REV Demonstration Project

Optimal Export Demonstration Project

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Orange and Rockland Utilities, Inc. Optimal Export Demonstration Project

Introduction

The increasing penetration of distributed energy resources ("DERs"), driven by improving economics, clean energy policy goals, and other factors, has already begun to face limitations based upon the static interconnection and planning criteria traditionally employed by utilities. However, by actively managing DERs interconnected with the grid, a higher penetration (in both volume and MW capacity) can be realized.

By employing new methods and technologies to make interconnection a more dynamic process, numerous benefits can be achieved including lower costs to utilities, lower costs to developers, and a more efficient deployment of capital so as to realize New York State's Clean Energy Standard ("CES") and the NY-Sun targets.

1. Executive Summary

Based upon traditional planning and interconnection criteria, there is typically a limit to the amount of DER that can be interconnected before that resource may introduce detrimental impacts to the grid. While interconnection screening processes have evolved to better accommodate the unique attributes of individual DER projects, active management of these resources through the deployment of new technologies should allow for higher penetrations of DERs to interconnect with the grid than possible under current conditions.

The Electric Power Research Institute has formally defined hosting capacity as:

> [T]he amount of DER that can be accommodated without adversely impacting power quality or reliability under existing control configurations and without requiring infrastructure upgrades. Hosting capacity can vary across many feeders, along a single distribution feeder, as well as within a secondary distribution system. Hosting capacity will also change over time as the distribution system infrastructure and operations change.[1]

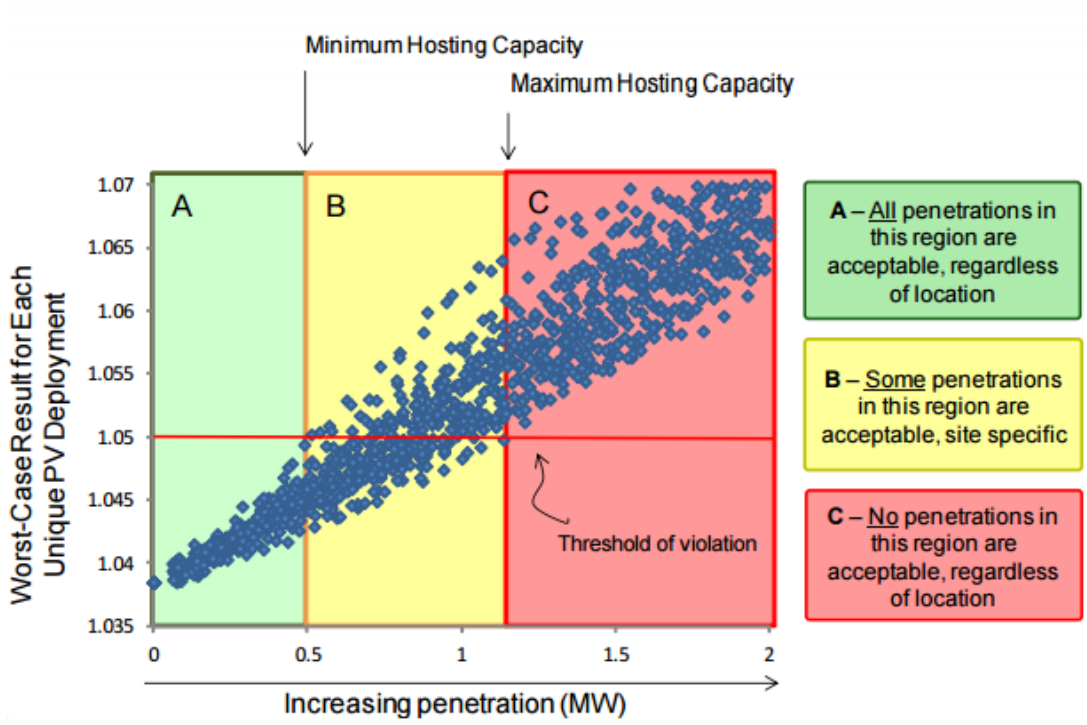
Increasing hosting capacity to accommodate greater numbers of DER has emerged as a consistent priority of the Reforming the Energy Vision ("REV") proceeding.[2] Increasing hosting capacity is a necessary precondition to the siting of distributed generation

[1] Electric Power Research Institute, *Defining a Roadmap for Successful Implementation of a Hosting Capacity Method for New York State, 2016*. 3002008848, p. 3.

[2] Case 14-M-0101, *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision ("*REV Proceeding"*)*, Order Adopting Regulatory Policy Framework and Implementation Plan ("Track One Order") (issued February 26, 2015)

resources.[3] Communicating hosting capacity to the developer community, in conjunction with the efforts outlined here is essential to providing proper economic signals to developers so as to enable greater penetration of clean sources of energy.

