
DIRECT TESTIMONY OF TERESA RINGENBACH**ON BEHALF OF****ARMADA POWER, LLC**

1

2 **Q1. PLEASE STATE YOUR NAME, BUSINESS ADDRESS, AND ON WHOSE**
3 **BEHALF YOU ARE TESTIFYING?**

4 A1. My name is Teresa Ringenbach. I am the Vice President, Business Development
5 with Armada Power, LLC. My business address is 230 West Street, Suite 200,
6 Columbus, Ohio 43215. I am presenting testimony in this proceeding on behalf of
7 Armada Power, LLC.

8 **Q2. PLEASE DESCRIBE ARMADA POWER, LLC'S BUSINESS.**

9 A2. Armada Power creates technology solutions for the electric utility industry, and our
10 mission is to make the power grid more reliable, renewable, and cost effective. Our
11 main product line is a combination of our smart and secure water heater controller
12 with our software platform FleetCommander. We use the FleetCommander
13 software platform to turn thousands of connected water heaters into flexible energy
14 storage for the power grid while minimizing the impact to the water heater user.

15 **Q3. WHAT ARE YOUR JOB RESPONSIBILITIES?**

16 A3. I lead Armada Power's business development, and its government and regulatory
17 affairs. My team includes legal, lobbying and regulatory functions. The role of
18 the team is to educate the public and governmental officials about Armada
19 Power's technology and to expand Armada Power into new markets.

1 **Q4. WHAT IS YOUR ENERGY EXPERIENCE AND EDUCATIONAL**
2 **BACKGROUND?**

3 A4. I hold a Bachelor’s Degree in Business Administration with a concentration in
4 International Business from the University of Toledo. I started in the energy
5 industry in 2001 with Integrys Energy Services, Inc. (formerly WPS Energy
6 Services, Inc. and FSG Energy Services, Inc.), as a Customer Service and
7 Marketing Specialist promoting and managing Ohio residential and small
8 commercial electric offers. In 2002, I became an Account Manager – Inside Sales,
9 where I sold and managed Government Aggregation Programs for both gas and
10 electric. In 2005, I was promoted to Regulatory Specialist. In that position, I was
11 responsible for regulatory compliance throughout the United States and Canada. In
12 2006, I accepted the position of Regulatory Affairs Analyst – East which required
13 covering New England, New York, New Jersey, Ohio and Pennsylvania gas and
14 electric issues. In the spring of 2008, I accepted the Regulatory Affairs Analyst
15 position for the Midwest region covering Ohio, Michigan, Illinois, Indiana,
16 Kentucky, and all of Canada. In that position, I directed the regulatory and
17 legislative efforts affecting Integrys Energy’s gas and electric business. In August
18 2009, I joined Direct Energy as the Manager of Government and Regulatory Affairs
19 for the Midwest. I managed the regulatory and legislative activities of Direct
20 Energy throughout the Midwest, primarily in Ohio, Illinois, Indiana, Kentucky, and
21 Michigan. My responsibilities covered electric, gas, and home services issues for
22 all levels of customers, from residential to large industrial customers. In October

1 2020, I joined Armada Power, LLC and Nationwide Energy Partners as a shared
2 service, which is my current professional position.

3 **Q5. HAVE YOU PREVIOUSLY TESTIFIED BEFORE A REGULATORY**
4 **AGENCY?**

5 A5. Yes. A list of cases in which I have previously provided official testimony is
6 attached hereto.

7 **Q6. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

8 A6. I am testifying in support of Ameren incorporating a behind the meter thermal
9 storage program (“Program”) into the demand response and demand side management
10 portions of its Integrated Resource Plan (“IRP”). The Program would be a utility owned
11 water heater controller project to utilize technology for residential demand response
12 which would also act as a non-wires alternative to battery and circuit requirements on the
13 grid.

14 **Q7. COULD YOU PLEASE DESCRIBE THE PROGRAM?**

15 A7. The Program would place Ameren owned controllers onto customer owned electric
16 resistance water heaters. Unlike traditional water heater direct load controls, which only
17 turn the water heater on and off, the controllers would be grid connected for multiple
18 purposes beyond limited demand calls. Residential customers would receive demand
19 response and time of use benefits, while the utility, as described more fully below, would
20 have grid control actions.

21 **Q8. WHY DOES ARMADA PROPOSE THE PROGRAM AS BOTH DEMAND**
22 **RESPONSE AND A NON-WIRES ALTERNATIVE?**

1 A8. While the water heater controllers act as a grid asset, the water heater controllers are
2 unlike traditional utility wires side technology because these water heater controllers
3 would need installation inside a customer’s home or business. The most efficient way for
4 this to happen would be for Ameren to receive approval to control the device within the
5 home or business by providing the device to the customer for free in return for the
6 control.

