State of New York
Public Service Commission

Proceeding on Motion of the Commission in Regard to Petition of Pareto Energy Ltd. to Implement a Microgrid Business Model as a Least-Cost Resource to Meet Reliability Contingencies and Demand Management Objectives at Consolidated Edison Company of New York, Inc.	CASE 15-E-0250

REQUEST FOR THREE REGULATORY RULINGS ON A PROJECT FINANCING AND PROFIT SHARING PLAN FOR DEMONSTRATING A TWO-SIDED MICROGRID PLATFORM BUSINESS MODEL IN BROOKLYN AND QUEENS

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1 INTRODUCTION

Last April, a petition by Pareto Energy, LTD ("Pareto Energy") informed the New York State Public Service Commission ("Commission") about a Power Electronics Platform and Project Financing and Profit Sharing Plan for demonstrating a Two-Sided Microgrid Business Model in Brooklyn and Queens.[1]

Pareto Energy's Business Model will use combined heat and power ("CHP") facilities that have superior affordability, reliability and power quality on the downstream side of the Platform to generate economic benefits for the utility transmission and distribution network ("Macrogrid") on the upstream side of the Platform. Ten existing or planned CHP sites in Brooklyn and Queens with a total of 369 MWs of CHP have been targeted.[2]

For interconnecting the CHP Microgrids to the Utility Macrogrid, investing $1.50 per watt to use power electronics rather than $2.50 per watt to use mechanical switchgear facilitates an economically viable business model. The much less expensive power electronics, with their superior functionality, enable microgrid-to-macrogrid financial transactions that mechanical interconnection cannot technologically accomplish.

Three heavily subsidized distributed energy resource ("DER") programs of the Consolidated Edison Company of New York, Inc. ("Con Edison") compete against Pareto Energy's privately-funded Business Model.[3] Where a customer has selected Pareto Energy's Two Sided Platform in the competitive market place for interconnection

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[1] Case 15-E-0250, *Proceeding on Motion of the Commission in Regard to Petition of Pareto Energy Ltd. to Implement a Microgrid Business Model as a Least-Cost Resource to Meet Reliability Contingencies and Demand Management Objectives at Consolidated Edison Company of New York, Inc.*, Petition by Pareto Energy LTD to Eliminate Regulatory Uncertainty ("Petition" or "Pareto Energy Petition"), April 10, 2015.
[2] The target CHP facilities are described in Pareto Energy Petition, P. 2-4.
[3] The three Con Edison DER programs are: Indian Point Energy Center Reliability Contingency Plan ("IPEC Plan"), Brooklyn-Queens Demand Management Program ("BQDM Program"), and Virtual Power Plant Demonstration Project ("VPP Demonstration").

services for a project that offers net earnings for utility ratepayers and shareholders, Con Edison vehemently opposes the demonstration of Pareto Energy's Two-Sided Microgrid Platform Business Model.[4]

1.1 An update of Pareto Energy's innovative project financing and profit sharing plan for its Two-Sided Microgrid Platform Business Model

Pareto Energy is privately financing a $12 million demonstration of its Two-Sided Microgrid Platform Business Model. The project will interconnect 8 MWs of an existing CHP facility that serves the Kings Plaza Shopping Center and Marina in Brooklyn ("KP-CHP Demonstration Project"). Pareto Energy will privately fund the KP-CHP Demonstration Project with $4 million of cash contributions and $8 million of borrowing.[5]

Since Pareto Energy filed its Petition with the Commission last April, the New York Independent System Operator ("NYSIO") has announced that it intends to open a Behind-the-Meter Net Generation ("BTM:NG") market for Microgrid-to-Macrogrid transactions.[6] The NYISO also committed in its recent long range plan to support demonstration projects.[7] Consequently, Pareto Energy began engaging with NYISO officials last August to demonstrate the size and scope of transactions from the Two-Sided Microgrid Platform Business Model that could animate the emerging BTM:NG market.

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[4] Case 15-E-0250, *Proceeding on Motion of the Commission in Regard to Petition of Pareto Energy Ltd. to Implement a Microgrid Business Model as a Least-Cost Resource to Meet Reliability Contingencies and Demand Management Objectives at Consolidated Edison Company of New York, Inc.*, Comments of Consolidated Edison Company of New York, Inc. in Response to Petition by Pareto Energy LTD ("Con Edison Opposition"), July 6, 2015.

[5] Pareto Energy Petition, "Project Financing and Profit Sharing Plan", pp. 15-20.

[6] For a detailed explanation of the new BTM:NG Market see Ganesan, Pradip and Pratt, Donna, *Concepts for Behind-the-Meter Net Generation*, New York Independent System Operator Joint Meeting of Installed Capacity, Market Issues and Price Responsive Load Working Groups, September 4, 2015.

[7] NYISO, *2016-2020 Strategic Plan*, September 30, 2015, P. 11.

As a result of its consultation with NYISO officials, Pareto Energy now believes that much larger cash flows from the NYISO's BTM:NG Market than were anticipated at the time of Pareto Energy's Petition will enable ratepayers to recapture any first-year subsidies paid to the Demonstration Project. Therefore, as may be seen in Table 1 below, implementations of Pareto Energy's Two Sided Microgrid Platform Business Model may be privately funded with no net ratepayer subsidies.

As may be seen in Table 2 below, Pareto Energy's privately-funded Business Model for the KP-CHP Demonstration Project generates economic benefits that are not available from several the heavily subsidized Con Edison programs with which it competes.

Pareto Energy's Business Model also provides much more compelling life-safety benefits for critical infrastructure and places of refuge and much larger economic benefits for low-income households and small businesses than Con Edison's DER programs. Pareto Energy's Petition to the Commission identified ten potential CHP installations in Brooklyn and Queens with 369 MWs of opportunities to implement the Two-Sided Microgrid Platform Business Model. All of the sites pertain to critical infrastructure and/or points of refuge that can continue operating during Con Edison outages. All of the sites also border neighborhoods with many low income households and small businesses; with Con Edison's innovations in grid sectionalization, these energy users can be served with more affordable, reliable and sustainable power from the CHP sites.

Table 1 Pareto Energy Project Financing and Profit Sharing Plan Per Watt Contributions and Revenues of Project Stakeholders for the KP-CHP Demonstration Project			
Party	**Contributes**	**Earns**	**Notes**
Total Project	**$1.50 per watt x 8 MW= $12 Million.** **$4 Million from Pareto Energy cash contribution.** **$8 Million from Pareto Energy Borrowing**	**$0.60/watt/yr x 10 years x 8MW = $48.00 Million**	Project Internal Rate of Return = 43%. The competing Con Edison VPP demonstration has a -2% IRR. After loan repay, ~$0.60/watt of average annual profit is shared with rate payers ($0.13), utility shareholders ($0.07), CHP owner ($0.33), and Pareto Energy ($0.07).
Ratepayers	**$0.89/watt in year 1 x 8 MW = $7.12 Million** (Note Pareto already has $0.25 per watt from a NYSERDA contract and seeks $0.64 per watt from the IPEC Plan)	**$0.13/watt/yr x 10 years x 8MW = $10.40 Million for net gain of $3.28 Million**	The Demonstration Project has already won a $2 million NYSERDA demonstration contract. Ratepayers would avoid paying a $1.60 per watt customer incentive for competitive Con Edison DER programs ($12.8 Million avoided)
Con Edison Shareholders	**$0**	**$0.14/watt/yr x 5 Years x 8 MW = $5.60 Million**	Profit sharing with Con Edison is to offset lost earnings from delaying investments in more expensive T&D infrastructure solutions.
CHP Owner	Access to **$45M** CHP asset for 10 years	**$0.33/watt/yr x 10 years x 8 MW = $26.40 Million**	Provides a return on assets comparable to the alternative of investing in shopping center real estate and therefore provides an incentive to invest in CHP.
Pareto Energy	**$1.50 In construction period before year 1** **($0.50 cash contribution and $1.00 of borrowing)**	**$1.03/watt year 1 loan repay** **$0.07/watt/yr X 10 years x 8 MW = $5.6 Million**	Equates to a 12% internal rate of return for the $0.50 equity investment at risk during the construction period. This is the hurdle rate necessary to secure a construction loan from a private project finance bank.

Table 2 Comparison of per watt ratepayer subsidies for Pareto Energy's Two-Sided Microgrid Platform Business Model and the utility-sponsored DER programs with which it competes[8]			
DER Projects	**First Year Ratepayer Subsidy per Watt**	**Ratepayer Recapture per Watt**	**Notes on Financial Feasibility**
Pareto Energy Two-Sided Microgrid Platform without relief requested from the NYS-PSC	**$0.25** (NYSERDA Contract)	**$0.25**	The project is not financeable because Con Edison will not provide validation of the interconnection technology that is needed to secure borrowing.
Pareto Energy Two-Sided Microgrid Platform without relief requested from the NYS-PSC	**$0.89** ($0.25 NYSERDA Contract+$0.64 IPEC Plan Outreach Fee)	**$0.89**	The project is not financeable because Con Edison will not provide validation of the interconnection technology that is needed to secure borrowing. Otherwise, the increase in the first year ratepayer subsidy improves the opportunity to borrow by softening the risk due to NYISO BTM:NG amounts not being contractually established until 2017.
Con Edison VPP Platform	**$6.67**	**$3.34**	The project is fully financeable because ratepayers are covering all upfront costs and because Con Edison has approved the power electronics interconnection technology without the time consuming and costly interconnection approval process that it imposed on Pareto Energy's Demonstration Project.
Con Edison Peak Shaving EIM	**$5.00**	**$0.00**	Con Edison's historical performance in demand management programs suggest that the projects are financeable at a ratepayer subsidy of $5 per watt.
Con Edison BQDM Program	**$3.74**	**$0.00**	Con Edison's historical performance in demand management programs suggest that the projects are not financeable at a ratepayer subsidy of less than $5 per watt.
Con Edison IPEC CHP Plan	**$2.24**	**$0.00**	Only 20 percent of projects have been financeable due to the extreme cost of mechanical interconnection technologies that Con Edison insists on using.

[8] For Con Edison program and financial plans see Attachment D which provides excerpts from various Con Edison filings with the Commission.

1.2 Purpose of the Filing

In recent comments on the NYS-DPS Staff White Paper on Ratemaking and Utility Business Models for distributed energy resource ("DER") projects, the United States Federal Trade Commission ("FTC") warned about the potential of a utility performing as a distribution system platform operator ("DSP") to:

> "…raise the costs of – or otherwise discriminate against – independent providers of services to DER projects. As envisioned by Section III.B. of the White Paper, affiliates of the incumbent DSP operator would provide services for DER projects, and thus the incumbent DSP operators (the distribution utilities) would become competitors of independent firms also providing services for DER projects, while retaining control over the timing and costs of connections between DER projects and the distribution system."[9]

Pareto Energy seeks relief from three such forms of unfair competition that prevent the implementation of the privately-financed and innovative Two Sided Microgrid Platform Business Model in Brooklyn and Queens:

1.2.1 Improper and inconsistent use of an interconnection approval process

Pareto Energy cannot secure borrowing for the Demonstration Project unless Con Edison provides a letter to Pareto Energy's bankers, a draft of which has been provided to Con Edison and has also been attached herewith.[10] In the letter, Con Edison must indicate that it has reviewed testing reports of Pareto Energy's power electronics platform and that it agrees with the reports' conclusions that the Platform eliminates microgrid-to-macrogrid fault current contributions and, therefore, complies with IEEE 1547 standards and UL 1741 certifications for interconnection.

GE Power Conversion prepared the testing reports in June and August 2014 using an installation of the power electronics platform in the field at one of their customer sites. Pareto Energy previously filed copies of GE's testing reports with the Commission.

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[9] REV Proceeding, Reply Comment of the Staff of the Federal Trade Commission, 23 Nov 2015, P. 7.
[10] See Attachment C for a draft of the letter that was requested from Con Edison.

To solve the lengthy impasse with Con Edison, Pareto Energy proposed a settlement conference of engineers from Con Edison, NYS-DPS and NYSERDA Staff, Pareto Energy, and the supplier of the power electronics platform, GE Power Conversion ("GE-PC").[11] Con Edison has refused to convene such a settlement conference.[12]

After receiving the testing reports from GE, Con Edison has subjected Pareto Energy to a very lengthy and costly interconnection approval process and yet refused to provide the requested letter to Pareto Energy's bank. Meanwhile, Con Edison has assured the Commission that the competitive power electronics platform that it has selected for its own heavily-subsidized VPP project "… will ensure streamlined approaches to both the interconnection challenges, and the technical requirements for system interconnection."[13] Therefore, Con Edison's ratepayer-subsidized projects compete unfairly with Pareto Energy's privately-funded Two-Sided Microgrid Platform Business Model when it comes to the cost and time for approving interconnection.

Additionally, Con Edison's interconnection approval process improperly interferes in Pareto Energy's contractual relationship with NYSERDA and business relationships with potential customers for its Business Model. Pursuant to Commission orders for the periodic review and reform of the interconnection approval process and New York State law on intentional interference, Pareto Energy seeks relief in the form an order by the Commission for Con Edison to issue the letter needed by Pareto Energy's bankers.

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[11] See Attachment E, PP. 181-182
[12] IBID
[13] REV Proceeding, Con Edison Rev Demonstration Project: Clean Virtual Power Plant, July 1, 2015, P. 13.

Commission guidelines for periodic review and reform of the interconnection approval process

The relief proposed above would be consistent with NYS-DPS Staff recommendations "… that the Commission consider a periodic interconnection review and reform process to expedite interconnection processes and minimize costs …" [14] The Commission's order implementing the Staff's recommendation concluded that:

> "In order for distributed generation to compete on an equal footing, interconnection with the grid must be enabled through technical rules and processes that are not only safe but also efficient and expeditious … Our approach to improvement is to ensure that utilities are employing the best available analytic processes, and to align utilities' financial interests with our objective of cost-effective and expeditious interconnections. Standardization of interconnection products and testing protocols is achieved through national bodies; where an applicant has satisfied these standards the process of utility approval should be as swift as possible, consistent with safe operation."[15]

The Commission's Order for reforming the interconnection process was prescient in foreseeing the promise of fault ride through and protection technologies such as those enabled by Pareto Energy's power electronics platform:

> "…the automated application and management process should be integrated with grid optimization planning. This will expand on simple measurement of DER penetration, to include modeling of potential system impacts of DER (both beneficial and adverse) on load flows and system protection at the feeder or more granular level. This should include risk assessment of the potential for DER to reduce system congestion, and for DER with ride-through capabilities to assist with a resilient response to system events … capabilities should result in economically desirable DER projects having ready access to interconnection approval, and potential market participants having ready access to information to assess the viability of a project from a system interconnection standpoint."[16]

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[14] REV Proceeding, Order Adopting Regulatory Policy Framework and Implementation Plan ("REV Framework Order"), February 26, 2015, P. 89.

[15] REV Framework Oder, P. 92

[16] REV Framework Order, P. 93.

Evidence of the standardization of Pareto Energy's Power Electronics Platform and testing procedures that makes the Platform consistent with Commission guidelines for periodic interconnection review and reform

For implementing the Two-Sided Microgrid Platform Business Model, Pareto can procure all the off-the-shelf power electronics from multiple suppliers. Therefore, the standardization and commercial readiness of the power electronics platform for the Demonstration Project has been validated by:

1. An independent engineer's opinion letter that all parts of the power electronics platform are available off-the-shelf from multiple suppliers with demonstrated compliance with all IEEE standards and UL certifications. See pages 11 to 14 of Attachment A for a copy of the engineer's opinion letter.

2. Testing and simulation reports from an existing installation of the power electronics platform in the field by GE Power Conversion at the site of one of their customers. The testing reports have been filed with the Commission. See Attachment B for two protocols that resulted from the GE tests: 1) A Technical Concept & Application Guide provided the information to evaluate project applications for the power electronics platform; and 2) A Product Standard Approval Package provided the engineering specifications and quality plan by which Con Edison could expedite approve the installation of the power electronics platform.

3. Selection of the power electronics platform at a cost of $1.50 per watt by CHP operators in the competitive marketplace for interconnection technologies. The incumbent operators of the Demonstration Project considered mechanical interconnection and rejected it because of its higher cost ($2.50 per watt) and lower functionality (unlike the always-on power electronics interconnection, the

mechanical interconnection requires lengthy black starting of the CHP after a utility outage).[17]

4. Contract awarded by NYSERDA to Pareto Energy for the Demonstration Project.[18] Whereas Con Edison erroneously describes Pareto Energy's power electronics platform as a concept in the "infancy" of its technological development[19], NYSERDA only awards these types of contracts to demonstrations that use "…under-utilized technologies that are past the 'proof-of-concept' stage" and that do not "include technology or product development tasks".[20] Con Edison provided a letter of support for Pareto Energy's NYSERDA Contract in February 2014 that was conditional on the hardware testing that Pareto Energy and GE Power Conversion completed between June and August of 2014.[21]

5. Two independent engineering reviews.[22] The first review was peer reviewed and published by the Institute of Electrical and Electronic Engineers ("IEEE"). Pareto Energy included the first review as an attachment to its Petition last April. New York University and Con Edison electrical engineers conducted the review. They considered a 20 MW microgrid interconnected to the medium voltage side of a networked grid in Brooklyn. The authors from NYU and Con Edison concluded that, under interconnection with Pareto Energy's power electronics platform, disturbances or power quality issues within a local system do not propagate and affect other systems and, therefore, all types of distributed resources may be interconnected without system impacts. It also concluded that equipment operating

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[17] See Attachment A, P. 22.
[18] NYSERDA Agreement Number 41313 for PON 2715, Category D for Pareto Energy's Demonstration of a Power Electronic Microgrid Solution.
[19] Con Edison Opposition, P. 6.
[20] See http://lifenynews.com/-/media/Files/FO/Closed-Opportunities/2014/2715summary.pdf.
[21] See Appendix E, P. 165.
[22] See Attachment A, PP. 25 to 43 for copies of the two reviews.

at different frequencies can safely interact without jeopardizing reliability or stability.

The second engineering review was completed by the Electrical and Electronic Engineering Department of the University of Connecticut ("UCONN") and is now undergoing peer review by the IEEE for publication. The UCONN engineers compared a microgrid interconnected with Pareto's power electronics platform in Brooklyn to the mechanical interconnection of the NYU CHP facility in Manhattan. The UCONN engineers concluded that Pareto Energy's power electronics platform provides much faster switching speeds along with advanced sensing and controls that can be used to eliminate fault current contributions, thus making DER coordination with the utility distribution network negligible. The review used steady state short circuit analysis to show that the power electronics platform isolates fault current contributions bi-directionally, from the utility to the CHP facility and from the CHP facility to the utility. The report concluded that: a) large fault current contribution from the NYU CHP with mechanical interconnection pushes the short circuit capacity of Con Edison's substations to their limit; b) it is challenging for the mechanical interconnection platform at NYU to respond to various short circuit levels in both islanded and parallel mode; and c) the NYU mechanical platform is a solution at a substantially higher cost than Pareto Energy's power electronics platform.

<u>Evidence of the beneficial system impacts of the Power Electronics Platform to reduce system congestion and provide DER ride-through capabilities that assist with a resilient response to system events and, therefore, makes the Power Electronics Platform consistent with Commission guidelines for periodic interconnection review and reform</u>

Pareto Energy has provided Con Edison with abundant and impressive testing from GE Power Conversion to demonstrate the beneficial system impacts of the power electronics platform for load flows and system protections at the feeder level. Clearly, operating experience in the field at sites substantially similar to the use cases in

Brooklyn and Queens proves the fault current mitigation and ride through capabilities of the power electronics platform to assist with a resilient response to system events.

Far from ensuring that potential market participants have ready access to this critical information, Con Edison has deliberately used the self-imposed complexities and long approval time of their interconnection process to eliminate CHP resources from the BQDM Program and allow NYSERDA to limit the CHP project size in the IPEC Plan to less than 1.3 MWs.

Likewise, Con Edison's response to the Staff's White Paper on Ratemaking and Utility Business Models virtually eliminates CHP as a peak shaving resource due to interconnection difficulties that can be readily solved by power electronics platforms available from multiple suppliers.[23]

For the Commission's further consideration of Con Edison's intransigence in acknowledging the receipt of General Electric's testing and agreeing with the conclusions therefrom, here are the key elements of Pareto Energy's 18 months of unsuccessful negotiations:

- In a June 11, 2014 meeting between Con Edison, Pareto Energy and GE Power Conversion ("GE-PC") engineers that Robert Schimmenti (then Con Edison Vice President of Engineering and Planning) chaired, Con Edison received and reviewed conclusions from tests performed by an independent engineer at an installation of the power electronics platform at a GE customer site in the field. Con Edison received a report of the tests from GE-PC engineers on June 23, 2014. NYS-DPS Staff now also have a copy of the testing report.
- In a Conceptual Approval Letter of August 8, 2014, Con Edison acknowledged receipt of the test report but did not agree with all the conclusions therefrom. Of particular concern to Pareto Energy and its project finance bankers was Con Edison's false assertion that the hardware testing did not demonstrate certain UL certifications for the power electronics product specification or the ability of

[23] See Attachment D, PP. 10-12.

that product specification to comply with certain UL standards for its installation. Negotiations continued and a supplementary test report was provided by GE Power Conversion to Con Edison on August 25, 2014.

- On December 16, 2014, Con Edison's new Vice President of Engineering and Planning, Patrick McHugh, convened a meeting with Pareto Energy to: 1) review the prototype tests and agree that, pursuant to the conclusions from the two GE-PC test reports, the product specification for the GE Power Electronics Platform meets all UL certifications and complies with all IEEE standards required for its installation; and 2) to walk through plans for factory testing and acceptance and site testing and acceptance of the actual power electronics platform manufactured for the demonstration.

- By the end of 2014, Pareto Energy had spent $704,000 on the prototype testing. At that time, NYSERDA accepted the prototype testing and approved a payment on Pareto Energy's demonstration contract to defray $502,000. Pareto Energy then placed an order with GE-PC for the power electronics platform.

- On January 8, 2015, Pareto Energy consolidated and delivered to Mr. McHugh and his Chief Distribution Engineer all the testing reports, parts specifications, brochures and certificates, and engineering working papers that had been previously provided to Con Edison as part of the product specification and approval and acceptance plans.

- Since filing its opposition to Pareto Energy's Petition on July 6, 2016, Con Edison will not acknowledge their receipt of the prototype tests and subsequent product specification and acceptance and approval plans. Despite the prototype tests, Con Edison continues to stand by the false claims of their August 8, 2014 Conceptual Approval Letter that the product specified for the demonstration has not been tested for the necessary UL certifications and cannot comply with the recommended IEEE Standards. Con Edison's claim that the power electronics platform has never been shown to be viable for connecting distributed generation to an electrical distribution system defies the physical evidence to the contrary from many working installations by multiple suppliers.

<u>The applicability of New York State Law on Intentional Interference</u>

To further consider the extent to which Con Edison's interconnection approval process for the KP-CHP project may be anti-competitive, the Commission should also refer the State laws on improper interference in a contract or business relationship.[24] To prevail on a claim for interference with business relations in New York, a party must prove:

1. That it had a business relationship with an identified third party.
   a. Pareto Energy has a contract with NYSERDA and a business relationship with the owners of the KP-CHP.
2. That the interferer knew of that relationship.
   a. Con Edison provided a letter of support for Pareto Energy's contract with NYSERDA and has met three times with the owners of the KP-CHP, Macerich.
3. That the interference caused injury to the relationship with the third party.
   a. So it can complete tasks for factory testing and be paid by NYSERDA, Pareto Energy has persistently asked Con Edison for a letter confirming that prototype hardware tests have been received and that Con Edison agrees with the conclusions therefrom. Con Edison holds to the position that no prototype has ever been built and that it has never received any hardware tests. Similarly, with respect to the relationship with Macerich, Pareto Energy cannot develop the borrowing to implement its business model while Con Edison maintains that the power electronics has not been tested. As a result it has been substantially delayed in earning profits from the KP-CHP project.
4. That the interference was intentional and that the interferer acted solely out of malice or used improper means that amounted to an independent tort.
   a. As shown in Attachment E since 2011, Pareto Energy has made in depth presentations of our microgrid business model and power electronics platform to over 50 representatives of Con Edison, including dozens of engineers and personnel from the Distribution Engineering department. Over the course of nearly four and a half years, Pareto Energy has discussed the architecture and interconnection for three different projects in numerous meetings and phone calls, and over 150 emails. Pareto Energy engineers have submitted and reviewed with Con Edison engineers results from multiple simulations and hardware tests conducted by two reputable power electronics companies (Woodward and General Electric), as well as third party reviews in the form of

[24] See for example Amaranth LLC v. J.P. Morgan Chase & Co., 71 A.D.3d 40, 47 (1st Dep't 2009)

two engineering opinion letters (Burns & McDonnell and URS), and two peer-reviewed IEEE articles (NYU Polytechnic Institute and the University of Connecticut).

As a reference, Pareto Energy received interconnection approvals from two other utilities in four and six months, respectively. The two approvals required far less supporting evidence to prove the standardization of the technology and testing approach.[25] Both approvals resulted in fairly immediate bank funding of the projects under review. At this point, the Commission should find it hard to believe that not one of Con Edison's fifty engineers can either understand the power electronics platform to validate it as a standardized interconnection platform or provide any guidance about additional evidence that would enable them to do so.

Given Con Edison's Long Range Electric Plan to identify and pilot test viable new interconnection technologies, it should concern the Commission that, Con Edison's planning documents and progress reporting for the IPEC Plan, BQDM Program, REV Demonstration Projects, REV White Papers, and other open Commission proceedings, Con Edison never publically reported on its four and one half years of work on power electronics solutions with Pareto Energy. The Commission can have no reasonable explanation other than to interpret Con Edison's interconnection approval process as a direct attempt to hinder the balance of competition in the marketplace between independent DER service providers and Con Edison DER programs. Meanwhile, the relief requested by Pareto Energy is not onerous: Con Edison simply needs to acknowledge in a letter for Pareto Energy's bankers that they received GE's reports for prototype testing in June and August of 2014, that they now agree with conclusions therein, and that they have approved the factory and site testing protocols proposed by Pareto Energy last January (see Attachment B for the protocols; see Attachment C for a draft of the letter needed for Pareto Energy's bankers).

[25] See Attachment A, PP. 2-8.

1.2.2 Unfair subsidies of utility programs that compete with Pareto Energy's Business Model

As shown in Table 1 above, the Commission has approved large first-year ratepayer subsidies for DER programs invented by Con Edison. These programs pay between nine and twenty-seven times more than the first-year ratepayer subsidies for DERs under Pareto Energy's Two-Sided Microgrid Platform Business Model. Pareto Energy seeks relief in the form of a Commission order that Pareto Energy's Demonstration Project shall earn a first-year ratepayer subsidy of $0.89 per watt, subject to a 100 percent recapture from earnings in subsequent years.

Even with the relief requested in this section, Con Edison programs that compete with Pareto Energy's privately funded Two-Sided Microgrid Platform Business Model would still receive between two to seven times the first-year ratepayer subsidies. Moreover, only one competing Con Edison program earns enough to enable ratepayers to partially recapture their first-year subsidies, whereas Pareto Energy's Profit Sharing Plan fully rebates all first-year ratepayer subsidies. Therefore, the Commission should also order Con Edison to show cause why it should not implement the Two-Sided Microgrid Platform Business Model at the nine CHP facilities in Brooklyn and Queens that were identified by Pareto Energy's April Petition. In making its decision, Pareto Energy implores the Commission to compare Pareto Energy's Project Financing and Profit Sharing Plan for demonstrating its Two-Sided Microgrid Platform Business Model with Consolidated Edison's financial plan for demonstrating s Virtual Power Plant ("VPP") business model.

Less than six months after it was submitted, the Staff of the New York State Public Service Commission ("NYS-DPS Staff") enthusiastically supported Con Edison's proposal for an engineering and transactional platform called a Virtual Power Plant.[26] NYS-DPS Staff has never responded in like fashion to the Pareto Energy Petition to demonstrate a more affordable and technically superior power electronics platform that was submitted almost eight months ago. However, they agreed with Con Edison that the public benefit of demonstrating the inferior VPP Platform merits ratepayer subsidies of more than seven times the amount requested by Pareto Energy in its Petition.

Whereas the VPP Business Model will not be economically viable until five years from now, and neither rebates all ratepayer subsidies nor provides profit sharing with Con Edison shareholders, the Pareto Energy Business Model proposed for the ten CHP facilities in Brooklyn and Queens will be economically viable within one year, rebate all subsidies, and provide profit sharing with both Con Edison ratepayers and shareholders.[27] Further comparison between the KP-CHP and VPP projects is provided in Table 3 below.

[26] REV Proceeding, NYS-DPS Project Assessment Report of Con Edison: Clean Virtual Power Plant, November 20, 2015.

[27] See Table 4 in Section 3.5 of this Filing

Table 3 Comparison of KP-CHP and VPP Demonstration Projects		
Criteria	**KP-CHP**	**VPP**
Business Model	Two-Sided Microgrid Platform Business Model can be implemented immediately for 9 other existing CHP projects with 369 MW in Brooklyn and Queens.	Business model will not be viable economically until 2021 and will be implemented for only 1.8 MWs.
Technology Choice	Chosen by the customer in the competitive market place.	Chosen by Con Edison without competition.
Cost	$1.50 per watt	$6.67 per watt
Financing	Because the project is privately financed from fuel efficiency improvements and NYISO BTM:NG Market transactions, ratepayer contributions will be rebated and a profit share will be paid to Con Edison ratepayers and shareholders for lost earnings from traditional T&D upgrades that are postponed.	100% funding by ratepayers before the system is proven to operate. Con Edison admits the project is unprofitable so shareholders will not recoup their investment and shareholders will not earn anything.
Project Internal Rate of Return	28%	-3% (2% if customer will pay extra for resiliency)
Technology Risk	The power electronics platform has been in use for many years at multiple locations and hardware tests prove the power electronics platform will work for the intended transactions with the NYISO. No extraordinary communications or telemetry is needed as existing GPS and Internet networks suffice.	The solar and storage platform has not been widely in use for many years and there are no tests from a prototype to prove that it can perform for the intended transactions. Extraordinary communications and telemetry will be needed but there is no specification for that part of the platform yet.
Resiliency	KP-CHP has a 35 year track record with only one outage and has operated through all major Con Edison outages. Storage for the KP-CHP project are BTUs of natural gas from a pipeline that has never failed to deliver fuel in a natural disaster such as Superstorm Sandy.	The VPP technology has not been proven to be physically resilient to storms in the same way as the several of City's CHP facilities, including the KP-CHP, which ran seamlessly during Superstorm Sandy. Storage for the VPP project is limited to the amount of time that the batteries can be dispatched. Moreover, "fuel" from the sun might not be available during a hurricane or snow storm.

1.2.3 Unreasonable delay in responding to a proposal to implement the two-sided platform Business Model at the Kennedy International Airport Cogeneration Facility as a least-cost resource for the BQDM program

In response to a Con Edison BQDM request for information about non-wires resources that could solve 52 MW of overcapacity at the Brownsville substation, Pareto Energy proposed, more than a year ago, to implement its two-sided platform Business Model at the 107 MW Kennedy International Airport Cogeneration Facility ("KIAC").

Because the power electronics platform is proven to eliminate any fault current contribution from KIAC to the utility distribution grid, and would also enable ride through of any faults on the utility distribution grid, the KIAC project can be readily approved for interconnection and operating in less than a year.

Importantly, the power electronics platform solution proposed for the KIAC project can entirely meet the BQDM Program objective for Brownsville at a cost of $1.50 per watt or less.

From its latest BQDM Program report to the Commission, Con Edison is paying customers served by the Brownsville substation incentives of over $2.00 per watt for new energy efficiency and demand response resources. They are also spending an additional $1.70 per watt for sales, training, marketing, program implementation and administration and technology measurement, verification, and evaluation.

Meanwhile, Con Edison has eliminated CHP as a resource because "… the project lifecycle of a sizeable CHP deployment can easily span multiple years, making CHP a less viable solution given the BQDM program deadlines."

As one alternative to using CHP resources, Con Edison now proposes to develop new non-CHP fuel cell projects as follows:

> "The initiative involving analysis of customer energy use patterns that was initially developed to identify viable potential candidates for new CHP system installations was instead used to inform analysis of viable alternative solutions such as fuel cells, as further discussed below …These resources can be built with minimal lead time, while using a relatively small footprint in the land-constrained targeted area. The Company has investigated business arrangements that would incent adoption of such technologies such that third party capital can be leveraged in a manner that is both beneficial to the customer and cost-effective to the Company."

As another alternative, the company proposes to sole-source the development of "Queens Resiliency Microgrid" with a new non-CHP gas generator as follows:

> "The Company initiated exploration of opportunities with a large customer in Queens for load relief and other benefits. Discussions have included the potential for installation of a natural gas behind-the-meter generator to both power a community micro-grid and for potential use as a demand response resource. The Company also explored other possibilities, such as an on-site solar installation and the use of the location as an emergency staging area. This is a complex potential project and conversations with the customer and other stakeholders are on-going.
>
> To additionally minimize potential operational risks to the customer, the project scope has been refined to focus on using available space to site a natural gas generator on the customer property, but connecting it as a direct-grid resource (rather than integrally with the customer) with dual functionality for BQDM peak shaving as well as micro-grid resiliency. The Company has engaged with a third party, who has a maintenance and operations agreement with the customer, to assist with the project. In addition to an established relationship with the customer, the third party understands the complexity of the site and has the requisite expertise to successfully execute the planned project. A full proposal is expected during the third quarter of 2015."

Clearly, the interconnection of a proven CHP resource such as KIAC with Power Electronics that can be implemented with rebates to Con Edison ratepayers and shareholders should be a least cost resource. This argument is only compounded when compared with new unproven non-CHP resources that will cost Con Edison ratepayers $3.70 per watt to implement.

In any case, these opportunities should never be sole-sourced by Con Edison to a particular technology company. As with Pareto Energy's proposed KP-CHP and KIAC projects, the technology should be chosen by the customer in the competitive market place for interconnection services. As noted earlier, Con Edison did conduct a competitive RFI for solutions over a year ago, unfortunately no response to submissions has been forthcoming from Con Edison.

The Commission ordered third-party review of all decisions under the BQDM Program:

> “To ensure that the Company is impartial in its selection of those projects which are most beneficial, it is imperative that the RFI and RFP project selection process be as transparent as possible while maintaining the Company’s ability to enter into contracts on a timely and confidential basis, as necessary … Third-party oversight of this process will ensure that project selection proceeds in a timely manner and that the selection of the portfolio is fair and equitable to all.”

It should concern the Commission that thus far Con Edison has not effectuated any third-party review of their technology decisions, including the elimination of all CHP resources from the implementation of the BQDM Program for Brownsville.

As Con Edison has neglected their responsibility to the rate payers of New York to attend to this urgent problem with commensurate urgency, they have effectively abdicated their authority to provide a critical solution to their customers, and the Commission should order Con Edison to provide an adequate reason as to why the proposed KIAC project is not a least-cost solution.

2 FURTHER INFORMATION ON THE RELATIONSHIP BETWEEN POWER ELECTRONICS AND THE TWO-SIDED MICROGRID PLATFORM BUSINESS MODEL

Advanced grid-facing power electronics enable ultra-fast control of the CHP alternating current wave form that is not technologically possible with a mechanical interconnection platform. Providing very high quality power from CHP facilities can solve some very expensive challenges that Con Edison and the NYSIO face in regulating the voltage and frequency of the transmission and distribution network, especially with the expected increase in distributed generation interconnections.

Therefore, the Two-Sided Business Model participants profit from delivering higher-quality power from customer-owned CHP facilities on the downstream side of the platform to solve instabilities on the utility-owned upstream side of the platform. As shown in Section 3 of this filing, proceeds from the expanded transactions enable an economically viable project financing and profit sharing plan. In New York City, that Plan results in net rebates to Con Edison's ratepayers. It also provides earnings for Con Edison shareholders that meet or exceed what they would earn from investing in more traditional transmission and distribution.

It is very important to understand that, unlike mechanical interconnection, the power electronics platform can eliminate fault current, provide fault ride through, and deliver fast response voltage and frequency control wherever it is implemented in New York City. With the product specification for the power electronics platform, the need for a lengthy project-by-project interconnection approval process that plagues mechanical interconnection disappears.

Instead, following a short period of analysis, Con Edison can instruct Pareto Energy and its power electronics supplier how to set the control parameters for the needs of its distribution network at a particular location. Of course, all actual installations must then prove that the equipment being installed has gone through routine factory and site verification testing to ensure it complies with the UL certifications and IEEE standards of the product specification.

2.1 Understanding the mechanical interconnection problem and power electronics solution

Con Edison and independent third-party engineers agree that the difficulty of mechanically interconnecting large amounts of CHP in New York City relates to the challenge of mitigating fault current contributions from the CHP to the utility distribution network and vice versa.

The idea to use power electronics as a solution is not new. Since at least 2007, New York engineers have recognized interconnection with power electronics as a solution for mitigating fault current from CHP to the utility grid and enabling CHP to ride through faults from other sources on the utility grid. It is best to understand the complexity of the mechanical interconnection problem and the simplicity of the power electronics solution by quoting directly from the published writings of New York engineers below.

In a study written for NYSERDA in 2007 and published in 2010, Columbia University engineers first recognized the problem with synchronous mechanical interconnection and the promise of power electronics for a non-synchronous interconnection:

> "The fault current margin will always be linked to the total amount of electricity-generating capacity connected to the grid. As demand continues to increase each year around the city, requiring additional generation to be connected to the grid, the technological 'fixes' called for by the Public Service Commission will work for some time. At some point, however, the upgraded circuit breakers may also reach their higher-rated capacity limit, requiring yet another round of system upgrades … A second technical solution external to the grid involves the use of power electronics, which are a mix of devices used to convert, control, and improve power quality. Some manufacturers use two complementary forms of power electronics – a rectifier and an inverter – to switch from AC to DC and back to AC power in order to produce higher quality power and facilitate

> interconnection. The duration and complexity of the review is likely to be substantially less than for synchronous interconnection." [28]

In December 2010, Con Edison recognized the problem of mechanical synchronous interconnection but failed to consider a non-synchronous power electronics solution that had been earlier recommended in Columbia University's NYSERDA report. Note, that Pareto Energy had introduced its version of the power electronics platform to Con Edison's distribution and R&D engineers by this time.

> "The City proposed a conceptual CHP installation with an electric power generator supplying a portion of the energy requirements at a municipal hospital campus. After its review, Con Edison noted that all the technical interconnection requirements, e.g., transfer trip, short circuit study and fault current mitigation, voltage and stability studies, telemetry, would have to be met, that the customer would be responsible for interconnection costs, including studies and system reinforcement, and that a primary connection for the generator would require telemetry, would have to be met, that the customer would be responsible for interconnection costs, including studies and system reinforcement, and that a primary connection for the generator would require that the customer employ personnel trained in high tension switching on site 24 hours a day, seven days a week. Based on those case-specific assumptions, Con Edison advised that it considers this site to be a reasonable candidate for this type of connection. Despite positive qualities of this particular City proposal, and Con Edison's agreement to investigate ways to interconnect DG in this fashion, as a general matter, this type of approach is not the preferred interconnection method for Con Edison and may be cost prohibitive for the customer. Con Edison's concerns are: … both planned and unplanned feeder outages require customer interaction with the Company for communications and breaker operations…if a feeder is planned to be removed from service, when the customer opens the breaker, Con Edison personnel would need to lock-out and tag the breaker so that outage work may be performed. When the feeder is ready to be returned to service, all of these steps must be repeated by the customer and Con Edison personnel in reverse order. Feeder testing coordination could be required, which may require actions

[28] Hammer, Stephen, "CHP in NYC: A Viability Assessment," New York City: Columbia University School of International and Public Affairs, Center for Energy, Marine Transportation and Public Policy, Urban Energy Program, September 2007, p. 20-21.

> by customer personnel. Additional connection to high-tension feeders inherently adds potential failure points."[29]

Throughout 2014, authors from the Polytechnic Institute of New York University (now the NYU Tandon School of Engineering) independently reviewed the power electronics platform proposed by Pareto Energy for CHP microgrids in Brooklyn. In April, 2015, the IEEE peer reviewed an article about the work and accepted it for publication. The principal authors are from NYU, but a Con Edison Engineer, R. E. Uosef, was also an author. The article concluded the following about the power electronics platform:

> "This paper proposes a non-synchronous microgrid to be implemented in the medium voltage side of a networked grid in (Brooklyn) New York City …In a typical NYC distribution network, the short circuit power is close to the capacity of the breakers. This often forces the utility to prevent the installation of distributed resources in its system. Otherwise, the generator owner would have to finance the cost of any system upgrades. These issues may be overcome with the benefits of using non-synchronous microgrid technologies as discussed and demonstrated in this paper by means of steady state and transient studies."

> "Another important aspect of microgrids is the nonsynchronous interconnection over traditional synchronized ac systems. Therefore, disturbances or power quality issues within a local system do not propagate and affect other systems. All types of distributed resources may be interconnected without system impacts. Also, equipment operating at different frequencies can safely interact without jeopardizing reliability or stability."

> "The advantages of using non-synchronous microgrids in heavily meshed secondary networks have been demonstrated. As shown in the paper, with transient simulations, a nonsynchronous microgrid isolated by means of a dc bus facilitates the integration of distributed generation because the grid and microgrid are electrically isolated. Therefore, the transient phenomena in one side do not propagate to the other. This is of paramount importance when the substation breakers operate close to their short-circuit rating." [30]

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[29] Case 09-E-0428 – Proceeding on Motion of the Commission as to the Rates, Charges, Rules, and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service, "2010 DG Collaborative Report," November 2, 2010, p. 12-13.

[30] Salcedo, R, et. al., "Benefits of a Non-Synchronous Microgrid on Dense-Load Low-Voltage Secondary Networks", IEEE Transactions on Power Delivery, Issue 99, April 14, 2015, PP. 1-3, 7.

Also in 2014 and the beginning of 2015, electrical engineers from the University of Connecticut used the GE testing and simulations from a field implementation of the power electronics platform proposed for the KP-CHP interconnection and compared it to the mechanical synchronous interconnection using commutating current limiters at the CHP facility serving NYU's Washington Square Campus:

> "Following a comprehensive overview of the technology challenges and solutions for protection scheme in microgrids, a comparative study of the protection solutions for MGs with synchronous and non-synchronous interconnections was conducted based on two real cases in New York City."
>
> "NYU microgrid has one of the largest private CoGen plants in New York City. Current limiting fuse (CLiP) installed between old and new Cogen system provide protection for the under-rated old Cogen system at a substantial cost savings over replacement of the original circuit breakers ("CBs"). It is challenging for CBs to respond to various short circuit levels in both islanded and parallel mode. Numerical relays and selectable trip CBs is a solution at a substantially higher cost. Large fault current contribution from local CoGens from NYU push the short circuit capacity of substations to its limit. Moreover, solid state relays and circuit breakers (3 to 5 cycles) is not enough for interconnection protection."
>
> "Kings Plaza microgrid utilizes non-synchronous interconnection with back-to-back inverters. Inverters provide much faster switching speeds along with advanced sensing and controls that can be used to eliminate fault current contributions, thus making DER coordination negligible. Steady state short circuit analysis shows that the back-to-back inverters isolate fault current contributions bi-directly, from the utility to the microgrid, and from the microgrid to the utility. Transient stability study shows that back-to-back inverters can also isolate transient fault disturbance, and support voltage stabilization."[31]

In a filing with the Commission in October 2015, Con Edison confirmed that it had made no progress on the mechanical interconnection solution and did not mention the KP-CHP power electronics solution at a cost of $1.50 per watt or NYU mechanical CCL

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[31] Luh, Peter, et. al.,"Real Case Based Comparative Study of MicroGrid Protections for Synchronous and Non-Synchronous Interconnections", Report of the University of Connecticut Department of Electrical and Electronic Engineering, September 15, 2015.

solution at a cost of $2.50 per watt. Con Edison did not acknowledge the recommendations of NYU engineers and one of their own engineers in the above-quoted IEEE article, nor the GE Power Conversion hardware tests and simulations that had been provided to them in June and August of 2014. As a result, they indicated that peak shaving goals recommended by NYS-DPS Staff will largely be met with energy efficiency and demand response at a cost of $5.00 per watt:

> "Switches, called network protectors, are designed so that the multi-directional power on the secondary network does not back-feed and create a fault on the primary feeders. Also, the relay protection for the primary feeder is designed such that when a fault occurs on the primary feeder, after the substation breaker opens, all the network protectors on the feeder will sense the reverse power flow and open to isolate the feeder with the fault condition. Failure of the network protectors to open on the reverse power flow will result in the fault condition remaining energized. These network protectors must be coordinated with any type of DER that exports onto the secondary system and presents challenges that do not exist with radial systems."[32]

> "Con Edison is committed to developing capabilities to accept more injections. However, synchronous generators, like combined heat and power ("CHP") that operate regularly, have more potential to cause back-feed issues. Consistent with reliability standards, Con Edison requires a detailed review of CHP units that plan to export power, and will require any resulting system modifications to be paid for by the customer installing the CHP unit. For smaller and more intermittent resources like rooftop solar energy, Con Edison can address many of the concerns through modifications to the relay settings on the network protectors. As REV enables increased levels of renewable energy, Con Edison will continue to monitor what implications this may have, especially for projects that propose oversized net-metered generators."[33]

> "In its Track Two White Paper, Staff proposes an EIM to reduce peak demand by 14 percent over a five-year period, incorporating a target to reduce statewide peak demand by 545 MW per year, incremental to existing DER programs. The Companies are concerned that this EIM does not take into account existing customer needs, consequences of proposed solutions, and the ability and cost of achieving it. Further, the proposal could have unintended consequences such as stunting economic growth in Con Edison's service territories. In proposing such an aggressive target, the Track Two

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[32] REV Proceeding, Comments of Consolidated Edison Company of New York, Inc. and Orange & Rockland Utilities, Inc. on Staff's White Paper on Ratemaking and Utility Business Models, October 26, 2015, P. 3
[33] IBID, p. 4-5

White Paper assumes peak load reductions will benefit customers, but fails to estimate the costs that would be incurred to reach its stated goal. In fact, these aggressive peak reduction targets are unrealistic and unlikely to be cost-effective. For example, as explained in the Joint Utilities' Comments, Con Edison's Demand Management Program that focusses on system peak reductions costs approximately $5 million per MW. Extrapolating to the total 4,846 MW of peak reduction proposed in the Track Two White Paper, customers could be paying $24 billion over a five-year period for these resources."[34]

[34] IBID, P. 6-7.

3 UPDATE ON PARETO ENERGY'S PROJECT FINANCING AND PROFIT SHARING PLAN TO DEMONSTRATE A TWO-SIDED MICROGRID PLATFORM BUSINESS MODEL

3.1 Description of the first demonstration project at the Kings Plaza Shopping Center Combined Heat and Power Facility

Pareto Energy's Petition showed that an informed customer, Macerich (the owners of the KP-CHP), had reviewed the GE field tests of Pareto Energy's power electronics platform. Macerich subsequently selected the power electronics platform over other available technologies in the competitive marketplace to interconnect 8 MWs of the CHP system that serves their KP-CHP. The KP-CHP plant performs more reliably, affordably, and sustainably than the alternative of power from the utility grid. For example, the KP-CHP has suffered only one major outage in over 35 years of operation and provided power during all major Con Edison blackouts, including those during Superstorm Sandy. Moreover, it operates at half the cost of using power delivered by Con Edison and with a 35 percent lower carbon footprint.

Interconnecting the KP-CHP system to make 8 MWs of capacity available to the utility distribution network would have three main public benefits to the low income neighborhood around the KP-CHP:

- During a Con Edison blackout, the shopping center would serve as a place of refuge and the marina could facilitate water rescues.
- When Con Edison's network serving the neighborhood is not blacked out, the power electronics platform can be combined with Con Edison's grid sectionalization innovations to wheel the KP-CHP's remarkably reliable, affordable, and sustainable power to the neighborhood's low income customers and small businesses.[35]

[35] Con Edison has invested part of a $200 million Federal stimulus grant to develop switches for sectionalizing its grid.

- Low income and small business customers and rate payers would avoid substantial costs for alternative measures being undertaken by Con Edison to meet load growth and relieve congestion on the distribution network that serves the KP-CHP.[36]

On July 15, 2013, Pareto Energy presented the above-listed public benefits of the KP-CHP project to the Acting Chairman of the Public Service Commission, Garry Brown, and New York State Department of Public Service counsel, Leonard Van Ryn, and engineer, Michael Worden. The Chairman recommended that Macerich and Pareto Energy work with Con Edison to develop a Petition to the Commission to fund the installation of the power electronics at the KP-CHP.

Initially, Macerich delivered a proposal to Con Edison on August 23, 2013 for utility ratepayers to fund the installation of the power electronics platform to interconnect 8 MWs of the KP-CHP at a cost of $12 million ($1.50 per watt). Con Edison never formally responded to Macerich over the course of 15 months. As a result, in January 2014, Pareto Energy agreed to fund the entire cost of the project construction by investing $4 million of its own equity and borrowing the additional $8 million from an investment bank.

3.2 Relation of the KP-CHP Project to the Indian Point Energy Center Reliability Contingency Plan and Brooklyn-Queens Demand Management Program

After Macerich and Pareto Energy initially proposed the KP-CHP opportunity, the Commission ruled separately that the public benefit of new CHP projects would be worth Con Edison ratepayer funding of $2.64 per watt to meet the objectives of the Indian Point Energy Center Reliability Contingency Plan (“IPEC Plan”) and $3.70 per watt

[36] Currently, Con Edison is spending $2.64 and $3.70 per watt of ratepayer funding for the objectives of the Indian Point Energy Center Reliability Contingency Plan and Brooklyn Queens Demand Management Program, respectively.

to meet the objectives of the Brooklyn-Queens Demand Management Program ("BQDM Program"). The KP-CHP project contributes to both objectives.[37]

Con Edison has acknowledged that it has outsourced the implementation of the IPEC Plan to NYSERDA where $1.60 of the $2.64 budget is being paid by NYSERDA to owners of new CHP systems as an incentive.[38] The remainder of the IPEC Plan costs pertain to hiring outreach contractors to find CHP projects ($0.64 per watt) and program administration ($0.40 per watt).

Because it has never been interconnected to Con Edison's distribution network, NYSERDA should consider the KP-CHP to be a new source of generation. It is difficult to imagine that the existing KP-CHP plant, with its long track record of reliable, affordable, and sustainable service, would be less beneficial for the IPEC Plan objectives than commitments from new CHP projects that might not ever get built or operate with any reliability. Apparently, Con Edison agreed as their Senior Vice President of Electrical Operations attempted to develop such funding.[39]

Pareto Energy has approached NYSERDA about paying the $0.64 per watt Outreach Contractor Fee to the KP-CHP project. In this case, ratepayers would access a new source of CHP power without paying $12.8 million of customer incentive (i.e. 8 MWs times $1.60 per watt).

In its implementation of the IPEC Plan on behalf of Con Edison's ratepayers, however, NYSERDA has persistently refused to consider paying any amount for new CHP

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[37] Since the filing of Pareto Energy's Petition, Con Edison has filed a need for BQDM resources on the Bensonhurst substation to which the KP-CHP would be interconnected. See Case 14-M-0101, *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, "Bensonhurst NWA," Consolidated Edison Company of New York, Inc., 31 July 2015.
[38] Con Edison Opposition, P. 4.
[39] See email communications in Attachment E and Con Edison Opposition, p. 2.

resources over 1.3 MW or any new power from a pre-built CHP resource of any size. Meanwhile, NYSERDA has developed commitments of only 5.2 MWs of the 25 MW CHP objective for the IPEC Plan with the average project size being just 0.12 MW.[40]

It is perfectly reasonable to leverage unused funds of this under-performing program to secure a private construction loan to retrofit an existing CHP resource that meets the objectives of the fund's intent.

On August 1, 2015, Con Edison informed the Commission that the Bensonhurst distribution network serving the low income neighborhood around the KP-CHP would need 85 MWs of non-wires solutions to relieve overcapacity.[41] If Con Edison replicates the BQDM Program for the Brownsville substation, then its ratepayers would be paying $3.70 per watt for the non-wires alternatives. The initial payment of the $0.64 per watt IPEC Plan Outreach Contractors Fee that Pareto Energy has been seeking from NYSERDA and the Commission would enable ratepayers to avoid $29.6 million in BQDM Plan funding in addition to the $12.8 million for avoided IPEC Plan Customer Incentives.

3.3 A brief introduction to the typical functioning and terminology of two-sided platform Business Models with reference to Con Edison's experience as a distributed system platform provider

A formative article from the Harvard Business Review sheds light on the nature of two-sided platform business models as follows:

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[40] Case 12-E-0503, *Proceeding on Motion of the Commission to Review Generation Retirement Contingency Plans*, "Third Quarter 2015 Demand Management Program Report," Consolidated Edison Company of New York, Inc. and New York State Energy Research and Development Authority, 30 November 2015, P. 2.

[41] *REV Proceeding*, "Bensonhurst NWA", 1 August 2015. Con Edison forecasts that Bensonhurst sub-transmission feeders will exceed their design capacity by 5MW by the summer of 2021 and 45 MW by summer of 2025 and that Bensonhurst Area Substation No. 2: is projected to exceed its design capability by 2MW in the summer of 2022 and 19 MW in the summer of 2025.

> "Products and services that bring together groups of users in two-sided networks are platforms. They provide infrastructure and rules that facilitate the two groups' transactions … The two groups are attracted to each other—a phenomenon that economists call the network effect. In creating strategies for two-sided networks, managers have typically relied on assumptions and paradigms that apply to products without network effects. As a result, they have made many decisions that are wholly inappropriate for the economics of their industries … Two-sided networks can be found in many industries, sharing the space with traditional product and service offerings."[42]

After enactment of the REV proceeding, Con Edison will continue to offer its traditional product and service offerings alongside a new distributed system platform ("DSP"): i.e. many customers will not own downstream distributed generation that needs an interconnection and transactional platform to sell power and control services to the upstream grid. However, by virtue of their experience in the IPEC Plan, BQDM Program, and the REV VPP Demonstration Project, the same Con Edison managers of the traditional one-way service have already begun organizing as a DSP with a two-sided platform business model.

The Harvard Business Review article also sheds light on the type of competition that Con Edison will face as it begins functioning as a DSP.

> "Fueled by the promise of increasing returns, competition in two-sided network industries can be fierce. Platform leaders can leverage their higher margins to invest more in R&D or lower their prices, driving out weaker rivals. As a result, mature two-sided network industries are usually dominated by a handful of large platforms … In extreme situations, such as PC operating systems, a single company emerges as the winner, taking almost all of the market."[43]

3.4 Updated overview of the Project Financing and Profit Sharing Plan for the KP-CHP demonstration project

Pareto Energy's Project Financing and Profit Sharing Plan taps into the positive network effects from converting CHP systems from a mechanical to a power electronics

[42] Eisenmann, Thomas R., et. al., "Strategies for Two-Sided Markets, Harvard Business Review, October 2006, P. 1-4.
[43] IBID, P. 3

platform. The power electronics platform enables CHP to sell electricity, voltage and frequency regulation to the utility and NYISO at strategic locations on the grid. The platform's advanced grid-facing power electronics are capable of providing acute waveform control, and therefore, can provide valuable grid support services that are not technologically possible using the traditional mechanical interconnection platform.

Proceeds from transactions with the upstream side of the platform, as paid by the New York Independent System Operator's Behind the Meter Net Generation Market ("NYISO BTM:NG Market"), would enable ratepayers to recapture all their first-year subsidies and share in the profits of the projects. Further, these proceeds also enable generous profit sharing with utility shareholders to compensate them for the lost earnings opportunity of investing in more traditional transmission and distribution infrastructure. Consequently, Pareto Energy's Project Financing and Profit Sharing Plan results in a fully market-based business model without utility ratepayer or shareholder subsidies.

3.5 Detailed Cash Flow Analysis of the Project Financing and Profit Sharing Plan for Additional Projects

Pareto Energy's Petition listed 369 MWs of additional opportunities to convert from no interconnection or mechanical interconnection to electronic interconnection at nine other sites in Brooklyn and Queens. For one of these sites, the 107 MW KIAC Facility, Pareto Energy submitted a detailed proposal and initial engineering design in response to Con Edison's BQDM Request of Information in September 2014.[44]

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[44] Pareto Energy expended funds to create a design and proposal to the BQDM RFI at the suggestion of Con Edison Distribution Engineers. Pareto has never received a formal response from the RFI team and no timeline has been offered to indicate when a response may be forthcoming. Pareto would note that it is a highly unusual industry practice to fail to respond to RFI proposals for more than 15 months.

The intent of this section is to inform the Commission about the economic impact of implementing the two-sided platform Business Model demonstrated at the KP-CHP for the entire 369 MW CHP market in Brooklyn and Queens.

Considering the funding amounts for the KP-CHP demonstration, the power electronics platform, which enables the Two-Sided Microgrid Platform Business Model costs $1.50 per watt to install as compared with $2.50 per watt or more for mechanical interconnection using either commutating current limiters or static switches.[45] As shown previously, Pareto Energy will fully fund the cost of installing the power electronics platform with an equity investment for one-third of the project cost and a construction loan from an investment bank for the remainder.

Converting from mechanical interconnection to a power electronics platform will generate fuel use efficiency savings of $0.22 per watt per year and will also enable up to $0.44 per watt in annual revenue from transactions with the NYISO once its BTM:NG Market opens in 2017.[46] This is the principal revenue source that enables a rebate of year-one ratepayer funding and a profit share for utility shareholders.

Con Edison agrees that power electronics platforms will enable substantial earnings from expanded microgrid-to-macrogrid transactions. For the power electronics platform prosed in their VPP REV Demonstration program, Con Edison appears to see revenues of approximately $0.58 per watt per year, which is somewhat higher than

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[45] For a detailed independent engineers cost comparison that was provide to NYSERDA, See Attachment A, Page 22.

[46] The largest amount of revenue from the NYISO BTM:NG Market pertains to the capacitive/inductive capability of the power electronics platform to respond to frequency under/over speeds within 4 milliseconds. This fast response capability pertains to CHP resources with a fuel use efficiency generally exceeding 70 percent and enables less frequent dispatching of very large high-inertia generators with a fuel use efficiency of less than 30 percent. These response times were verified in the two GE Power Conversion testing reports provided to the Con Edison in June and August 2014, copies of which have also been filed previously with the Commission.

Pareto Energy's estimate of $0.44.[47] Unfortunately, the cost of their platform at almost four and half times the cost of the power electronics for Pareto Energy's Two-Sided Microgrid Platform Business Model will not enable net earnings by their ratepayers or shareholders.

Conversely, as can be seen in Table 5 below, CHP with mechanical interconnection actually increases the need for frequency response from high inertia generators with low fuel efficiency. Because the earnings from the NYISO BTM:NG Market would be less, the analysis suggests that ratepayers must subsidize the mechanically interconnected projects for almost $5 per watt and utility shareholders will not be able to share in profits.

Considering the per-watt cash flow analysis in Table 4 and the 369 MW CHP market in Brooklyn and Queens, Con Edison rate payers would avoid at least $590 million in customer incentive payments and earn net rebates of $150 million by implementing the power electronics platform demonstrated at KP-CHP.[48] Pareto Energy's Profit Sharing Plan would also pay Con Edison shareholders $677 million as compensation for lost earnings as the increased use of CHP delays more expensive investments in traditional transmission and distribution infrastructure.

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[47] See Attachment D, PP. 2-9 for Con Edison's financial analysis.

[48] This estimate is most likely understated because it has been based only on avoiding $1.60 per watt in customer incentives being paid under the IPEC Plan; some projects will not contribute new energy for the IPEC Plan but will contribute to the BQDM Program. However, it appears that incentives being paid under the BQDM Plan are more than $2.00 per watt. Also, it appears that 217 of the 369 MW opportunity would avoid the payment of incentives for both the IPEC Plan and the BQDM Program.

Table 4

Cash Flow Model for Existing CHP with Interconnection using a Power Electronics Platform
As compared with mechanical interconnection, higher fuel efficiency and enhanced NYISO earnings enable a rebate of all ratepayer subsidies and a share of profits with utility shareholders
All Figures in $ per Watt

Year	0	1	2	3	4	5	6	7	8	9	10
Project Cash Outflows:											
Interconnection Cost	$ (1.50)										
Construction Loan Repayment		$ (1.03)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Utility Shareholder Fee	-	$ (0.15)	$ (0.14)	$ (0.14)	$ (0.13)	$ (0.12)	$ -	$ -	$ -	$ -	$ -
Ratepayer Rebate		$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)
Shared Savings to Microgrid Owner	-	$ (0.33)	$ (0.33)	$ (0.33)	$ (0.33)	$ (0.33)	$ (0.33)	$ (0.33)	$ (0.33)	$ (0.33)	$ (0.33)
Total Cash Outflows	$ (1.50)	$ (1.64)	$ (0.60)	$ (0.59)	$ (0.59)	$ (0.58)	$ (0.46)	$ (0.46)	$ (0.46)	$ (0.46)	$ (0.46)
Project Cash Inflows:											
Cash From Project Finance Loan	$ 1.00	$ -									
IPEC Plan or BQDM Program		$ 0.64									
NYSERDA Demonstration Project Contract		$ 0.25									
Increased fuel efficiency		$ 0.22	$ 0.22	$ 0.22	$ 0.22	$ 0.22	$ 0.22	$ 0.22	$ 0.22	$ 0.22	$ 0.22
NYISO BTM-NG Market	-	$ 0.44	$ 0.44	$ 0.44	$ 0.44	$ 0.44	$ 0.44	$ 0.44	$ 0.44	$ 0.44	$ 0.44
Total Cash Inflows	$ 1.00	$ 1.55	$ 0.66	$ 0.66	$ 0.66	$ 0.66	$ 0.66	$ 0.66	$ 0.66	$ 0.66	$ 0.66
Project Net Cash Flow Loss or Gain	$ (0.50)	$ (0.09)	$ 0.06	$ 0.07	$ 0.07	$ 0.08	$ 0.20	$ 0.20	$ 0.20	$ 0.20	$ 0.20
Equity Investor Internal Rate of Return	12%										
Ratepayer Cashflows											
IPEC Customer Incentives	$ -										
IPEC Plan Outreach & Technical Contractors	$ -										
IPEC Admin Fees	$ -										
NYSERDA Demonstration Project Contract	$ (0.89)										
Unfunded Frequency/Voltage Control		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ratepayer Rebate		$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13
Total Ratepayer Costs	$ (0.89)	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13
NPV of Ratepayer Costs	$ -										

Table 5

Cash Flow Model for Existing CHP with Interconnection using a Mechanical Platform

Because the operational limitations of synchronous interconnection prevent participation in some NYISO markets,project investors would lose $0.21 per watt, even with the full $1.60 per watt of incentives funded by ratepayers

All Figures in $ per Watt

Year	0	1	2	3	4	5	6	7	8	9	10
Project Cash Outflows:											
Interconnection Cost	$(2.50)										
Construction Loan Repayment		$(1.72)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Utility Shareholder Fee	-	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ratepayer Rebate		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Shared Savings to Microgrid Owner	-	$(0.13)	$(0.13)	$(0.13)	$(0.13)	$(0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)
Total Cash Outflows	$(2.50)	$(1.84)	$(0.13)	$(0.13)	$(0.13)	$(0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)	$ (0.13)
Project Cash Inflows:											
Cash From Project Finance Loan	$ 1.67	$ -									
IPEC Plan or BQDM Program		$ 1.60									
NYSERDA Demonstration Project Contract		$ -									
Increased fuel efficiency		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
NYISO BTM-NG Market	-	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25
Total Cash Inflows	$ 1.67	$ 1.85	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25	$ 0.25
Project Net Cash Flow Loss or Gain	$(0.83)	$ 0.01	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13
Equity Investor Cash Flows	$(0.83)	$ 0.01	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13	$ 0.13
Equity Investor Five Year NPV Assumming a 12% rate of return	$(0.21)										
Ratepayer Cashflows											
IPEC Customer Incentives	$(1.60)										
IPEC Plan Outreach & Technical Contractors	$(0.64)										
IPEC Admin Fees	$(0.40)										
NYSERDA Demonstration Project Contract	$ -										
Unfunded Frequency/Voltage Control		$(0.15)	$(0.15)	$(0.15)	$(0.15)	$(0.15)	$ (0.15)	$ (0.15)	$ (0.15)	$ (0.15)	$ (0.15)
Ratepayer Rebate		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Ratepayer Costs	$(2.64)	$(0.15)	$(0.15)	$(0.15)	$(0.15)	$(0.15)	$ (0.15)	$ (0.15)	$ (0.15)	$ (0.15)	$ (0.15)
NPV of Ratepayer Costs	$(3.41)										

4 POINT-BY-POINT RESPONSE TO CON EDISON'S OPPOSITION TO THE DEMONSTRATION OF THE TWO-SIDED MICROGRID PLATFORM BUSINESS MODEL

On July 6, 2015, Con Edison strongly opposed Pareto Energy's Two-Sided Microgrid Platform Business Model based on two principal claims: 1) that the power electronics platform "…has never been successfully tested as a viable interconnection platform between a generator and an electric distribution system"[49]; and 2) that "the Petition seeks full funding of project costs (approximately $12 million) from Con Edison."[50]

The following subsections provide rebuttals to specific Con Edison objections.

4.1 Consideration of Con Edison's first principal claim that the power electronics platform has never been successfully tested as a viable interconnection platform between a generator and an electrical distribution system

Pareto Energy urges the Commission to dismiss Con Edison's first principal claim that the power electronics platform has never been tested.

We do so by referencing a third-party engineering opinion letter supplied to Con Edison by Pareto Energy in 2012[51] and hardware testing reports from an implementation of the power electronics platform in the field submitted by GE Power Conversion and Pareto Energy to Con Edison in 2014.[52] Two reports from the GE-PC

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[49] Con Edison Opposition, p. 2.

[50] Con Edison Opposition, P. 7.

[51] See Attachment A, Pages 11 to 14 for an independent engineer's opinion letter that was provided to Con Edison in 2012 about the technical and commercial readiness of the Power Electronics Platform ("Engineer's Opinion Letter"). Note the Engineer's Opinion Letter indicates that no prototype of the power electronics had been developed. Subsequently, however, Pareto Energy determined that the suppliers GE Power Conversion, Woodward, and Ingeteam all had numerous working models of the power electronics platform at customer sites in the field.

[52] Between June 11, 2014 and January 8, 2015, Pareto Energy supplier, GE Power Conversion, provided Con Edison with hardware tests from an implementation of the power electronics platform in the field. See Attachment B for two protocols that resulted from the hardware tests: 1) A Technical Concept & Application Guide provided the information to evaluate project applications for the power electronics platform and 2) A Product Standard Approval Package provided the engineering specifications and quality

tests have been submitted to the NYS-DPS Staff to provide undeniable, concrete evidence attesting to the falsity of Con Edison's claim.

The record shows that in January 2015, Con Edison had accepted the hardware testing of the power electronics platform to the extent that the Utility's Senior Vice President of Electric Operations began working proactively to support funding a demonstration of the Two-Sided Microgrid Platform Business Model.[53]

4.2 Consideration of Con Edison's second principal claim that Pareto Energy seeks full funding of the $12 million demonstration project costs from the utility

Pareto Energy also urges the Commission to dismiss Con Edison's second principal claim that the Utility will fully fund the demonstration by referencing the Project Finance and Profit Sharing Plan in Pareto Energy's Petition.[54] Pareto Energy's petition clearly asks that the costs of the project be shared by Pareto, Macerich, NYSERDA and Con Edison.

Pursuant to a research contract with NYSERDA, Pareto Energy will fully fund the $12 million demonstration of the Two-Sided Microgrid Platform Business Model by investing

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plan by which Con Edison would approve the installation of the power electronics platform. Detailed GE Power Conversion reports from the hardware tests have been provided to the Staff of the New York Department of Public Service.

[53] In January 2015, before Pareto filed its Petition with the Commission, Con Edison's Senior Vice President Robert Schimmenti supported full funding of Pareto's demonstration of the two-sided platform business model at a cost of $1.50 per watt. He agreed that the demonstration would have public benefit for the Indian Point Energy Center Reliability Contingency Plan ("IPEC Plan") where the New York State Energy Research and Development Authority was paying new CHP resources a customer incentive of $1.60 per watt and spending an additional $0.64 per watt for outreach contractors to find projects. Mr. Schimmenti also expressed support for funding Pareto's demonstration of the two-sided platform business model pursuant to new Commission guidelines for demonstration projects under the Commission's Reforming the Energy Vision Proceeding ("REV Proceeding"). See the highlighted portions of email communications in Attachment E herewith for relevant communications between Pareto Energy and Mr. Schimmenti.

[54] Pareto Energy Petition, PP. 11-16.

$4 million in equity and securing an $8 million construction loan from a project finance bank.

Pareto Energy will close the construction loan from three types of future payments after the power electronics platform is operating successfully: 1) transactions for the sale of energy and grid control to the NYISO BTM:NG Market; 2) a year-one payment for the public benefit of avoided costs for outreach contractors to find CHP projects (this fund could be paid from either the NYSERDA IPEC Plan outreach budget or the Con Edison BQDM Program outreach budget) ; and 3) a year-one $2 million research contract that Pareto Energy won from NYSERDA to demonstrate the power electronics at the KP-CHP. The second and third costs will be rebated to ratepayers from the NYISO transactions in subsequent years.

4.3 Point-by-Point response to other Con Edison claims

Con Edison makes other unsubstantiated claims in its opposition. The following sections summarize Pareto Energy's point-by-point rebuttal to Con Edison's opposition. Con Edison's unsubstantiated claims are included in the section headings.

4.3.1 Since early 2011, Pareto has sought the Company's investment in the power electronics platform at projected installation costs of approximately $12 million.

In June 2013, Pareto Energy met with Commissioner Garry Brown, NYDPS Assistant Counsel Leonard Van Ryn, and NYDPS Chief Engineer, Michael Worden to present the KP-CHP opportunity. At that time, Commissioner Brown informed Pareto Energy that the KP-CHP Project could be a candidate for funding with ratepayer money if it could demonstrate a clear public benefit. He recommended that, if necessary, Pareto Energy should petition the Commission to show such public benefit and request funding.

Subsequently, Macerich, the owners of the KP-CHP project sent a letter to Con Edison on August 23, 2013 requesting a meeting to discuss ways to collaborate in funding the project for the benefit of Macerich and Con Edison shareholders and ratepayers. Con Edison did not agree to convene that meeting until June 11, 2014.

However, in January 2014, Pareto Energy offered to fully fund the project in exchange for post-installation payments from Con Edison, NYSERDA, and the NYISO for the R&D and public benefits that resulted. At that time, Pareto Energy suggested a joint petition with Con Edison to the Commission as originally recommended by Commissioner Brown. Con Edison did not respond to Pareto Energy and Macerich's proposal for a joint petition until January 8, 2014, at which time it declined the opportunity for a joint petition but agreed not to oppose any petition submitted by Pareto Energy.

Later in January 2014, Pareto Energy shared a copy of its draft petition with Con Edison's Distributed Generation Ombudsman and worked with him and Con Edison Senior Vice President Robert Schimmenti to seek post-implementation payments from the IPEC Reliability Contingency Plan and Con Edison and NYISO markets for demand response. These efforts proved to be unsuccessful.

The funding proposals of Macerich and Pareto Energy have always been consistent with mobilizing a least-cost resource for Con Edison rate payers. Further, we have always supported providing Con Edison shareholders with an incentive for interconnecting CHP resources that met or exceeded the opportunity for earnings from more expensive investments in transmission and distribution infrastructure or other distributed energy resources.

4.3.2 No prototype of the power electronics platform has ever been built (Con Edison Opposition, P.3).

Multiple suppliers, including Pareto Energy's supplier, GE Power Conversion ("GE-PC"), have applied the same technology for similar interconnection and control at numerous locations worldwide. The applications from all the suppliers are fully compliant with IEEE Standard 1676 - Guide for Control Architecture for High Power Electronics (1 MW and Greater) used in Electric Power Transmission and Distribution Systems. As previously mentioned, Pareto Energy and GE-PC provided Con Edison with hardware testing of a field demonstration of the system in 2014. Those tests were submitted to NYS-DPS Staff.

4.3.3 The power electronics platform has never been successfully tested as a viable interconnection platform between a generator and an electric distribution system (Con Edison Opposition, P.3).