Figure 1: Hosting Capacity Thresholds (Source: EPRI)



Orange and Rockland Utilities, Inc. ("O&R" or the "Company") proposes the Optimal Export Demonstration Project ("Project") in response to the requirement established in the New York Public Service Commission's ("Commission") DSIP Order.[4] The DSIP Order states that, "as part of the Supplemental DSIP, utilities shall propose individual demonstration projects that provide them the opportunity to use alternate approaches to increasing hosting capacity and facilitate greater DER penetration on their networks."[5] This Project will provide practical experience through solar photovoltaic ("PV") test cases for the use of advanced inverter functionality coupled with supporting technology to optimize DER export to the Company's distribution system. The Company will explore customer/third-party interest and acceptance of active DER management solutions as an alternative to incurring traditional system upgrade costs to interconnect. The Company proposes that this Project will commence in 2017 and will run for approximately three years. In parallel

[3] REV Proceeding, Track One Order, p.3, where the Commission described DER as a wide variety of resources, including end-use energy efficiency, demand response, distributed storage, and distributed generation. This Project focuses on DER.

[4] [4] REV Proceeding, Order Adopting Distributed System Implementation Plan Guidance (issued April 20, 2016) ("DSIP Order")

[5] DSIP Order, p. 45.

with this Project, the Company is working with the Joint Utilities,[6] to determine the appropriate means for calculating and presenting hosting capacity.

This Project will allow for the testing of new technologies and business models for increasing hosting capacity on the O&R distribution system. By employing a combination of new protection methods and advanced technologies to increase hosting capacity on circuits while maximizing the size and export capability of DERs, the Company anticipates that the Project will result in customer alternatives to incurring significant system upgrade costs to interconnect to the Company's distribution system. Large DER applications, *i.e.*, 500 kW to 5 MW in size, may face significant distribution system upgrade costs to interconnect to the utility's distribution system. This Project will demonstrate whether advanced inverter functionality and third-party monitoring and control hardware and software technology will maximize the proposed DER project's ability to export without negatively impacting reliability, power quality, and/or distribution system performance. Through this Project, the Company will validate the use of these new technologies on the O&R distribution system and will also gain valuable insight into the value proposition and developer willingness to employ such technologies as an alternative to traditional interconnection arrangements.

2. **Business Model(s) Overview**

a. Problem (the Market Opportunity)

The electric distribution system has historically been designed for unidirectional power flow (*i.e.*, from central generation to load) to deliver power reliably and affordably to all customers in a utility's service territory. The increasing penetration of DERs, presents new challenges and the grid must be robust enough, and in some cases re-engineered and/or reinforced, to accommodate bidirectional power flows as well as intermittent generation resources. Quantification of the distribution utility's ability to accommodate DER interconnection to the electric system (which includes accommodating exported power, modifying relay settings and accommodating two-way power flows) can be expressed through hosting capacity.

Hosting capacity constraints may require the utility to upgrade infrastructure to accommodate the interconnection of additional DERs and impose additional costs on the interconnecting DER customer/developer. Some of the factors that impact hosting capacity may include the type and size of DER being interconnected, the characteristics of the local distribution system (*e.g.*, radial or networked, three phase or single phase circuit), the loading of the local distribution system, the size and order of other projects in the queue, and the local penetration of other DER on the same circuit or substation.

[6] The Joint Utilities are the electric distribution companies in New York State, *i.e.*, O&R, Central Hudson Gas & Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric & Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid, and Rochester Gas and Electric Corporation.

The operational constraints and the cost impacts for additional utility infrastructure to interconnect DER on project developers can adversely affect developers' business cases and may ultimately reduce DER penetration. This in turn leads to lower resource diversity and can present hurdles to achieving New York State's CES goals. Conversely, identifying hosting capacity up front and having standard techniques for increasing hosting capacity when a constraint is identified, may help the customer/developer to size the optimal project for its needs with relative certainty of cost and schedule. In parallel efforts, both within New York and other jurisdictions, utilities, regulators, and stakeholders are working to quantify and present hosting capacity estimates. This work is ongoing; however, O&R currently provides a map displaying general areas/circuits where the cost to interconnect more than 1MW of DER will be higher than traditional interconnection costs which require only distribution protection (found at www.oru.com/solar).

b. Solution (REV Demonstration Project Idea)

This Project will focus on both the introduction of a new protection methodology and corresponding monitoring and control technology and development of a value proposition to increase hosting capacity on the system by:

- Using a non-traditional protection interconnection methodology to increase hosting capacity on circuits and maximize the size and export capability of DER interconnection applicants; and
- Providing a variety of interconnection options to customers who would have incurred significant system upgrade costs due to the company's traditional interconnection protection methodology.

Large Applications (1 MW - 5 MW):

For large projects facing significant distribution system upgrade costs to interconnect, this Project will demonstrate whether advanced inverter functionality paired with supporting technology will maximize the proposed DER project's ability to export power without negatively impacting O&R's reliability, power quality, and distribution system performance.

Some utilities manage DERs via centralized control, such as a Distributed Energy Resource Management System ("DERMS") or Advanced Distribution Management System ("ADMS"). However, these are complex and expensive deployments with lengthy implementation times. This Project proposes testing the speed, impact, and cost efficiency of deploying location-specific solutions at the DER site. These solutions will have local control and logic, while coordinating with O&R's Distribution Management System ("DMS") via Supervisory Control and Data Acquisition ("SCADA") infrastructure. O&R intends to implement a technology platform that enables participation of the DER(s) in distribution system ancillary markets, consistent with the REV vision of a grid-edge marketplace and the utility as a Distributed System Platform ("DSP") provider. .

