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April 1, 2019

VIA ELECTRONIC DELIVERY
Tanowa Troupe
Docketing Division
Public Utilities Commission of Ohio
180 East Broad Street
Columbus, Ohio 43215

Re: In the Matter of the PowerForward Distribution System Planning Work Group, Case No. 18-1596-EL-GRD

Dear Ms. Troupe:

Pursuant to the Finding and Order of the Public Utilities Commission of Ohio, February 27, 2019, please find attached Duke Energy Ohio, Inc.'s Current-State Assessment report to be filed in the above-captioned proceeding.

If you have any questions, please contact me or Elizabeth Watts.

Thank you,

Dianne Kuhnell
Senior Paralegal

Enclosure

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Duke Energy Ohio
Distribution System Planning
Current State Assessment

April 1, 2019

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INTRODUCTION

On August 29, 2018, the Public Utilities Commission of Ohio (PUCO or the Commission) released "PowerForward: A Roadmap to Ohio's Electricity Future" (Roadmap). As set forth in the Roadmap, "an essential first step in the distribution system planning process would be for each electric distribution utility (EDU) in Ohio to conduct a current-state assessment of their respective distribution system's present capability to integrate and accommodate the broad array of EDU and non-EDU initiatives likely to occur, and file this assessment with the Commission for its consideration." (page 18) Pursuant to the Commission's request in Case No. 18-1596, Duke Energy Ohio, Inc. (Duke Energy Ohio) is providing this Current State Assessment of its Distribution System planning capabilities with data as of December 31, 2018.

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DISTRIBUTION SYSTEM PLANNING OVERVIEW

Technology is transforming Ohio, and changing the way customers use electricity and interact with their electric provider. Reliability remains essential as an increasingly connected population continues to expand, especially in urban areas of the state. Today, the need for consistent, reliable service isn't just the expectation of industry and manufacturing, but extends to homes and businesses – especially at a time when reliability is challenged by the increasing frequency of severe weather events and the threat of physical and cyber-attack.

The century-old model of one-way power flow from power plant to customer is evolving to one of distributed resources, and customers are increasingly connecting to innovative technologies like private solar, battery storage, and electric vehicles. Power lines that were once the last mile of a constant and consistently flowing electric grid are now the first stop for a network of generation sources, pushing a dynamic flow of energy onto an energy highway that was not engineered for multi-directional flow.

Customers today want a new experience – a better experience – built upon information about how they personally use energy and incorporating tools to harness that energy and power their lives. They also want a power grid that can adapt to meet their changing energy needs, repair itself faster when there are problems and serve as the backbone of their lives and of the state's digital economy.

The reality is that today's grid, while well maintained, is simply not engineered to handle the expanding demands it is expected to serve. To deliver on customer expectations, we must do more than maintain the power grid; we must transform it, leveraging technology to modernize its operation, making it more reliable, smart and secure.

This means converting the grid from a radial one-way design to a two-way distribution system that can automatically route power from where it is produced, regardless of where that happens on the system, to where it is needed. Duke Energy Ohio has made excellent use of the existing grid system, but it and other utilities throughout the nation, must address unique challenges from Distributed Energy Resources (DERs), physical and cyber security, increased severe weather events and increased customer reliance and expectations since the grid was initially built.

Duke Energy Ohio's distribution system planning approach focuses on ensuring the electric grid is safe, resilient, reliable and operates in a manner that will allow Duke Energy Ohio to meet its customers' expectations.

CURRENT STATE ASSESSMENT

The following is a current state assessment of Duke Energy Ohio's distribution system's present capabilities.

Requirement # 1a
System Characteristics: • ***Total customers served, AMI coverage (percent of customers and percentage of delivered energy), other interval meter or interval data recorder (IDR) coverage (percent of customers and percentage of delivered energy).***

Total Customers Served (Meters)	Total AMI Meters Installed	Total AMI Meters (% of Total Meters)	Total Other Interval Meters Installed	Total Other Interval Meters (% of Total Meters)
748,440	737,329	98.5%	5,147	0.7%

Total Retail Delivered Energy [1] (kwh)	Total AMI Delivered Energy	Total AMI Delivered Energy (% of Total Retail Delivered Energy)	Total Other Interval Delivered Energy	Total Other Interval Delivered Energy (% of Total Retail Delivered Energy)
20,806,199,100	9,777,242,968	47.0%	10,080,827,006	48.5%

Note 1: Total Retail Delivered Energy (kwh) will be finalized with the FERC Form 1 submission to the PUCO on April 15, 2019.

Requirement # 1b
System Characteristics (cont'd): • ***Number of circuits and substations, number of circuits serving critical facilities, percent of substations with SCADA, and percent of substations that have been fully or partially automated to IEC 61850 or a comparable standard.***

Circuit and Substation System Characteristics	
# of Circuits (including 4 kV)	747
# of Substations (including 4 kV)	247
% Substations with SCADA	78%
% Circuits with SCADA	82%
# of Circuits Serving Critical Facilities	707
% Substations fully or partially automated to IEC 61850	78%

Requirement # 2

Overview of the distribution planning process, including frequency, duration and roles/ responsibilities of stakeholders involved.

Duke Energy Ohio's distribution planning process utilizes personnel from the Distribution Planning organization to evaluate system performance against common criteria. The first step in this process is to segment the distribution system into load areas that are smaller in size and represent a natural operating area. Common criteria, such as percent loaded, outlines the normal and emergency operating characteristics. The Distribution Planners calculate growth rates in the load areas, utilizing historical summer and winter peak load data. These load area growth rates are projected twice each year - once after peak data is collected during the summer and again after the winter peak. Using the most recent peak data, the Distribution Planners model the performance of the distribution circuits in the load areas for the current peak as well as future peak load conditions. Results are then compared against criteria to determine when infrastructure upgrades are required (summer and winter).