Between June 11 and December 16, 2014, Con Edison had requested and received hardware tests and simulations of the power electronics platform that were provided by General Electric using a customer installation in the field. A meeting on December 16, 2014 with Con Edison's Vice President of Engineering and Planning, Patrick McHugh, Department Manager for Distribution Engineering/System Design, Chris Jones, and Distribution Engineer in charge of interconnection applications, Dan Sammon, resulted in an agreement on all procedures for insuring required UL Certifications and compliance with IEEE standards.

4.3.4 The power electronics platform has never been tested for UL 1741 or IEEE 1547.1 (Email between Susan Vercheak and Guy Warner, September 29, 2015.)

The General Electric tests above proved to Con Edison that Pareto Energy and GE-PC could verify that the product specification to be installed for the KP-CHP opportunity complied with all required UL and IEEE standards. A factory testing and acceptance plan and site testing and acceptance plan to verify that the actual units to be installed performed in the same way as the prototype equipment under test was presented to Con Edison on January 8, 2015. Pareto Energy is fully funding the manufacture, testing and installation of the power electronics platform and, therefore, assumes all the risk in the highly unlikely event that UL certificates cannot be shown or compliance with IEEE standards cannot be verified.

4.3.5 Pareto Energy does not intend to build and test a prototype of the power electronics platform until it receives a formal offer to purchase the technology (Con Edison Opposition P. 3).

In 2012, Pareto Energy provided Con Edison with an independent engineering opinion that the power electronics platform was available from multiple suppliers. Thereafter, Pareto Energy and GE Power Conversion funded more than $700,000 of tests of the power electronics platform at a working installation in the field.[55] Going forward, Pareto Energy is fully funding the $12 million construction and installation of the power electronics platform with a $4 million equity investment and an $8 million construction loan from a project finance bank.[56]

Far from seeking project funding from Con Edison, Pareto Energy's Project Financing and Profit Sharing Plan provides rebates to both Con Edison ratepayers and shareholders.[57]

4.3.6 Pareto Energy's Petition is an untimely collateral attack on the IPEC Order for a project that has not been submitted to NYSERDA (Con Edison Opposition P. 3-5).

Pareto Energy submitted a formal proposal in February 2014 to NYSERDA for a $2 million contract to demonstrate the project. Under NYSERDA rules, the contract must be for developed technology that is underutilized in New York. Con Edison provided a letter of support that was conditional on Pareto Energy showing the state of product development by conducting tests of a prototype. On June 23 and August 25, 2014, GE Power Conversion provided test reports from an installation of the power electronics platform in the field. Meanwhile, the Commission's IPEC Plan order directed Con

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[55] Pareto Energy has been fortunate that NYSERDA covered more than $500,000 of this amount as part of a research contract that Pareto Energy won after a competitive proposal to NYSERDA.
[56] Pareto Energy Petition, Project Financing and Profit Sharing Plan, pp. 11-20 which was updated in Section 1.1 and Section 3 of this Filing.
[57] See Table 1 in Section 1.1 of this Filing.

Edison, working with DPS Staff, NYPA, and NYSERDA, to intensify its efforts to identify and exploit these additional opportunities for CHP resources, and required Con Edison to report on these efforts.[58]

It is noteworthy that Con Edison never identified the KP-CHP opportunity to the Commission in its April 16, 2014 report, well after the time it agreed to support the project with NYSERDA for demonstration as a developed technology that was underutilized in New York. It is also noteworthy that by the time Con Edison was required to report new opportunities to the Commission, one of their engineers had coauthored an engineering journal article that was later peer reviewed and accepted for publication by the IEEE.[59] Finally, Con Edison's CFO featured the KP-CHP Microgrid demonstration project in a presentation on the REV to investment bankers.[60] Pareto Energy believes that the Commission clearly kept the window open for new CHP opportunities. Con Edison's failure to identify the KP-CHP opportunity does not, therefore, mean that Pareto Energy's Petition represents a collateral attack on the IPEC Plan Order.

4.3.7 The KP-CHP demonstration project does not qualify for REV Demonstration Project Funding because it is a project that involves the installation of untested technology and that is otherwise in the infancy of its technological development and does not demonstrate a new business model similar to Con Edison's REV Demonstration Project for a virtual power plant (VPP).

The commercial readiness of the power electronics platform which costs $1.50 per watt to implement has been validated by:

1) NYSERDA acceptance as developed technology;

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[58] Case 12-E-0503, Proceeding on Motion of the Commission to Review Generation Retirement Contingency Plans, Order Accepting IPEC Reliability Contingency Plans and Establishing Cost Allocation and Recovery and Denying Requests for Rehearing ("IPEC Order"), November 4, 2013, p. 5-6.
[59] See copy of the Article in Attachment A, PP. 25-33.
[60] See presentation page in Attachment A, PP. 23-24.

2) An independent engineers report that all parts of the platform are available off-the-shelf from multiple suppliers;

3) Testing of a prototype in the field by GE-PC;

4) A peer-reviewed and published article by the IEEE with a Con Edison engineer as co-author which validates the functionality and cost savings of the power electronics platform in Brooklyn;

5) Selection of the technology by an informed client in the competitive marketplace for interconnection technologies because of the promise of a business model with fuel savings and more lucrative transactions with the NYISO; and

6) A Project Financing and Profit Sharing Plan that shows that net rebates to Con Edison ratepayers and substantial earning opportunities for Con Edison shareholders can be enabled within one year by the fully competitive NYISO BTM:NG Market.

By contrast, the competitive Virtual Power Plant platform to enable grid transactions with installed home solar systems uses a technology selected by Con Edison, not the energy user, with full funding by Con Edison ratepayers at a cost of $6.67 per watt under a business model that will not be economically viable until at least 2021. Also, Con Edison's VPP Business Model does not target locations on the grid that clearly need the technology; Pareto Energy's two-sided platform Business Model deploys demonstrations at a proven place of refuge within a low income neighborhood suffering from substantial grid congestion and also at one of the most important transportation hubs in the nation where power from the CHP system has never been used on-site to improve the power reliability and resiliency of JFK Airport.

4.3.8 The KP-CHP demonstration project does not qualify for REV Demonstration Project Funding because Pareto Energy seeks full funding of the $12 million project costs from Con Edison. (Con Edison Opposition P. 7)

Under the Project Financing and Profit Sharing Plan in the Petition, Pareto Energy is fully funding the KP-CHP project and then earning cash flows if and when the power electronics platform performs technically and transactionally as expected.

Part of the cash flows were based on earning only the IPEC Plan outreach fee and not earning the IPEC Plan customer incentive paid to new, less proven CHP resources. Progress in work with the managers of the new NYISO BTM:NG Market now indicates that even the outreach fee can be rebated to Con Edison's rate payers, and Con Edison's shareholders can earn $14.85 million without any investment. Con Edison also ignores Macerich's contribution of a $45 million CHP asset with a proven track record of reliable and affordable operation.

It does appear that Con Edison's VPP demonstration project fails the REV criteria; it is being fully funded by Con Edison ratepayers at more than four times the cost of the KP-CHP project.

4.3.9 The KP-CHP demonstration project does not qualify for REV Demonstration Project Funding because Pareto Energy fails to demonstrate how the power electronics platform and its corresponding generators could be successfully integrated into Con Edison's retail rate design and structure. Despite Pareto's attempt to couch its proposal as a new business approach, at its core, Pareto's proposal is simply that Con Edison should fund the installation and testing for the power electronics platform. (Con Edison Opposition, pp. 7-8).

The Project Financing and Profit Sharing Plan in Pareto Energy's Petition follows Commission guidance that the markets that will be enabled and potentially operated by the DSP will not establish commodity prices; commodity prices, the prices for capacity, energy and bulk ancillary services will be set by the NYISO.[61]

By working directly with the managers of the NYISO BTM:NG Market, Pareto Energy contends that there will be sufficient cash flows from the Two-Sided Platform Business Model to enable a net rebate of $3.25 million to Con Edison rate payers and earnings of $14.85 million to Con Edison shareholders. We also have the opportunity to extend the two-sided platform Business Model to nine other planned or existing CHP sites in

[61] REV Framework Order, P. 50

Brooklyn and Queens for a total market of 369 MWs. Acting on that opportunity would save New York rate payers $590 million in avoided customer incentives for new CHP and enable net ratepayer rebates of $150 million. Con Edison shareholders would earn $677 million as compensation for lost profitability as the increased use of CHP delays more expensive investments in traditional transmission and distribution infrastructure.

Because Con Edison's opposition invites comparison to its VPP REV Demonstration project, we remind the Commission of Con Edison's admission that the Business Model there will not be economically viable until 2021.

Unlike the specific transactional capabilities of the power electronics platform for spinning reserves and voltage and frequency control that were proven in prototype testing by GE Power Conversion and for which there will be specific payments from the NYISO's BTM:NG market, the VPP Platform proposal provided no testing and does not connect to specific markets for the transactions that will supposedly make it profitable in five years from now. Does Con Edison not have to meet its own standards for product testing? Is this not an anecdotal of monopolistic influence, and what are reasonable expectations for how this type of impropriety should effect the private market?

According to the very first Commission criteria, REV demonstrations should include partnerships between utilities and third party service providers. Unfortunately, Pareto Energy has never developed such a partnership with Con Edison. Despite our repeated attempts over the last 6 months, Con Edison has refused to even meet with us, to discuss a settlement.

4.3.10 Pareto Energy's proposal for funding under the BQDM Program is premature (Con Edison Opposition, P. 8)

Con Edison has not responded to Pareto Energy's year-old proposal to Con Edison's BQDM Request for Information to convert the Kennedy International Airport Cogeneration Facility from mechanical to electronic interconnection. Note that Pareto

Energy funded all the outreach and design costs to prepare the detailed engineering proposal and project financing plan for KIAC.

By January 2016, Con Edison is supposed to have selected projects from the BQDM RFI and had them reviewed by an independent third party. Under normal industry standards, taking one year to respond to a proposal for resources that are needed before June 2016 is unreasonable. There seems to be no telling how much longer Con Edison will take to select the third party reviewer much less come to an actionable implementation of proposals.

Meanwhile, without any third party review ordered by the Commission, Con Edison has eliminated all CHP as a resource under the BQDM Program. Much like Pareto Energy's KIAC proposal, it is likely that, if asked, many independent CHP service providers would have privately funded the outreach and engineering design costs to find such projects. It is also possible that such projects would never have required any ratepayer funding to be fully implemented. [62]

Instead Con Edison is spending significant ratepayer funds for outreach and utility designs of non-CHP generation with fuel cells and natural gas generators, the latter being a sole sourced microgrid to a single supplier without any competition or third-party review and without any consideration of whether it is located at a spot on Con Edison's network that has the same resiliency benefits and benefits for low income neighborhoods as Pareto Energy's proposals for the KP-CHP and KIAC.[63]

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[62] Case 14-E-0302, *Petition of Consolidated Edison Company of New York, Inc. for Approval of Brooklyn/Queens Demand Management Program*, BQDM Quarterly Expenditures & Program Report: Q2-2015 ("BQDM 2nd Quarter Report"), August 31, 2015, pp. 15-16.

[63] Case 14-E-0302, *Petition of Consolidated Edison Company of New York, Inc. for Approval of Brooklyn/Queens Demand Management Program*, BQDM Quarterly Expenditures & Program Report: Q2-2015 ("BQDM 2nd Quarter Report"), August 31, 2015, pp. 15-16.

In sum, Con Edison is using the complexity and cost of the interconnection technology that it chooses for the customer and tapping ratepayer funds for project outreach and design to compete against Pareto Energy. Meanwhile, Pareto Energy has superior technology validated by third-party engineers that customers have chosen in the competitive market for interconnection services.

ATTACHMENT A

Evidence from Third Party Reviews that the Power Electronics Platform Proposed to Support Pareto Energy's Two-Sided Microgrid Platform Business Model is Based on Standardized Off-the-Shelf Components and is Cost Effective as Compared with Mechanical Synchronous Interconnection Technologies

November 10, 2008

Bryan C. Barbera
Manager of Marketing
Inside Sale and Distributed Generation
The Connecticut Light and Power Company
Distributed Resources
P.O Box 1409
Hartford, CT 06143-1409

Subject: **Load Reduction**
Stamford Energy Improvement District
Stamford Government Center
888 Washington Boulevard
Stamford, Connecticut
URS No. 36916556

Dear Mr. Barbera:

On behalf of Pareto Energy ("Pareto"), URS is submitting this letter informing you of an ongoing project with the City of Stamford.

As part of the Pareto team, we are proposing to implement a capital program at the Stamford Government Center at 888 Washington Boulevard with a net result of reducing the electric power demand that the Center imposes on your electrical system. Specifically, we are proposing to add on-site power generation resources to partially reduce the Center's net external power requirements. Additionally, the reduction of external power requirements should result in a displacement of power flows in the utility local distribution lines, with a potential reduction in capital requirements for utility distribution system upgrades.

The current annual energy consumption at the Government Center is approximately 4,745,000 kilowatt-hour (kWh), and the reduction in consumption of grid resources is anticipated to exceed 90%. In addition, the use of absorption chillers should further reduce the peak demand, from approximately 1350kW to approximately 360kW (apart from planned and unplanned maintenance outages of the on-site resources).

The design of the new facilities will include protective safeguards to isolate the utility system from the Government Center's power flows.

URS Corporation
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Rocky Hill, CT 06067
Tel: 860.529.8882
Fax: 860.529.3991
www.urscorp.com

Proposed Facilities

Recognizing the high value placed on the safety and reliability of the utility power delivery system, our plan is to implement an expansion program with safeguards that preclude any potential detrimental effects on the power delivery system. The integration of the new equipment will be achieved with the use of an "interconnection inverter" to eliminate the potential of voltage, frequency and phase-angle mismatching between the Government Center facilities and the utility grid. Attached for your review are three sketches showing our current conceptual plan of expansion. Specifically, the attachments are:

- A-101: Garage and Tower Ground Floor Plan;
- A-102: Tower Basement and Roof Plan;
- BD-001: Block Diagram.

Sketch A-101 shows the overall footprint of the Government Center ground level and the proposed location for the new fuel cell and new generation (lower left). The fuel cell and new generation represent state of the art proven technology to ensure a high level of availability and reliability.

Sketch A-102 shows the footprint for the Government Center basement level. The existing utility equipment and space will not be affected by the new equipment. Existing available area will be used to install all the required protection, switching and interconnection-inverter equipment.

Sketch BD-001 is a simplified diagram showing the overall conceptual electrical arrangement of the proposed new facilities, and the integration into the existing utility distribution system via an interconnection inverter. The diagram reflects the two separate utility radial feeds identified during our site visits and investigations.

Discussion

As shown in sketch BD-001, the proposed electrical arrangement results in an efficient, safe and reliable system, where the "interconnection inverter" provides for the continuous interconnected operation of the Government Center and the utility system but with separation of voltage, frequency and phase-angle between the two systems. The technology of the interconnection inverter is conceptually the same as back-to-back converters utilized throughout the utility industry to ensure reliable operation between utility systems. The key aspects of the operational functionality of the proposed system are:

- Operation across the "interconnection inverter" during times when the Government Center is not or not fully self-generating;

- Interconnection inverter provides isolation of detrimental effects or changes in voltage, frequency and phase angles at the Government Center from impacting the utility distribution system;
- Protection and interconnection system will be fully automated;
- Control system will prevent power back-flow to the utility system;
- Full compliance with industry standards and guidelines for electrical facilities.

We look forward to receiving your comments and to initiating discussions to ensure a coordinated development effort.

Sincerely,

Douglas Roberts

Senior Project Manager
URS corporation AES
douglas_roebrts@urscorp.com

cc: Guy Warner, CEO, Pareto Energy
Dannel Malloy, Mayor, City of Stamford
Ray Necci, President, CL&P
Dominic M. Lauria, Circuit Zone Manager, CL&P
Joseph N. Debs, Distributed Resources Project Manager, CL&P
Matthew Brown, URS - Washington Division
Anthony Lopez-Lopez - Washington Division

Connecticut Light & Power
The Northeast Utilities System

Distributed Resources Department

The Connecticut Light & Power Company
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CONDITIONAL APPROVAL

02/17/09

Attention: Richard A. (Rick) DiIoia, Vice President, Marketing Pareto Energy Ltd.

Re: Stamford EID Government Center Load Reduction Project

Pareto Energy Ltd.

Dear Mr. DiIoia:

CL&P has reviewed the Stamford EID Government Center Load Reduction Project data, one-line diagram BD-001 dated 1/22/09 and your response data sheet February 4, 2009. Based on the information submitted, CL&P has concluded the Application Review and has determined that the proposed generator will not have an impact on the CL&P distribution system.

In order to allow your proposed system to interconnect to the CL&P system, the following conditions must be met. Please submit accordingly.

1. Please update the one line diagram BD-001 in accordance to all the comments outlined in the letter dated February 03, 2009. This one line will be included in the Interconnection Agreement (IA) Appendix.
2. CL&P will require a 59 N device on the 13KV side unless the following conditions are met:
   - CL&P understands that any currents phased for power in excess of zero out of the rectifier will cause the Beckwith relays shown on the one-line diagram BD-001 to trip, both the breaker and the inverter without time delay (instantaneous Tripping).
   - CL&P will require a witness test with injected currents to demonstrate that the Beckwith relay will trip for the specified current as indicated.
   - The customer must program each of the inverter's current limit to 110% FLA, (this will be verified during the witness test).
3. Please provide CL&P with a detailed description of the Generating facility. This description will be included in the IA Appendix B.
4. In accordance to the DPUC approved Generator Interconnection Guidelines, an IA must be signed by the City of Stamford. I have

included a draft copy of the agreement for you review. Please review and confirm the information in RED.

5. Provide CL&P with proof of insurance for the city of Stamford as outlined in section 11 of the IA.
6. Please provide documentation, which indicates that the local electrical inspection has approved the installation.
7. Please provide a $1000 upfront payment for the witness test.
8. A witness test by the CL&P test department is required. Two weeks prior to the scheduled witness test, the customer/consultant must provide a "test procedure", a three-line and a control diagrams. The test procedure must include the bench and functional tests of the Beckwith Relays, demonstration of the polarization of function 32 device towards CL&P, rotation check of the generator and fuel cell with the CL&P system, verification that the fuel cell only operates in Grid Connected when connected in parallel with the CL&P system, and the operation of the Kirk Key Interlock systems.
9. Once you have met all the items above, CL&P will schedule a witness test. Allow ten (10) business days for the test. CL&P will also like to schedule a pre-test meeting will all parties to review the test procedure prior to conducting the test. At the conclusion of a successful witness test, CL&P will issue a written authorization to interconnect your generator to the CL&P system.

Should you or your team have questions or need clarification on our requests, please do not hesitate to call me. I look forward to hearing from you and to begin working on your project.

Sincerely

Joseph N Debs
Distributed Resources, Project Manager
Tel: 860-665-5616
E-mail: debsjn@nu.com

C.C. Bryan Barbera, David Ferrante, John Ferrantino, Carol Sherwood, Guy Warner, Shalom Flank

Pepco Holdings, Inc

201 West Gude Drive
Rockville, MD 20850
(301) 548-4351

June 1, 2011

Mr. Shalom Flank, Ph.D.
Chief Technology Officer & Microgrid Architect
1101 30th Street NW Suite 500
Washington, DC 20007

Dear Mr. Flank,

This letter confirms Pepco's Engineering approval of the Level 4 Interconnection application for the installation of two (2) 4.5 MW generators at Howard University located at 100 6th & Trumbul Street, NW, Washington, DC 20011. The approved micro-grid system will operate in a one-way power flow mode only with no excess generation exported into Pepco's Distribution System.

Based on the engineering analysis (Feasibility/Impact Study) performed, it was determined that the following operational conditions will be met by the Interconnecting customer:

1. The proposed generators will not operate in parallel with the Pepco electric distribution system. Specifically, the generator output will not be "synchronized" to the Pepco grid as a result of connection through a series of power inverters.

2. The customer will provide documentation to show that the proposed micro-grid has been certified to meet IEEE 519 and UL347A standards prior to operating the micro-grid with the Pepco system.

3. The Points of Common Coupling will be the new circuit breakers labeled 52 on the customer's one-line diagram. The customer will grant Pepco field personnel access to these breakers. Pepco will have the capability to remotely trip the inter-tie breakers via dedicated phone line.

4. Each of the six (6) feeders will include current transformers and potential transformers to convey real-time data to the protection device that opens and closes breaker 52. Pepco will receive real-time generator output (kW) data, revenue metering (kwh) drawn from Pepco,

and inter-tie breaker status, real time kilowatts, real time amperes, single phase voltage and harmonics data at each breaker.

5. The Interconnection customer will ensure all six (15637, 15638, 15639, 15640, 15641, and 15642) will be balanced within 10%. The customer will provide notification to Pepco's Control Center if one feeder is to be turned off. A minimum of 1 AMP of load per feeder will be sufficient to assure Pepco there is positive power flow from the Pepco system into the customer.

6. The Customer will submit design drawings to include one-line, site plan, equipment layout, control scheme, installation of communication equipment and a relay coordination study for Pepco's review and approval.

7. The following cost estimate has been developed based on Pepco's understanding of the Customer's installation.

   Direct Costs- Material and Labor ………………$54,500
   Indirect costs – Overheads ………………………$4,300
   Total without CIAC Gross Up …………………..$58,800

8. Prior to placing the equipment in service an Interconnection Service Agreement shall be executed between Howard University and Pepco.

Should you have further questions, please feel free to contact me at (301) 548-4351.

Sincerely,

James Pringle
Sr. Account Manager
Pepco Commercial Services

Cc: Mr. Basil Allison
Ms. Jane Verner
Mrs. Amy Strope
Mr. Mason Mattox
Mr. Joseph Wolete
Mr. Dwayne Kerr
Mr. En Chai
Mr. Chander Bhan

701 Pennsylvania Avenue, N.W. | Washington, D.C. 20004-2696 | 202.508.5000 | www.eei.org

Power by Association℠

Edison Electric Institute

May 6, 2011

Mr. Guy Warner
CEO
Pareto Energy
1101 30th Street, N.W.
Suite 500
Washington, D.C. 2007

Dear Mr. Warner:

I'm writing to invite you to participate in an EEI project to assess the implications of smart grid-enabled distributed resource development. Participation would entail (1) working with us to document your **Stamford, Connecticut "Energy Improvement District"** project as a case study, and (2) reviewing nine other case studies of similar developments and joining with us in a workshop to discuss/assess the implications for market development and public policy.

As I'm sure you realize, the marriage of smart grid (SG) technologies with distributed energy resources (DER) (that is, the use of new "smart" control technologies to aggregate, optimize and integrate portfolios of distributed resources in real-time within our power system) has the potential to change fundamentally traditional utility operating paradigms, and the utility business. This has become more pressing as public policy encourages the development of DER owned by customers and third parties. We think it is vital, therefore, to understand the implications of these new technologies and policies. This means understanding new business opportunities that may be emerging, and identifying public policies that can help to foster them.

We have laid out a two-phase plan (see Figure) in which we develop case studies describing a representative sample of SG/DER applications (what we're calling "Energy Internet" for want of a better term), then facilitate case study participants (see List of Invited Participants) in assessing the implications of such developments in a dedicated workshop. Results of the case study evaluations and the workshop will be shared with all EEI members, and will be used to frame discussions with EEI-member CEOs.

We have identified your project work as among the cutting-edge demonstrations in this area.

We believe your perspectives and experience can contribute significantly to building a knowledge base about pilots that: (1) Demonstrate the integration and interoperability of multiple types of DER at multiple levels (grid, site, device); (2) Leverage new and evolving information and communication technologies; (3) Establish frameworks for stakeholder collaboration and participation by new market players; and (4) Address alternative business and regulatory models.

Of particular interest to EEI are your innovative governance structure and your "GridLink" technology that enables a safe connection between a microgrid and a traditional grid. These innovations, that you introduced in the Stamford, Connecticut project, represent significant sustainable economic development assets.

We are excited about this project, and hope you will decide to participate. I will contact you to schedule a time in the near future to discuss the project. Larisa Dobriansky, Director, Global Energy Network, who is supporting me on this project, will join in the call.

Sincerely,

Eric Ackerman

Eric Ackerman
Director, Alternative Regulation
(voice) 202 508 5528
(fax) 202 508 5038
eackerman@eei.org

Enclosures: List of Invited Participants
Figure 1 (diagram of EEI Project)

November 9, 2011

Ms. Michelle Vensel
Pareto Energy, Ltd.
2300 M St NW, Suite 800
Washington, DC 20037

Re: GridLink™ – Engineering Opinion

Dear Ms. Vensel:

We are very pleased to provide our engineering opinion as part of an initial technical screening of the GridLink™ system. After discussions with Pareto Energy's design and engineering team and review of the conceptual level design of the GridLink™ system, it is our opinion the GridLink™ system utilizes existing, proven AC/DC power conversion equipment applied in a manner consistent with its intended use. All of the hardware utilized in the creation of the GridLink™ is manufactured for other customers to use for similar functions but in differing applications.

What makes GridLink™ different from the existing applications of this equipment is the controlling software which allows the equipment, applied as it was originally designed, to perform a new function within the electrical system. Although there are technical challenges yet to be overcome by the Pareto team, we do not foresee any challenges beyond those normally found in applying equipment in a new manner. Once fully realized, GridLink™ provides a potentially revolutionary aid in development of Microgrids and distributed generation for a myriad of customers with varying applications.

Our review team included practicing, licensed consulting electrical engineers with backgrounds in power generation and distribution for institutional and industrial facilities. Actual review was limited to GridLink™ conceptual level, hardcopy design documents and Pareto Energy staff input. Our understanding is a prototype or model of an actual GridLink™ product is not yet available; however, by definition, all the components and wares to build GridLink™ are commonly manufactured and a fully functional prototype is the next step of the product's development. Given the fact this is an adaptation of existing hardware, even without the working prototype, we do not see any insurmountable technical obstacles to the success of the GridLink™ system within a proper design and application.

Hardware/equipment:

The GridLink™ system is composed of multiple components arranged in a manner to electrically isolate a customer's electrical distribution system from the serving utility's electrical distribution system. Importantly, this isolation includes the ability to balance or control the actual electrical characteristics of the customer's interconnection as seen from the utility – even with multiple feeders serving a MicroGrid. The electrical interface is achieved through implementation of power electronic components arranged in back-to-back AC/DC-DC/AC three-level converter topology controlled via software. In addition, step-down/step-up transformers, switchgear, protective relays and enclosures are included to facilitate interconnection and protection of the power electronic devices.

All electrical and physical components proposed for the GridLink™ application are regularly manufactured electrical equipment available from multiple equipment manufacturers' typical product offerings. The converter control system software is updated by the equipment's manufacturer to enable additional control features to facilitate implementation of the electrical isolation and output control elements required for the GridLink™ application.

Packaging multiple commercially available electronics and communications modules together to form a system for a specific application is a relatively common industry practice. The Institute of Electrical and Electronics Engineers (IEEE) recognized the importance of this segment of the power industry and developed IEEE Standard 1676 – *Guide for Control Architecture for High Power Electronics (1MW and Greater) Used in Electric Power Transmission and Distribution Systems* to define hierarchical control architectures for packaged systems. The intent is to standardize control system designs to facilitate the use of commercially available electronics and communications modules to reduce the cost for power electronics applications.

Controls/software:

IEEE-1676 defines five recommended levels of control for a packaged power electronics system as follows:

System Control – All functions involved in the determination of the system mission of the power electronics system.

Application Control – All functions involved in the operation of the power electronics system to meet the mission determined by the system control.

Converter Control – All functions that enable the application control level to perform its functions by controlling functions common to all converters such as synchronous timing, current and voltage filtering, measurements and feedback control calculations.

Switching Control – All functions that enable the power electronics to behave as a switch-mode controlled source including modulation control and pulse generation.

Hardware Control – All functions that manage everything specific to the power devices.

Of these control systems, only the System Control is completely unique to GridLink™. As previously stated, GridLink™ employs a packaged power electronics system made up of commercially available electronics and communications modules. The four other levels of control are incorporated into this equipment by that equipment's manufacturer. The System Control software developed by Pareto utilizes the equipment and lower level control systems to synchronize multiple power sources together to serve a common load while electrically isolating the sources from each other and the load.

This equipment has been used extensively in the wind power industry to facilitate connection of variable frequency synchronous wind turbine generators to the fixed frequency electrical grid. In a wind farm arrangement, multiple converters can be simultaneously controlled to act together to control the phase angle between the voltage and current output to provide dynamic volt-amp reactive (VAR) support for the utility grid. In addition, the output waveforms are controlled to mitigate generation of harmonic currents to meet requirements of IEEE Standard 519 – *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*. In addition, the System Control software connects to multiple GridLink™ converter modules to facilitate paralleling of multiple modules. Whether it is a building's air conditioning system, an on-site generator paralleled to the utility grid, or an entire college campus' building management system, implementing software control of multiple components operating together as a system is common industry practice. Again, we do not see any insurmountable technological barriers to the successful adaptation of this control system.

Systems integrity/testing:

The proposed GridLink™ system approach incorporates multiple converters operating in parallel with separate direct current (DC) buses such that a failure in one converter stage or DC bus would only affect that section of the system allowing the remaining sections to continue operation. Any level of redundancy (i.e. N+1, N+2, etc.) can be delivered based on project specific reliability requirements. The level of redundancy required for a specific project is typically defined by the Owner based on the criticality of the load being served (i.e. healthcare, data centers, life safety, non-essential, etc.). The GridLink™ system can be tailored to each individual Owner's specific redundancy requirements.

The individual building blocks of the GridLink™ system can be factory tested prior to integration using existing testing standards. During converter design, computer simulations of input and output waveforms are typically performed to anticipate behavior of the completed system. These simulations are validated during system functional testing at the factory.

It is our understanding that once the GridLink™ system is constructed, the overall system or E-house will be tested prior to being shipped to the project site. Loads, utility interconnections and onsite generators can be connected to the finished GridLink™ system to verify the proper function of each individual E-house. Connecting two E-houses together with loads, utility interconnections and onsite generators allows functional testing of the overall system control software and system response to normal and upset conditions. Test reports documenting results of functional tests will likely be required by the interconnecting utility to validate system operation and compliance with necessary standards. If required by the Owner or interconnecting utility, third party testing by a Nationally Recognized Testing Laboratory (NRTL) can be completed prior to shipment of the complete E-houses to the project site.

Finally, although not an endorsement of the technology per se, Pareto Energy has been granted approval to interconnect the GridLink™ system by multiple utilities. Utility interconnection agreements for any projects which include on-site generation operating in parallel with the utility are critical to the success of the overall project and many times are the most risky component to a project's viability. Given the extremely cautious nature of utilities to allow any generation to be connected to their systems, Pareto Energy's success again demonstrates the normalcy of the application of this hardware. In fact, at least one utility came to the conclusion that onsite generation was not operating in parallel with their system once the GridLink™ system was inserted between the utility and onsite generator.

In summary, based on the information provided, we conclude the GridLink™ system is an integrated package of commercially available components arranged to facilitate interconnection and provide electrical isolation of the utility and customer's on site generation within a utility distribution (MicroGrid) system. The software controlling the function of the overall system is specifically designed to provide the necessary control functions needed to ensure system performance as desired.

We look forward to supporting any additional technical reviews as Pareto Energy moves forward with development of hardware and software for initial equipment manufacture and testing. Should you have any questions, please do not hesitate to contact me by phone at 816-823-7029 or by email at eputnam@burnsmcd.com.

Sincerely,

Eric Putnam, P.E.
Associate Electrical Engineer

DEPARTMENT OF THE ARMY
US ARMY INSTALLATION MANAGEMENT COMMAND
HEADQUARTERS,UNITED STATES ARMY GARRISON, FT BRAGG
2175 REILLY ROAD, STOP A
FORT BRAGG, NORTH CAROLINA 28310-5000

REPLY TO
ATTENTION OF

March 27, 2012

Directorate of Public Works

Mr. Shalom Flank, Ph.D.
CTO & Microgrid Architect
Pareto Energy, LTD
2300 M Street NW, Suite 800
Washington, District of Columbia 200037

Dear Mr. Flank:

Fort Bragg, Department of the Army, is submitting this letter as evidence of willingness to participate as a host site in the research and demonstration project, "The Power of Independence: The GridLink Solution for Simplifying Military Microgrids" being proposed by Pareto Energy under the Department of Defense's Environmental Security Technology Certification Program (ESTCP). Fort Bragg is committed to implementing energy efficient solutions in its facilities, particularly those that enhance energy security and allow simplified interconnection of renewable energy technologies; the proposed technology is aligned with our goals. We believe that the technology will be a suitable fit for our site.

We look forward to working with Pareto Energy on this project. Our point of contact will be Mr. Thomas Blue, Energy Manager, and Mr. Keith McAllister, Resource Energy Manager, who can be reached at (910) 396-7523 and (919) 656-8183 respectively, or email: thomas.s.blue.civ@mail.mil and keith.s.mcallister.ctr@mail.mil.

Sincerely,

GREGORY G. BEAN
Director of Public Works

Enclosure

The City of New York

OFFICE OF THE MAYOR
253 Broadway - 10th Floor
New York, New York 10007
www.nyc.gov/planyc2030

SERGEJ MAHNOVSKI
Director, Office of Long Term Planning and Sustainability

(212) 788-1466

October 22, 2012

New York State Energy Research and Development Authority
17 Columbia Circle
Albany, New York 12203-6399
Attn: Ms. Roseanne Viscusi
Re: Letter of Support for PON 2474

Dear Ms. Viscusi:

I am writing to express support for the Polytechnic Institute of New York University's Microgrid Research proposal for the PON 2474 grant from NYSERDA. Early stage funding from NYSERDA would enable NYU-Poly to complete the requisite engineering assessments for a multi-building microgrid system at their Metrotech campus in Brooklyn. This project has the potential to provide reliable distributed energy to several adjacent buildings while seamlessly integrating into the bulk power system. As one of the first of its kind in New York City, this project could enable the development of a replicable model for microgrid deployment in a dense, urban environment.

The accelerated adoption of clean distributed generation (clean DG) and smart grid technologies is a key objective of *PlaNYC*—the City's comprehensive sustainability plan—and an essential strategy to achieve the goal of reducing citywide greenhouse gas emissions 30% by 2030. Since the release of PlaNYC in 2007, the marketplace has developed over 150 MW of clean DG. However, challenges to interconnecting large systems still exist and we have not yet realized the promise of microgrids to improve reliability and load management at multi-building sites.

The NYU-Poly microgrid has the potential to address these challenges with innovative yet readily available technological solutions. The project will provide a unprecedented opportunity for the NYU-Poly research community—as well as Con Edison, City and State policy makers, and other stakeholders—to analyze the performance of microgrid technology and assess its impact on the electric distribution system, local air emissions, and on-site energy management. The project will also elucidate and provide opportunities to address the legal, regulatory, and economic barriers that may counteract wide-scale adoption of microgrids.

NYU-Poly is the ideal institution to develop a state-of-the-art microgrid system. As a participant in the Mayor's Carbon Challenge, NYU-Poly has agreed to reduce its greenhouse gas intensity by 30% in 10 years. NYU-Poly is also a leading member of the Center for Urban Science & Progress (CUSP), a collaborative of academic institutions and technology companies that seek to address the science, engineering and technology challenges of rapid urbanization across the globe.

We greatly look forward to seeing the progress and outcomes that emerge from this exciting opportunity, and urge NYSERDA to join us in our support.

Very truly yours,

Sergej Mahnovski

a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

Office of the Vice President
Research & International
Strategic Partnerships Office
2260 West Mall
Vancouver, BC Canada V6T 1Z5

Phone 604 822 4988
Fax 604 822 6295
www.research.ubc.ca

Date: October 11, 2012

Mr. John Adams
Sustainable Development Technology Canada
45 O'Connor Street, Suite 1850
Ottawa, Ontario K1P 1A4

Subject: UBC Commitment of support for Pareto Energy Microgrid Demonstration Project

Dear Mr. Adams

Pareto Energy Canada Ltd will submit, for SDTC consideration, a proposal to install and evaluate a groundbreaking microgrid power distribution system. I am happy to convey The University of British Columbia's commitment, subject to the finalization of the budget and other necessary agreements, to provide, on our Point Grey campus, a site for the project. The objective of the project, to demonstrate the ability to reduce CO2 emissions by enabling greater penetration of distributed renewables and energy storage onto distribution systems, directly parallels UBC's goals of GHG reduction and technology-demonstration leadership. The project is positioned to install and test the first prototype microgrid unit in conjunction with our recently opened, $29 million, Bio-Energy Research and Demonstration Facility. Utilization of the Pareto technology will enable this clean-energy facility to produce un-interruptible, digital quality power, while eliminating negative impacts to the upstream utility from the distributed generation.

UBC is in a unique position, through its *Campus as a Living Lab initiative*, to demonstrate and evaluate this technology and, acting in our role as an *Agent of Change,* to assist Pareto in taking this technology solution to communities beyond UBC. Replication of this technology shows tremendous potential. In Canada, for example, it has the promise of enabling the greater integration of renewables into the national power grid. Yet, realizing this potential requires the technology to be proven and demonstrated. I am hopeful that you will share our enthusiasm and, through your financial support, join with us to bring this technology "solution" to the province, Canada and the world.

Sincerely,

Brent J. Sauder RPF
Director, Strategic Partnerships Office

The City of New York

OFFICE OF THE MAYOR
253 Broadway - 10th Floor
New York, New York 10007
www.nyc.gov/planyc2030

DANIEL A. ZARRILLI, PE
Director, Office of Recovery and Resiliency

(212) 788-8534

April 25, 2014

U.S. Department of Energy – National Energy Technology Laboratory
Morgantown Campus
3610 Collins Ferry Road
PO Box 880
Morgantown, West Virginia 26507-0880

Attn: Mr. John Hatfield

Re: Letter of Support for Pareto Energy

Dear Mr. Hatfield:

I am writing to express support for Pareto Energy's application to the U.S. Department of Energy Funding Opportunity Announcement 0000997: Microgrid Research, Development, and System Design. Demonstration funding from the US Department of Energy would enable Pareto Energy to deploy their GridLink technology on distributed generation units, allowing buildings to consume energy from the grid, operate as a microgrid system, or provide power back to the grid. This technology has the potential to provide reliable distributed energy to buildings while seamlessly integrating into the bulk power system. As one of the first of its kind in New York City, this project could enable the development of a replicable model for microgrid deployment in a dense, urban environment.

The effects of Hurricane Sandy have demonstrated the need for a more decentralized power supply in New York City. The accelerated adoption of clean distributed generation and microgrid technologies is a key objective of *PlaNYC: A Stronger, More Resilient New York*, and an essential strategy to increasing the City's resiliency in light of climate change and more frequent extreme weather events. Since 2007, the marketplace has developed to approximately 180 MW of clean DG. However, challenges to interconnecting large systems still exist and we have not yet realized the promise of microgrids to improve reliability and load management in buildings.

Pareto Energy's GridLink technology has the potential to address these challenges with innovative, yet readily available technological solutions. The project will provide an opportunity for utilities, City and State policy makers, and other stakeholders to analyze the performance of microgrid technology and assess its impact on the electric distribution system. The project will also elucidate and provide opportunities to address the legal, regulatory, and economic barriers that may counteract wide-scale adoption of microgrids. The New York City Mayor's Office of Recovery and Resiliency is interested in reviewing the impacts of GridLink, and urges Pareto Energy and the Kings Plaza Shopping Center to also consider demonstrating how this technology can be a benefit to the entire community in this area of Brooklyn, especially during power outages and peak demand days.

We greatly look forward to seeing the progress and outcomes that emerge from this exciting opportunity, and urge the Department of Energy to join us in our support.

Sincerely,

Daniel A. Zarrilli

MACERICH

April 22, 2014

To whom it may concern:

Please accept this letter offering strong support for Pareto Energy's application for the US Department of Energy's "Microgrid Research, Development and System Design" grant application. Macerich owns several shopping malls throughout the United States and five in the New York metropolitan area, including the Kings Plaza Shopping Center in lower Brooklyn where the proposed project will take place.

For decades, Kings Plaza has sought to interconnect the mall's completely-islanded 12.8MW combined heat and power facility to the Consolidated Edison distribution system in order to sell power to the grid and have a backup power source. However, the extremely high costs to complete the synchronous interconnection process and unattractive sell-back tariff rates have made the project financially infeasible. Connecting our system to the utility grid using Pareto's GridLink non-synchronous technology would eliminate these hurdles, allowing the mall's redundant power to be fully-utilized, and its reliability benefits to be distributed to the local community in Brooklyn's storm-vulnerable southern coast.

Pareto's non-synchronous interconnection approach offers an alternative to the traditional synchronous approach, and we could not be more enthusiastic about the opportunity to work with them and our partners at Consolidated Edison to demonstrate its full-potential at our site. Using GridLink to connect to the grid would give Kings Plaza the ability to offer much-needed relief during utility grid outages and emergency situations like Superstorm Sandy in 2013. In addition to offering emergency power benefits, the mall would serve as a site of refuge during a storm to enable community access to critical services. In December 2013, we had a very constructive meeting with Con Edison discussing breadth of benefits that Kings Plaza's CHP system could provide to both the utility and their rate payers.

It should not be overlooked that one of the most promising aspects of this demonstration project can be found on the business side: to illustrate the new financing models for implementing highly-reliable DG systems that are made possible by GridLink. We look forward to working with Pareto and Con Edison to demonstrate these new technical and financial innovations, which promise to provide a blueprint to similar DG and CHP users throughout the country.

Thank you for your time and consideration.

Sincerely,

Leah M. Zeller, Administrative Assistant
on behalf of

Jeffrey Bedell

VP, Sustainability

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701 9th St NW
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William M. Gausman
Senior Vice President
Strategic Initiatives

202 872-3227
202 872-3302 Fax
wmgausman@pepco.com

April 24, 2014

Mr. Guy Warner
Chairman and CEO
Pareto Energy LTD.

Dear Mr. Warner:

This is to confirm Pepco Holding Inc.'s ("PHI") interest in the General Electric and Pareto Energy research and development project that is being submitted in response the US Department of Energy's Funding Opportunity Announcement Number 81.122 for Microgrid Research, Development and System Design ("DOE-FOA").

We understand that Pareto Energy is proposing a proof-of-concept project in Brooklyn. Therefore, PHI's interest would be in the context of the DOE-FOA's suggestion to "expand the demonstration of the developed systems/controls into a wider area, other communities, or other sites to include additional, diverse distributed energy resources, other utilities, and different interconnections."
We believe that Pareto Energy's patented GridLink technology using GE's Microgrid Control Platform has promise for post-proof-of-concept application on utility and/or customer-owned microgrids in Maryland -- where we also believe that regulatory enabling exists -- and possibly in the District of Columbia, New Jersey and Delaware -- if regulatory enabling is established in the future.

As shown in the attached letter, PHI engineers previously gave conditional approval for Pareto Energy's GridLink control technology for a customer-owned microgrid interconnection application in the District of Columbia. We also understand that the University of Maryland Eastern Shore will propose GridLink to better interconnect 2.8 MWs of existing solar power and 4 MWs of future combined heat and power on their campus in Princess Anne, MD.

In a recent presentation to the Maryland Resilience through Microgrids Task Force, PHI concluded that:

- Pepco and Delmarva Power are eager to participate in developing microgrids in Maryland.
- Utilities and customers have the authority to own generation.

- Even where the utility does not own the microgrid, utility provides a critical role in interconnecting the microgrid to the distribution and transmission grid and ensuring reliability.
- Utilities may be able to operate the microgrid to gain maximum benefits for the grid, achieve demand response and facilitate sale of energy into PJM or for retail supply.

While PHI has considered and approved synchronous technologies for interconnecting customer-owned distributed generation in Maryland in the past, we believe that Pareto Energy's non-synchronous approach, which separates the voltage, frequency and phase angle of the microgrid from that of the utility grid, shows promise for safer and more affordable interconnection.

Nothing in this letter commits PHI to implement the technology from Pareto Energy's proof-of-concept project for the DOE-FOA. Beyond the technology, any commitment to implement a microgrid in Maryland must also consider any negative economic impacts on other Delmarva Ratepayers and/or PHI Shareholders. In this context, we believe that retrofitting existing generation to better interconnect distributed generation at UMES has promise, but an exact calculation of the ratepayer and shareholder costs and benefits has yet to be made.

Please contact Robert Stewart, Manager of Advanced Technology and New Business at (202) 872-2071, who will coordinate PHI's participation in the research and development collaboration with General Electric and Pareto Energy, if you have any questions.

Sincerely,

William M. Gausman

Cost Comparison of Mechanical Synchonous Interconnection versus Non-Synchonous Interconnection with a Power Electroncics Platform Reseach Conducted by and Independent Engineer for a Pareto Energy Research Contract with NYSERDA Data Based on a 5 MW Microgrid Proposal using Combined Heat and Power in Brooklyn, NY							
System	**Component**	**Quantity**		**Equipment**	**Unit Cost**	**Equipment Cost**	
		Conventional Synchronous	**Power Electronics Platform**			**Conventional Synchronous**	**Power Electronics Platform**
Primary Electric Service	PES Characteristic	N+2	Radial				
	PES Feeders	4 -Circuits	2-Circuits				
	PES Transformers	4	2	5MVA, 26400V:4160/3300V Cast Coil	$400,000	$1,600,000	$800,000
	PES Switchgear & Circuit Breakers	4	2	38kV, 40kA, 150kV BIL Primary	$200,000	$800,000	$400,000
	PES Switchgear & Circuit Breakers	4		5kV 65kA, 75 kV BIL Secondary	$150,000	$600,000	$0
			2	3.3kV 60kV BIL 1200A	$75,000		$150,000
	PES Feeder Protection Relay Packages	8	2	Primary & Secondary Feeder Protection	$30,000	$240,000	$60,000
	PES Transformer Protection Relay Packages	4		Transformer Differential Protection	$50,000	$200,000	$0
	Clip or Static Switch	4	0		$1,500,000	$6,000,000	
	Cost of feeders from ConEd		2		$200,000		$400,000
		4			?	$2,000,000	
	Ringbus Switchgear	16	0	5kV, 65kA, 75 kV BIL	$125,000	$2,000,000	$0
PES-Generator Collector Switchgear	Buss Differential Protection Relay Packages	4		Buss Differential Protection	$50,000	$200,000	$0
	Gridlink Inverters & E-houses		1		$6,000,000		$6,000,000
	System Engineering		1			$500,000	$600,000
	Existing Powerhouse Switchgear Rebuild	1				$5,000,000	
					System Totals	**$19,140,000**	**$8,410,000**
					Cost per Watt	**$3.83**	**$1.68**

Con Edison, Inc.

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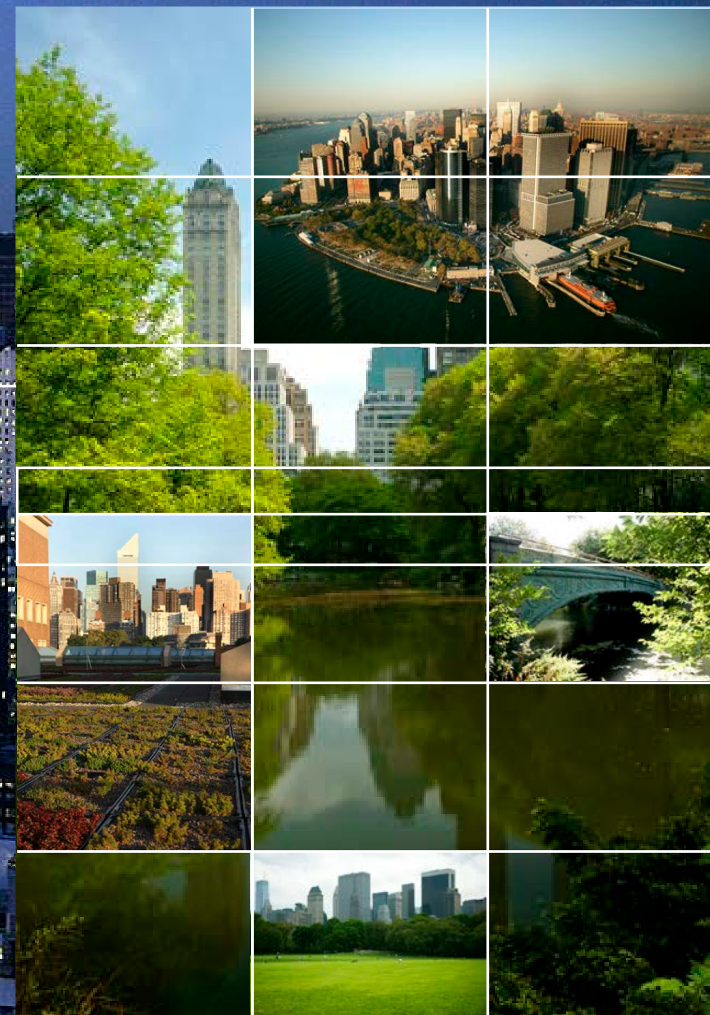

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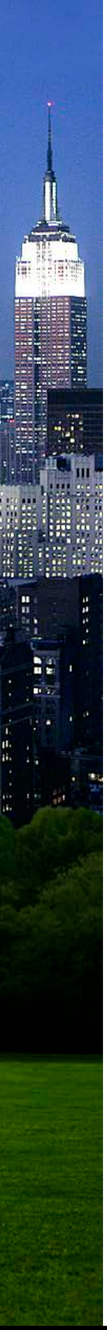

Doing What is Best for the Customer: Reliability Varying Approaches

- Storm hardening
  - 20,000 storm outages avoided this year
- New transmission: Indian Point Contingency
  - $371 million investment for Ramapo-Rock Tavern and Staten Island Un-bottling transmission projects
  - 2016 in-service dates
- Micro grid: Kings Plaza Shopping Mall
  - Collaboration with Pareto Energy and GE
- Distribution substation relief: Brooklyn/Queens Demand Reduction petition
  - Defer $1.1 billion substation project for at least five years
  - Savings for customers

Benefits of a Non-Synchronous Microgrid on Dense-Load Low-Voltage Secondary Networks

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Key Words:	Microgrid, Distributed generation, Conservation voltage reduction

Benefits of a Non-Synchronous Microgrid on Dense-Load Low-Voltage Secondary Networks

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Abstract— The paper describes the advantages of using non-synchronous microgrids in networked systems containing densely concentrated loads. The non-synchronous bus arrangement, in addition to allowing for the integration of substantially larger distributed generation, completely isolates transient disturbances from and to the network and the microgrid. Significant is the fact that distributed generators installed in the microgrid do not contribute to the short-circuit current that needs to be interrupted by the substation breakers. The behavior of the grid and the microgrid is investigated by comparing: the occurrence of faults, voltage reduction, and losses, in the presence and absence of the microgrid. The benefits of the dc microgrid are made evident with steady state and transient studies performed on a real distribution network in New York City.

***Index Terms*—CVR, distributed generation, microgrid, non-synchronous interconnection.**

I. Introduction

NON-SYNCHRONOUS microgrids offer an effective solution for the interconnection of distributed energy resources, loads, and storage [1]. Previous research has shown the importance of microgrids [2]-[5] and the usage of ac-dc-ac links [6]-[7]. A quantitative study evaluating dc microgrids statistically showed a potential for power availability of about 0.999, termed 3-nines [9]-[10]. Loss reduction of 10% to 22% over ac systems was shown in [11]-[12].

Recent trends introduced hybrid microgrids that comprise a dc bus and ac microgrid interconnected by power electronic interfaces [3], [13], [14]. While dc microgrids have operational advantage over ac microgrids, protection systems and standards are more mature for ac systems than for dc systems [6], [15]. However, dc-bus based systems do not have synchronization, reactive power flow, power quality, frequency control, and stability issues [16].

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The advantage of dc microgrids over ac microgrids have been highlighted in many studies [2], [7]-[11], [16]-[20] and can be summarized as: 1) easier to build and integrate with different power sources, including dc sources; 2) flexible scalability; 3) higher efficiency; 4) lower losses from the sources to loads due to elimination of multiple power conversion stages and filtering requirements; 5) compatible for future energy uses, such as electric vehicles; 6) facilitates the integration of modern electronic loads, energy storage devices, and DG technologies; possibility for volume and cost reduction [2], [9], [17].

DC microgrids are in use in residential [6], [17], [21]-[22], commercial [23]-[24], and industrial [25] applications. The advanced control architecture for the successful implementation of microgrid requires a high pulse width modulated control with fine resolution [26]. Phase shift control [27] and fuzzy control [28] are other techniques used in microgrid applications [27]. As considered to be a small-scale version of a conventional interconnected power system, a microgrid is distinguished from the utility by its philosophy of operation, presence of distributed energy resources, and requirements for fast islanding [30].

In this paper, a non-synchronous microgrid connected via a dc bus to a low voltage ac distribution network is presented. Since an active rectifier is the only interface between the utility and the microgrid, including on-site generation, the utility is electrically isolated and only connected non-synchronously to the microgrid. Therefore, the microgrid looks like a resistive load from the utility's perspective [29]. The objective of this paper is to evaluate the benefits of a non-synchronous microgrid for heavily meshed networked utility grids.

This paper proposes a non-synchronous microgrid to be implemented in the medium voltage side of a networked grid in (Brooklyn) New York City. Steady-state and transient analyses are performed to show the virtues of the proposed microgrid topology. The behavior of the grid and the microgrid is investigated by comparing: the occurrence of faults, conservation voltage reduction, and losses, in the presence and absence of the microgrid.

The basic interconnection of the network under investigation is shown in Fig. 1. The area substation is composed of 5 transformers 138/27 kV, 3 capacitor banks, and 52 bus breakers and feeder breakers. The voltage of the substation transformers is controlled using Line Drop Compensation (LDC) in the under-load tap changers (ULTCS). There are thousands of primary sections energizing hundreds of network transformers connected to the secondary grid or spot networks. Nearly 10,000 secondary mains feed several thousands of distributed loads.

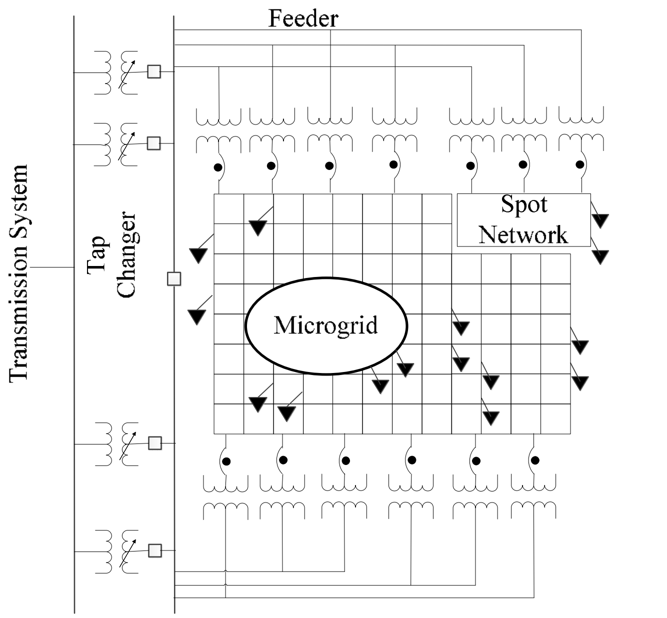

Fig. 1. Basic interconnection of the overall distribution network. The microgrid is embedded in the network.

Due to the growing requirements of electrical power quality and reliability in urban areas such as New York City, utility companies must operate networks conservatively. In downtown areas of densely populated cities, it is typical for distribution transformers to be interconnected on the low voltage (LV) side by means of network protectors forming a grid, often heavily meshed, that eventually increases service continuity and reliability due to redundancy [38]. Network protectors are LV circuit breakers which operation prevents the continuous flow of reverse power (backfeeding from the secondary grid into the primary network) [38], [39]. The operation of these devices is instrumental for system reliability, especially in the event of a fault on a MV feeder.

II. Description of the Novel Microgrid

The architecture of the non-synchronous microgrid under investigation was originally proposed in [44] under the name of GridLink. A simplified diagram of the microgrid design is given in Fig. 2. This arrangement provides several advantages to current distribution system infrastructures, especially to networks having fast growing concentrated loads and substation circuit breakers reaching short-circuit duty limitations. In a typical NYC distribution network, the short circuit power is close to the capacity of the breakers. This often forces the utility to prevent the installation of distributed resources in its system. Otherwise, the generator owner would have to finance the cost of any system upgrades [45]. These issues may be overcome with the benefits of using non-synchronous microgrid technologies as discussed and demonstrated in this paper by means of steady state and transient studies.

Each non-synchronous microgrid of the type shown in the diagram is connected towards the end of three heavily loaded utility medium voltage (MV) feeders (of about 40 MW total capacity). The step-down transformers connecting the utility system with the microgrid are rated 5 MVA 27/3.3 kV at 60 Hz. The three independent microgrid units are coordinated via high-speed communication providing *N*-2 redundancy as required by Con Edison for distribution systems. The active rectifiers at the input to the dc buses have sufficient filtering capabilities to mitigate switching voltage spikes and comply with voltage distortion standards [43]. Three synchronous generators rated 5 MW operating at 50 Hz are connected to each individual dc bus via active rectifiers. Because of the microgrid topology, several inverters can be connected at the dc buses providing customers with multiple line feeds for reliability and continuity of services. The voltage can be stepped-down from 3.3 kV to utilization level by network transformers configured with primary windings connected in delta and secondary windings in grounded-wye. Although Fig. 2 shows the microgrid loads connected as spot networks; it is possible to create a low-voltage (LV) secondary grid for distributed loads as presented in [40].

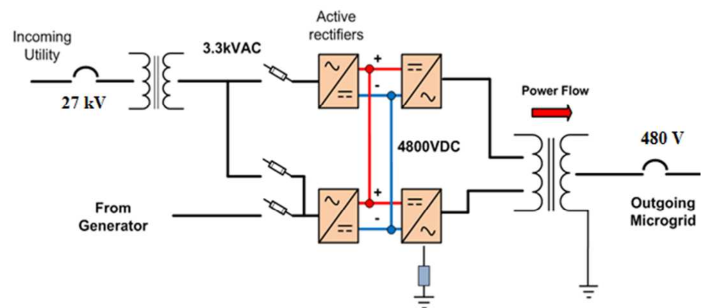

Fig. 2. Basic architecture of the non-synchronous microgrid.

A. *Benefits of Flexible and Rapid Current Control*

The key factors of the non-synchronous microgrid scheme offering effective advantages to distribution system over ac microgrids are the dc power conversion, the fast power electronic switches and the broad spectrum of possible control algorithms available when having all ac systems (utility, cogeneration and load) operating independently from each other. Basic operation of power electronic converters permits the control of current in relatively small windows of time; usually a fraction of a millisecond. The flexibility of controlling current along with the topology of operation proposed in [44] provides substantial benefits such as ensuring unidirectional power flow into the load side by controlling the on/off pulsing patterns of the switches. Unidirectional power flow is required for interconnecting with a distribution system while preventing the occurrence of continuous current reversal into the MV feeder (backfeeding condition), therefore, eliminating power oscillations, voltage quality issues, as well as possible impacts to the upstream utility system. Moreover, current flow can be forced to be in phase with voltage such that the microgrid ideally appears as a resistive load at the utility terminals. Finally, since the microgrid is designed to operate in zero-export mode, the active rectifiers are not required to be IEEE Std. 1547 certified increasing the range of vendors [42].

B. *Benefits of Non-synchronous Interconnection*

Another important aspect of microgrids is the non-synchronous interconnection over traditional synchronized ac systems. Therefore, disturbances or power quality issues within a local system do not propagate and affect other systems. All types of distributed resources may be interconnected without system impacts. Also, equipment operating at different frequencies can safely interact without jeopardizing reliability or stability. Additionally, because of the asynchronous interconnection and the unidirectional power flow (import only) features of the topology, islanding is guaranteed to never be an issue – the microgrid is essentially always islanded. Approvals for installation (or expansion) of cogeneration can therefore be expedited. Ensuring non-export conditions and negligible fault contribution further reduces the risk of rejection or delay, even when distribution feeders have reached maximum power penetration of distribution generation [45].

C. Benefits During Short Circuit on a MV Feeder

Backfeeding during a fault on a MV feeder may impose catastrophic conditions to the system infrastructure such as prolonged faults and long duration overvoltages [41]. For these reasons it is important for utilities to assess any possible backfeeding conditions in their system.

In the event of a short circuit, the non-synchronous microgrid immediately eliminates the occurrence of backfeeding by implementing a fault detection system that operates and isolates the faulted MV feeder in a fraction of a cycle. The fault detection operates based on under-voltage conditions with measurements on the upstream MV feeders. Using the advantage provided by power electronic converters for fast switching of current, it is possible to achieve complete fault isolation in a relatively small time frame. Although this method of fault detection would prevent reverse currents well before current magnitudes reach pickup level of the overcurrent relays, proper settings must be applied to the voltage monitoring system to avoid unintended (nuisance) tripping.

III. Steady State Behavior

This section is devoted to analyzing the steady-state performance of a microgrid installation in a densely loaded low-voltage secondary network. Microgrids are beneficial to reduce voltage violations on geographical zones with low voltages (low voltage pockets) and to help relieve overloaded feeders [31]. However, other benefits often dismissed are the increase in flexibility to allocate power generation and the energy savings by reducing losses in the system [31]. Without a microgrid, it is simple to allocate power generation by installing distributed generators (DG) scattered around the network. Although this configuration seems more flexible, it poses problems with short circuit currents and overvoltage situations. Since these two configurations are the most plausible to allocate extra power in a given network, this paper explores their performance. All simulation results are compared with the network base case which does not have a microgrid or DG installations.

A. Description of Study Scenarios

Three different scenarios are analyzed:

1) Base case scenario:

This scenario represents the network densely loaded and before the addition of a microgrid or scattered DG. Results from this case serve as reference framework for the simulation of upgrades in the system.

2) Microgrid scenario:

This scenario represents the network upgraded with a microgrid. As previously described, the microgrid is composed of three individual generators of 5 MW each. Therefore, simulation cases of the microgrid will assume a total generation of 5 MW, 10 MW or 15 MW. This study does not consider losses within the microgrid installation as network losses because of the electrical isolation from the utility grid. Basically, the utility serves the microgrid as a lumped load equal to the addition of the microgrid demand and the internal losses minus the available generation.

3) DG scenario:

This scenario models the performance of the network when DGs are not concentrated in the microgrid but are scattered across the geographical area occupied by the microgrid. This serves to address the case where individual customers, and possibly the utility, have distributed generation installed at particular locations. The objective is to represent scenarios that are comparable in power penetration to the microgrid scenarios. Therefore, cases with a total generation ranging from 1 MW up to 15 MW are analyzed. Since the number of possible scenarios is very large for each generation level, an equivalent DG case is computed by randomizing the position and size of the DGs and then averaging the results of these cases. For each generation level, 20 different DG scenarios are computed. This has been found to be the minimum number of random scenarios to ensure a convergent average response of the network in terms of voltage violations; see [35]. The randomization is performed as follows: 1) the location of DGs is randomly set within the area of study. This randomization is applied by using a normal statistical distribution amongst the connection points in such area. 2) The power supplied by each DG unit is also distributed with a normal statistical distribution.

B. Voltage Violation Analysis

Voltage violations are defined as voltages with deviation exceeding ±5% from rated voltage during normal operating conditions and ±10% for emergency conditions [42]. A discussion covering voltage violations results is presented for each described scenario.

1) Overvoltage violations:

In the base case scenario no overvoltage violations are present in the system. In the DG cases, the number of overvoltage violations increase with the total power injected because the DG units boost the voltage locally [32], [33]. On the other hand, in the microgrid case there is no overvoltage violations reported, demonstrating the valuable advantage of a microgrid implementation over scattered DGs [32]. These behaviors can be observed from the top plot of Fig. 3.

2) Undervoltage violations:

In the DG scenarios, the undervoltage violations (voltages under 0.95 pu) decrease when the total injected power increases [33]. Similarly, the microgrid helps reduce undervoltage violations as the injected power increases. The microgrid scenario is more effective at reducing undervoltage violations than the DG implementation. This is due to the electrical isolation created by the dc bus. Thus the microgrid is capable of boosting the voltage at all points within this area to the desired voltage level. Voltage violations occur for peak load conditions in low voltage pockets that are located far from the microgrid area. Also, it is important to note that the DG scenarios and microgrid scenarios do not present voltage violations under 0.90 pu.

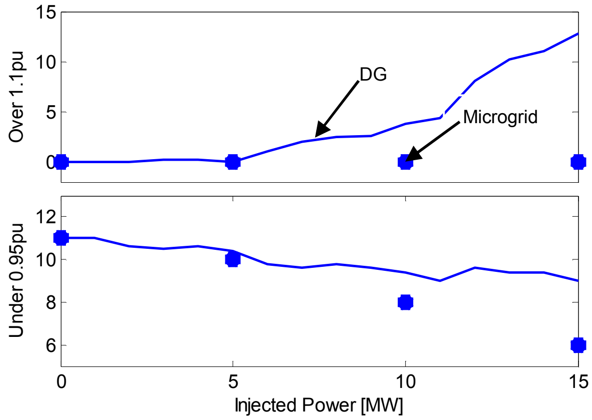

Fig. 3. Voltage violations with no voltage reduction applied as a function of injected power for the DG scenarios (solid line) and also the microgrid scenario (dot). Top plot represent the 1.1 p.u. overvoltage violations and the bottom plot represents the 0.95 p.u. undervoltage violations.

C. Loss Analysis

The major sources of loss in a system are transformer and cable losses. For the example under study, cable losses are around 1.5% of the total demand of the system and the losses in transformers represent around 2%. Both of these losses are analyzed for the DG and microgrid scenarios.

1) Losses in cables:

In the DG scenarios, as long as the injected power increases, the overall network demand decreases, and as a consequence, there will be a reduction in cable losses [34], [36]. This behavior is observed in the top plot of Fig. 4 from 0 MW to 5 MW. However, in certain cases with LDC mechanism, the reduction in demand results in a reduction of the tap at the substation transformers. Therefore, the voltage on the secondary side is reduced and the series losses increase. This is observed for the DG cases in the same figure from 5 MW up to 15 MW power injections. For the microgrid, the total losses in cables decrease because the overall demand of the system decreases (as it was previously mentioned, the internal losses of the microgrid system are not included in Fig. 4).

2) Losses in transformers:

The microgrid and DG cases demonstrated significant transformer loss reduction in comparison to the base case. This reduction of losses is a result of the decrease in system loading, which reduces the transformer tap. Both scenarios present a transformer loss reduction of approximately 4%. Internal efficiencies of the microgrid subsystems are not computed in steady state because the microgrid is modeled as a single lumped load.

D. Voltage Reduction Analysis

In this section, the performance of the microgrid is compared to the scattered DG scenarios in voltage reduction situations. Previous literature describes conservation voltage reduction (CVR) as an effective means to reduce energy in dense-load low voltage secondary networks, but under voltage violations may occur [34], [37].

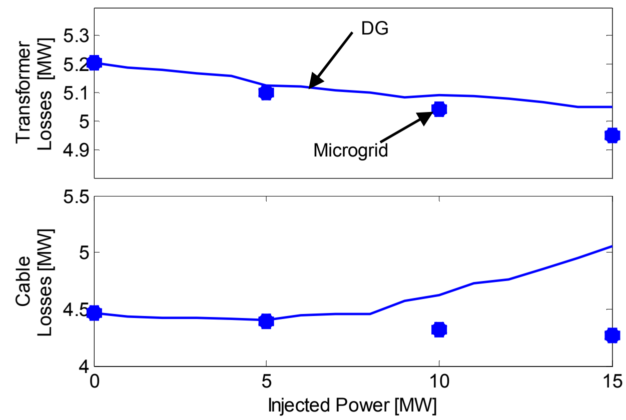

Fig. 4. Total losses in cables and transformers with no voltage reduction applied for the DG scenarios (solid line) and also the microgrid scenarios (dot).

1) Voltage violation analysis:

This part analyzes the performance of the system when voltage reduction operations with voltage reduction of 2.25% and 4% are conducted (these are the typical voltage reduction percentages used by the utility). To evaluate the performance of the system, the undervoltage violations below 0.9 pu are observed. In the scenario where 2.25% of voltage reduction is applied, the system does not present any undervoltage violations in the microgrid or the DG scenarios. For 4% of voltage reduction, the system behaves similar for microgrid and DG, reducing the number of voltage violations from 8 nodes (base case) to 7 nodes (microgrid and DG scenarios). That is because the DG and the microgrid only help to reduce violations in their “electrically-nearby” region, and in this particular case, only 1 violation occurred in the surrounding area of the microgrid.

2) Cable losses analysis:

When voltage reduction is applied, the voltage profile in the network is reduced. As a consequence, the current circulating through the majority of the grid increases, and therefore, the series losses increase (see Fig. 5) [34]. As previously mentioned, large power allocation caused the LDC settings of the transformers to reduce the tap position, and consequently, the series losses would increase as a function of DG penetration. The top plot of Fig. 5 shows the effect of voltage reduction for three different voltage reduction levels, 0%, 2.25% and 4%.

3) Transformer losses analysis:

The transformer losses (including losses of substation and distribution transformers) for different cases are compared in Fig. 5. The losses are presented as a function of allocated power penetration for different voltage reduction levels. For larger percentage of voltage reduction, a substantial decrease in transformer losses is observed. For the case of 4% voltage reduction, there is a relative difference in transformer losses of 4% in comparison to the case where voltage reduction is not applied [34]. The advantages of voltage reduction may be combined with the reduction of transformer losses caused when DG penetration increases. In the case of a presence of a microgrid of 15 MW, the transformers losses can be further reduced an extra 4%. The combination of microgrid and voltage reduction would result in a total reduction of transformer losses of 8%. This behavior can be observed on the bottom plot of Fig. 5.

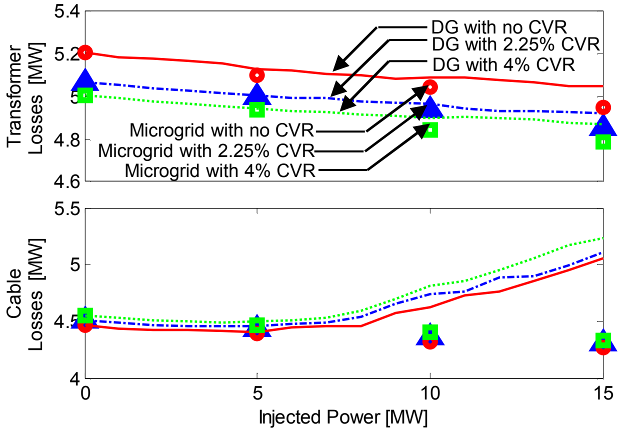

Fig. 5. Loss analysis with voltage reduction conducted for DG scenarios and Microgrid scenarios.

E. Steady Benefits and Conclusions

By comparing the performance of microgrids and DG units in a densely loaded secondary network, it was possible to observe two advantages of microgrid systems over individual DG penetration. First, microgrids are a more advantageous and flexible alternative to allocate onsite generation and control voltage violations in the network. Also microgrids can help reduce undervoltage violations while allowing network operation at a lower voltage, thus reducing the transformer losses in the system. Also, microgrids relieve loading on feeders by generating and delivering energy within the isolated non-synchronous system, therefore reducing the series losses in the system. Furthermore, microgrid systems when combined with voltage reduction operations proved to be beneficial to enhance the overall efficiency of the network. Results show that for a 15 MW microgrid operating together with 2.25% voltage reduction would reduce transformer losses by 4.5% and series losses by 2%. The microgrid would be able to operate year round because, as opposed to configurations with individual DG units, overvoltage violations in low load conditions are avoided by the microgrid. These enhanced voltage reduction operations, in a network with a total yearly consumption of approximately 550 GWh, would lead to yearly savings of around $200,000 and to gains in system efficiency. The total losses reduce from 3.5% to 3.38% (a 3.5% reduction) [46].

IV. Transient Behavior

Several time-domain simulations have been performed to analyze the dynamic behavior of the non-synchronous microgrid when installed in a secondary distribution network. These simulations consider three cases: (1) a three phase short circuit at a utility MV feeder, (2) a three phase short circuit at the terminals of a microgrid onsite generator, and (3) a short circuit at the microgrid dc bus.

Each case intends to address utility safety and operational concerns regarding the integration of a non-synchronous microgrid into the network. Some of these concerns include: potential short circuit contribution from the microgrid into the upstream network, the effect of fluctuations on the generators, possible voltage instability at the utility and the customer connection points, power quality issues at customer terminals in case of contingencies, compliance with the interconnection conditions of IEEE Std. 519.