Deployment of this alternative solution may have certain drawbacks. For example, peer to peer communications will not be possible without additional back end integration. Therefore, multiple installations will not occur on the same circuit as part of this Project. The Company will consider additional back end integration in the future once this Project is complete and the technology is scaled.

For the demonstration of an optimal export solution with large projects (*i.e.*, 1 MW to 5 MW) the Company intends to partner with Smarter Grid Solutions ("SGS") to apply their Active Network Management ("ANM") technology to three to five project developers that have proposed DER projects in the interconnection queue. (Additional information on SGS is set forth in Appendix A to this filing.) The ANM platform can enable automated, real-time generation management for O&R to control and adjust for the feeder-level constraints that could otherwise limit hosting capacity. Candidate projects will be screened in the Company's interconnection online application portal, PowerClerk, and have a Coordinated Electric System Interconnection Review ("CESIR") completed.

Because this proposed solution has not been tested in its service territory, O&R is requiring that additional protection equipment be installed so that customers and the distribution system are protected while determining whether the deployed technology operates as designed. This cost will be borne by O&R, rather than the project developer, so that the business case for this new technology solution can be tested.

Mid-Sized Applications (50-750 kW):

In addition to the solution described above, O&R will also explore solutions for mid-sized DER projects (*i.e.*, 50-750 kW). There is an existing, but smaller, pool of projects (compared to typical 2MW Community Distributed Generation projects) that face significant distribution system upgrade costs in order to interconnect. O&R receives approximately 12 applications per year for mid-sized CDG applications. Advanced inverter technology and other solutions exist that would reduce system upgrade costs. Because this technology is unproven, the Company would require additional protective systems to be installed, making the projects uneconomical. As a result, many of these projects have been cancelled by the customer after exploring integration options. While fewer mid-sized candidates apply for interconnection than larger ones, mid-sized projects represent a potential missed opportunity to interconnect additional DER.

In response, the Company will develop partnerships with third parties to demonstrate the ability of advanced inverter functionality and supporting technology to allow a project's size to be maximized without incurring significant system upgrade costs or additional system protection. This will be accomplished by leveraging technology to match the DER system's export with a customer's real-time load plus hosting capacity available on the circuit segment.

Compared to the large project category, mid-sized projects are more complex in terms of both the project attributes and distribution upgrades required for interconnection. In

addition, mid-sized projects cannot afford the typical interconnection costs associated with distribution grid protection (*e.g*., reclosers). Therefore, the Company will identify projects in the queue that require distribution grid protection and work with the customer and developer to determine the best technologies for interconnection to minimize interconnection costs. The technologies being demonstrated for this size interconnection vary based upon system conditions, DER technology, costs for required protection and the capacity of the DG being installed. O&R will host several different technologies for projects in this range of projects based upon customer/developer feedback, initial installation cost to the customer to integrate the technology and interconnection challenges presented onsite. As with the large projects, mid-sized projects will enable O&R to test various technologies and advanced inverter functionalities to determine if they are capable of operating safely and reliably on the Company's distribution system.

O&R is currently in discussion with a mid-sized commercial interconnection applicant that is a viable candidate for this demonstration project. The commercial customer, an orchard, is seeking to install a PV system that significantly exceeds the load of the facility. Due to hosting capacity constraints on the local circuit, the customer will not be able to connect without incurring significant expenses to upgrade the existing distribution system. However, there may be an opportunity to use less expensive technologies and advanced inverter functionality to moderate the project's export without requiring costly distribution upgrades to interconnect.

The applicant above is an example of the type of project that could benefit from third-party technology, and will therefore continue to be pursued by the Company. As potential applicants are identified, O&R will develop experience with different vendors and interconnection arrangements as each unique situation requires. Within the context of this Project, O&R will assume interconnection protection costs in relation to additional monitoring and control while measuring the performance of the third-party equipment during the demonstration period to facilitate the testing of the third-party solution.

The success of this demonstration project will enable additional smaller projects to interconnect by reducing costs for requirement monitoring and control costs for grid protection. While the upfront costs for protection seem abundant, the outcome of this project may enable the Company to reduce interconnection costs for mid-sized projects from 70 – 90% of the traditional installation of a recloser for interconnection. The current market for projects in this size range is small, but this solution will enable a sector of small commercial customers to take advantage of opportunities to interconnect DER to the grid and grow this market across the state.

c. Hypotheses Being Tested

Hypotheses to be tested are:

- Whether interconnecting a DER with the use of advanced inverter functionalities, coupled with supporting technology, will allow customers to interconnect a larger DER system than otherwise would be possible;

- Whether monitoring and control capabilities of third-party software and hardware integrated with the utility SCADA monitoring and control system will allow less costly alternatives to traditional upgrade costs;
- Whether smart inverter technology paired with this third-party integration can maximize a DER system's ability to export back to the grid up to, but not above, a level that would negatively impact O&R's reliability, power quality, and operating parameters, thus avoiding costly upgrades for developers; and
- Whether offering customers an array of interconnection options will encourage development and interconnection of greater numbers of DERs.