In addition to developing projects to resolve capacity issues, the system is also reviewed for power quality (voltage level and reliability) and system protection conditions resulting from circuit loading. Once an improvement need is identified, the Distribution Planner will determine the scope of the investment as well as estimate the cost of the improvement. Annually, each investment project is presented by the sponsoring Distribution Planner and evaluated by peers. The following considerations are used in determining project priority:

- Percent Loading of Transformer: Use current and projected load to determine to what extent the transformer is or will be overloaded during system peak conditions.
- Percent Loading of Feeder: Use current and projected load to determine whether the feeder is or will be overloaded during system peak load conditions.
- Percent Loading of Feeder Circuit Breaker or Station Regulator: Use current and projected load to determine whether the circuit breaker or station regulator is or will be overloaded during system peak load conditions.
- Estimated Unserved Load: The amount of mega volt amp (MVA) that cannot be supplied by an alternate source for a first contingency failure.
    - Consideration is also given to projected switching time when load can be restored via a mobile transformer installation or from an alternate source.
- Growth Rate: Growth rates and load projections are made using historical load data.

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Requirement # 3

Categories of projects that result from the planning process, types of projects within each category and percent of expenditures in each category.

The categories of projects that result from the distribution planning process are as follows (% of expenditures vary by year):

- Substation Capacity (approximately 45% of expenditures):
  - Transformer replacement to increase size and capacity of the substation
  - Transformer addition to increase the capacity of the substation
  - New substations
- Feeder Capacity (approximately 30% of expenditures):
  - Feeder reconductoring to increase wire size/capacity
  - Additional feeder
- Reliability Improvement (approximately 23% of expenditures):
  - Extension of feeder to create ties to transfer load between feeders or restore service during an outage
  - Installation of automated switching devices (reclosers and sectionalizers) on feeders and between feeders to reduce the number of customers impacted by an outage
  - Installation of fuses to reduce the number of customers impacted by a fault
- Power Quality Improvement (approximately 2% of expenditures):
  - Transfer of single phase branch circuits between phases to balance the load among the three phases
  - Installation of capacitor banks
  - Installation of line regulators
  - Feeder reconductoring to increase wire size/capacity

Requirement # 4

Planning assumptions including, growth rates and design criteria.

Duke Energy Ohio planning assumptions are as follows:

- Distribution circuit load growth trends are determined based on the historical annual peak loading using linear regression analysis to determine growth rate.
- Standard station transformer sizes include 10.5, 22.4, and 33.6 MVA. However, there may be different size transformers still in service because they have not reached the end of their useful life. Limiting the size of transformers permits the back up of station transformers with mobile transformers. A portion of the load may need to be transferred to other substations via field switching to accommodate the use of mobile transformers.

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- Transformer installation projects are initiated with proposed in-service dates scheduled to meet a timeframe when transformer load is projected to reach 100% of the rated capacity.
- Transformers are generally operated up to a calculated equipment rating based on IEEE (Institute of Electrical and Electronic Engineers) standards.
- Transformers may be operated between the calculated equipment rating and the calculated thermal limit for emergency restoration purposes.
- Circuit conductor ratings are determined by conductor ampacity and construction standards.
- Circuit reconductor projects to increase capacity are initiated when circuit loading is projected to reach 100% of conductor rating.
- Circuits are designed to a standard maximum loading of 12MW. However, some circuits are designed to carry less load due to projected load growth on the circuit.
- Customer voltage along the circuit is maintained within a range of 114-126V on a nominal 120V supply, based on ANSI (American National Standards Institute) standards.
- Customer voltage imbalance is maintained on the circuit so as not to exceed 3% based on ANSI standards.
- Circuit load imbalance is reviewed annually and configuration modifications are made to ensure current imbalance is less than 5%.

Self-Optimizing Grid criteria:

- The circuits are designed such that power can be restored to all un-faulted feeder mainline segments 90% of the hours in a year by switching to alternate sources through circuit ties.
- The mainline on the distribution circuits is segmented with automated devices based on the following characteristics:
    - No more than 2 MW peak load in the segment.
    - No more than 3 miles of overhead exposure in the segment.
    - No more than 400 customers in the segment.

Requirement # 5

Load and DERs Forecasting Methods.

For the purposes of this report, load forecasting methods are described for the distribution transformer and individual circuit loading.

Circuits and substations are reviewed twice each year - after the summer and winter peaks. The data set for forecasting is obtained from the Supervisory Control and Data Acquisition (SCADA) system and composed of annual load peaks and daily load profiles. Linear regression analysis is applied to the data for forecasting load growth. The forecasts are determined at both the feeder and transformer levels. Additionally, planned load increases due to new commercial, industrial, and residential facilities are added to coincide with the expected load increase.

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DERs are currently integrated into the Distribution Planning process by the results achieved in reducing circuit load. The reduced load information is then utilized in determining load growth trends and infrastructure upgrades as described above.

Requirement # 6

Software tools used for planning, including forecasting, system modeling and mapping, power flow analysis, system protection, and hosting capacity analysis.