To start, the network is assumed operating in steady-state conditions with nodal voltages within 5% of nominal voltage. Before applying the fault, the voltage and current waveforms were observed to be sinusoidal (without harmonic distortion). Measurements at the generators and at load terminals were sinusoidal and complied with the requirements of power quality standards [43]. The three phase short circuits occur at approximately 600 ms of simulation time, after the system fully stabilizes.

A. Short Circuit Studies at Utility Side

The major concern with a short circuit on the utility side relates to possible current backfeeding from the microgrid into the MV feeders. To show the impact of a non-synchronous microgrid during an upstream short circuit, the primary of a main power transformer connecting the utility system into the microgrid was selected as fault location (see Fig. 2). A fault on the MV side of a main power transformer is the worst case scenario for possible backfeeding current from the microgrid. The instantaneous current waveform as observed through the primary winding of the faulted transformer is shown in Fig. 6. When the fault occurs (at 600 ms), the fault detection system immediately senses an under-voltage condition and switches off the corresponding converter within one half of a cycle, significantly eliminating backfeeding of current. Most off-the-shelf controlled rectifiers can accomplish this disconnection in a smaller time frame; say one fourth of a cycle or less [47]. The MV feeder briefly experiences at most the first peak of reverse current (nearly 200 A) from the microgrid. Once the fault is isolated, the remaining feeders and generators will pick up the load originally supplied by the disconnected line.

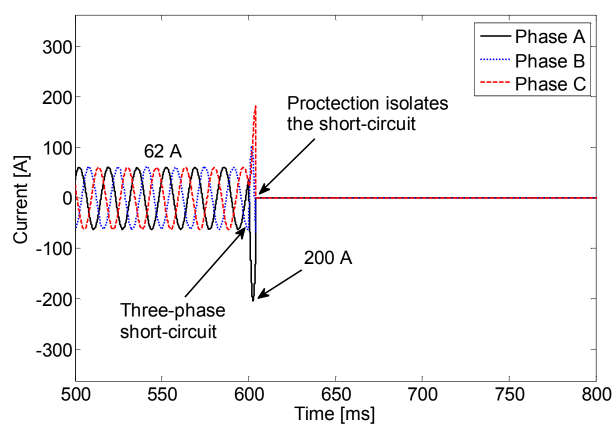

Fig. 6. Instantaneous current at the MV side of the faulted transformer.

As shown, the non-synchronous microgrid does not affect the short circuit capabilities of the upstream network. Moreover, it may provide a delay to the upgrades of substation circuit breakers which would have normally been required using typical paralleling of DGs with the utility system. In a conventional distribution network without a non-synchronous microgrid, a short circuit on a MV feeder serving the area would produce a considerable voltage dip at the load terminals, probably restarting computers and other sensible equipment. In contrast to classic distribution infrastructure, the non-synchronous microgrid would prevent this decrease in voltage as a result of the separation of ac systems. Therefore, voltage and current at the load terminals remain constant and sinusoidal throughout the simulation further demonstrating power quality improvements and the "always-islanded" nature of a non-synchronous microgrid.

B. Short Circuit at a DG Terminals

The simulation of a three phase fault on the terminal of a generator serving the microgrid provides an insight of the advantages obtained with the non-synchronous interconnection between ac systems. The instantaneous output current of the faulted generator observed at its terminals is shown in Fig. 7. It has a pre-fault value of 1160 A. The shape of this current depicts the classic decaying response of a synchronous machine to a three phase short-circuit. The microgrid system is protected by a circuit breaker that opens at approximately 650 ms of the simulation followed by the generator protection which opens at approximately 700 ms. Although the fault could have been rapidly isolated from the microgrid using similar fault detection as the implemented for the MV feeder network, it is desirable to use typical protection equipment and its inherited delays to analyze the behavior of the dc microgrid when briefly sustaining a fault, and its impact to the load and the upstream system.

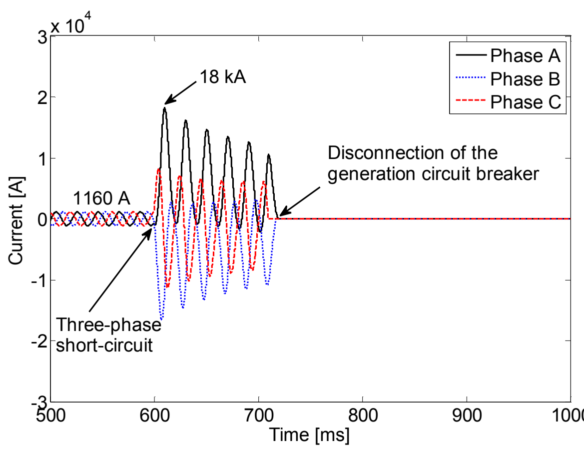

Fig. 7. Instantaneous current output of a generator during a three-phase fault at its terminal.

The contribution of the microgrid to the fault current is presented in Fig. 8. As it can be noted from the plot, before the fault occurs, the current flowing into the microgrid was 1160 A. At the moment of the fault, the current reverses and flows from the microgrid to the fault with an asymmetrical shape and a first peak of approximately 2600 A. During the first half a cycle after the short circuit appears in the network, the dc bus voltage of the associated rectifier drops from 4800 V to 4300 V. Then, it recovers with a combination of a linear response when the microgrid feeds the fault and oscillations when the short circuit is isolated from the microgrid; see Fig. 9. When the oscillations are most significant, the current of the corresponding MV feeder (see Fig. 10) shows minor disturbances as a result of the load change and the instability of the dc bus voltage. The current in the MV feeder is illustrated in Fig. 10. The current swing rapidly damps with the system impedance. Furthermore, current and voltages at the other MV feeders, the generators and the loads terminals are sinusoidal and without voltage quality issues.

If the under-voltage fault detection was considered in this case, the short circuit would have been immediately isolated from the microgrid eliminating oscillations at the dc bus.

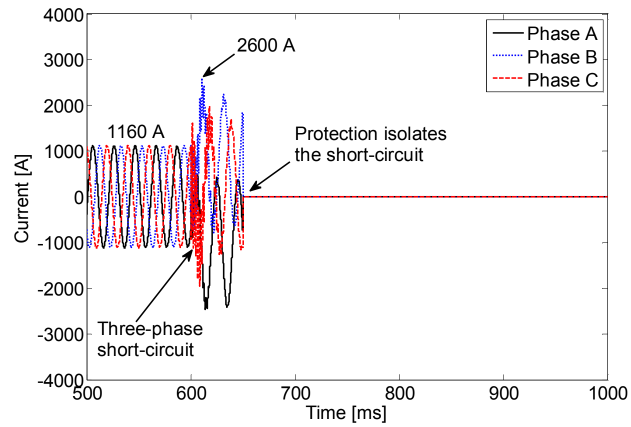

Fig. 8. Microgrid contribution to fault current during a fault at a generator terminal.

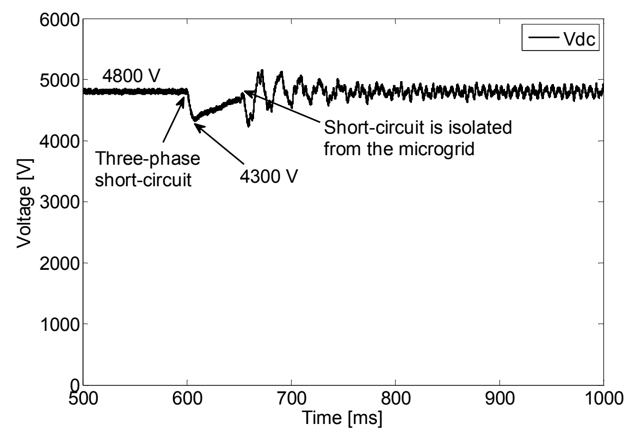

Fig. 9. Voltage at the dc bus when the microgrid contributes to fault current at a generator terminal.

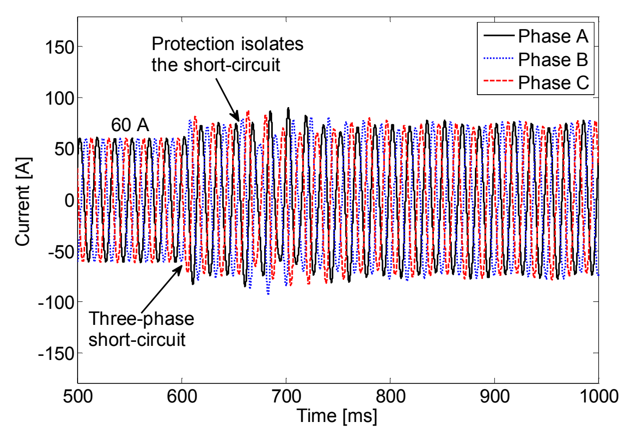

Fig. 10. Instantaneous current at the MV feeder interconnected with the faulted generator through the dc bus.

C. Short Circuit to the Microgrid dc Bus

Due to the connection arrangement of the microgrid, a short circuit at any of the dc buses would result in the simultaneous loss of supply from a generator and a utility feeder. This would appear to the microgrid systems as a double contingency, having one line and one generator out of service. In the event of such a fault, the remaining feeders and generators will be required to support the load previously supplied by the severed components. Moreover, it should be noted that the increase in power demand from the remaining feeders and generators might exceed the rating of the rectifiers causing instability in the microgrid. Therefore, the rectifiers must be properly sized to account for this scenario. It is important for the microgrid installation not to cause power quality problems or substantial decrease in voltage levels during this type of scenario.

Simulation results show that when the short circuit appears at the dc bus, the power electronics switches immediately disconnect, isolating the generator and the feeder. At this point, the dc voltage of the unfaulted rectifiers reduces as more current is drawn from their corresponding feeder and generator, see Fig. 11. Once current reaches steady-state, the rectifier dc voltages stabilize. The voltage waveforms of these feeders and generators remain unchanged throughout the simulation. The behavior of the voltage at the load terminals is shown in Fig. 12. As can be seen in the figure, the voltage drops from 1.02 pu to 0.87 pu for a brief period of time; approximately 5 cycles having voltage deviation exceeding 5% from its nominal voltage which is considered an undervoltage [42].

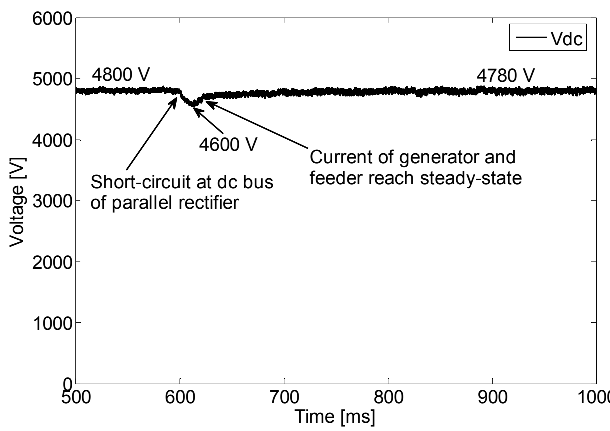

Fig. 11. Voltage at dc bus of an unfaulted rectifier.

V. Conclusions

The advantages of using non-synchronous microgrids in heavily meshed secondary networks have been demonstrated. As shown in the paper, with transient simulations, a non-synchronous microgrid isolated by means of a dc bus facilitates the integration of distributed generation because the grid and microgrid are electrically isolated. Therefore, the transient phenomena in one side do not propagate to the other. This is of paramount importance when the substation breakers operate close to their short-circuit rating.

The behavior of the grid and the microgrid has been investigated also in steady state with voltage reduction (CVR) comparing the losses and voltage profile in the presence and absence of the microgrid. The superiority of the dc microgrid compared with random distributed generation and no generation are made evident by the reduced number of buses with voltage violations.

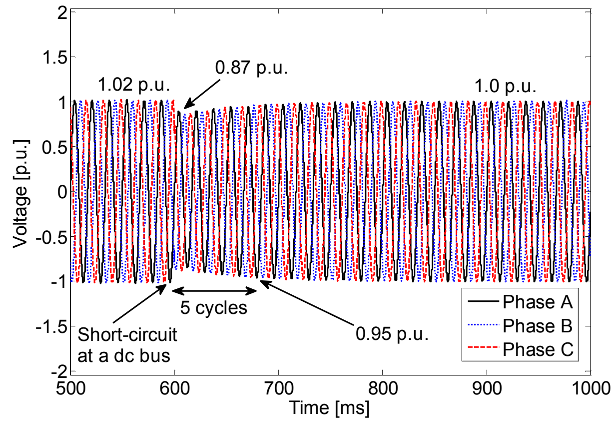

Fig. 12. Instantaneous voltage at load terminal during a short circuit at a dc bus.

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Real Case Based Comparative Study of MicroGrid Protections for Synchronous and Non-Synchronous Interconnections

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***Abstract*—Microgrids evolve rapidly as a viable solution for large scale deployment of distributed and renewable energy generation into congested power grids for enhanced efficiency and resiliency. Integration of distributed generations to the grid and the increasing penetration level changes fault current level and direction in networks. Traditional protection schemes shall be redesigned in order to meet these fundamental changes. Protection solutions for microgrids usually rely on digital relays and communication technologies. Recently developed and maturing power electronic techniques make non-synchronous interconnection an effective and competitive solution for distributed generation integration. A comparative study of the protection solutions for microgrids with synchronous and non-synchronous interconnections was conducted based on power system simulation and analysis of two real-case microgrid projects, New York University and Kings Plaza. Load flow calculation, short circuit analysis and transient stability simulation were performed by power system simulation softwares. The benefits of non-synchronous interconnection are made evident with steady state short circuit analysis and transient stability studies in terms of fault current contribution and transient fault disturbance as well as potential fault ride through capabilities.**

***Index Terms*—Microgrid, protection, interconnection, non-synchronous, back to back converter.**

I. Microgrid Protection: Challenges and Solutions

DURING the last decade, microgrid (MG) has emerged as a remarkable option of integrating sustainable distributed energy sources in the electric network [1] due to its vast benefits such as locally supplied power, reduced grid investment needs due to lower network capacity requirements, reduced operation costs and losses, peak load shaving capability, increased reliability and, most importantly, its inherent resiliency [2], [3], [4], [5], [6]. Supported by distributed generators (DG), a MG can disconnect from the main grid during a major power outage to operate autonomously into an islanded mode and help mitigate grid disturbances to strengthen grid resilience while providing power supplier to critical loads within. However, along with these benefits, microgrid concept has to overcome a number of challenges in microgrid management, control and particularly protection. Novel solutions have to be developed to protect a MG in both the grid-connected and the islanded modes of operation against all different types of faults. In case of utility faults, the MG protection system should sense the fault and isolate the microgrid from the utility grid as rapidly as necessary to protect the microgrid loads, while for faults within MGs, protection system should isolate the smallest possible section of the feeder to eliminate the fault. Addtional technical challenges for MG protection include [2]

- Generation systems in both medium voltage (MV) and low voltage (LV), resulting bidirectional power flow;
- Topological changes in LV network due to connection/disconnection of generators, storage systems and loads;
- Intermittence in the generation of several micro-sources connected in the microgrid;
- Increasing penetration of rotating machines, which may cause fault currents that exceed equipment ratings.
- Insufficient level of short-circuit current in the islanding operation mode, due to power-electronics interfaced distributed generation;
- Reduction in the permissible tripping times when faults occur in MV and LV systems, in order to maintain the stability of the microgrid;
- Nuisance tripping of protection.

Among these key issues, a holistic protection strategy for MGs operated under both grid-connected/parallel mode and islanded/stand-alone mode stands out as the most prominent technical challenge. However, the characteristics of most protective devices used in today's microgrids are usually similar to those used in distribution networks which are based on over current (OC) protection and may not be sufficient. For instance, under islanded-operation, the utility grid cannot contribute to the fault and, therefore, fault current magnitude is limited to what the micro-sources can provide. Consequently, large difference of fault current levels and characteristics are expected for these two modes, which can pose protection sensitivity and selectivity problems in case of fault depending on the relay settings. In addition, microgrids have inherently dynamic structures, i.e. several DGs and loads connect/disconnect at any instant, and various operating modes. Fault current levels may vary for all these situations and existing protection designs are not sufficient to tackle these issues. To address this most pressing issue, a number of alternative solutions have recently appeared in technical literature, a brief survey of which are listed below

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- Adaptive Protection Systems
  Adaptive microgrid protection system modifies online the preferred protective settings in response to a change in system conditions/requirements in a timely manner by means of externally generated signals or control action [2] [7]. It utilizes numerical directional OC relays which can change the setting of tripping characteristics locally or remotely according to MG operation conditions. Communication infrastructure and standard communication protocols are needed such that individual relays can communicate and exchange information with a central computer fast and reliably. Practical implementation of an adaptive microgrid protection system is based on a comprehensive off-line analysis and a timely on-line operation. For the first part, extensive power flows and short circuit calculations of all possible faults and all possible topology including islanding are pre-calculated, and relay setting are designed and stored in an event look-up table. During on-line operation, the setting of relays has to be parameterized online in a timely manner to respond to all faults.
- Voltage Based Methodologies
  For adequate MG protection based on voltage measurements, the micro-source output voltages are monitored and converted from the abc operating frame to DC quantities in the d-q frame [8]. In order to differentiate between in-zone and out-of-zone faults, a communication link is used between the relays. Besides, this technique requires a decision-making procedure for the comparison of the average voltage values in each relay.
- Differential Protection
  A combined methodology for microgrid protection based on differential protection and analysis of symmetrical components was also proposed [9]. Based on a network zoning approach, the relay dividing each zone uses differential protection to detect single line-to-ground (SLG) faults that occur in its down-stream zone.
- Distance Protection
  Distance protection uses admittance or impedance measurements for fault detection, e.g., a admittance relay with inverse time tripping characteristics capable of detecting faults in both grid-connected and islanded operation modes [10]. Apart from adding inverse time characteristics to each zone of protection, it also has the ability to isolate the faults occurring at either side of the protected circuit, since it can also operate for reverse faults.
- Overcurrent Protection and Symmetrical Components
  To enhance the performance of traditional overcurrent protections, a possible solution for fault detection in islanded microgrids was proposed based on the measurements and calculations of current symmetrical components, which involves zero-sequence current detection in the event of an upstream single line to ground (SLG) fault (coordinated with unbalanced loads) and negative sequence current for line-to-line (LL) faults [9].
- Use of External Devices for Protection Improvement
  External device can be installed to equalize the fault current level in both grid-connected and islanded operation via the following two approaches: 1) incorporating energy storage devices (flywheels, batteries, etc.) into the microgrid to increase the fault current to a desired level, allowing overcurrent protection to operate in a traditional way [11], [12]; 2) installing certain devices between the main grid and the microgrid to alleviate the contribution of fault current from the utility grid [13], [14].

All the above proposed MG protection solutions are developed for MGs with synchronous interconnections. The success of these protection schemes relies on continuous and comprehensive monitoring of the operational states of a MG with high accurate and temporal resolution as well as on the fast communication protocol and physical network for real time protection response and remediation. Often times, a trade-off study has to be conducted for optimal depth of protection against the nuisance tripping. Furthermore, the above proposed protection schemes are based analysis and simulations conducted on model systems under idealized conditions. In many cases, the information given in these references is short or incomplete, barely including verification simulations or tests, most of them to be more of an idea than a thoroughly studied solution. Ultimately these proposed MG protection schemes will need to be tested and validated with real case applications.

Meanwhile, power converters based non-synchronous interconnection emerges as a competitive and appealing alternative solution for MG interconnection. In contrast with synchronous interconnection, it isolates the voltage, frequency, phase-angle of the on-site DGs completely from utility grid. The same power electronics that provide the non-synchronous utility interconnection provide also fault ride through capability, resulting in significant improvement of power quality and reliability for MG and the main grid. Recently, a non-synchronous interconnection solution has been approved by Consolidated-Edison (Con-Ed) to connect Kings Plazas microgrid, located at Brooklyn, New York, to Con-Eds main power grid. In this paper, a comparative study of MG protections was conducted based on this Kings Plaza (non-synchronous interconnection) microgrid under commission and a recently commissioned microgrid project at NYU (synchronous interconnection). It is anticipated that in-depth power system simulation and analysis based on these two real cases with regards to their fault characteristics and protection coordinations will provide insight into MG system topology down selection as well as the designs of controls and protection schemes.

II. NYU and Kings Plaza MicroGrids General Description and Protection Schemes

A. NYU MicroGrid

New York University, founded in 1831, is located in the heart of Greenwich Village in lower Manhattan. Its previous Co-Generation (CoGen) system before upgrade had 7x1MW diesel generators, which served 7 buildings and was operated in islanded mode with backup from Con-Ed at low tension service. In January 2011, it was announced that the natural gas-fired CoGen plant of NYU was completed. The new CoGen plant is consisted of two 5.5 MW gas turbines and a 2.4 MW steam turbine, providing electricity to an additional 22

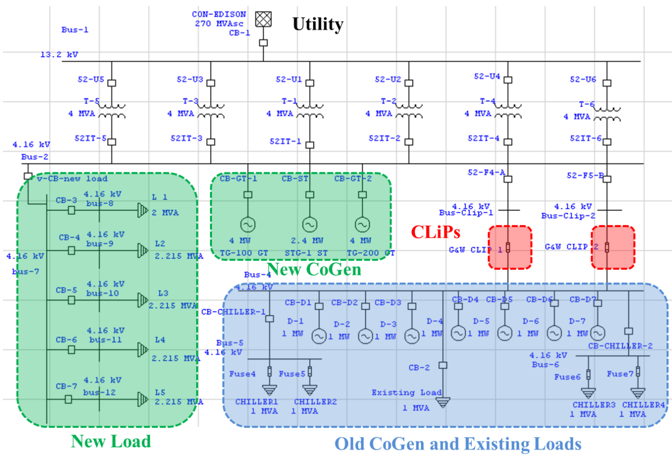

Fig. 1. Simplified NYU microgrid one-line diagram, green box represents new CoGen system, and blue box represents old CoGen system, in the red box are two CLiPs.

buildings up from 7 with the old oil fueled CoGen plant. The new CoGen plant approaches 90% energy efficiency while producing 13.4 MW of electricity, i.e., twice the output of the previous system. It also produces heat and hot and milled water to 37 buildings and is expected to save the university \$5-8 million in energy related costs per year. During Hurricane Sandy, the New York City experienced severe power outage. In contrast, key NYU facilities were consistently supported by the NYU microgrid throughout the whole duration of the Sandy event with no interruptions.

Figure 1 is the simplified one-line diagram of NYU microgrid with six feeders serving NYU electrically connected to a single common bus at the Con-Ed substation. Green box represents new CoGen system, and blue box represents old CoGen system. Two Current Limiting Protectors (CLiPs, manufactured by G&W, rated for 5.5kV, 1.2kA continuous current, 40kA maximum current interruption capacity) are installed between old CoGen system (250 MVA) and new CoGen system (500 MVA), to provide protection for underrated old CoGen system. CLiP is an electronically sensed and triggered, commutating form of current limiting fuse. The interrupt process of this shunt fuse is typical of the traditional current-limiting fuse with 1/4 cycle extinction of symmetrical and 1/2 cycle extinction of asymmetrical faults [15]. CLiP is a single-shot device and the fuses need to be replaced after actuation.

NYU microgrid operates in parallel/grid-connected model at normal condition, i.e., power supply from CoGen plant and utility simultaneously. NYU microgrid is connected to Con-Ed via 6 x 13.2kV high tension feeders with synchronous interconnection. Depending on the load, NYU can import power from Con-Ed or sell power to Con-Ed, i.e., it can support both electricity importing and exporting. Parallel operation mode also provides seamless electricity back up from power grid if CoGen plant has a forced outage. NYU microgrid can be disconnected from power grid and operates in the islanded mode when an abnormal condition is detected at utility side. Islanded operation assures power continuity when utility experience permanent fault and power outage.

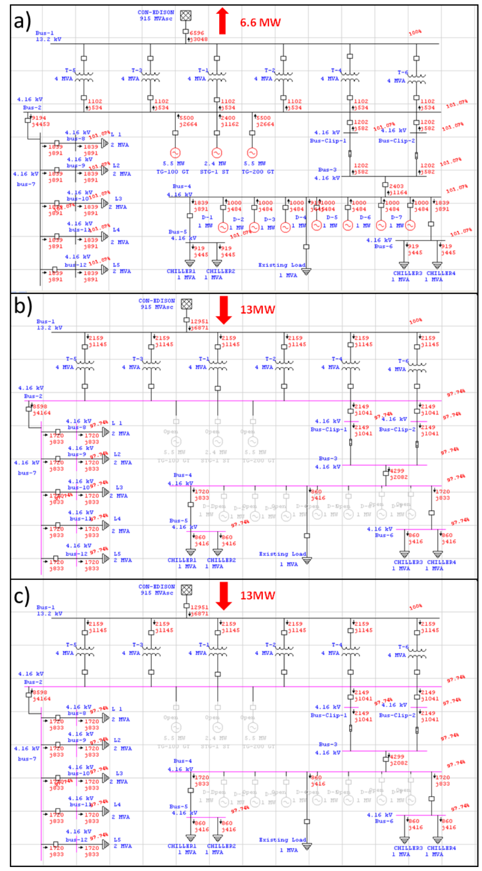

Fig. 2. Operation modes and load flow calculation of NYU microgrid. a) Load flow calculation of NYU microgrid in parallel mode (power export). With all generators operate at maximum capacity, 6.6 MW power can be exported to power grid; b) Load flow calculation of NYU microgrid in parallel mode (power import). When all DGs are out of service, 13 MW power can be imported from the power grid; c) Load flow calculation of NYU microgrid in islanded mode.

Load flow calculations by Electrical Transient and Analysis Program (ETAP) demonstrate different operation modes of NYU microgrid. The parameters used in the simulations are from one line diagram of NYU, vendor information of power equipment, information provided by Con-Ed concerning the 13 kV supply feeders, and are listed in the appendix. A high load of 13.5 MW and 90% power factor is assumed. It shall be noted that building loads which are directly connected to new CoGen system are simplified as 5 $\times$ 2MW static loads. At normal operation, the new CoGen plant produces electricity at its maximum capacity of 13.4 MW, and sells the excess electricity to Con-Ed. As shown in Figure 2(a), when all generators operate at its maximum capacity, it can export an excess 6.6 MW electricity to power grid. In a circumstance when all DGs are forced to shut down, 13 MW electricity can be imported from power grid through 6$\times$13.2kV high tension feeders as shown in Figure 2(b). Each feeder has 3MW capability with a total capability of 18MW. As a result, NYU MG is well protected with redundancy. NYU MG can also operate in the islanded mode, which means the circuit breaker between NYU and Con-Ed disconnects NYU MG from Con-

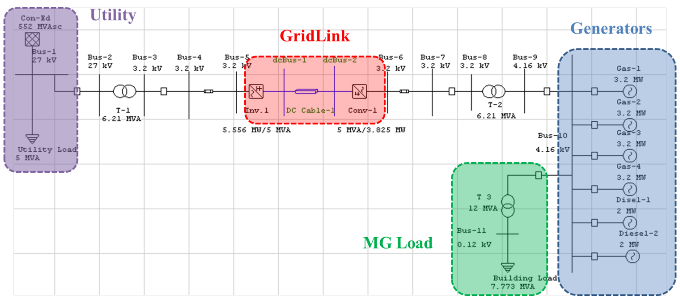

Fig. 3. Simplified Kings Plaza one-line diagram.

Ed power grid. As a result, all power is supplied from local CoGens. Figure 2(c) shows ETAP load flow simulation of NYU microgrid operated in the islanded mode.

B. Kings Plaza Microgrid

Kings Plaza shopping mall is located at 2483 Flatbush Avenue, Brooklyn, New York. It has 6 synchronous generators, 4 $\times$ 3.2 MW gas turbine and 2$\times$ 2MW back up diesel generator, which can produce a total electricity of 16.8 MW. The Kings Plaza is presently served by a 4 unit Combined Heat and Power (CHP) plant that has never been connected to Con-Ed's grid. The Mall has had only one major power outage in more than 28 years. The new non-synchronous interconnection under commission will extend these benefits to other nearby business by connecting the local DGs to Con-Ed via two 27 kV feeders.

Figure 3 is the simplified one line diagram of Kings Plaza microgrid, with the red box represents the non-synchronous interconnection (GridLink), the blue box represents the local DGs, and the green box represents MG load and purple box represents utility. Inside of the GridLink are power electronics with back-to-back AC-to-DC-to-AC converters which enable the voltage, frequency, and phase angle of the utility grid and the on-site generators to be completely isolated from one another.

For Kings Plaza Microgrid operation and load flow calculation, the GridLink non-synchronous interconnection is modeled as a converter and an inverter connected by a DC cable in ETAP as shown in red box of Figure 3. The load of Kings Plaza mall varies between approximately1.4 MW and 7 MW. A high load of 7 MW is assumed and two back up diesel generators are disabled in this model. The Con-Ed feeder short circuit current is 11.8 kA symmetrical with an X/R of 10. Load flow simulation demonstrates different operation modes of Kings Plaza microgrid, i.e., it can be operated in both parallel mode and islanded mode, and the back-to-back inverters can be configured to export power or import power. In normal operation, the GridLink non-synchronous interconnection is configured for exporting power to the utility (Figure 4).

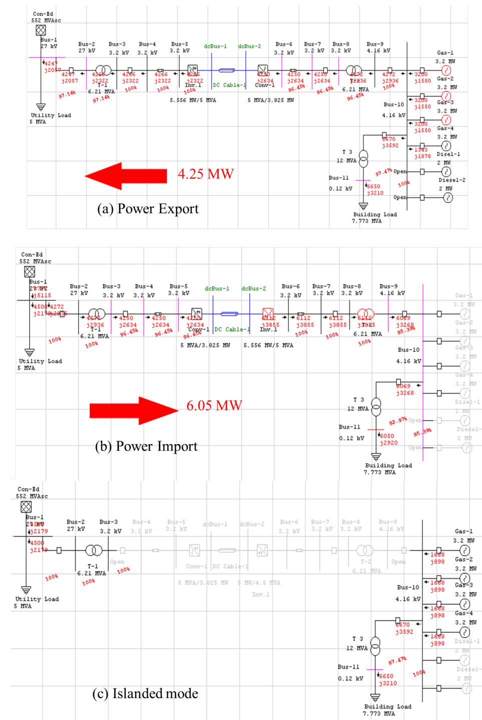

Fig. 4. Load flow simulation of Kings Plaza in different operation modes (unit kW). a) Load flow calculation of Kings Plaza microgrid in parallel mode (power export). 4.25 MW of power can be exported to power grid; b) Load flow calculation of kings Plaza microgrid in parallel mode (power import). 6.05MW of power can be imported from the power grid; c) Load flow calculation of Kings Plaza microgrid in islanded mode.

III. NYU and Kings Plaza MicroGrids Short-circut Analysis

A. NYU Short Circuit Calculation and Fault Analysis

1) Short Circuit Study with External Fault : NYU microgrid short circuit calculation and fault analysis were performed with ETAP. ETAP provides two short circuit calculation methods based on ANSI/IEEE and IEC standards. In this report, a 3-phase fault study per IEC 60909 standard was used (steady state current magnitude). The substation short circuit current was estimated to be 40kA symmetrical with a X/R of 25 [16]. Con-Ed requires that the short circuit contribution produced by the proposed DGs to be managed to specific levels to insure the safe and reliable operation of the main system due to safe operating limits of the Con-Ed equipment. The possible current back-feeding from the microgrid into MV feeders is the major concern of utilities for DG interconnection. A fault on the MV side of a main power transformer is the worst case scenario for possible back-feeding current from the microgrid. In this short circuit study, an external 3 phase fault is introduced at utility MV feeder, i.e., bus 1 in Figure 5. The net additional current flow to the power grid system, contributed by the NYU's cogeneration plant, is approximately 4.2 kA. This current contribution is not small when considering the fact that the Con-Ed system short circuit current levels are reported to be in the range of 15 kA to 25 kA [16]. The potential fault currents flow into Con-Eds substations from the DGs may cause significant problems and damage. This is especially true in substations that are near their maximum fault current duty. In a typical NYC distribution network, the short circuit power is close to the capacity of the breakers. This often forces the utility to prevent the installation of distributed resources in its system. Energy users considering implementing synchronous parallel cogeneration in the Con-Ed service territory are faced

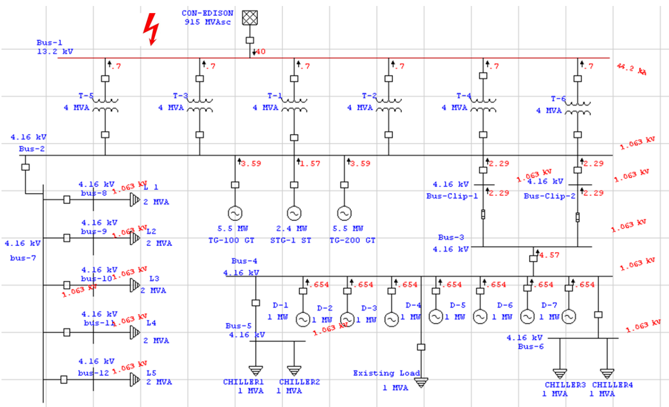

Fig. 5. A 3 phase fault at MV feeder bus 1 in parallel operation mode results in a net additional fault current contribution of 4.2kA.

with the prospect of paying for significant substation upgrades.

2) Short Circuit Study within Old Cogen System: NYU MG's old CoGen system had 7 × 1 MW diesel generators. The new CoGen plant is consisted of two 5.5 MW gas turbines and a 2.4 MW steam turbine, providing 13.4 MW of electricity. NYU microgrid installed two CLiPs for improved protection between its old and new CoGen systems. Typical adoption of CLiP is for microgrid interconnection protection and about 1/3 of the microgrid systems would need CLiPs, such as in the case of NY Presbyterian Hospital [16]. For the case of NYU, available fault currents have increased substantially due to expanding power requirements. CLiPs are used for the protection of under-rated circuit breakers within the old CoGen system.

Figure 6(a) represents the old CoGen system before expansion and Figure 6(b) represents NYU microgrid after adding its new CoGen system. When a 3 phase fault is introduced at the end user (bus 5) in the old CoGen system, short circuit current reaches 6.14 kA at bus 5. The original circuit breakers installed in the old Co-Gen system was designed to meet the short circuit rating of the old system, i.e., the original circuit breakers should trip at 6.14 kA. When a 3 phase fault is introduced at the end user (bus 5) of NYU after expansion, fault current at bus 5 reaches 54.9 kA in parallel mode since there is a large fault current contribution from both the utility and local CoGens. This short circuit current level is considered quite high and may exceed the thermal, mechanical and interrupt capability of the original circuit breakers, potentially causing a catastrophic failure. As a result, after the expansion of NYU microgrids CoGen system, the original circuit breakers installed within the old CoGen system should be upgraded to meet the higher short circuit levels. The other alternative approach is to install a current limiting fuse like CLiP as in the case of NYU microgrid. In addition, for applications where available fault currents have increased due to expanding power requirements, simply replacing the circuit breakers may not be an adequate protection for other under-rated equipment on the system. The application of a CLiP for protection of under-rated circuit breakers can provide significantly improved protection at a substantially lower cost than replacing those circuit breakers.

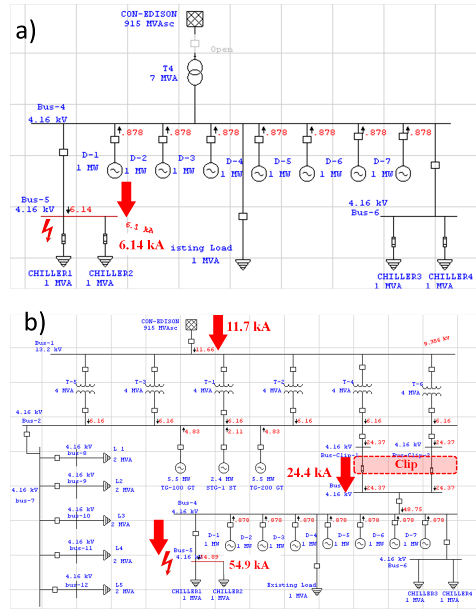

Fig. 6. Short circuit calculation comparision between old CoGen system and new CoGen system with 3 Phase fault at user end (bus 5). a) Old CoGen system before expansion; b) New CoGen system after expansion.

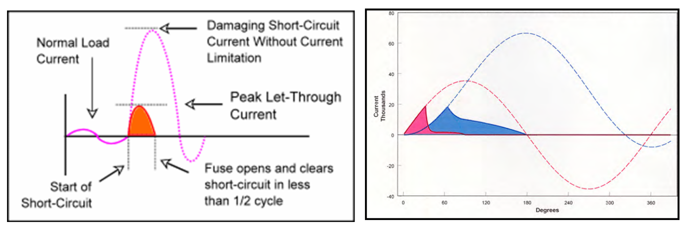

Fig. 7. (a) Schematic of a typical current limiting fuse, (b) CLiP symmetric and asymmetrical typical fault current interrupts.

A current limiting fuse, within its current limiting range, opens within 1/2 cycle or less, and can greatly reduce the effective let-through current so as to protect its downstream circuit breakers. Figure 7(a) shows a schematic of a typical current limiting fuse. The area under the current curves over a time period is indicative of the energy let-through. The amount of thermal energy delivered is directly proportional to the square of the current multiplied by clearing time (I^2t). The application of current limiting fuse reduces the damaging short circuit current down to the peak let-through current, which greatly alleviates the thermal, mechanical stress exposed to the downstream circuit breaker. The interrupt process of CLiP is typical of the traditional current-limiting fuse, with 1/4 cycle extinction of symmetrical and 1/2 cycle extinction of asymmetrical faults as shown in Figure 7(b), much shorter than circuit breakers which usually clear faults in 3 to 5 cycles. These devices have very fast response and are designed to trip before other circuit breakers operate.

If there are less than 3 transformers in line at NYU microgrid, CLiPs are disabled. This operation is based on the short circuit analysis which suggests that CLiPs are required only when 3 or more transformers are in line for the protection of microgrid gears between the 350 MVA and 500 MVA systems

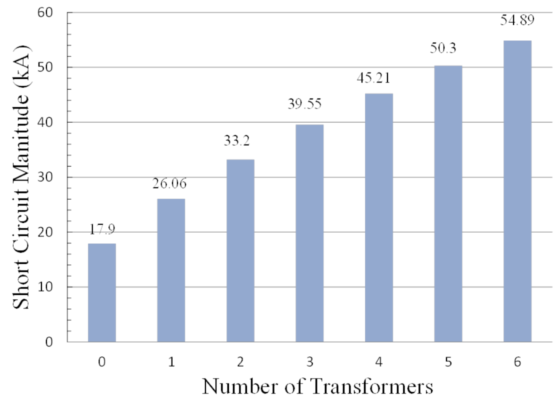

Fig. 8. Short circuit current(kA) with different numbers of transformers in line.

[NYU Operations SETS (Sustainability, Energy and Technical Services)]. Short circuit current level with different numbers of transformers in line are plotted in Figure 8. Maximum interruption capacity of the circuit breakers within old Cogen system is estimated to be in the range of 33.2kA. For higher short circuit current (39.55 kA to 54.89kA), CLiPs should be engaged to protect under-rated downstream circuit breakers.

3) Short Circuit Study within New CoGen System: The Con-Ed requirement for interconnection includes a high speed protective device which will interrupt the cogeneration plant short circuit current within 1/2 of 1 cycle as a primary protection with secondary overcurrent protection provided by relay supervised circuit breakers. NYU microgrid only has solid state relays and circuit breakers for interconnection protection. As will be expected, there are high fault current contribution from utility to microgrids, which cause huge difference in fault current levels in different operation modes.

A 3 phase fault at bus 12 which directly connected to the new CoGen system was introduced. Short circuit calculations were carried out in different operation modes. In parallel mode, fault current contribution from power grid is 11.7 kA, fault current at bus 12 is 54.9 kA as in Figure 9(a). Most circuit breakers, at 4.76 kV, the maximum interruption capacity is less than 50 kA. Extra fault current from power grid may expose circuit breakers to mechanical and thermal stress that is beyond their limits. It may be challenging for circuit breaker to clear this high level fault current in parallel mode (54.9kA). In islanded mode, since there is no fault current contribution from power grid, fault current at bus 12 is 17.9 kA as shown in Figure 9(b). During unplanned grid outrages, similar to Sandy hurricane, NYU microgrid proactively matched its 8 MW load. In Sandy hurricane, NYU run 2 units of 5.5MW gas turbine and produced 8MW to match its load. In this situation, fault current at bus 12 is 7.02kA as in Figure 9(c).

Transient short circuit calculation per IEC Standard 61363-1 was also calculated in different operation modes as shown in Figure 10. The transient short circuit calculation presents fault current waveforms as a function of time after the fault. The short circuit calculations show drastically different short circuit current levels in different operation modes.

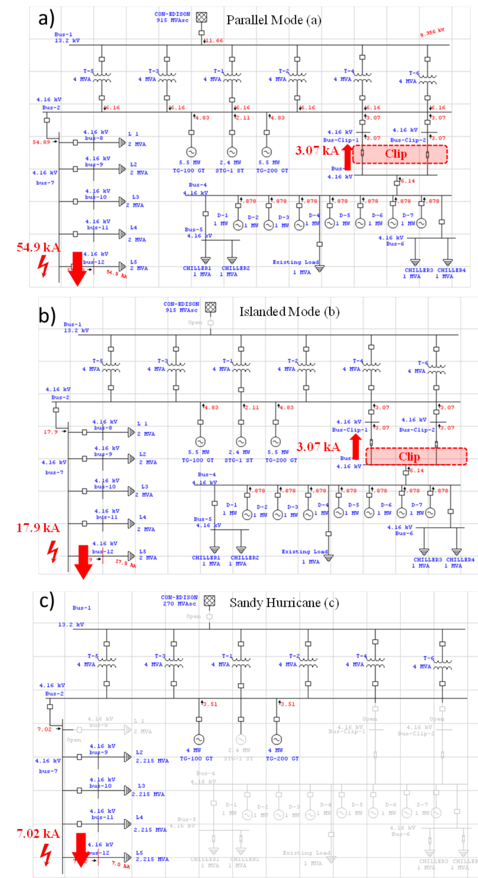

Fig. 9. NYU microgrid short circuit simulation in different operation modes with a 3 phase fault at bus 12. a) Short-circuit simulation of NYU microgrid in parallel mode (3 phase fault at bus 12). Short circuit current at bus 12 reaches 54.9kA. b) Short-circuit simulation of NYU microgrid in islanded mode. Short circuit current at bus 12 is 17.9kA. C) Short-circuit simulation of NYU microgrid during Sandy Hurricane. Short circuit current at bus 12 is 7.02 kA.

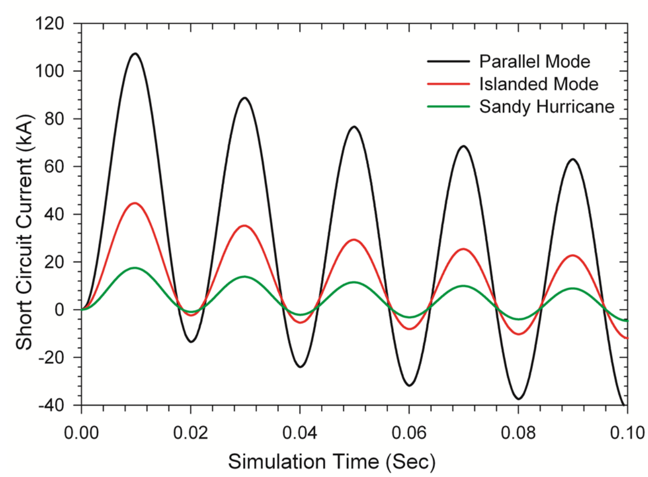

Fig. 10. Transient short circuit calculation in different operation modes.

Short circuit current seen by circuit breakers installed in the new CoGen system in different operation mode varies a lot as in Table I, i.e. CB-7, CB-New Load, CB-GT-1, CB-GT-

TABLE I
SHORT CIRCUIT CURRENT SEEN BY CIRCUIT BREAKERS AT DIFFERENT OPERATION MODE

Operation modes	CB-7	CB-New Load	CB-GT-1 2	52IT 1 6	CB-ST	G&W Clip 1 2	52-F4-A, 52-F5-B	CB-D1 7
Parallel	54.89	54.89	4.83	6.16	2.11	3.07	3.07	0.878
Islanded	17.9	17.9	4.83	0	2.11	3.97	3.07	0.878
Sandy	7.02	7.02	3.51	0	0	0	0	0

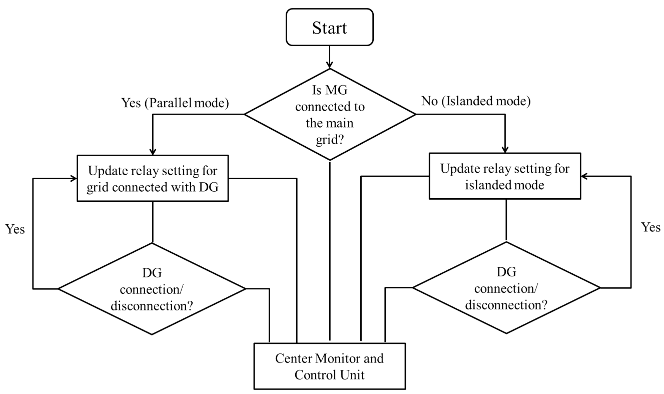

Fig. 11. Flowchart microgrid protection stragety which modifies the preferred protective response to a change in system conditions.

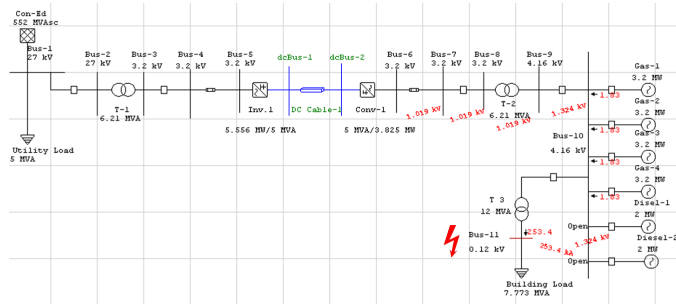

Fig. 12. ETAP short circuit simulation, 3 phase fault is introduced at bus 1. Fault contribution from Kings Plaza is 0.175 kA.

2. It will be challenging for the protective relays and circuit breakers to respond to different fault current levels. Conventional overcurrent circuit breakers and electromechanical relays (1900s) are inapplicable since they do not provide the flexibility for changing the settings of tripping characteristics. Microprocessor/numerical relays (1980) should be adopted, the tripping characteristics (several settings groups) of which can be parameterized locally or remotely automatically or manually. In modern digital relays, a tripping short-circuit current can be set for a wide range, e.g. 0.6-15*CB rated current. Another important feature is microprocessor-type relays should have the ability to communicate and exchange information with a central computer or between different individual relays fast and reliably by new/existing communication infrastructure and standard communication protocols. As shown in Figure 11, the operation conditions of the microgrid should be monitored dynamically, and a center control unit or software should be adopted, which could change the tripping settings of circuit breakers timely according to different operation modes and the number of DGs connected.

B. Kings Plaza Short Circuit Calculation and Fault Analysis

To understand fault characteristics and protection coordination of a microgrid interconnected by back-to-back inverters, fault characteristics of inverter based distributed energy resources (DER) should be understood. Benefits of power electronic switches include switching speed, package size, and the ability to be finely controlled by other electronic systems and software. Inverters can also be controlled in a manner unlike rotating machines because they can be programmed to vary the length of time it takes them to respond to fault conditions. Fault clearing time response could be adjusted as desired either to conform with fault clearing coordination or interconnection standards (LVRT). Accordingly inverters can be programed as in fault current mitigation mode or low voltage ride through mode.

When inverters are programmed in fault mitigation mode, inverter based fault current contribution contain a rule of thumb of 1 to 2 times an inverter's full load current for one cycle or less[17]. Methods for determining inverter-Based DER fault characteristics include short circuit testing and short circuit modeling. Short circuit testing was conducted according to UL 1741 test procedure and equipment set up [17]. Inverters test results suggest that inverters designed to meet IEEE 1547 and UL 1741 produce fault currents anywhere between 2 to 5 times the rated current for 1 to 4.25ms, depending on the inverter type, single-phase or a 3-phase [18]. This fault current level is significantly less than the fault current contributions of a machine-based DER. Experimental test of inverters also shows that fault current can continue propagating for approximately 7 cycles and at a magnitude of approximately 1.2 times steady-state current before shutting down if inverters are programmed in LVRT mode. The GridLinks inverters have LVRT capability which can ride through a certain range of 27 kV power grid voltage dips. LVRT test results of the inverters are included in the report [19].

The other method to determine fault characteristic of inverter based DER is short circuit modeling. A 3 phase fault is assumed at bus 1 which is directly connected to Con-Ed utility. Figure 12 shows the short circuit simulation by ETAP. Fault current contribution from Kings Plazas generator is 0.175 kA, all of which is from the inverters of the GridLink unit. An inverter is modeled as a voltage source to the AC system in ETAP. When its terminal bus is faulted, the fault current contribution from an inverter is equal to the multiplication of its AC full load ampere by a constant k. In this model, we use default value of k 150%. Short circuit simulation shows that the fault current contribution from DGs of Kings Plaza is small compared with short circuit levels of Con-Ed (15kA 25kA). In contrast to ETAP model, inverters in GridLink units can be programed such that the fault current contribution can be

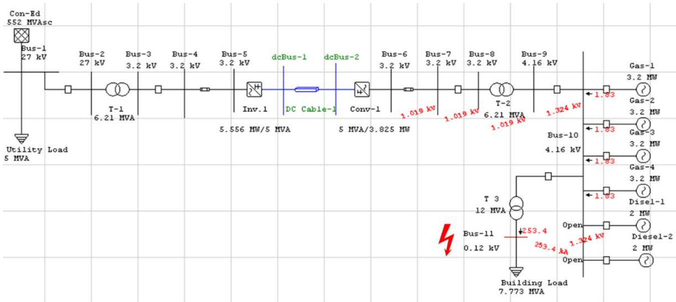

Fig. 13. ETAP short circuit simulation, 3 Phase fault is introduced at load bus 11. All fault current contribution is from DGs, no fault current contribution from power grid.

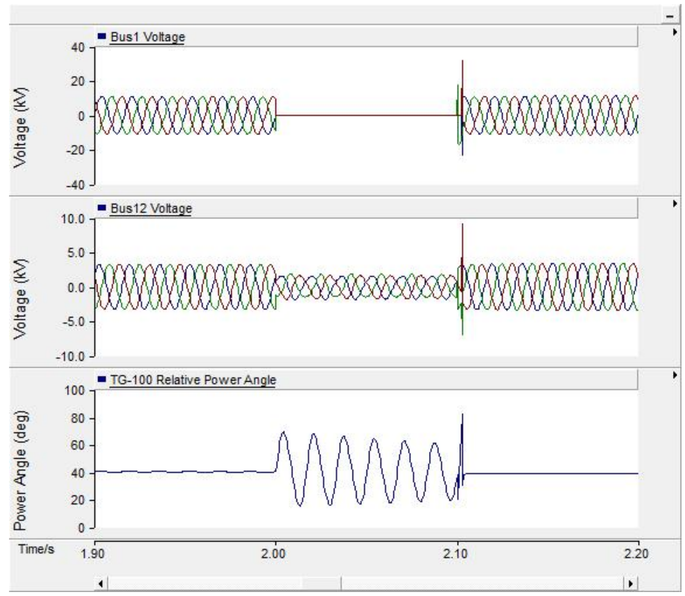

Fig. 14. Tranisient analysis result of a 3 phase fault at utility bus for NYU microgrid.

reduced to effectively zero in real operation.

When a 3 phase fault introduced at bus 11 at load side as shown in Figure 13, ETAP short circuit simulation shows that there is no fault current contribution from Con-Ed, all fault current contributed from local DGs. In other words, back-to-back inverters of GridLink unit insulate fault current contribution from both sides.

IV. NYU and Kings Plaza MicroGrids Transient Study

A. NYU Microgrid Transient Study

The ability of a synchronous power system to return to stable condition and maintain its synchronism following a relatively large disturbance arising from very general situations like switching on and off of circuit elements, or clearing of faults etc. is referred to as the transient stability in power system. The electrical power transient stability calculation enables engineers to accurately model power system dynamics and transients by simulating system disturbances and other events. Event is any occurrence (intentional or unintentional) in an electrical system that may affect the stability limit of the power system. This special transient stability study was conducted by using PSCAD.

As shown in Figure 14, for NYU microgrid, suppose that a 3-phase fault will occur at utility side, 13.2 kV main bus(bus 1) and will be cleared after 0.1 sec. When the fault occurred, the voltage of the faulted bus will drop to zero, the voltage of the end user (bus 12) will experience under-voltage, and the generator power angle swing to 70 deg approximately. After the fault was cleared, the relative power angle of the generator oscillated and was damped approaching closely to its initial position. Based on this behavior, synchronous generator TG-100 stays in synchrony with the utility after the fault cleared. So the CoGens of NYU microgrid do not need to be tripped off-line during system transients.

B. Kings Plaza Transient Study

Transient stability was also simulated for the Kings Plaza with PSCAD for the case that a 3-phase fault will occur at utility side (bus 5) and will be cleared after 0.1 sec. When the fault occurred, the voltage of the faulted bus (bus5) will drop to zero as shown in Figure 15(a). The voltage of end user (bus 11) did not experience any disturbance as shown in figure Figure 15(b). The relative power angle of the local generator did not oscillate as shown in Figure 15(c). In a word, the back-to-back inverters of GridLink not only isolate voltage, frequency, phase angle of the utility grid and on-site generators, but it also enables transient disturbance of the utility grid and the on-site generators to be completely isolated from one another.

The transient stability study of NYU microgrid shows that, the CoGens do not need to trip off line and will stay in synchrony with the utility after system fault cleared. However, the end-user will experience severe under-voltage during the event. Our simulation result shows one other benefit of GridLink non-synchronous interconnection, i.e., the end user will not experience any under voltage or over voltage during system transient faults. However, more detailed simulation involving dynamic behavior of transistors should be carried out to confirm this conclusion.

V. Comparative Study: Synchronous and Non-Synchronous Interconnection

Comparison of synchronous and non-synchronous micro-grid interconnection technology in terms of protection is summarized here based on two target site, i.e., NYU microgrid (synchronous interconnection) and Kings Plaza (GridLink non-synchronous interconnection).

- **Fault current contribution**. NYU microgrids synchronous interconnection allows fault current contribution from both sides. In case of fault within microgrid, Con-Ed will contribute a high level of fault current. In case of fault at utility side, fault current will be injected to Con-Edison from NYU CoGens. GridLink non-synchronous interconnections is based on power electronic inverters, which insulates fault current contribution from both sides (Figures 12,13).

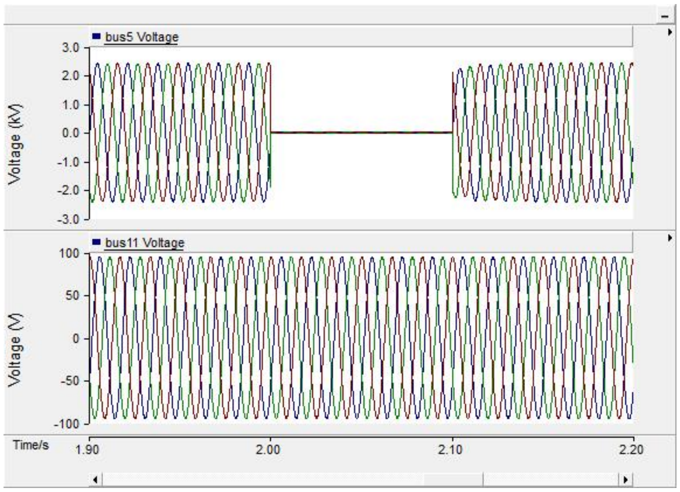

Fig. 15. Tranisient study of a 3 phase fault at AC side of inverter for Kings Plaza microgrid.

- **Transient Stability Evaluation**. Additional transient analysis by PSCAD shows that NYU microgrids local synchronous generators can stay synchronous with utility after 3 phase fault. However, the end user will experience under voltage during the fault. For Kings Plaza microgrid, the back-to-back inverter completely isolated transient disturbance of the utility grid and the on-site generators.
- **Speed**. NYU microgrid utilizes CLiPs to protect under-rated old CoGen system. The interrupt process of CLiPs is typical of the traditional current-limiting fuse with 1/4 cycle extinction of symmetrical and 1/2 cycle extinction of asymmetrical faults. NYU use relays and circuit breakers for power grid interconnection protection which are relatively slow interrupting devices (3-5 cycles), which may not prevent a secondary catastrophic failure. GridLinks inverters can be programed at fault mitigation mode, it can trip in 2.5μSec, less than 1/4 cycle.
- **Fault ride through capability**. LVRT requirements stipulate that generation facilities need to stay connected through a temporary fault scenario to provide post-fault voltage support. In addition, generation facilities need to stay connected to the distribution or transmission system to help maintain grid stability. For Kings Plaza, Con-Ed has approved the design setting that the inverters will trip in 1/2 cycle if the fault is on the feeder feeding the Gridlink inverter, but ride through if the fault is on one of the other 27 kV feeders coming out of Bensonhurst.
- **Expandability**. The application of protection schemes based on current limiting fuse and circuit breakers is only possible up to certain amount of DGs connected. The magnitude of total fault current from all sources, power grid and DGs, cannot exceed the interrupt rating of the protection devices. GridLink unit is based on inverters, it has unlimited expansion possibilities since additional GridLink units can be added to the system if future DGs are to be connected.
- **Project approval time**. Since NYU microgrid has fault contribution from both sides (Con-Edison and NYU). A long and detailed review was needed to analyze the fault contribution to each other. The analysis took about one to two months. Total project approval time is a year back and forth. GridLinks non-synchronous interconnection has negligible fault current contribution, so the project approval time is relatively short $\sim$ 2 month.
  Other comparisons like cost, transportation, maintenance are not included in this paper.

VI. Conclusion

Following a comprehensive overview of the technology challenges and solutions for protection scheme in microgrids, a comparative study of the protection solutions for MGs with synchronous and non-synchronous interconnections was conducted based on two real cases.

NYU microgrid has one of the largest private CoGen plants in New York City. Current limiting fuse (CLiP) installed between old and new Cogen system provide protection for the under-rated old Cogen system at a substantial cost savings over replacement of the original circuit breakers. It is challenging for CBs to respond to various short circuit levels in both islanded and parallel mode. Numerical relays and selectable trip CBs is a solution at a substantial higher cost. Large fault current contribution from local CoGens from NYU push the short circuit capacity of substations to its limit. Moreover, solid state relays and circuit breakers (3 $\sim$ 5 cycles) is not enough for interconnection protection.

Kings Plaza microgrid utilizes non-synchronous interconnection with back-to-back inverters. Inverters provide much faster switching speeds along with advanced sensing and controls that can be used to eliminate fault current contributions, thus making DER coordination negligible. Steady state short circuit analysis shows that the back-to-back inverters isolate fault current contributions bi-directly, from the utility to the microgrid, and from the microgrid to the utility. Transient stability study shows that back-to-back inverters can also isolate transient fault disturbance, and support voltage stabilization.

In future study, the short circuit characteristic and low voltage fault ride through characteristic of the inverter will be numerically and experimentally determined. Fault current model parameters should be expanded to be included in system level protective device coordination studies. Fault ride through capability of inverters should be quantitatively determined, and protective relay coordination shall be studied with system level communication and control studies.

Acknowledgment

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John Doe Biography text here.

Jane Doe Biography text here.

Appendix A
ETAP Simulation Parameters

ATTACHMENT B
Power Electronics Platform
Technical Concept and Application Guide
and
Product Standard Approval Package

GridLink Product Documentation

The intent of the GridLink Product Documentation is to provide the technical and performance information that will serve as the basis for investment grade analysis and application engineering guidance. The Technical Concept & Application Guide provides the information to evaluate product applications and project evaluation. The GridLink Product Standard Approval Package provides engineering specification and quality plan for the installation of the GridLink product.

January 7, 2015

Inverter Micro Grid Concept

- **Multi-terminal DC Link concept**

An illustration of this can be found in the Manufacturer's brochures included in the working papers.

Directional Power Flow

- **Watt and VAR (PQ) Import and Export from the Utility Grid capability**

Full 4-quadrant capability. Ratings are given in the meeting report, page 2.

It was decided to rate the units at 4MW with 0.9pf under +/-10% voltage swings on the grid side, thus requiring a 2.9kV transformer rating, with harmonic filters sized accordingly.

Voltage Regulation

- **Supply voltage steady state maintained to x.x%**
- **Transient voltage recovery characteristics**

The Active Front End can ride through any voltage dip. See page 24 of the FRT report (Sec.4.3.9 – 100% voltage dip)

Dynamic VAR can be programmed to help stabilize the utility voltage if so desired.

Harmonics Regulation

- **Reflected harmonics to the Grid limited to xx% THD**
- **Inverter xx pulse application**

See the Harmonic Analysis Report for reference to IEEE 1547 compliance. Also, see page 44/63 for conclusions of the Con Edison side harmonics.

Reactive Power

- **Export PQ curve capability xx rated capacity leading and xx rated capacity lagging**
- **Load PQ curve capability xx rated capacity leading and xx rated capacity lagging**
- **Grid Reactive Power consumption**

Generally sized for 0.9pf lead or lag in all voltage ranges. Thus, the full rating of 4.4MVA is available, voltage dependent (high or low on lead or lag), see page 6/7 of meeting report included in the working papers for a description.

Asynchronous Connection

- **Customer Generation – Utility interconnection synchronization**

See the FRT report for general configuration. For Con Edison, the grid side synchronizes to the grid after the 27kV transformers are energized, as per Con Edison EO-2022 specifications. Mall side generators are NOT synchronized to grid.

Grid Isolation

- **Inverter energization in-rush current characteristics**

No in-rush, controlled pre-charge.

Limitations

- **Fault current contribution during Utility fault**
- **Fault current contribution to Customer fault**

The limitations are programmable with a 0-thermal limit.

Overload Capacity

- **Inverter thermal load limit**

See page 14/45 of specification report. The inverter lowers the switching frequency to obtain higher overload limits during faults or other anomalies.

Customer Applications

- **Asynchronous Interconnection of Combined Heat & Power systems**
- **High Reliability Supply of Mission Critical systems**
- **Distributed Grid Generation systems**

Reliability

- **Overall system reliability metric**
- **Restoration duration descriptions**
- **Fault Tolerance of Inverters**

The general design concept is to allow each of the isolated parts of the system to fail without affecting the other parts. In the case of a mall side generator failure, GridLink can reduce failure problems by supplying lost power instantaneously.

Failure of a GridLink unit will not affect the rest of the system as it runs now, other than to create power balance issues.

Maintainability

- **Utility outage requirements options**
- **Customer Generation outage options**

With the Kings Plaza design, both the mall and the grid stay running as they are now if the GridLink system needs to be taken out of service. An outage of the utility trips the GridLink inverter tied to that feeder, but not the rest of the system.

- **Customer load outage options**

One of the features of this system is to be able to feed the mall with GridLink, obtaining power from the grid. Details of this approach have been presented in sales presentations to Con Edison.

- **Inverter on-line diagnostics**
- **Inverter de-rating and component modularity**
- **Non-Proprietary Programming language**
- **Control platform centered on xxx PLC**

See product brochures for these details. System interface will be through an industrial PC running on VX Works, supplied by GEPC.

Operability

- **Programmable Automatic Control parameters**
- **Import/Export Control capabilities**
- **PQ Control capabilities**
- **Utility SCADA interface options**
- **Local/Remote Manual Control options**

As mentioned above, all I/O control will go through a system controller, which is an industrial PC running on VX Works. Internal to the inverters, this system controller communicates on a proprietary fast EtherCAT bus, but to the outside world it can use any communications protocol.

Con Edison has not yet determined how they wish to communicate, but the proposal calls for DNP3.0 with a converter to Modbus TCP.

To the Powerhouse master control, GridLink interfaces to their existing PLC. As many local hardwired controls and HMI's can be added as needed.

Constructability

- **Inverter-DC Link modular design**
- **Factory Commissioning and Quality Assurance**

See general arrangement drawings of the inverter lineup, which goes into an e-house. The transformers and main breakers will be mounted on a separate skid.

Expandability

- **Inverter Control software options**
- **Scalable Configurations module power rating options**

Automatic controls or algorithms can be written into the system controller, or sent to it as needed. It is not yet determined how the dispatch model will work for economic optimization, but this could be done remotely and communicated over an internet connection as well.

Larger power ratings would require more inverters to be added in parallel, which is possible.

GridLink Product Standard Approval Package

- Performance Specification
    - Power Transfer Capacity
    - System Electrical Ratings
    - Protection & Control Functions
    - Operating Environment Range
    - Module Dimensions & Weights
- Prototype Test Results
    - Continuous Load Capability
    - System Efficiency
    - Dielectric Characteristics
    - Fault Protection Scheme
    - Fault Withstand Rating
    - Power Flow Control
    - Independent Testing Certification Listings
- Factory Acceptance Test Plan
    - Component Quality Assurance
    - Continuous Load Test
    - Fault Withstand Test
    - Fault Protection Functional Test
    - Component Dielectric Test
    - Control Cabling Continuity Test
    - Control & Protection Calibration Test
    - Control & Protection Functional Test
    - Special Utility/AHJ Inspection & Test
- Site Acceptance Test Plan
    - Module Assembly Inspection
    - Ground System Test
    - Module Dielectric Test
    - Control & Communication Functional Test
    - Protection System Functional Test
    - Continuous Load Test
    - Live Load Control Tuning

ATTACHMENT C:

REQUEST FOR DRAFT LETTER FROM CON EDISON TO PARETO ENERGY'S INVESTMENT BANK TO ENABLE PRIVATE FUNDING TO DEMONSTRATE THE TWO-SIDED MICROGRID PLATFORM BUSINESS MODEL

Dear Troy,

I appreciate your continuing efforts to review the materials that Pareto Energy submitted between June 11, 2014 and January 8, 2015.

Based on work with the NYISO to estimate the amounts that an installation of GridLink at Kings Plaza could earn from the Behind-the-Meter Net Generation Market (BTM: NG Market) that opens in 2017, Pareto Energy believes that it can fund the Project by $4 million of our own investment and an $8 million loan from an investment bank that is securitized by the eventiual BTM:NG Payments. However, no investment bank will place such a loan while Con Edison specifically insists that "GridLink has never been successfully tested as a viable interconnection platform between a generator and an electric distribution system" as it did in the Company's July 6, 2015 opposition to the Kings Plaza project and while Con Edison also generally rejects the possibility of CHP being a resource under the BQDM Program and REV, as the Company did in its recent comments on the Staff Ratemaking and Utility Business Model White Paper.

Therefore, we need the following letter to take to investment banks:

REF: New York State Energy Research and Development Authority (NYSERDA) Agreement Number 41313 for PON 2715, Category D For Pareto Energy's Demonstration of a Power Electronic Microgrid Solution

Dear ______:

As a condition of its support for the above-referenced NYSERDA research contract, Con Edison requested testing of Pareto Energy's power electronics platform. We understand that the power electronics platform is available from multiple suppliers that have implemented it for the interconnection of a generator to an electrical distribution system. We also understand that Pareto Energy has selected GE Power Conversion to supply the power electronics platform for interconnecting 8 MWs of the combined heat and power system serving the Kings Plaza Shopping Center and Marina in Brooklyn ("KP-CHP) and for a proposal to the Port Authority of New York and New Jersey to interconnect 107 MWs at the Kennedy Center International Airport Cogeneration Facility ("KIAC").

On June 11, 2014, Con Edison held a working sessions with engineers from GE Power Conversion ("GE-PC") and Pareto Energy. As a result, Con Edison received on June 23, 2014 a confidential report of hardware tests from an installation of a medium voltage inverter Type MV7000 at a GE-PC customer site in the field ("GE-PC FRT Report"). On August 24, 2014, Con Edison received a report of additional GE-PC simulations regarding Harmonic Generation Levels and Harmonic Filtering Performance. On January 8, 2015, Con Edison received a GridLink Technical Concept & Application Guide that provided information to evaluate product applications and project evaluation and a GridLink Product Standard Approval Package that provided an engineering specification and quality plan for approving the installation of the GridLink product.

Based on a lengthy review of these three documents, Con Edison now agrees with the following conclusions about the Gridlink system submitted for review:

- That the inverter proposed, GEPC model MV7312 is commercially available, and that the report submitted shows that a similar type MV7000 has been been successfully tested as a viable interconnection platform between a generator and an electric distribution system.
- That the protection scheme proposed with the protective relays can meet the protection requirements of UL1741
- That the inverter can be used as a fault current mitigation device, subject to full system verification testing
- That the design submitted for review can meet the power quality requirements of UL1741, subject to full system verification testing

Nothing in this letter shall constitute an approval of the interconnection of any generator in Con Edison's service territory. A list of the specific actions consistent with the GridLink Product Standard Approval Package that will enable interconnection approval for the Kings Plaza project has been attached.

ATTACHMENT D

Excerpts from Con Edison Filings to the New York State Public Service Commission

1.0 EXECUTIVE SUMMARY

More New Yorkers installed solar panels on the roof of their homes in 2014 than all previous years combined, and the trend is accelerating due to the incentives in place to install this low carbon footprint technology. There are benefits broadly to the population from the improved air quality, reduction in greenhouse gases and ability to generate energy closer to load, but these distributed solar systems' peak generation hours do not coincide with Con Edison's peak load hours, which typically occur after 5 PM. This means high carbon peaking turbines are still dispatched at night, limiting the total environmental gains solar could be providing. It also means the transmission and distribution systems do not benefit from the local generation because they must be built to supply the peak load. In addition, what has yet to be factored in is the potential for additional costs of voltage regulation in areas of very high solar adoption, as are already seen in areas such as Hawaii and Germany.

This REV demonstration project is designed to demonstrate how aggregated fleets of solar plus storage assets in hundreds of homes can collectively provide network benefits to the grid, resiliency services to customers, monetization value to Consolidated Edison Company of New York, Inc. ("Con Edison"), and results that will help inform rate design and development of distribution-level markets.

<u>Aggregation of Distributed Solar Plus Storage into Virtual Power Plant</u>

For the limited purposes of the proof of concept being tested in this demonstration project, Con Edison will partner with SunPower and Sunverge to integrate residential behind-the-meter storage resources into the grid. The SunPower / Sunverge platform provides aggregated control of individual residential resources, converting them into a "virtual power plant" (VPP), resulting in grid-scale impact and benefits to Con Edison and all its customers. The VPP will have a total capacity of 1.8 MW and an aggregated energy output of 4 MWh. The concept being tested is that the Virtual Power Plant would act as a controllable power generation source that can be optimized to provide distribution and transmission level benefits as markets evolve.

<u>Resiliency Value</u>

An integrated solar plus battery system provides customers with resiliency services in the event of a momentary or sustained utility outage. When a grid outage occurs, the integrated system will provide the customers participating in this demonstration continued power to critical components in their home automatically. This solution offers a simpler, cleaner alternative to the gasoline backup generators available in the market today. Among other concepts being tested, this demonstration project will examine customers' willingness to pay for resiliency services.

Network Value

Batteries installed with solar systems (photovoltaic or 'PV' plus storage) can mitigate intermittency and the peaking nature of an as available resource. For example, PV plus storage can be configured to smooth intermittency by charging the battery so that there is only a constant power output when a cloud passes by ("firm" solar output), and so that the system stores all of the energy produced during the day for a constant output at night ("shift" solar output). Together, solar energy and battery storage can be a reliable, dispatchable resource that can be deployed to help reduce load in a constrained area and has the potential to defer or avoid capital investments transmission and distribution ("T&D") deferral. The green energy produced during the day can also provide an alternative to other generation sources in the evening. Voltage fluctuations from partly cloudy days can also be eliminated are eliminated.

Market Mechanisms for Monetization Value

In this project, Con Edison will explore how hundreds of residential distributed energy resources ("DER") can be aggregated into grid operations to provide firm capacity for participation and monetization in competitive capacity and energy markets, e.g., New York Independent System Operator ("NYISO") wholesale capacity markets and demand response programs). The testing of competitive market mechanisms for the monetization of grid services is also consistent with the development of a distribution system platform ("DSP"). This demonstration provides a platform for evaluating the potential for new revenue streams related to aggregation and operations of aggregated fleets of distributed energy resources. This new grid services revenue stream will make battery installations profitable in the near future, as the price of the technology comes down.