7 **Q9. DOES THE PROGRAM FIT THE REQUIREMENTS OF RELIABILITY?**

8 A9. Yes. The IRP is to allow Ameren to recover investments in its grid. The Armada
9 Power technology allows a utility to defer replacement and investment in additional
10 equipment, such as upgrading transformers or conductors on capacity constrained
11 circuits, or to reduce the amount of battery storage needed while being more cost
12 effective. Also, the Armada Power water heater controller technology helps reduce
13 restoration times after sustained outages by removing the water heaters from the initial
14 cold load pickup. This allows circuits to be re-energized faster with less risk of tripping
15 out up stream protection. By placing Armada Power’s technology at a fleet level of
16 thousands of units across constrained portions of the Ameren system, Ameren can use
17 Armada Power’s technology in the following ways:

18 a) Storage: The Armada Power solution is a more cost-effective storage solution
19 than batteries for many grid applications. Water heater control allows for the
20 shifting, in real time, of the second largest residential electric load with little to no
21 comfort impact to the end user. That shifting in real time to support the power
22 grid is effectively grid storage. This flexible storage asset can be used to absorb
23 unpredictable renewable generation output, reduce system load to avoid higher

1 generation fuel costs, or even extend the life of grid scale batteries by reducing
2 the number of quick discharge cycles. The Armada Power technology can be used
3 to absorb the small fluctuations in power output that occur with renewable sources
4 like wind and solar. Armada Power has demonstrated experience in using the
5 difference between forecast and real time output of wind farms to drive a control
6 signal for fleets of water heaters in the local power grid to absorb excess wind or
7 delay usage when wind output falls below forecast. This process is referred to as
8 renewables firming. Armada Power has demonstrated this technology as a wind
9 firming resource in Hawaii, and “solar sponging” resource in Arizona.

10
11 b) Load Shift and Peak Shave: Two-way advanced water heating control allows for
12 multi-hour load shift while avoiding rebound peaks after the events. Armada
13 Power has been operating in multiple states and with utilities doing daily Time of
14 Use peak optimization, as well as Demand Response events saving money for end
15 use customers and utilities.

16
17 c) Voltage: Armada Power controllers can automatically respond to local voltage
18 deviations and provide revenue quality measurements to augment other
19 distribution automation systems. For example, with a Conservation Voltage
20 Reduction (CVR) or Integrated Volt Var Control (IVVC) system, grid operators
21 may want to use CVR to drop system voltage to the minimum American National
22 Standards Institute (ANSI) limits. However, the grid operators must compensate
23 for voltage drop across the line, and the grid operator must ensure delivery at the

1 end of the line is within ANSI specifications. By having the Armada Power
2 controllers deployed on a targeted circuit, the technology could be another
3 verification point to observe voltage drop and could enable a control system to
4 maximize the CVR effect while staying within band.

5
6 d) Droop Control: Armada Power can also provide primary frequency stability
7 through our patented simulated droop control which allows water heaters to
8 respond to locally measured deviations in system frequency within a few cycles.
9 The Armada Power fleet responds with a greater magnitude of water heater use
10 (speeds up like a generator) with larger changes in frequency, and the Armada
11 Power fleet responds with a smaller magnitude of water heater use (slows down
12 like a generator) with smaller changes in frequency simulating the governor
13 control on a generator. This supports system stability without introducing
14 oscillations.

15 **Q10. HOW DOES THE ARMADA PROJECT OFFER CUSTOMER SIDE**
16 **BENEFITS?**

17 A10. Customer Control: This technology gives customers control over the second
18 largest energy consuming device in their home. The Armada Power smart phone app
19 allows customers to opt-in or opt-out of grid events, set away modes when on vacation,
20 (which reduces standby losses), and optimize usage around time-of-day rates.

21 Maintenance: Customers will receive maintenance alerts for failed heating
22 elements and an optional leak sensor. If a service call is required, it generally only
23 requires two service call visits, with the first visit used to identify what went wrong, and

1 the second visit to make the needed repair. The maintenance alerts are specific to the
2 element that failed, which allows for a faster repair time by identifying the issue and
3 failed part(s) in advance of the first service call.

4 Durability: The Armada Power technology turns a standard electric water heater
5 into a superior storage and energy management tool vs. “premium” price point smart
6 water heaters or heat pump water heating. The Armada Power controller is rated for over
7 4 million full load switching cycles and can switch on or off instantly at any time. It does
8 not wear out after a few thousand switches like traditional demand response switches, or
9 require compressor cycle times to expire before the next use.