Electric distribution system planning and analysis software is used to model the system and perform various analysis functions. The analysis functions include the following:

- Power flow and equipment loading analysis under normal system configuration
- Contingency planning for system anomalies
- Impact of projected load growth on the system
- Optimization of switching or restoration plans
- System protective device coordination
- Impact of proposed distributed energy resources (hosting capacity)
- Power quality analysis
- Available fault current and arc flash analysis

Both myWorld, by Ubisense and GE Smallworld GIS software are used for mapping the distribution grid. The software also provides geospatial asset management for distribution grid planning, design, analysis and operation. **See requirement # 5 above for forecasting tools used.** Duke Energy Ohio performs hosting capacity analysis on an ad-hoc basis **(see requirement # 12 below for additional details).**

Requirement # 7

Existing DERs (all types) connected to the distribution system.

The table below lists existing DERs connected to the Duke Energy Ohio distribution system as of December 31, 2018.

Type	# of Installations	Total MW
Diesel	12	15.35
Natural Gas	3	21.8
Waste Gas	1	0.262
Solar	1,070	19.9039
Wind	10	0.0575

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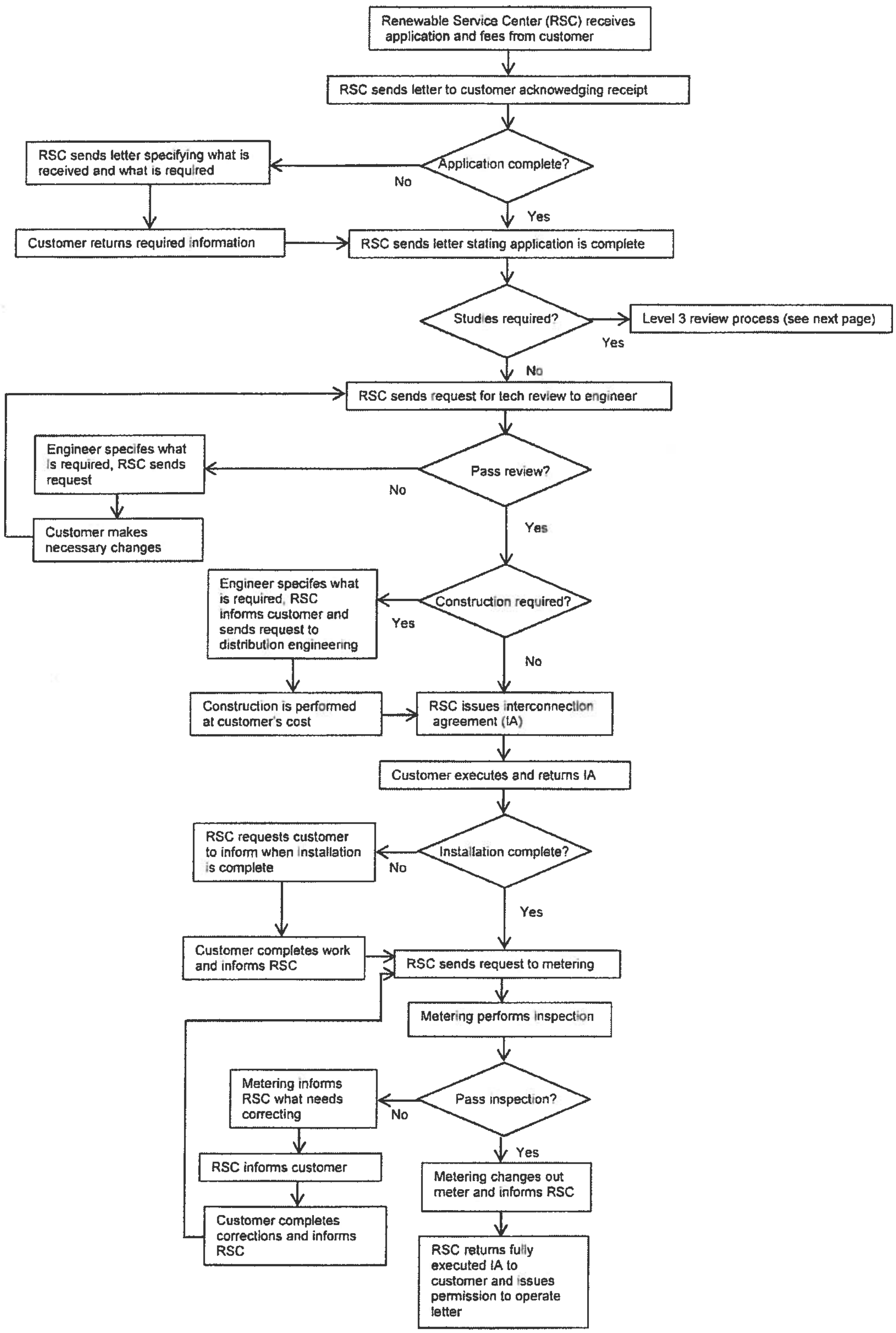
Requirement # 8

Overview of distributed generation (DG) interconnection processes, including technical screening rules for fast-tracking applications and inclusion of updates to key standards.

The flowchart on the following pages provides an overview of Duke Energy Ohio's distributed generation processes. The process is the same for interconnection Levels 1 and 2 **(refer to Requirement #9)** and is consistent with reviews defined in the Ohio Administrative Code (O.A.C) 4901:1-22 "Interconnection Services."