Rate Design

The deployment of customer-sited solar plus storage assets also enables Con Edison to test how different rate designs may be used to incentivize desired customer behavior. Examples include time-of-use (TOU) tariffs that align cost of generating energy to customer bills, residential demand charges encouraging predictable and stable behavior patterns for customers, and other event payments for behind-the-meter energy storage participation in demand response events. The VPP software's capability in creating sub-groupings of assets enables Con Edison to create localized tests of rates.

2.2 SOLUTION

Pairing solar with energy storage has the potential to address the concerns raised above. For utilities, storage can smooth intermittency of solar and be used to dispatch energy at times when customers need it most. For the residential customer, solar plus storage provides access to a clean alternative to backup generators and that can also be dispatched to respond to price signals from the utility. The aggregation of a fleet of residential systems into a virtual power plant provides opportunities to both deliver resiliency services to homeowners, as well as additional distribution and transmission level value to Con Edison and the grid network.

In this demonstration project, Con Edison will partner with SunPower and Sunverge to offer a cost-effective solar and energy storage solution to customers and develop an advanced control platform to aggregate the distributed systems into a single, dispatchable capacity and energy resource. The platform will give Con Edison the ability to dispatch the assets and evaluate opportunities in existing and future competitive markets at the DSP and NYISO.

Key elements of the project include:

- SunPower, in partnership with Sunverge, will provide a platform that aggregates control of individual residential resources into a virtual power plant. Total aggregated VPP size will be 1.8 MW inverter capacity, and 4.0 MWh of stored energy capacity.
- Con Edison will purchase, own and control the fleet of energy storage assets during the duration of this Demonstration Project. Con Edison and SunPower are designing a mechanism through which Con Edison can designate a finite time period for its ownership and control of the energy storage assets after the completion of this demonstration project.
- Con Edison, along with SunPower, will offer residential customers an energy storage offering. This energy storage product will be presented to the customer by SunPower and SunPower's installation partners as an integrated solar and storage offering.
- SunPower will deploy an advanced end-to-end customer engagement process using sophisticated customer targeting and acquisition strategies.
- The customer offering would consist of the following elements
    - A solar system that would be financed or purchased by the customer in the same way as they would under a normal solar-only scenario,
    - An energy storage system that would be a Con Edison-owned asset , and
    - A monthly resiliency payment that the customer would pay to SunPower for the resiliency services that are offered by the integrated solar and energy storage system.

- An integrated solar and storage product will be installed at customer locations. Projects will be sized to customer loads at single-family residences.

Con Edison has designed a three-phase approach to the demonstration project.

Phase I: Customer Adoption of Resiliency Services

In Phase 1, Con Edison will partner with SunPower to present a fully packaged solar plus storage solution to residential customers. The customer offer can be SunPower-branded or co-branded with Con Edison-. SunPower will solicit residential customers in single family homes to sign up for a solar plus storage system. With no up-front cost to the customer, the provider will install the solar panels and battery system with inverter and other balance of system components. The solar system will be sized according to each prospective customer's profile and may vary by site.

In the customer economic model, i) the solar equipment and installation will be financed via a 20-year third-party provided lease product at no expected upfront cost to the homeowner, while ii) the storage equipment and installation will be purchased by Con Edison. Over the term of the customer contract, the customer would:

i) receive the benefits of solar generation and resiliency services without increasing their electric bill,
ii) make monthly lease payments over 20 years to the third party equity special purpose vehicle (SPV) for the SPV-owned solar system, and
iii) make monthly payments to Con Edison or SunPower for the resiliency services provided by the Con Edison-owned storage system.

To test the customer's willingness to pay for resiliency services, SunPower will use the results of customer segmentation analyses to create personalized solar proposals for prospective customers, including a presentation of i) how much money that household would be estimated to save by having only solar PV installed, ii) how much the customer would be charged for resiliency services provided by an energy storage appliance, and iii) how much money that household would be estimated to save after having solar PV plus storage installed. To test customer reception to different formulations of paying for resiliency services, SunPower plans to test three pricing frameworks: i) resiliency payment as a percentage of expected solar savings, ii) resiliency payment as a percentage of current electric utility bill, and iii) resiliency payment as a dollar value. Because different customers exhibit different profiles (e.g., level of existing load consumption, level of expected savings from solar), this methodology would provide Con Edison with findings on how to position resiliency payments to different types of customers, and what monetary values are ascribed to resiliency services by customers.

Con Edison and SunPower will work to determine a mutually agreeable way to operationalize the resiliency payments from the customer. The customers' total monthly solar plus storage energy bill will be either equivalent to or less than current bills, while they gain the benefit of solar power and enhanced reliability.

SunPower is expected to install 1.8MW of aggregated storage inverter power capacity, with an estimated 4.0MWh of energy storage aggregated utilizing residential customers. The homes will have a solar array connected with the battery system.

Phase II: Virtual Power Plant Integration into Con Edison Operations

Part of the customer installation process is the establishment of communications from the provider's Network Operations Center (NOC) to each customer's energy storage system. In this way, performance metrics of each individual system will be captured from the day it is placed in service. Phase II will establish communications (data transfer and VPP control) between Con Edison's systems and the SunPower / Sunverge platform's NOC. The timing of this phase is in sync with Con Edison's existing SCADA system upgrade, which must be completed prior to beginning work with the vendor. Once this link is established, the VPP can be operated to meet system needs, and performance can be tested to assess risk of entering capacity and energy markets. Con Edison will determine how assets in the VPP will be controlled (e.g. set priorities and business rules). SunPower, in conjunction with Sunverge, can either operate the VPP fleet for Con Edison, or provide Con Edison with active operational control.

In Phase II, Con Edison will also conduct shadow bill analysis to inform rate design for residential DER. The SunPower / Sunverge platform has been deployed in utility projects to assess and test rate design. For example, the 2500 R Midtown housing development project in the Sacramento Municipal Utility District's service territory incorporated the following two rate structure use cases:

i. Demand response for a critical peak pricing structure, where solar and battery power was dispatched during high price demand response events, and
ii. Peak load reduction for a time-of-use rate structure, where solar and battery power was dispatched during utility peak load periods during which consumers are subject to TOU rates.

Con Edison can use the asset base of DER resources to test how integrated solar and storage systems can help shape customer economics under different time-of-use or critical peak price rate structures.

Phase III: Market Participation

In Phase III, Con Edison expects to test the role of these VPP assets in the wholesale and/or distribution markets. Whether it be a Con Edison-NYISO transaction or one that involves an early version of the DSP, the Company expects to leverage the demonstration project to help understand the regulatory and market requirements to monetize distributed assets.

- Value of resiliency offered by battery

Pricing for Resiliency

It is Con Edison's hypothesis that some segment of customers will pay a premium for guaranteed, clean back up power in case of an outage. It is difficult to estimate today, how much customers are willing to pay for this service given the already high levels of reliability in our service territory. The demonstration project will allow us to test various price levels and payment structures that will be necessary to develop a commercial offering and to inform future rate design

5.2 INVESTMENTS

The total projected cost attributed to the demonstration project over the term is approximately $12M. The costs that will be incurred in the demonstration project include the energy storage system, balance of system components, installation and associated O&M services, fees for development and implementation of the program, operation of the Virtual Power Plant, and integration of the VPP into Con Edison's communication and control systems. Con Edison expects its costs for this demonstration to be recovered through the Monthly Adjustment Clause (MAC). Revenues from third party service providers, lenders, and customers that participate in the demonstration will be credited to ratepayers. The Company may propose incentive mechanisms as the Demonstration Project develops.

The residential solar systems deployed during the demo will be financed to the customer through a lease arrangement with SunPower by leveraging third party equity capital at no cost to Con Edison. The payments made by program participants for resiliency services, or backup power, will offset the total project cost to Con Edison.

5.3 RETURNS

Revenue to Con Edison for the duration of the trial comes from selling the firmed capacity captured by the VPP to the wholesale market, DR programs, or the DSP as well as a resiliency payment per unit. We value that capacity by using the forward curve for capacity starting at $20 per kW per month. Due to the high price of storage today, we will not generate profit on the sale of firmed capacity during the 2+ year term of the demonstration project. Should we generate profit during the course of the trial, those returns will be returned to the ratepayers.

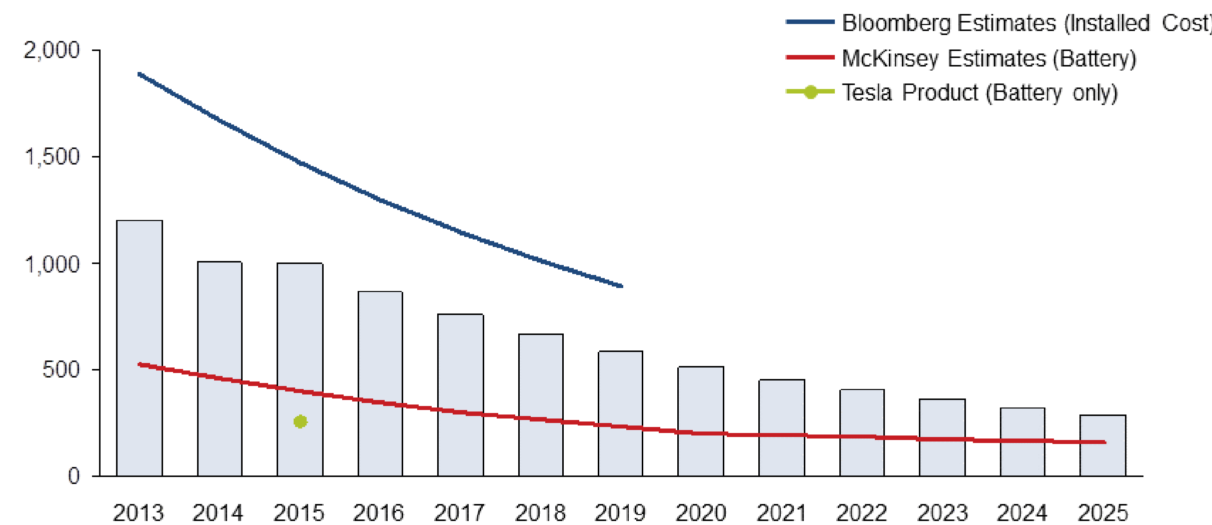
5.4 COST EFFECTIVENESS

By all estimates, the cost of battery storage is declining. Figure 5-1 shows our estimates relative to those by Bloomberg and McKinsey and the announced price from Tesla. As the price of storage come down, the value of capacity and resiliency are going up – there is a clearly a cross point in the near future. Our analysis suggests business model viability in

2021 based on the cost of storage relative to the value in the wholesale market alone. If you incorporate additional value from DR market participation and/or resiliency payments it could happen much earlier (Figure 5-2).

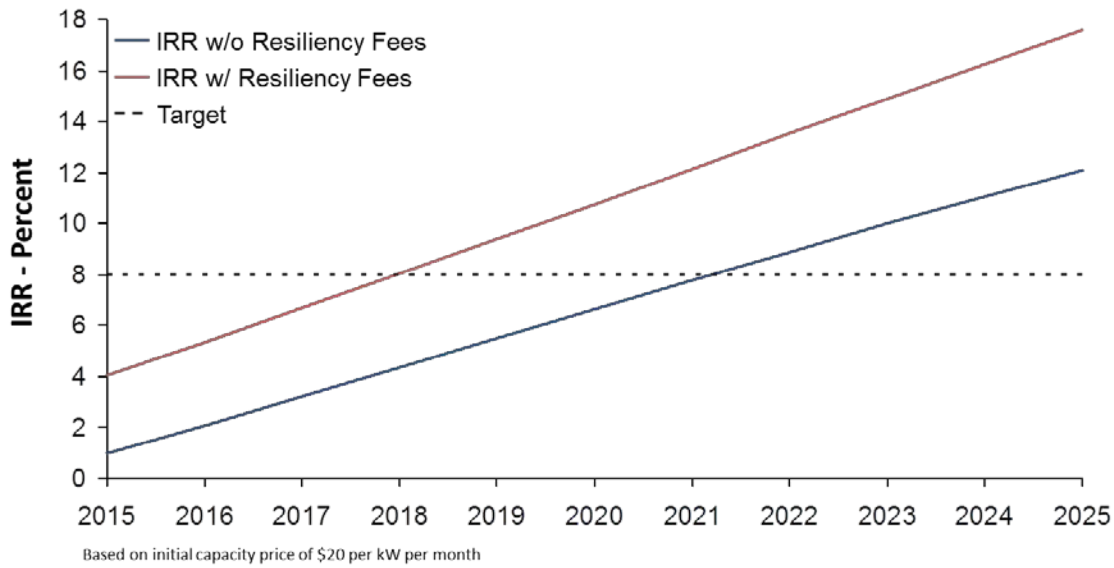
The reason to start now is to get the technology in place in terms of establishing a market for distribution level services. This provides the intelligence and control that would come at scale over time. These costs are currently embedded in the Sunpower storage solution and would then in future be spread over many more units – reducing cost and allowing more commodity solutions to enter the marketplace.

Figure 5-1. Cost Curve for Behind the Meter Batteries (Installed Cost, $kWh)



Source: Houlihan Lokey Strategic Consulting

Figure 5-2. IRR Based on Value of Firmed Capacity and Resiliency



Con Edison uses an “N-2” design criteria to minimize outages to high-rise buildings, transportation systems, and other critical loads (in contrast, radial systems are typically “N-1”). This N-2 (*i.e.*, second contingency) design criteria means that any two supply elements can be out-of-service and the remaining elements will be able to serve the peak load. This combination of network design and second contingency criteria provides Con Edison’s network customers with one of the highest levels of reliability in the nation. This combination also produces some potentially unique performance characteristics relative to traditional radial systems that constitute most of the electrical grid outside New York City. For example, the higher fault currents inherent in a secondary mesh design can impact the cost to interconnect generating units to the distribution network.

The secondary network is designed to mitigate the potential for unwanted back-feed during fault conditions on a feeder or simple low-load conditions on a part of the network. In this case, the network protector switch is designed to open and isolate the low-voltage grid from the primary feeder. The density of the Con Edison load can mitigate potential back-feed because the output of a generator can often (but not always) be consumed locally.

Con Edison is committed to developing capabilities to accept more injections. However, synchronous generators, like combined heat and power (“CHP”) that operate regularly, have more potential to cause back-feed issues. Consistent with reliability standards, Con Edison requires a detailed review of CHP units that plan to export power, and will require any resulting system modifications to be paid for by the customer installing the CHP unit. For smaller and more intermittent resources like rooftop solar energy, Con Edison can address many of the concerns through modifications to the relay settings on the network protectors. As REV enables standards, there are local pockets of strong growth, such as various neighborhoods of Brooklyn, Manhattan, and Queens. Such local growth continues to be a hallmark of the local economy, with each neighborhood having electricity needs that are different from other areas, and certainly different in many cases from overall system needs.

For all of these reasons, the Commission should provide additional flexibility for REV initiatives. For example, Con Edison, along with interested customers and third-party service providers, are currently expending significant resources to develop the BQDM alternatives. BQDM provides a unique opportunity to learn from efforts to deploy significant amounts of DER systems and these results should be used to inform future REV endeavors. As a result, the Companies recommend using experiences from BQDM and demonstration projects to tailor REV to meet the specific requirements of each utility as well as their respective customers and third-party service providers. Such flexibility for implementing REV will ultimately be more effective than blanket requirements and should be considered a guiding principle of REV.

Peak Reduction EIM

In its Track Two White Paper, Staff proposes an EIM to reduce peak demand by 14 percent over a five-year period, incorporating a target to reduce statewide peak demand by 545 MW per year, incremental to existing DER programs. The Companies are concerned that this EIM does not take into account existing customer needs, consequences of proposed solutions, and the ability and cost of achieving it. Further, the proposal could have unintended consequences such as stunting economic growth in Con Edison's service territories.

In proposing such an aggressive target, the Track Two White Paper assumes peak load reductions will benefit customers, but fails to estimate the costs that would be incurred to reach its stated goal. In fact, these aggressive peak reduction targets are unrealistic and unlikely to be cost-effective. For example, as explained in the Joint Utilities' Comments, Con Edison's

Demand Management Program that focusses on system peak reductions costs approximately $5 million per MW.[4] Extrapolating to the total 4,846 MW of peak reduction proposed in the Track Two White Paper, customers could be paying $24 billion over a five-year period for these resources.

The Companies are concerned that the costs of such a program could be even higher and that there may be little in the way of offsetting benefits. Wholesale market benefits may be hard to realize because of the current capacity surpluses throughout the State, as well as the wholesale market design and dynamics. In addition, the lack of coincidence between the statewide system peak and the Companies' local network peaks means that system peak reduction programs will provide little benefit for the local distribution system and can potentially increase local area peak demand. Of Con Edison's 82 networks, only 18 peak during the same hour as statewide system peak, with 35 networks peaking earlier and 29 networks peaking later. Networks where demand growth is projected to require infrastructure investments that could potentially be deferred or avoided with DER are primarily evening peaking and are not coincident with the system peak demand.

Focusing reduction goals on the system peak may be the wrong measure because it has the potential to increase the distribution network peak demand in areas that experience their peak demand at times other than the statewide system peak. For example, commercial customers who participate in DR programs tend to "pre-cool" their buildings in the period before they reduce demand. If demand reductions begin at 2:00 pm, commercial customers in a noon-peaking network may pre-cool their buildings at noon, increasing the peak of the network in which they are located. Similarly, the system experiences an increase in load called "snap back" in the

[4] This includes customer costs, implementation and administrative costs, and incentives as would be used in a Total Resource Cost Test ("TRCT").

Customer-side Solutions Pipeline Activities

Residential Energy Efficiency Program(s)

The Company has reviewed the existing residential energy efficiency programs offered by both NYSERDA and the Company. These programs tend to focus on measures which deliver kWh and heating fuel savings and are designed in a manner that does not correspond well with the specific objective of the BQDM program, which is to achieve load relief during hours of overload. With the greater flexibility enabled via the BQDM program, the Company is designing a residential program that will advance new opportunities in this important space that align with the needs of the BQDM program. The Company has been working with a firm with expertise in the residential segment to assist with designing a program and an outreach approach to enable the installation of measures at homes that will foster greater community engagement, provide customers will bill savings, create opportunities for the Company to learn from newer technologies such as Wi-Fi enabled devices, and, critically, provide load relief to the Company during the key hours of reliability need.

CHP and Alternative Solutions

The Company worked closely with NYSERDA's combined heat and power ("CHP") program administrators as well as the natural gas provider in the area, National Grid ("NG"), and its CHP team to investigate the potential for CHP development. The Company conducted an initial review of typical CHP system costs and benefits, based upon preliminary and incomplete data of very site specific projects, and found positive potential for CHP projects. Through that review it was also determined that the project lifecycle of a sizeable CHP deployment can easily span multiple years, making CHP a less viable solution given the BQDM program deadlines. As such, the Company made a decision to not pursue traditional CHP as a potential solution category within the BQDM portfolio. The initiative involving analysis of customer energy use patterns that was initially developed to identify viable potential candidates for new CHP system installations is now being used to inform analysis of viable alternative solutions such as fuel cells, as further discussed below.

New York City Housing Authority

The Company identified that publicly administered housing buildings within the BQDM Program Target Area account for over 46 MW of demand, including over 60 complexes and over 29,000 housing units. The Company worked with the New York City Housing Authority ("NYCHA") and a contracted partner to prepare a report identifying energy and demand savings opportunities in such facilities, and existing funding opportunities that may be available but may not as yet be fully leveraged.

The final report was completed during the second quarter and identified 26 potential load reduction measures, estimated peak demand reduction impacts for each measure, and the associated costs to implement each measure across the entire NYCHA portfolio in the BQDM Area. The suite of measures reflects a holistic approach, including common area and in-unit lighting, HVAC retrofits, ventilation and other electric systems maintenance and upgrades, building envelope improvements, and tenant and staff education programs. The report also discusses potential financing models and implementation considerations.

The Company has reviewed the report, analyzed the proposed measures, and is currently working jointly with NYCHA to identify which measures are cost effective and actionable within the BQDM Program timeframes. NYCHA may have specific buying approaches which may provide a vehicle to pursue some of the solutions identified, and there may also exist opportunities to pilot new solutions in conjunction with any already planned NYCHA capital projects. The Company plans to have a project scope completed, with an executable project developed, by the end of the third quarter 2015.

Innovative Distributed Generation-Fuel Cells

The Company continues to analyze the acquisition of resources, including fuel cells, such that the overall portfolio of solutions serves to meet the reliability needs in the targeted area during the entire period of overload. To provide additional assurance that the Company has sufficient resources to meet its reliability needs, while also being cognizant of potential resiliency benefits, the Company is investigating possible innovative solutions that would provide reliable load relief during the entire period of more than 12 hours of potential overload. In particular, the Company continues to study the viability of using efficient fuel cells that generate electricity through non-combustion chemical mechanisms, or other similar resources that are able to provide long periods of load relief efficiently and reliably, with minimal operational overhead. It is also important these resources can be built with minimal lead time while using a relatively small footprint in the land-constrained targeted area. As part of its analysis, the Company is investigating novel business arrangements that would incent adoption of such technologies.

Queens Resiliency Microgrid

The Company initiated exploration of opportunities with a large customer in Queens for load relief and other benefits. Discussions have included the potential for installation of a natural gas behind-the-meter generator to both power a community micro-grid and for potential use as a demand response resource. The Company also explored other possibilities, such as an on-site solar installation and the use of the location as an emergency staging area. This is a complex potential project and conversations with the customer and other stakeholders are on-going.

To additionally minimize potential operational risks to the customer, the project scope has been refined to focus on using available space to site a natural gas generator on the customer property, but connecting it as a direct-grid resource (rather than integrally with the customer) with dual functionality for BQDM peak shaving as well as micro-grid resiliency. The Company has engaged with a third party, who has a maintenance and operations agreement with the customer, to assist with the project. In addition to an established relationship with the customer, the third party understands the complexity of the site and has the requisite expertise to successfully execute the planned project. A full proposal is expected during the third quarter of 2015.

Opportunities with City Agencies

In addition to work with NYCHA described above, the Company is working with City agencies to identify a range of viable demand reduction solutions. Preliminary analysis suggests more than 5 MW of opportunities. The Company is investigating feasibility, deployment strategies and potential to leverage City agency funding opportunities for cooperation and constructive engagement in obtaining cost-effective load relief.

Commercial Refrigeration

The Company identified inefficient commercial refrigeration as a viable segment for obtaining load relief based on both the current inefficiencies in such equipment in the BQDM area as well as the potential load relief that can be achieved throughout the entire forecasted overload period. Refrigeration typically runs 24 hours, regardless of business hours, making it an especially attractive target for efficiency upgrades that will lower demand for energy across all hours. The Company is developing an RFP, with the expectation of participation by some firms who submitted responses to the RFI as well as others, to solicit efficiency upgrades and controls for customer sites where there is a significant refrigeration load and anticipates conducting a solicitation in the second half of 2015.

Request for Information ("RFI")

On July 15, 2014 the Company issued a broad RFI, which closed on September 15, 2014 and drew 78 proposals. An RFI, by its nature, allows for broader responses than an RFP but requires a greater level of scrutiny and validation of the information provided. The proposals presented via the RFI have provided the Company with valuable insight into potential solutions, including indicative pricing, operational needs and reliability, potential environmental impacts and, in a few cases, potential customer partners. As the quality of the RFI responses varied significantly, gaining confidence and insight has taken considerable work. Developing a comparative analysis among the solutions presented has been a complex undertaking.[9]

The Company recognizes that the solutions presented in the RFI responses do not represent the complete universe of potential solutions for the BQDM Program. The Company has remained open to other solutions, either via solution providers or customers, and has received additional responses that are currently being evaluated. The Company will continue to use both RFI submissions and other available solutions to inform purchasing actions for the BQDM Program.

Distributed Energy Resource Evaluation Tool

The Company has built a tool, using both internal and external expertise, to evaluate on a comparable basis a diverse range of distributed energy resources ("DER") while accounting for the duration of their availability (e.g., four-hour battery, eight-plus--hour energy efficiency, two-hour demand response), their risk, their maturity, their flexibility and their ability to otherwise meet the needs in the BQDM Area. The Company also developed a portfolio approach to identify a mix of resources that can meet the reliability need over the 12 hours on a design peak day. Using the evaluation tool, the Company is evaluating DER solutions using a combination of multiple criteria. Con Edison is using the tool to inform some of the solutions that the Company is considering for inclusion in the BQDM portfolio. The Company intends to supplement results from the evaluation with additional qualitative assessments of the

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[9] The Company's efforts in this regard are being conducted in a manner to provide the broadest benefit to future efforts by the Company in other targeted projects and to contribute to the Commission's REV initiative.

Measurement & Verification Pilot

The Company has undertaken significant efforts to enhance customer energy data collection and metering services to better understand the customer energy usage patterns in the MFEE and SBDI segments. An analysis of the data is anticipated to provide more accurate estimates of the hourly load relief amounts for the SBDI and MFEE programs. The Company expects to revise current best estimates of the hourly load relief after the project and related data analysis is completed by the end of the fourth quarter of this year.

In February 2015, the Company began a several month process of engaging with various BQDM and internal stakeholders to identify key parameters of interest and define the scope of this expanded data collection and metering effort. In addition to the metering and data collection for this effort, further tasks were identified that would be of use to Con Edison. The first two such items were a dashboard to display real-time program-verified and forecasted contributions to the BDQM program, and a data mining effort of information previously collected from other measurement and verification efforts and those planned for this summer, to develop typical load and savings profiles. Additionally, through engagement with the stakeholders, the Company is looking to develop a framework that has the additional potential to be used for estimating savings forecasts or building models for future targeted areas.

Demand Management Tracking System

The Company is developing a new Demand Management Tracking System ("DMTS") with capabilities to manage customer relationships, project management activities and to serve as the system of record for the Company's demand management programs. This system is being utilized to process, monitor and store project information, in addition to leads, and for the purposes of program reporting. DMTS is currently being used for the Demand Management Program and is expected to begin to support the BQDM Program in August, with an ability to extend to other programs in the future. DMTS is expected to become the primary source of information for internal and external reporting, including regulatory reporting, once the project has been fully implemented.

For the BQDM program, DMTS will begin by including details related to the SBDI and MFEE projects. Project details are expected to include load relief quantities which will be used to validate payments to contractors.

3.2 Utility-side Solutions

Distributed Energy Storage System

The Distributed Energy Storage System ("DESS") will provide Con Edison with 12 MWh of stored energy and can be configured to deliver this power at 1 MW for 12 hours or 2 MW for 6 hours. The DESS RFP was competitively issued via the Company's Oracle System in September 2014 and nine vendor proposals were received in November 2014.

Following an in-depth review, three shortlisted vendors were invited to present their solutions to the Company early in January 2015. Following the vendor presentations, Con Edison completed the technical evaluation of the proposals by February 2015. The results of the technical evaluation were submitted to the Company's purchasing department for a financial evaluation of all solutions that technically met the requirements of the RFP.

Con Edison completed its financial review, following a round of final and best offers, in May 2015. Con Edison is pursuing contract negotiations with shortlisted vendors with a target date for the contract award of August 2015.

Distributed Generation (DC-Link)

Con Edison is investigating alternative, cost-effective methods of load reduction utilizing the latest in distributed generation technologies. An RFP is under development to investigate additional usage of battery storage, fuel cells, low emission gas driven synchronous generation etc. at both Company and customer locations (connected directly to the Company.)

As part of this RFP Con Edison will assess alternative technologies which could be combined with the deployment of the Company's existing Mobile Power Interface ("MPI" or "DC Link") for load reduction purposes. In addition to providing area load support, the technologies will be examined to test their ability to provide a micro-grid type solution that could support local loads in times of emergency, thus adding resiliency to the system.

The RFP is targeted for release in the third quarter of 2015 with an anticipated in-service date of June, 2017.

Voltage Optimization

The purpose of the project is to optimize the voltage on the 27kV primary system, including the 4kV overhead system, by implementing enhanced, efficient voltage control. The Company estimates that approximately 7 MW of demand reduction can be achieved. A pilot program will commence in 2015, and if successful, the project is anticipated to enable 3 MW of load relief for summer 2016 and an additional 4 MW of load relief for summer 2017.

For the 2015 pilot, voltage monitoring equipment has been installed in 20 locations in the network system and the 4kV system. Phase balancing across the three phases has commenced as a result of the data from the voltage monitoring equipment. Phase balancing is the process of shifting load from one phase that has higher connected load to another phase that has lower connected load. The goal is to have all three phases equally loaded in order to maximize voltage optimization levels. New tap changing controllers have been installed in the 4kV unit substations. With the installation of the controllers complete, the Company anticipates that the voltage optimization pilot will commence in the third quarter. The initial plan is to optimize the voltage by 1.2% at the Richmond Hill 4kV Unit Substation Grid.

Con Edison has selected a vendor for performing the Measurement, Verification and Evaluation ("MV&E") protocols for the validation of projected energy savings from the voltage optimization measures. A MV&E plan will be developed in the third quarter.

Utility Sided PV Pilot

The Photo-Voltaic ("PV") project is in the pre-RFP early stages. It attempts to investigate utility-operated large PV located on Company owned premises at the Brownsville No.1 and Brownsville No.2 substations as well as at the Cleveland Street work out location. Additionally, the project team is investigating the possibility of generating an aggregate of 1 MW by means of PV systems installed on the grounds of 10 unit substations and other buildings located in the BQDM Area.

Challenges include engaging and incenting the large scale PV providers, determining the ownership and operation of the systems, and developing operating protocols. The Company, while recognizing the many challenges involved, has set an in-service target of June, 2017.

Utility Sited Fuel Cell

Similar to storage solutions, the Company believes there are many benefits to using fuel cell technology on the Company's system and, through an RFP process, the Company will attempt to analyze the potential for this technology, ultimately identifying applications having the greatest potential value in meeting reliability needs. The RFP solicits solutions of up to 1 MW in size at a Company owned location within the BQDM Area.

The Fuel Cell RFP was competitively issued in June 2015 and the solicitation is expected to close on July 17, 2015. Following the RFP solicitation, the Company will commence analysis of the proposals. The project has an anticipated in-service date of June, 2017.

Challenge:

Based on Con Edison's January 5, 2015 Load Forecast, Plymouth Street Area Substation ("PS Station") is projected to be in excess of its design capability by 23 Megawatts (MWs)[1] by the summer of 2016 and by 38 MWs by 2017. Current projects are in progress to address these overloads. These projects include the following:

- For 2016, Con Edison is planning on replacing limiting 27 kV bus and 138 kV sub-transmission feeder sections.
- For 2017, Con Edison is planning on installing transformer cooling on all five area station transformers.

However, even after the implementation of the traditional solutions described above for 2016 and 2017, as shown on Table 1, the Company projects that the Plymouth Street substation will be in excess of its design capability by 4 MW[2] starting in the summer of 2018, with an overload of 24MW by the summer of 2025.

Table 1:

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Plymouth Street											
Borough Hall	315	343	358	365	368	369	370	372	374	375	385
Radial	28	28	28	28	28	28	28	28	28	28	28
Total Load	343	371	386	393	396	397	398	400	402	403	413
Total Adjustments	-2	-2	-2	-3	-3	-3	-3	-3	-3	-3	-3
Net Load	**341**	**369**	**384**	**390**	**393**	**394**	**395**	**397**	**399**	**400**	**410**
Projected Deficiency				**-4**	**-7**	**-8**	**-9**	**-11**	**-13**	**-14**	**-24**
Transformer Capability	**346**	**380**	**417**								
138kV Feeder Capability	**346**	**385**									
Percentage Overloads	**99%**	**97%**	**100%**	**101%**	**102%**	**102%**	**103%**	**103%**	**104%**	**104%**	**106%**
		Note 1	***Note 2***								

2016 Note 1: Replace limiting 27kV bus and limiting 138kV sub-transmission feeder sections.
2017 Note 2: Install transformer cooling for the 5 area transformers.

[1] Several new customer buildings and building expansions are scheduled to be completed by 2015.
[2] Con Edison planning departments define an overload to be any substation rounded to 101%. The calculation for overload is net load (per given year) divided by the most limiting capability (transformer or feeder capability) to be greater than 101% (rounded value). For example, Con Edison identifies an overload in 2018 because the net load of 390 MWs divided by 385 MWs (most limiting capability) is greater than or equal to 101%. If there was a reduction of the net load by 4 MWs, then new net load is 386 MWs divided by 385 MWS is less than 101%. Any reduction greater than 4 MWs will be less than 101%, making the 4 MW load reduction the minimum value to reduce load by to potentially resolve the projected overloads.

Alternatives:

In order to resolve the projected overloads at Plymouth Street starting in 2018, the Company has identified three alternatives:

Option 1: Utilize non-wires alternative[3] projects, similar to the Brooklyn Queens Demand Management ("BQDM") Program, to resolve the projected overloads.

Option 2: Build a new area substation and expand the Gowanus substation to supply the new area station.

Option 3: Replace or install additional cooling on five (5) Farragut 345 / 138kV transformers to increase its supply capability to Plymouth Street and replace multiple sub-transmission feeder sections to handle the increased supply from Farragut.

Option 1 is in line with "Reforming the Energy Vision" (REV) for a non-wires solution. This option will utilize customer-side solutions and non-traditional utility-side solutions, similar to the BQDM Program. In order to utilize a customer-side or non-traditional utility-side solution, that will need to provide load relief during the projected exposure hours (area under the load curve), similar to the BQDM program.

The hours of potential overload are calculated from a typical daily peak load curve of the Borough Hall network, which projects eight hour duration overloads in 2018 and that duration increases to 11 hours by 2025. Con Edison expects that the customer-side solutions and the non-traditional utility side solutions could be required for up to two (2) days per given year. The total projected hours of overload in Borough Hall network, therefore, is 16 hours in 2018 and increases to 22 hours by 2025. Please refer to Table 2 for the projected hours of exposure to this overload and Figure 2 for the projected load curves, based on historical data from the Borough Hall network.

[3] Non-wires alternatives include customer side solutions and non-traditional utility side solutions. These types of solutions were identified as some of the solutions for the BQDM Portfolio of projects.

Challenge:

Based on Con Edison's January 5, 2015 Load Forecast, two distinct elements in the Bensonhurst Load Area ("BLA"), the Bensonhurst sub-transmission feeders and the Bensonhurst Substation No. 2 are projected to be in excess of their design capabilities by 2021 and 2022, respectively. The sub-transmission feeders supply Bensonhurst Substation No. 1 and No. 2.

Bensonhurst sub-transmission feeders:

The feeders are projected to exceed their design capability by 5MW[1] by the summer of 2021 and 45 MW by summer of 2025, which represents 101% and 106% feeder overloads, respectively.

Bensonhurst Area Substation No. 2:

Substation No. 1 is not projected to exceed its design capability as shown below in Table 1. However, Substation No.2 is projected to exceed its design capability by 2MW in the summer of 2022 and 19 MW in the summer of 2025,[2] which represents 101% and 105% substation overloads, respectively.

Table 1:

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Bensonhurst No. 1											
Ocean Parkway	176	178	179	182	184	187	188	190	191	192	194
Sheepshead Bay	176	177	177	180	183	186	188	191	193	195	197
Radial Load	68	68	68	68	68	68	68	68	68	68	68
Total Load	420	423	424	430	435	441	444	449	452	455	459
Total Adjustments	-1	-2	-3	-3	-3	-4	-4	-2	-2	-2	-1
Net Load	**419**	**421**	**421**	**427**	**432**	**437**	**440**	**447**	**450**	**453**	**458**
Station Capability	**505**										
Bensonhurst No. 2											
Flatbush	285	289	292	294	297	301	304	308	313	315	319
Brighton Beach	104	105	106	107	108	109	110	111	112	113	114
Radial	9	9	9	9	9	9	9	9	9	9	9
Total Load	398	403	407	410	414	419	423	428	434	437	442
Total Adjustments	-1	-2	-2	-2	-2	-1	-2	-2	-1	0	1
Net Load	**397**	**401**	**405**	**408**	**412**	**418**	**421**	**426**	**433**	**437**	**443**
Capability	**414**										
Capability at 27.6 kV	**423**										
% Station Overloads	**94%**	**95%**	**96%**	**96%**	**97%**	**99%**	**100%**	**101%**	**102%**	**103%**	**105%**
Bensonhurst Nos. 1 & 2											
Net Forecasted Load	**816**	**822**	**826**	**835**	**844**	**855**	**861**	**873**	**883**	**890**	**901**
Net Load	816	822	826	835	844	855	861	873	883	890	901
Feeder Capability	852										

[1] Con Edison defines an overload to be any substation asset loading rounded to 101%. The calculation for overload is net load (per given year) divided by the most limiting capability (transformer or feeder) to be equal or greater than 101% (rounded value).

[2] See fn. 1 above for how the overload is calculated.

Alternatives:

In order to resolve the projected overloads in the BLA (138kV feeders and Station No.2 overloads) starting in 2021, the Company has identified three (3) alternatives:

Option 1: Utilize Non-Wires Alternative[3] (NWA) projects, similar to those included in the Brooklyn Queens Demand Management ("BQDM") Program, to resolve the projected overloads.

Option 2: Add additional 138 kV feeder capability by 2021 and install a fifth transformer at Bensonhurst No. 2 by 2022 to increase both the sub-transmission and station capability for the BLA.

Option 3: Build a new area substation and expand the Gowanus substation to supply the new area substation with a subsequent load transfer out of Bensonhurst No.2 area substation.

Option 1 is consistent with "Reforming the Energy Vision" (REV) goals to investigate non-wires alternatives to traditional infrastructure solutions. This option will utilize customer-side solutions and non-traditional utility-side solutions, similar to the BQDM Program. Note overloads exist at two distinct elements in the BLA: sub-transmission feeders supplying Bensonhurst No. 1 and No. 2 *and* the station capability for Bensonhurst No. 2 Substation.

The alternate solutions are planned to remedy the overloads on these two specific elements. The required MWs (per year) to be provided by alternate solutions for each respective element are shown in Table 2. The following table, Table 3, describes how the NWA projects are incorporated into the planning documents. The overall % loading for the feeder capability and Substation No. 2 capability after the NWA application is at 100% up to 2025. Any additional MW gain from the NWA may result in further deferral of traditional infrastructure build.

Table 2:

	2021	2022	2023	2024	2025
MWs required to from NWA Solutions for the Bensonhurst Load Pocket	(in MWs)				
Total NWA MW Need for sub-transmission feeders support [A]	5	17	27	34	45
Amount of NWA MW Need that ***must*** support Bensonhurst No. 2 [B]		-2	-9	-13	-19
NWA MW Need from either Bensonhurst No. 1 ***or*** Bensonhurst No. 2 [C]	5	15	18	21	26

Note A: Total MWs to mitigate the overload conditions at the Bensonhurst Load Area.

Note B: Amount of MWs that ***must*** be achieved from Bensonhurst No. 2 Networks (Flatbush or Brighton Beach).

Note C: The difference in MWs where NWA solutions can be achieved from either Bensonhurst No. 1 ***or*** No. 2.

[3] Non-wires alternatives include customer side solutions and non-traditional utility side solutions. These types of solutions were identified as some of the solutions for the BQDM portfolio of projects.

distribution facilities have premises wiring systems that are governed by both the National Electrical Code ("NEC"), as adopted by the local jurisdictional authority, and the interconnected utility's own electric service rules for the safety of users from the hazards of electricity.

The Joint Utilities support community microgrids as an additionally permissible microgrid model provided that the following requirements[11] are met to ensure reliable service:

1) The electric distribution facilities of community microgrids should be utility-owned and operated under state and local jurisdiction.[12] Utilities, which are already regulated, are best suited to own and operate such distribution facilities that connect the participants of a community microgrid. As the Commission stated in the REV Track One Policy Order, "where a microgrid serves electricity to separate customer accounts and is not otherwise exempt under law, it will be an electric corporation under the Public Service Law."[13] Given that electric distribution facilities have the potential to harm the public if improperly operated or maintained, such facilities must adhere to safety and reliability codes and standards with appropriate oversight from the Commission.[14] The community microgrid's electric distribution facilities, including emergency response and restoration related to such distribution facilities, should be regulated accordingly and it is in the best interest of the public that a utility have controlling ownership.

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[11] Consumer protection requirements are discussed in Part VI herein.

[12] In the alternative, should the Commission not adopt a model for community microgrids whereby the utilities shall own all supporting electric distribution facilities between loads within a microgrid, at a minimum all such facilities located in the public right-of-way should be exclusively utility-owned and operated to ensure adherence to safety and reliability requirements that may otherwise be compromised when a public right-of-way is shared with other franchisees or licensees distributing energy.

[13] REV Track One Policy Order, p. 111.

[14] *See* ANSI/IEEE C2, NESC, *supra* note 10.

2) DER interconnection equipment, protective systems and microgrid controllers at the point of common coupling ("PCC") to the utility are to be designed and operated according to utility requirements and specifications as well as to applicable codes and industry standards. These assets may be owned and operated by customers or third parties.

3) The utility must be able to control the isolation of a community microgrid at each PCC if the utility is to be held accountable for the safety and reliability of service within such a microgrid. This isolation can be achieved by visible break disconnect switches, interrupting devices or a combination thereof and can be manually or remotely operated by the utility. DER and QFs, if any, may be permitted to automatically trip a microgrid PCC isolation device in order to island the community microgrid; however, they should be blocked from closing such a device until authorized to do so by the interconnecting utility. The control scheme that will disconnect and reconnect the community microgrid from the utility system must be reviewed and approved by the utility through an interconnection study (and subsequently memorialized in an interconnection agreement among the parties) and may be subject to witness testing and/or periodic testing as necessary. Other scenarios that may be permitted will each have their own complexities. As such, each community microgrid will require that specific protocols be developed to ensure that customer safety and the overall electric power system ("EPS") safety and reliability are not in any way compromised.

III. ENSURING THAT MICROGRID CUSTOMERS RECEIVE RELIABLE SERVICE AT JUST AND REASONABLE RATES

By way of overall guidance, the Commission directed that its REV policy toward microgrids will be centered on five attributes,[15] including the "obligation to provide reliable power at just and reasonable rates within the microgrid."[16] In reviewing the acknowledged complexity of microgrid issues,[17] the Commission determined that "[w]here a microgrid serves electricity to separate customer accounts and is not otherwise exempt under law, it will be an electric corporation under the Public Service Law."[18] The Commission is seeking responses to how microgrid customers may be ensured of receiving reliable service at just and reasonable rates. The question also implicates any requirements to govern the interactions between and among the DER owners, the interconnected utility, and the customers.

There are a number of scenarios that must be examined in the course of developing the appropriate regulatory oversight to ensure that community microgrid customers receive reliable service at just and reasonable rates. Included in these scenarios are whether the community microgrid is developed to provide basic utility delivery service or value-added service, and whether the community microgrid is operating in grid-connected or island mode.

When a community microgrid is operating in grid-connected mode, the Joint Utilities suggest that the most effective means to provide regulatory safeguards, including the fundamentals of reliable service, is utility ownership and operation of electric distribution

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[15] The other attributes are the ability to optimize system efficiency within the microgrid and advance REV objectives such as integration of clean distributed generation and addressing grid constraints, interconnection with the larger utility system based on a DSP market, resilience and ability to island during system outage, and consumer protections for residential customers as required by the Home Energy Fair Practices Act. *See* REV Track One Policy Order, at p. 112.

[16] *Id*.

[17] *Id*.

[18] *Id*., at p. 111.

facilities within the community microgrid, as discussed elsewhere in these comments. Such an approach would provide for seamless continuity of the utilities' existing obligation to provide reliable service.

Particularly with respect to reliable service, community microgrid distribution facilities owned and operated by utilities would be required to provide reliable service without any change to law.[19] It is already the business of utilities to provide reliable service. The Commission determines the rates that utilities/electric corporations are allowed to charge customers to ensure that such rates are just and reasonable.[20] Moreover, as described above, utility adherence to codes and industry standards further supports the provision of reliable service. The guiding principles set forth in IEEE Standard 1547.4-2011 provide that "[i]t is expected that when a distributed resource is operating in parallel with a utility system, the power quality of the area electric power system (EPS) as seen by all other customers connected to the same portion of area EPS will not be diminished." IEEE Standard 1547.4-2011 further provides that "[i]t should be expected that in cases in which an area EPS operator contemplates the establishment of a planned intentional island on a portion of its system with one or more distributed resources that the area EPS operator will desire to provide the same level of power quality as mandated by tariff or regulatory guidelines."[21]

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[19] Regardless of the type of microgrid, the utility must approve the interconnection of the microgrid to the utility's electric distribution system to insure safety and reliability for other customers served by the electric power system and no diminution in the level of service to the utility's other customers as a result of the interconnection of the microgrid.

[20] *See* Public Service Law ("PSL") Section 65.

[21] A distinction can be made between a "planned intentional island" and "unplanned intentional island" – both distinct from an unintentional island. Under IEEE Standard 1547.4 -2011, Section 4.4.2, "A transition-to-island mode can be a result of scheduled or unscheduled events. Scheduled transitions are intentional events for which the time and duration of the planned island are agreed upon by all parties involved. Unscheduled transitions are inadvertent events that are typically initiated by loss of area EPS or equipment failure, and the DR island system may be automatically sectionalized from the area EPS by protective equipment."

When a community microgrid is operating in a planned island mode, in order for the community microgrid system to reliably deliver power the reliability design requirements of the community microgrid should be agreed to by the microgrid owner, on behalf of its members, and the electric utility, as the electric distribution facility owner. The reliability design requirements should be appropriately documented in the form of an agreement between the parties.[22] Additionally, when a campus or facility microgrid is owned by customers or third parties, the responsibility for providing reliable service must be a contractual obligation between those customers or the third party in accordance with reliability standards promulgated by New York State.[23]

Utility ownership and operation of electric distribution facilities within a community microgrid may require the development of a new tariff structure to address the provision of just and reasonable rates. Just and reasonable rates must take into consideration the benefits the community microgrid provides to the electric grid as well as the costs the community microgrid places on the electric grid to ensure there is no cross-subsidization of such benefits and costs. This is anticipated to be addressed in the ratemaking design of REV Track Two.

IV. ENSURING THAT MICROGRID/UTILITY IS ADVANCING THE OBJECTIVES OF REV

As described above, among the beneficial attributes of a microgrid identified by the Commission in the REV Track One Policy Order is "resiliency and ability to island in the event of a system outage."[24] The Joint Utilities agree that the utilities' role with respect to microgrids is critical to advancing this REV objective. Indeed, in considering microgrids, the Commission

[22] Such agreements may also require Commission approval.
[23] *See* NERC Standard FAC-001-1, Facility Connection Requirements.
[24] REV Track One Order, p. 112.

has already recognized the utilities' key role in the REV vision of microgrids: "Because a microgrid can effectively act as a resource in a DSP market, the role of utilities in microgrids is closely tied to the issue of utility engagement in DERs."[25]

As noted above, utility ownership and operation of electric distribution facilities within a community microgrid will facilitate the development of such microgrids while at the same time meeting the REV objective of system reliability and resiliency.[26] In this role, utilities can foster the deployment of DER where needed most to benefit the electric grid. Moreover, in most situations, consistent with REV goals,[27] third parties will own DER. As one of the resilience opportunities cited in the REV Track One Policy Order, the Commission states "[a] less centralized and more automated electric system, which may include microgrids, will have greater operational visibility, and ability to isolate circuit faults, resulting in reduced damage and improved recovery times following weather events or other causes."[28] As the DSP, the utilities will be able to "foster broad market activity…by enabling active customer and third party engagement…"[29] As the Commission described the utility/DSP can be the "market enabler" where "[t]he market must also support alternative supply models such as…microgrids…"[30]

Accordingly, the utilities should be integral to the design and construction of microgrids, whether the microgrid is customer-driven or utility-driven. Utilities can do this through their understanding of their own EPS designs and enhanced knowledge of resource and load diversity among a group of customers. Moreover, with the utilities' ability to identify a system need, design a microgrid solution, and engage the market for implementation, utility-driven microgrids

[25] REV Track One Order, p. 111.
[26] REV Proceeding, Order Instituting Proceeding (issued April 25, 2014), p. 2.
[27] *Id.*
[28] REV Track One Policy Order, p. 23.
[29] REV Track One Policy Order, p. 31.
[30] REV Track One Policy Order, p. 34.

can advance REV. The Joint Utilities will also be able to build upon lessons learned from successful microgrids and demonstration projects that can test microgrid innovation. Utilities are best positioned to engage in, and analyze, demonstration projects[31] with new technologies, markets, business models, and customer engagement on a scalable basis. The utilities are also current participants in the various code making and IEEE industry standard committees evaluating applicable engineering for microgrids[32] and, as a result of this engagement, will be in the best position to move forward with appropriate planning and design.

An additional critical component of REV should be addressed. The Commission, in its recognition of the exploratory and iterative nature of REV, has emphasized the importance of demonstration projects to test REV concepts. Here, in particular, with respect to the issue of community microgrids, New York State, through the establishment of NY Prize, has begun the process of learning more about the sound development of community microgrids for use in broader applications. Thus, the Joint Utilities urge that development of the REV microgrid proposals recognize the importance of being informed by these initiatives.

V. THE RELATIONSHIP BETWEEN THE OUTCOMES PRODUCED BY THE MICROGRID AND THE SYSTEM-WIDE OUTCOMES FOR WHICH THE DISTRIBUTED SYSTEM PLATFORM/UTILITIES MAY BE HELD ACCOUNTABLE

It is difficult and premature at this stage of the REV proceeding to say what the relationship between microgrids and the system will be, for which the DSP may be held accountable. The Joint Utilities certainly believe that it is in the best interest of customers to

[31] For example, National Grid is currently engaged in the Potsdam community microgrid concept study undertaken pursuant to NYSERDA PON 2715.

[32] The IEEE Standards Coordinating Committee 21 IEEE 1547.4 Guide for Design, Operation, and Integration of Distributed Resource Island Systems with Electric Power System, NFPA 70 National Electrical Code Committee (Code-making Panels 4 and 13); and ANSI C2 National Electrical Safety Code Committee.

align the objectives of microgrids with the objectives of the EPS of utilities and for the utilities to own and operate the electric distribution facilities of community microgrids.

The outcomes produced by microgrids should be counted or considered as part of the system-wide outcomes for which the DSP/utility may be held accountable based on the role of the DSP/utility, including ownership and operation of the electric distribution facilities for community microgrids and the interconnection of microgrids.

VI. APPLICABILITY OF PUBLIC SERVICE LAW ARTICLE 2 (HEFPA) AND SUBMETERING REGULATIONS TO MICROGRIDS SERVING RESIDENTIAL CUSTOMERS

The customer protections afforded to all customers through Article 2 of the Public Service Law ("PSL"), 16 NYCRR Part 11 ("HEFPA"), 16 NYCRR Part 96 ("Submetering Rules"), and to protections to non-residential customers through 16 NYCRR Part 13 ("Non-residential Rules") serve important needs and must be applied to utility customers and microgrid participants in any type of microgrid.

The Joint Utilities anticipate that they can play a vital role in the development of community microgrids and will continue to comply with the PSL, HEFPA, and the Non-residential Rules, as they currently do for all customers to the extent they continue to have a direct relationship with the end-users of the electricity service. In the alternative, to the extent a third party is responsible for billing and/or terminating service to end-users, such entities should similarly be responsible for complying with the PSL, HEFPA, and the Non-residential Rules so that customers continue to be provided with comprehensive protections in areas such as application for services and termination of service. Entities considering the various microgrid arrangements must factor these critical customer protections and associated operational needs into their business models.

If the microgrid arrangement involves utility master-metering with submetering, the Commission's submetering regulations at 16 NYCRR Part 96 would require the submeterer to comply with HEFPA. In other words, to the extent that there is any residential submetering within a microgrid, the submeterer must comply with all aspects of Part 96.

VII. CONCLUSION

For the foregoing reasons, the Joint Utilities recommend that it is in the public interest in terms of reliability, resiliency and sound regulatory policy that utilities design, own, operate and maintain the electric distribution facilities within community microgrids. The Joint Utilities appreciate this opportunity to provide initial comments, particularly in regard to the emerging issues associated with community microgrids, and look forward to working with Department of Public Service Staff and other stakeholders as proposals are developed on microgrid configurations and appropriate regulatory oversight.

Date: May 1, 2015

NIAGARA MOHAWK POWER CORPORATION d/b/a NATIONAL GRID
By: */s/ Janet M. Audunson*

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CENTRAL HUDSON GAS AND ELECTRIC CORPORATION
By: */s/ Michael Mosher*
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CONSOLIDATED EDISON COMPANY OF NEW YORK, INC. and ORANGE AND ROCKLAND UTILITIES, INC.
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Susan Vercheak*
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NEW YORK STATE ELECTRIC & GAS CORPORATION and ROCHESTER GAS AND ELECTRIC CORPORATION
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Email: mark_marini@rge.com

* Admitted in New Jersey only

ATTACHMENT E
Communications between Con Edison and Pareto Energy
Related to Pareto Energy' Four and One Half Year Failed Effort to
Standardize the Interconnection Approval Process
for a Power Electronics Platform and
Fund a Win-Win Two-Sided Microgrid Platform Business Model
For CHP Owners and Con Edison Ratepayers and Shareholders

From: Sherri Sklar [mailto:sherri.sklar@campusgreenup.com]
Sent: Friday, March 25, 2011 12:46 PM
To: Leighton, Allison ; Jolly, Margarett L.
Cc: Monty Graham; David De Armas; Matthew Fairy; alan.mcdonnell
Subject: Thank You and Next Steps

Allison and Margarett,

Thank you so much for putting together all the right people from ConEdison to talk with us about our work with NYU Polytechnic University and their desire to implement a microgrid. It was great to meet with you both, David, David, and Karen. I would love to send the others a copy of this email but didn't have their contact information; Allison, if you could send that to me I would be so appreciative.

So we're all on the same page, I thought I'd summarize our next steps together. Please let me know if I've missed anything or if you'd like to change what I've written here:

a) ConEd Energy Services needs to see the 1-line diagram from us

b) Before we can provide that, we will need the following:

- We would very much appreciate an email from Margarett stating that ConEd had this meeting with us, and are very interested in taking the next steps in support of NYU-Polytechnic University's desire to implement a microgrid on campus. This will give NYU Polytechnic University the confidence that ConEd is working with us toward mutually beneficial goals with this project.

- Could someone in your group provide to us, as step one, a 1-line diagram of the NYU Polytechnic Brooklyn campus--please send that to my email, but address your letter with this diagram to: Mr.George Zulick, Director of Facilities, NYU-Polytechnic University. Let me know if you need the exact address for George. We think that NYU Poly should be in possession of this letter for their own files.

c) Karen Bruce wants to get the 3G Systems of the Future Group together with us to discuss our microgrid technology and solutions. Allison, should I reach out to Karen directly or should we ask you to set that meeting up? We should try to schedule that meeting as soon as possible, since it has some implications for how we approach the city with our microgrid technology.

Thanks so much again and we look forward to taking these next steps together!

Best,Sherri
Sherri Sklar
Co-founder, Campus GreenUp
646-262-8700
sherri.sklar@campusgreenup.com
www.campusgreenup.com

From: Leighton, Allison [mailto:LEIGHTONA@coned.com]
Sent: Friday, March 25, 2011 3:52 PM
To: Sherri Sklar; Jolly, Margarett L.
Cc: Monty Graham; David De Armas; Matthew Fairy; alan.mcdonnell; Pearce, David; Logsdon, David R; Bruce, Karen
Subject: RE: Thank You and Next Steps

Hi Sherri,
The other participants in yesterday's meeting are cc'd here. I am working on getting you the M&S plate so that your team can submit to ConEd a draft single-line diagram for review. I will also draft an email expressing ConEd's interest to NYU-Poly's Director of Facilities.

Please connect with Karen directly to schedule a follow-up meeting with her group.

Sincerely,

Allison Leighton
Account Executive - Energy Efficiency Programs
Con Edison | 4 Irving Place | New York | NY 10003
212-460-6226 (office) | 917-755-7319 (cell) | leightona@coned.com

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Monday, March 28, 2011 9:03 AM
To: Bruce, Karen
Cc: 'Monty Graham'; 'David De Armas'; 'Sherri Sklar'; 'Matthew Fairy'; 'Guy Warner'
Subject: ConEd 3G Smart Grid Project

Karen,

Thank you for attending the meeting on Thursday. Hopefully we can schedule a meeting with your group soon.

Prior to that meeting, I would like to put together a presentation to outline some of the possibilities of microgrids in the distribution system with diagrams to make it more clear. Perhaps you and I could chat first to go over some of these things?

If you have anything you can e-mail me to go through regarding your priority projects, please send along. I look forward to our next meeting, and would like to include the CEO of Pareto Energy (the NYU project developer) along with us.

Best Regards,

Alan McDonnell
Non-Synchronous Energy Electronics, LLC
94 Middlesex Rd.
Merrimack, NH 03054
(603) 546-5785

From: Bruce, Karen [mailto:BRUCEK@coned.com]
Sent: Monday, March 28, 2011 3:03 PM
To: Alan McDonnell <alan.mcdonnell@nonsynchronous.com>
Cc: Fanek, Baeth <FanekB@coned.com>; Ghafurian, Reza <GHAFURIANR@coned.com>; Leighton, Allison <LEIGHTONA@coned.com>; Jolly, Margarett L. <JOLLYM@coned.com>; Logsdon, David R <LOGSDOND@coned.com>; Pearce, David <PEARCED@coned.com>; Monty Graham <monty.graham@campusgreenup.com>; David De Armas <david.dearmas@campusgreenup.com>; Sherri Sklar <sherri.sklar@campusgreenup.com>; Matthew Fairy <matthew.fairy@campusgreenup.com>; Guy Warner <gwarner@paretoenergy.com>
Subject: RE: ConEd 3G Smart Grid Project

Hi Alan,

Thank you for contacting me. I would like to schedule a meeting with my group to discuss the technology and possible applications, as well as the NYU-Poly project.

Again, we work very closely with Margarett Jolly and David Pearce. They handle all DG interconnections with the company, while we focus on Smart-Grid development.

Please let me know your availability for the week of April 11th. Let's discuss tomorrow morning.

Thanks,

Karen R. Bruce
3G Systems of the Future
brucek@coned.com
Office: 212-460-6640
Mobile: 646-306-3916

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Wednesday, April 06, 2011 9:16 AM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: ConEd names

Guy,

Here is the review team from ConEd. Fanek, Baeth; Ghafurian, Reza; Leighton, Allison ; Jolly, Margarett L.; Logsdon, David R; Pearce, David; No one is from ConEd Solutions

Karen Bruce is our contact with the 3G smart grid group, Reza is tech. director.

Margaret Jolly is the boss of DG, David Pearce one of the senior engineers. Allison Leighton is the rep for NYU and other universities

-Alan

Non-Synchronous Energy Electronics, LLC

A future urban distribution network including islanded microgrids

A technical presentation for;

Con Ed 3G Smart Grid of the Future Group

Alan McDonnell, President

Apr. 22, 2011

Why a Microgrid?

Non-Synchronous Energy Electronics, LLC

- The main reason for this technology to be deployed by utilities is to add new capacity or replace older distribution assets with the most cost effective solution
- **"The Lowest Cost of the Next MW !"**
- The microgrid design simply allows distributed generation, such as CHP, to be installed according to energy needs only, such that no upgrades or changes to the existing grid are required to accommodate the DG.

An explanation of the difference between a microgrid and standard DG

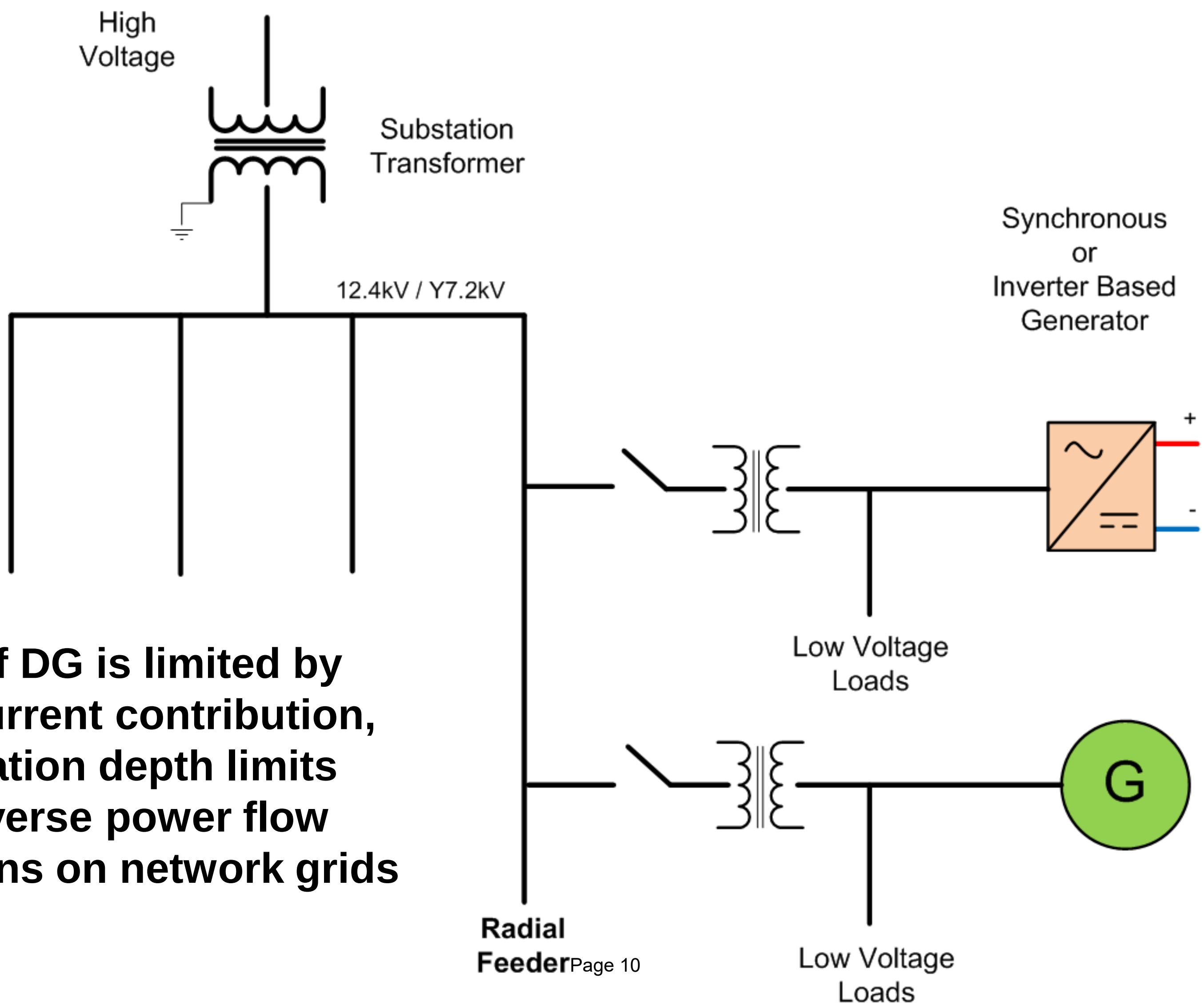
Non-Synchronous Energy Electronics, LLC

- The microgrid is simply the enabling tool to add DG or energy storage without upgrades to the existing grid

- DG and storage can be made more cost effective if designed for energy concerns without regard to electrical concerns

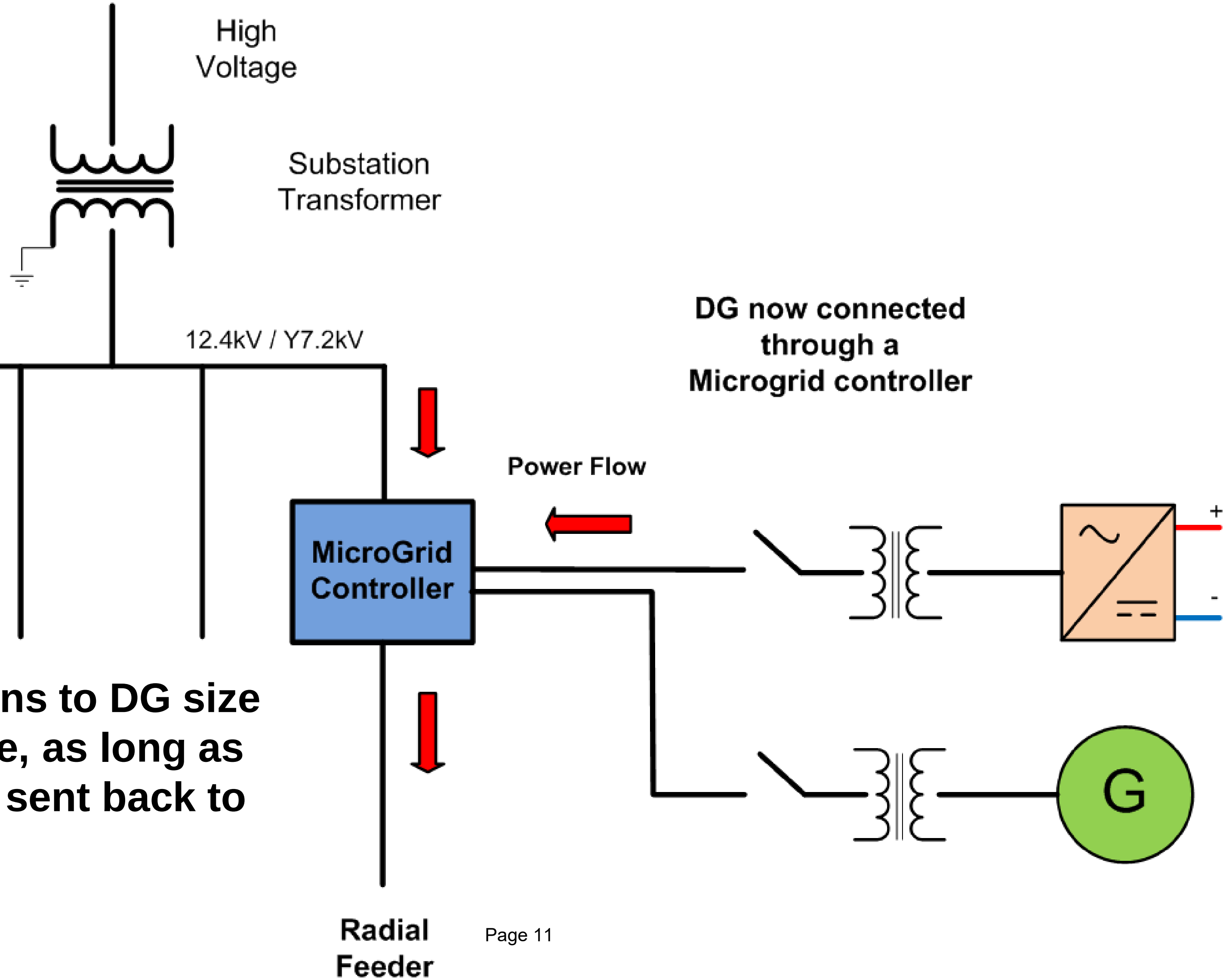
Parallel Connected DG

Non-Synchronous Energy Electronics, LLC



***Size of DG is limited by fault current contribution, penetration depth limits and reverse power flow concerns on network grids**

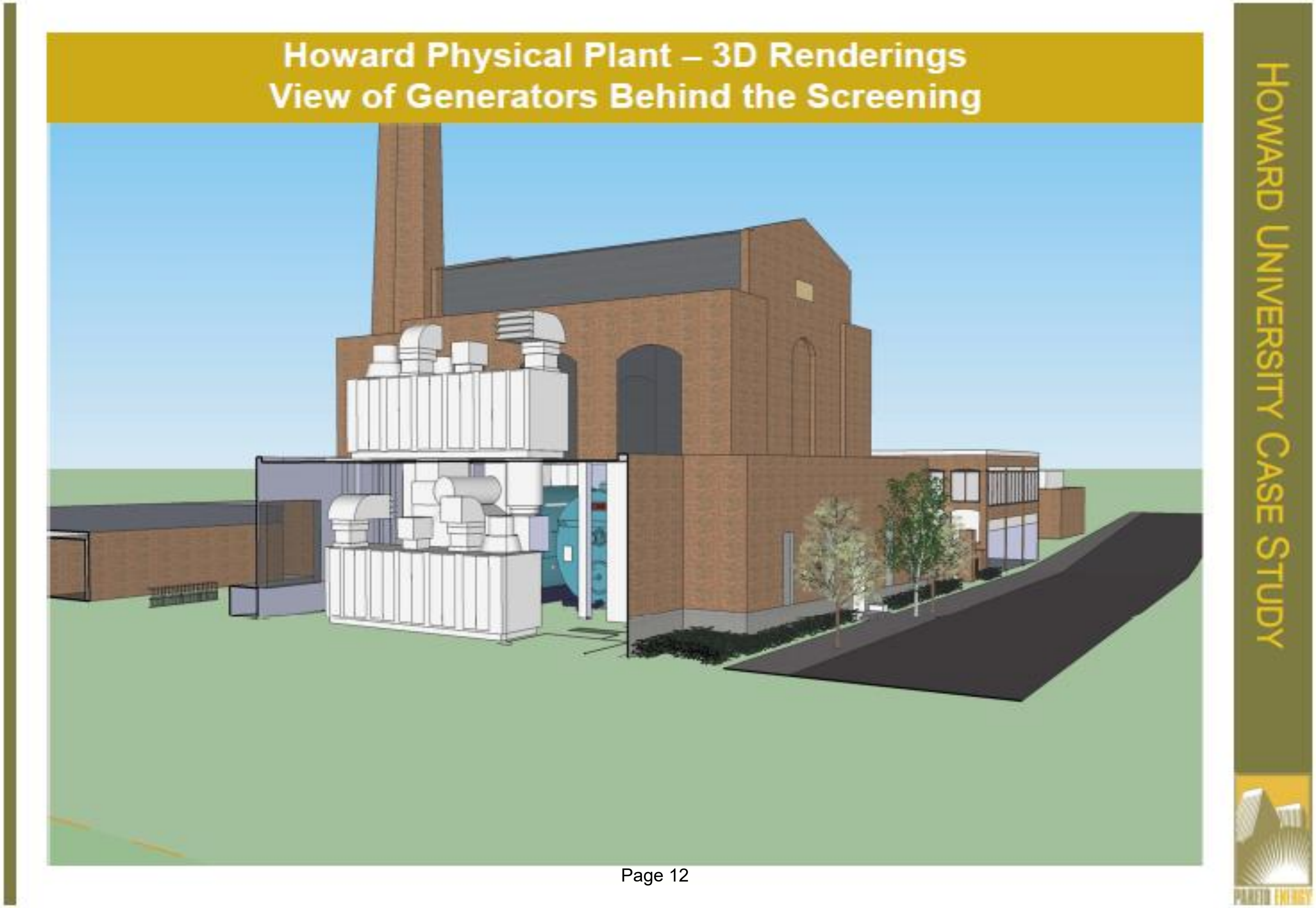
The Solution….
Start a new "microgrid"



*** All limitations to DG size are overcome, as long as power is not sent back to the grid**

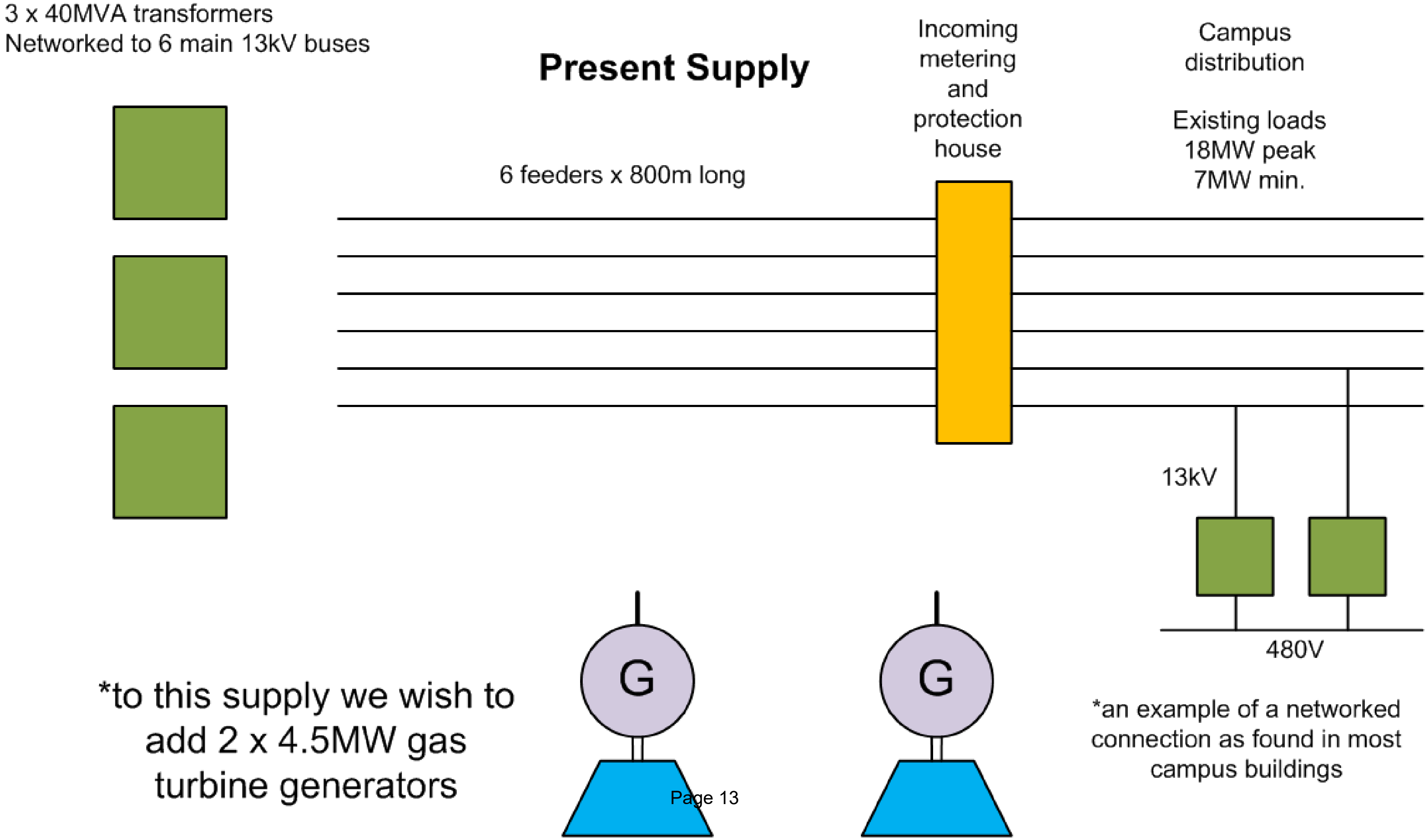
Project Example; Howard Unversity

Non-Synchronous Energy Electronics, LLC



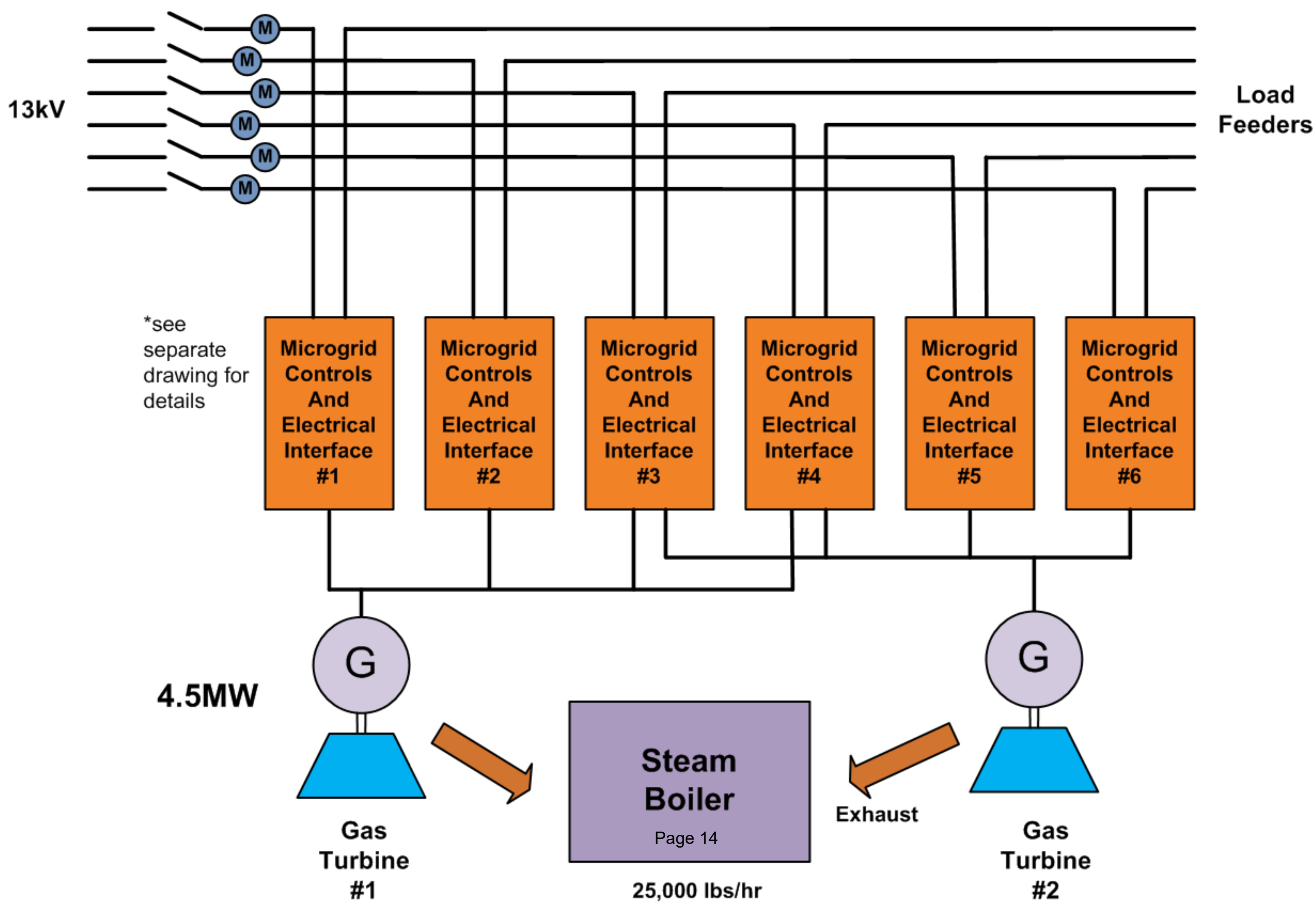
A overview of the electrical grid feeding Howard U.