d. Commission's REV Demonstration Principles Being Addressed

This Project addresses several of the demonstration project criteria outlined in the Track One Order. In addition, this Project will contribute to achieving REV policy objectives that align with the Commission's Standard Interconnection Requirements ("SIR").[7] Alignment with specific demonstration project criteria is outlined below:

i. *Third-Party Participation and Partnership* – This Project will provide opportunities for third-party solution providers to deploy solutions in the field, using REV Demonstration Project funds to prove the technology integration while overcoming hurdles for commercial adoption.

ii. *Utility Identified Problem, Market Identified Solution* – In this case, O&R has identified the conditions under which grid infrastructure upgrades are required to accommodate proposed DER capacity. The market will be able to provide solutions to customers through advanced inverter functionality paired with complementary technology offerings that dynamically manage export to the grid without incurring significant upgrade costs to interconnect or fundamentally altering the utility's planning or operating criteria. Also, mid-sized projects rarely can overcome financial hurdles for interconnection due to the cost of traditional monitoring and control schemes. This Project will allow various third-party software and hardware integration options with a portfolio of price points amicable to the developer community.

iii. *Delineation of Economic Value* – For customers facing steep distribution system upgrade costs to interconnect a proposed DER system, this Project offers alternatives that may allow interconnection of DER without detrimentally impacting the economics of the DER project.

iv. *Competitive Market for Grid Services* – This Project proposes to test some of the capabilities of advanced smart inverters, when the specification is released in late 2017, to provide benefits to the grid, treating the DER as a dynamic resource capable of being dispatched, curtailed and aggregated rather than as a "set it and

[7] Case 15-E-0557, *In the Matter of Proposed Amendments to the New York State Standardized Interconnection Requirements (SIR) for Distributed Generators 2 MW or Less ("*NYS SIR Proceeding*")*.

forget it" generator. Advanced control of the DER inverter provides the opportunity to maximize the value of the resource to the grid, and provides a platform for participation in distribution ancillary services markets, aligning with the goals of REV and DSP functionality, such as Volt-VAr optimization.

v. *Market Standards and Rules* – This Project builds upon rules for the DER interconnection process established through the SIR, and will help inform technical standards for new solutions. Active management of the DER may allow the resource owner to maximize compensation through the new Value of DER ("VDER") tariff introduced in early 2017, modifying system performance to capture as many value streams as possible. Further, greater control of the DER allows for potential participation in wholesale markets, subject to the New York Independent System Operator ("NYISO") and Federal Energy Regulatory Commission ("FERC") market rules.

vi. *Pricing and Rate Design Modifications* – While this Project is not intended to test pricing and rate design, by introducing active management of DERs, developers may be given additionally flexibility to participate in evolving tariffs and market structures in future years. As mentioned above, this includes the VDER tariff and emerging distribution-level ancillary services markets.

vii. *Advanced Distribution Systems* – The technologies offered as a means of increasing hosting capacity are at the cutting edge of distributed control technology. Each includes secure two-way communications, real time operation of dynamic generation, and other system technologies that support awareness, flexibility, efficiency, and cost effectiveness.

viii. *Customer Engagement* - Through this Project, O&R will have the opportunity to work with multiple DER customers to test customer engagement and acceptance of alternative interconnection solutions for mid-size and large projects. These customers span the, industrial, and commercial sectors, and the Project will allow interconnection for each customer class.

3 Market Attractiveness

a. Unique Value Proposition (from the following perspectives)

a. *Participating Customers* - Participating customers will be able to choose from a variety of solution providers to maximize the capacity of their DER systems while reducing the cost to interconnect.

b. *Third-Parties* - Both the technology vendor partners and the third-party DER developers should benefit from this Project:

Technology Vendors

Technologies for actively managing DER output and maximizing export, while preventing negative impacts to the grid, have seen limited deployment in New York State. Technology vendors will benefit through demonstration of their technologies and approval for their equipment to be used in O&R's service territory. Due to the additional measurement and protection equipment required to test these technologies, significant commercial hurdles exist to their deployment in the absence of a demonstration project.

DER Developers

DER developers will benefit from reduced interconnection costs, streamlined interconnection process, a wider choice of options to interconnect,and greater cost certainty for projects. The cost certainty should decrease the risk of projects, thus improving business model options for developers and improving the efficiency of the marketplace.

c. *Company* - The Company will benefit by gaining experience with advanced and alternative technologies to interconnect DER, determining and increasing local hosting capacity, and enabling monitoring and control via third-party software and hardware solutions. This experience could lead O&R to allow these technologies as an alternative to traditional interconnection upgrades post-demonstration. Also, by facilitating more DER interconnections on otherwise constrained circuits, the demonstration will help meet REV, NY-Sun, and New York's CES goals and requirements. The lessons learned in this Project will be shared among other New York utilities.

b. Customer Segmentation and Demographics

The technology-enabled opportunities to interconnect will accommodate proposed DER projects that would otherwise require significant infrastructure upgrade costs. These projects can be identified based on the interconnection queue or theCESIR. The applications are expected to be segmented both by the type and size of DER and location on the Company's system.

c. Channels (Communication, Sales, Promotion)

The Company will promote awareness of this Project through multiple channels. The primary channel will be through the interconnection process. The Company will present this Project as an option to select projects where preliminary technical reviews have identified that significant system upgrades are required to interconnect. O&R's Interconnection team will perform direct outreach to project developers with proposed DER projects in the interconnection queue that match the criteria for participation in this

Project. O&R will also use technology vendors' existing relationships with DER developers to communicate the existence of this Project and solicit participation.