Renewable Service Center (RSC) receives application and fees from customer
RSC sends letter to customer acknowledging receipt
Application complete?
No
RSC sends letter specifying what is received and what is required
Customer returns required information
Yes
RSC sends letter stating application is complete
Studies required?
Yes
Level 3 review process (see next page)
No
RSC sends request for tech review to engineer
Pass review?
No
Engineer specifes what is required, RSC sends request
Customer makes necessary changes
Yes
Construction required?
Yes
Engineer specifes what is required, RSC informs customer and sends request to distribution engineering
Construction is performed at customer's cost
No
RSC issues interconnection agreement (IA)
Customer executes and returns IA
Installation complete?
No
RSC requests customer to inform when installation is complete
Customer completes work and informs RSC
Yes
RSC sends request to metering
Metering performs inspection
Pass inspection?
No
Metering informs RSC what needs correcting
RSC informs customer
Customer completes corrections and informs RSC
Yes
Metering changes out meter and informs RSC
RSC returns fully executed IA to customer and issues permission to operate letter

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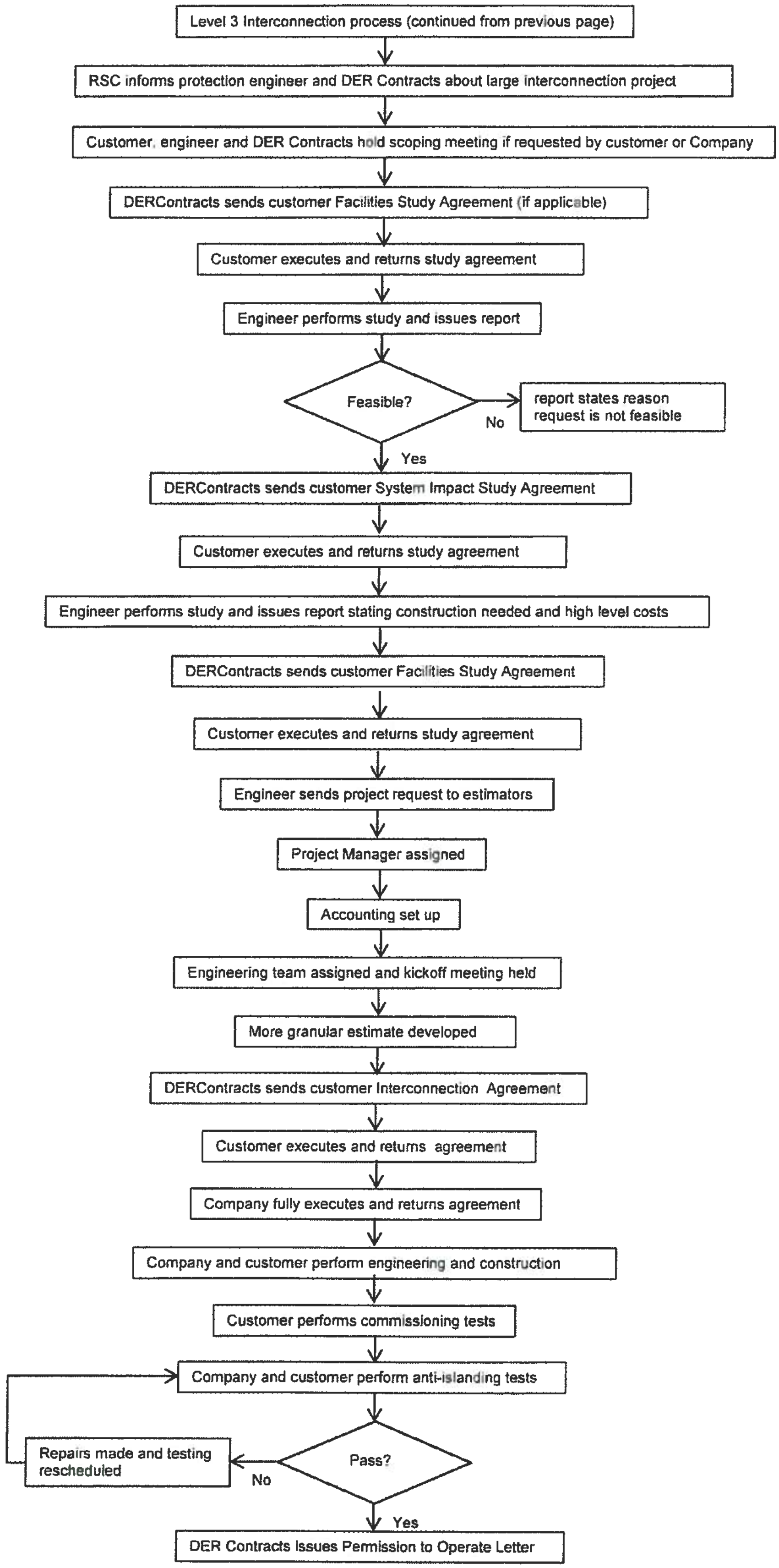
Level 3 Interconnection process (continued from previous page)
RSC informs protection engineer and DER Contracts about large interconnection project
Customer, engineer and DER Contracts hold scoping meeting if requested by customer or Company
DERContracts sends customer Facilities Study Agreement (if applicable)
Customer executes and returns study agreement
Engineer performs study and issues report
Feasible?
No
report states reason request is not feasible
Yes
DERContracts sends customer System Impact Study Agreement
Customer executes and returns study agreement
Engineer performs study and issues report stating construction needed and high level costs
DERContracts sends customer Facilities Study Agreement
Customer executes and returns study agreement
Engineer sends project request to estimators
Project Manager assigned
Accounting set up
Engineering team assigned and kickoff meeting held
More granular estimate developed
DERContracts sends customer Interconnection Agreement
Customer executes and returns agreement
Company fully executes and returns agreement
Company and customer perform engineering and construction
Customer performs commissioning tests
Company and customer perform anti-islanding tests
Pass?
No
Repairs made and testing rescheduled
Yes
DER Contracts Issues Permission to Operate Letter

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Requirement # 9

Interconnection request volumes and average time to approve applications.