Feb 2, 2011 version

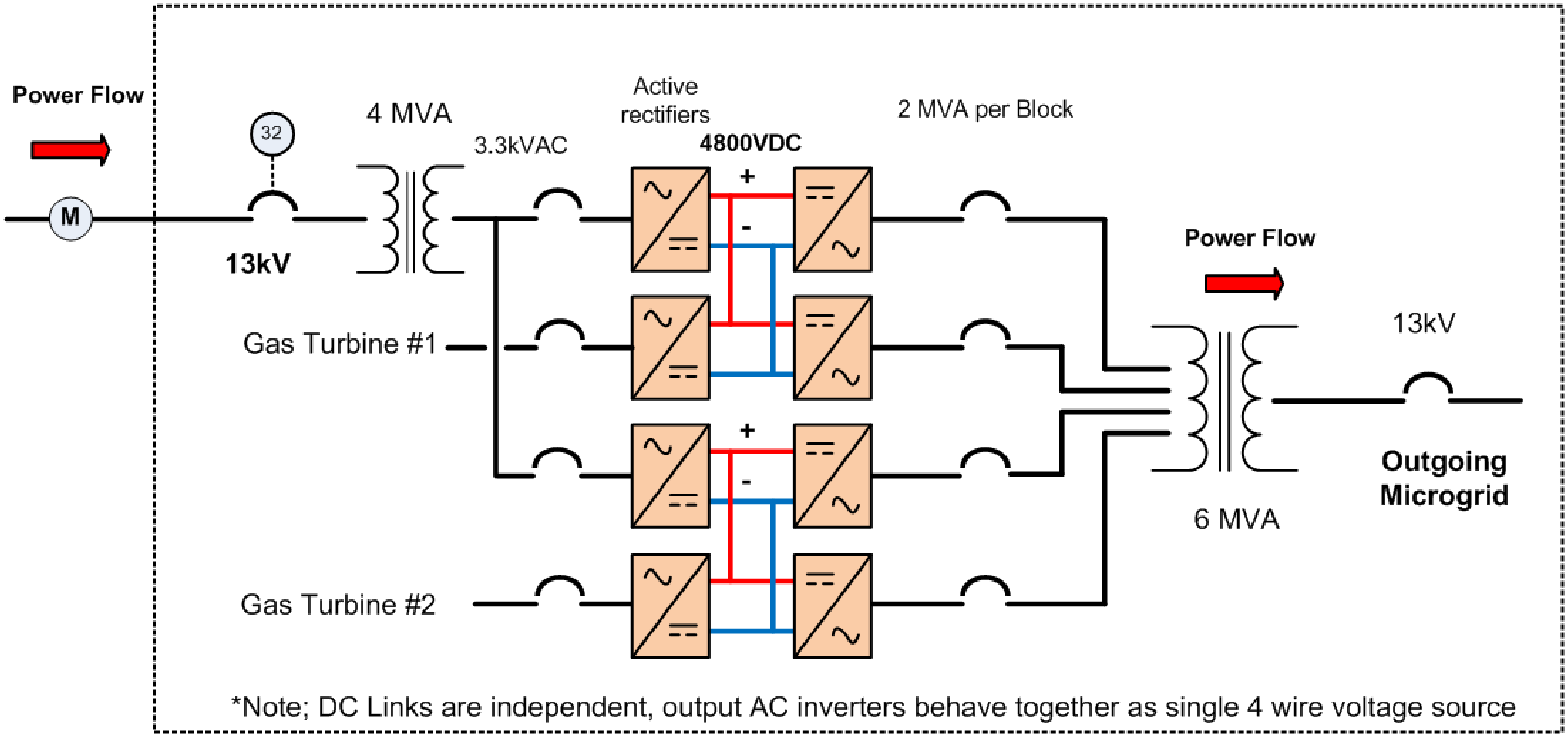


Electrical layout of the microgrids

NSEE
Non-Synchronous Energy Electronics, LLC

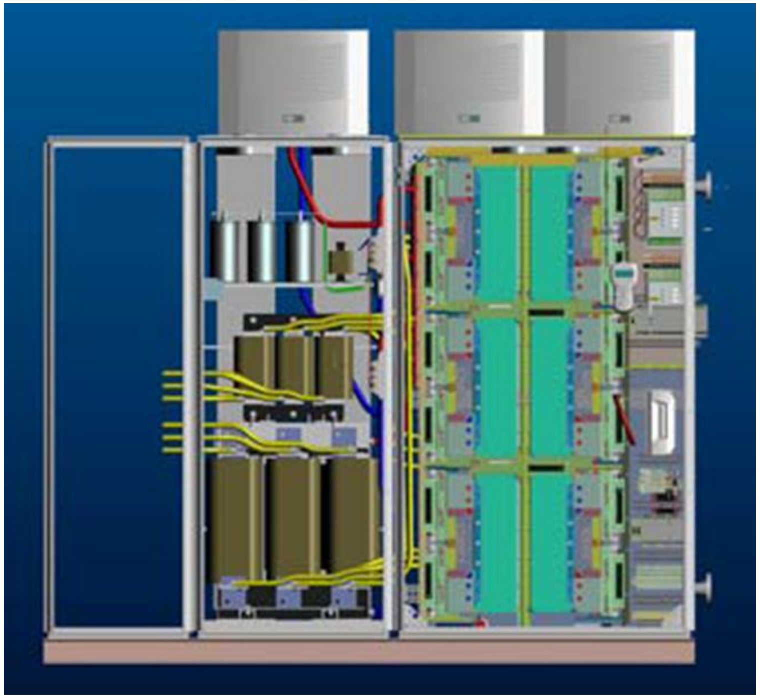


Internal layout diagram of microgrids #3 & 4



The enabling technology…

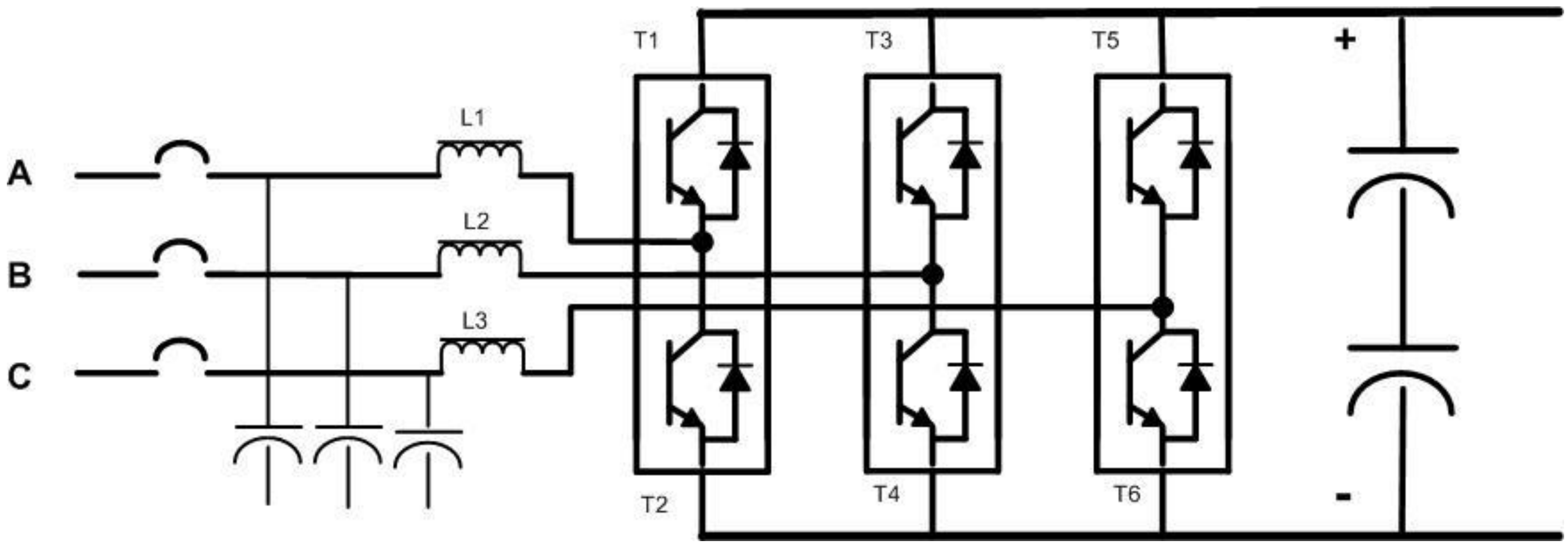
Non-Synchronous Energy Electronics, LLC



AC/DC Power Converters with;

- •High Power
- •High bandwidth
- •High Efficiency

The interconnection permitting key;
the
"Active Rectifier"



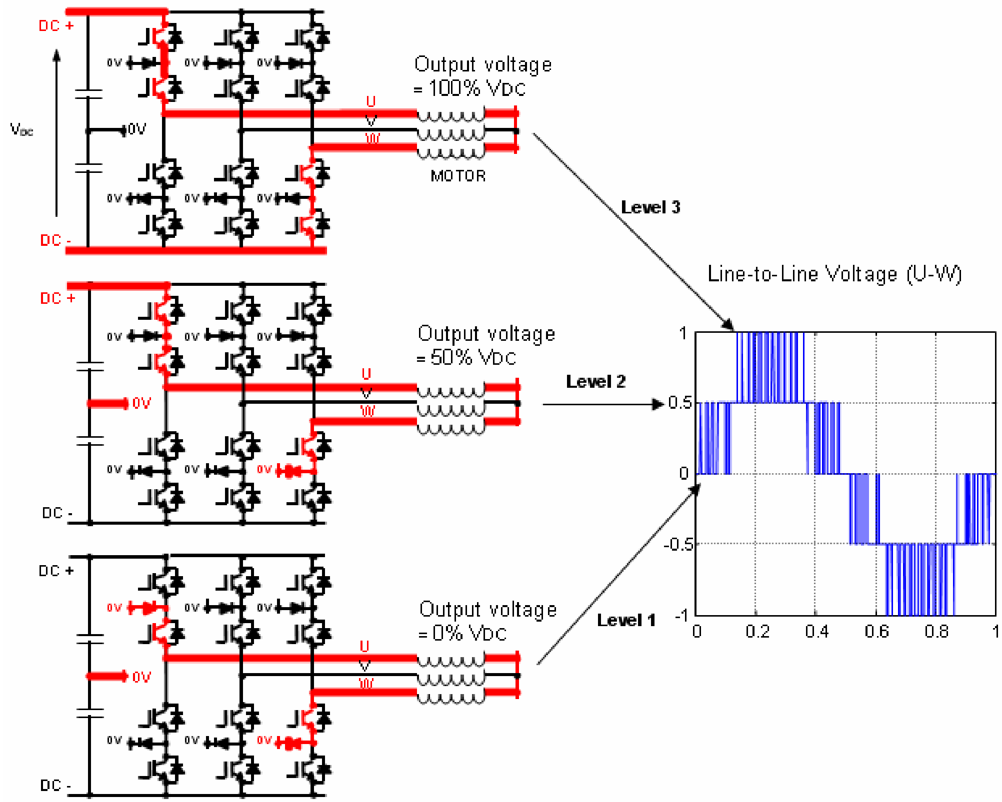
By showing the operating sequence of the transistor firing, it can be shown how kW or kVARs can be taken from the grid to the DC Bus, and prevented from flowing the other way, even during an upstream fault.

This eliminates the problems with traditional "Generator Interconnection"

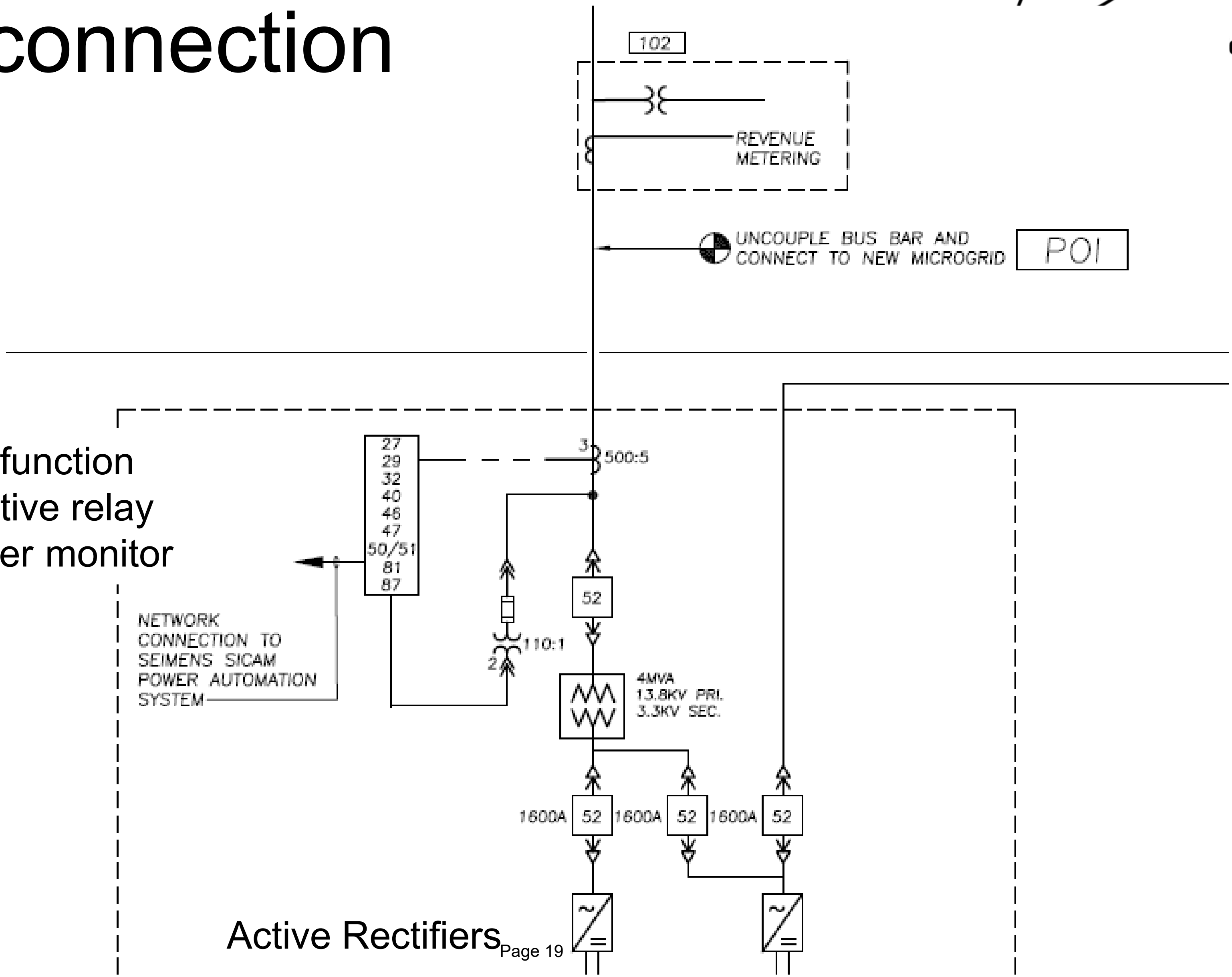
The 3 level inverter detail…

Non-Synchronous Energy Electronics, LLC

The actual inverters used have a topology known as “Neutral Point Clamp”, which gives a 3 level waveform and allows for higher voltages to be used for the given silicon voltages



Example; The Howard U. interconnection



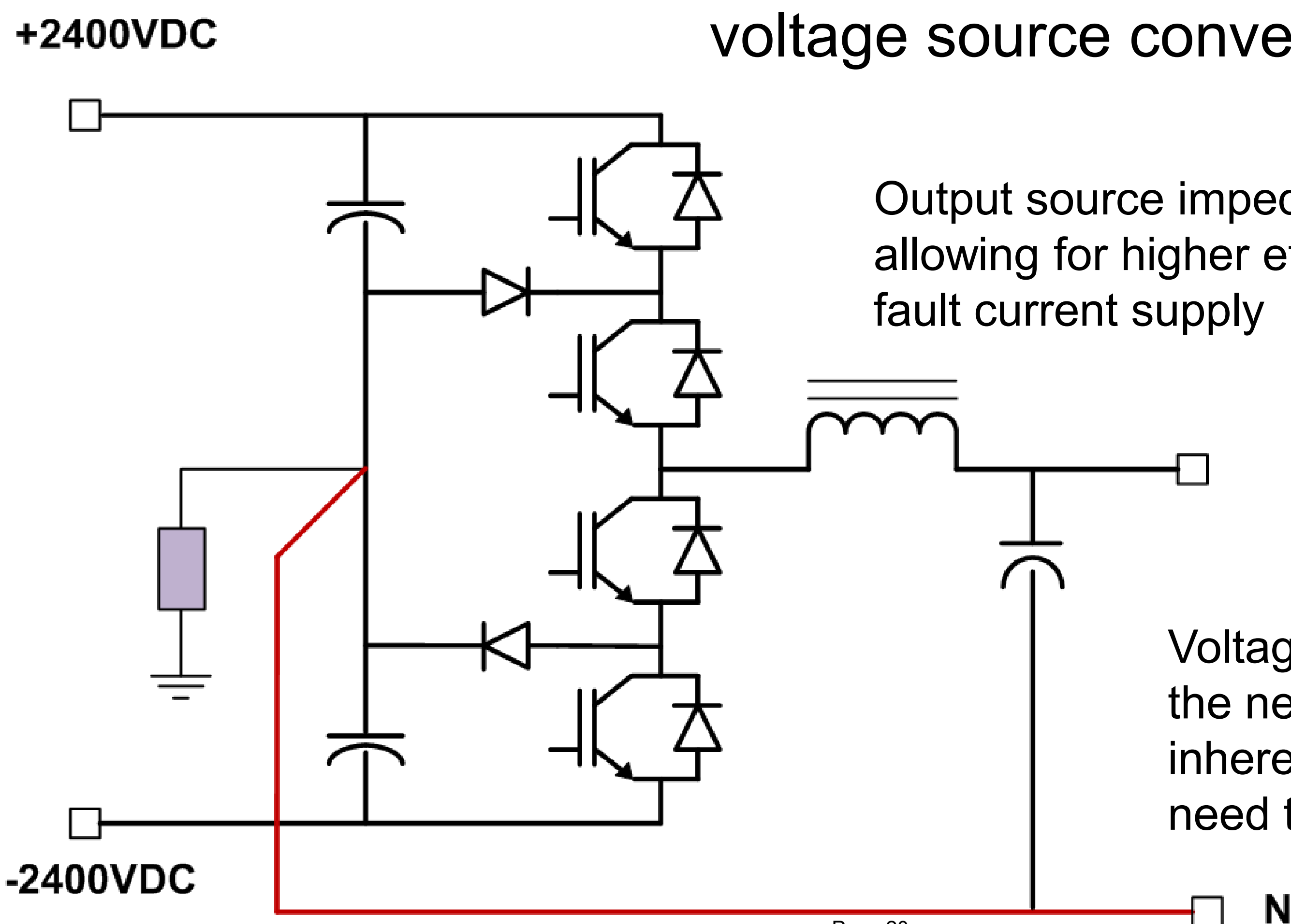
-Multi-function protective relay & power monitor

Active Rectifiers

The microgrid output; true 4-wire voltage source

Non-Synchronous Energy Electronics, LLC

Each of 3 phases of 4 wire voltage source converter



Output source impedance is minimized, allowing for higher efficiency and higher fault current supply

Voltage regulation of the neutral point is inherent, does not need to be added

Meeting the utility (PEPCO) burdens for permitting

Non-Synchronous Energy Electronics, LLC

- The biggest hurdle was to explain how the active rectifier prevents fault current additions from the new, added generators
- We added real time power monitoring to assure harmonic compliance of the rectifiers under all load conditions
- The protective relays and real time power monitoring use “off the shelf”, certified components for added protection

Summary of Design and Operational Characteristics

Non-Synchronous Energy Electronics, LLC

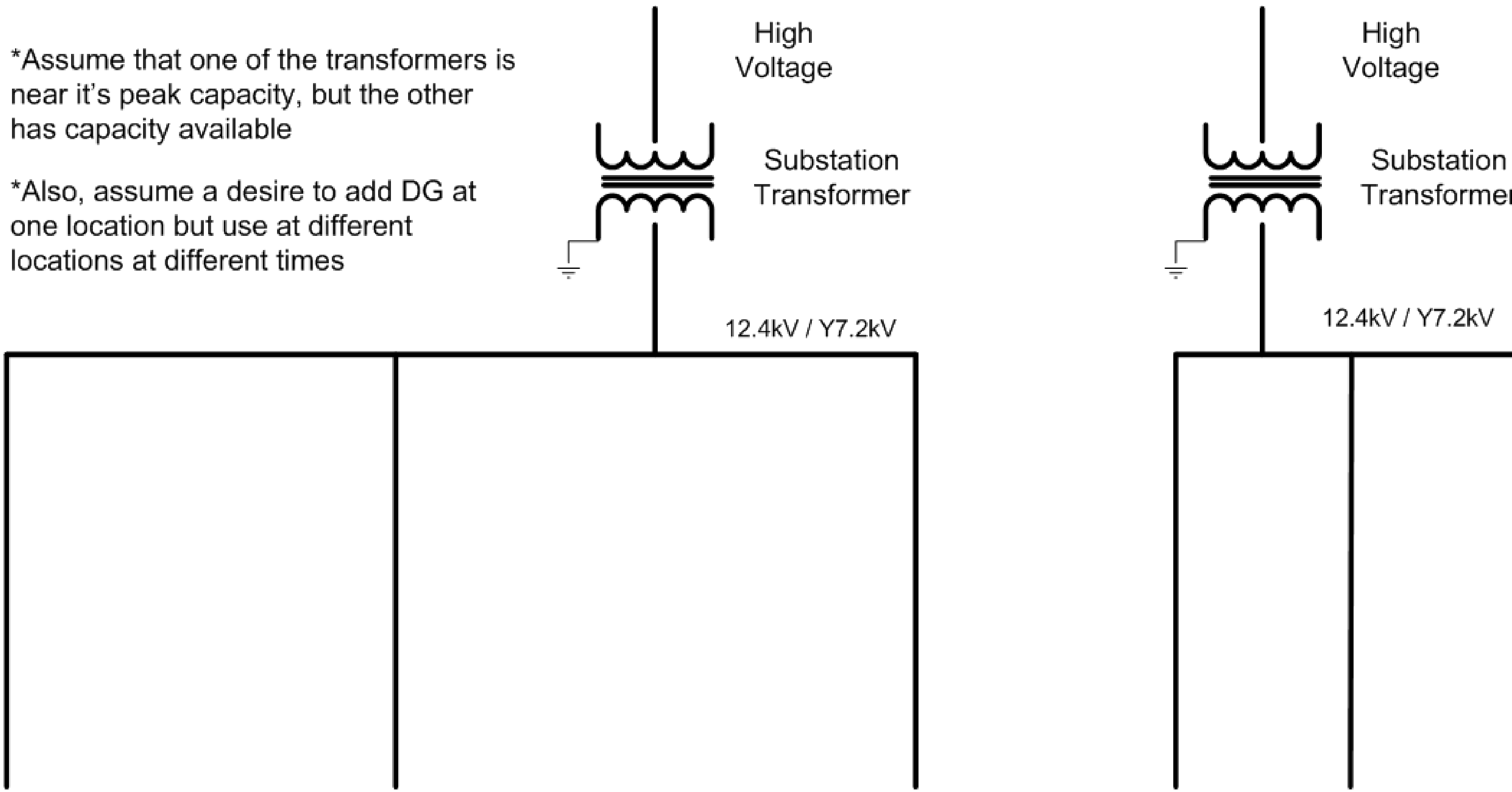
- The power converters are modular, and can be arranged as needed and paralleled for higher power applications
- Different design considerations are used for the input and output sections
- Power to or from different sources is easily shared along a “common DC bus”, regularly used in industrial process applications

An example of some of the design flexibility…

Non-Synchronous Energy Electronics, LLC

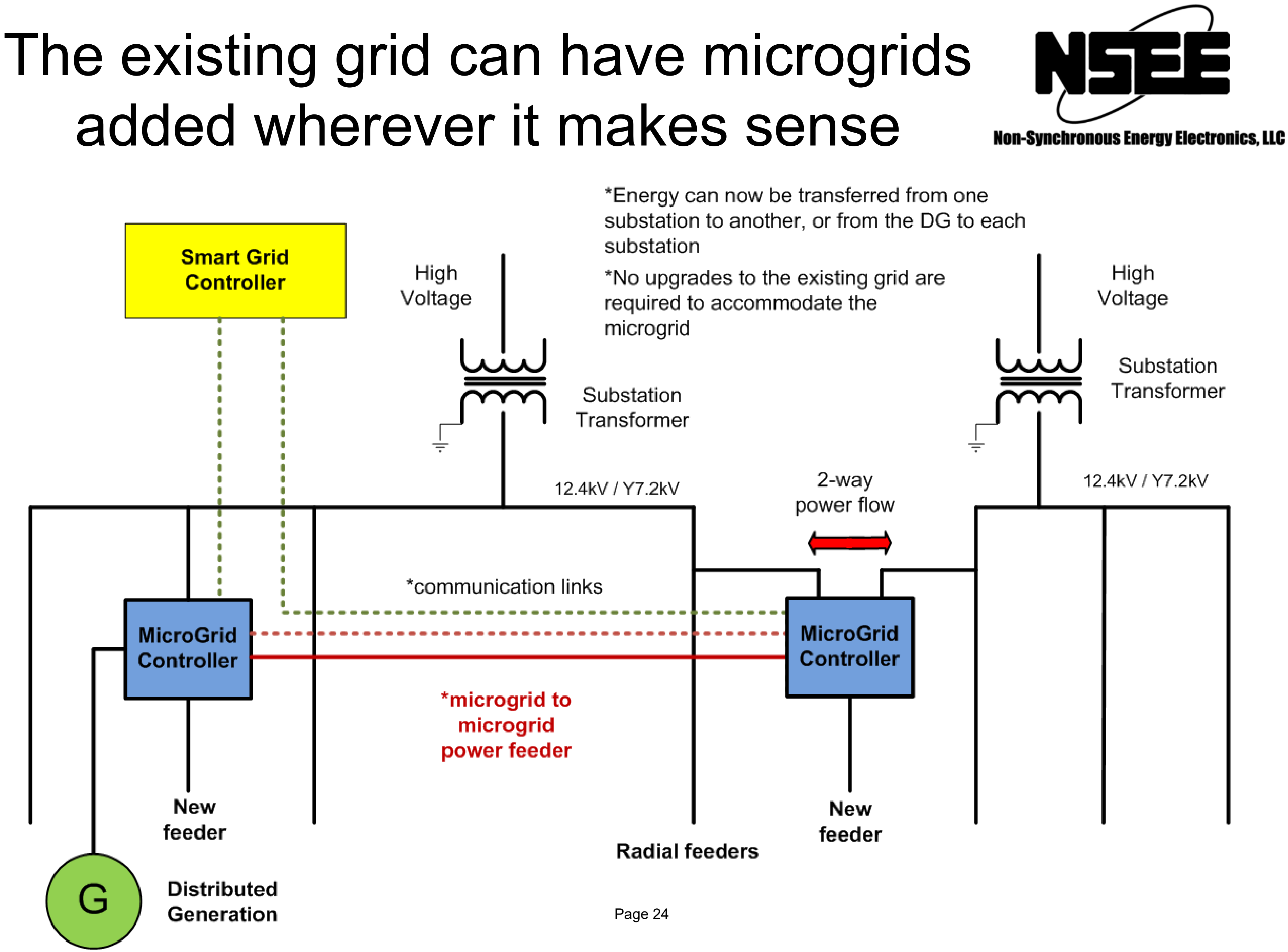
*Assume that one of the transformers is near it's peak capacity, but the other has capacity available

*Also, assume a desire to add DG at one location but use at different locations at different times



Radial feeders

The existing grid can have microgrids added wherever it makes sense



Non-Synchronous Energy Electronics, LLC

An infinite level of flexibility in terms of adding new power generation to existing grids, making the power grid of the future look like the internet, without the need for upgrades to the grid

Non-Synchronous Energy Electronics, LLC

Alan McDonnell

President

Non-Synchronous Energy Electronics, LLC

94 Middlesex Rd.

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From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Wednesday, May 18, 2011 12:23 AM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Matthew Fairy optonline <mfairy@optonline.net>; Shalom Flank <sflank@paretoenergy.com>; Christopher Niebylski <cniebylski@paretoenergy.com>

Subject: NYU follow up

More to come, but here's a quick run down of my teleconference with Baeth Fanek today.

My view is that we ask NYU Poly to sponsor the microgrid. They have an old building that they are planning to tear down one day. We should ask to build a new building that has the strength to host a couple of turbines, boilers and chillers on the roof. At least 20MW of power generation.

There is enough load in the immediate area, almost don't need to cross roads, but is mostly Forrest City Ratner buildings. Matthew set up a meeting with NYU Poly facility manager George Zulick next week, and he will make the initial calls to Ratner. He deals with Ratner now, the new data center is planned for 2 Metrotech Center.

Baeth offered to re-wire a couple of city blocks if that's what it took to make it happen. He came to the meeting to help push 2 or 3MW…every little bit helps at this point. If we can do 20+MW, he mentioned bunch of areas like Metrotech that could be done.

I'll put together some more details after I go through some notes and maps.

-Alan

Minutes from Meetings with NYU Poly Facilities Manager George Zulik and Con Edison Engineer Baeth Fanek During the Week of May 23, 2011

The meeting at Poly could not have been better. George offered and encouraged us to look at using the roof of the Dibner Library (5 Metrotech) to mount the power plant and e-houses. He told us that the building was originally designed for 8 floors, but construction stopped after 4, so there should be plenty of weight bearing capability. It has a surface area of 25,000 sq. ft.

The meeting with Baeth at Con Ed was also very good. Baeth went through the issues at their housing authority sites and we worked through a solution of how to implement a microgrid into their distribution feeders. He mentioned that he could bring many such projects to us. The larger ones have a peak load of 5 – 7MW, the smaller ones 3 to 4 MW.

Baeth will do all he can to help at Poly. He mentioned that he would like to set up a meeting next week before he leaves for vacation, in order for us to meet Elliot Chebli, the head of distribution engineering, so that we keep him in the loop with our plans.

I told Baeth that I will get some conceptual diagrams of what we have in mind by the end of this week (June 3).

We still need some more M&S plate info from Con Edison, I will send a rquest to Allison Leighton, copied Baeth and Karen.

More to follow as we go through it.

-Alan

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Friday, June 03, 2011 12:14 PM
To: Leighton, Allison <LEIGHTONA@coned.com>; Fanek, Baeth <FanekB@coned.com>
Cc: Jolly, Margarett L. <JOLLYM@coned.com>; Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>; Bruce, Karen <BRUCEK@coned.com>; sherri.sklar@campusgreenup.com
Subject: Presentation for next NYU-Poly meeting

Allison, Baeth,

Here is a brief presentation of some conceptual plans for what we'd like to do at Poly, for your review prior to our next meeting. Please forward to the other participants. We do hope to have a chance to meet before Baeth leaves for vacation. If we can meet first on this project, perhaps we can meet on the Housing Authority opportunities once Baeth returns.

This is very early stage and this plan relies on many assumptions not yet secured, but we do have support from NYU.

Plenty of questions to come during the meeting and afterwards.

It would help us significantly in our early stage discussions with other parties if, after our meeting, we could get written confirmation from ConEd that they are aware of both the technical and commercial differences between this approach and standard DG projects, and encourage us to continue forward towards a detailed submission to ConEd.

Hope to see you then,

Alan McDonnell
Non-Synchronous Energy Electronics, LLC
94 Middlesex Rd.
Merrimack, NH 03054
(603) 546-5785

From: "Bruce, Karen " <BRUCEK@coned.com>
Date: Mon, 06 Jun 2011 11:09:02 -0400
To: Matthew Fairy<mfairy@optonline.net>
Cc: Alan McDonnell<alan.mcdonnell@nonsynchronous.com>
Subject: RE: your thoughts so far

It looks like Baeth is taking over for the NYU-Poly project. I want to continue working with you on conceptual designs.

With the project at Howard University, you've established yourselves as innovation leaders in economic development zones/low-income urban communities. We continue to find opportunities there for peak shaving and infrastructure investment deferral. After the NYU-poly meeting, let's set-up a conference call to discuss other applications for cogeneration and your technology.

Thanks,
Karen

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Monday, June 06, 2011 11:30 AM
To: Fanek, Baeth <FanekB@coned.com>
Cc: Jolly, Margarett L. <JOLLYM@coned.com>; Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>; Bruce, Karen <BRUCEK@coned.com>; sherri.sklar@campusgreenup.com; Leighton, Allison <LEIGHTONA@coned.com>
Subject: Commercial punch list for ConEd (Baeth Fanek) on NYU Poly proposal

Baeth,

As discussed, here is a punch list of commercial issues to consider regarding the presentation sent last week. The options and precedents set will have an impact on how we move forward on the housing authority and other proposals as well.

1. The presentation assumes that the commercial buildings will sign on to become customers of the special purpose entity that owns and operates the power plant. This is essentially an extension of the principal that the building would have its own power plant, but in this case, one across the street.

2. The two main requirements we would need from Con Ed for the commercial assumptions made in the presentation are that we would get assistance or permission from Con Ed to run the extra feeders down the street (even though it's a pedestrian walkway) because Con Ed owns the rights to do this, and the question of ownership or rental of the transformers inside the buildings.

3. Note again that the design is made specifically to avoid any changes or upgrades to the existing distribution system in order to accommodate the addition of the new DG.

4. A separate option exists, which we will need to explore for the housing authority projects, where we could put a set of meters on the outgoing feeds of the microgrid "blue boxes" and sell the power at some specially negotiated rate to Con Ed, and have Con Ed keep the meters in the buildings as shown in Slide 8. There is precedent for such an arrangement, as was done on the project at 1 Bryant Park. This would avoid us having to bring the existing commercial customers under contract, nothing would change for them.

5. Further to point 4, it would also be an option for Con Ed to own and have control over the "blue boxes", as distribution equipment, and the special purpose entity would own and operate the power plant and take care of thermal sales. The meters could be put on the generator outputs.

6. It is understood that points 4 & 5 would require Con Ed to assume the technical risk of new technology, not something utilities are ever comfortable with. It would also require some sort of sole source procurement, which can be difficult. If not on this first project, it is an option for later projects once the risk is taken out.

7. The main advantage to Con Ed of going with option 4 and/or 5 is that there is no shrinkage of the Con Ed rate base, in fact growth can occur without expensive upgrades to the transmission grid and central power plants which are not owned by Con Ed anyways. This is much like an old regulated phone company embracing internet technology instead of getting passed over by it. Something to consider at the higher corporate levels since this technology is moving ahead with projects in other locations anyway, and will find it's way into NYC one way or the other.

We can go into more detail as required, and probably best in a face to face meeting. As you can see, there is a lot of flexibility to how best to do this. Let me know if you have any questions.

-Alan McDonnell

From: Bruce, Karen [mailto:BRUCEK@coned.com]
Sent: Wednesday, June 29, 2011 10:52 AM
To: Alan McDonnell
Cc: Jolly, Margarett L.; mfairy@optonline.net; Guy Warner; sherri.sklar@campusgreenup.com; Leighton, Allison ; Fanek, Baeth; Luong, Richard; Logsdon, David R; Chen, Shao
Subject: RE: Commercial punch list for ConEd (Baeth Fanek) on NYU Poly proposal

Hi Alan,

We have reviewed the design and punch-list submitted on June 6th. We understand and appreciate the technical differences between this approach and standard DG projects. However, in turn, we have a list of items for you to consider.

1. Your operation of electric lines across streets does not pose a problem for Con Edison. However, you will likely need a revocable consent for same from New York City. Under such a scheme, you will likely need your own metering system. Easement to install feeders and pipe is outside of Con Edison's authority. Must be granted by the City.

2. Where will NYU-Poly and the other customers take standby service? To the generator (Primary)? To each customer (Secondary)? As you recall, the NYU Washington Square location has primary and secondary back-up.

3. It is extremely unlikely that we can grant building-owner ownership or operation of our transformers. This is an OSHA/safety/City Code issue. Transformers and bus are designed to utility operation standards, not City Code/NEC. Furthermore, we will need those transformers to provide back-up power.

4. How would we take you off-line to perform maintenance on our feeders and transformers?

5. How do you intend to use the Micro-grid Controller? Please specify or separately list the possible options. We need a better understanding of how to distinguish what, where and how electricity comes through the Con Edison system. If Con Edison were to have control over the 'blue boxes', it might be as an R&D pilot effort. There is no tariff that covers this setup.

6. There is already a tariff to sell energy back to Con Edison through the SC-11 buy-back rate. The max capacity to sell back to the grid is based on a technical assessment. You could also elect to sell to the NYISO.

We would like to meet again in mid July, once Baeth Fanek is back in the office. At that time we'd like to discuss a final design that allows you prove out the micro-grid controller technology.

Thank you,

Karen R. Bruce
3G Systems of the Future
Consolidated Edison Company of New York
4 Irving Place, New York, NY 10003

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Friday, July 15, 2011 11:44 AM
To: Bruce, Karen
Subject: Aug. 1st meeting conf.
Karen,

Just wondering if you've been able to confirm a a meeting date?

Thanks for all your help.

-Alan McDonnell

From: Bruce, Karen [mailto:BRUCEK@coned.com]
Sent: Friday, July 15, 2011 1:19 PM
To: Alan McDonnell
Cc: Matthew Fairy; Fanek, Baeth
Subject: RE: Aug. 1st meeting conf.

Alan,

I spoke to Baeth. It appears that the Aug. 1st will work for us. An invitation and tentative agenda will be sent out shortly.

Thanks,
Karen

From: Bruce, Karen [mailto:BRUCEK@coned.com]
Sent: Tuesday, July 26, 2011 11:12 AM
To: Alan McDonnell <alan.mcdonnell@nonsynchronous.com>
Cc: Fanek, Baeth <FanekB@coned.com>; Jolly, Margarett L. <JOLLYM@coned.com>; Leighton, Allison <LEIGHTONA@coned.com>; Matthew Fairy <matthew.fairy@campusgreenup.com>; Guy Warner <gwarner@paretoenergy.com>
Subject: RE: Aug. 1st meeting conf. (NYU-Poly Congregation/Micro-Grid)
Alan,

Baeth advised me to direct you to Margarett Jolly, as the single-point of contact for the NYU-Poly DG project. Please contact Margarett to set-up a meeting for mid-August.

Margarett Jolly, Distributed Generation Ombudsman
Jollym@coned.com
212-460-3328

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Tuesday, July 26, 2011 12:46 PM
To: 'Leighton, Allison '
Cc: 'Matthew Fairy'
Subject: NYu Poly Project

Allison,

I'm sure you've seen the e-mail chain from Karen regarding the previously planned Aug. 1st meeting. I was wondering if you might have a chance to call me to discuss where we're at and what we need for help at this time. I also recall at our first meeting that Guru had mentioned that you could give him a call if things got gummed up, and perhaps that's something we may need to consider.

I'm sure Baeth is busy in his new role, and needs to offload some of his workload where possible, but we do need the help of someone technical like Baeth. The issues that need resolved are listed below in Karen's e-mail of June 29th, particularly point #3.

What we are proposing at Poly, and including their Metrotech neighbors, is a new technology approach that cannot rely solely on past decisions for guidance. Margaret Jolly had mentioned at one of the meeting that her group deals with completed proposals, and that's what they'd like to see from us. Our problem is that it takes a significant amount of time and cost to fully engineer a project for submittal, and no one (especially NYU Poly) will risk the capital involved if there are fundamental uncertainties as to how Con Ed will respond. Note also that the concerns of Karen's e-mail are generic to any of these microgrid projects, not just this one, although this is the first that we wish to submit.

We are happy to meet with Margaret and/or others if we can get resolution to the outstanding issues prior to committing to the cost of the detailed project design.

I copied your e-mail from when you sent us some of the M&S plate info as a reminder of how much help you've been. I know these are not usually given out, and these were very helpful, and we realize that we never did get any more once we started using them for reference. This is the type of procedure following that gums up any new type of technology introduction, due to the inability to do things the same way previous projects have been done. You can see the catch-22 we're in.

I can fill you in more and discuss different scenarios for moving forward if you have a chance to call sometime, or let me know a good time to call you.

Thanks for everything you've done thus far, hope to hear from you,

-Alan McDonnell

Best regards,
Karen R. Bruce

From: "Leighton, Allison " <LEIGHTONA@coned.com>
Date: Tue, 26 Jul 2011 14:51:59 -0400
To: Alan McDonnell<alan.mcdonnell@nonsynchronous.com>
Cc: Matthew Fairy<mfairy@optonline.net>
Subject: RE: NYu Poly Project

Hi Alan,

I just had a conversation with Matthew about the points below. I don't want you to think ConEd has lost interest in this project, basically the technical lead is shifting to Margarett Jolly, as she our DG Ombudsman. I understand this is more than just distributed generation, and Karen's group will continue to be involved.

I owe Guru an update, and I will send him an email outlining where we are now and how we got here, as well as ConEd's concerns.

Margarett is on vacation this week, and when she is back we'll discuss how to move forward and schedule a meeting in which Guru and someone from legal will be invited.

Sincerely,

Allison Leighton
Account Executive - Energy Efficiency Programs
Con Edison | 4 Irving Place | New York | NY 10003
212-460-6226 (office) | 917-755-7319 (cell) | leightona@coned.com

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Friday, August 12, 2011 12:30 PM
To: Jolly, Margarett L. <JOLLYM@coned.com>
Cc: Leighton, Allison <LEIGHTONA@coned.com>; Guy Warner <gwarner@paretoenergy.com>; Matthew Fairy optonline <mfairy@optonline.net>; Sherri Sklar <sherri.sklar@campusgreenup.com>; Fanek, Baeth <FanekB@coned.com>; Bruce, Karen <BRUCEK@coned.com>
Subject: RE: NYU Poly Project

All,

Per my discussion with Margarett, I will put together some more detailed diagrams of how we would like to configure the microgrid to deal with the transformer issue. The basic approach is to install new transformers that can meet all of the necessary requirements, and disconnect the Con Ed feeds completely from the building such that Con Ed workers will have no need to perform maintenance.

Also, I will update the diagrams to show where the new feeds (and meters) from Con Ed will need to come to feed the microgrid at Dibner Library.

The goal is also to arrive at a solution that is easily repeatable at other projects, such as the housing authority networks.

I will have it sent to Margarett by next Tuesday (Aug. 16th). Margarett will pass it around to distribution engineering and we will probably have a face to face meeting to discuss and hopefully reach agreement.

-Alan McDonnell

(603) 546-5785

PARETO ENERGY

TECHNICAL DESCRIPTION OF THE PARETO ENERGY PROJECT AT NYU POLYTECH UNIVERSITY

Presentation to:

Con Ed Distribution Engineering Group

Aug. 19, 2011

August 26, 2011

Ms. Margarett L. Jolly PE
Distributed Generation Manager
Distribution Engineering
Consolidated Edison Company of New York, Inc.
VIA EMAIL

Ref: Proposed Microgrid to Serve the NYU Polytechnic Institute and Other Properties

Dear Margarett:

Pareto Energy very much appreciates recent meetings and email exchanges with Consolidated Edison to consider the development and interconnection of microgrids in New York City. While we are working now with seven utilities on microgrids, we believe that our interactions with Consolidated Edison offer the best opportunity to forge a win-win-win business model for microgrid users, other ratepayers and utility shareholders alike.

The following is to provide updates about the design of the microgrid to serve the campus of the NYU Polytechnic Institute in Brooklyn, as well as some nearby hotels and offices. We also wish to confirm our understanding of the results of our work to date with Consolidated Edison. Finally, we respectfully conclude by suggesting next actions for your consideration.

1. Project Updates

Since we last met, Pareto Energy has completed a technical and economic feasibility study for the Microgrid. The study enabled us to draft a memorandum of understanding ("MOU") with the potential users of the Microgrid by which Pareto will continue to fund development. We have secured terms from a money center bank and an equity investor to finance the next phase of pre-construction design, permitting and project finance. However, one condition for obtaining signatures on the MOU and securing the initial funding from the bank will be a written agreement with Consolidated Edison about interconnection.

Initial engineering analysis from the feasibility study concludes that the microgrid generators and GridLink E-Houses could be located on the roof of NYU's Dibner Library. Given the 15 to 20 MW of capacity that could be located on the roof, the project could significantly improve load balances and scale economies by distributing power across public rights-of-way to buildings that are located off-campus. Therefore, another condition for obtaining signatures on the MOU and securing the initial funding from the bank will be a confirmation that Consolidated Edison does not oppose Pareto Energy's legal applications to the City and State for such distribution.

Finally, we now know that the Project qualifies to apply for two competitive grants that are being awarded on a first come, first serve basis: the Federal New Market Tax Credit that provides matching funds for up to 39% of total project costs and NYSERDA funding that could provide as much as $1.5 million. Pareto Energy believes there would be no chance of winning either grant if we did not consummate an agreement with ConEd on interconnection and provide evidence that Con Ed will not oppose legal applications for the multi-building distribution of power. With these grants, the microgrid size and distribution of project cash flows could be adjusted to optimally share

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benefits between Microgrid users, other ratepayers and ConEd's shareholders. There is some urgency to achieve formal agreements with Consolidated Edison given that the NYSERDA grant requires projects to be "under contract" by December and a limited amount New Market Tax Credits are being awarded now to other projects.

2. Confirming Conclusions to Date and Suggesting Next Actions

With respect to the safe interconnection of the micro-grid to the Utility grid, we assume that some, but perhaps not all, of Consolidated Edison's engineers now believe that the use of Pareto Energy's GridLink technology does not represent a traditional interconnection and, therefore, will not require a significant amount of time or fees for a system impact study. It is my understanding, however, that some engineers at Consolidated Edison have expressed reasonable concerns about transformer management to which Alan McDonnell has responded. I hope that Alan's latest response to those concerns proved useful. Would it be possible to meet or teleconference with all the engineers and managers that may have concerns about interconnection so that we can begin closing agreements with ConEd that are similar to those that we have achieved with other utility companies?

We have retained legal counsel who has recommended several options for completing the regulatory approvals for distributing power to other users. Based on emails from Karen Bruce, Pareto Energy now assumes that ConEd does not, so far, see any legal impediments to distributing power from Dibner to other buildings across public rights of way. We acknowledge that it will be necessary to complete formal regulatory approvals with the City and the State. Would it be possible to arrange a meeting or teleconference between our respective attorneys to review our approach to applying for multi-building distribution of power so that we can confirm to our clients, banks and grantors that ConEd will not oppose it?

Finally, as we prepare to present grant proposals, we will be using a model that measures the impact of the Microgrid on its users, other ratepayers and Con Ed Shareholders. Would ConEd be interested in reviewing and/or critiquing that analysis?

We know you have been particularly busy with other more pressing matters and we are grateful for your efforts to pull the whole ConEd team together for the next meeting. Given our clients' desire to move forward more quickly, especially in light of the exigencies of applying for State and Federal grants, would it be more timely and convenient to have individual team members break out issue-by-issue on teleconferences?

Again, I want to express our admiration for the extraordinary cooperation that ConEd has extended to our clients in consideration of the Microgrid. We remain keen to lock arms with you and your colleagues to ensure a balance of microgrid benefits accrue not only to microgrid users but also to other ratepayers and to utility shareholders.

Sincerely,

Guy

Guy G. Warner
Chairman and CEO

General Arrangement Description

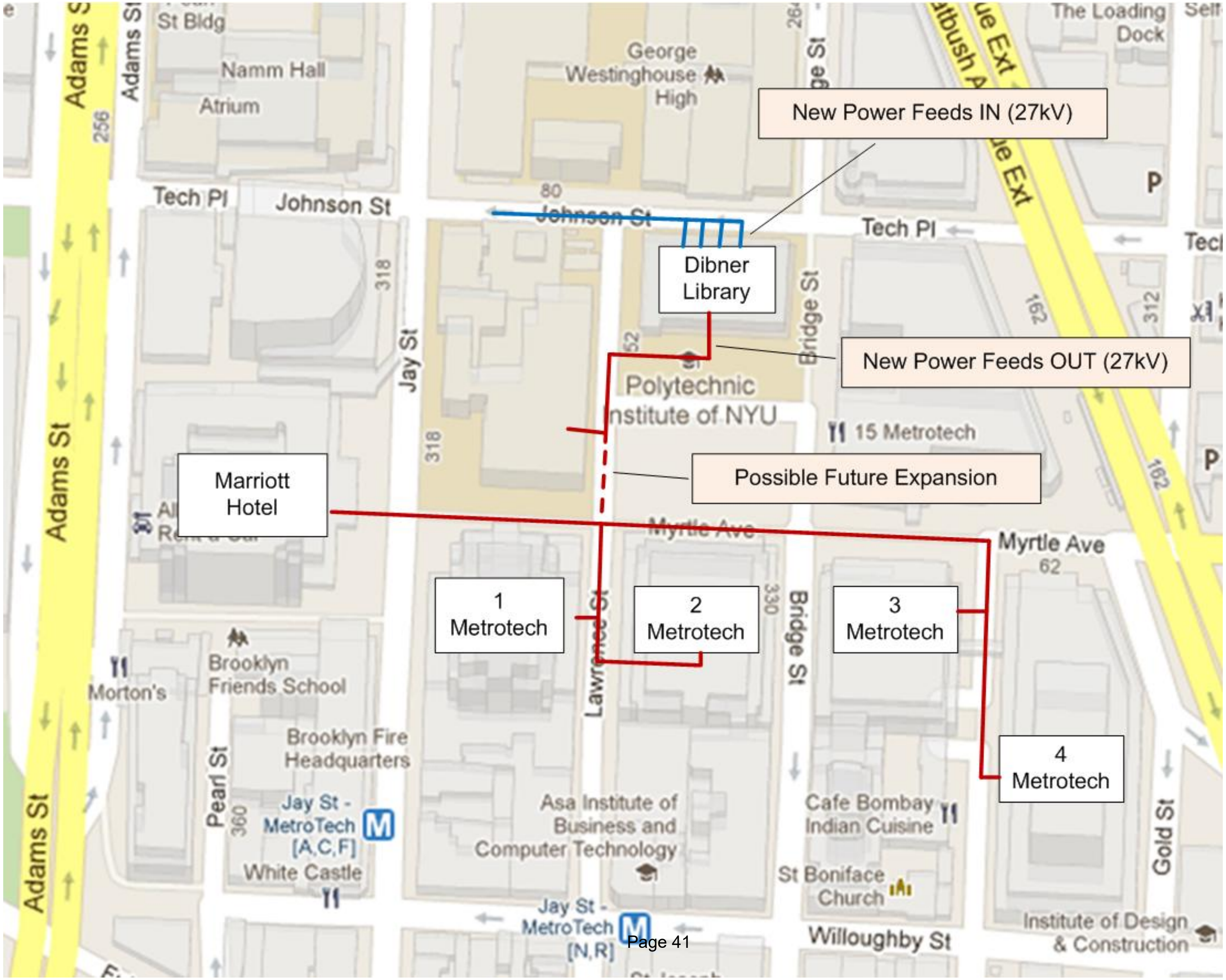
- The following diagrams help show the general arrangement requirements of the proposed microgrid installation at NYU Polytech & the surrounding neighborhood.

- As of Aug. 15th, 2011, NYU Poly has committed to moving forward with a plan to build a power plant on the roof of Dibner Library to power the NYU campus and hopefully much of the surrounding neighborhood.

- The basic operating description of the plant is that it would provide as much of the power to the buildings as possible, drawing whatever else is needed from Con Ed through new feeds into the Dibner Library.

- The Interconnection topology allows for the integration of distributed generation without the need for studies or upgrades the existing distribution grid to support the DG.

Project Location



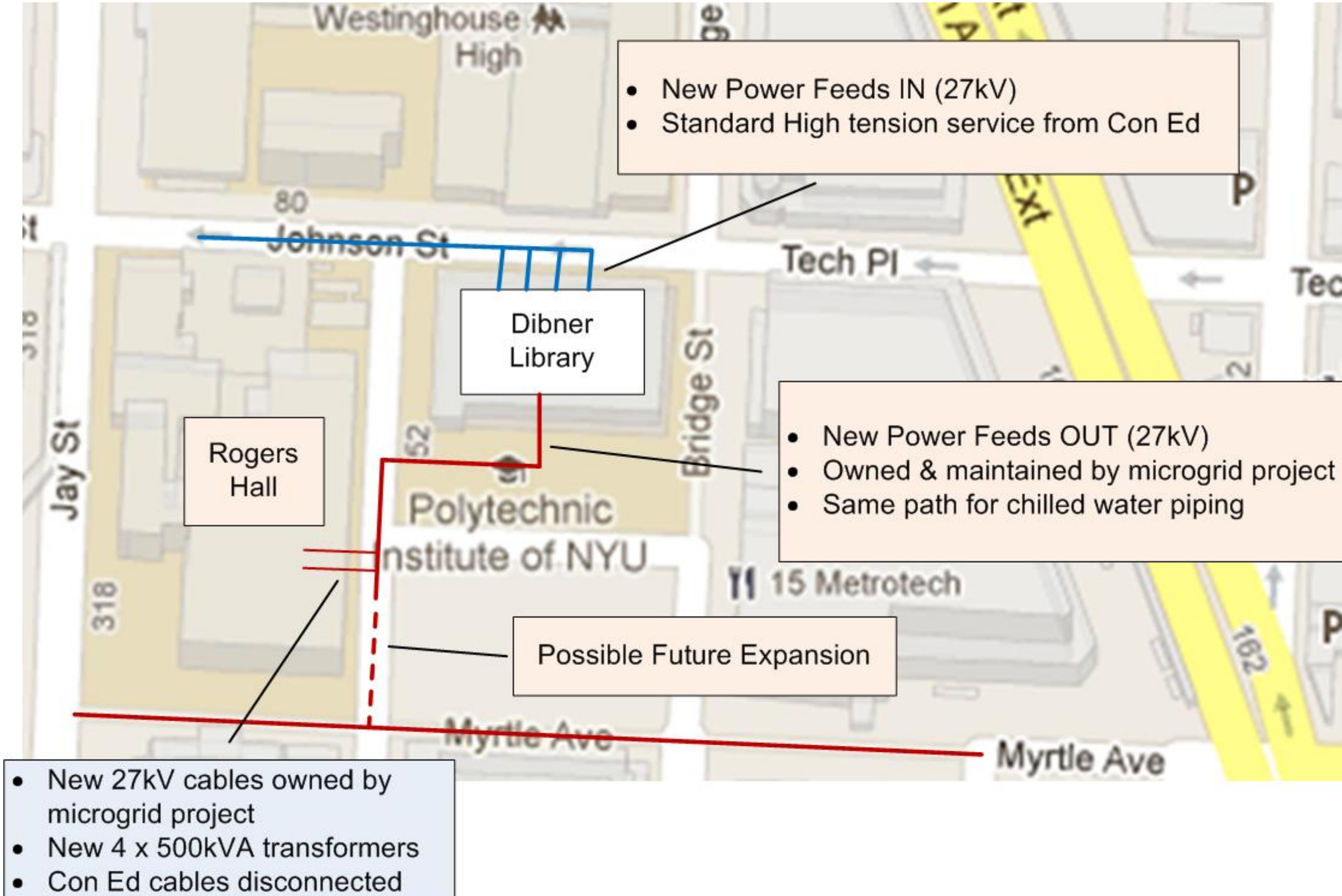
Notes on new feeds IN from Con Ed

- These new feeds would be much like adding new high tension service to the Dibner Library

- There would not be an increase in load from the substation since power feeds are being removed from nearby buildings

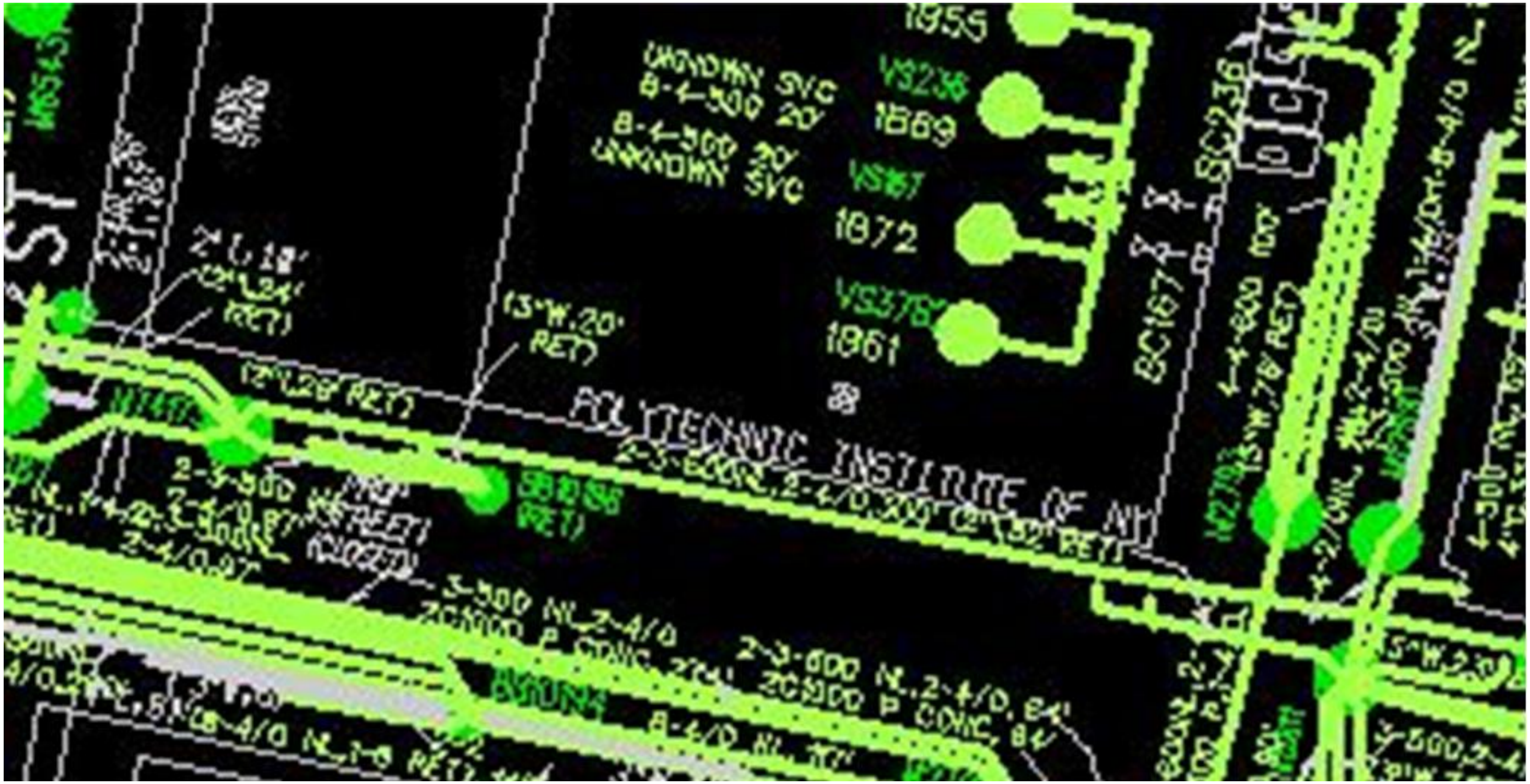
- With the power plant in operation, the net power draw from the substation would be less than that existing today

More detailed location description



M&S Plate info

This is the best information we had available for our design. Once detailed design commences we will get more detailed information



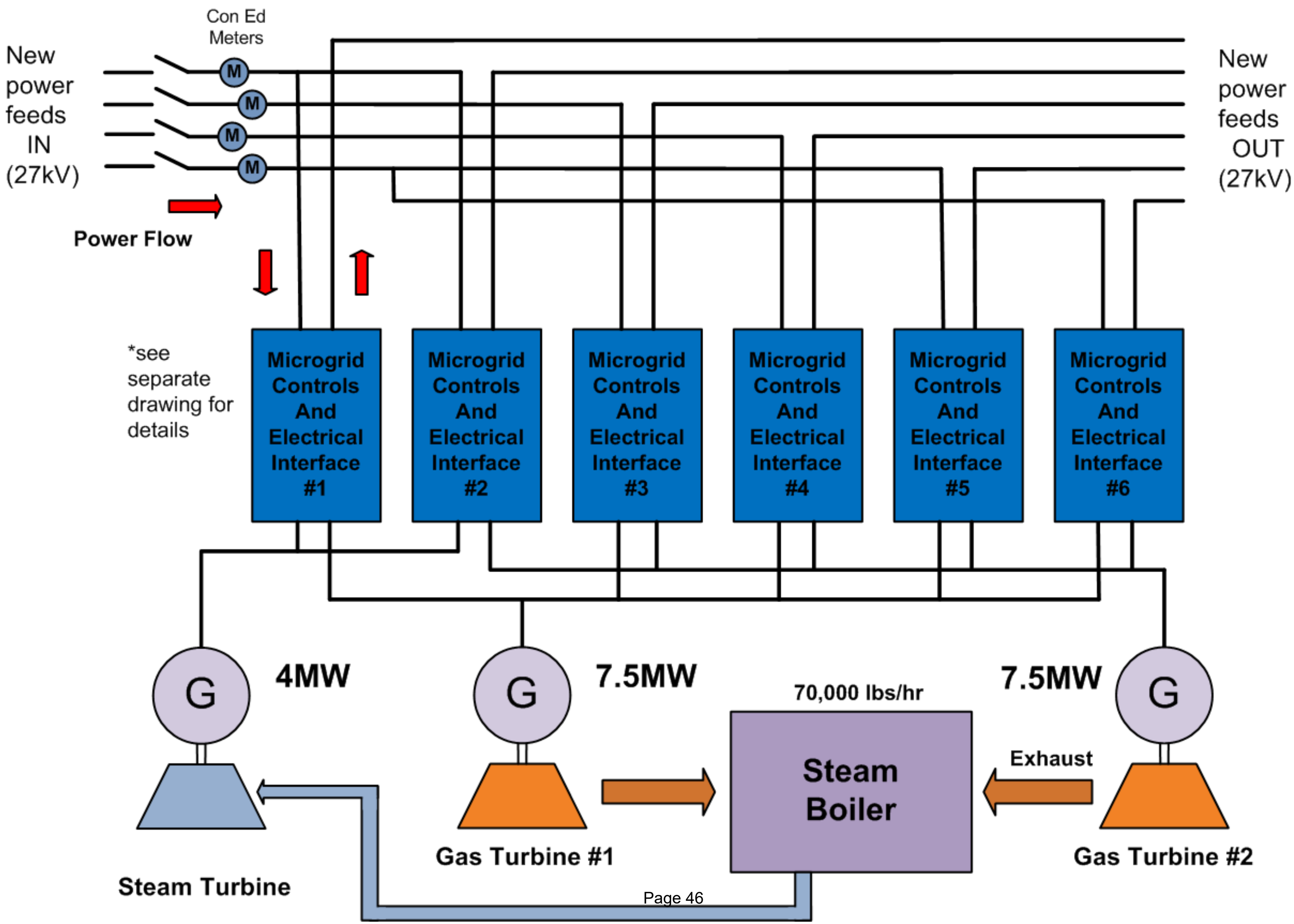
Power Plant Description

- It is envisioned that we would use a conventional CCGT design, with low pressure steam feeding hot and chilled water needs.

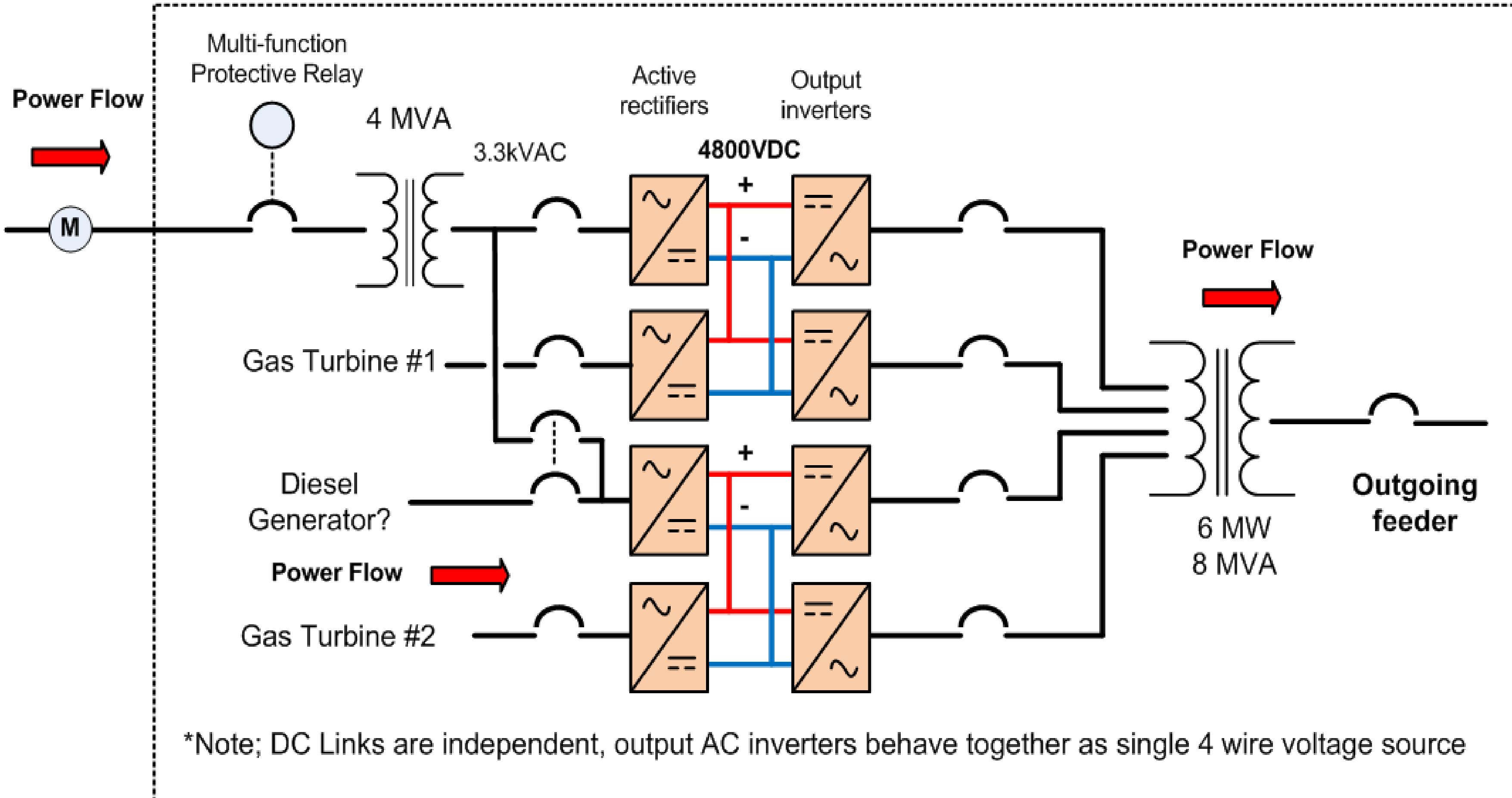
- The following diagrams show the maximun we think is possible to install at this location. It may end up being smaller, and it may be done in steps, given that the modular nature of the microgrid controls allows for growth.