In addition, O&R will advertise this Project through several different types of outreach that it conducts. These will include www.oru.com/solar, O&R semi-annual demonstration project updates, and meetings that the Interconnection Policy Working Group team conducts with developers. O&R will also work closely with the REV Connect team in the development and outreach for this Project.

d. Ability to Scale

As O&R gains experience with actively managing DERs on its network through advanced inverter functionality paired with supporting technology, similar solutions will be offered across the O&R service territory as alternatives to infrastructure upgrades for eligible customers. These solutions likely will contain eligibility criteria and requirements developed through experience gained through this Project. Through industry use, lessons learned about the technologies' ability to increase hosting capacity on circuits will also contribute to the development and future deployment of these offerings.

4. Demonstration Plan

a. Metrics for Success (Now and in the Future)

The metrics to evaluate this Project's success should measure both the functional effectiveness of the new technology and the market response to the lower cost interconnection option.

Technical Success Metrics:

- The occurrence and magnitude of voltage fluctuations and overvoltage conditions attributed to the DER unit;
- The occurrence and magnitude of thermal impacts on feeders with DERs;
- Successful mitigation of power factor degradation to allow DER interconnections rather than requiring costly upgrades for interconnection; and
- Successful implementation of advanced third-party control technologies in optimizing DER output based upon operating performance.

Market Response Metrics:

- Engagement with DER developers and customers on interconnection options;
- Reduction in DER application withdrawals due to interconnection costs;
- Difference in cost estimates associated with DER applications that elect to participate in this Project, relative to the cost estimates for the work required for traditional system upgrades; and
- Post-Project adoption of demonstrated technologies, measured by number of installations

b. Timelines, Milestones and Data Collection

Assuming an approval cycle similar to those of past demonstration projects, and given the availability of the new proposed technology, the targeted roll-out of the Project is Q4 2017. This Project will include overlapping phases, as the deployment of each project site will likely be staggered. Efforts to identify and analyze the viability for participation of subsequent sites will likely still be underway as the first participating site begins construction. A detailed project plan will be developed as part of the implementation plan, prior to Project commencement. However, the timeline to incorporate solutions with participating sites will be heavily dependent on those sites being able to begin construction and interconnect, which will be impacted by the outcome of a number of ongoing regulatory actions including Commission orders regarding queue management and the Value of DER.

Preliminary Timeline:

O&R Hosting Capacity Demonstration Preliminary Timeline																									
	2017		2018												2019										
Tasks:	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Phase 1 - Analysis and Engagement																										
Phase 2 - Deployment																										
Phase 3 - Evaluation and Scaling																										

- Phase 1- Analysis and Engagement: November 2017 – November 2018 (up to 12 Months)

  The Company will focus its efforts on developing the demonstration implementation plan and identify existing interconnection applications in O&R's service territory that are viable candidates for the third-party technologies. The project team will review this pool of project candidates and model the impact of third-party technologies. Multiple scenarios will be modelled making assumptions on the activities of other developers with active interconnection applications on the same feeder. This exercise will produce a detailed report for each new DER seeking interconnection on constrained feeders, including the interconnection cost with selected solution(s) and associated risk value(s).

  The project team will seek interest in a more cost effective solution with third-party vendors inviting developers to model the risk impact to project economics together with the cost of the solution and compare it to the business as usual scenario. Performed across the developers on a given feeder, this analysis will yield actively managed hosting capacity that will be defined by the project economics of the developers rather than the traditional static pass/fail screens. This actively managed hosting capacity value, as determined by the market, will be unique to each feeder and project. DER developers who find that the alternative interconnection solution meets internal rate of return requirements will have the chance to move forward.

The key deliverables for Phase 1 include:

- Optimal Export Demonstration Project Implementation Plan;
- Comprehensive review of the pool of interconnection applications for deployment;
- Detailed curtailment report delivered to the developer that will include an analysis of the project's feeder impact (based upon load data and PV production profile) and a curtailment number (with associated yield loss). The developer will use this report when modeling project yield and sourcing third-party capital to build the system;
- Engagement with viable deployment cases, which includes a willing DER developer and customer;
- Proof of concept design and configuration of end-to-end communications for integration of alternative interconnection solutions with O&R's SCADA system; and
- Bench testing of communications within a controlled test environment

- Phase 2 - Deployment: March 2018 – March 2019 (12 Months)

  During this phase O&R and SGS will work with identified developers and the projects in the interconnection queue to complete interconnection agreements (modifications to the agreements will be considered as needed) and review ownership arrangements.

  This phase also includes the delivery, installation, and commissioning of the solution to a range of candidate sites. This Project will consider different use cases, risk mitigation strategies, and utility interfaces. Control room visibility and monitoring of the individual installations will be explored through potential interfaces to the existing SCADA system, where status information and interaction with the DER could be performed.