Interconnection applications are broken into three review levels as defined by O.A.C 4901:1-22:

Level 1: Certified inverter-based less than 25 kW

Level 2: Certified equipment that falls within the guidelines specified in the following table:

Line Voltage	Expedited Review Regardless of Location	Expedited Review on a 600-amp line and w/in 2.5 feeder miles from substation
less than or equal to 5 kV	less than or equal to 500 kW	less than 2 MW
greater than 5 kV and less than or equal to 15 kV	less than or equal to 2 MW	less than 3 MW
greater than 15 kV and less than or equal to 30 kV	less than or equal to 3 MW	less than 4 MW
greater than 30 kV and less than or equal to 69 KV	less than or equal to 4 MW	less than 5 MW

Level 3: Does not meet the Level 1 and 2 requirements or does not utilize certified equipment.

The chart below shows the number of applications received, number of applications connected, and the average connection time by level for 2018.

Application Level	Applications Received	Applications Connected	Average connection time (days)
1	292	236	43
2	9	3	54
3	1	-	-

"Average connection time" includes the amount of time it takes for the customer to return the executed interconnect agreement, build the system, and inform Duke Energy Ohio that the system is built. It also includes the time for construction needed by Duke Energy Ohio for things such as transformer changeouts, if necessary. Duke Energy Ohio is compliant with O.A.C 4901:1-22 in terms of the amount of time to inform the customer that the application is complete and the time used to provide an interconnection agreement to the customer. Duke Energy Ohio will replace the meter within 10 business days of the customer informing us that the system is built, if the customer has returned the executed agreement.

The "Applications Received" number includes applications that have been canceled or withdrawn by the customer, transfers of ownership and those applications received late in the year that were unable to be connected by the end of the year.

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Requirement # 10

Organization structure for planning and interconnection, including number of full-time equivalent employees and descriptions of roles and responsibilities.

There are five distribution Planning Engineers responsible for system capacity planning in Duke Energy Ohio, one of which is responsible for the capacity and reliability of the feeders and substations that supply the Cincinnati underground network. Their work is managed by a departmental manager, who has responsibility for Distribution Planning.

The Planning Engineers are responsible for analyzing the performance of the distribution system and developing system modifications to meet capacity and reliability requirements using computer simulations. They also analyze electric system operating problems and conduct field investigations during system studies. While developing long-term plans for the electric system, their recommendations often lead to system expansion and the replacement of obsolete facilities.

There is one Interconnection Engineer in the Duke Energy Ohio Distribution organization, and one trainee occasionally assisting. The Interconnection Engineer performs technical review and interconnection studies of interconnection projects, sponsors distribution construction projects needed to accommodate interconnection, provides technical language needed for interconnection agreements, assists in the development of interconnection standards, provides technical support related to interconnection policy, and provides content for state interconnection reports. There are also separate supporting departments (Renewables Service Center and DER Contracts) for all jurisdictions of Duke Energy.

Requirement # 11

Descriptions of existing and planned energy efficiency and demand response programs, and how they are integrated into distribution planning.

Duke Energy Ohio's Energy Efficiency (EE) and Demand Response (DR) programs are summarized below. These programs are found in Duke Energy Ohio's annual EE/DSM (Demand Side Management) filings.

Energy Efficiency Education Program for Schools

The Energy Efficiency Education Program for Schools is an energy conservation program available to students in grades K-12 who reside in households served by Duke Energy Ohio.

The Program provides principals and teachers with an innovative curriculum, including education materials focused on teaching students about energy, renewable fuels, using energy resources wisely and classroom energy efficiency. All workbooks, assignments and activities meet state curriculum requirements.

Students are encouraged to complete a home energy survey with their family so that they can receive a free Energy Efficiency Starter Kit. The starter kit contains specific energy efficiency measures to reduce home energy consumption.

The centerpiece of the curriculum is a live interactive theatrical production with professional actors presented to students in grades K-8.

RESIDENTIAL PROGRAMS

My Home Energy Report

My Home Energy Report (MyHER) is a periodic usage report that compares a customer's energy use to similar residences in the same geographical area based on the age, size and heating source of the home.

The reports, distributed up to 12 times per year, deliver energy savings by encouraging customers to use energy more efficiently. The monthly and annual energy usage of each home is compared to the average home (top 50%) in their area, as well as, the efficient home (top 25%) and provides suggested energy efficiency improvements given the usage profile for that home. In addition, measure-specific offers, rebates or audit follow-ups from other Duke Energy Ohio programs are available to customers, based on the customer's energy profile.

MyHER customers also have access to the Interactive portal. The portal includes weekly email challenges and allows customers to see their energy usage, set and track energy saving goals, interact with calculators and ask experts for advice.

Neighborhood Energy Saver Program

The Neighborhood Energy Saver (NES) Program assists low-income customers in reducing energy costs. The program targets neighborhoods with a significant low-income customer base. Participation is driven through a neighborhood kick-off event that includes community leaders supporting the benefits of the program. The purpose of the kick-off event is to rally the neighborhood around energy efficiency and provide information to customers on how the program will operate in their neighborhood.

Customers can sign-up for an energy assessment at the time of the event. The energy assessment identifies energy efficiency opportunities in the home and provides customers with one-on-one education on energy efficiency techniques. Additionally, qualified customers can receive up to sixteen energy-saving products installed by professionally trained technicians.

