI range (less than 120 volts). By the mid-1980s, the program was saving almost 3 billion kWh/year. The final program report in 1987 called it one of the most effective electricity conservation programs in California.

Utilities in the Pacific Northwest began testing CVR in the 1990s. A 2008 study by the Northwest Energy Efficiency Alliance found that on average a 1% drop in voltage delivered a 0.7 to 0.8% drop in power. The study also concluded that most feeders could safely drop 3-4 volts reducing energy consumption by 2-3%.

Q. Why don't more utilities implement VO?

A. As I stated previously, most utilities have a financial incentive to maintain higher voltage levels, deliver more energy and generate more revenue. Furthermore, there is a fundamental business-model conflict from VO in that utilities incur the full costs while customers receive the majority of the benefit.

There have also been technical limitations – voltage levels at locations on a distribution feeder outside the substation are typically modeled, not measured directly. Due to this lack of visibility, utilities typically maintain voltages at higher-than-necessary levels to prevent end-of-line locations from falling below 114 volts.

Q. Have other utilities used VO as a way to reduce customer energy consumption and peak demand?

A. Yes. There are several examples in addition to the California and Pacific Northwest utilities I mentioned previously.

Both Baltimore Gas and Electric and Potomac Electric Power Company have included CVR programs as part of their EmPOWER Maryland energy efficiency portfolios.

Dominion Virginia Power explicitly included the customer energy savings from VO in its business case for AMI, projecting over $1 billion of customer energy savings. Dominion has subsequently created a subsidiary called Dominion Voltage Inc., patented their VO software, and is offering their VO planning and implementation services to other utilities.

AEP conducted a smart grid VO demonstration project in Ohio that delivered a 2.9% reduction in energy and 2-3% reduction in peak demand. They announced earlier this year an expansion of their VO R&D and deployments into their Michigan service territory.

PECO, based in Philadelphia, included CVR as one of the 18 programs in its 2009-2012 EE/DR plan. The initial plan projected 110,000 MWh of annual energy savings by 2012 from CVR with a Total Resource Cost Benefit to Cost ratio of 26.7. According to the May 2013 quarterly update, CVR has delivered gross energy savings of 320,373 MWh/year across all customer classes since program inception, which is 22% of the energy savings from their entire portfolio of EE programs. My understanding is that PECO achieved these energy savings for less than 2 cents per kWh.

Q. Have other State public utility commissions embraced VO as an EE/DR measure?

A. I'm not familiar with the point-of-view of all state commissions on CVR or VVO. However, I do know that the National Association of Regulatory Utility Commissions (NARUC) issued a resolution in November of 2012 (Exhibit 2.1) encouraging State public service commissions to:

- Evaluate the energy efficiency and demand reduction opportunities that can be achieved with the deployment of Volt-VAR Optimization (VVO) technologies
- Work with State legislatures and other agencies to certify energy efficiency and demand reductions associated with the deployment of VVO as qualified resources in meeting Energy Efficiency Resource Standards.
- Avoid implementing policies that result in unnecessary barriers to the deployment of VVO technologies

Q. Does Ameren have prior experience with VO?

A. Yes. Ameren conducted a Voltage Optimization Pilot in 2012 on several circuits. I understand that data collection and retention issues complicated their effort but the preliminary results are promising. For the feeders in the pilot, they calculated a 0.44-1.24% reduction in power from a 1% reduction in voltage. My understanding is that they intend to continue the pilot project to better assess the potential impacts. However, I recommend that they develop a system wide strategy for implementing VO beyond the pilot.

Q. Do you believe that the AMI technologies adopted by Ameren are well suited for VO?

A. Yes, I do. I believe Ameren has selected Landis+Gyr's advanced metering and two-way communications solution for their AMI deployment. Landis+Gyr also offers a solution (jointly with Dominion) that utilizes the meters as voltage monitors to enable continuous voltage and reactive power management. This solution is intended to help utilities take advantage of their AMI investment to realize the EE/DR benefits of VO.

Q. Why should Ameren include VO in its EE/DR portfolio now?

A. Ameren indicates in its proposed Plan 3 that they will not be able to meet the electric energy savings targets while staying within the mandatory spending limit. Including a very cost effective measure such as VO could allow Ameren to achieve more energy savings and peak demand reductions for the same budget.

Furthermore, VO energy savings and peak demand reductions:

- Are easily implemented;
- Impact every customer on the feeder;
- Are immediate, predictable, measurable, persistent and scalable; and
- Require no behavioral change on the part of customers.