10 Income Level Agnostic: The customer would not need to pay, and then later
11 receive a refund or rebate. The device would be utility owned for distribution grid
12 reliability, which is the primary purpose. Because the device would be utility owned, a
13 low-income customer will not need to purchase the device and then seek a rebate.
14 Additionally, rented dwellings would have consistent access to the technology, which
15 would likely lead to higher participation in the Program and provide customer benefits.
16 The other customer benefits, such as use of the app and maintenance alerts, would be
17 optional to the customer. The Armada Power technology allows traditionally
18 underserved communities to participate in energy management and cost savings while not
19 sacrificing comfort and service. Notably, the only restriction to participation is the type
20 of water heater on the premises.

21 **Q11. WHAT IS THE COST OF A 10,000 UNIT ARMADA PROJECT?**

22 A11. Ameren’s service covers 1.2 million customers, and as such, a Program to service
23 approximately 1% of customers would require approximately 10,000 controllers.

1 Option 1 – Wi-Fi. A purchase of 10,000 Wi-Fi controllers (i.e. units), including
2 installation and a 5-year software license, is approximately \$3 Million.

3

4 Option 2 – Cellular. A purchase of 10,000 Cellular controllers (i.e. units), without
5 pre-paying data/communication and license costs, would cost approximately \$2.9
6 Million for hardware and installation. Further, there would be an annual
7 approximate cost of \$420,000 for data/communication and license fees.

8 **Q12. WHAT IS THE BENEFIT OF CELLULAR VERSUS A WI-FI OPTION?**

9 A12. The cellular option (*See above*) would offer Ameren direct connectivity without
10 requiring the homeowner or tenant to provide access to their own private Wi-Fi network
11 with respect to the functionality of the device. However, at the time of installation of the
12 device, the homeowner or tenant would still need to provide consent in order for Ameren
13 to control the device. Under the cellular option, there would be no concern of the
14 customer’s Wi-Fi network connection failing, disconnecting, or any other type of Wi-Fi
15 connection disruption (e.g. Wi-Fi password change, etc.). Many multifamily
16 communities have community wide Wi-Fi networks. For those communities, a Wi-Fi
17 enabled option could access the community Wi-Fi network. This would eliminate the
18 need for the tenant to enable access to their personal Wi-Fi network while also reducing
19 Wi-Fi network disruptions that might occur as the result of tenants moving in/out of
20 units, and thereby making changes to the personal Wi-Fi network of that unit or tenant.
21 However, the normal single-family home would continue to need to reconfigure Wi-Fi
22 for the unit at installation and for any Wi-Fi changes (password, etc.). It should be noted
23 that for many energy efficiency and demand side management programs, setting up

1 technologies to Wi-Fi does occur today. However, to achieve the greatest grid control,
2 ensuring connectivity through cellular may be a better option.

3 **Q13. IS THERE A COMFORT OVERRIDE CONCERN WITH USING ARMADA**
4 **AS A GRID DEVICE?**

5 A13. When utilities look to behind the meter technologies for grid control, there is
6 always the possibility of a comfort override. A comfort override includes things like
7 failure to re-connect the device to the Wi-Fi network due to it being a low priority item
8 for the customer, a thermostat customer turning up the heat because they are cold, or the
9 customer shifting the time of charging their electric vehicle to a different time of day
10 because of a change in schedule. In the end, customer lifestyle will dictate the frequency
11 and demand of use. Unlike most of these options, the water heater is the least invasive
12 appliance and can be held to a very specific temperature. People do not regularly change
13 their water temperature. Therefore, as long as the hot water is available and at the desired
14 temperature, there is usually no need for a customer to comfort override a call for demand
15 reduction or grid control. While the Armada Power technology is designed to operate
16 without interference to the customer's lifestyle, the Armada Power app will allow for the
17 customer to opt-in or opt-out per event if the customer chooses. This retains ultimate
18 control with the customer.

19 **Q14. CAN AN ARMADA CUSTOMER OVERRIDE A CONTROL?**

20 A14. Yes. As noted above, the customer has the option to opt-in or opt-out of events.
21 However, given that the basic function of the water heater is to provide hot water, the
22 override is generally used by the customer for the maintenance and/or time of use setting,
23 rather than to override demand response calls. The Armada Power customer has access to

1 this information via the Armada Power app or the utility smart dashboard that shows the
2 following:

- 3 • The current amount of water available at the customer’s chosen temperature;
- 4 • Whether the utility allows opt-in/out functionality;
- 5 • Status of functionality (i.e. whether an upper or lower element has, or is about to,
6 fail/leak);
- 7 • Time of use schedule (i.e. the customer can set specific usage times to meet their
8 chosen time of use product); and
- 9 • Whether the utility has called upon the customer’s water heater for things like
10 solar sponging or droop.