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Residential Energy Assessments Program

The Residential Energy Assessments program currently consists of one assessment, the Home Energy House Call (HEHC). HEHC is a free in-home assessment designed to help residential customers reduce energy usage and save money. During the assessment, a Building Performance Institute (BPI) energy specialist completes a 60 to 90-minute walk through of the home and analyzes energy usage to identify energy saving opportunities. The specialist discusses both behavioral and equipment modifications that can help the customer save energy and money. A customized report is provided that identifies actions the customer can take to increase their energy efficiency.

Smart $aver® Residential Program

The Smart $aver® Residential program offers a variety of programs and measures that allow customers to take action and reduce energy consumption. The program includes:

Free LED Program

The Free LED Program is designed to increase the energy efficiency of residential customers by offering customers LED light bulbs to install in high-use fixtures within their homes. The LEDs are offered through an on-demand ordering platform, enabling eligible customers to request LEDs and have them shipped directly to their home. Eligibility is based on past campaign participation (i.e. coupons, business reply cards and other Duke Energy Ohio programs distributing free light bulbs). Bulbs are available in 3, 6, 8, 12 and 15 pack kits that contain 9-watt bulbs that are the equivalent of a 60-watt incandescent. The maximum number of bulbs available per customer is 15.

Online Savings Store

Duke Energy Ohio expanded its lighting offer to include specialty bulbs such as recessed lights, candelabras, globe, three-way bulbs, capsules and dimmable bulbs. Purchase limits are at the account level (36 bulbs for the lifetime of the account), however, customers may purchase additional bulbs without incentives if they choose. The web based ecommerce store provides discounted specialty lights and ships directly to the home.

Multifamily Energy Efficiency Program

The Multifamily Energy Efficiency Program provides apartment complexes with free installed lighting and water measures. Eligible units are Duke Energy Ohio served apartments on a residential rate. The program helps property managers upgrade lighting with energy efficient bulbs and save energy by offering water measures such as bath and kitchen faucet aerators, water saving showerheads and pipe wrap. The water measures are available to eligible customers with electric water heating.

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Save Energy and Water Kit Program (SEWKP)

The SEWKP is designed to increase the energy efficiency of residential customers by offering customers high efficiency, low flow water fixtures and insulated pipe tape to install in high-use fixtures within their homes. These energy saving devices are offered through a direct mail campaign, enabling eligible customers to request to have these devices shipped directly to their homes free of charge.

Heat Pump Water Heater Program

The Heat Pump Water Heater Program is designed to encourage the adoption of energy efficient water heating in new or existing residences. Duke Energy Ohio served homeowners currently residing in or building a single-family residence, condominium, or duplex home, with electric water heating, are eligible for this program. Installation of a high efficiency heat pump water heater will result in a $350 incentive.

Variable-Speed Pool Pump Program

The Variable-Speed Pool Pump Program is designed to encourage the adoption of energy efficient, variable-speed pool pumps for the main filtration of in-ground residential swimming pools. Duke Energy Ohio served homeowners currently residing in, or building, a single-family residence with an in-ground swimming pool are eligible for this program. Installation of a high efficiency, variable-speed pool pump will result in a $300 incentive.

Residential Heating, Ventilation and Air Conditioning (HVAC) Program

Duke Energy Ohio served homeowners currently residing in, or building, a single-family residence, condominium, duplex or mobile home are eligible for this program. Installation of a high efficiency heat pump or air conditioner will result in a $300 incentive. The HVAC incentives have been modified to include a tiered incentive structure, based on the efficiency rating of the new unit installed, along with an add-on optional smart thermostat measure, customers can choose to combine with equipment replacement for additional efficiency savings. Customers can receive up to $525 for replacement of an HVAC with a high efficient unit combined with a qualifying smart thermostat.

Low Income Services Program

The Low-Income Services Program provides assistance to low income customers by providing funding for energy efficiency measures. The upfront costs of high efficiency equipment are an especially difficult barrier for low income customers to overcome. This program includes the following:

- Weatherization and Refrigerator Replacement program - available to all customers within Duke Energy Ohio's service territory, with a household income up to 200% of the federal poverty level and who have not participated in the program within the past 10 years.

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- Electric Maintenance Service program - available for low-income elderly and disabled customers, with a household income up to 175% of poverty level. This program offers low-cost solutions for energy efficiency. Customers may receive energy efficiency products and services such as energy efficient lighting, water saving showerheads and aerators, water heater wraps, HVAC cleaning, HVAC filters, and energy efficiency education.
- Pay for Performance - this component of the program is offered to customers residing in the Duke Energy Ohio service territory. The program is offered through a partnership with People Working Cooperatively (PWC) and other qualified weatherization agencies. The program targets low income customers and focuses on energy efficiency. Customers receive whole-home weatherization services which include installation of energy efficiency measures and education. Duke Energy Ohio will purchase and recognize the energy and demand savings achieved through whole-home weatherization services that are currently funded by leveraged funds, funding from sources other than Duke Energy Ohio, that are not explicitly tied to energy efficiency.

These programs are promoted through, but not limited to, Community Action Agencies, Non-Governmental Organizations (NGO's), and direct mail to customers.

Power Manager® Program

The Power Manager Program provides incentives to residential consumers who allow Duke Energy Ohio to control their air conditioners during peak summer demand periods. Customers receive a one-time enrollment incentive of $25 or $35 depending on the Power Manager option they choose. In addition, they receive credits during each month of the Power Manager event season (May through September). Customers receive a total seasonal minimal credit amount of $5 or $8 depending on the option they enrolled in.