Finally, Ameren has recent field experience with VO from their pilot that will be very valuable as they consider incorporating VO into Plan 3.

Q. Is AMI necessary to implement VO?

A. No, but AMI can make VO more efficient and effective.

Q. How can AMI make VO more efficient and effective?

A. As I stated previously, one of the technical limitations of deploying VO is the reliance on modeled, not measured, end-of-feeder voltage. With AMI, this limitation goes away since voltage levels are now known at every customer meter.

The two-way communication infrastructure associated with AMI can also be utilized for VO. The distribution devices I mentioned earlier for VO (load tap changers, voltage regulators, capacitors, reactors, etc.) can be linked with AMI two-way communications to work more effectively.

Q. How else can Ameren's AMI program improve its EE/DR portfolio?

A. As I stated previously, the expected benefits of the AMI and smart grid investments under the Act include expanded energy efficiency offerings, dynamic pricing, and other innovations to help customers reduce their energy use and peak demand. These expanded offerings often require additional hardware on the customer side of the meter. I earlier referred to this hardware as Smart Devices, and enabling them is critical for fully realizing the benefits of AMI.

Q. What are examples of Smart Devices?

A. These include thermostats, plugs, power strips, switches, smart chargers for electric vehicles, gateways, and in-home displays that can communicate with the smart meter, can connect to a local-area network, and can be controlled with smart phones, tablets, and computers.

Q. Are these Smart Devices available today?

A. Energy management devices for local-area networks that can be controlled with smart phones are widely available today but none that I'm aware of have been enabled to communicate with an Ameren smart meter. I recommend that Ameren enable these Smart Devices to communicate with their AMI meters.

Q. Should Ameren be providing these Smart Devices under Plan 3?

A. At this time I don't think Ameren should be adding additional costs to install and maintain hardware under Plan 3. I recommend that Ameren establish interoperability standards for Smart Devices to communicate with the Ameren smart meters and be willing to verify and register devices that a customer may purchase and install on their own. I also recommend that Ameren consider offering discounts or other incentives for these Smart Devices in markets where its smart meters are installed.

Q. What is an example of these interoperability standards?

A. ZigBee Smart Energy Profile is an industry standard for smart meters to communicate with devices in homes and businesses.

Q. What do you mean by verifying and registering a device?

A. Customers who purchase a Smart Device would contact Ameren and provide details of the device along with their account information. Ameren would verify that the device is compatible with the smart meter and activate the communications. From that point on, any use of the device is the responsibility of the customer.

Q. How would customers know which devices are compatible with Ameren's smart meters?

A. At minimum, Ameren could maintain a list of verified and compatible devices on their website. Ameren could also work with manufacturers and retailers to modify packaging or signage to indicate a device's compatibility with their meters. I envision a day when customers can walk into any hardware or home improvement store and shop for Smart Devices that are clearly labeled as compatible with their smart meter.

Q. Have any other utilities followed this approach?

A. Yes. San Diego Gas & Electric (SDG&E) recently implemented a program that allows its customers to register devices they purchase themselves to connect with their smart meter. Devices that SDG&E customers have registered to-date include thermostats, in-home displays, gateways, and plug load controllers. ZigBee Smart Energy Profile 1.0 or 1.1 is SDG&E's established standard for devices to communicate with their smart meters.

SDG&E maintains a list on their website of devices that have been tested and determined to be compatible with their smart meters. In some cases, discounts for the certified devices are available on the website.

Q. Does this approach raise any concerns about privacy of customer usage data?

A. No. Customers effectively opt-in or grant their permission for their electricity consumption to be accessed by a device when they register it.

Q. Why is this a preferred approach?

A. As Ameren proceeds with its AMI rollout, there will be a (perhaps small) segment of customers who will want to begin interacting with their smart meter immediately. This approach satisfies these customers without adding significant costs to Plan 3.

Secondly, utilities are typically reluctant to assume the liability and overhead costs associated with installing and maintaining devices inside a customer's home or business. This approach eliminates this concern.

Finally, I believe this approach may unlock innovation in the marketplace as entrepreneurs and Alternative Retail Electric Suppliers would have the ability to bundle these enabled Smart Devices with other products and services offered to customers.

Q. What are the benefits for Ameren with this approach?

A. As I stated previously, I believe this is a relatively low-cost approach for allowing customers to begin realizing the benefits of AMI and provides Ameren a low-cost way to begin delivering the benefits more immediately.