  The key deliverables for Phase 2 include:

  - Executed interconnection agreements;
  - Implementation of interconnection solutions; and
  - Factory acceptance testing, physical deployment, site acceptance testing and integration of new technologies.

- Phase 3 - Evaluation and Scaling: May 2018 – December 2019 (20 Months)

  The efforts on this phase will overlap with the completion of the demonstration deployments. Initial actions within Phase 3 will include the evaluation of the performance of DER projects using the identified solution and confirming that the technology is maximizing DER output without negatively impacting the Company's electric delivery system. Assuming favorable performance of the demonstration, efforts can begin to scale the integration of actively managed interconnection solutions into a business-as-usual interconnection option for DER developers in

O&R's service territory. This is in pursuit of increasing hosting capacity across the service territory as DER developers consider business model modifications to integrate risks.

The key deliverables for Phase 3 include:

- Integration of a scalable screening system into O&R's interconnection process to identify potential candidates for Project-enabled interconnection;
- Adoption of the selected technology and other similar technologies as a business as usual solution to hosting capacity limitations;
- Increase familiarity among DER developers and financiers with risk and optimal export interconnection concepts; and
- Expand the selected technology and other similar technologies to remaining suitable applicants.

c. Participation

i. Target Population, Sample Size, Control Group

This Project will be offered to those DER developers that have applications in the queue following Commission action on queue management in 2017. O&R expects that it will have a number of eligible applications based on the queue size at the time of filing. Given the relatively small sample size of eligible customers (*i.e.*, those with large enough DER applications in specific locations on the system), there are not enough interconnections to divide them into separate control group and test groups. As such, the results will have to be compared against existing data.

ii. Third-Party Partner(s)

For the demonstration of an optimal export solution with large projects (1 MW to 5 MW) the Company intends to partner with SGS (additional information on SGS is located in the Appendix).

To demonstrate an optimal export solution with mid-sized projects (50 kW to 750 kW), O&R will explore relationships with various technology solution providers and customers on a case-by-case basis. Potential participants in this Project will include DER developers with residential, C&I, remote net-metered, and community DG applications that would otherwise require significant system upgrades to interconnect.

iii. Utility Resources and Capabilities

This Project will require resources from across the Company. In particular, members of the following organizations will contribute:

- Technology Engineering – Standard Interconnection Requirement process administration;

- Distribution Engineering – Load flow modeling of system impacts of proposed DER;
- System Engineering - Monitoring and control development and communications coordination;
- O&R Control Center – Control of disconnect and reconnect when planned work is near DER; and
- Utility of the Future – Experiment design, project implementation, reporting, measurement and verification, and oversight.

d. Customer Outreach / Community Engagement

i. Outreach to Affected Communities

In addition to advertising this solution to developers through the interconnection process, O&R will work closely with the REV Connect team and platform to identify potential developer/third-party participants and share lessons learned with other utilities and stakeholders.

ii. Motivating Customers / Communities

Depending on specific feeder-level constraints, DER interconnection applicants will likely be motivated by an alternative to costly system infrastructure upgrade costs in order to interconnect. DER developers will be better able to weigh the relative economics of the business as usual interconnection pathway with new solutions in deciding how to proceed with their projects.

e. Conditions / Barriers

i. Market Rules and Standards

The recently issued VDER Order,[8] coupled with recent actions by the Commission on queue management, will impact developer decision-making and cost-benefit analysis when approaching interconnection options. Advanced inverter functionality and active management of DER presents the opportunity to maximize the benefits of DER on the grid, and its associated compensation under the VDER tariff. Further, these technologies may enable aggregation and participation in the NYISO wholesale markets, subject to evolving FERC and NYISO rules.

ii. Consumer Protections

There are no relevant consumer protections needed for this Project beyond what is offered in the SIR.

iii. Channel or Market Challenges

[8] Case 15-E-0751 et al., *In the Matter of the Value of Distributed Energy Resources, et al*., Order on Phase One Value of Distributed Energy Resources Implementation Proposals, Cost Mitigation Issues, and Related Matters (issued September 14, 2017) ("VDER Order"),

This Project faces several potential challenges. First, the, success of this Project is largely determined by participation in the developer community, which O&R proposes to address through significant outreach as described in Section 3c above.

Second, the general complexities involved in development of DER projects may also present a challenge. Many unforeseen hurdles arise through the DER development process which can serve to prolong the process or prevent a particular project from moving forward. A few examples include town planning board moratoriums, issues surrounding real property rights, the discovery of endangered species at the project site, unexpected regulatory changes, and developer financial challenges. O&R and a third-party technology partner could spend months on a particular project with a DER developer, only to have the project cancelled due to one of these developments.

Finally, developers might be apprehensive to try a new technology solution due to the potential uncertainty around system yield. To mitigate this risk, the Company will work to improve customer and developer understanding of the cost savings that may be achieved, and quantify the impact to DER system yield, by actively managing DER system output. Through these efforts, the Company will gain a better understanding of DER developer business models and how the new solutions align with them.