11 **Q15. WHAT INFORMATION AND CONTROL WOULD THE UTILITY BE**
12 **ABLE TO VIEW AND UTILIZE?**

13 A15. The utility will have control to schedule time of use rates, schedule and configure
14 demand response events, and see live data via the Armada Power dashboard. Further, the
15 utility will be able to: (i) monitor fleet level power consumption and associated charges;
16 (ii) see whether a customer has elected to opt-in/out; and (iii) know whether a device is
17 offline. If the Commission were to approve, the utility would also be able to see whether
18 the water heater has failed -- similar to maintenance alerts that the customer receives. For
19 example, if a customer calls to complain that their water is cold, then the utility can
20 advise them whether the water heater is broken, leaking or otherwise malfunctioning.
21 Armada Power has found that this technology is critically helpful to the utility and
22 customers.

1 **Q16. HOW COULD THE PROGRAM BE USED IN CONJUNCTION WITH**
2 **OTHER PROGRAMS?**

3 A16. As I noted earlier, to ensure the most efficient and least costly installation,
4 allowing Armada Power technology to be installed alongside other programs, including
5 HVAC, thermostat, etc., would decrease overall installation costs and increase customer
6 participation in multiple programs.

7 **Q17. ARE THERE OTHER INSTALLATION OPTIONS IN ADDITION TO**
8 **SINGLE FAMILY?**

9 A17. Yes. I am recommending Ameren incorporate a multifamily component to the
10 Program. This will allow Ameren to partner with multifamily property owners who
11 typically have both their own maintenance staff and access to water heaters on a larger
12 scale. By incorporating a multifamily component to the Program, a faster, deeper and
13 more beneficial penetration is highly likely.

14 **Q18. HOW DOES THE ARMADA POWER TECHNOLOGY, AND IN TURN**
15 **THIS PROGRAM, DIFFER FROM TRADITIONAL WATER HEATER**
16 **CONTROL?**

17 A18. Armada Power's technology is a two-way real time secure controller with revenue
18 grade accuracy. Traditional control programs operate "blind" without knowledge of how
19 much charge is available or how much performance was achieved. The Armada Power
20 algorithms and technology make it simple to manage demand at the fleet level for the
21 grid operator, while ensuring end user comfort. Control inputs like automatic generation
22 control (AGC) or other data can also be directly integrated into the system to perform

1 advanced grid functions like renewables firming, cold load pickup, and the other features
2 I have already discussed herein.

3 **Q19. HAVE OTHER STATES APPROVED SIMILAR PROJECTS?**

4 A19. Yes. To the best of my knowledge, Arizona and California are two examples.
5 Ohio has a pending case to approve a stipulation which would include a low-income
6 water heater program. In addition, Armada Power is operating behind the meter with
7 several Co-Ops.

8 **Q20. WHY IS IT APPROPRIATE FOR THE COMMISSION TO APPROVE**
9 **THE PROJECT IN THIS CASE?**

10 A20. Armada Power is a grid asset which operates on a fleet basis. The full value will
11 not be realized through a traditional customer purchase and rebate construct because the
12 timing to reach fleet would take too long. There are benefits to customers that fall into
13 both the energy optimization and demand response categories, the core function of the
14 system is to act as a distribution asset ---- meaning it can be called upon outside of
15 normally scheduled DR events and used in a manner that is also a wires side asset as
16 described earlier. Finally, the Armada Power technology works to improve integration of
17 renewable technologies into the grid. Therefore, it is appropriate for the Commission to
18 approve the Program in this case, which is where distribution utilities recover and receive
19 approval for distribution system improvements and planning for these new resources and
20 for customer side demand management programs. It is well documented that renewables
21 and forms of distributed energy resources (“DER”) are being placed onto Ameren’s
22 system, and that system must begin looking at both wire and non-wire options to meet
23 this change. The Commission should not restrict Ameren’s ability to use new

1 technologies as an alternative to more expensive grid investments, but rather, the
2 Commission should incorporate these technologies in order to ensure that the least
3 expensive technology options are used.

4 **Q21. DOES THIS CONCLUDE YOUR TESTIMONY?**

5 A21. Yes, but I respectfully reserve the right to supplement my testimony.

6

7

Respectfully Submitted,

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Teresa L. Ringenbach

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Teresa Ringenbach, Vice President

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Business Development with Armada Power, LLC

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03 / 30 / 2021

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