- Not show, but planned, are future DG projects, especially converting existing diesel generators to gas/CHP at the end user locations. The interconnection of these would be done on the microgrid feeders, so no involvement from Con Ed would be necessary, and the interconnection to Con Ed would not change.

Example General Arrangement of Power Plant



A Description of each “Blue Box”



Microgrid connection description

•The new microgrid uses power electronics to create a new grid just like the network it is replacing. Each of the “blue boxes” is synchronized with the others, such that the outputs can be connected in the manner now used in the buildings.

•At each building, the feeds need to be connected as shown in the following diagrams.

•The “cut & splice” method needs to take place in the medium voltage side of the grid in order to accommodate the amount of power required and to transport to other buildings in a cost efficient manner.

•This requires feeding the step down transformers in the buildings from the microgrid feeds.

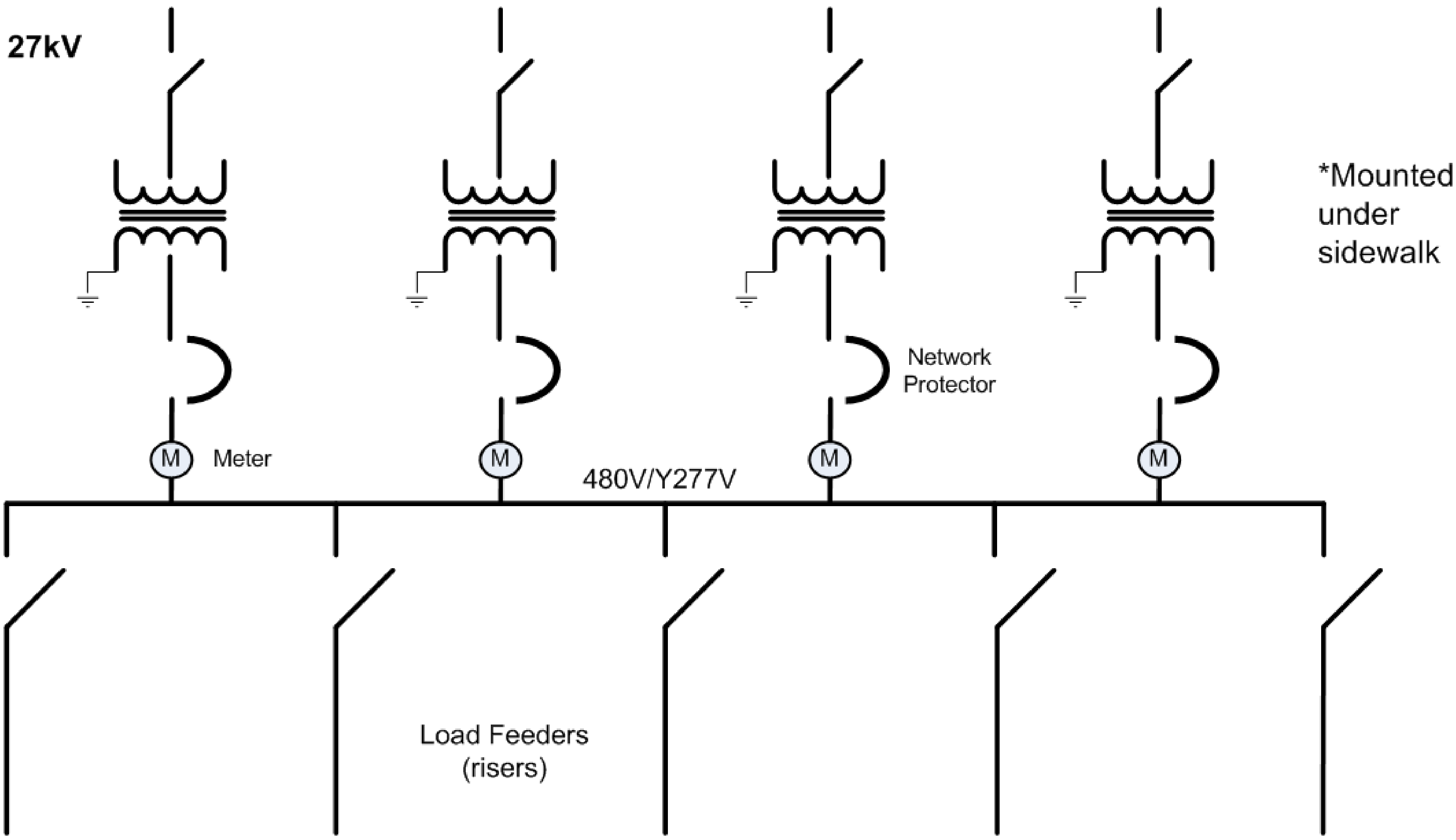
Transformer Replacement

•These transformers are presently owned by Con Ed in most (but not all) of the buildings.

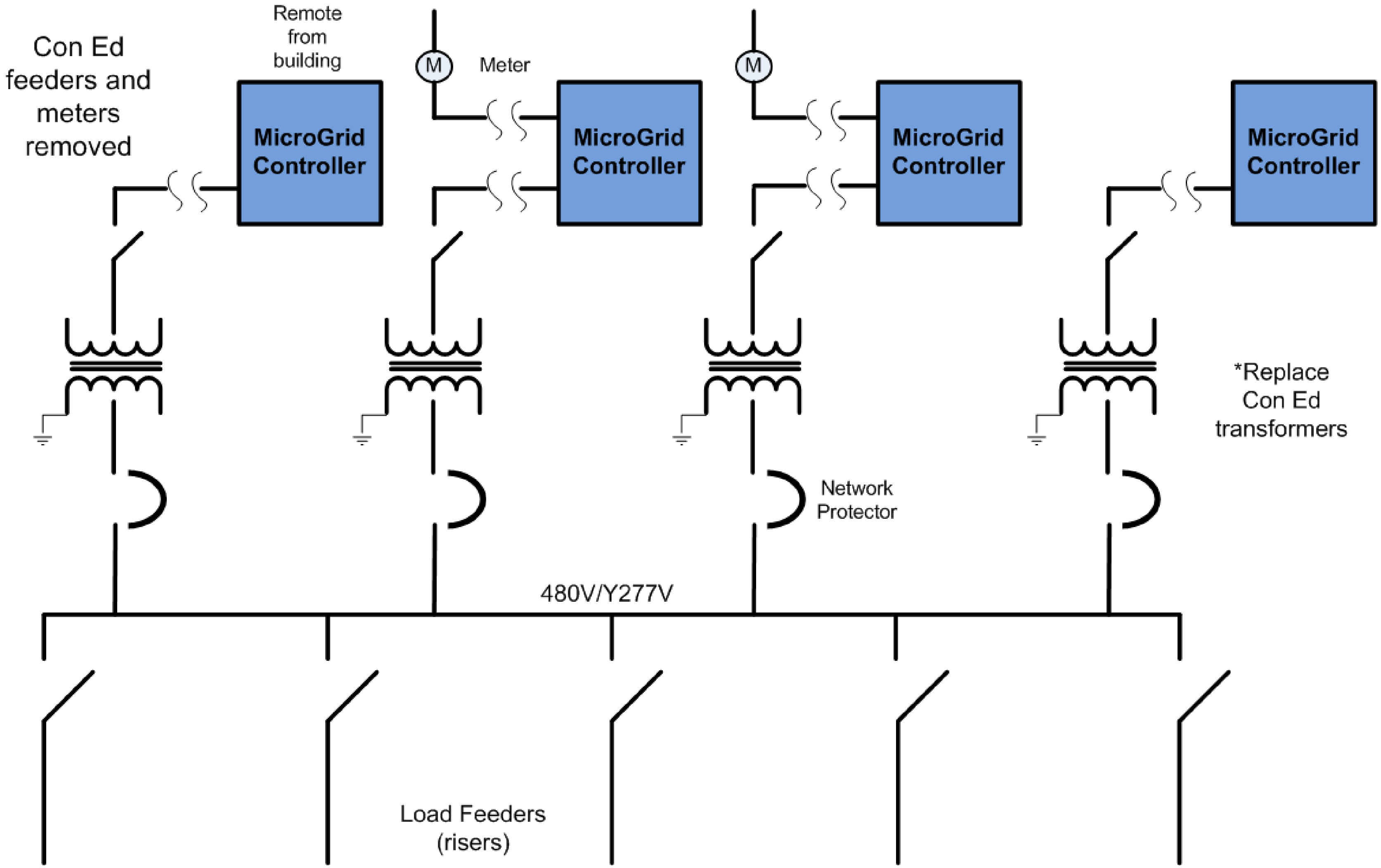
•We propose that the project owner/operator replace the transformers with ones that are not owned by Con Ed and with which Con Ed maintenance staff will have no requirement to service. It will be the project responsibility to see that all codes and standards are met.

•The microgrid will take power from the new Con Ed feeds to make up peak requirements above what the generators can provide, and provide back up service for generator down time. All the power to the buildings will come through the microgrid.

Typical Large Building Feeder Arrangement



Same Building now fed with microgrid(s)



*Note; This building is one of several, only 4 of 6 (or more) microgrid feeders feed this building.

*see separate drawing for microgrid details

Issues of Concern for Con Ed

•We realize that there are significant code and safety issue concerned with replacing the transformers and cables. We seek to work collaboratively with Con Ed to find a workable solution.

• The feeds into the buildings that are presently used will be disconnected at the buildings, and new ones that are not connected or synchronized to Con Ed will be run in their place. This absolves Con Ed from requiring access for maintenance

•These are high reliability customers, presently served by an N+2 feeder arrangement. The responsibility for redundant feed capability now moves to the project operators in conjunction with the end users.

Questions?

Please Contact;

Alan McDonnell

(603) 546-5785

Alan McDonnell Minutes from Telephone Exchanges with Margarett Jolly
Friday, August 26, 2011 12:36 PM

We have been asking for an official response to the design we provided to Karen Bruce on June 3. I also copied Karen's June 29th e-mail again. Everything else is simply a matter of explanation, most of which was covered in my presentation to Margarett last week.

I had a verbal conversation with Margarett early last week, and it seemed we had verbal agreement on the transformer issue, but she needed agreement from others (I'm assuming distribution engineering and legal) before we could get something in writing.

My take from Karen's e-mail, especially the first two sentences, is that the issue of connecting with the active rectifier has been examined and accepted as we propose. It hasn't come up again.

On August 19, I sent Margarett Jolly a revised deck from the one we originally provided to Karen Bruce on June 3 and for which we have not received the written response we have requested

After pestering Allison Leighton to get a faster response I spoke with Margarett today.

We don't need to go through Karen's list for Margarett. Margarett now has a very good understanding of what we want to do. See was hoping to have an internal meeting first and then get back to us with a date for a final meeting with us. Sherri Sklar also spoke with her the other day, Matthew sent a note, stating that she is very supportive.

We requested a letter from Margarett getting them to clarify the two main issues, crossing public roadways and replacing the transformers, and a general letter of support so we can go to NYSERDA, is all we need now.

From: Jolly, Margarett L. [mailto:JOLLYM@coned.com]
Sent: Tuesday, August 30, 2011 6:26 PM
To: Alan McDonnell <alan.mcdonnell@nonsynchronous.com>; Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>
Cc: Leighton, Allison <LEIGHTONA@coned.com>; Sherri Sklar <sherri.sklar@campusgreenup.com>; Fanek, Baeth <FanekB@coned.com>; Bruce, Karen <BRUCEK@coned.com>; Vercheak, Susan J - Regulatory <VERCHEAKS@coned.com>; Mimnagh, Thomas P. <MIMNAGHT@coned.com>; Ghafurian, Reza <GHAFURIANR@coned.com>; Seidman, Elissa <SEIDMANE@coned.com>; Luong, Richard <LUONGR@coned.com>; Logsdon, David R <LOGSDOND@coned.com>; Carbonara, Joseph <CARBONARAJ@coned.com>

Subject: RE: NYU Poly Project

Hello Alan, Matthew and Guy, in response to Alan's slides and questions/comments regarding ownership/operation of the equipment downstream of the Dibner Library we have the following: (some were answered in the slide deck but we are asking 'are you sure?'!)

- What is the expected phasing of the project. E.g. which buildings will be connected first, second, when would DG, new service, etc be installed.
- A new High Tension service to the Dibner Library, shown in blue on the Project Locations slide, would be expected to meet the HT spec EO-2022 rev 15.
- Since the customer is not permitted, by city code, to operate the Low Tension (spot network) transformers, open bus between transformers, and the associated network protectors the customer would have to either get a waiver from the Electric Advisory Board of the DoB (unlikely to be granted in our view though we could advise you on the application process). Without the waiver ConEd would not sell the equipment but would likely remove it so that the customer could install code compliant equipment. ConEd also owns the vaults which we might be able to value and sell to the customer. This would require a filing with the PSC who would have to approve the valuation.
- The feeders downstream of the Dibner Library would also be sold to the customer? Or parallel customer owned lines run?
- It appears that the supply to the customers downstream of the Dibner Library are connected through a single radial feed providing them with zero contingency delivery. If this is the case the PSC may have a concern.
- Is the customer expected to receive back up from ConEd? Subject to the Standby rate, how would the Contract Demand be determined. Would customer load be dropped if the Contract Demand is less than the fully connected peak load less the customer side generation?
- Is there a ConEd breaker upstream of the BlueBox such that ConEd can isolate any individual feeder for fault conditions and/or for work?

We look forward to meeting with you to discuss these issues further. And would be very interested if you are able to share your Microgrid Impact model. Legal contact on our end is Susan Vercheak cc'ed in this email and at 212-460-4333 Best. Margarett Jolly

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Tuesday, August 30, 2011 7:59 PM
To: Jolly, Margarett L. <JOLLYM@coned.com>; Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>
Cc: Leighton, Allison <LEIGHTONA@coned.com>; Sherri Sklar <sherri.sklar@campusgreenup.com>; Fanek, Baeth <FanekB@coned.com>; Bruce, Karen <BRUCEK@coned.com>; Vercheak, Susan J - Regulatory <VERCHEAKS@coned.com>; Mimnagh, Thomas P. <MIMNAGHT@coned.com>; Ghafurian, Reza <GHAFURIANR@coned.com>; Seidman, Elissa <SEIDMANE@coned.com>; Luong, Richard <LUONGR@coned.com>; Logsdon, David R <LOGSDOND@coned.com>; Carbonara, Joseph <CARBONARAJ@coned.com>
Subject: RE: NYU Poly Project

Margarett,

Thank you for your detailed reply. As noted below, I think a face to face meeting to discuss some of the finer points would make sense, and we are available ASAP.

I would like to give some quick answers to some of the points such that some of the biggesr misconceptions are dealt with. Again, we look forward to going through the finer points in person.

Please see my notes in **RED.**

Thanks Again,

-Alan McDonnell
Non-Synchronous Energy Electronics, LLC
(603) 546-5785

- What is the expected phasing of the project. E.g. which buildings will be connected first, second, when would DG, new service, etc be installed.

We will need to get back to you on this as we are still discussing with all the potential end users. One design principle of the microgrid is the ability to add more modules in parallel as we go, like a data rack.

- A new High Tension service to the Dibner Library, shown in blue on the Project Locations slide, would be expected to meet the HT spec EO-2022 rev 15.

Will Do.

- Since the customer is not permitted, by city code, to operate the Low Tension (spot network) transformers, open bus between transformers, and the associated network protectors the customer would have to either get a waiver from the Electric Advisory Board of the DoB (unlikely to be granted in our view though we could advise you on the application process). Without the waiver ConEd would not sell the equipment but would likely remove it so that the customer could install code compliant equipment. ConEd also owns the vaults which we might be able to value and sell to the customer. This would require a filing with the PSC who would have to approve the valuation.

We very much appreciate your help on this. I expect that the easiest solution is for us to remove Con Ed transformers and replace with ones owned by the microgrid. It is understood that this will need more discussion, and we may need the involvement of an experienced NYC Contractor/Engineer to guide us through the code issues.

- The feeders downstream of the Dibner Library would also be sold to the customer? Or parallel customer owned lines run?

The slides were perhaps not as clear as they should have been. The way the microgrid works is that there will be many (6-8) separate 27kV feeds coming out of the Dibner Library. They will all be new, installed and owned by the microgrid. They operate like the existing multiple feeds into a building operate now, in that they will each go to several buildings and at each building the low voltage side of the transformers will be connected together.

An important part of the design, and business model, is that each building disconnects itself from Con Ed and gets ALL of its power from the microgrid.

- It appears that the supply to the customers downstream of the Dibner Library are connected through a single radial feed providing them with zero contingency delivery. If this is the case the PSC may have a concern.

As per the note above, there will be as many feeds to each building as there are now. The drawing was a bit too simple, but what it meant was that they all run in the same conduit, or parallel conduits. It is important for our sales purposes that we guarantee reliability that is at least as high as they have now.

- Is the customer expected to receive back up from ConEd? Subject to the Standby rate, how would the Contract Demand be determined. Would customer load be dropped if the Contract Demand is less than the fully connected peak load less the customer side generation?

The customers receive no power from Con Ed, only from the microgrid. The microgrid receives power from on-site generators AND new Con Ed high tension service. We will need to discuss the maximum possible load draw from Con Ed and tariffs and rate structures. That is more of a business discussion that I will leave to Guy and Matthew for now.

Technically, the system should be designed to supply all of the peak power they use now, even in the event of a fuel disruption that knocks out all of the generators. Note that the Con Ed feeds are always active, so the change would be seamless, but the active rectifiers are capable of drawing full load (20MW+) in about ¼ cycle. We can go into details about this subject as we move forward. For Howard U. with Pepco, we agreed to always draw at least 1A from each of the 6 feeders (which they monitor continuously through a new modem link), such that the integrity of the feeders is always known.

- Is there a ConEd breaker upstream of the BlueBox such that ConEd can isolate any individual feeder for fault conditions and/or for work?

Yes, usually required by code. We have such an agreement in place with Pepco at Howard. They have remote trip capability through a modem, but not remote close. They can manually access a breaker and lock it out. It can be thrown anytime, even under load, without damage, but it does not shut down the microgrid output.

See slide 13 of the attached presentation from Good Friday, which shows the Howard Interconnection.

We look forward to meeting with you to discuss these issues further. And would be very interested if you are able to share your Microgrid Impact model. Legal contact on our end is Susan Vercheak cc'ed in this email and at 212-460-4333

Best.

Margarett Jolly

-Alan

From: Guy Warner
Sent: Wednesday, August 31, 2011 8:52 AM
To: Jolly, Margarett L. <JOLLYM@coned.com>
Subject: RE: NYU Poly Project

Dear Margarett:

Thanks so much for the list. Would it be productive for my attorney to speak with Susan Vercheak before the next meeting or would you prefer to wait on that?

Coincidently, I have been using information from ConEd's excellent 2010 DG Collaborative Report to the NY PSC for completing our microgrid impact study and I believe that Susan Vercheak was the attorney on that effort. Later today, I will send drafts of the microgrid impact work and copies of the associated Excel spreadsheet models.

In the meantime, I am reading that ConEd has laid 93,000 feet of new cable and restored 85 percent of the power outages due to the Storm. Amazing!

All the best,

Guy G. Warner
CEO
Pareto Energy LTD

From: Jolly, Margarett L.
Sent: Friday, September 02, 2011 8:58 AM
To: Alan McDonnell; 'Matthew Fairy'; 'Guy Warner'
Subject: RE: NYU Poly Project

HI Alan, I'm working on scheduling folks – will likely be between Sept 14th and 23rd. (I'll be away until the 14th). Will you be bringing legal to this meeting?

Also, lets start working on meeting agenda items!

Best, Margarett

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Friday, September 02, 2011 9:14 AM
To: Jolly, Margarett L. <JOLLYM@coned.com>; Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>
Cc: Frederick.Fucci@aporter.com
Subject: RE: NYU Poly Project

Margarett,

Yes, Guy would like to bring a legal rep.

I was thinking that we may want to allow for the meeting to be split at some point in the interests of time such that I can deal with the technical issues with engineering and the legal / commercial discussions can be done at the same time?

Whatever works best for you.

I will get Guy to send a separate note if he has specific requests for the agenda or attendees.

On the technical side, I would like the agenda to include whatever it needs to such that the necessary Con Ed folks have a good understanding of what we plan to do and can offer suggestions, like you've been doing, on unique code and compliance issues we need to address. Same to on the legal / commercial front, such that at the end we can get something in writing from Con Ed regarding there being no deal-breaking Con Ed issues, that we can take back to both end users and financiers to justify investing the money necessary for the detailed project studies and formal applications.

Thanks,

-Alan McDonnell

From: Guy Warner [mailto:gwarner@paretoenergy.com]
Sent: Friday, September 02, 2011 9:14 AM
To: Jolly, Margarett L.
Cc: Alan McDonnell; Matthew Fairy
Subject: Re: NYU Poly Project

Dear Margarett,

We will involve our attorney if and when you think it is optimal. My sensation is that a teleconference between our attorney and yours now might make the mid September meeting more productive. What do you think?
Sent from my iPhone
All the best
Guy
Guy G. Warner
Chairman and CEO
Pareto Energy LTD
Tel: (202) 247-6171

From: Jolly, Margarett L. [mailto:JOLLYM@coned.com]
Sent: Friday, September 02, 2011 9:25 AM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Alan McDonnell <alan.mcdonnell@nonsynchronous.com>; Matthew Fairy optonline <mfairy@optonline.net>; Vercheak, Susan J - Regulatory <VERCHEAKS@coned.com>
Subject: RE: NYU Poly Project

Hi Guy, agreed that telecom between lawyers is a good idea prior to broader meeting. For ConEd legal rep will be Susan Vercheak – 212-460-4333, cc'ed on this email as well.

Best, Margarett

From: Fucci, Frederick R. [mailto:Fred.Fucci@aporter.com]
Sent: Friday, September 16, 2011 7:28 AM
To: alan.mcdonnell@nonsynchronous.com; Guy Warner <gwarner@paretoenergy.com>
Cc: Shalom Flank <sflank@paretoenergy.com>
Subject: Re: NYU Poly Project - call with Susan Vercheak

Guy -

I had an introductory call with Susan Vercheak Thursday afternoon. As I was heading to the airport, I couldn't speak to her as long as I would have liked. However, I did broach the two main issues I took away from our call on the 8th, namely whether Con Ed would be willing to sell the transformers to Pareto and who owns the vault.

On the transformer issue, Susan said that Con Ed has no objection to selling them to Pareto. Con Ed would have to have them valued and get PSC approval. However, she said that Con Ed feels duty-bound to tell purchasers that they are utility grade transformers and that their understanding of the NYC building code is that there are limitations on who can operate them, namely only utilities. If a non-utility company wanted to operate them, this would require a waiver from the Electric Advisory Board to the DOB - and Susan says they are difficult to obtain.

I asked if she could point me to the relevant regulation so I can check the exact terms. She said she would forward something to me. If she doesn't, I can run it down myself.

I didn't have time to discuss the vault issue with her in any depth.

When I described the overall project to her, she did not seem familiar with the Burrstone decision, so I explained to her what it meant. I will follow up with her on the point.

I will try today to schedule a follow up call with her on Monday. In the meanwhile, if you have further things you'd like me to ask her, please let me know.

Best.

Fred Fucci
Arnold & Porter LLP
399 Park Avenue
New York, NY 10022-4690

Telephone: +1 212-715-1323
fred.fucci@aporter.com
www.arnoldporter.com

From: Fucci, Frederick R. [mailto:Fred.Fucci@aporter.com]
Sent: Friday, September 23, 2011 6:19 PM
To: Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>
Cc: alan.mcdonnell@nonsynchronous.com; Matthew Fairy optonline <mfairy@optonline.net>
Subject: RE: NYU Poly Project - call with Susan Vercheak - Follow-Up

Yesterday, I had a follow up call with Susan Vercheak of the Con Ed Law Department regarding legal issues associated with the NYU/Poly Project.

I began by asking her if she had had any further discussions with Margaret Jolly or any of the other business people. She said that she had not. However, she said that Con Ed was taking Pareto's requests quite seriously and that they were posing novel and interesting questions.

Transformers

We discussed again whether Con Ed would be willing to sell the transformers to Pareto. She reiterated that Con Ed would be happy to sell them to Pareto. She asked specifically which transformers Pareto would want. If you are willing to give this information to Con Ed at this time, please provide it to me.

We discussed in more detail the issue of what the New York City Electrical Code would require for a non-utility entity to operate the transformers. She said she would forward to me the relevant provisions of the NYC Electrical Code, which she has not yet.

We drilled down a little on the source of the problem, which is that under the Code, a utility is allowed to operate the transformer at a lower level of Code compliance on the assumption that the Con Ed crews can operate more challenging equipment.

I asked if Susan was aware of any private party that has operated its own transformers. I didn't want to reference FCR directly since I hadn't heard back from you as to whether they operate any of their own. Susan said that one customer had explored this issue. As far as she was aware, the Electric Advisory Board, which advises the Department of Buildings on the Code, didn't rule on it, but that they were looking for substantial investment to improve the installation, again on the theory that Con Ed can operate assets with lower compliance levels, but if it is someone else, they will want upgrades to the equipment.

As to whether there were other customers who operated their own transformers, she said she would inquire.

Vault Ownership

I asked Susan if she knew who owns the vaults. I explained a little about how they are locked and under Con Ed control, but that ownership is not necessarily clear. She did not know. She said she would track it down.

Approvals

Susan asked me what kind of approvals we were going to need. We talked about NYC permits and the need to get a consent from the City to cross the streets. I discussed the Burrstone ruling from the New York PSC. She seemed unfamiliar with it. I followed up by sending a copy to her and said I would also provide some analysis.

Standby-by Tariff

Susan asked me what my view is on the appropriate stand-by tariff for the project. The only Con Ed stand-by tariff of which I am aware is SC-14, which normally would apply to a single customer DG project. I explained that the idea here is that the participants in the mini-grid would be removed from Con Ed and that the Con Ed grid would connect only through the grid link boxes, such that if the NYU/Poly cogen plant is down, Con Ed will provide back-up power to the mini-grid. Susan was not sure that SC-14 is the right fit for this situation. We agreed that we would give more thought to this issue.

Follow-Up

Susan asked if we could speak again the week after Rosh Hashanah, e.g the week of October 3. If we had anything pressing for her, though, she will be in Monday the 26th and Tuesday the 27th.

Obviously, I could provide answers to some of the open questions or form views by doing some research. However, I am holding off on this pending Guy's more specific approval.

Please let me know what follow up you would like on my end.

Best regards.

Fred Fucci
Arnold & Porter LLP
399 Park Avenue
New York, NY 10022-4690

Telephone: +1 212-715-1323
fred.fucci@aporter.com
www.arnoldporter.com

From: Fucci, Frederick R. [mailto:Fred.Fucci@aporter.com]
Sent: Wednesday, October 05, 2011 4:39 PM
To: Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>
Cc: 'alan.mcdonnell@nonsynchronous.com' <alan.mcdonnell@nonsynchronous.com>; Matthew Fairy optonline <mfairy@optonline.net>
Subject: RE: NYU Poly Project - call with Susan Vercheak - Follow-Up

Guy, Shalom -

Haven't heard anything from Susan Vercheak in a while, I will follow up with her.

From: Fucci, Frederick R. [mailto:Fred.Fucci@aporter.com]
Sent: Monday, October 17, 2011 5:08 PM
To: 'Alan McDonnell' <alan.mcdonnell@nonsynchronous.com>; Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>
Cc: Matthew Fairy optonline <mfairy@optonline.net>; Alan McDonnell <amcdonnell@paretoenergy.com>
Subject: RE: NYU Poly Project - call with Susan Vercheak - Further Follow-Up

Susan Vercheak had told me that she would be available early last week to discuss. I never heard from her, so I followed up with her on Friday. I got a note from her today that she is available to speak Wednesday afternoon, so I have a call scheduled with her at 3:30 pm on Wednesday the 19th.

I'll ask about the letter of support. Let me know if there is anything else you would like me to ask her about.

Best. Fred.

From: Fucci, Frederick R. [mailto:Fred.Fucci@aporter.com]
Sent: Wednesday, October 19, 2011 6:28 PM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Matthew Fairy optonline <mfairy@optonline.net>; Shalom Flank <sflank@paretoenergy.com>
Subject: NYU / Poly Project - Further call with Susan Vercheak / Inquiries re Letters of Support for NYSERDA Application

Guy -

As planned, I had a follow up call this afternoon with Susan Vercheak of the Con Ed law department regarding the NYU Poly project. Following is a summary of what we discussed.

- General - I began by asking her is there is anything she could tell me in general about the project. Susan said that she had heard that Margaret Jolly had spoken to Matthew Fairy fairly recently about the project. Her understanding of what Margarett told Matthew is that Con Ed is interested in continuing to work with Pareto to explore a microgrid for NYU Poly itself but is not interested in a microgrid that goes beyond NYU Poly. I asked her why and she was pretty direct, namely that Con Ed is not enthusiastic about losing customers to another entity. Perhaps Matthew can let us know if this is a correct characterization of his conversations with Margaret.
- Meaning of Con Ed Support - I asked what Susan's understanding was of what Con Ed support for the NYU Poly aspect means. She thinks it means that technical discussions can go forward on how a microgrid serving NYU Poly can be developed.
- Further Meetings - Regarding Margaret Jolly, she is apparently out-of-pocket this week and next - at a special conference - but is willing to schedule meetings afterwards to go forward on the NYU Poly part.
- Sale of Transformers - I asked whether Con Ed would still be willing to sell the transformers to NYU Poly or Pareto, as she said would be the case in our last conversation. She responded that Con Ed in theory could sell them, but that the specific transformers that serve NYU Poly also provide support to other parts of the distribution system. I understood that Con Ed will not be willing to sell these specific transformers for that reason and since they service other customers.
- NYC Code Requirements re Transformers - Regarding the operation of transformers if sold, Susan again referred me to the NYC Electrical Code, which exempts utilities from its requirements, but not other entities, such that it would be quite difficult for non-utilities to operate utility transformers. Attached is a link to relevant provisions that she sent me after the conversation. I have not yet had time to study these.
- Operation of Transformers by Other Customers In response to my question as to whether other customers operate their own transformers, Vercheak said there were some taking service under a modified high tension tariff that is no longer available. She said she didn't know who they were. She also said that that tariff ended in 1998.

- Ownership of Vaults - Susan asserted that Con Ed believes that it owns the vault. I asked her the basis for that belief. She said that she did not do a title search, but that she did have internal discussions. She could not be more specific.
- Burrstone Decision - I asked if she had time to look at the copy of the Burrstone decision that I sent her. She said that she did and that it was an interesting precedent. We talked a little bit about its implications, one of which is that is that the utility cannot in principle stop a qualified cogenerator from selling electricity to a neighboring facility if it meets the statutory criteria. She asked if I could provide some further analysis of this. If you do not object, I will do so.
- Letter of Support - I asked if she was aware of Pareto's request for a letter of support for the NYSERDA application process. Her understanding is that Pareto sent Margaret Jolly a letter asking for assurances on a number of points and that a response would go out "fairly soon". I asked if we would have to wait until Margaret gets back from vacation. She did not think so. I had the impression that the response will not be very positive.

Please let me know if you would like me to dig further into any of these points.

Best Fred

October 22, 2012
Roseanne Viscusi
New York State Energy Research and Development Authority
17 Columbia Circle
Albany, NY 12203-6399
Re: Pareto Energy LTD- PON 2474.

Dear Ms. Viscusi:

Please accept this letter in support of the application by Pareto Energy, LTD (Pareto) in response to NYSE RDA PON 2474 for Category B: Engineering Study. Specifically Consolidated Edison Company of New York, Inc. (Con Edison) supports Pareto's application to fund the engineering study in support of the technical interconnection of its technology. Pareto's application describes its Microgrid proposal for the Polytechnic Institute of New York University's Campus Green Up Program. The proposal is to install a grid interconnection technology into the New York City area network. The project would pilot the "Grid link" interconnection technology that Pareto projects will meet Con Edison's stringent technical interconnection requirements.

Pareto has made a series of presentations to the 3G and Strategic Planning Staffs of Con Edison as well as recently to Distribution Engineering. We understand that Pareto is preparing to explore the "nuts and bolts" of technical interconnection with the Con Edison Distribution System. In supporting this request for engineering studies, Con Edison notes that any technical innovation must also be reviewed in light of the business impacts. To date, in various discussions with Pareto, Con Edison has sought to highlight these business concerns that should be reviewed in tandem with the technical parameters of an interconnection are evaluated.

Con Edison notes that its support of this application for engineering studies is not an endorsement or statement of agreement with the details of the application. Con Edison reserves all of its rights to take whatever positions it deems appropriate on any applications that Pareto may make to Con Edison, New York City, the State of New York, or any other governmental agency with respect to any off-campus distribution that NYU Polytechnic Institute or Pareto might seek. Finally, Con Edison specifically disclaims any characterizations that Pareto makes in its application with respect to customers of Con Edison.

Con Edison is keenly interested in all interconnection technologies that allow DG to interconnect economically while maintaining our high safety and reliability requirements and we look forward to further exploring the potential for the Gridlink technology to address these requirements. Thank you for your consideration of this letter.

Sincerely,
Margarett Jolly

From: Jolly, Margarett L. [mailto:JOLLYM@coned.com]
Sent: Thursday, December 15, 2011 5:55 PM
To: Alan McDonnell <amcdonnell@paretoenergy.com>
Cc: Fanek, Baeth <FanekB@coned.com>; McAndrews, Thomas <MCANDREWST@coned.com>; Guy Warner <gwarner@paretoenergy.com>; Matthew Fairy optonline <mfairy@optonline.net>; alan.mcdonnell@nonsynchronous.com; Leighton, Allison <LEIGHTONA@coned.com>
Subject: RE: Con Ed / Pareto Energy meeting Dec. 13, 2011 follow up

Hi Alan, it was good meeting with your team this week – please see responses below! best, Margarett

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Wednesday, December 14, 2011 4:01 PM
To: Jolly, Margarett L.
Cc: Fanek, Baeth; McAndrews, Thomas; Guy Warner; Matthew Fairy optonline; alan.mcdonnell@nonsynchronous.com
Subject: Con Ed / Pareto Energy meeting Dec. 13, 2011 follow up

Dear Margarrett,

Thank you again for you and your team's time yesterday to meet with us regarding the NYU Poly Microgrid project.

We would like to get confirmation on the procedures moving forward with the project, as we understood from the meeting.

We plan to submit to Tom McAndrews a "Load Letter" and an updated one-line diagram and site plan drawing detailing what feeds we need for the active rectifiers, the power levels and redundancy needs, the site location of the connection points and the protection and controls. We will also confirm that you are in receipt of the necessary authorizations from the account customers. Correct – (I'm afraid I was not able to locate the original authorization letter – Allison?)

Separately will detail the "contract demand", which is a recurring cost and can be adjusted. Will need to be clear on conditions that allow for adjustments up and down.

We hope to have this letter and information sent shortly into the new year.

It is our understanding that once Con Ed receives this information, we can begin to negotiate the technical details as well as cost and tariff fees going forward. Once we receive one-line and application information we can clarify the technical protection requirement and how the tariff will be applied.

Please feel free to add any more detail you see as pertinent at this time, or any questions you have for us prior to your receipt of the load letter.

Again, thank you for your time,

Alan McDonnell
VP Engineering
Pareto Energy LTD
amcdonnell@paretoenergy.com
www.paretoenergy.com
2300 M St NW, Suite 831
Washington, DC 20037
Mobile: (603) 546-5785
Office: 202-973-6440
Fax: 202-973-3083

From: Matthew Fairy [mailto:mfairy@optonline.net]
Sent: Wednesday, November 30, 2011 2:45 PM
To: Jolly, Margarett L.; Nadkarni, Gurudatta
Cc: ddintino@poly.edu; George Zulick; ssklar@nyc.rr.com; 'Guy Warner'; Alan McDonnell; Leighton, Allison; Fanek, Baeth
Subject: NYU Poly microgrid
Importance: High

Dear Margaret and Guru,

I wanted to give you an update on the NYU Poly microgrid project we have been discussing since April of this year. You had asked us to get back with you if things got gummed up, they did a little- but seem to be moving in the right direction once again. After a huge amount of effort from Campus green up, Pareto energy, your incredible team from the 3G group, the Mayor's office, some finance sources and most importantly NYU Poly, Poly has almost unanimously agreed to move forward with the project. We still need a meeting with Con Edison to finalize some outstanding things, but the positive news is this has become a reality.

We would very much like to discuss these final points and get things rolling. You may remember last time we spoke by phone that you agreed we would meet again after receiving your letter. We would like to do a final meet (per your original request) and outline and cover any technical concerns with your engineering staff, Can you please give us some times and dates as soon as you can that work for you for the meeting - it would be very helpful if we could get this meeting done before the Christmas holidays.

Once again,

Thanks so much for your support, encouragement and cooperation.

Sincerely,

Matthew Fairy

From: Jolly, Margarett L. [mailto:JOLLYM@coned.com]

Sent: Friday, March 02, 2012 10:30 AM
To: Guy Warner; dcoran@smartgridobserver.com
Cc: Ackerman, Eric
Subject: RE: Slide of Microgrid Virtual Summit

HI Gang, here are my proposed slides and a few notes/questions on Guys slides:

Slide 3 – shouldn't arrows on Distribution be going out from B to the b's?

Slide 8 – it is NYC that includes 800MW of 'clean DG' by 2030. ConEd is committed to supporting the policy goals through working with customers, developers, and our own R&D on interconnection technologies.

Slide 38 – not sure what this means – very little of NYC power comes from PJM, though some does 'wheel' through NJ.

Slide 40 – I can add here there we're at the cusp of Phase II.

Best,
Margarett Jolly, PE
DG Ombudsperson
Consolidated Edison Company of New York
jollym@coned.com
212-460-3328
www.coned.com/dg

From: Guy Warner [mailto:gwarner@paretoenergy.com]
Sent: Monday, March 05, 2012 05:56 AM
To: Jolly, Margarett L.
Subject: RE: Slide of Microgrid Virtual Summit

Dear Margarett:

I still have the PJM slide in my deck. The context are the future plans for the direct current lines from New Jersey. I have two quotes about concerns in NJ and PJM about that:

"The single greatest challenge in the Mid-Atlantic region is how southeastern New York will meet its electricity needs in the years ahead ... As framed by a New Jersey public utility commissioner: '... There are at least 3,000 MW of projected projects that will take power out of New Jersey and run them across the Hudson River or the northernmost boundary or cross the water into Long Island out of New Jersey and out of PJM into New York . . . . And there are very few rules that indicate how New York has to make up for that deficit.' ... Similarly, according to PJM, 'We are as concerned as New Jersey that as we continue to try to solve and fix our problems, those solutions should not be simply used and leveraged by New York at an unfair arrangement.'" -- National Electric Transmission Congestion Study, U.S. Department of Energy, 2009

“In-City generation also benefits neighboring regions economically, especially New Jersey. More energy produced in NYC means that less energy must be produced and exported from New Jersey, lowering prices for consumers there. The development of new in-City generation capacity would also create economic activity and jobs in the City and region, both during construction and on an ongoing basis.”-- A Master Electrical Transmission Plan for New York City, New York City Economic Development Corporation, May 28, 2009.

All the best,

Guy G. Warner
CEO
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Offic: 202-973-6440
Fax: 202-973-3083

From: Jolly, Margarett L. [mailto:JOLLYM@coned.com]
Sent: Monday, March 05, 2012 8:30 AM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: Re: Slide of Microgrid Virtual Summit

Agreed those are concerns but my view is that they are highly inflated. Of course generators want to sell into the nyc markets (which might raise prices in pjm) and there are projected needs in nyiso (with many nys centric solutions) . However 3000MW is far above anyone's project needs. I think realistic is 1/3 that by 2016 if nothing else replaces Indian Point --- these will all be good discussion points for us! Gas infrastructure will be needed whether solution is distributed gen of not - though gas buildout is much more expensive in-city.....speak soon. Margarett

From: Shalom Flank [mailto:SFlank@ParetoEnergy.com]
Sent: Thursday, June 21, 2012 7:20 PM
To: Guy Warner
Cc: Alan McDonnell; Matthew Fairy
Subject: ConEd follow-up
Guy,

Matthew and I had lunch with Margarett Jolly yesterday. Great relationship-building conversation. The most substantive part was the discussion of standards-compliance for GridLink. She already believes that 1547 etc aren't the right standards for us, because we're always islanded. I was telling her just a little about our simulation results, and that we can now quantify the harmonics and our compliance with IEEE 519 -- she was very interested, so I went into the details about what we worked out with Pepco.

She said, it's definitely not too early for us to be having that conversation with ConEd engineers, and that she would set that up for us. I think it's good opportunity to connect with more of their technical team, give them more confidence that our solution will be good for ConEd too. And also an opportunity to firm up their commitments to us, without getting anywhere near Legal.

Thanks,

--Shalom

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Thursday, June 21, 2012 7:28 PM
To: Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>
Cc: Alan McDonnell <amcdonnell@paretoenergy.com>; Matthew Fairy <mfairy@paretoenergy.com>
Subject: RE: ConEd follow-up

Shalom,

As a bit of background, all of those issues were covered with Baeth, but he's 3G not Distribution Engineering. We were supposed to have a meeting with Distribution Engineering about this time last year, but then everything died when the legal war started.

If we can get a meeting with Distribution Engineering, that would be good. We should invite Baeth, or at least prep the meeting with the fact that none of these issues are new, everything was gone through at least once with ConEd.

-Alan

On Thu, Jun 28, 2012 at 2:53 PM, Shalom Flank <SFlank@paretoenergy.com> wrote:

Dear Mr. McAndrews,

At Margarett Jolly's suggestion, we are sending you a draft of the load letter for the Brooklyn Microgrid project at NYU-Poly. She thought you might want to review the letter before we submit it, and may also want to have a preliminary meeting to go over the one-lines and to discuss any related issues. We are happy to talk by phone or to meet at your convenience, once you've had a chance to review the attached.

As you may recall, Pareto has already had technical discussions with representatives from Distribution Engineering and from the 3G System of the Future group. Please feel free to invite those groups to a preliminary meeting, or to keep the attendance more limited, however you prefer.

We look forward to working together on this exciting project.

Thanks,

Shalom Flank, Ph.D.

CTO & Microgrid Architect
Pareto Energy LTD
SFlank@ParetoEnergy.com
202-797-8820 (direct)
202-973-6440 (main)

From: Shalom Flank [mailto:SFlank@paretoenergy.com]
Sent: Tuesday, July 10, 2012 4:17 PM
To: McAndrews, Thomas; Jolly, Margarett L.
Cc: Budu, Kwame; Guy Warner; Alan McDonnell; Matthew Fairy
Subject: Re: Load Letter for Brooklyn Microgrid <External Sender>

Dear Tom,

It was good talking with you and Kwame last week. We appreciate your taking the time to review the Brooklyn Microgrid project, especially with so many other demands on management's time at the moment.

We have incorporated the results of last Thursday's call into a revised load letter, attached. The letter now includes meter numbers for the loads at NYU-Poly, a recap of the transformer vault issues, and a revised site plan which preserves a 15' separation between feeders. Please let me know if you'll need anything else to move the formal process forward.

We are happy to travel to New York for a more in-depth technical discussion, including Distribution Engineering along with Margarett's and Baeth's groups. Just let us know what time may be convenient.

Thank you again for your assistance in moving forward with this new approach.

Thanks,

Shalom Flank, Ph.D.

CTO & Microgrid Architect
Pareto Energy LTD
SFlank@ParetoEnergy.com
202-797-8820 (direct)
202-903-0758 (main)

m: Alan McDonnell

Sent: Tuesday, July 31, 2012 11:55 AM
To: Shalom Flank <sflank@paretoenergy.com>
Cc: Guy Warner <gwarner@paretoenergy.com>; Matthew Fairy optonline <mfairy@optonline.net>; Brian Mehler <bmehler@paretoenergy.com>
Subject: ConEd response

Shalom,

I don't think the letter below should have been sent.

We were not expecting the letter from ConEd. The way I understood it was that the next action was an in person meeting that included Baeth and distribution engineering. This was on hold until the strike cleared.

We should have asked them why the plan had changed.

We should take exception to everything they wrote, and note that we had a verbal agreement on such issues as the N+1 feeders into the microgrid, and the 5MW per feeder rating. To not do so could be seen as a tacit acceptance of what they wrote. Note that this went through legal as well. Perhaps we should note also that the letter demonstrates a complete lack of understanding on their part of the operating principles of the Gridlink system, which is why we need the in-person meeting.

I think we should send back a strongly worded response taking exception, noting what already been agreed to verbally at the last in-person meeting of Dec. 13th, 2011 and requesting the next one ASAP, and insisting that Baeth attend.

We should keep this letter from being shared with others, especially Vanderweil.

-Alan

On Fri, Jul 27, 2012 at 4:02 PM, Budu, Kwame <BuduK@coned.com> wrote:

Dear Dr. Flank,

Please find the attached letter in response to your load letter.

Thank you.

Kwame Agyeman-Budu
Customer Project Manager

From: Shalom Flank
Sent: Monday, July 30, 2012 1:03 PM
To: Budu, Kwame
Cc: Tom McAndrews; Alan McDonnell; Matthew Fairy
Subject: Re: 5 METRO TECH - NYU-POLY MICROGRID - HIGH TENSION SERVICE - RESPONSE TO CUSTOMER LOAD LETTER

Dear Kwame,

Thank you for this initial response, and especially for getting the response to us when the company is so short-handed -- we appreciate your efforts.

As we had discussed from the outset, we would like to arrange an in-person meeting at Con Edison to discuss some of the issues involved, such as the redundancy requirements and the arrangements for the transformer vaults. Based on our previous discussions with them, we believe that Margarett Jolly and Baeth Fanek would like to attend, along with you, Tom McAndrews, and whoever Tom feels would be appropriate from Distribution Engineering.

We are happy to make the trip to New York at a mutually convenient time -- please let us know if you need any additional documentation in order to set the meeting. We also understand that there may be some delays while the lockout continues; it will be fine if you just keep us informed of what you think the timing may be.

Thanks again for your help,

Shalom Flank, Ph.D.
CTO & Microgrid Architect
Pareto Energy LTD

Memorandum for the Record

Re:	Meeting to review Microgrid project in the MetroTech neighborhood of Brooklyn, based at the NYU Polytechnic Institute.
Date:	14 August 2012
Attendees:	Tom McAndrews, Kwame Budu, Margarett Jolly, Bayeth Fanek (via teleconference), Dan Sammon, Tom Mimnagh, Dan Dabek (Con Ed), Alan McDonnell, Matthew Fairy, Shalom Flank (Pareto)

Introduction:

General discussion of the role of the Microgrid approach in simplifying the installation and operation of distributed generation, for both end-users and for the utility. Pareto description of their Microgrid technology as an island DG type system that will be connected to the Con Edison system through a rectifier and DC bus, and will take power in only one way. Discussion of the background of the previous 18 months of discussion with ConEdison's 3G System of the Future group and other ConEd personnel, and the role of this first meeting with technical staff within Distribution Engineering. Identification of the current project as an appropriate pilot project under ConEdison's commitments for DG under PlaNYC.

Issue #1: Level of utility service to the Microgrid

- Pareto currently has approximately 2.5 MW of load aligned and is seeking to obtain 10 MW in total, with 7-8 MW of load at a minimum. The 2.5 MW of load are from NYU Poly which is the "anchor tenant" at this time.
- ConEdison noted that its EO-2022 standard includes "second contingency" service, so that two feeders can be brought down without any impact on the customer. Con Edison stated they would typically provide a 3 feeder HT service for a 5MW load and a 4 feeder HT service for a 10MW load.
- Pareto is requesting "single contingency" service, with only a single redundant feeder, intending to rely on the Microgrid's own generating resources for the second contingency.
- ConEdison described the level of redundancy that other DG projects have paid for, including NYU's downtown campus, and issues that have arisen when other customers requested less than second contingency service (such as Montefiore) and were then dissatisfied with the level of service.
- ConEdison is also concerned about a draw on remaining feeders, if one or more feeders are out of service, that may exceed the requested 5MW per-feeder load.

Tentative agreement:

1) Pareto Energy will provide documentation that NYU Poly fully understands the difference between ConEdison's standard service and what is being requested for this project, including Poly's technical due diligence into Pareto's nonsynchronous inverter-based approach. The customer letter should explicitly recognize and accept the possibility of load-shedding and other measures that the Microgrid may take to meet load.
2) Pareto Energy will provide to Dan Sammon the "Sequence of Operations" document that it prepared for its interconnection approval with Pepco DC. Dan will review the brief descriptions of procedures for normal operations and various exceptional operations, including feeder outages, generator outages, gas supply outages, load shedding, and black-start.
3) Pareto Energy affirms that it will set a hard limit on the power draw from each feeder – in this

case 5MW – regardless of load requirements and other circumstances. This limiting function is made possible by the "active rectifier" inverter front-end of the Microgrid.

4) Pareto also affirms Con Edison can take down any single feeder for emergencies or for repairs without notification, since it will not affect Microgrid operations.
5) ConEdison will make a preliminary estimate of the cost of installing the requested 3-feeder high-tension service.
6) Pareto and ConEdison will later agree on a Contract Demand amount for stand-by service for the Microgrid, or equivalent tariff arrangements.

<u>Issue #2:</u> Interconnection agreement for the Microgrid

- ConEdison noted that a pilot project featuring a new approach that does not follow existing specs (e.g., no collector bus) will require a greater level of scrutiny before approval.
- Pareto will provide the technical background, data, and in-person meetings as needed for Dan et al. to be convinced about zero fault current contribution, about the ability of the inverter front-end to shut down its draw in the event of a fault or other grid disturbance, and the elimination of power exports and harmonics back onto ConEd's feeders.

Tentative Agreement:

1) Dan Sammon will convene a group of ConEdison experts, such as himself and Guillermo Sibucao, to conduct additional technical sessions with Pareto as needed to assure that all safety and operational needs are met by the "GridLink" approach, and to identify its potential benefits from the utility's perspective.
2) ConEdison will provide feedback and guidance on any revisions needed for the one-line diagram to be complete (e.g. adding a G&T device on the primary feeder).
3) ConEdison and Pareto will work together to document the features and requirements of the Microgrid in a microgrid interconnection agreement that can also serve as a template for other projects using similar technology. Margarett will provide a template. The agreement will be between ConEdison and the Microgrid company, and will include commitments such as lock-out provisions, a limit of 5MW power draw per feeder, compliance with IEEE 519 limitations on total harmonic distortion, and so on. Pareto will provide to ConEdison the equivalent commitments documented by Pepco in their interconnection approval letter, as a potential model for ConEdison to provide engineering-level approval on the Microgrid project.

<u>Issue #3:</u> Vault transfer

- Pareto expressed a desire to re-use the existing customer transformer vaults that will be vacated as soon as the customer no longer needs to be connected to the ConEd grid (once the Microgrid is operating).
- ConEdison noted that although the vault space is permitted via a Revocable Consent permit with DOT, that the utility owns everything within the space. ConEdison has no experience with the process for transferring vaults to anyone else, since the Microgrid is the first project that would be able to make use of the constrained space while still being NEC compliant. The Microgrid would be responsible for working with DOT to ensure an appropriate Revocable Consent permit is in place.
- ConEdison noted that once its equipment has been removed, if the customer would like to restore service through that vault, the costs of doing so would need to be borne by that customer.

- The street-tie circuits are the primary concern, since they serve other customers besides Microgrid participants. A "second contingency" level of service would still need to be provided for all customers on the low-tension network.

Tentative Agreement:

1) In order for ConEdison to transfer the vault, the customer currently served through that vault needs to certify that they are giving up direct service from ConEdison when switching to the Microgrid, and that they recognize their responsibility for any costs if direct ConEd service were restored within (for example) five years.
2) Economic allocation still needs to be worked out, based on cost of removing existing transformers, the value of those transformers, security deposits or taxes (if any) with the city, etc. ConEdison will provide a preliminary estimate of the cost of removal and any other economic considerations.
3) Placement of additional low-tension assets such as street feed transformers may be required to maintain the required level of service on the street-tie network. ConEdison will propose a preliminary approach for any additional work needed on the low-voltage side for the two vaults in question, along with a preliminary cost estimate.

Additional minor items:

- For the proposed Microgrid underground vault where the new high-tension feeders would terminate, standards have changed. Equipment now needs to be submersible if a site is in a Category 3 flood zone. ConEdison will take a look at this site, and provide additional information.
- A qualified switchman is required on-site 24/7 to operate the high-tension equipment.
- A brief discussion outlined ConEdison's HT process: 1-line, 30% design submittal, 60% design submittal & Mfr. Dwgs.
- Pareto was informed that installing new high-tension service can take as long as 18 to 24 months from approval of the service request.
- The Load Letter should clarify that Pareto's request is not for standard high-tension service, which involves a collector bus, coordinated breakers, etc., but instead for simple radial service.
- ConEdison can provide interim documentation of progress on the Microgrid project, for example for grant agencies such as NYSERDA.
- Dan Sammon can work with Pareto to determine the most appropriate standards for the "always-connected / always-islanded" microgrid approach (e.g., IEEE 1547, UL 1741, IEEE 519, UL 347A)

TELECONFERENCE MEETING ON FRIDAY, September 14, 2012 AT 9:00 A.M.

Attendance:
Pareto: Alan Mcdonnell, Guy Warner, Shalom Flank, Mathew Fairy

Con Edison: Dan Sammon, Kwame Budu

ONE-LINE DIAGRAM
The customer was notified that, their existing one-line diagram does not have the downstream information required to have a complete drawing to review. We requested that, the customer must show how the customer's rectifier and generator will be connected to Con Edison's electrical grid and to make sure they are connected correctly, reliably and operate efficiently.

Alan stated that, instead of revising the existing drawing, he will provide to Con Edison a written description of the downstream configuration and the sequence of operation (the sequence of operation has already been sent to Kwame Budu, of which I confirmed receipt). The description will clearly show how their generator is tied to their rectifier and the rectifier tied into Con Edison's electrical grid. Alan promised to forward the required information to Con Edison by the close of business on Monday, 9/17/12.

Dan informed the customer that, if a written documentation will be provided, and to clearly describe the downstream of the one-line diagram it will be accepted for a review. And upon receipt of the required information, Con Edison will review the document and schedule a meeting if required. We have tentatively agreed to have a meeting schedule during the week of 9/24/12.

Action items:

1. Written Description of how the customer's generator and rectifier are tied to Con Edison's electrical grid (Alan)
2. The customer sequence of operation to be forwarded to Dan (Kwame Budu – Copy is forwarded to Dan).
3. Next meeting date (base on submission and completion of review)

From: Guy Warner
Sent: Friday, September 14, 2012 4:49 PM
To: Jolly, Margarett L. (JOLLYM@coned.com)
Subject: Concerns about Communications with Consolidated Edison

Dear Margarett:

I am reaching out to you in your role as Consolidated Edison's Distributed Energy Ombudsperson to express my concerns about our work with Kwame Badu.

Please refer to the action items from the attached minutes of Pareto Energy's August 14th meeting with Dan Sammon that Kwame approved.

On August 22nd, I provided Kwame with all the information that was requested by Dan Sammon: namely the Sequence of Operations document that Pareto Energy prepared for its interconnection approval with Pepco DC. In turn, Dan was supposed to convene a group of Con Edison experts to conduct additional technical sessions with Pareto as needed to assure that all safety and operational needs are met by the "GridLink" approach, and to identify its potential benefits from the Utility's perspective.

We learned today that Kwame decided not to forward the information that Dan requested. His minutes of a conversation between Dan, Alan, and I are attached. As the minutes state, of course, we are willing to provide additional explanations of plans for generators downstream of GridLink's active rectifier. You will know that we have been doing so since April 2011 and David Pearce and Tom Mimnagh of the Distribution Department have received copies of those explanations at one time or another in 2011. No worries. We will now re-assemble them for Dan Sammon.

However, I remain concerned that Kwame's minutes continue to wonder how the "generator will be connected to Con Edison's electrical grid". Pareto Energy, on behalf of NYU-Poly, is not seeking a parallel interconnection of a generator to Consolidated Edison's Grid. NYU, went through the time and expense involved in that type of permitting for its CHP installation at Washington Square. When Pareto Energy was engaged to plan the NYU-Poly CHP project, we observed that "this type of approach is not the preferred interconnection method for Con Edison and may be cost prohibitive for the customer" (quote from Consolidated Edison's Distributed Generation Collaborative Final Report). Also, we were aware of Consolidated Edison's commitment in its 2010 Long Range Electric Plan to "… continue partnering with customers and other stakeholders, including … distributed generation advocates, to facilitate the interconnection of distributed generation installations and examine the opportunity to pilot new projects and concepts." (quote from Page 48 in the part of the Long Range Plan that is entitled Assessment Documents: Distributed Generation.)

Therefore, we have proposed an electrical arrangement that results in an efficient, safe and reliable system, where back-to-back converters provide for the use of power from both a customer-owned CHP system and from Consolidated Edison's grid, but with a separation of voltage, frequency and phase-angle between the two systems. The GridLink technology is conceptually the same as back-to-back converters utilized throughout the industry to ensure reliable operation between utility systems. It has been previously endorsed by consulting electrical engineers and by utility engineers(see letters attached). The utilities used the same one-line information and explanations of generation plans down-stream of the active rectifier that we have provided to Con Edison.

Pareto Energy shares the concerns that Tom Mimnagh so clearly expressed at the August 14th meeting about the risks of a parallel interconnection of generators such as the type that was approved for the NYU CHP system at Washington Square. That is why we invented GridLink and that is why I asked you to arrange a second conversation with Tom. You can count on me to apologize for Matthew's unfortunate argument with Tom. Recall, however, that Kwame never communicated to us that Tom was attending the meeting – we have known about his concerns at NYU Washington Square for some time so we could have arrived with documents to compare that interconnection approach versus what we are proposing with GridLink. It is also unfortunate that Kwame never communicated to us Tom's request for NYU-Poly authorities and facilities managers to attend the meeting – we could have brought them with us, avoided the unpleasantness, and held useful discussions about how GridLink can solve the problems that Tom indicated were "keeping me up at night".

In sum, we are not getting the cooperation from Kwame that we deserve. We need to know what the Distribution engineers want so we may respond in an efficient, professional and cordial way, and, when sending them information that they requested, we need to know that they are receiving it.

There are numerous entities in New York City considering customer-owned distributed generation – both City-owned and privately-owned – that do not want to incur the time and expense of parallel synchronous interconnection. Their in-house and consulting electrical engineers share the same safety concerns that Tom Mimnagh discussed and they have taken note from the DG Collaborative that Consolidated Edison does not prefer this type of interconnection. These seasoned and experienced electrical engineers buy into the GridLink solution and are waiting to see if Con Edison will approve the use of non-synchronous microgrids for the NYU-Poly proposal as was done by Northeast Utilities and PEPCO. We do not want to have to report to them that work between Alan and Shalom with Con Edison's Distribution Department was unproductive because of Kwame's failure to communicate.

All the best,

Guy

Guy G. Warner
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Office: (202) 903 0758

From: Jolly, Margarett L. [mailto:JOLLYM@coned.com]
Sent: Friday, September 14, 2012 5:53 PM
To: Guy Warner
Subject: RE: Concerns about Communications with Consolidated Edison

Was your conversation with Dan this morning not specific in terms of his requirements for the one-line diagram?

While I know that you continue to say that the interconnection will not be parallel that is not our view and we cannot use that wording until we have a clear picture of what is downstream of the gridlink and its interactions, if we are providing backup then from our point of view you are parallel!

I am sorry that Kwame is not providing the level of comfort you need. Perhaps a meeting with our executives so you know we are dedicated to providing quality service. Meanwhile the interconnection process for a high tension standby service is the interconnection process you need to follow, and it seems that you are asking for something else – basically saying 'trust us' while we are saying 'show us'!

Best, Margarett

CONSOLIDATED MINUTES OF MEETING
WEDNESDAY, 1/9/2013
NYU-POLY MICROGRID HIGH TENSION PROJECT

Attendees:

Con Edison: Budu Kwame, Tom McAndrews, Rosanna Zranchev, Tom Mimnagh, Dan Sammon, Guillermo Sibucao, Dan Dabeck, Sergey Dinershteyn, Baeth Fanek, Margarett Jolly (phone)
NYU-Poly: George Zulick, Francisco DeLeon, Darius Czarsowski and Kurt Becker (phone)
Pareto: Shalom Flank, Alan McDonnell, Matthew Fairy, Brian Mehler

Load/Scope

NYU-Poly is requesting 3-feeder service initially. NYU-Poly will include space for a 4th feeder in their design. Con Edison agreed to use the three existing feeders at Dibner Library.

Con Edison current policy for distributed generation still requires 2nd-contingency service.

NYU-Poly should limit their load to 5 MVA, until either adding the 4th feeder or reaching agreement with Con Edison on designating the on-site generation as the second contingency.

Con Edison agreed to provide a capacity of at least 5 MVA for each feeder. Once specific meter numbers for all microgrid loads are provided, and assuming that all microgrid loads are substitute loads already on the Con Edison network, then Regional Engineering can perform an analysis of the specific feeders involved, and calculate whether the 5 MVA rating can be increased. This capacity estimate may be more favorable, if Con Edison is assured that GridLink can successfully set and control the maximum load seen by each feeder.

Con Edison acknowledged that their long-term intention is to work out policies for which on-site power and microgrids would be reliable enough to designate as the second contingency, but has not yet taken any concrete steps in that direction.

All parties agreed to re-visit the 2nd-contingency issue at a later date.

Cost and Risk Acknowledgements

NYU-Poly customer representatives acknowledged and discussed their responsibilities under this project plan:

Since no new load is being connected, Con Edison costs for new service will be at expense of the project.

Since NYU-Poly buildings will now only be connected to the microgrid and not to Con Edison, all service issues and calls must be directed to the microgrid operators and not to Con Edison. Con Edison assistance during emergencies with building disconnects and similar issues within the microgrid cannot be assumed.

Any request to re-connect Poly buildings with the Con Edison grid would require NYU-Poly to cover all associated costs. Pareto clarified that this agreement would be required not just from NYU-Poly but from all future participants in the microgrid.

Con Edison expressed appreciation for the attendance of the NYU-Poly representatives and their clear statement of the customer's perspective.

Customer's Load Sharing and Redundancy

Con Edison desired to understand how load sharing and redundancy is achieved internally for the microgrid. Con Edison explained the impact on Company reputation and operations, if the loss of a single Con Edison feeder were to disrupt service to an internal microgrid customer.

Pareto agreed to provide a "typical of N buildings" addendum to the one-line drawing, showing how redundancy of service is provided to each building within the microgrid and demonstrating that the loss of any given Con Edison feeder cannot disrupt service to a customer's load.

Inverter/Rectifier

Con Edison was again informed that Pareto's inverter-based "Active Rectifier" cannot back feed any power, and appears as a load only. Con Edison requested that additional explanation be provided to Dan Sammon of how this functionality is achieved, including inverter behavior if a feeder is taken off-line. Pareto agreed to provide a brief explanatory white paper on the theory of operations for this equipment, including how an inverter functions as a rectifier.

Con Edison was again informed that the requested high-tension service will be for three radial feeds, and that the feeders will not be networked in any way. Con Edison acknowledged this information, and requested that the submitted drawings comply with Con Edison's 2022 spec for radial feeders. Con Edison suggested an analogy with the Company's current arrangements with the MTA, which uses 3000 KVA rectifiers.

Con Edison was again informed that the Active Rectifiers prevent any fault current from flowing onto the Con Edison system. Con Edison requested that additional explanation be provided to Dan Sammon of how this functionality is achieved when a fault occurs on a parallel feeder. Pareto agreed to provide a white paper presenting hardware-based computer results demonstrating this functionality. Con Edison agreed to review which requirements may be eliminated due to this functionality, including CLIP, transfer-trip, anti-islanding, network protectors, etc.

Con Edison suggested that at a later date, witness testing would be required for the actual hardware to measure the zero fault current contribution and the grid-fault ride-through behavior, including ½ cycle operation for a 3-phase fault on a remote feeder. The witness tests would be certified by Pareto and by the engineer of record, Company personnel do not need to be present.

Pareto suggested and Con Edison acknowledged that Con Edison will not see any benefits from voltage reduction, for a load served via GridLink.

Feeder Configuration

Pareto described their design-review conclusions in the wake of Storm Sandy, and requests an alternative feeder configuration that avoids below-grade equipment (even though the MetroTech Plaza area is not in a designated flood zone and above the storm surge line for a Category 3 storm). An alternative approach would provide Point of Entry at the sidewalk area on Tech Place, with customer-owned 27kV feeders in concrete-encased ducts directly to the roof of Dibner Library, with Cast Coil type transformers on the roof in two splice chambers separated by 20' (two feeders in one, one feeder plus room for a spare in the second).

Con Edison acknowledged the desirability of this alternative configuration. Pending further review, the Company could install primary and two (2) disconnect manholes (DMs) to meet the needs of the new service. Con Edison does not piggyback from vaults, so the existing sidewalk vaults at Dibner would not be needed in this configuration. Con Edison will provide cost estimates using the lowest-cost approach, including re-use of the three primaries at Dibner.

Design issues

Con Edison identified the microgrid-owned 3.3kV 52 breaker on the one-lines as the Point of Interconnection (POI), and requested that those three breakers be identified as 52IT1, 52IT2, and 52IT3, one for each microgrid, with voltage, current and MVA ratings.

Con Edison identified the desired interlock behavior of the main service breaker and the transformer secondary breaker.:

- They should be interlocked, so the secondary can't close until the primary breaker closes.
- The secondary must see stable voltage for (notionally) five minutes after 27kv breaker closes before re-closing.
- The secondary can't close if there is any possibility of reverse current, meaning it must measure that the DC bus voltage is higher than RMS*root2 of the 3.3kV feeder voltage.

Additionally, Dan will review to determine what, if any, of the anti-islanding protection of 1547 may still be needed.

Other relay protections, status, and ratings were requested by Dan Sammon. Pareto suggested including a simple statement, for example that all protective gear will comply with EO-2022, but this was considered insufficient, even for a Preliminary Review. The anticipated switchgear manufacturer may be able to provide some assistance in preparing the required documentation.

Con Edison requests that in addition to EO-2115, submitted designs should also use EO-2022, EO-4035, and the high-tension handbook (to be provided by Kwame). Guillermo specifically requested that the one-line include all the relevant items listed under EO-2022 Sec. 14.1.3, and recommended that the 52IT POI relay should include 32, 27, 59, and 81 O/U protections or their equivalent. EO-2022 recommendations on circuit breakers for radial installations and multiple-feeder substations (10.2.8 and 10.2.9) will also be relevant.

Con Edison provided some specific suggestions when revising the one-line drawings, including moving the utility metering to the line side of the main service breaker, providing a separate relay for 27/59 located on the load side of the main service breaker that trips the breaker directly, and uprating the main service breaker and switchgear to 38kV.

Minimum Imports and Contract Demand

Minimum import setting may be requested by Con Edison, to help them maintain real-time assessments of feeder status. If a minimum import is required, it will be set at the lowest possible rating (1 Amp or lower).

Contract Demand to be negotiated.

Schedule

NYU was informed that a typical HT design/build service will take approximately 18 to 24 months.

Service Date

Pareto will finalize their technical aspect of their technology and will notify Con Edison of their commencement of the project. At that point, a service date will be mutually set between the customer and Coned.

Follow ups

NYU to submit new load letter for 3 feeders and specify associated loads.

Pareto to provide the two requested white papers on Active Rectifiers and on Fault Current Elimination.

Pareto to submit new 1-line with more detail ensuring parallel of load on LV side.

Testing of new inverter/rectifier to commence this year by Pareto and will submit test results to Con Edison.

From: Shalom Flank [mailto:SFlank@ParetoEnergy.com]
Sent: Monday, February 25, 2013 4:41 PM
To: Jolly, Margarett L.
Cc: Alan McDonnell; Matthew Fairy; Budu, Kwame
Subject: What's different about connecting microgrids?

Dear Margarett,

On a recent conference call, you asked me what the differences are between a microgrid connection and a traditional interconnection process. The steps in the process may be somewhat similar. But just as there is a vast gap between what's required for a single-family rooftop solar application and a Rikers Island-type system, so too will the microgrid applications be radically simpler -- once Dan, Guillermo, and the rest of the technical team are fully satisfied that our design does everything that we claim it does.

I've attached a few small edits to your guidebook. You've already done an excellent job in focusing on the process, not the technical requirements or the expected outcomes, so the changes are quite minimal. But I also wanted to give you a taste of how much easier life will be for everyone, once our standard design has been approved.

Regardless of the details of a particular site or the condition of the Con Edison service at that site, every non-synchronous microgrid installation that is not exporting power will share the following characteristics, regardless of how large it is. (And note that these are essentially the same characteristics found when connecting any similarly sized load.)

- No synchronizing gear
- No fault current contributions
- No short-circuit studies
- No transfer-trip devices for generators, and no equipment at the substation
- No audio-tone requirement or other real-time communications links required
- No fast-transfer switches or commutating current limiters or other equipment for islanding
- No additional relays to prevent power exports
- In a networked grid, the high-tension service effectively becomes a set of radial feeders
- No inter-ties on secondaries and no associated breakers
- No isolation-only transformers (without step-up or step-down)
- No ring bus
- No anti-islanding requirements
- No flicker, output fluctuations, or harmonics
- Less restrictive settings for under-voltage trips and other ride-through conditions

Does this list give you a better sense of what we mean, when we make those grand statements about non-synchronous microgrids being a game-changer for interconnection?

As always, we are available to talk anytime in more detail about any of these topics.

Thanks,

Shalom Flank, Ph.D.
CTO & Microgrid Architect

From: Jolly, Margarett L. [mailto:JOLLYM@coned.com]
Sent: Monday, February 25, 2013 4:47 PM
To: Shalom Flank
Cc: Alan McDonnell; Matthew Fairy; Budu, Kwame
Subject: RE: What's different about connecting microgrids? <External Sender>

Hi Shalom, we agree that solving those problems would be very helpful. However to know that your standard design does any and all of those things listed below we'll need to kick the tires! Also yours is one type of microgrid interconnection so I'm not sure we can say that microgrids generically solve all those problems – the term 'microgrid' is used in many many ways, including ConEd dedicated supplies to network fringes.

Thank you again for your very helpful comments to the guide.

Best, Margarett

From: Budu, Kwame <BuduK@coned.com>
Date: Wed, Mar 27, 2013 at 2:18 AM
Subject: NYU POLY MICROGRID - COMMENTS ON WHITE PAPER
To: Shalom Flank <SFlank@paretoenergy.com>
Cc: "Sibucao, Guillermo" <SIBUCAOG@coned.com>, "Budu, Kwame" <BuduK@coned.com>

Flank,

Below is the comments on your submission of the White. Please review and respond. Let's arrange for a meeting after your response at your convenience.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
Distribution Engineering, Network Systems, 03-25-2013
NYU POLY MICROGRID
Con Edison Project File No. On File
Anticipated Service Date: To be provided by the Customer
Feeders: On File

The project is located in Brooklyn, NY. The project is for the installation of new three 27kv services consisting of high tension switch gears, transformers, high tension feeders, synchronous generators and active rectifiers to supply power to a microgrid.

Con Edison has reviewed the customer's two white papers submitted and the comments are as follow:

GRID LINK TECHNOLOGY: THE ACTIVE RECTIFIER FRONT END

1. Submit documentation from Pepco, Silicon Valley Power and Connecticut Light and Power to support the statements stated.

2. Elaborate more on "no net energy and no reactive power are supplied to the grid" and "appropriate controls to maintain these lock out". Identify the difference between energy and net energy.

3. Get Con Ed a date when can NYU complete the simulation studies for proper operation and for Con Ed to witness the simulation.

GRID LINK TECHNOLOGY: INVERTER BEHAVIOR AND RESPONSE TO FAULT CONDITIONS

1. Paragraph 6 - In case of a fault, what is the voltage differential to trip the inverters?

INVERTER TEST DATA and INFO

1. If a similar inverter to be used for the job has been installed and in operation, submit inverter info, settings test data for Con Ed's reference review.
2. Submit manufacturer's literatures of the inverters to be used by the project.