5. Financial Elements / Revenue Model

a. Investments

i. Details and Timing of Spending

O&R's total cost for this demonstration project is estimated to be $1,155,000. Exact costs will depend on the specific configuration of DER sites included in this Project and the necessary monitoring and control associated with each site.

O&R has not deployed any technology to date that is capable of actively managing a DER's interaction with the grid in response to measured system constraints. As such, O&R is requiring a recloser advanced metering distribution automation device with sensors to confirm that the installed solutions perform as designed. Without REV Demonstration project funding, the need for redundant protection equipment would render a new technology solution not economically viable, despite its ability to increase capacity of the grid, to bring more DER online and move the State towards its NY-SUN and CES goals. REV Demonstration Project funds will enable the deployment of interconnection solutions for both large and medium-size DER projects that maximize DER systems' output without negative impacts on the system, test the business models for these technologies, and offer customers a wider variety of options to choose from when determining whether and how to interconnect DER.

Large Applications:
Costs incurred by O&R for each project site will include the sensors, monitoring, and control equipment required to confirm that the installed solutions perform as intended. In addition, O&R will retain SGS to provide analysis, support, and software integration throughout the demonstration project. O&R will purchase a demonstration device for use in the test environment, with a 50% discounted software license. O&R will also incur internal project management and system engineering costs at the launch of the project (anticipated in Q1 2018). O&R will not pay any development, license or deployment costs for the interconnection solutions deployed in the field.

Costs for the new solution software license, hardware, and deployment will be borne by the DER project developers. These costs will be incurred as a part of the interconnection payment that a developer makes to O&R to connect to the grid. This will satisfy one of the goals of the Project, *i.e.*, to test the business model of employing advanced inverter functionality and associated technology to optimize DER output while lowering interconnection costs.

SGS will commit internal resources to the success of this Project, including an approximate 25% cost share as part of the overall projected budget associated with SGS services and products. These costs include an SGS contribution toward the license fee for the demonstration device and in-kind labor services to O&R for several tasks that will be performed throughout this Project and are described further below.

Mid-sized Applications:
O&R's costs associated with the mid-sized projects will include protection installation, commissioning, and additional monitoring and control costs for interconnection to test the efficiency and functionality of the third-party technology. The additional measure is so that the third-party solution does not negatively impact the grid or adjacent customers. Overall cost will be determined by the number of customer sites that qualify for the application of the solution and the unique electrical configuration and project constraints for interconnection. The Company is assuming that customers/developers in this category of size are not capable of any traditional protection costs to upgrade or install Company provided solutions with a financially feasible outcome. In the future state, the Company anticipates that once a third-party technology is proven as an adequate means of monitoring and control, a suite of third-party solution providers will be offered to this customer class for interconnection for protection. While the upfront costs for protection seem abundant, the outcome of this Project may enable the Company to reduce interconnection costs for mid-sized projects from 70 – 90% of the traditional installation of a recloser for interconnection. The protection installed during the demonstration project shall be repurposed for installation on other DER projects or used in the Grid Modernization (Smart Grid) plan for the Company.

ii. Leveraging Third-Party Capital

This Project leverages third-party capital and resources in a number of ways. For large projects, SGS is committing significant internal resources for the development of this Project and acquisition of customers. This cost sharing includes project developer engagement, in-depth analysis of interconnection applicants to assess their potential as participants in this Project, project management, and training for O&R staff. SGS is also contributing intellectual capital through the analysis they will perform to assess potential Project candidates. O&R will be able to retain these lessons and integrate them into alternative interconnection offerings, and future REV use cases, on a post-demonstration basis. SGS assumes much of the risk of customer acquisition. For example, the market may not accept this Project as a viable alternative to a traditional interconnection arrangement or a project developer may decide not to move forward with the project due to unforeseen development hurdles. The developer will bear the cost of the interconnection arrangement using the SGS technology. As such, SGS will assume a loss of potential revenue should the technology not function accordingly and not be accepted in the market as an alternative solution.

b. Returns

By using actively managed, REV market-enabling interconnection technologies in lieu of traditional grid reinforcement to interconnect DERs, project developers stand to save significant development costs. Similar technology deployed in the United Kingdom saved developers an average of 75 percent on interconnection costs/upgrades as compared to a business as usual solution, according to SGS statistical data. These savings will enable a greater number of DERs to interconnect, while keeping the grid within planning and operating limits, while assisting the State to achieve its NY-Sun and CES goals, and the clean and efficient grid objectives of REV. These savings will help the DER marketplace become more efficient and self-sustaining.

i. Cost Effectiveness

The benefits of participation in the Project will vary by customer based on the specifics of the interconnection application and the proposed location on the system for interconnection.

At static hosting capacity limits, the grid reinforcements required for interconnection become expensive for the DER developer and could limit DER growth. These grid reinforcements, such as new transformers, reconductoring, and voltage regulators are designed and installed to cover a worst case planning scenario. Given REV goals to increase the capacity utilization of the electric grid, the traditional solution is less cost effective than new interconnection technologies that can actively manage DER output by mitigating and/or curtailing resources during the worst-case planning scenario. This Project seeks to test the business model for this new, more cost effective solution for DER interconnection.