NON-RESIDENTIAL PROGRAMS

Power Manager® for Business Program

This is a combination EE and DR program for non-residential customers who allow Duke Energy Ohio to reduce the operation of the customer's A/C unit to help manage the power grid. Customers can choose between a Wi-Fi thermostat or load control switch, professionally installed for free, for each air conditioning or heat pump unit that they have. In addition to the equipment choice, customers can choose their unit reduction percentage level (30%, 50% or 75%). This is the percentage reduction of the normal on/off cycle of the unit. During a conservation period, Duke Energy Ohio will send a signal to the thermostat or switch to reduce the on time of the unit by the reduction percentage level selected by the customer. Customers participating in the program receive an annual incentive applied directly to their energy bill.

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Small Business Energy Saver Program

The purpose of the Small Business Energy Saver program is to reduce energy usage through the direct installation of energy efficiency measures within qualifying small non-residential Duke Energy Ohio customer facilities. Program participants receive a free, no-obligation energy assessment of their facility followed by a recommendation of energy efficiency measures to be installed in their facility. The assessment includes the projected energy savings, materials and installation costs, and up-front incentive amount. Once the customer decides of which measures to install, the installation is scheduled.

Smart $aver® Custom Rebate Program

The Smart $aver® Custom Incentive (Rebate) program is designed to meet the needs of Duke Energy Ohio non-residential customers with electrical energy saving projects involving more complicated or alternative technologies, or those measures not covered by standard prescriptive Smart $aver® incentives. Custom incentives require approval prior to the customer's decision to implement the project. Proposed energy efficiency measures may be eligible for custom incentives if they clearly reduce electrical consumption and/or demand.

Smart $aver® Non-Residential Prescriptive Program

The Smart $aver® Non-residential Prescriptive Incentive Program provides incentives to commercial and industrial consumers to install energy efficient equipment in applications involving new construction, retrofit, and replacement of failed equipment. The program uses incentives to encourage maintenance of existing equipment to reduce energy usage. Incentives are provided based on Duke Energy Ohio's cost effectiveness modeling to assure cost effectiveness over the life of the measure.

The program promotes prescriptive incentives for the following technologies – lighting, HVAC, pumps, variable frequency drives, food services, process equipment, and information technology equipment. Equipment and incentives are predefined based on current market assumptions and Duke Energy Ohio's engineering analysis. The eligible measures, incentives and requirements for both equipment and customer eligibility are listed in the applications posted on the Duke Energy website.

Non-Residential Energy Assessments Program

The purpose of the Non-Residential Energy Assessments Program is to assist non-residential customers in assessing their energy usage and providing recommendations for a more efficient use of energy. The program helps identify those customers who could benefit from other Duke Energy Ohio EE non-residential programs.

The cost of the on-site assessment varies based on complexity, size of the facility, and length of time required. Customers determined eligible will receive financial assistance for the cost of the service.

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Mercantile Self-Direct Rebates Program

The Duke Energy Ohio Mercantile Self-Direct Rebates program was enacted in accordance with O.A.C 4901:1-39-05(G) and the PUCO's Opinion and Order in Case No. 10-834-EL-POR. Customers who use 700,000 kWh or greater annually and national accounts are eligible for the program.

A mercantile self-direct customer may elect to commit energy savings or demand reductions from projects completed in the prior three calendar years, that did not receive Smart $aver® incentives, to Duke Energy Ohio's benchmark achievements. In return, Duke Energy Ohio will assist the customer in filing an application with the PUCO for approval of the portion of the incentive the customer would have received had they participated in Duke Energy Ohio's standard Smart $aver® Non-Residential programs.

PowerShare® Program

The PowerShare® program is Duke Energy Ohio's demand side management (or demand response) program geared toward commercial and industrial customers. The primary offering under PowerShare® is "CallOption" and it provides customers a variety of offers that are based on their willingness to shed load during times of peak system usage. In this program, credits are received regardless of whether an event is called or not. Energy credits are available for participation (shedding load) during curtailment events. The notice to curtail under these offers is between 30 minutes (emergency) and day-ahead (economic). There are penalties for non-compliance during a curtailment event.

Integrated Volt/VAR Control

Duke Energy Ohio utilizes voltage reduction through Integrated Volt/VAR Control (IVVC) to improve energy efficiency, provide demand reduction and satisfy energy conservation objectives. Electric utility experience and industry studies have shown that many loads consume less real and reactive power when voltage is slightly lowered. When voltage is reduced continuously the primary intent is energy conservation.

Voltage reduction can be used in emergency situations as a means of reducing power quickly during peak conditions or to defer the building or use of baseload generation. Duke Energy Ohio has implemented IVVC in the continuous 24/7/365 mode, lowering system voltage approximately 2% to reduce energy consumption.

IVVC is an integrated Distribution Management System (DMS) advanced application. The application generates several control actions to improve system operations in order to achieve one or more user pre-defined objectives; for example, to keep the node voltages and branch currents inside operational limits, to change the operation point to satisfy power factor requirements at specific locations in the network, or to reduce total demand or losses in the whole network. Control actions can be implemented by tap position adjustments of power transformers and regulators and on/off switching of shunt capacitors. The Minimize Demand problem formulation minimizes the total demand (loads plus loss) in the distribution system. Volt/VAR Management attempts to reduce the load voltages, lowering the overall demand.