Thank you.

Kwame Agyeman-Budu

212-460-2599

March 28, 2013

Answers to Con Edison Questions about Pareto Energy's Two White Papers Provided in Telephone Call to Dan Sammon
Questions in Black; Answers in Red

The project is located in Brooklyn, NY. The project is for the installation of new three 27kv services consisting of high tension switch gears, transformers, high tension feeders, synchronous generators and active rectifiers to supply power to a microgrid.

There are NO synchronous Generators as part of the ConEd interface to the microgrid, nor are they necessarily part of the microgrid.

Con Edison has reviewed the customer's two white papers submitted and the comments are as follow:

GRID LINK TECHNOLOGY: THE ACTIVE RECTIFIER FRONT END

1. Submit documentation from Pepco, Silicon Valley Power and Connecticut Light and Power to support the statements stated.

2. Elaborate more on "no net energy and no reactive power are supplied to the grid" and "appropriate controls to maintain these lock out". Identify the difference between energy and net energy.

Not sure what the confusion is here, perhaps best left to an in person meeting. Mostly what we were trying to explain is that in normal mode, we only import power…no net energy goes backward. Even during an upstream fault, or simulation shows no energy being sent upstream.

3. Get Con Ed a date when can NYU complete the simulation studies for proper operation and for Con Ed to witness the simulation.

Not sure what simulation studies they are expecting, but we do need to submit detailed one-line drawings and installation drawings.

GRID LINK TECHNOLOGY: INVERTER BEHAVIOR AND RESPONSE TO FAULT CONDITIONS

1. Paragraph 6 - In case of a fault, what is the voltage differential to trip the inverters?

This is programmable. For Pepco we picked 70%, or a 30% dip, but in a meeting with Dan Sammon in Sept. he expressed a wish for it to be calculated under a specific test scenario of a phase-phase fault on an adjacent substation feeder.

INVERTER TEST DATA and INFO

1. If a similar inverter to be used for the job has been installed and in operation, submit inverter info, settings test data for Con Ed's reference review.

2. Submit manufacturers literatures of the inverters to be used by the project.

We are hoping to do these tests and have this documentation from the factory in late April

From: Dawes, Gerald [mailto:DAWESG@coned.com]
Sent: Friday, April 19, 2013 3:25 PM
To: Dennis Dintino
Cc: Braz, Aubrey T.
Subject: NYU Poly project - ConEd update April 2013

Dennis,

Hope things are well.

I wanted to follow-up with you from our meeting yesterday (4/18) where we discussed the status of the Pareto Energy Microgrid Project.

There are 2 primary technical requirements that we continue to work to resolve with them. These requirements are described below. We have on-going communications with Pareto Energy and are optimistic that we will be able to resolve these technical issues. However, we cannot yet provide approval to proceed until these issues are resolved.

A brief description of the technical issues is as follows:

All customer Distributed Generation (DG) interconnection schemes must undergo our engineering review to ensure the following two (2) key elements:

1. Short-Circuit contribution/mitigation – (We require no current contribution (export) to the Con Edison system during short circuits (faults) on the Con Edison grid). In discussions, Pareto indicates that their inverter technology prevents short circuit current contribution because it is designed to remove their generation (and any contribution to a fault on the grid) faster than our existing substation circuit breakers. We have indicated that this will need to be reviewed in detail since the inverters are NOT UL 1741 tested (UL 1741 is the interconnection testing standard that indicates suitable operation for interconnecting DG's). Pareto has submitted test data that indicates the ability to mitigate fault current contribution and have indicated that they will be performing additional more pertinent testing that they will share with us. We eagerly await this additional information.

2. Anti-Islanding protection (For safety and other reasons we require no backfeed of power back to the grid when our feeder is denergized) - The interconnection requirements are also an item to be reviewed since the "non-UL 1741" inverter will need to have "anti-islanding" protection. This is standard protection that the UL-1741 tested inverters have incorporated into their operation. Pareto stated in meetings that because they are programming the inverter to act as a rectifier (They call it an "active rectifier"), the inverter does not need to follow the operating requirements detailed in UL 1741, since it operates much more like a rectifier (passive load) and cannot export back into the distribution system. This is an important issue since such a passive load characteristic will eliminate the need for the installation of a potentially expensive direct transfer trip anti-islanding protection. Pareto has submitted information regarding the inverter/active islanding capability, and we asked them subsequently to elaborate on the operation and the programming.

There has been considerable discussion with Pareto stretching over the last year and I expect that they will submit suitable documentation to satisfy our concerns. We are hopeful that they can. We think that the approach is doable but the devil is in the details, which is still sketchy. We are waiting on them to provide suitable documentation.

I will keep you posted as we move forward.

Thanks

Gerry

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]

Sent: Monday, April 22, 2013 8:41 AM
To: Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>; Alan McDonnell <amcdonnell@paretoenergy.com>; Brian Mehler <bmehler@paretoenergy.com>; Kevin McDonnell <kmcdonnell@paretoenergy.com>; Kenny Strachan <kstrachan@paretoenergy.com>; Shalom Flank <sflank@paretoenergy.com>
Subject: RE: NYU Poly project/Meeting with Con Ed

All,

Just so there is no misunderstanding, what ConEd is talking about isn't the drawings, Dan Sammon seems to accept that this is more of a 'dotting I's and crossing T's" type requirement that will get done once we hire and Engineer who has done these types of drawings on a previous project before.

Both of these points below relate to the testing of the actual inverter first units such that the real world test results confirm the computer simulations and the descriptions we sent in the white paper. A 'proof-is-in-the-pudding" kind of acceptance. The difficult part for us has been that they haven't been willing to grant a conditional type of approval the way Pepco did, they want to see an actual machine doing what we say it can.

To that end Woodward is building their first working unit of this type for use on an offshore wave generating machine where the distance from the land to the generator requires the medium voltage rating along with the multi-level waveform quality. The difference is that this inverter supplies power from the generator to the grid in a traditional manner.

They have had prototyping delays as is typical with this type of equipment, but they are almost ready to ship.

I have asked Woodward to allow me to be able to come and witness this unit once it is running but before it ships…a very narrow window of time.

I have also asked them to help us by taking it and setting it up as an active rectifier and show it taking power from the grid. I then asked if they could set up a jig that will allow them to mimic a large voltage dip on the input, and set the active rectifier controls up such that they trip as soon as they see this voltge dip. This will confirm the operation of both of the points mentioned below. We have sent computer simulations that show this, and now if we send real world information they will grant us the approval we seek.

Woodward has been good about doing everything they can to help us with this data, but it does get uncomfortable asking for more until we pay they the next installment.

These tests are so important to our future in NY that I will push them to get them done even if we agree to shut down the building of our unit until we raise the funds. Hopefully we will have this test data by Fri. May 3rd, and I can e-mail it from their office to ConEd.

-Alan

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Monday, April 22, 2013 8:50 AM
To: Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>; Alan McDonnell <amcdonnell@paretoenergy.com>; Brian Mehler <bmehler@paretoenergy.com>; Kevin McDonnell <kmcdonnell@paretoenergy.com>; Kenny Strachan <kstrachan@paretoenergy.com>; Shalom Flank <sflank@paretoenergy.com>
Subject: Further notes on ConEd

Just a couple more points;

The good part about what it written below is that it shows that the ConEd Engineers now understand our system. It has taken a while, but it is very valuable to have this understanding.

Further, the Kings Plaza project WILL require UL1741 rated inverters, interconnected in the traditional sense. I will discuss this during the next visit to Zurich. Woodward is working on a new 900VAC unit that should be able to meet the requirements. These units will be in the 1MW – 1.5MW range each. What is unique about Kings Plaza is how we will control the frequency of the islanded generator bus, and in general the arrangement for splitting the power distribution into multiple ConEd feeders.

-Alan

From: Alan McDonnell
Sent: Tuesday, April 23, 2013 12:29 PM
To: SAMMOND@coned.com
Subject: NYU Poly project update

Dan,

I just wanted to give a heads up in regard to our next deliverables to you on the NYU Poly project, based on notes I was given on a meeting that ConEd had with NYU, see below.

We have two new drawings to deliver, one on the electrical one-line with breaker details as per ConEd specifications, and the other a physical layout drawing showing connections into the ConEd feeders. Also required is the test data from the actual inverters that confirm the computer simulations that we had sent earlier.

When I read the email from Gerry Dawes, these look more like the test data concerns. My schedule is to travel to the manufacturer next week and hopefully send the test data to you by May 3rd. They have had prototyping delays as is common with new medium voltage equipment, but seem to have everything working now.

We hope to have the drawings done the week after that, we had been held up waiting for the finalization of the NYSERDA grant. As you know, Pareto is funding all of this, NYU Poly has not had to pay for any of our work, so the NYSERDA grant really does help after a couple years of work.

If you have any questions, please contact me anytime. I will be in touch as soon as I can with the data.

Cheers,

Alan McDonnell

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Thursday, April 25, 2013 7:56 PM
To: Matthew Fairy optonline <mfairy@optonline.net>; Guy Warner <gwarner@paretoenergy.com>
Cc: Alan McDonnell <amcdonnell@paretoenergy.com>
Subject: Ul 1741 Inverters

I now have confirmation can get the certification testing done by Woodward in Zurich. On top of UL1741, which their commercial inverters have, we need to know that we can get the units mechanically connected for testing with a common DC bus power arrangement with several MW worth of units tied together, along with the frequency stability feature for the existing generator bus.

We also need the multi-level waveform for efficiency savings and size/weight reductions.

I have discussed with them before, but now we need to discuss the possibility of delivering units in 12-15 months.

-Alan

From: Alan McDonnell
Sent: Friday, April 26, 2013 1:56 PM
To: SAMMOND@coned.com
Subject: Kings Plaza

Dan,

Further to my last regarding the data for NYU Poly, we have another project in the early stages that we spoke about before, which is the Kings Plaza Mall in Brooklyn.

It is at present completely islanded from ConEd, there are no wires into the mall. They have authorized us to speak to you regarding potential solutions using our power converter based approach to connect ConEd and sell power into the surrounding area.

I have some conceptual diagrams, but would prefer a chance to speak to you about it first if possible.

Basically we would plan to use a number of independent UL1741 rated inverters, maybe rated around 1MW to 1.5MW each, to connect to several different 4160V feeders that are in the nearby area.

If you have a chance next week, I am available Monday and Tuesday, and then travelling to Europe. I am also going to be in NY on Tuesday the 7th visting Poly.

I do hope to hear from you, we see this potential project as an absolute win-win for everyone involved.

Thanks for your continuing help,

Alan McDonnell

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Tuesday, April 30, 2013 8:22 AM
To: Alan McDonnell
Subject: RE: Kings Plaza <External Sender>

Hello Alan,

I am not available till later this week. You will need to discuss this with our regional people first to determine what it would take to interconnect to the electric distribution system and supply your loads.

Why don't you send your one-line to me.

Dan
P.S.
I will not be available for the next two weeks.

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Tuesday, April 30, 2013 8:33 AM
To: Alan McDonnell
Cc: Sibucao, Guillermo
Subject: RE: NYU Poly project update <External Sender>

Hello Alan,

I eagerly await your partial drawing submittal. Before you get too far into design details however I would like you to address the comments to the white paper submittals.

I have to correct you that although the test data is necessary our comments address more. We are looking to understand the operational details of the "active rectifier."

You have indicated that this is a passive device that will not backfeed and your white paper states that this is done by programming the inverter.

How will this be done?

Also please send the submittals to the Energy Services representative assigned.

Thanks,

Dan

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Tuesday, April 30, 2013 9:00 AM
To: Sammon, Daniel
Cc: Sibucao, Guillermo; Matthew Fairy; Guy Warner
Subject: RE: NYU Poly project update <External Sender>

Dan,

Thanks for the reply. We'll send the drawings and data to all concerned. As you can see, there are now quite a few people watching this one.

The test data will be focused on the Active Rectifier. We call it this because it differs from a normal diode, or passive, rectifier in that it is a programmed inverter. The inverter can be programmed to control current flow when connected to the grid. It can control amplitude, waveform shape and phase angle. By controlling the phase angle, it can be programmed to only allow energy flow in a single direction.

I will work with the manufacturer to come up with some explanations of this programming that meet your needs for description. I think it will be something like a protective relay, whose settings are programmable and whose settings must be recorded and not be changed without strict procedures followed.

On Kings Plaza, we need to find out about the distribution feeders in the surrounding neighborhood. We will send a note to Tom McAndrews and go from there. If you can think of a more appropriate contact, please let me know.

We can follow up in a couple weeks when you are available.

Thanks for your time,

-Alan McDonnell

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Tuesday, April 30, 2013 9:40 AM
To: Alan McDonnell
Subject: RE: NYU Poly project update <External Sender>

OK Alan,

This looks like a good plan.

Dan

TEXT OF LETTER FROM MACERICH TO CON EDISON

April 25, 2013
Mr. Thomas McAndrews
Consolidated Edison Company of New York
4 Irving Place
New York, NY 10003-3502
Dear Mr. McAndrews:

Please accept this letter as notice that we have granted Pareto Energy Ltd. the right to propose an approach on behalf of Kings Plaza Energy, LLC, for the purpose of electric interconnection of the Kings Plaza cogeneration power plant to the Con Edison distribution system. The primary goal is using our excess generating capacity to export power, but we believe there are a number of mutual benefits that will also be achieved, thanks to the new microgrid approach being pursued by Pareto Energy.

Our company seeks to consider the feasibility of combining our existing on-site power and the Utility's existing grid power by means of Pareto Energy's patented Gridlink "Non-Synchronous Interconnection" to ensure the safety and stability of both on-site and utility grid infrastructure. By relying on high throughput power electronics to achieve full control over all on-site power flows, Pareto's approach appears able to meet the following criteria:

A) Inverter-based fault-current limitation with 1/4 cycle sensing and tripping, instead of relying on fast switches or relays

B) Potential for positive impacts on frequency and voltage stability

C) No harmonics and no islanding issues (IEEE 1547-compliant)

Nothing in this authorization shall be construed so as to form joint venture or other form of legal partnership between Kings Plaza Energy, LLC and/or Pareto Energy and/or Con Edison or to otherwise authorize Pareto Energy to act as an agent for anything other than the specific discussions with the Con Edison regarding the microgrid connection. Ultimately, any legal and binding agreements would be executed with the direct involvement or Kings Plaza Energy, LLC. We will notify by separate letter any authorization to execute such a change once designs, negotiations and contracts have been agreed upon.

If you have any questions, please contact me directly.

Sincerely,

Jeff Bedell

VP Sustainability
cc: Steve Oser and Matthew Fairy, Pareto Energy

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Friday, May 10, 2013 11:52 AM
To: McAndrews, Thomas
Cc: Sammon, Daniel; Jolly, Margarett L.
Subject: Kings Plaza letter of authorization <External Sender>

Tom,

I should have attached this on the last e-mail. We had them address it to you because we couldn't figure out who else to start with.

Note that unlike a traditional interconnection, Kings Plaza is NOT presently a ConEd customer, as they are completely islanded.

In the configuration we envision, they would be either an export only customer, if there's a definition of such, or just a regular customer who mostly exports. Through negotiation it may make sense to use the ConEd grid as a back-up source, especially at night during low loads, to allow them to run their plant more efficiently.

Anyway, once we figure out how much power can be exported, we can go from there. In their present configuration they could supply about 4.5MW during peak times, and with the addition of another generator into a pre-existing empty bay, another 4MW+, for a total of almost 9MW.

I look forward to working on finding a workable design.

Thanks,

Alan McDonnell

From: Klopf, Robert [mailto:KLOPFR@coned.com]
Sent: Tuesday, May 14, 2013 2:45 PM
To: Alan McDonnell
Subject: RE: Kings Plaza - ConEd meeting <External Sender>

Tom and I would like to speak with you on the phone tomorrow morning. Are you available at 9?

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Tuesday, May 14, 2013 11:43 AM
To: Klopf, Robert
Cc: McAndrews, Thomas
Subject: RE: Kings Plaza - ConEd meeting <External Sender>

Rob,

Thursday of this week or anytime next week is fine. I'm hoping we can get on this soon. I was hoping Dan Sammon might be available to join us as the inverter SME, but his voicemail box is full, so I;m not sure if he's in. Even without Dan, I'd like a chance to meet with Tom McAndrews and the local Brooklyn engineers. Late morning or early afternoon is preferred if it fits your schedule.

Thanks,

-Alan McDonnell

From: Alan McDonnell

Sent: Tuesday, May 28, 2013 3:24 PM
To: Klopf, Robert <KLOPFR@coned.com>
Cc: mcandrewst@coned.com; Guy Warner <gwarner@paretoenergy.com>
Subject: Kings Plaza - Load Letter

Robert,

We would like to begin a formal load letter process for the project discussed at Kings Plaza shopping mall in Brooklyn. As discussed, even though Kings Plaza is not currently a ConEd customer, and they are looking to sell power, not purchase it, the load letter process seems the best place to start.

Could you help guide us through the formal filing requirements?

The basic project explanation is thus;

We would like to export power to the ConEd system in the amount of 8MW peak, dispatchable natural gas fired power generation

We would like to connect to 2 x 27kV radial feeders to export the power, and we would like the connection to be made at Ave. U, just West of Flatbush Ave.

The power will come fromtwo independent, inverter based sources, each requiring a single radial connection to the 27kV feeder

We can control the powerflow from the inverters in a very tight, real time fashion so as to not exceed voltage or fault current limits of the feeders

For now, we could set up all the controls internally, but are willing to have ConEd control the inverters from an outside signal if desired, and are prepared to assist ConEd to develop such signals and controls

At this time, it is planned that all power exports will be at unity power factor, but we are willing to use the VAR control capabilities of the inverters to enhance voltage stability for ConEd if desired, and again to allow ConEd to have remote control of such voltage stability controls

I can send a block diagram presentation for clarification of the general arrangement if necessary

Also, once you have accepted the load letter, could you give us some sort of project or tracking # such that we may engage the rates division at the same time as engineering.

Thanks for your help, and we look forward to working with you on this proposal.

Best Regards,

Alan McDonnell

From: Alan McDonnell
Sent: Friday, May 03, 2013 6:17 PM
To: 'Sammon, Daniel'
Cc: Matthew Fairy; Brian Mehler; Guy Warner; Kevin McDonnell
Subject: Active Rectifier Test and Operation Details

Dan,

Please see the attached presentation showing test results of the active rectifier inverter of similar type to the ones we will be using at NYU Poly (and elsewhere).

It may make sense to meet and go through any more questions you may have concerning how the unit works or behaves under an upstream fault.

We will get the more detailed one-line diagrams shortly, showing the detailed breaker controls and information. We will submit those also to the necessary project representatives as well as you directly.

Thanks for taking the time to review this and I look forward to moving forward with many projects in NY with you and your team.

Cheers,

Alan McDonnell

Sent: Tuesday, May 14, 2013 1:09 PM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: Test Status of Inverter System as of May 3, 2013
The status of the inverter tests as of May 3, 2013 are as follows;

A bi-directional unit with AC/DC coupled to DC/AC inverters was built and tested as per specification. See a picture in the attached report. The UUT (unit under test) was a 3-level neutral point clamp design, rated at 3.3kV AC, 4.8kV DC, 200A AC RMS, glycol cooled (grounded, no de-ionized water required)

For the purposes of testing the "Active Rectifier" function, power was drawn in from the grid to feed the losses of the filters and inverter. An output voltage source was created on the other inverter, and power quality was measured consistent with previous computer simulations.

To prove that the active rectifier simply behaves like a load, and will not export any energy into the grid, even during an upstream fault, an under-voltage trip condition was set up to simulate what the inverter would measure if there were an upstream grid fault. When the inverter controller measured the voltage dip, it tripped the inverter off and inverter current went to zero in 2.5mSec, with filter capacitor currents discharged shortly after that.

This proves that the claim of NO upstream fault current contribution from the microgrid is valid. This allows for an unlimited number of microgrids to be allowed to be installed in a utility distribution network, no matter how weak or lacking in additional fault current capacity.

This test was done first and a report issued as it is the primary concern of the utilities, in this case ConEdison on NY. The issue of voltage limits of the utility distribution is similarly a non-issue for the active rectifier, as it appears as any other load. If desired by the utility, the dynamic VAR capabilities of the active rectifier could be used to increase utility voltage stability.

The VAR capability was used to create the under-voltage condition, by drawing in VAR current through the relatively high-impedance, 400V 50Hz voltage source in the test lab.

The basic building block of a single inverter system has now been fully tested. Future tests include parallel output of two separate inverters with DC buses tied together, and in future several units tied together with separate DC bus sources. Also, the actual units purchased for the NSEE inverters will use transistors rated at 1200A DC peak, for an output of 400A cont., 800A short term peak.

The first UUT for our application will also include two separate inverter inputs, one used for DC bus voltage control, as in the unit just tested, and the other for kW control of power from a separate source, usually a generator.

The plans for testing of our unit will be for the whole system to be tested at 3.3kV at the factory, specifically the feature of parallel output. Further testing will be done at 13kV and with a generator input at 3.3kV at the e-house factory in Wisconsin. From there it will ship to site and be integrated into the host utility and on-site generator and islanded load output.

Alan McDonnell

From: Alan McDonnell
Sent: Wednesday, May 15, 2013 1:43 PM
To: Guy Warner <gwarner@paretoenergy.com>; Kent-e@ewprc.com; Szold-s@ewprc.com; Pisarski-s@ewprc.com; Jeffrey.bedell@macerich.com; Joseph.venne@macerich.com; Daryl.finn@macerich.com; gardner-l@ewprc.com
Subject: Kings Plaza ConEd Progress

Jeff & All,

Just a quick note to update on the progress with ConEd regarding this proposal.

I had a good chat with Tom McAdrews last Friday and again today. There is a fairly straightforward workable solution to sell as much spare power as Kings Plaza could generate, including with the addition of a 5th unit. I estimate the peak outbound power at about 4MW + now and then an additional 4.4MW unit (TCG 2032 V16 50Hz).

We hope to have something more specific in terms of next steps sent out by Friday afternoon. It quickly gets into rates and policy, and all sorts of quirky issues with ConEd policy that we are challenging due to the nature of how the inverter can perform.

More to follow soon.

Best Regards,

Alan McDonnell

From: Alan McDonnell
Sent: Tuesday, May 21, 2013 2:29 PM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Brian Mehler <bmehler@paretoenergy.com>
Subject: ConEd - Dan Sammon / NYU Poly update May 21

Guy,

To summarize our earlier conversation,

I spoke with Dan Sammon, who is back from 2 weeks off. He said he will review the test results and get back to me. Hopefully I can go through it with him to get the necessary sign off on the operation of the active rectifier. I will contact him tomorrow or Thursday if I don't hear back from him first.

I will discuss the drawing details again with Dan once he's over the active rectifier hump.

Hopefully we will have this completed by the time of the NYSERDA kick-off meeting such that you can submit something for billing.

Once we are through Dan, I will try and get something in writing to get formalized by Tom McAndrews, which you can then take higher. A Pepco type letter from Tom McAndrews will need the drawings and need to go through the larger approval process.

-Alan

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Wednesday, May 22, 2013 3:06 PM
To: Sammon, Daniel
Subject: Follow up, active rectifier analysis <External Sender>
Dan,

Thanks for your time yesterday. I just wanted to follow up and see if there's anything more you need from me in the way of explanations or descriptions of the active rectifier.

What we are driving towards at this stage is some sort of agreement like the Pepco letter for Howard U. (attached), which describes the multiple radial feeder active rectifier system, similar to what we want to install at Poly. I've also attached the earlier one-line, which shows the 3 feeders coming into the 27kV breakers. We will have more detailed drawings of these submitted, including 3-line breaker drawings with the protection scheme marked.

Again, if you'd like to discuss in more detail, please contact me anytime.

Cheers,

-Alan

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Wednesday, May 22, 2013 3:58 PM
To: Alan McDonnell
Cc: Sibucao, Guillermo
Subject: RE: Follow up, active rectifier analysis <External Sender>

Alan,

I looked over the documents submitted. They do not answer my questions.

How does the inverter get programmed to be an “active rectifier?” How is export prevented?

Also the tests indicated that there was no generator connected? How does this test then show that it mitigates fault current contribution from the generator?

Thanks,

Dan

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Wednesday, May 22, 2013 4:57 PM
To: 'Sammon, Daniel'; 'Alan McDonnell'
Cc: 'Sibucao, Guillermo'
Subject: RE: Follow up, active rectifier analysis <External Sender>
Dan, (and Guillermo)

Thanks for taking the time to review.

We tried to describe how the active rectifier controls current in previous submittals, but let me try again here. By manipulating the transistors, the inverter can control both the amplitude and wave shape of the current, and it's phase angle relative to the voltage. In most cases the wave shape is selected as pure sinewave, and in this case the phase angle is zero, such that all of the current is real power.

The difference between importing power or exporting power is a 180 deg. phase shift of the current. If it transitioned from one mode to another, such as an elevator going up and then down, the amplitude of the current would drop to zero , and then start increasing 180 deg. out of phase with the other mode.

In our test case we show the inverter current simply cutting off very quickly when the transistors stop firing. If any energy had gone upstream into the grid, the phase angle would have transitioned 180 deg. from where it was before the trip.

Your next part about there being no generator is in fact the whole point of this, there is no generator interaction with the rectifier, and hence no interaction with the upstream grid. It was important for us to have this noted in Pepco's approval letter for Howard (previously attached), which they did.

When the active rectifier detects an upstream under-voltage, it trips as programmed, it doesn't are what the generators or loads do since they are not directly connected to the rectifier.

Might I suggest we speak tomorrow some time? I may be able to dig up some other diagrams that show more clearly the phase angle relationship between an inverter drawing power from the grid or sending power to the grid? If need be, I could come visit again and draw some diagrams and go through it step by step as well.

Thanks again for your time on this, and I look forward to clearing up all the unknowns.

Cheers,

-Alan

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Wednesday, May 22, 2013 8:54 PM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Shalom Flank <sflank@paretoenergy.com>; Kevin McDonnell <kmcdonnell@paretoenergy.com>; Brian Mehler <bmehler@paretoenergy.com>
Subject: Dan Sammon - ongoing

Patience here seems to be the required tactic…

He is obviously having some difficulty with inverter theory, in a way that other utility engineers like Joe Debs at CL&P and James Pringle at PEPCO didn't, but at least he's getting onto it and giving it some time, and copying Guillermo.

We'll see what tomorrow brings. There really is no other solution than to keep throwing shit at the wall until enough sticks.

-Alan

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Thursday, May 23, 2013 8:24 AM
To: Alan McDonnell
Subject: RE: Follow up, active rectifier analysis <External Sender>

Hello Alan,

Our discussions seem to be going around in circles.

You will need to show through manufacturer's documentation and studies how the inverter is prevented from backfeeding and that the contribution to fault arising from the synch generator does not contribute to system faults.

The operative word is "show" not "state."

If you would like to discuss again please give me a call.

Dan

From: Alan McDonnell
Sent: Thursday, May 23, 2013 12:21 PM
To: SAMMOND@coned.com
Subject: More documentation
Dan,

Thanks for your time earlier today, I think we're getting closer.

I spoke with the manufacturer and we are going to put together documents from them that show how the reverse power flow is inhibited, even in the event of an energy source trying to force energy through, such that nothing is exported to the grid.

We will also show how the software protections can be set up such that they can't be changed by end users. Separately, I will try to get something from our engineer about how they have done previous agreements with ConEd with respect to not changing protective relays settings on high tension service agreements.

I should be able to send something Wed. morning, and was wondering if we could set up a call for Wed. afternoon if you can make it?

Thanks again for your time,

-Alan

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Tuesday, May 28, 2013 2:55 PM
To: Sammon, Daniel
Cc: Sibucao, Guillermo
Subject: RE: Follow up, active rectifier analysis <External Sender>

Dan,

Please see the attached presentation focusing on the issue of generator current. I have also included a document from the manufacturer that explains how the inverter current control works, both grid tied and generator units. For our application, they will add the new microgrid voltage source unit.

They have significant test data available for wind power units that have gone through such tests as grid fault ride through or, on the other side, anti-islanding. Whatever the utility specifications call for, they can supply it, including our reverse power flow inhibit requirement.

I hope this provides you with the documentation you need to be able to send a note up higher that our design does protect your grid from any fault current contribution caused by on-site generators, and that the generators are NOT in parallel with the ConEd system.

Perhaps we could schedule a call to discuss further? I'm free whenever you are.

-Alan

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Wednesday, June 05, 2013 8:45 AM
To: Alan McDonnell
Cc: Sibucao, Guillermo; Sammon, Daniel
Subject: RE: Follow up, active rectifier analysis <External Sender>

Alan,

Thanks for the presentation but I am still waiting on the documentation promised earlier (see attachment above).

I expect it to be detailed and thorough so please forward it to me as soon as you. I want to give it the attention it deserves and you know the summer load period is upon us here in Con Ed territory.

Dan Sammon

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Wednesday, June 05, 2013 9:04 AM
To: 'Rich Bernhardt' <rbernhardt@johnwinstonengineers.com>
Cc: 'kevin santella' <kevin@dylanassociates.com>; Guy Warner <gwarner@paretoenergy.com>; Shalom Flank <sflank@paretoenergy.com>; Alan McDonnell <amcdonnell@paretoenergy.com>
Subject: Dan Sammon project

Rich,

Below is the last from Dan Sammon this morning. It just doesn't make any sense, and I can't understand what documentation he could require in addition to all of the test results and manufacturers control description etc. that I have sent. For instance, there is no way to show how the rectifier mitigates fault current from a generator that isn't connected to it.

At this point I don't want to argue with him, so I think it would be best if you made the next contact and explain that you have been brought in to help bring this stage of the review to a close, and then perhaps get him to open up a bit as to what it is he wants. We can then put together more documentation or drawings as required.

The larger problem is that Dan doesn't understand the inverter theory, and he won't allow anyone from else from ConEd who does understand it into the process. His default position is to rag the puck forever and we get nowhere.

Perhaps we can have a call later as well and discuss strategy?

Please let me know,

-Alan

From: Alan McDonnell [mailto:alan.mcdonnell@nonsynchronous.com]
Sent: Wednesday, June 05, 2013 9:50 AM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: On the phone with Dan Sammon
Guy,

I was on the phone to Dan when you called. He sent the one below to me regarding Kings Plaza and offered for me to call.

We are making progress on the Poly understanding. It seems he didn't read one of the submissions, which he will and we will talk further. I will be in the office shortly.

-Alan

From: Alan McDonnell
Sent: Wednesday, June 05, 2013 11:34 AM
To: 'Sammon, Daniel'
Cc: Sibucao, Guillermo
Subject: RE: Follow up, active rectifier analysis <External Sender>

Dan,

As discussed this morning, please see the attached description from the manufacturer detailing the current control algorithms for their wind turbine units, of which ours uses the same control.

Let me provide a brief explanation here of what it describes and how it relates to the active rectifier, and perhaps we can discuss over the phone some time after you've had a chance to go through?

The first page shows a diagram of all of the feedback loops for a layout that includes one inverter tied to an AC grid and another tied to a generator.

In the case of a wind turbine, the goal is to harvest as much energy from the wind as possible, and assume that the grid can take it all. The basic control strategy then is as follows:

The generator tied inverter control the current amplitude and phase angle, which controls generator torque in an induction generator.

The generator torque command comes from a system controller that looks at the turbine speed and blade pitch angle to follow a speed-torque curve that is a function of the aerodynamics of the turbine. This torque changes dynamically with wind speed.

The energy from the turbine gets dumped into the DC Bus.

The grid tied inverter is commanded to regulate the DC Bus voltage to a fixed level. It takes energy from the DC Bus that came from the turbine inverter and dumps it onto the AC grid.

There are limits in the AC current control that are set by the grid operator to help stability, and may also include VAR current control which is done independently of the real power, which is simply the DC Bus voltage regulation.

One of the more complicated features that this particular controller can achieve is something called "grid fault ride through". This allows the inverter to keep supplying 100% rated current to the grid, even with an AC voltage level as low as 1%, for a couple of seconds. This helps the grid operator from having all of the wind power go dark in the event of a short fault on the 400kV grid a couple of hundred miles away.

In the event of such a fast power limit need, the wind turbine energy flows into a dynamic brake resistor, much like a Subway system when decelerating.

In our case with the active rectifier, the control loop is programmed to also regulate the DC Bus voltage level. When power is sent from the DC Bus to the loads, the system controller commands the generator rectifiers to get a certain amount of the power, and the rest comes from the active rectifier, which gets energy from the utility grid to make up the balance.

Within the limits that can be programmed into the grid current control are the ability to prevent the phase angle from going negative, which is essentially the reverse power inhibit. We can also set minimum real current import levels, such as the 1A min. we agreed to with Pepco so that we know the feeders are always in working order.

Page 2 and 3 of the attachment show the grid tied inverter parameter settings. As you can imagine, everything has setpoints, gains and deadbands in order to stabilize the system.

The voltage sensing that forms the fast trip protection is separate from current control, since the current loops would be adjusting and settling due to the much reduced voltage. The trip function is a simple and direct sense and shut-off, which as shown on the test results takes about 2.5mSec. from sense.

The generator side control description is less relevant to the active rectifier, but there for your information

Again, feel free to contact me anytime to go through in more detail.

Thanks for your time thus far,

-Alan

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Tuesday, June 04, 2013 3:19 PM
To: Sammon, Daniel
Cc: Sibucao, Guillermo
Subject: Poly & Kings Plaza <External Sender>

Dan,

Just wondering if you had a chance to look at the last presentation I sent on the active rectifier last week?

Also, we've submitted a project request for the Kings Plaza proposal. The initial request is for service for outbound power only at 8MW.

You'll probably get a note from Tom McAndrews group at some point, but you had mentioned wanting to see it, so I've attached a presentation of the proposal and the case # is shown below. It will be a more traditional grid connect inverter system subject to UL1741, but we have a few ideas we'd like to offer if the amount of power is deemed too high for low load conditions.

We are just finalizing an agreement with Rich Burnhardt to do the detailed engineering on NYU Poly, including the relay protection scheme's in the format you've used before, so hopefully we will have that to you soon as well.

As always, if you have any questions, feel free to contact me anytime.

Cheers,

Alan McDonnell

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Wednesday, June 05, 2013 9:29 AM
To: Alan McDonnell
Cc: Sibucao, Guillermo
Subject: RE: Poly & Kings Plaza <External Sender>

Hello Alan,

This presentation is too "high level" for me to discuss any details. I recommend that you submit your application to our Energy Services Department in Brooklyn.

They would have to determine if the existing service is capable, where the interconnection would be located, what feeders would be allocated to the service, etc.

I would appreciate a more detailed one-line drawing showing the interconnection incorporating our requirements for a DG of this size as well as the necessary high tension service requirements (See Company specification EO-2022 available at the Con Edison DG website).

I understand from your write-up that export would be a part of the operating scenario here but please note that S/C mitigation is a concern here as well. Also With a DG facility of this size telemetering would be necessary and if it is ruled for export under SC-11 direct transfer trip protection for anti-islanding would be required to replace the standard requirement of a directional reverse power relay.

It would also be necessary to perform system stability studies to determine this facility's effect on the system.

I recommend that you call Mr. Spencer Chow, our Energy Services Manager in Brooklyn to discuss what would be needed in terms of documents.

If you would like to discuss further please feel free to call me.

Dan Sammon

From: Alan McDonnell
Sent: Wednesday, June 19, 2013 10:04 AM
To: Rich Bernhardt <rbernhardt@johnwinstonengineers.com>
Cc: kevin@dylanassociates.com; Guy Warner <gwarner@paretoenergy.com>; Shalom Flank <sflank@paretoenergy.com>
Subject: RE: ConEd submittals

Rich,

I will prepare a presentation that explain the operating modes of the microgrid system for Dan. One of the things I'm going to do is show a single one of the three systems, because they each operate separately, and then a block diagram showing how the main system controller operates them together and synchronizes and load balances them.

Send me what you have on the one-line once it's done and I'll send you the presentation which should address all of the unknowns for Dan.

We had a breakthrough yesterday when I was able to show Dan how similar this system is to the rectifiers used for the subway. Our system does include a small amount of internal dynamic braking, but I will show it more clearly.

We might want to add it to the one-line as well, but we can do that later. It basically includes a single phase inverter leg used as a chopper to send DC power into a resistor if the DC Bus gets too high, prior to the DC Bus hitting the trip point. This could occur if we lose the load for some reason and want to release the generator load slowly such that the generator doesn't trip on overspeed. The calculations of how big this needs to be is done in conjunction with the generator manufacturer.

Stay in touch,

-Alan McDonnell

From: Alan McDonnell
Sent: Wednesday, June 19, 2013 2:11 PM
To: SAMMOND@coned.com
Subject: NYU Poly progress follow up June 18
Dan,

Thanks for your time on Tuesday. As discussed, it would help us out if you could send a quick note to Aubrey Braz, and perhaps Gerry Dawes, and just let them know that we are making progress and we expect to have the new drawings and operational sequencing submittals to you next week.

If you could send me a copy so that I can update Poly, I would appreciate it. We have a call with them at noon tomorrow to give them an update, and all eyes are on me.

Thanks again for your help,

-Alan McDonnell

(603) 546-5785

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Monday, June 24, 2013 8:56 AM
To: Sammon, Daniel
Subject: FW: NYU Poly progress follow up June 18 <External Sender>

Dan,

I didn't hear back from you last week, so I just wanted to check and see if you contacted Aubrey Braz yet?

We will have our submittals to you this week and we have submitted the change request to Kwame for the letter describing the radial feeders.

Thanks Again,

-Alan McDonnell

From: Sammon, Daniel [mailto:SAMMOND@coned.com]
Sent: Monday, June 24, 2013 9:17 AM
To: Alan McDonnell
Subject: RE: NYU Poly progress follow up June 18 <External Sender>

Hello Alan,

I was not able to work up a summary of our meeting yet.

I will try to get it done today.

Thanks for reminding me.

Dan

From: Alan McDonnell

Sent: Wednesday, June 05, 2013 3:33 PM
To: Bedell, Jeff <Jeffrey.Bedell@macerich.com>; 'Lawrence Gardner' <gardner-l@ewprc.com>; 'Kent-e@ewprc.com' <Kent-e@ewprc.com>; 'Szold-s@ewprc.com' <Szold-s@ewprc.com>; 'Pisarski-s@ewprc.com' <Pisarski-s@ewprc.com>; Venne, Joseph <Joseph.Venne@macerich.com>; Finn, Daryl <Daryl.Finn@macerich.com>
Cc: Brian Mehler <bmehler@paretoenergy.com>; Steve Oser <Soser@paretoenergy.com>; Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>
Subject: KIngs Plaza ConEd update

Jeff & All,

Just an update on our progress and next steps.

We had a discussion with Tom McAndrews and have submitted a project request through their system. We decided to file for 2 x 4MW for now, as it's easier to scale back than up later. See the attached presentation for a rough idea of what I have in mind.

Tom was able to get the distribution diagrams out and told me that there are several 27kV feeds running down Ave. U. right beside the mall, so we should be able to connect to them. We are thus far holding firm that we only want two feeders in radial configuration. If they are in standard second contingency configuration for customers then the price would kill the job, at least another $1M/feeder plus two more feeders.

Tom will probably call us into a meeting to go ver the design once they look at the feeder loading. Once we know how much power can be exported without making upgrades to their grid, then we can discuss the economics of rates.

Their engineers will tell you that the Bensonhurst Substation is old and heavily loaded. To take 8MW of peak load off of it without adding to the fault contribution levels has a significant value, it will just take some negotiations to determine how we get enough of that value to justify the project from our perspective..

We'll keep you up to date as we get further along, but feel free to contact me if you have questions.

Best Regards,

Alan McDonnell

From: Alan McDonnell
Sent: Wednesday, June 19, 2013 9:48 AM
To: Shalom Flank <sflank@paretoenergy.com>
Cc: Guy Warner <gwarner@paretoenergy.com>; Rich Bernhardt (rbernhardt@johnwinstonengineers.com) <rbernhardt@johnwinstonengineers.com>; kevin@dylanassociates.com
Subject: NYU Poly - ConEd update & tasks
Shalom,

I met with Dan Sammon yesterday and we mapped out a clear path to Preliminary Approval, which is the step required BEFORE 30% design.

One of the things Dan needs is for ConEd to issue a letter like the one Kwame sent back in Sept. that clearly states that they will provide 3 independent radial feeders. The feeders will operate in an N+2 redundant mode, but it is important that they not be listed as being second contingency, because that carries all sorts of legal requirements for the transfer switching and protection schemes that we are NOT using.

If you could get in touch with Kwame and see if he can re-issue a letter like the one above, as opposed to just writing an e-mail, we will need to include it in the submissions to Dan Sammon.

I will work with Rich on the drawing details. My understanding from yesterday was that we only need one-line, not three line, drawings at this stage, and we don't need the detailed physical layout drawings either. I will confirm with Rich.

Thanks,

-Alan

From: Alan McDonnell
Sent: Wednesday, June 26, 2013 11:52 AM
To: SAMMOND@coned.com; BuduK@coned.com
Cc: Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>; Brian Mehler <bmehler@paretoenergy.com>
Subject: Radial ffeeder issue MINUTES OF MEETING - NYU POLY MICROGRID - 1-9-13

Kwame,

Shalom will submit the revised load letter through the project center tomorrow. We will separately copy everyone involved.

In reviewing the minutes of the formal meeting in Jan., and your notes below, there is a misunderstanding on our part that Dan cleared up for me last Tuesday, in that we always thought 2nd contingency simply meant redundant feeders, but actually includes all of the complicated transfer switchgear and control schemes that we don't need. I'm not sure if we ever replied to your red comments below on the inverter/rectifier section, but the feeds will be radial and will NEVER be connected, not even on the secondary side. Our drawing submittals will show this.

The 3 x radial service, which is N+2 redundant, is what we had in our minds, and thus will make clear in the load letter request.

What we seek from Dan at this time for both NYSERDA and NYU is a conceptual approval of the general concept, especially the active rectifier interface, which includes the radial feeds and protections. Dan has informed us that he can't do conceptual approvals, and needs to do a more formal preliminary project approval, which is why we are submitting formal drawings for the project. Note that the drawings will include radial feeders, with concurrence from the engineer, Rich Bernhadt, that this complies with proper engineering practice.

We will keep pushing forward and keep you informed.

Thanks for your help,

Alan McDonnell

From: Alan McDonnell
Sent: Wednesday, June 26, 2013 12:23 PM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: Difficulties of the ongoing approval process with ConEd

Guy,

Dan is basically saying that he doesn't understand the basic inverter theory, and has had to be schooled on it step by step. The formal drawings are an issue now for the project approval, but they wouldn't have helped back when this was sent a month ago.

There is definitely a lack of management problem at COnEd, in that they have allowed the distribution engineering department to ring fence themselves off from anyone else. We haven't met anyone else in distribution engineering that understands this any better than Dan.

After the meeting with Dan last Tuesday, I had a better understanding of his concerns with generator unloading conditions and other anomalies that are normally addressed, which is why I put the whole system theory of operation presentation together afterwards.

We can submit all of this to NYSERDA if it helps us get paid. It certainly hows the efforts we're gone to to get this technology approved.

-Alan

From: Alan McDonnell
Sent: Monday, July 01, 2013 1:46 PM
To: SAMMOND@coned.com
Cc: Rich Bernhardt (rbernhardt@johnwinstonengineers.com)
Subject: FW: Attachment Upload for CASE NO: 1328140, SERVICE ADDRESS: 5 METROTECH , Brooklyn
Dan,

Please see the attached drawing from Rich Bernhardt regarding the Poly preliminary approval, and the note below that we have formally submitted it to the project center.

I'm not sure what the formal process is from here, but what we are in need of first is some sort of comment from you regarding our assumptions of the theory of operations of the active rectifier interface and the planned protection scheme, and radial feeder supply.

I know there will be more detail as we go along. For now we'd like to send a note to ConEd's Mgmt, NYSERDA and NYU that we have submitted the first engineering submittal and are awaiting Distribution Engineering review. NYU is awaiting conceptual approval on the active rectifiers before proceeding further, and NYSERDA is asking us to apply for the next stage grant, of which the deadline is soon, but needs to see that we've completed the tasks on this first grant before moving on.

If there is anything more you need at this stage in terms of submittals, please let me know directly. If it is necessary to have another in person meeting to achieve such approval, Rich and I will both plan to attend. I have attached again the presentation on the theory of operations of the whole system, of which the attached drawing shows in detail one of the 3 microgrids, each being independent.

I look forward to moving this first of its kind microgrid project through the next phases.

Thanks for your help thus far,

Alan McDonnell

From: Alan McDonnell
Sent: Tuesday, July 09, 2013 11:02 AM
To: 'Sammon, Daniel'
Cc: Sibucao, Guillermo
Subject: RE: NYU Poly drawing <External Sender>

Dan, Guillermo,

Please see the attached revisions, this should address all of the comments on the last submittal. We will bring some paper copies on Thursday as well and look forward to the discussion. We will make a formal submission to the project center after Thursday's meeting.

See you then.

Best Regards,

Alan McDonnell

From: Budu, Kwame [mailto:BuduK@coned.com]
Sent: Friday, July 12, 2013 11:48 AM
To: Shalom Flank; Alan McDonnell; Sammon, Daniel; Sibucao, Guillermo; Klopf, Robert; Pinnock, Daniel
Cc: Budu, Kwame
Subject: MINUTES OF MEETING 7-11-13 KINGS PLAZA MALL 2483 FLATBUSH AVE

The attached is the minutes of our meeting on Thursday, 7/11/13.

Thank you.

Kwame

MINUTES OF MEETING
KINGS PLAZA MALL HIGH TENSION PROJECT
DATE: Thursday, July 11, 2013 AT: 4 Irving Place NY, NY 10Fl Conf Room D
TIME: 10:00 AM

PROJECT OVERVIEW

The customer is requesting a 2 feeder high tension with an inverter base generator for export only. At normal situation, the customer will export 8 MW onto our grid and will not exceed 4 MW on a single feeder. The customer has also indicated that, Con Edison will have control as to how much the customer can export to the grid.

COST

The customer has been notified that he will bear the cost of the work that will be performed by Con Edison plus and annual maintenance fee.

The customer has also been informed that a transfer trip will be required for the export of power.

FLOOD ZONE

The customer has been notified to build his High Tension Substation in compliance with Storm Surge of Category 3 Hurricane since the customer is a flood zone area.

CONTRACT DEMAND AND RATE

The customer will be billed at SC 11 (Sell Back) and a Contract Demand will be set when the interconnection agreement is made and finalized

DISTRIBUTION ENGINEERING (DE) COMMENTS

1-line diagram has been give to Guillermo to review for comments. The customer will explain in details to our Engineer how the inverter will work without any power from Con Edison back to the customer.

ACTION ITEMS

Plot Plan with a Point of Entry	Customer/Shalom
Service determination letter	Con Edison/Kwame

Manhattan Major Services
4 Irving Place 10th Floor North
New York, NY 10003

July 17, 2013

Re: NYU - POLY – HIGH TENSION SERVICE
WR # 1328140

NYU-POLY – Polytechnic Institute of NYU
Dennis Dintino – VP for Finance & Business Affairs
Six MetroTech Center
Brooklyn, NY 11201

Dear Mr. Dintino,

We have received your request for electric service at the above referenced location and look forward to working with you and your contractor. We reviewed the revised High Tension service request for 5MW of load and determined that 3 underground high tension feeders will be provided to you. This correspondence details the Company's service determination with reference to your request to insure the safe delivery of energy to your property. Safety of the public and Company employees is paramount to Con Edison.

1. The NYU-Poly 5 MW High Tension Service is determined for 3 underground feeders. Con Edison can take any two feeders out of service for an emergency, routine maintenance or repair work without prior notification. On the customer side of the Point of Common Coupling, these feeders will not be tied together on the transformer secondaries.
2. A contract demand charges will be associated with the new high tension service.
3. Con Edison preferred point of entry (POE) is from Tech Pl. (Johnson St.) North of the Dibner Library.
4. The feeders, their short circuit currents and impedances are listed below:
   1B54: 26496.6 Amps, 0.1186 + j 0.5629 Ohms
   1B69: 26391.9 Amps, 0.1233 + j 0.5642 Ohms
   1B72: 23285.9 Amps, 0.1442 + j 0.6385 Ohms
5. There will be a cost to the installation of Cam Op Disconnect Switches (if required). Further studies and review are required.
6. Customer service date is set at **07/31/2015**.
7. Customer will pay for work to provide the High Tension service since the existing services is adequate. Other costs will include but not limited to the removal of existing transformers, removing and relocating secondary street ties to support our network (if appropriate and required). Cost estimate to follow at a later date.
8. Customer will incur charges, if NYU-POLY decides to re-connect to Con Edison's grid. The amount and the number of years will be detailed in the interconnection agreement.
9. Con Edison's transformer vaults will not be transferred to the customer, but the space under Department of Transportation rights of way can be vacated for customer use subject to an appropriate NYC DOT Revocable Consent Permit and other costs described above.

Thank you and looking forward to working with you and your team. Truly yours, Kwame Agyeman-Budu

From: Shalom Flank [mailto:SFlank@ParetoEnergy.com]
Sent: Friday, July 19, 2013 12:16 PM
To: Budu, Kwame
Cc: Sibucao, Guillermo; Alan McDonnell
Subject: Re: 2483 FLATBUSH AVE - KINGS PLAZA MALL HIGH TENSION PROJECT <External Sender>

Kwame,

I hope you and everyone else at ConEd haven't been hit too hard by the current heat wave. We submitted just some simple block diagrams for the Kings Plaza project before (which I've attached again just in case). We won't be paying our engineers to prepare the one-line diagrams until after we have the service determination.

But I did promise you the information for the service location / Point of Entry. That would 540 feet from the curb line on Flatbush Ave, heading east on Avenue U, on the south side of the avenue (i.e. just before the Mall entrance).

Let us know if you or Daniel need anything else for the service determination. And thanks again for issuing the meeting minutes on this project and the revised service determination letter on the Poly project.

Have a great weekend,

--Shalom

From: Sibucao, Guillermo [mailto:SIBUCAOG@coned.com]
Sent: Friday, July 19, 2013 12:22 PM
To: Shalom Flank; Budu, Kwame
Cc: Alan McDonnell; Sammon, Daniel
Subject: RE: 2483 FLATBUSH AVE - KINGS PLAZA MALL HIGH TENSION PROJECT <External Sender>

Thank you. However, Con Ed is looking for a single line diagram similar to that of the nyu poly metro job. if it is not ready at this time, pls send a copy when done.

gs

From: Alan McDonnell
Sent: Friday, July 19, 2013 12:26 PM
To: Sibucao, Guillermo <SIBUCAOG@coned.com>; Shalom Flank <sflank@paretoenergy.com>; Budu, Kwame <BuduK@coned.com>
Cc: Sammon, Daniel <SAMMOND@coned.com>; Guy Warner <gwarner@paretoenergy.com>; Brian Mehler <bmehler@paretoenergy.com>
Subject: RE: 2483 FLATBUSH AVE - KINGS PLAZA MALL HIGH TENSION PROJECT <External Sender>

Guillermo,

Yes, the full single line diagram is the next step in the engineering of the project. We are working with the Owner on an economic study as well, and due to summer vacations we don't expect to have single line diagrams finished for several weeks. We will submit them as soon as they are complete.

Thanks,

Alan McDonnell

From: Alan McDonnell

Sent: Wednesday, July 24, 2013 8:55 AM

To: Bedell, Jeff <Jeffrey.Bedell@macerich.com>; 'Lawrence Gardner' <gardner-l@ewprc.com>; 'Kent-e@ewprc.com' <Kent-e@ewprc.com>; 'Szold-s@ewprc.com' <Szold-s@ewprc.com>; 'Pisarski-s@ewprc.com' <Pisarski-s@ewprc.com>; Venne, Joseph <Joseph.Venne@macerich.com>; Finn, Daryl <Daryl.Finn@macerich.com>

Cc: Brian Mehler <bmehler@paretoenergy.com>; Steve Oser <Soser@paretoenergy.com>; Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>

Subject: KIngs Plaza ConEd letter

All,

Please see the attached service determination letter from ConEd this morning.

For now we have what we need from ConEd to be able to proceed with rates negotiations and further engineering work. That decision is Macerich's to make, but this design will keep costs to a minimum given the amount of power to be exported. 8MW assumes that we add a 5th engine, but we could explore a first stage with just the existing engines.

Note that the restriction on inbound power is only at this stage and for purposes of simplicity. If power is to be imported, then Kings Plaza needs to become a ConEd customer and ConEd would normally be required to provide a complicated 4 feeders parallel service, which would more than double the cost of the project. My plan is to explore inbound power under special circumstances once they have approved the outbound power design, and have them make an exception to the service requirements.

Regards,

Alan McDonnell

Manhattan Major Services
4 Irving Place 10th Floor North
New York, NY 10003

July 24, 2013

Re: KING PLAZA MALL - HIGH TENSION SERVICE
WR # 1429239

Kings Plaza Mall – Macerich
Mr. Jeffrey M. Bedell
401 Wilshire Blvd, Suite 700
Santa Monica, CA 904-1452

Dear Mr. Bedell,

We have received your request for electric service at the above referenced location and look forward to working with you and your contractor. We reviewed the High Tension service request for 8MW of load for export only and determined that 2 underground high tension feeders will be provided to you. This correspondence details the Company's service determination with reference to your request to insure the safe delivery of energy to your property. Safety of the public and Company employees is paramount to Con Edison.

1. The King Plaza Mall, 8 MW High Tension Service is determined for a 2 27kV feeder high tension to be supplied by UG feeders. Note that the load on each-feeder installation **must not exceed 4MW**. Con Edison can take any feeder out of service for an emergency, routine maintenance or repair work without prior notification. Con Edison will have absolute control as to how much the customer can export to the grid.
2. A contract demand charges **maybe** be associated with the new high tension service.
3. The customer will be supplied by feeders 4B14 and 4B19. Feeder 4B14 will be extended by one section to the customer manhole and feeder 4B19 will be extended by 3 sections to the customer manhole.
   Short Circuit Current & Impedance:
   4B14: 11874.8 Amps, 0.5142 + j 1.1761 Ohms
   4B19: 11340.7 Amps, 0.6166 + j 1.1942 Ohms
4. The customer will bear the cost of the work that will be performed by Con Edison plus an annual maintenance fee of 12.4%.
5. A transfer trip will be required for the export of power.
6. Other costs will include but not limited to the cost to the installation of Cam Op Disconnect Switches.
7. The customer is required to build his high tension service substation in compliance with the Storm Surge of Category 3 Hurricane, since the customer is in a flood zone area.
8. Customer service date is set at **07/31/2015**.

Thank you and looking forward to working with you and your team. Truly yours,
Kwame Agyeman-Budu

To: Budu, Kwame
Cc: Sammon, Daniel; Chebli, Elie A.
Subject: nyu poly micro submittal comment

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
Distribution Engineering, Network Systems, July 25, 20l3
Distributed Generation Project
First Submittal
Con Edison Project File No.

NYU POLY MICROGRID Distributed Generation Project is located at 6 METRO TECH CENTER, Brooklyn, NY and this First Submittal was received by Con Edison's NSDE for review on 07/11/2013. This project includes the installation of 3-26.4kv feeders and 3-Smw sync generators and active rectifiers, 3.3kv ac input and 4.8kv de output, three-phase, 60 Hz, units driven' by sync generators to be operated in parallel with Con Edison distribution system under the SC 14-RA, Standby Service - Retail Access rate. Per Special Provision P, customers with Designated Technologies will be billed under their Otherwise Applicable Rate (SC9), but the Interconnection Charge and Power Demand Charge will apply. This customer will be supplied from the 26.4kv, three-phase, three-wire, 60 Hz, high tension service coming from the Brooklyn's 4M network. To be considered for parallel operation with the Con Edison distribution system, the customer 1 s DG facility must meet all the requirements contained in the latest Con Ed's E0-2115 and E0-2022.

Con Edison reviewed the customer's ONE and THREE LINE DIAGRAMS, DWG NOS E-10 AND E-11 dated 7 /8/2013 ._,No revision, and found that the design of this DG facility, as shown, does meet the basic design requirements of the New York State Public Service Commission, SIR. Nevertheless, it is suggested that the customer incorporate the review comment into the drawings and the other comments below.

ONELINE DIAGRAM

1. The two other con Ed feeders should also be shown on this drawing.

THREE LINE DIAGRAM - No comment at this time.

OTHER COMMENTS

1. The active rectifier harmonics should be mitigated to meet the minimum requirement of IEEE 1547.

2. The customer interfacing cannot export power into testing. inverter is programmed as an active rectifier andCon Ed grid. This should be confirmed by customer as such during

3. Likewise, the active rectifier shall mitigate fault contribution into faulted remote Cone Ed feeder. This should be demonstrated successfully during the testing.

4. The customer shall install a reverse power relay for minimum import to providebackup protection against export from the active rectifiers.

5. Direct Transfer Trip is a requirement for all DG interconnection to Con Ed's primary sources. It is the customer's contention that active rectifier behaves like a traction load and cannot island. **DTT will** not be required if the customer can demonstrate that the active rectifiers {not **UL** 1741 certified) capabilities can prevent anti-islanding.

Guillermo Sibucao, PE
Sr. Engineer
NSDE
Con Edison
4 Irving Place

New York, NY 10003-3502
212-460-2050

From: Alan McDonnell
Sent: Thursday, July 25, 2013 3:05 PM
To: Shalom Flank <sflank@paretoenergy.com>; Guy Warner <gwarner@paretoenergy.com>
Cc: Brian Mehler <bmehler@paretoenergy.com>; Chet Warner <cwarner@paretoenergy.com>
Subject: RE: NYU - POLY MICROGRIG - HIGH TENSION PROJECT - COMMENTS FROM DE

Shalom,

We need to have changes made. The generators need to be noted as 3 x 2MW (not 5MW) 50Hz 3.3kV. The active rectifiers are inverter based (not synchronous).

I think we can live with the comment that the generators run in parallel with the grid (we've discussed this issue before) but it must be noted that they run un-synchronized with the grid.

We never submitted a 3-line drawing, that comes with 30% submittals.

The one-lines we submitted included 2 drawings, one a detailed single feeder and the other a 3 feeder. Not sure we want to quibble about this.

On the other comments section, we already comply and concur on points 1-4, and point 5 is agreed to by us.

-Alan

From: Shalom Flank

Sent: Friday, July 26, 2013 12:41 PM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Chet Warner <cwarner@paretoenergy.com>; Brian Mehler <bmehler@paretoenergy.com>; Alan McDonnell <amcdonnell@paretoenergy.com>
Subject: Remaining steps before we "have" a ConEd approval

Guy,

ConEd's Distribution Engineering department has reviewed our submissions for Kings Plaza.

They have just given us draft comments, stating that our design meets the requirements for interconnection (within the two weeks they had promised).

They have requested certain tests before the system is deployed, to confirm GridLink's operations (tests we are hoping NYSERDA will fund under Category C).

We will respond to those comments, correcting certain errors, but agreeing to the main substance. They will issue modified comments, until we reach agreement (or agreement to disagree, on issues like "parallel").

They will issue a letter, stating that we have agreed to their final comments, and that we are authorized to proceed with the project. This is the "Preliminary Approval" for the interconnection.

I estimate two weeks before we get that final letter.

(I spoke with Kwame this afternoon to confirm this sequence).

Good luck!

--Shalom

From: Shalom Flank [mailto:SFlank@ParetoEnergy.com<mailto:SFlank@ParetoEnergy.com>]
Sent: Tuesday, August 20, 2013 9:30 AM
To: Nadkarni, Gurudatta
Cc: Atlas, Sharon; McAndrews, Thomas
Subject: Re: Next step: ConEd & GridLink testing <External Sender>

Dear Guru:

You had asked us to keep you informed about our progress in working with Con Edison on Pareto's GridLink non-synchronous microgrid technology. I have some good news, and then a request for next steps.

I am pleased to report that GridLink has been thoroughly reviewed and approved by Distribution Engineering for the proposed NYU-Poly microgrid. We worked with Dan Sammon and Gulliermo Sibucao on the detailed review over the last year. I have attached last week's letter from Tom McAndrews' group, with which Margarett Jolly assisted.

Since we last met with you, in the session with Aubrey Braz, Gerald Dawes, and Frances Resheske last January, we have also worked effectively with Distribution Engineering to approve a second GridLink project for Kings Plaza in Brooklyn. This project will provide grid access to an existing 12.5 MW combined heat and power system that has never been connected to or used grid power.

In other signs of our progress with GridLink, we were awarded a NYSERDA grant in April. This grant enabled our New York City engineer of record, Rich Bernhardt, to complete drawings for ConEdison for both projects. We also successfully completed factory tests of the first GridLink inverters earlier this year – results that we shared with Dan Sammon. On August 14th, we applied for a second NYSERDA grant to complete full-system tests of the first GridLink eHouse at Brookhaven Labs, including the tests requested in Con Edison's approval for NYU-Poly. DNV Kema will provide third-party verification under this proposal, which was also supported by the Mayor's Office (see attached letter).

As we look ahead to the first GridLink deployments in ConEd territory, the ability to safely and affordably island distributed generation has become a key feature of both State and City policy in the wake of Hurricane Sandy. Therefore, within the last month, we completed meetings with other participants in the 2010 DG Collaborative, such as the NYPA and the Chairman and staff of the NY-PSC, to inform them of GridLink's capability to always-island customer-owned DG.

We would very much appreciate the chance to meet with you and to meet Troy Devries and his R&D team, now that Fred has retired. A specific agenda item would be a potential proposal to NYSERDA in February of next year to implement a microgrid pilot project, as the DG Collaborative envisioned back in 2010 as the next stage once better interconnection technologies became available. NYSERDA has encouraged us to work together with ConEdison on a utility-sponsored project, which we think would also be an excellent model for the PSC moving forward.

I will be in New York next Tuesday through Thursday, if it's possible to get together then. If not, please let us know some potential meeting dates that would work for you. We look forward to seeing you again soon.

--

Thanks,

Shalom Flank, Ph.D.

CTO & Microgrid Architect
Pareto Energy LTD
SFlank@ParetoEnergy.com<mailto:SFlank@ParetoEnergy.com>
202-797-8820<tel:202-797-8820> (direct)
202-903-0758<tel:202-903-0758> (main)

From: Nadkarni, Gurudatta <NADKARNIG@coned.com<mailto:NADKARNIG@coned.com>>
Date: Wed, Aug 21, 2013 at 8:26 AM
Subject: RE: Next step: ConEd & GridLink testing <External Sender>
To: Shalom Flank <SFlank@paretoenergy.com<mailto:SFlank@paretoenergy.com>>
Cc: "Atlas, Sharon" <ATLASS@coned.com<mailto:ATLASS@coned.com>>, "McAndrews, Thomas" <MCANDREWST@coned.com<mailto:MCANDREWST@coned.com>>, "Jolly, Margarett L." <JOLLYM@coned.com<mailto:JOLLYM@coned.com>>, "Devries, Troy" <DEVRIEST@coned.com<mailto:DEVRIEST@coned.com>>, "Braz, Aubrey T." <BRAZA@coned.com<mailto:BRAZA@coned.com>>

Shalom

Thanks for the update. Unfortunately the next two weeks are not good for me. Can we look at the week of September 9th? Hopefully we can find something that works. We should share with you our latest thinking on Microgrids as well.

--- Guru

NOTE THAT A MEETING WITH NADKARNI AND VARIOUS ENGINEERS FROM CON EDISON'S DISTRIBUTION ENGINEERING DEPARTMENT AND R&D DEPARTMENT RESULTED IN AN ARGUMENT ABOUT PARETO ENERGY'S DISCUSSIONS OF NEW BUSINESS MODELS WITH SENIOR MANAGEMENT AT CON EDISON AND A COMPLAINT ABOUT HOW PARETO WAS COMMUNICATION TO MANAGEMENT ABOUT THE INTERCONNECTION NEGOTIATION FOR THE KP-CHP PROJECT.

AFTER THE MEETING, R&D DIRECTOR TROY DEVRIES TOOK CONTROL OF THE COMMUNICATIONS AND CENTRALIZED THE NEGOTIATIONS WITH PARETO ENERGY AND MACERICH

TEXT OF LETTER FROM BROOKHAVEN NATIONAL LABS AGREEING TO PERFORM TESTING OF GRIDLINK FOR THE KP-CHP PROJECT THAT WAS REQUIRED BY CON EDISON

NOTE THAT BROOKHAVEN SUBSEQUENTLY DECLINED TO CONDUCT THE TESTING WITHIN THE TIME FRAME NEEDED TO RESPOND TO CON EDISON'S REQUIREMENTS AND IT WAS DECIDED TO PERFORM THE TESTS AT GE POWER CONVERSION CUSTOMER SITE IN THE FIELD

August 5, 2013

Roseanne Viscusi
NYS Research and Development Authority
17 Columbia Circle
Albany, NY 12203-6399
Dear Ms. Viscusi:

I am writing in support of Pareto Energy's application for NYSERDA's Smart Grid program, PON2715, Category C. Pareto Energy's GridLink product concept is designed to provide a pre-packaged microgrid solution to integrate distributed energy resources into tomorrow's power grid. By using power electronics to insulate utility distribution systems from any negative impact such as fault current or voltage instability, Pareto Energy's GridLink could seamlessly combine both multiple generation sources and multiple loads. GridLink could serve as an important Smart Grid technology to provide enhanced grid resilience and stability through islanding, dVAR, frequency regulation, andother ancillary services at the distribution system level.

We at Brookhaven National Laboratory (BNL) see real potential benefits from solutions such as GridLink, and are very interested in seeing such promising technologies developed and demonstrated to determine the true potential. To this end, BNL feels that our testing facilities in Upton, NY are well suited to test GridLink's expected capabilities. If Pareto Energy's efforts to develop GridLink advance successfully through their proposed effort to NYSERDA, BNL is prepared to work with Pareto Energy to develop a live demonstration at the BNL site as a follow-on activity.

To this end, Pareto Energy advises BNL that Consolidated Edison has requested that Pareto perform certain tests of its technology. BNL is willing to work with Pareto to establish a test plan that is acceptable to Pareto, BNL, and utility partners. It is expected that utility engineers from Con Edison, National Grid, PSEG and other utilities will be invited to participate in a follow-on demonstration phase. BNL and Pareto see testing at BNL as an important path to commercialization.

New grid technology, such as GridLink, is one of the reasons BNL is investing in these new test facilities; to provide energy solutions for New York State and the nation. We look forward to working with NYSERDA and Pareto Energy to help transition the new GridLink technology to commercial adoption.

Sincerely,

J. P. Looney
Department Chair
Sustainable Energy Technologies Department

Manhattan Major Services
4 Irving Place 10th Floor North
New York, NY 10003

August 13, 2013

NYU-POLY – Polytechnic Institute of NYU
Dennis Dintino – VP for Finance & Business Affairs
Six Metro Tech Center
Brooklyn, NY 11201

Dear Mr. Dintino,

We are pleased to notify you that your proposed Microgrid project has received Preliminary Approval for interconnection with Con Edison's distribution system.

The NYU Poly MICROGRID Project is located at 6 METROTECH CENTER, Brooklyn, NY and this First Submittal was received by Con Edison's NSDE for review on 07/11/2012. This project includes the installation of 3-26.4kv feeders and active rectifiers, 3.3kv ac input and 4.8kv dc output. The active rectifiers also interface with multiple generators, three-phase, 50 Hz, 3.3kv ac output operated non-synchronously with the Con Edison distribution system (i.e., independent in voltage, frequency, and phase angle).

Con Edison reviewed the customer's ONE LINE DIAGRAM, DWG NOS E-10 AND E-11 dated 7/8/2013 (No revision), and found that the design of this Microgrid facility, as shown, with all three feeders configured identically to the feeder shown on DWG NO E-10, does meet the basic design requirements of the New York State Public Service Commission, SIR. Nevertheless, it is suggested that the following testing be conducted, and the results incorporated into subsequent submissions.

OTHER COMMENTS

- The active rectifier harmonics should be mitigated to meet the minimum requirement of IEEE 519.
- The customer interfacing inverter is programmed as an active rectifier and as such cannot export power into the Con Ed grid. This should be confirmed by customer during testing.
- Likewise, the active rectifier shall mitigate fault contribution into faulted remote Con Ed feeder. This should be demonstrated successfully during the testing.
- The customer shall install a reverse power relay function to provide backup protection against export from the active rectifiers.
- Direct Transfer Trip is normally a requirement for all DG interconnections to Con Ed's primary sources. It is the customer's contention that the active rectifier behaves like a traction load and cannot cause unintentional islanding. DTT will not be required for the Microgrid connection if the customer can demonstrate that the active rectifiers (which are not UL 1741 certified) demonstrate the capability to prevent unintentional islanding.

The next step in our standard process is for you to proceed with full project design using the Microgrid approach that you submitted to us, and to provide us with 30% engineering drawings when they are available for further review.

Thank you and looking forward to working with you and your team.

Truly yours,

Kwame Agyeman-Budu, CPM

From: Brian Mehler [mailto:bmehler@paretoenergy.com]
Sent: Monday, August 26, 2013 1:11 PM
To: Braz, Aubrey T.
Cc: Guy Warner; Nadkarni, Gurudatta; Atlas, Sharon
Subject: DG Pilot Project from Macerich, Kings Plaza Shopping Center <External Sender>

Dear Aubrey,

Please find the attached proposal from Macerich, the owners of the Kings Plaza Shopping on Flatbush Ave. in lower Brooklyn, to develop a "DG" Pilot Project with Con Edison at the mall's fully-islanded 12.8MW CHP plant. The proposal would integrate the islanded system with Con Edison's distribution grid using GridLink to offer excess power to the utility and potentially provide standby service to Kings Plaza. In our work with Con Edison's Distribution Engineering team, we have received a Load Letter within a short 4-week timeframe (attached). Macerich now wishes to meet with you to discuss the possibility of continuing the process in the context of the Company's DG goals as stated in the 2010 DG Collaborative and the Company's 2010 Long Range Electricity Plan.

We are seeing great interest in this application of our technology as there are other sites in New York that could be retrofitted with GridLink to provide similar services and believe this pilot project would provide a template for doing so in a way that benefits Con Edison's shareholders, DG end-users, and other rate-payers. Many other large energy users, such as the New York City Housing Authority, are also examining the possibility of adding CHP to provide enhanced reliability at their sites. We believe a pilot project at Kings Plaza would help demonstrate the optimal process for doing so. Furthermore, the access to local power during peak hours, the ability to defer expensive substation upgrades and voltage stability support services made available by GridLink offer a suite of attractive benefits to the utility's shareholders that we would like to discuss in greater detail. We are meeting with several members of Con Edison on September 9th to discuss GridLink's testing and application at NYU-Polytechnic, and understand that you have been invited to that meeting as well.

If you are available, Macerich's senior staff wishes to fly from Santa Monica to New York to discuss the proposal outlined herein on September 16-18th or 23-27th. I would be more than happy to work with your staff to align our schedules and set the meeting time.

Thanks, and we look forward to meeting with you.

All the best,

Brian Mehler
Pareto Energy

From: Braz, Aubrey T. [mailto:BRAZA@coned.com]
Sent: Tuesday, August 27, 2013 5:39 PM
To: Brian Mehler
Cc: Guy Warner; Nadkarni, Gurudatta; Atlas, Sharon
Subject: RE: DG Pilot Project from Macerich, Kings Plaza Shopping Center <External Sender>

Hi Brian,
I have changed jobs and am no longer responsible for Smartgrid projects. I have forwarded your proposal below to Bob Schimmenti and Matt Ketschke for their consideration.

Best Regards,

Aubrey Braz
Vice President
Substation Operations

From: Alan McDonnell
Sent: Tuesday, September 10, 2013 2:52 PM
To: carbonaraj@coned.com
Cc: SAMMOND@coned.com; Guy Warner <gwarner@paretoenergy.com>
Subject: ConEd Pareto microgrid research follow up

Joe,

It was good to meet you yesterday, even though we didn't have enough time to get into the details of the research collaboration that we hope to be involved in together.

We'll have to make some time for s future discussion to get into those details, but I thought I would just mention some of the history and some ideas of mine on what would make sense as far as future microgrid research is concerned, and hopefully you will pass this along to your managers as well so that we can include them in the future discussions.

Dan, good to see you again and I'd also like to make an offer to bring Patrick McHugh up to speed on where we're at and perhaps some of the research possibilities as well.

The preliminary approval that was part of the discussion yesterday is just that, see the attached letter dated Aug. 13th, and it includes several more steps of approval before a final engineering approval is given. We are following ConEd's standard procedure for project approval here, of which the end user was very insistent that we clear this step with ConEd before anyone spends more money on the other project tasks to follow. Also, our present NYSERDA grant was a cost share to help get us through this level of permitting.