6. Reporting

a Information to be Included in Quarterly Reports to the Commission

O&R will submit quarterly reports to the Commission that will include a status report on project milestones, actual versus budgeted project spending, and success metrics. In addition, these quarterly reports will include lessons learned that may prove beneficial to stakeholders.

7. Conclusion

The Company is ultimately responsible for the safe and reliable operation of its electric delivery system. This responsibility is of paramount importance to the Company as it designs and operates the system, including the evaluation of DER interconnection requests. O&R is working with the developer community to refine current methodologies, seeking alternative protection solutions and piloting new technologies to facilitate the adoption of DERs in the Company's service territory. This Project tests the protection methodology of using new technologies for DER interconnection applicants facing high costs to connect to the grid.

a. Post-Demonstration Benefits

i. Qualitative

This Project may allow DER applicants to interconnect that would have otherwise chosen not to do so due to high costs. This will result in increasing DER penetration on O&R's distribution system and contributing to CES and State Energy Goals. This Project will also allow the Company to gain experience with the performance and monitoring and control of various inverter functionalities and supporting technologies on the distribution system.

ii. Quantitative

The quantitative benefits of this Project include the increase in hosting capacity, and, in turn, higher penetration of DERs than would otherwise be possible on the system.

b. Plans to Scale

i. Break Points in Scaling

Following the evaluation phase at the conclusion of this Project, proven technologies and best practices developed through the implementation of this Project are expected to be used to develop offerings that would be made available to all eligible interconnection applicants in the O&R service territory. Outside of the O&R service territory, testing new interconnection technologies will enable replication and establishment of best practices statewide.

c. Advantage

The desired outcome of this Project is a less expensive interconnection process that enables more successful DER interconnection applications. This will be achieved by reducing the costs to interconnect in certain situations and locations. In addition, successful projects will begin to test technologies and lay the groundwork for advanced DER control that could enable participation in both distribution ancillary services and wholesale power markets, in pursuit of REV principles and the vision of a DSPP.

Appendix A

Smarter Grid Solutions ("SGS") Overview:

SGS delivers products and services that enable utilities and developers to integrate DER. It provides Active Network Management ("ANM") products, planning tools, and a range of consultant and engineering services. SGS uniquely combines real-time, autonomous, and deterministic control into its ANM solutions, a variation of which will be employed in this demonstration project. SGS currently supports customers worldwide from its offices in New York, California, Glasgow, and London.

An SGS ANM platform can enable automated, real-time generation management for O&R to control and adjust for the feeder-level constraints that could dictate hosting capacity. ANM has been deployed in the United Kingdom, controlling 276MW to date, and selectively in the United States. SGS has an ongoing demonstration in New York with New York State Electric and Gas Corporation ("NYSEG") through the Flexible Interconnection Capacity Solution ("FICS") project, and in California with Southern California Edison's Integrated Grid Project. SGS recently completed an 18-month ANM demonstration project at the U.S. Department of Energy's National Renewable Energy Laboratory's Energy System Integration Facility.

Appendix B

Connect+ Overview:

Connect+ is a software platform contained within a ruggedized panel placed next to the DER that controls the output of the DER in real-time in response to grid-level constraints. *Connect+* has a variety of integration adapters that allows it to integrate with legacy smart grid infrastructure and utilize all commonplace utility communications media. *Connect+* can interface with a Distribution Management System ("DMS") via Supervisory Control and Data Acquisition ("SCADA") infrastructure, providing configurable control-room visibility and monitoring of device status and allowing manual override.

Connect+ functionality includes:

- **Autonomous, Real-Time Control of DER:** use thresholds, operating margins, and rules based approaches to autonomously control real and reactive power in response to real-time measurements and grid events, including thermal and voltage constraints. Includes circuit breaker trip and reclose functionality and can integrate data from remote monitoring points;
- **Multi-DER Coordination:** can coordinate multiple DER like solar PV, wind, and energy storage to optimize site energy usage; includes generation-storage pairing and load following capability;
- **Scheduled Control with Real-Time Intervention:** creation of schedules to perform DER dispatch and rules that trigger automatic intervention and deviation from the schedule in real time;
- **Deterministic and Fail to Safe Functionality:** guarantees performance, maintains grid security, and protects against system failures; and
- **Data Exchange Standards:** The *Connect+* platform can support the majority of electricity network field data exchange standards and can be configured to converse with network equipment using Modbus, DNP3 and IEC 61850. It integrates with existing SCADA systems and controls through fiber cable, RF mesh, cellular networks or other systems.

Connect+ is installed at the location of the generator to be controlled, and collects measurements directly from both a local transducer at the point of common coupling (PCC) and status information from the circuit breaker. Figure 2, below, shows an example of a *Connect+* deployment. *Connect+* can monitor up to two power flow or voltage measurements against pre-defined thresholds and calculate real power capacity available to a generator while ensuring that the constraint measurement remains within acceptable limits. The voltage at the generator's point of connection is a typical measurement point for a *Connect+* deployment, shown as a "Local MP" in figure below. *Connect+* can also monitor a voltage or power flow measurement point that is remote to the generator.

Figure 2: *Connect+* Interfaces