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The automation of capacitor banks is foundational to the IVVC program and Duke Energy Ohio's distribution system data acquisition methodology. IVVC coordinates substation voltage with line voltage regulators and capacitor banks on the distribution circuit. The operation of these devices is coordinated by an IVVC algorithm to allow voltage to be systematically reduced at the substation and across the circuit, while sustaining acceptable voltage levels for customers. The reduction in voltage results in reduced energy consumption and energy demand on the distribution system. To sustain acceptable voltage levels, decisions to operate capacitors and line voltage regulators must be coordinated with the operation of the substation voltage regulator.

INTEGRATION INTO DISTRIBUTION PLANNING

The programs listed above are integrated into the Distribution Planning process by the results that are achieved in reducing system and circuit load. The reduced load information is then utilized in determining load growth trends and infrastructure upgrades as described in the Distribution Planning Overview section **(requirement # 2)** of this report.

Requirement # 12
Proposed use cases, methodology and timeline for hosting capacity analyses (HCA) and other relevant analyses.

Currently, Duke Energy Ohio performs hosting capacity analysis as needed, based on the size and location of interconnection requests.

Requirement # 13
Proposed non-wire alternatives (NWA) suitability criteria, identification of candidate capacity, and voltage or reliability projects for NWA pilots.

Pursuant to the Commission's Opinion and Order in Duke Energy Ohio's recent electric security plan Case Nos. 17-1263-EL-AIR, *et al.*, (December 19, 2018), Duke Energy Ohio received approval to move forward with its planned pilot battery storage program. As ordered, Duke Energy Ohio will file project details with the Commission for approval and cost recovery once the pilot projects are identified and sufficiently developed. Duke Energy Ohio is currently assessing potential projects that could be included in the pilot program.

Distribution Planners identify potential battery storage opportunities by evaluating five common energy storage applications: back-up power, Volt/VAR optimization, power factor correction, photovoltaic (PV) smoothing, and peak-load shaving. These applications will enable battery storage projects to defer or potentially eliminate the need for a traditional distribution investment and harden the grid.

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Requirement # 14

Any relevant planned technology investments (e.g. AMI, ADMS) and how they will be used to support or improve distribution planning.

INTEGRATED SYSTEMS OPERATIONS PLANNING (ISOP)

Requirements for modern electric utility systems are evolving rapidly with the advent of emerging new energy technologies, changes in policy, and rapid advancements in information exchange and customer needs. Integrated System Operations Planning (ISOP) focuses on the integration of utility planning disciplines for generation, transmission, distribution and customer programs to improve the valuation and optimization of energy resources across all segments of the utility system to best serve electric customers.

The ISOP process addresses key operational and economic considerations across all segments of the system through integration and refinement of existing system planning tools and, in some cases, development of new analytical tools to assess characteristics that have not historically been captured or considered in long-term planning. Some examples include locational values for distributed resources, system ancillaries and reserves needed to support future operations, and energy resource flexibility to support new dynamic operational demands on the system.

ISOP is a multi-year development program to build the tools, such as the Advanced Distribution Planning (ADP) Tool, and related processes needed to accommodate an increasingly integrated approach that will be required to optimize planning and operation of the electric utility system of the future. Components of the tool currently being evaluated include time series power flow, non-wires solution option assessments, and portfolio solution optimization utilizing both wires and non-wires solutions. This toolset is current being developed.

DER DISPATCH ENTERPRISE TOOL

This Distributed Energy Resources (DER) Dispatch Enterprise tool will coordinate with the Distribution Management System (DMS) and Energy Management System (EMS) to improve the way DERs are integrated in the energy supply mix, both at the Distribution and the bulk power level.

By providing system-wide visualization and control of large-scale DERs, the DER Dispatch Tool will enable system operators to model, forecast, and dispatch a portfolio of distributed energy resources, like solar generation, biofuel generation and energy storage, based on system conditions and real-time customer demand. This tool will help meet the need to match energy demand with supply, especially in emergency conditions.

Current processes and tools provide system operators with a rudimentary ability to quickly shed large blocks of solar generation in emergency conditions to meet standards for real power control (i.e. - North American Electric Reliability Corporation (NERC) standard BAL-001-2). The proposed solution will provide operators with a more automated and refined toolset to optimize management of both utility and customer owned DERs to meet system stability requirements. This tool is currently being developed.

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SYSTEM INTELLIGENCE & MONITORING

The system intelligence & monitoring program consists of leveraging current and future program system deployments (i.e. AMI, ADMS, remote asset management and analytic platforms) and future and current operational technology deployments (including additional sensing and data capture capability on new distribution line devices, edge computing, etc.) to develop a more complete picture of a customer's power quality & reliability (PQ&R) experience, including the ability to more proactively evaluate momentary outage and potentially harmonic and voltage sags/surges to the overall representation of the customers PQ&R experience.

The program evaluates several interconnecting proofs of concepts and pre-scale deployments that will further allow Duke Energy Ohio to develop and scale this capability, including the addition of sensing points at line devices (addition of new sensors that can capture additional data points to provide inputs to the data algorithm).

This program is currently being evaluated.

ENERGY STORAGE MANAGEMENT SYSTEM

The Energy Storage program includes the development and deployment of an Energy Storage Control System (ESCS) to manage a fleet of energy storage resources. Implementation of this platform is a critical step in preparing the organization operationally for scale adoption of storage.

Energy Storage systems provide new options for addressing various distribution grid challenges including traditional capacity planning. This extends to functioning as complementary assets that also improve distribution grid hosting capabilities and provide enhanced power quality capabilities. Additionally, there are opportunities to leverage these resources for upstream value to the transmission and generation components of the grid.

This program is currently in process.