This approach allows Ameren to maintain visibility into the impacts of these devices through their AMI network that otherwise would not exist if customers purchased and installed the devices but did not register them.

The approach also allows Ameren to directly market their own current or future EE/DR programs, such as time-of-use rates, to the customers with registered devices. The AMI two-way communications network available to Ameren will increase the efficiency and effectiveness of any future EE/DR programs.

Finally, this approach will help Ameren monitor market demand for and technical viability of Smart Devices, which can inform future decisions on potential EE/DR programs.

Q. Do you have any further thoughts on Ameren's role regarding Smart Devices?

A. Yes. There are policy questions regarding the role of the utilities in getting customers to use the Smart Devices to reduce energy consumption and demand, as opposed to just allowing the competitive market to work. I believe a key issue is determining the best way to get customers to use Smart Devices and transform the market. AMI and Smart

Devices not only help individual customers save energy, but they also have the potential to significantly affect market prices. Therefore, the Commission needs to determine whether Ameren should be providing customers with Smart Devices in order to accelerate market penetration, or whether it should just let the market evolve.

Q. What specifically do you recommend for VO?

A. For VO, I recommend that the Commission order Ameren to conduct a feasibility/potential study to determine the impact and costs. Ameren's experience from their recent VO pilot will provide valuable input into the analysis. As I stated previously, experts believe that 80% of the benefits from VO come from 40% of the feeders, so the focus of the study should be on the highest-potential circuits with primarily residential and small commercial load and should geographically follow the planned AMI deployment.

I also recommend that the Commission formally certify the energy efficiency and demand reductions associated with VO as qualified resources in meeting IL EE/DR standards, and commit to allowing recovery of prudently incurred costs.

I recommend that the Commission order Ameren to use the results of the VO feasibility/potential study to reprioritize the programs under Plan 3. I believe VO is a very cost effective energy efficiency and demand reduction resource and, if incorporated into Plan 3, will allow Ameren to achieve significantly more energy savings for the same constrained budget.

Finally, I recommend that the Commission order Ameren to work with the SAG to develop an appropriate measurement and verification methodology for VO.

Q. What specifically do you recommend for enabling Smart Devices?

A. Ameren has $5.13 million allocated in their proposed Plan 3 for gas and electric Emerging Technologies. Smart Devices, particularly smart thermostats, can lead to savings of both gas and electricity. I recommend that the Commission order Ameren to use this $5.13 million budget to develop and implement a comprehensive plan, involving manufacturers and retailers, to enable Smart Devices to interact with Ameren's smart meters as I described previously, and to make it easy for customers to identify and purchase these devices. Further, I recommend that the Commission consider whether Ameren should develop programs to provide these Smart Devices directly to customers in conjunction with the AMI rollout.

Q. Does this conclude your direct testimony?

A. Yes.

Appendix

Statement of Qualifications – Curt Volkmann

I graduated from the University of Illinois at Urbana-Champaign in 1984 with a Bachelors of Science in Electrical Engineering with an emphasis in Power Engineering. I also graduated from the University of California at Berkeley in 1992 with a Masters of Business Administration with an emphasis in Finance. From 1987 to 1995 I held a Registered Professional Electrical Engineer Certification from the State of California.

I was employed from 1984 to 1993 by Pacific Gas and Electric (PG&E) in various roles, including Distribution Planning Engineer where I developed system protection and voltage optimization schemes and analyzed the impacts from cogeneration on the distribution network. I also served in a Project Manager role where I evaluated the impact of demand side management programs on the need for distribution substation upgrades.

From 1993 to 1994, I worked for the consulting firm UMS Group where I led multi-utility benchmarking studies examining global best practices in electric transmission, distribution and fleet operations. Participating utilities were from the U.S., Canada, Australia, New Zealand, Europe and Africa.

From 1994 to 2013, I was employed by Accenture, a global management consulting and technology firm. I held several positions including Executive Director with client account leadership responsibilities for several gas, electric and water utilities in the U.S. In this role I oversaw several utility cost reduction, energy efficiency and smart grid programs. From 2010 to 2013, I was Managing Director in Accenture's Sustainability Services practice where I oversaw energy efficiency and demand reduction projects for commercial and industrial clients across multiple industries.

I am currently a Senior Clean Energy Finance Specialist at the Environmental Law and Policy Center where I provide technical and financial expertise on a variety of clean energy, water, transportation and natural resource protection issues. I am focused on opportunities to better utilize smart grid investments to accelerate energy efficiency, peak demand reduction, and renewable deployment.