The future research we contemplate includes two basic components. The first is to have ConEd's SCADA system communicate to the microgrid to be able to send control signals and read monitoring and status information. Due to the high dynamic performance and size of the inverters, some significant levels of control over both real and reactive current could help make the existing grid more robust for what should be a reasonable price.

Just as a point of reference, the microgrid is designed to have internal load controls that are capable of seamlessly keeping power on during a loss of all input feeders from ConEd. Thus, ConEd's SCADA system might sense a problem during a peak time when the microgrid might be consuming supplemental power and it could be told to reduce the input power draw by say 99%...effectively zero, without tripping any breakers. The inverters could react faster than the SCADA system could communicate, so finding ways to communicate faster would be a significant topic of research.

We have also been discussing such possibilities with Siemens, and they are very interested in partnering with us on this.

A further area of research involves the operations inside the microgrid, and this could be important if ConEd were to own such a system. I have a separate pitch I'll make later about the possibilities with the Westchester system, where it would make a lot of sense for the utility to own and control what amounts to a bridge between two grids. The big area of research here is how we can load control, and control input DG, by varying the grid frequency slightly. This is a big problem for utilities in that simple voltage control without frequency changes don't have the required impact.

There is another series of projects, such as Kings Plaza, where the power does get sent upstream, but we'd like to research how we can use the high performance nature of the inverters to send larger amounts of it than generally accepted if the level of control is high enough and coordinated out of the utility SCADA.

As mentioned, we are working with NYSERDA on this and are informing them of these possibilities. It might make a lot of sense to talk to them collaboratively as well?

Keeping the big picture in mind here, the goal is that we prove our technology, and the theories that underlie it, to the point where there is no more need to install new high voltage grid assets. Everything can be done with new DG inside the microgrids without causing stability or safety problems for the existing grid. That is a game changer along the lines of what happened to the phone system of old, and we'd like to be there with ConEd, and others, as the change comes.

More to follow I'm sure. Please pass this note upstairs, and contact me anytime if you have questions.
Thanks,

Alan McDonnell
VP Engineering
Pareto Energy LTD
2101 L Street NW, Suite 800
Washington, DC 20037
Tel: (202) 903-0758
Mobile: (603) 546-5785
amcdonnell@paretoenergy.com
www.paretoenergy.com

From: Alan McDonnell
Sent: Tuesday, October 01, 2013 6:07 PM
To: devriest@coned.com
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: Pareto meeting follow up

Troy,

Just a quick note to thank you for your active participation in the meeting today.

As I mentioned, we would like to work with ConEd's research group separately to move forward new technologies that at present there are no standards for in the distribution engineering group.

Separately, our CEO, Guy Warner (introduced here) has worked extensively on the issue of PSC backed funding for such projects. One of the opportunities that we have on the go right now is in Brooklyn at a shopping mall called Kings Plaza. Attached are some of the details of the project, but basically it would be the fastest way for us to get an installation into ConEd's territory due to the fact that the power plant is already there and running.

Also, other than financial risk, there is no risk to potentially disrupting electric service if there are operation problems with Gridlink. The attached letter from ConEd (Tom McAndrews group) is a first in that they have agreed with our assertion that we should be allowed to connect radial feeds and forego the second contingency requirement due the DC Bus configuration. This pens up significant future opportunities in NY that we'd like to pursue much further.

The main area of research would involve having ConEd control the outbound power flow and VAR current over a new high speed communications protocol. As this is an outbound power scheme, then the material presented today about the active rectifier don't apply, but the fast tripping for fault current mitigation may.

I realize you are not available on Oct. 16th, when the owners of the Kings Plaza Shopping Center from CA are in town, but we were wondering if someone else such as Matthew Ketschke might be? Either way, if you could pass this note along to him we would appreciate it.

If you have any further questions on anything I presented today, I'd be more than happy to send along more details. I realize that it doesn't just leap off the page that the active rectifier solution is the missing piece required to begin the change in architecture of the power grid to one of mostly local distributed generation.

We have given a lot of thought to how we can make this all a win-win for ourselves as well as ConEd and the ratepayers, and if you and Matt have time we'd like to go through that with you as well. These first pilot projects can show the way through to that future, and we hope to work collaboratively with you on them.

Thanks again for your time and I look forward to future discussions.

Alan McDonnell

VP Engineering
Pareto Energy LTD

Received From Troy Devries, Con Edison Director of R&D
Consolidated Edison/ConEdison Solutions
Review of Pareto Energy's GridLink Technology
October 1, 2013
4 Irving Place, New York, NY

Meeting Participants

Consolidated Edison
Troy Devries
Anthony Barna
Sergo Sagareli
Serena Lee
Patrick McHugh (invited)
Kwame Budu (invited)
Matthew Ketschke (invited)
Baeth Fanek (invited)
Matthew Sniffen (invited)
Juan Martinez (invited)
Stavros Livanos (invited)
Jackie Wong (invited)

Pareto Energy
Alan McDonnell

ConEdison Solutions
Michael Gibson
James VanderPas
Ward Strosser
Andre LeBlanc (by phone)
Matthew Fairy – consultant
John Bosch – consultant

Discussion Agenda

I. Introductions
II. Pareto Energy's GridLink Technology and its Applications
III. Pareto Energy's NYU Poly Microgrid Project
IV. Questions and Answers
V. Next Steps

Disclaimer

This meeting will be conducted consistent with the requirements of FERC's Standards of Conduct and the NY PSC's Affiliate Rules. The participants at this meeting will not discuss any non-public Transmission Function Information nor any non-public customer information and will adhere to CEI's FERC Standards of Conduct Compliance Procedures and Affiliates Transactions Policy. Attendance will be taken and minutes of the meeting will be kept.

From: Alan McDonnell
Sent: Thursday, October 03, 2013 2:36 PM
To: mcandrewst@coned.com
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: ConEd Solutions disclosures

Tom,

Thanks for the call. As per your request, please accept this e-mail as consent to discuss with ConEd Solutions (who we have an NDA in place with) issues regarding our status with ConEd on the NYU Poly microgrid project.

Best Regards,

Alan McDonnell

From: Brian Mehler [mailto:bmehler@paretoenergy.com]
Sent: Thursday, October 03, 2013 2:07 PM
To: Schimmenti, Robert
Subject: RE: DG Pilot Project from Macerich, Kings Plaza Shopping Center <External Sender>

Dear Bob,

My name is Brian Mehler and I am leading Pareto Energy's efforts in the New York region.

I wanted to check-in with you quickly in reference to my correspondence with Aubrey Braz from August 27th (below) to see if you would be available to meet with us and Macerich, the owners of the 12.8MW Kings Plaza CHP plant, on October 16th at Con Edison's Irving Place HQ to discuss the proposal? We wanted to give you sufficient time to look it over, but Macerich has now come back to us with a great deal of urgency on whether or not you are available to meet that day as they are trying to firm up their travel plans to the east coast (they operate out of Santa Monica, CA but will be in NYC on business).

If you could let me know either way if you are available to meet that day, I can get back to Macerich so they can finalize their travel plans. If you are not free on the 16th, could we schedule another time for the folks at Macerich to fly out to discuss their proposal? I have also reached out to Matt Ketschke on this basis as he was able to meet briefly with our Chief Engineer, Alan McDonnell, and Troy Devries by phone for a meeting earlier this week, however, Matt's assistant told me that he would be out of the office for the rest of the week.

Thanks for your time, and I look forward to hearing from you.

All the best,
Brian Mehler

From: Jolly, Margarett L.
Sent: Thursday, October 03, 2013 2:59 PM
To: Devries, Troy
Subject: FW: DG Pilot Project from Macerich, Kings Plaza Shopping Center <External Sender>

Another example of Pareto going to the execs, again today. Who do I call out at Pareto….

From: Devries, Troy [mailto:DEVRIEST@coned.com]
Sent: Thursday, October 03, 2013 3:14 PM
To: Alan McDonnell
Cc: Jolly, Margarett L.; Carbonara, Joseph; SCHIMMENTIR@coned.com
Subject: FW: DG Pilot Project from Macerich, Kings Plaza Shopping Center <External Sender>

Alan,

Can you address this? This is what I was talking about on Monday, when we met. There are too many points of contact, which creates confusion and gives us an uncomfortable feeling about what you are trying to accomplish. R&D should be your contact regarding the Kings Plaza location but, I am not available on the 16th. Joe Carbonara from Con Edison R&D was working to set up another date.

From: Alan McDonnell
Sent: Thursday, October 03, 2013 3:43 PM
To: 'Devries, Troy'
Cc: Jolly, Margarett L.; Carbonara, Joseph; SCHIMMENTIR@coned.com
Subject: RE: DG Pilot Project from Macerich, Kings Plaza Shopping Center <External Sender>

Troy,

Sorry for any confusion created by our side. We've also been meeting different people from different departments within ConEd over the years, many of whom tell us to keep them in the loop or let them know if we get stuck.

Brian Mehler works as an assistant to Guy Warner, but Guy can always be reached if anything from Pareto is done out of order.

In the case of Kings Plaza, we were being pressured by the new owners of the mall, who are a big company from California that own malls all over the country, that they were going to be in NYC on the 16th, and were hoping to meet someone from ConEd who would be involved if this project were to go through.

We have made other arrangements with them given your travel schedule, and we will let you know when we have another request.

Of course you can always contact me anytime as well.

Thank you for your time on Tuesday, and if you have any other technical questions, please let me know. Guy also told me that I may have been incorrect in what I told you about the pilot project funding, of which I'm no expert, and he mentioned that when you have time he'd like to speak to you and the others involved regarding this.

Sorry again for any confusion.

Best Regards,

Alan McDonnell

From: Schimmenti, Robert [mailto:SCHIMMENTIR@coned.com]

Sent: Thursday, October 03, 2013 3:08 PM
To: Brian Mehler
Cc: McAndrews, Thomas; Jolly, Margarett L.
Subject: RE: DG Pilot Project from Macerich, Kings Plaza Shopping Center <External Sender>

Brian,

My schedule is booked but I would recommend speaking with Tom McAndrews and Margarett Jolly since they are most intimate with the DG project interconnection process and division of responsibility. I would recommend that the customer be involved to any discussions or correspondence as things move forward.

Feel free to reach out as activities progress.

Regards,

Bob

Note: Con Edison Solutions expressed an interest in project financing. Matthew Fairy was the agent that introduced us to Jack Bosch of Con Ed Solutions

From: Alan McDonnell
Sent: Thursday, October 10, 2013 7:01 PM
To: Matthew Fairy optonline <mfairy@optonline.net>
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: Notes for Jack Bosch

Matthew,

Further to our discussions, here are some thoughts of mine to help steer Jack towards the big picture and not let him get obsessed with minor details on the Poly due diligence.

The preliminary approval of the Gridlink system for the NYU Poly Microgrid opens up a potential for an unlimited amount of DG to be installed in ConEd's service territory. This preliminary approval is for a project that includes 3 x 2MW sized generating units, but that could be expanded.

The active rectifier design that allows for no upstream grid disturbance means that Gridlink can be permitted like a load, and just like the load growth over the last 100 years, there is no functional limit to how much load can be installed.

Since the technology proposed at Poly is new, the many possible features need to be introduced in a step by step way. Here is an explanation of three of those features that could significantly increase the size of the Poly project.

Given that the active rectifiers could export power with a software and protection change, the system at Poly could be used to export power up to a certain limit without causing problems for the upstream grid. Thus, if ConEd were to permit all of the feeders to export power to the limit that they have agreed upon for import, we could add 3 x 5MW (15MW) of power generation to the planned generating capacity.

Further, ConEd has announced plans to allow projects with on-site DG to be fed with N+1 instead of N+2 service if they can demonstrate multi-year reliability. Thus the Poly project could go from 5MW to 10MW simply by this permitting change.

The third is the ability to synchronize other generating sources to the output of the Gridlink feeders, again with no impact on the ConEd side of Gridlink. If we use a conservative number of 50%, assuming a 10MW load from Gridlink, we could add another 5MW.

All in, that's 30MW of power generation without having to change the ConEd permitting or feeder sizing of what is permitted and will be built now in this first stage. Given the dense nature of the areas at Metrotech, 30MW of load could be found in just a couple of blocks, so the cable lengths wouldn't be too long. The generator space could be found by replacing existing diesels with new 50Hz gas engines.

.

For Critical load facilities, they could be given first priority in cases of system outages. I can easily see projects such as 10-15MW at all of the train feeder power stations, hospitals, prisons, data centers, trading floors and on and on….and not just in NYC!

We need the first one working and proven, the sooner the better, and Poly is the place to build the first large scale integrated network system, once we've built and tested the first simple radial feed unit.

Let's hope CES sees the future our way soon!

Cheers,

-Alan

-----Original Appointment-----

From: Alan McDonnell
Sent: Thursday, December 05, 2013 9:59 AM
To: Guy Warner

Subject: Accepted: Meeting between Macerich, Pareto Energy and Consolidated Edison to Discuss King's Plaza (see letter proposal with agenda attached)

When: Wednesday, December 18, 2013 10:00 AM-11:00 AM (UTC-05:00) Eastern Time (US & Canada).

Where: Consolidated Edison Office, 4 Irving Place, NY, NY

Note that Pareto Energy switched inverter suppliers from Woodward, where previous testing for fault current mitigation had been performed and sent to Con Edison to GE Power Conversion (GE-PC) because the GE inverters were UL 1741 certified and had passed European codes for fault ride through in addition to fault current mitigation. GE-PC had installations of the power electronics platform in the Europe and the US that were directly comparable to the power electronics platform proposed for the Kings Plaza demonstration that had been installed according to IEEE 1547 standards. It was anticipated at this time that a testing facility in South Carolina would be available to perform additional testing required by Con Edison because Con Edison did not accept the GE-PC product specification without hardware testing. Eventually, there was a delay in the commission of the South Carolina facility so Con Edison accepted hardware tests at a GE-PC German customer site in the field.

12/9-10/15 First Design Meeting with GE-PC Berlin

From: Zingel, Reinhard (GE Energy Management) [mailto:reinhard.zingel@ge.com]
Sent: Monday, December 16, 2013 11:34 AM
To: Alan McDonnell; Kevin McDonnell
Cc: Packiam, Johnson (GE Energy Management); Vargas, Wayne (GE Energy Management); Brandt, Axel (GE Energy Management); Moehlenkamp, Georg (GE Energy Management); Hartge, Stefan (GE Energy Management); Moutaux, Eric (GE Energy Management)
Subject: Letter: Pareto´s visit the GEPC, Berlin

Dear Alan, Kevin,

attached, please find the requested letter of willingness and its enclosures also summarizing the bottom line of our meeting on December 9, 10,.

Unified MV7315	Unified MV7312	Unified MV7310
6600mm long	6400mm long	5600mm long

In January we are looking into compiling a quotation splitting one-off prices from the normal ones.

We appreciate if you tell us in advance which inverter fits best in length into the E-House from its dimension point of view.

Seasons greetings,

Best regards
Reinhard Zingel
Sales Senior Application Engineer
Power Quality, GE Power Conversion

From: Alan McDonnell
Sent: Monday, December 16, 2013 11:43 AM
To: Zingel, Reinhard (GE Energy Management) <reinhard.zingel@ge.com>
Subject: RE: Letter: Pareto´s visit the GEPC, Berlin
Dear Reinhard,

Thanks for all of your work on this. We have a meeting on Wed. with the power company and end user (shopping mall owner) that we expect will set the first project in motion. We have a meeting in Los Angeles on Jan. 9th for that project, which shall set us in motion for the detailed engineering studies.

I will get back to you at the end of the week with what we know, and then early in the new year with a schedule to move things forward. I will go through the power stack ratings details and send more comments.

Thanks again for all of your help and hospitality.

Best regards,

Alan McDonnell

NOTE: At a December 18. 2013 meeting between Guy Warner (CEO Pareto Energy), Joe Venne (VP of Operations Macerich), and Troy DeVries (just promoted from Director of R&D to Chief Distribution Enegineer) and Margarett Jolly (Just promoted from DG Ombudsperson to Director of R&D Con Edison), Macerich asked for an answer to its August proposal letter for funding Kings Plaza as a GridLink pilot project. Con Edison indicated that they would not contribute any R&D funding to the project. When Macerich and Pareto reminded Con Edison that the Commission Chair had recommended filing a petition for funding, the Con Edison attendees communicated that they were not authorized to discuss such a petition. Therefore, Pareto Energy and Macerich decided to pursue NYSERDA PON 2715 Category D funding which is designed for developed technologies past the proof of concept stage but underutilized in NY. Con Edison's R&D Department then refused to provide a letter of confirming their participation and support without another review of the GridLink technology which took place on February 4, 2014.

From: Brian Mehler
Sent: Thursday, January 30, 2014 12:02 PM
To: Alan McDonnell; Guy Warner
Subject: Joe Carbonara call

Guy & Alan,

I just spoke with Joe Carbonara. He's been waiting to hear back from Troy Devries on whether or not he will be able to attend the meeting on the 4th, as Troy and Margarett are both in San Antonio for a conference. Troy wanted to attend the deep dive, but Joe recommended that we plan on meeting on the 4th either way because the NYSERDA grant has created some urgency. Troy's associates will be attending the meeting anyway, and hopefully Troy will be able to join.

He asked what Con Edison's role in the grant should be exactly and suggested that they be formal "advisors" and "subject matter experts on interconnection" for the demonstration. I agreed that would be appropriate and asked about the Company contributing to the cost share on the grant. Joe said that was Troy's department, and why he should be involved in the discussion. As such, he recommended we move forward with the meeting either way, and then reach back to Troy (if he's not able to attend). He also suggested that if need be, we can set up a one-on-one session with Troy as well. Dan Sammon will attend on the 4th, as will Margarett, Manny Fernandez, and Anthony Barna, who is from Troy's office. Margarett asked to keep the meeting to an hour and a half.

All the best,

Brian

From: Brian Mehler
Sent: Friday, January 31, 2014 3:53 PM
To: Guy Warner <gwarner@paretoenergy.com>; Alan McDonnell <amcdonnell@paretoenergy.com>
Subject: Joe Carbonara call tis afternoon

Guy & Alan,

Joe Carbonara just called. He said Margarett won't be able to attend the meeting on Monday because something urgent came up. He said that we are more than welcome to come on Tuesday as planned to meet with him, or, that he, Margarett and Troy could all meet with us on Friday, Feb. 7th in the same time slot, 10-11:30. We could meet both days if we feel that is necessary/appropriate.

I told him I would call him back after consulting with you on what your travel plans were, so please let me know what you would like to do. He has not mentioned anything about a meeting on the 10th.

All the best,

Brian

From: Brian Mehler
Sent: Monday, February 03, 2014 10:40 AM
To: Guy Warner <gwarner@paretoenergy.com>; Alan McDonnell <amcdonnell@paretoenergy.com>
Subject: Con Edison Meetings this week

Guy & Alan,

Spoke with Joe Carbonara again this morning. He will be there ready to meet tomorrow morning at 10am. Alan- he said that Dan Sammon should be there, and he was reaching out to a woman who is heading their grid communications work, per your request.

Per Friday: Joe said there's a space in Margarett and Tory's calendars for Friday at 10am. He pinged them to reserve that time for us, and is waiting for a confirmation from them.

Best,

Brian

From: Brian Mehler [mailto:bmehler@paretoenergy.com]
Sent: Saturday, February 08, 2014 1:36 PM
To: Jolly, Margarett L.; Carbonara, Joseph
Subject: Draft Letter of Support for NYSERDA PON 2715 Category D <External Sender>

Dear Margarett,

As promised, please find a draft letter of support attached. I understand you will want to make some edits. I think there are two critical points included that came out of our meeting yesterday that are particularly important to include:

1) That Con Edison will be advisors and interconnections system experts for the demonstration project

2) That we have a mutually agreed-upon testing site and pathway.

Mentioning the testing agreement is critical for the grant because it differentiates us in Category D as opposed to Category C. It also keeps the time line consistent: we will receive the results of the grant application at the same time the testing will be taking place, and the funds (if awarded) will likely be released several months after that. That fits very well into the test -> grant funding -> demonstration implementation progression.

The grant is due on February 12th. Please feel free to shoot me an email or give me a call over the weekend if you have any questions.

Thanks again,

Brian

207.232.3992

TEXT OF CON EDISON SUPPORT LETTER FOR PON 2715, CATEGORY D FOR DEMONSTRATION OF TECHNOLOGY PAST THE PROOF OF CONCEPT STAGE BUT UNDERUTILIZED IN NY.

Consolidated Edison Company
of New York, Inc.
4 Irving Place
New York NY 10003

February 10, 2014

Re: Pareto Energy Microgrid Demonstration Application - NYSERDA PON 2715 Category D

Dear Ms. Viscusi:

This letter is to confirm our support of Pareto Energy's NYSERDA PON 2715 Category D application for a microgrid demonstration project at Kings Plaza Shopping Center in lower Brooklyn. The proposal is to demonstrate Gridlink's capability to safely connect King's Plaza's CHP system with the Con Edison distribution system. Con Edison supports the demonstration plan objectives, which includes a post-test demonstration of Pareto Energy's technology at the mall, and will participate in the project as Interconnection Systems Experts.

Pareto and Con Edison have met on numerous occasions to discuss the overall demonstration project. In our most recent meetings, Pareto and Con Edison have agreed on several technical benchmarks and certifications that must be achieved and verified in order to meet Con Edison's interconnection requirements. Based on those conversations, we agreed, in concept, to a specific, mutually agreed upon testing facility in the United States where those benchmarks will be tested.

Proposed capabilities include a simpler process for connecting DG to the grid, potentially offering VAR and voltage support to the grid.

Lastly, and most importantly, it is our understanding that Pareto and Macerich wish to demonstrate Gridlink's ability to create a safe haven and site of refuge for local communities in extreme weather events and emergencies. Con Edison is always interested in advancing innovative technologies for making the grid and the communities it serves more resilient and dependable.

Thank you for your consideration.

Very truly yours,

Margarett Jolly
Director Research and Development

CON EDISON ATTENDEES CONFIRMED IN INVITATION FOR FEBRUARY 13 MEETING TO DISCUSS MUTUALLY BENEFICIAL MICROGRID BUSINESS OPPORTUNITIES

1. Frances A. Resheske
2. David Gmach
3. Bob Schimmenti
4. David Logsdon
5. Matthew Sniffen
6. Margaret Jolly
7. Troy Devries

NOTE THAT SENIOR MANANGERS RESSHESKE AND SCHIMMENTI DID NOT ATTEND THE MEETING SO DISCUSSION OF THE BUSINEES OPPORTUNITIES WAS POSTPONED UNTIL JUNE 11, 2014 WHEN ROBERT SCHIMMENTI CONVENED A MEETING WITH PARETO ENERGY, GE AND MACERICH TO DISCUSS THE KP-CHP BUSINESS OPPORTUNITY

NOTE THAT CON EDISON'S DG OMBUDSPERSON CONTINUED TO COMPLAIN ABOUT PARETO ENERGY RESPONDING TO INQUIRIES FROM UPPER MANAGEMENT ABOUT THE BUSINESS MODEL OPPORTUNITIES FOR GRIDLINK. PARETO ENERGY HIRED MR. JIM CAPALINO OF CAPALINO & CO TO IMPROVE COMMUNICATIONS WITH CON EDISON

From: Schimmenti, Robert [mailto:SCHIMMENTIR@coned.com]
Sent: Tuesday, June 17, 2014 4:53 PM
To: james@capalino.com; Guy Warner
Subject: Pareto Energy Next Steps
Gents,

Thanks for an engaged and interesting conversation. I was happy to participate. My understanding is test data was presented that indicates we will proceed with next steps. Based on the discussion, the ability of fault-current mitigation while also providing additional benefits in managing power flow across the proposed interconnection with Kings Plaza is thoughtful and innovative. Here is what I thought were the follow-ups from the meeting:

1. Pareto/GE will submit a Formal Test Report demonstrating the device provides the required fault-current mitigation. Distribution Engineering will review and provide feedback promptly.

2. Pareto/Kings Plaza will submit formal request for interconnection, a proposed one-line including DTT and a Description of Operation.

3. Pareto/Kings Plaza will submit standby rate analysis to DG Group. DG Group will work with Rate Engineering to evaluate analysis and provide guidance to customer on expected rates under current tariff design.

4. DG Group to evaluate alternate funding opportunities for fault-mitigation.

If there was anything else let me know. I will review with my folks to ensure timely review/resolution.

Jaime Brennan has the point here and will steer the next steps as needed.

We can check in as needed and do not hesitate to reach out to me.

Best regards,

Bob

From: James Capalino [mailto:james@capalino.com]

Sent: Wednesday, June 18, 2014 6:58 AM
To: Schimmenti, Robert <SCHIMMENTIR@coned.com>
Cc: Guy Warner <gwarner@paretoenergy.com>; Chet Warner <cwarner@paretoenergy.com>; Reid Capalino <reid@capalino.com>
Subject: RE: Pareto Energy Next Steps

Dear Bob, thanks for your thoughtful email and enumeration of follow-up actions following the 04.11 meeting you kindly hosted.

We salute Con Ed's leadership in this energy efficiency/distribution arena!

I recommend that we consider convening an update progress meeting at Con Ed at an appropriate milestone in July to the chaired by Jamie Brennan. Hopefully, your schedule would permit you to spend some time during the meeting with the team.

Thank you for your interest and support of Pareto's goals for Kings Plaza.

Jim

James F. Capalino

From: Guy Warner
Sent: Thursday, August 13, 2015 10:32 AM
To: MCHUGHPA@coned.com
Cc: Alan McDonnell
Subject: NYSERDA PON 2715 Category D Contract for demonstrating GridLink

Dear Patrick:

I appreciate your continuing interest in ways that Pareto Energy's GridLink technology can provide useful interconnections of existing CHP systems in Brooklyn and Queens.

In light of the highlighted statements by Con Edison on pages 3, 6 and 7 of the attached filing with the NYS-PSC, NYSERDA has asked me to confirm the Company's support for Pareto Energy's PON 2715, Category D contract with NYSERDA for demonstrating GridLink at the Kings Plaza Shopping Center CHP facility ("KP-CHP").

NYSERDA requires that Category D grants pertain to "new or underutilized technologies that are past the 'proof-of-concept' stage. Projects in this category should not include technology or product development tasks." I have attached the support letter that Con Edison provided to NYSERDA at the time of our proposal, which was conditional upon the completion of certain tests.

Subsequently, GE Power Conversion performed the physical testing requested by Con Edison at a field implementation of the technology at a GE customer facility. The tests were reviewed in detail with Con Edison's distribution engineers in working sessions from June to August last year, which resulted in the preliminary engineering approval for the GridLink installation at the KP-CHP.

I have attached the test report. Page 14 of 26 describes the 5MW inverter system connected to a 20kV - 50hz distribution feeder, with the relevant test results following. This unit is of the same type (MV7000) with the same controller and software as that will be used for Kings Plaza. The Kings Plaza units have been designed to have a higher power quality and control bandwidth in order to meet the IEEE requirements. Note that this report was provided confidentially to Con Edison and NYSERDA and is not for public dissemination as requested by GE's host customer.

After Con Edison acceptance of the tests, Pareto Energy presented a Product Specification and Implementation Plan in working sessions with Con Edison's distribution engineers last December and January. Con Edison has never filed any exceptions to this specification and plan.

Pursuant to the tasks in our contract, NYSERDA has also seen and accepted the Test Report and the product specification and implementation plan. Now, however, concern has emerged about the position that Con Edison takes in its filing with the Commission that GridLink "has never been successfully tested as a viable interconnection platform between a generator and an electric distribution system".

I would be grateful if you would please provide some assurance that Con Edison's continues to support the KP-CHP project and the NYSERDA Category D contract, together with some explanation of how the comments in Con Edison's filing to the Commission are consistent with the testing, product specification and implementation plan prepared by Pareto Energy.

Again, I appreciate your continuing assistance and collaboration and am sure that we can work together to assure NYSERDA that Pareto Energy still qualifies for the conditions of the Category D contract in terms of the readiness of GridLink for application at the KP-CHP.

Should you have any questions about the testing or the product specification and implementation plan, please email or phone our lead engineer, Alan McDonnell at amcdonnell@paretoenergy.com or (603) 546-5785.

Guy

Guy G. Warner
Chairman and CEO
Pareto Energy LTD
Tel: (202) 903-0758
Mobile: (202) 247-6171
Email: gwarner@paretoenergy.com
2101 L Street, NW
Suite 800
Washington, DC 20037

From: James Capalino [mailto:james@capalino.com]

Sent: Wednesday, July 02, 2014 7:42 AM
To: Cooke, Charmaine D
Cc: Cooke, Charmaine D
Subject: Request for a follow-up meeting between Bob Schimmenti and Guy Warner, CEO of Pareto

From: "Brennan, James" <BRENNANJA@coned.com>
Date: July 3, 2014 at 5:06:23 PM EDT
To: James Capalino <james@capalino.com>, "Cooke, Charmaine D" <COOKEC@coned.com>
Subject: FW: Request for a follow-up meeting with Guy Warner, CEO of Pareto <External Sender>

Jim,

Regarding your request for a meeting with Bob, I wanted to let you know that I am currently working with Chet Warner to arrange a working meeting next week so we continue the discussion on all the topics you mentioned: engineering, rates, interconnection and financial opportunities. This session will help us close the current open items and further define the next steps necessary to move this exciting project forward. We will reach out to you after this meeting to determine your availability for a follow-up discussion with Bob Schimmenti.

Thanks and have a great holiday weekend.

Best Regards,

Jamie Brennan
Department Manager
Distributed Generation

From: James Capalino [mailto:james@capalino.com]
Sent: Thursday, July 03, 2014 5:40 PM
To: Guy Warner <gwarner@paretoenergy.com>; Chet Warner <cwarner@paretoenergy.com>
Cc: Reid Capalino <reid@capalino.com>; Ben Kleinbaum <ben@capalino.com>
Subject: Fwd: Request for a follow-up meeting with Guy Warner, CEO of Pareto <External Sender>

Gentlemen, I will press Bob for a meeting as soon as Chet and Jamie conclude their next discussion re open items.

Best wishes for a relaxing holiday weekend.

Jim

James F. Capalino
CAPALINO+COMPANY

From: Brennan, James [mailto:BRENNANJA@coned.com]
Sent: Thursday, July 03, 2014 4:43 PM
To: Alan McDonnell; Chet Warner; Guy Warner
Subject: FW: Kings Plaza Engineering Submittals <External Sender>

Chet,

It was great to talk with you this morning. As we discussed, a meeting next week to review the following issues would be really helpful in moving this project forward:

1) Dan has some questions on the test report. I know Alan was travelling this week but Dan and Alan will hopefully be able to tie in next week and finalize.
2) Rate Issues – Review your model of the existing rates to make sure we're on the same page.
3) Incentives – Model the various interconnection options to optimize the value available through the various Demand Management programs.
4) Fault-Mitigation Funding – Review Alan's cost comparison of equivalent fault mitigation to confirm level of funding.

If you could send me the analysis for 2. and 4. above as soon as they are available, I would really appreciate it. This will ensure that our meeting next week will be as productive as possible. If some or all of your team can't make it to the city, let me know and I'll set up a call-in number. I'd also be happy to come to Stamford if that's easier.

Thanks and have a great 4th of July weekend.

Thanks again,

Jamie Brennan
Department Manager
Distributed Generation
347-839-1692

From: Guy Warner [mailto:gwarner@paretoenergy.com]
Sent: Wednesday, October 01, 2014 2:20 PM
To: Brennan, James
Cc: Chet Warner; James Capalino; Schimmenti, Robert
Subject: FW: Pareto Energy Next Steps

Good Day Jamie:

Macerich, the owners of Kings Plaza Mall, have decided to go forward with the next planning steps for installing GridLink. They have retained engineering consultants that are now working with us. Structural engineers have selected a site for installing GridLink and are completing the constructability analysis of the site. At this time, we have no reason to believe that GridLink cannot be structurally installed.

Therefore, we would like to collaborate with you to complete task 4 from Bob Schimmenti's email below. Can we meet with you next week about this? In the meantime, we have attached the following analyses for your consideration that we believe will be useful for the work on task 4:

The first attachment is a detailed comparison of the CLiP technology versus GridLink at Kings Plaza. The data is based on a study of Kings Plaza interconnection by engineers working for the previous owner, Vornado. The quantitative analysis was never published or saved, so we have reconstructed this data by interviewing some of the engineers involved. We could contact Rich Bernhardt who worked on Vornado's consideration of the CLiP technology at Kings Plaza and who has also worked on the CLiP technology at NY Presbyterian Hospital, NYU Hospital, and NYU Main Campus CHP. The budget for the last project at NYU is publically available. I have attached a presentation that provides some details but does not break out the interconnection costs. The total cost of the project wound up being over $9 per watt and we believe that at least one quarter to one third of that cost was for synchronous interconnection (i.e. $2.25 to $3.00 per watt). Note that Rich Bernhardt is the engineer of record for Pareto Energy's submissions to Con Edison for Kings Plaza. Therefore, he is the single best source for comparing the costs of the two approaches.

In the third attachment, Rich Bernhardt also compared the cost of GridLink versus synchronous interconnection for Pareto Energy's GridLink project at Metrotech/NYU Polytech in Brooklyn. This data was provided to and reviewed by NYSERDA. Recall that the NYU-Poly project did not export any power onto Con Edison's grid as is the plan at King's Plaza. Therefore, cost differences between GridLink and synchronous interconnection would be much higher if there were export of power.

The final attachment is an independent article that compares synchronous versus non-synchronous interconnection. Note that this article has not been accepted for publication yet so please do not disseminate it beyond Con Edison.

If it proves useful, we can add an agenda item for our next meeting to review our work to develop GridLink projects at JFK Airport and Starrett City.

Guy

Guy G. Warner

-Original Message From: Schimmenti, Robert [mailto:SCHIMMENTIR@coned.com]
Sent: Tuesday, June 17, 2014 4:53 PM
To: james@capalino.com; Guy Warner
Subject: Pareto Energy Next Steps

1. Pareto/GE will submit a Formal Test Report demonstrating the device provides the required fault-current mitigation. Distribution Engineering will review and provide feedback promptly.
2. Pareto/Kings Plaza will submit formal request for interconnection, a proposed one-line including DTT and a Description of Operation.
3. Pareto/Kings Plaza will submit standby rate analysis to DG Group. DG Group will work with Rate Engineering to evaluate analysis and provide guidance to customer on expected rates under current tariff design.
4. DG Group to evaluate alternate funding opportunities for fault-mitigation.

From: Alan McDonnell
Sent: Friday, August 28, 2015 9:00 AM
To: MCHUGHPA@coned.com
Cc: Guy Warner
Subject: RE: NYSERDA PON 2715 Category D Contract for demonstrating GridLink

Patrick,

Not sure if this one just got buried in your inbox while you were on vacation, but I just wanted to follow up on Guy's e-mail below. I spoke with Dan Sammon earlier to ask if he had been asked to comment, and he mentioned that he hadn't heard anything.

We had a very good meeting with the NYISO yesterday to explain how our system works and to go through the reasons why this project can't get funding or the rates it should be entitled to. We pointed out that subsequent to the engineering preliminary approval, now that the higher level corporate types are involved there seems to be a lot of confusion about the technology and operations of the system. I stepped them through the operating theory and procedures, as well as the technology readiness level. Obviously there are still a lot for other players, such as NYSERDA and NYPSC, who are also not clear on these issues, especially given the response send by Susan J. Vercheak, attached.

It is my job to make sure that there are no misunderstandings about the technology, and to that end we continue reaching out to all parties concerned. If you have a chance to go through Guy's e-mail and see if we can't help move this project forward, we would appreciate it.

Best Regards,

Alan McDonnell
VP Engineering
Pareto Energy LTD
2101 L Street NW, Suite 800
Washington, DC 20037
Tel: (202) 903-0758
Mobile: (603) 546-5785
www.paretoenergy.com

From: Chet Warner
Sent: Monday, August 31, 2015 12:34 PM
To: Brennan, James <BRENNANJA@coned.com>
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: FW: NYSERDA PON 2715 Category D Contract for demonstrating GridLink

Dear Jamie,

Please see below for two emails that Pareto Energy has sent to Patrick McHugh requesting confirmation of Con Edison's support for our NYSERDA Demonstration Project at Kings Plaza.

We are still awaiting a response from Patrick on the key points outlined below. For this reason, I am requesting your assistance in contacting Patrick so that he may clarify these points as soon as possible and so that we may inform NYSERDA and our client Macerich of Con Edison's position.

Thanks as always for your consideration.

Regards,
Chet Warner

Pareto Energy, LTD
2101 L Street NW, Suite 800
Washington, DC 20037
Office: (202) 903 0758
Cell: (301) 922 9825

From: Chet Warner
Sent: Monday, August 31, 2015 12:34 PM
To: Brennan, James <BRENNANJA@coned.com>
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: FW: NYSERDA PON 2715 Category D Contract for demonstrating GridLink

Dear Jamie,

Please see below for two emails that Pareto Energy has sent to Patrick McHugh requesting confirmation of Con Edison's support for our NYSERDA Demonstration Project at Kings Plaza.

We are still awaiting a response from Patrick on the key points outlined below. For this reason, I am requesting your assistance in contacting Patrick so that he may clarify these points as soon as possible and so that we may inform NYSERDA and our client Macerich of Con Edison's position.

Thanks as always for your consideration.

Regards,

Chet Warner

From: Brennan, James [mailto:BRENNANJA@coned.com]
Sent: Tuesday, September 1, 2015 12:26 PM
To: Chet Warner <cwarner@paretoenergy.com>
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: RE: NYSERDA PON 2715 Category D Contract for demonstrating GridLink <External Sender>

I will follow up and get back to you.

From: Chet Warner
Sent: Tuesday, September 8, 2015 11:04 AM
To: Brennan, James [mailto:BRENNANJA@coned.com]; MCHUGHPA@coned.com
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: RE: NYSERDA PON 2715 Category D Contract for demonstrating GridLink <External Sender>

Dear Patrick and Jamie,

We have been attempting for nearly a month to clarify Con Edison's support of our NYSERDA Demonstration Project at Kings Plaza. We still require a response to key points outlined in emails (listed below) from August 13th and August 28th.

When can we expect to receive a response?

Regards,

Chet

From: Guy Warner [mailto:gwarner@paretoenergy.com]
Sent: Tuesday, September 08, 2015 4:33 PM
To: Vercheak, Susan J - Regulatory
Cc: Chet Warner; Brennan, James; McHugh, Patrick G. (VP Engineering and Planning)
Subject: NYSERDA PON 2715 Category D Contract for demonstrating GridLink <External Sender>

Dear Susan:

With respect to the emails attached below, I have been trying to persuade Patrick McHugh to respond to a request by NYSERDA. Specifically, NYSERDA asked Pareto Energy to determine if Con Edison has changed its support for Pareto Energy's GridLink demonstration project at the Kings Plaza Mall. We were surprised that Con Edison's public filing with the NYS-PSC in July that bears your name claimed that no GridLink prototype had every been built. In July 2014, Pareto Energy had responded to Con Edison's requests for physical demonstrations of GridLink's functionality by supplying tests of an implementation in the field at a GE customer site. Con Edison's engineers approved the tests and subsequently reviewed a GridLink product specification and implementation plan for the Kings Plaza project.

The grant that we won with NYSERDA must be for technology that is developed but underutilized. Con Edison provided a letter of support for the grant application conditional upon the tests that were subsequently completed and approved last year. If Con Edison now maintains that no prototype of the technology has ever been built such that it is not viable for customer use, then Con Edison would be claiming that one of the conditions for our grant award was never satisfied.

I would like very much to see if we can resolve this matter in negotiations, but unless Patrick McHugh or you engage with us by responding to our emails, we will have no recourse but to inform NYSERDA that we did not elicit any response.

Guy

Guy G. Warner
Chairman and CEO
Pareto Energy LTD
Tel: (202) 903-0758
Mobile: (202) 247-6171
Email: gwarner@paretoenergy.com
2101 L Street, NW
Suite 800
Washington, DC 20037

From: Jolly, Margarett L.
Sent: Wednesday, September 09, 2015 3:57 PM
To: 'gwarner@paretoenergy.com'
Cc: Vercheak, Susan J - Regulatory; McHugh, Patrick G. (VP Engineering and Planning)
Subject: FW: draft response to Guy Warner

Dear Guy, Patrick forwarded me your concern yesterday. In response to your question regarding my letter of February 10, 2014 to Roseanne Viscusi of the New York State Energy Research and Development Authority remains our position. If NYSERDA has further questions for Con Edison, please ask them to contact me at 212.460.3098 or jollym@coned.com.

Best regards as always,

Margarett Jolly, PE
Director R&D
Consolidated Edison Company of New York
jollym@coned.com
212-460-3098

From: Guy Warner
Sent: Wednesday, September 16, 2015 12:03 PM
To: 'Jolly, Margarett L.' <JOLLYM@coned.com>
Cc: Vercheak, Susan J - Regulatory <VERCHEAKS@coned.com>; McHugh, Patrick G. (VP Engineering and Planning) <MCHUGHPA@coned.com>
Subject: RE: draft response to Guy Warner

Dear Margarett,

Thank you for your response. I will include it in our quarterly progress report to NYSERDA.

With reference to the highlighted portion of your February 10 2014 letter attached, Pareto Energy and GE Power Conversion completed the certifications and benchmarks that Con Edison requested at an installation of GridLink at a GE customer site in the field. The test report was reviewed and accepted by Dan Sammon in the third quarter of 2014. It shows the similarity of the equipment under test to the installation at Kings Plaza and concludes that GridLink will not inject any fault current into Con Edison's grid, will ride through any faults from Con Edison's grid, and can inject reactive power to assist Con Edison's grid with voltage and frequency stabilization as needed.

The problem remains that, while Pareto Energy agreed with Con Edison to hold the report in private to protect the confidentiality of the customer that owns the equipment under test, Con Edison's publically-available filing with the NYS-PSC asserts that no prototype of GridLink has ever been built or tested such that it is not viable for customer use (see highlighted portions of pages 3, 6 and 9 of the attachment). Not only do these statements provide a highly inaccurate report to the NYS-PSC of GridLink's commercial readiness, they also negatively impact Pareto Energy's corporate valuation and ability to sell GridLink.

We recommend a settlement conference that includes engineers from Con Edison, Pareto Energy, Commission staff, NYSERDA and the NYISO to develop a consensus about the commercial readiness of GridLink. That way, the Commission will have more accurate information for making decisions about Pareto Energy's petition.

Guy

Guy G. Warner
Chairman and CEO
Pareto Energy LTD
Tel: (202) 903-0758
Mobile: (202) 247-6171
Email: gwarner@paretoenergy.com
2101 L Street, NW
Suite 800
Washington, DC 20037

From: Vercheak, Susan J - Regulatory [mailto:VERCHEAKS@coned.com]
Sent: Tuesday, September 29, 2015 11:11 AM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: McHugh, Patrick G. (VP Engineering and Planning) <MCHUGHPA@coned.com>; Jolly, Margarett L. <JOLLYM@coned.com>; Hayes, Kyle J <HAYESK@coned.com>
Subject: Response to Pareto Email, 9/16/15

Dear Mr. Warner,

This email responds to your email of September 16, 2015 to Margarett Jolly. That email refers to a test report that was "accepted" by Con Edison and states that that report "shows the *similarity* of the equipment under test to the installation of Kings Plaza." (Emphasis added).

Contrary to the email, Con Edison has never accepted a test report as adequate for the interconnection of GridLink with Con Edison. Moreover, Pareto Energy has never submitted to Con Edison any test results that demonstrate that GridLink has been sufficiently tested for interconnection to the Con Edison distribution system.

Consistent with the foregoing, please see the attached letter to you from Kwame Agyeman-Budu, dated August 8, 2014, addressing the Pareto proposal for King's Plaza. The letter specifically states that the proposal is "*conceptually* feasible," recommends testing of the procedure for fault mitigation, and states that because the "Gridlink is not UL 1741 or IEEE 1547.1 tested it will be *necessary* for the Customer to have the unit tested prior to interconnection."(Emphasis added).

Accordingly, Con Edison stands by its filing of July 6, 2015, with the New York Public Service Commission in response to the Petition filed by Pareto Energy LTD and does not agree that a settlement conference would be productive.

Susan Vercheak
Assistant General Counsel
Consolidated Edison Company of New York, Inc.
4 Irving Place, 1815-S
New York, New York 10003
212.460.4333
vercheaks@coned.com
(admitted in New Jersey only)

From: Alan McDonnell
Sent: Wednesday, October 14, 2015 10:29 AM
To: MCHUGHPA@coned.com
Subject: RE: Pareto follow up - Kings Plaza <External Sender>

Dear Patrick,

I have been asked by Guy if I can get some clarification regarding the approval process for Kings Plaza from Aug. 2014. I had a chat with Dan Sammon just now to try and clarify where we left things a year ago. I was wondering if you might speak with him, and if possible, clarify what else might be needed to overcome the apparent funding objections as noted below.

As per the e-mail below, there seems to be some confusion on the ConEd side, but I had thought that all of these issues were covered as far as we needed to at this stage, and that further details would be submitted on the next stage after the project financing. That now seems to be a sticking point, and thus I was wondering if you could clarify a couple of points from the ConEd letter (attached).

At the time, I decided not to make an issue of these points because I thought we would just deal with them at the next stage, which I thought was ConEd's position as well, given the remarks of the last paragraph and the subsequent meetings we had after this letter was issued.

Specifically, I was wondering if you could discuss with Dan and comment on the following points;

Sec. 1.1 - The drawings is labelled as having two (2) separate feeders, 4B14 & 4B19 as per the service determination letter. There are no tie breakers, just two independent feeders.

Sec. 1.2 - The power generation equipment is on the other side of the DC Bus, there is no other interconnecting equipment. All of the protective relaying and interlocking is shown. Later versions will show the construction details, cabling buswork etc.

Sec. 1.3 – A digital input for Direct Transfer Trip is shown on the drawing. Telemetering is to be discussed in the next phase.

Sec. 1.4 – Fault mitigation is shown at the end of the FRT (fault ride through) test summary submitted. Note also that this test showed a working model MV7000 being connected to a 20kV 50Hz distribution feeder, with energy fed from an operating wind turbine generator. This should also clear up any questions regarding this unit not having been installed on a distribution feeder before.

Sec. 3.1 – FRT relates to fault ride through, not frequency ride through

Sec. 3.2 – It is planned to submit the verification test results with the exact units that will be installed. Note that this feature is already incorporated into units that can do FRT, it's just a matter of programming when to trip. The manufacturer has no problem guaranteeing that upon the measured voltage dip, the inverter can trip in less than 4mSec., similar to speeds that it reacts to faults for fault ride through current limiting. It is understood that if the inverter did not pass this test, it wouldn't be approved for installation.

Sec. 4.2 – The issue of UL1741 compliance is a key issue, and has been addressed for this project. To reiterate;

- The relay protection scheme shown is UL1741 compliant for anti-islanding.
- The harmonic study submitted shows compliance with the power quality requirements of UL1741.
- The hardware safety requirements of UL1741 refer only to low voltage inverters, not medium voltage, as these units are. The e-houses which the equipment is mounted in will be manufactured in a UL approved facility and specially inspected for UL compliance prior to installation, along with any other local codes or standards.

Hopefully this will put to rest any of these technical misunderstandings such that we can move forward with the financing of the project. Past projects I have been involved with during my career that involved new technology or technology risk often involved funding commitments that were based on test results and compliance with target specifications, or which I see no reason why this cannot fall into a similar category. Again, if there is anything more we need at this stage, please let us know.

Thanks for your help,

Alan McDonnell
VP Engineering
Pareto Energy Ltd.
2101 L Street NW, Suite 800
Washington, DC 20037
Tel: (202) 903-0758
Mobile: (603) 546-5785
www.paretoenergy.com

From: Alan McDonnell
Sent: Wednesday, October 14, 2015 10:33 AM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: FW: Pareto follow up - Kings Plaza <External Sender>

Guy,

I had a long chat with Dan this morning. He is always nervous about getting involved in political disputes, which is why he wanted me to send this to Patrick, but we are still in agreement about where things stand in the project approval process. In particular, he agrees with my assertions on UL1741 compliance. I added some emphasis on the fault current mitigation testing in Sec.3.2.

-Alan

NOTE: McHugh delegated Chief Distribution Engineer Troy Devries to respond

From: Alan McDonnell
Sent: Monday, October 19, 2015 4:28 PM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Brian Mehler <bmehler@paretoenergy.com>; Chet Warner <cwarner@paretoenergy.com>; Nick Swingle <nswingle@paretoenergy.com>
Subject: ConEd follow up

Guy,

I had a call from Troy Devries, who had gotten my e-mail forwarded from Patrick McHugh.

He wanted to let me know that he is planning to go through it with Dan on Wed., Dan is out for a couple days, and he will get back to me later in the week. I explained that I had spoken to Dan for almost an hour last week, and that there shouldn't be any misunderstandings, but that they should call me right away if there are.

-Alan

From: Alan McDonnell
Sent: Wednesday, October 21, 2015 11:49 AM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: ConEd update

Guy,

I just got off the phone with Troy Devries and Dan Sammon.

We are in general agreement about the required next steps once the project moves forward, and that there is nothing more that ConEd engineering needs from us at this stage. He will be seeing Bob Schimmenti later today to update him.

I explained that it stemmed from the filings of ConEd on our petition that ConEd was opposed to funding for the project, and using technical deficiencies as a reason, and that it seemed that both the PSC and NYSERDA now had questions and didn't want to be in a position of opposing ConEd.

He explained that as he understood it, ConEd's position was that THEY didn't want to fund the project, despite Bob Schimmenti's efforts to find internal support, but weren't opposing the project if we got it funded from some other source. I explained that it would have helped if Susan Verchek had written that in the submission, but all of those discussions are at a higher level than he or I, so we just agreed to move on with e-mails and notes to clarify for everyone else where things stand.

We agreed to have a formal project # assigned now such that we can properly keep track of the back and forth in their system, and will follow up with Kwame on that.

I explained again why we had not done that yet, mostly due to the fact that Kings Plaza is not a customer and doesn't want to be. I explained just how much money would be charged if they were considered a customer like a synchronous connection and how high the stand-by charges would be ($1.5M/yr) and thus it is important that we don't inbound power and don't get charged standby fees. This project assignment will be along the lines of how they normally treat prospective customers and doesn't cause any further actions or burdens if the project doesn't go ahead.

We agreed that Dan will prepare a more detail description of going forward, such that there is less misunderstanding, and Kwame will issue it. That should help if we need to send something to the PSC.

Call me to discuss when you can, and I think it would be good to talk to Schimmenti once Troy has met with him.

-Alan

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Thursday, October 29, 2015 12:29 PM
To: Devries, Troy
Cc: Sammon, Daniel
Subject: Follow up from Oct. 21 call <External Sender>
Dear Troy,

As a follow up to our call of Oct. 21, I was wondering if we might have another call in order to discuss the most recent filing of ConEd with the PSC this past Monday, see attached. See also a response from Pareto attached.

We have a meeting with the PSC staff in a couple of weeks to discuss in person, and it's my job to clarify for all involved the understanding of the technical concerns and technical understandings to them of what we are proposing at Kings Plaza.

We concur with the filing regarding the complications of connecting DER into the network grids or mesh networks, and such concerns are what drove the design for our Gridlink systems in the first place. We don't understand why no mention of our proposal and ongoing work was mentioned as an alternative in the filing. In particular, the cost estimate of **$5M/MW** given at the top of page 7 is more than 3 times the budget of Kings Plaza or JFK,

I won't go into the weeds of the financials, that is for others, but the PSC is concerned about finding least cost options. We want to explain to them as well the many opportunities the Gridlink system presents for enhancing power quality and power system stability once it is installed and fine-tuned in conjunction with ConEd and NYISO, thus further mitigating costs upstream of traditional "heavy iron" solutions. We see many of the biggest future cost savings in these areas.

As explained in our filing to them, there are many opportunities to share revenue from the NYISO with ConEd, and even more so if there is deeper technical collaboration, which I hope to be an ongoing work in progress.

If you have time to arrange a call, please let me know a good time. I just want to make sure that there are no misunderstandings if the PSC comes back to ConEd for clarification and the powers that be come back to you with questions. I don't want to tell them anything that we haven't discussed with you first.

One last issue, you had mentioned in our last call about having Kwame set up a project number in the ConEd system, tell him he can send me any instrcutions or questions, and we'll get things set up administratively on our end.

Thanks again for your help.

From: Alan McDonnell
Sent: Wednesday, November 04, 2015 4:18 PM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: ConEd MVAR costs

Guy,

I have been trying to find some new ways to discuss the functioning of GridLink with Con Edison

I found the attached excerpt from the NYS-PSC order

The 107 MW GridLink installation that we proposed at Kennedy Airport could easily deliver 6MVAR, both +/-, unlike capacitors, and do so dynamically, unlike capacitors that are switched. So the functionality is much more valuable.

If the GridLink installation costs $1.50 per MW and Con Edison bought the superior functionality at the same price as the capacitors and load transfers then this transaction alone would pay back half the investment in GridLink.

As we have maintained with Con Edison's business managers since 2011, the pool of savings from interconnection with power electronics is more than enough to provide superior returns to CHP owners and Con Edison ratepayers and Shareholders.

-Alan

"The BQDM Program is composed of a total of approximately 52 MW of non-traditional utility-side and customer-side solutions. In conjunction with the BQDM Program, the Company plans to also undertake approximately 17 MW of traditional utility infrastructure investment, consisting of capacitor bank installations that will provide 6 MW of capability and 11 MW of load transfers from the affected area to other networks. The Company forecasts that it will spend $12.3 million to implement the capacitor bank installations that will provide 6 MW of capability and the load transfers of 11 MW. The Company states that if the BQDM Program proves successful, its implementation, along with the 17 MW of traditional utility infrastructure investment, will defer the need for the construction of a new area substation from its forecast need date of 2017 to 2019."

Note: Devries finally agreed to a teleconference on November 6, 2015 where he incorrectly claimed that GE had only done simulations of a model inverter that was different to the one on the GridLink design for Kings Plaza and that no inverter of this size had ever been used for connecting DG to an electric distribution grid. Alan pointed him to pages of the FRT Hardware tests that proved he was wrong and Devries asked for more time to review.

From: Alan McDonnell
Sent: Monday, November 09, 2015 8:52 AM
To: 'devriest@coned.com'
Cc: SAMMOND@coned.com
Subject: Kings Plaza follow up

Troy,

Here's a quick follow up regarding the key issue.

The main issue that is killing us with the NYPSC and NYSERDA is ConEd's position that this exact unit hasn't been built or tested before, that all we submitted were computer simulations. We thought we were through all of that after the Aug. 2014 letter. It is an untrue assertion and we cannot allow it to stand.

Just to re-iterate, I'm attaching another copy of the FRT report. See pages 14 & 15 of 27 for the test set-up description. This is a real MV7000 rated at 5MW feeding a 20kV distribution feeder. Also attached is a generic brochure if you wanted to buy one off the shelf. GE and its predecessor have built many hundreds of these units.

It is key that both the PSC and NYSERDA be informed that this unit has been built before and installed and tested on a distribution feeder, so if you could help with getting that message changed, I would very much appreciate it.

If you need any more clarification on anything from me, please contact me without delay.

Best Regards,

Alan McDonnell
VP Engineering
Pareto Energy Ltd.
2101 L Street NW, Suite 800
Washington, DC 20037
Mobile: (603) 546-5785
www.paretoenergy.com

From: Alan McDonnell
Sent: Wednesday, November 11, 2015 12:35 PM
To: 'devriest@coned.com'
Cc: MCHUGHPA@coned.com
Subject: RE: Kings Plaza follow up

Troy,

Just following up to see if you rec'd this.

Dan told me on Monday that he had forwarded his comments, and that you and Patrick and Bob would be getting together to discuss.

We are having back and forth discussions with the NYPSC on this, and I was hoping we could give them an estimate as to when you will meet and be able to issue something.

Any help you can give here is much appreciated.

-Alan

From: Devries, Troy [mailto:DEVRIEST@coned.com]
Sent: Thursday, November 12, 2015 8:13 AM
To: Alan McDonnell
Cc: Devries, Troy; Sammon, Daniel
Subject: RE: Kings Plaza follow up <External Sender>

Alan,
I have spoken with Dan. We will be meeting with Patrick and then Bob. I cannot and have not committed to any timeframe or specific outcome from these meetings. Please keep this in mind in your discussions with the PSC.
Thanks, Troy

From: Cooke, Charmaine D [mailto:COOKEC@coned.com]
Sent: Friday, November 13, 2015 11:14 AM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: Brennan, James <BRENNANJA@coned.com>; Cooke, Charmaine D <COOKEC@coned.com>
Subject: MEETING REQUEST: Teleconference w/ Con Edison - Kings Plaza

Good Morning Mr. Warner,

I am writing to coordinate a teleconference with you and any member(s) of your team that you would like to attend. The details are below:

- Meeting date: Friday, November 20, 2015
- Teleconference time: 8:30a.m. – 9:00a.m.
- Topic: Kings Plaza
- Con Ed attendees: Patrick McHugh, Troy DeVries, and Jamie Brennan

Kindly advise on your availability.

Regards,

Charmaine D. Cooke, MSOL
Office of Patrick G. McHugh
Vice President, Engineering & Planning

From: Alan McDonnell [mailto:amcdonnell@paretoenergy.com]
Sent: Friday, November 13, 2015 11:59 AM
To: Cooke, Charmaine D
Cc: Guy Warner; Brennan, James; Devries, Troy
Subject: FW: MEETING REQUEST: Teleconference w/ Con Edison - Kings Plaza <External Sender>

Dear Ms. Cooke,

We would like to request an agenda for the meeting. Further, we would first like to see a written response to the point-by-point response to the Aug. 8, 2014 approval letter and July 5, 2015 PSC filing, sent to Patrick McHugh by me a month ago, and discussed with Dan Sammon this past Monday.

Hopefully we can discuss a path forward on this project on the call.

Also we would like to request that formal minutes of the meeting be made, with a copy sent to Mr. Len Van Ryn at the NYPSC.

Thank you for your help,

Alan McDonnell

From: Brennan, James [mailto:BRENNANJA@coned.com]
Sent: Monday, November 16, 2015 5:53 PM
To: Guy Warner <gwarner@paretoenergy.com>
Cc: McHugh, Patrick G. (VP Engineering and Planning) <MCHUGHPA@coned.com>; Devries, Troy <DEVRIEST@coned.com>
Subject: FW: MEETING REQUEST: Teleconference w/ Con Edison - Kings Plaza <External Sender>

Guy,

Last week, you reached out to Bob Schimmenti looking to 're-establish a more mutually beneficial working relationship'. The purpose of this call is to get your perspective on how 'to establish an acceptable plan going forward'. If that's not of interest, I will cancel the call. The technical issues associated with KP-CHP continue to be worked through by Dan Sammon and Alan McDonnell.

Thanks,

Jamie

From: Guy Warner [mailto:gwarner@paretoenergy.com]
Sent: Tuesday, November 17, 2015 8:06 AM
To: Brennan, James
Cc: McHugh, Patrick G. (VP Engineering and Planning); Devries, Troy; Alan McDonnell; Schimmenti, Robert; Alan McDonnell
Subject: RE: MEETING REQUEST: Teleconference w/ Con Edison - Kings Plaza <External Sender>

Dear Jamie:

I would not have any perspective on a plan going forward to offer if we have not resolved the technical issues that we raised with Patrick three months ago and for which we still do not have a response.

We struggled to get Con Edison to issue a preliminary approval letter after GE submitted the testing in June 2014. Finally, an unacceptable "conceptual approval letter" was issued in August of 2014. It contained a number of inaccuracies, especially the assertion that no testing for UL 1741 and IEEE 1547 had been done. Alan visited and corrected all these inaccuracies with Dan at that time and a product specification and implementation plan with all the associated working papers was assembled and delivered to Patrick, Troy and you at our meeting on January 8, 2015.

In July 2015, Con Edison reported publically to the Commission that no prototype had ever been built and tested. When we complained about this inaccuracy, Con Edison stood on the August 2014 conceptual approval letter again. Therefore, Alan has now revisited all the inaccuracies of that letter with Dan. Dan has promised to give us his response but not until he meets with Troy, Patrick and Bob.

We have developed new sources to fund the project that we would like to review with you, but none of those are relevant while Con Edison maintains the technology is not tested.

Guy

Guy G. Warner

From: Brennan, James [mailto:BRENNANJA@coned.com]
Sent: Wednesday, November 18, 2015 9:38 AM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: RE: MEETING REQUEST: Teleconference w/ Con Edison - Kings Plaza <External Sender>

Guy,

In view of your insistence that Con Edison change its view on positions that we have consistently stood behind, there is no need for a meeting and I am cancelling the call on Friday.

Best Regards,

Jamie

From: Alan McDonnell
Sent: Wednesday, November 18, 2015 10:16 AM
To: Guy Warner <gwarner@paretoenergy.com>
Subject: RE: MEETING REQUEST: Teleconference w/ Con Edison - Kings Plaza <External Sender>

Guy,

Dan told me last Monday, Nov. 9th, after our Friday call with troy, that he had finished his comments to my list and forwarded it to Troy. He was not allowed to send me anything directly.

I am not working on anything with Dan, contrary to Jamie's assertion;

-Alan

4 Irving Place 10th Floor North
New York, NY 10003

Alan McDonnell, VP Engineering
Pareto Energy Ltd
2101 L Street NW, Suite 800
Washington, DC 20037
November 18, 2015

Dear Mr. McDonnell;

We have received your 10/15/15 response to our preliminary comments and have provided additional comments/clarifications as requested (annotated in red below):

The comments provided as part of our letter identifying the conceptual feasibility of your project (Kings Plaza) were intended to assist the Pareto design team going forward with the interconnection design, installation and testing. Past experience has shown that it is important to identify such items as direct transfer trip and telemetering equipment early in the process since they can be very costly. Also in this case, because there is less experience with the use of the inverter to perform the interconnection protection functions it is worthwhile to review testing requirements well in advance.

Testing has been the subject of considerable discussion regarding the inverter since it would have to be tested to insure that it performed the functions adequately. Much of the discussion centered around the testing protocols for any such testing and one possible approach would be to follow the existing testing standards (e.g., UL 1741 and IEEE 1547.1). The comment regarding the use of existing standards (i.e., UL 1741 and IEEE 1547.1) when developing intertie testing protocols and procedures is intended to highlight this approach for testing if the intent is to utilize the inverter to perform these functions.

In reading your response it is now clear that your proposed design for this project does not include using the inverter to perform the necessary interconnection protections but rather uses standard utility grade protection upstream of the inverter. Using utility-grade protections upstream of the inverter to perform the necessary interconnection protections will be an acceptable approach that will avoid the expense of such testing.

One exception still outstanding is the testing of the unit for fault mitigation. As you indicated the development and testing of the “Gridlink” by the Customer to effectively mitigate fault contributions from the Customer’s generation facility still remains to be developed and performed and may be a crucial and possibly costly component as the project progresses.

In summary, subject to this letter and the comments below, Con Edison has “conceptually” approved the project because it now uses standard utility-grade protection upstream of the Gridlink inverter. The interconnection will be subject to successful demonstration of fault mitigation. Without this standard utility-grade protection, Gridlink could not be installed because it has not satisfied testing protocols. As with any high tension or distributed generation project, there are various stages of design, installation and operational testing before final approval to operate in parallel with the distribution system. The details in the e-mail below are critical points that have been proactively

Manhattan Major Services

4 Irving Place 10th Floor North

New York, NY 10003

identified as critical to be addressed in upcoming phases of the design/approval. These are points that can be costly and require some time to work through.

Sec. 1.1 - The drawings is labelled as having two (2) separate feeders, 4B14 & 4B19 as per the service determination letter. There are no tie breakers, just two independent feeders.

Con Edison Response

This is an important item for the Company since the one line is such a crucial document both during the design and afterwards when the Customer's substation is completed and operating. While the preliminary one line is sufficient to perform the conceptual evaluation. The intent of the comment is to ultimately have one one-line show without ambiguity the complete high tension service. Eventually the one-line will be mounted on the wall of the Customer's switchgear room to be used whenever evaluating the status of the service and any switching operations.

Sec. 1.2 - The power generation equipment is on the other side of the DC Bus, there is no other interconnecting equipment. All of the protective relaying and interlocking is shown. Later versions will show the construction details, cabling buswork etc.

Con Edison Response

Presently the drawing is devoid of any generation and, as stated in comment 1.1, it is important to include generation on the one line to illustrate the complete picture and can be used when reviewing the design, as well as for reference when deliberating on switching moves after the service is energized and the generation is on line.

Sec. 1.3 – A digital input for Direct Transfer Trip is shown on the drawing. Telemetering is to be discussed in the next phase.

Con Edison Response

This comment was included to insure that these important items do not get forgotten at this juncture. The cost to the Customer for the installation of DTT and telemetering can be considerable. The drawing shows only the DTT receiver and associated control logic at the Customer's location. It should be noted that it is necessary to install a DTT transmitter at the Con Edison supplying substation as well. A similar requirement will need to be addressed for the telemetering which will need to interface with the Con Edison SCADA system.

Sec. 1.4 – Fault mitigation is shown at the end of the FRT (fault ride through) test summary submitted. Note also that this test showed a working model MV7000 being connected to a 20kV 50Hz distribution feeder, with energy fed from an operating wind turbine generator. This should also clear up any questions regarding this unit not having been installed on a distribution feeder before.

Con Edison Response

The comment was not seeking clarification. It was included to make sure that as the design progresses the need to address fault mitigation by the Customer is clearly identified.

Manhattan Major Services

4 Irving Place 10th Floor North

New York, NY 10003

Sec. 3.1 – FRT relates to fault ride through, not frequency ride through.

Con Edison Response

Duly noted.

Sec. 3.2 – It is planned to submit the verification test results with the exact units that will be installed. Note that this feature is already incorporated into units that can do FRT, it's just a matter of programming when to trip. The manufacturer has no problem guaranteeing that upon the measured voltage dip, the inverter can trip in less than 4mSec., similar to speeds that it reacts to faults for fault ride through current limiting. It is understood that if the inverter did not pass this test, it wouldn't be approved for installation.

Con Edison Response

Successful testing of the fault mitigation abilities of the installed inverter will be required.

Sec. 4.2 – The issue of UL1741 compliance is a key issue, and has been addressed for this project. To reiterate;

The relay protection scheme shown is UL1741 compliant for anti-islanding.

- The harmonic study submitted shows compliance with the power quality requirements of UL1741.

- The hardware safety requirements of UL1741 refer only to low voltage inverters, not medium voltage, as these units are. The e-houses which the equipment is mounted in will be manufactured in a UL approved facility and specially inspected for UL compliance prior to installation, along with any other local codes or standards.

Con Edison Response

The comment stems from previous discussions with Pareto that identified their preference to utilize the inverter's functions to perform these interconnection functions and it was determined that should Pareto decide to pursue such a path the best testing protocols would be to follow the existing testing standards (i.e., UL 1741 and IEEE 1547.1).

In reading Mr. McDonnell's response it is now clear that the Customer does not intend using the inverter to perform the necessary interconnection protections and has indicated a preference to use independent utility grade relays shown upstream of the inverter will be used to address these interconnection protections. Using these utility-grade protectionswill be acceptable to Con Edison and obviates the need to test the inverter for these protection functions.

Let me know if you need any further clarification and we look forward to moving forward on this project.

Thank you.

Kwame Agyeman-Budu
Customer Project Manager

From: Alan McDonnell
Sent: Wednesday, November 18, 2015 4:42 PM
To: Budu, Kwame <BuduK@coned.com>
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: RE: PARETO ENERGY - 2483 FLATBUSH AVENUE - KINGS PLAZA PROJECT

Kwame,

Thanks for the response.

One issue that came up more clearly subsequent to the list I prepared below, is that of the testing that was submitted. There was a misunderstanding by some in ConEd (although not by Dan Sammon) that the inverter was to be a prototype, not an existing unit. This was noted in my point Sec. 1.4. We acknowledge the need to submit the factory test results of the fault current mitigation as part of the future approvals process, but the issue of real world test vs. simulation needs to be clarified as well.

This issue is critical to our NYSERDA funding, and I would like to ask also for an acknowledgement that the testing reports submitted in the "FRT Report" were from a real world machine, of the same model number, voltage and rating, as the units proposed for Kings Plaza and connected on a 20kV distribution feeder.

Thanks for your help,

Alan McDonnell

From: Alan McDonnell
Sent: Wednesday, November 18, 2015 6:12 PM
To: Budu, Kwame <BuduK@coned.com>
Cc: Guy Warner <gwarner@paretoenergy.com>
Subject: RE: PARETO ENERGY - 2483 FLATBUSH AVENUE - KINGS PLAZA PROJECT

Kwame,

Not to nit-pick, but some of the issues raised in the letter can have impacts on NYSERDA funding and other sources of project financing, and thus we'd like further clarification.

One in particular that we would like re-written is the 2nd to last paragraph of the first page that deals with fault current. We never submitted that this needs to still be developed, as it is inherent in the inverter and is a no-cost option. We agreed to submit the test data of the finished system prior to final acceptance.

Much like the protective relay settings, the fault current mitigation trip settings will be calculated and agreed upon after system impact studies and in conjunction with ConEd.

Also, to re-iterate, and perhaps ConEd could acknowledge, that a UL1741 compliant inverter CANNOT provide fault current mitigation, and therefore is not acceptable to be installed in ConEd's high tension system the way Kings Plaza is planned for.

Note also that we provided real world tests of an inverter fault current mitigation test in May of 2013 as part of the NYU Poly application, but the inverter vendor was different than the one proposed for Kings Plaza, and thus submitted a computer simulation and offered to re-submit test data from the same model tests prior to final approval.

Thanks Again,

Alan McDonnell
VP Engineering
Pareto Energy LTD
2101 L Street NW, Suite 800
Washington, DC 20037
Tel: (202) 903-0758
Mobile: (603) 546-5785
www.paretoenergy.com

From: Alan McDonnell
Sent: Thursday, November 19, 2015 3:40 PM
To: 'devriest@coned.com'
Subject: Summary follow up

Troy,

Here is a summary of what we'd like to get, such that we can pass it on to the bankers and NYSERDA folks. Below is a draft from Guy of what he'd like to see. Attached is the product summary from last January that is mentioned, I'm not sure who it was sent to before.

I'll leave it to you to pass on higher if necessary regarding the funding programs listed, if we can just get clarification from Engineering on the details we've been discussing, then we should be good to move forward.

On Guy's last point below, I have had discussions with Dan about the back and forth that goes on through the various levels of approvals for projects like this, and thus was thinking you could provide us with something that explains that in addition to the verification tests of the equipment, that this project will follow standard EO-2022 procedures for new high tension service and EO-2115 procedures for new inverter based DG, treating Gridlink as a system.

Perhaps just mention as Dan has, that it is required to provide site testing of all of the protection functions as part of final system commissioning prior to connection to the ConEd feeders? We have accepted this requirement, and thus the costs such as mentioned in Kwame's letter are irrelevant to ConEd

Best Regards,

Alan McDonnell

Attachment: Guy Warner Note of Letter Needed for Bankers

Pareto Energy is funding 100% of the $12 million construction cost at Kings Plaza. We are investing $4 million of our own equity and raising an $8 construction loan from Macquarie Bank. The construction loan will be secured by eventual payments from the NYISO Behind-the-Meter Net Generation Program and/or from our Petition to the Commission for funding from the IPEC Plan, BQDM Program, or REV Demonstration Projects. Currently, we are recommending that NYSEDA pay us the $0.64/watt outreach contractors fee for the IPEC Plan (i.e. we will forgo the $1.60/w customer incentive from the IPEC Plan and the $2.06/w customer incentive from the BQDM Program). I have firm fixed prices for all the components of the KP-CHP GridLink project, including performance guarantees by GE that GridLink will function in the same way as the equipment under test for GE's FRT Report.

I cannot proceed with placing the construction loan with Macquarie unless I have the following in a letter from Con Edison:

1) Acknowledgement of the date that Con Edison received the real-world FRT Hardware Tests and any subsequent simulations (I believe this was sometime in June or July 2014).
2) Agreement with the conclusions of the FRT report and acknowledgement of the date of receipt of the GridLink Product Speciation and Implementation Plan (I believe this was January 8, 2015).

A punch list of the specific verifications that must be delivered to prove that the actual equipment manufactured for installation at Kings Plaza will perform in the same way as the equipment under test in the FRT Report.