PRE-FILED REBUTTAL TESTIMONY OF
SAMI ABDULSALAM
ON BEHALF OF MACADAMIA SOLAR LLC
NCUC DOCKET NO. EMP-119, SUB 0
NCUC DOCKET NO. EMP-119, SUB 1

I. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Sami Abdulsalam. My business address is 400 State St., Schenectady, NY, 12305.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Siemens Industry, Inc. Siemens Power Technologies International ("Siemens PTI") as a Senior Consulting Manager.

Q. PLEASE SUMMARIZE YOUR EDUCATION AND ACCREDITATIONS.

A. I received a Bachelor of Science degree and Master of Science degree in Electrical Engineering from the University of El-Mansoura in Egypt in 1997 and 2001, respectively. I received a PhD in Electrical Engineering from the University of Alberta in Edmonton, Alberta, Canada in 2007. I held a post-doctoral fellowship in the Electrical and Computer Engineering Department at the University of Alberta, Edmonton, Canada from 2007 to 2008. I am a registered Professional Engineer in Alberta, Canada.

Q. PLEASE SUMMARIZE YOUR WORK EXPERIENCE.

A. I joined Siemens PTI in June 2020 as a Senior Consulting Manager. I am responsible for power system analysis, transmission planning, and protection studies. Before joining Siemens PTI, I was a Principal at Sustainable Grid Power Inc., Transmission Division, Calgary, AB. Before that, I worked for 13 years with the Alberta Electric System Operator (AESO) in Canada in successive leadership roles in AESO's transmission planning, operations planning, and interconnection planning areas. From 2017-2019, I was Director of Transmission Planning in AESO's Transmission Division. From 2016-2017, I was Director of Transmission System Projects in AESO's Transmission Division. Before that, I held various managerial and senior engineering positions within AESO.

Q. HAVE YOU PREVIOUSLY TESTIFIED IN A REGULATORY PROCEEDING?

A. Yes. I have filed written expert testimony and have also testified in a number of proceedings before the Federal Energy Regulatory Commission ("FERC") (United States) and Alberta Utilities Commission (CANADA), details of which are listed in my attached RESUME (Exhibit - A).

Q. WHO ARE YOU TESTIFYING ON BEHALF OF IN THIS PROCEEDING?

A. I am testifying on behalf of Macadamia Solar LLC ("Macadamia" or the "Applicant").

II. PURPOSE OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. The purpose of my testimony is to respond to certain issues raised by Public Staff witness Jay B. Lucas in his prefiled direct testimony, filed in this docket on November 23, 2021, relating to Affected System Upgrades on the Duke Energy Progress ("DEP") system that may be triggered or relied upon by Macadamia. Macadamia is seeking a Certificate of Public Convenience and Necessity for a merchant plant (CPCN) from the North Carolina Utilities Commission. Macadamia is a 474 MW solar project located in Washington County, NC. This project is connecting to DENC's Trowbridge substation at the 230 kV level. Interconnection Studies conducted by PJM to assess the impact of this project to the interconnected electric system, identified the upgrade of the Everetts-Greenville 230 kV line as potentially necessary to address impacts of Macadamia and other projects on DEP's system. The current estimated cost of that upgrade is $10 million. Other interconnecting generators in the same area would be also contributing to the need for this upgrade. My testimony discusses the benefits of this specific upgrade to DEP's rate payers (loads) from Siemens PTI's point of view.

III. EXHIBITS

Q. WHAT EXHIBITS DO YOU SPONSOR?

A. In addition to my Prepared Direct Testimony, I sponsor the following exhibits:

- Exhibit A: Education, Experience, and Background of Sami Abdulsalam
- Exhibit B - North Carolina Transmission Planning Collaborative: Report on the NCPTC 2020 Offshore Wind Study, June 7, 2021 Final Report

IV. EVERETT-GREENVILLE 230 KV UPGRADE NEED DRIVERS

Q. BASED ON YOUR ANALYSIS OF THE INTERCONNECTION STUDIE(S) CONDUCTED IDENTIFYING THE OVERLOAD ON THE EVERETTS-GREENVILLE 230KV LINE, WHAT FACTORS ARE CONTRIBUTING TO THESE OVERLOADS?

A. The interconnection studies for Macadamia (AD1-074/75/76) (Attachment A, Attachment B, and Attachment C of Pre-filed Direct Testimony of Donna Robichaud), an earlier queued project, Sumac Solar, LLC (AD1-022/23), and another project in PJM's AD1 cluster, Sweetleaf Solar LLC (AD1-056/57), have all identified the need to upgrade the Everetts-Greenville 230 kV transmission line. All of these projects are being interconnecting within the PJM footprint and are contributing to the loading on the Everetts-Greenville 230 kV line, which is a major tie line between the PJM interconnection and the DEP system. The Everetts-Greenville 230 kV line is approximately 22 miles long. DENC owns the vast majority of this line (92% of its length) with DEP owning only a 1.7-mile segment (8% of the total length). Any of the aforementioned generation interconnections would trigger the need to upgrade the existing Everetts to Greenville 230 kV tie line.

The need to upgrade the Everetts to Greenville 230 kV tie-line is driven by a need to enable higher transfers between PJM and DEP to support flow of energy between the two territories during a low-probability, double contingency event in which two nearby transmission lines fail simultaneously during high loading periods. During normal operations, the existing capacity of the lines is sufficient.

Q. ARE THERE OTHER BENEFITS TO INCREASING THE CAPACITY OF THESE LINE THAT ARE NOT DRIVEN BY MERCHANT PLANTS IN PJM?

A. Yes. Increasing the capacity of the Everetts-Greenville Tie-Line benefits DEP ratepayers by allowing greater integration of renewables **within** the DEP footprint, not just in PJM. According to the findings and recommendations of the North Carolina Transmission Planning Collaborative ("NCTPC") 2021 study titled "2020-2030 NCTPC Offshore Wind Study"[1], attached as Exhibit B, the Greenville substation/site was short listed and selected as one of three preferred sites for offshore wind injection due to its direct access to tie line capability (in this case with PJM). The study analyzed a total of 32 sites, shortlisting only three offshore wind locations including the existing Greenville substation site.

The study states in its conclusion the following: "*The results of this study showed that 100s of MW of offshore wind generation can be injected at numerous substations in eastern DEP with moderate upgrades, up to around 1000 MW or so*

[1] NCTPC 2021 offshore study

at some sites, again with moderate upgrades (less than $100M)." NCTPC's report also states that the Greenville site as a preferred offshore wind injection site had a higher initial MW injection screening level. Upgrading the Everetts-Greenville tie line will provide a significant benefit to DEP ratepayers by accelerating the integration of offshore wind onto DEP's system at a relatively low cost, as identified by NCTPC.

The NTCPC study highlights the benefits of increased tie-line capability on enhancing access to markets and neighboring jurisdictions and load serving diversity. The upgraded tie-line capability, regardless of its nature, for flows in one direction (PJM to DEP) as demonstrated through the Macadamia studies for example, would also benefit and support enhanced (higher) flow levels in the opposite direction (DEP to PJM) when needed by system operating conditions. This is again one additional benefit to DEP's ratepayers that the existing interconnection process does not account for in terms of capacity enhancements (upgrades) to existing inter-regional tie-lines.

Q. WHAT ARE TIE-LINES?

A. Tie-Lines are transmission lines interconnecting two or more jurisdictions or service areas enabling power transfers capability between the interconnecting jurisdictions.

Q. PLEASE DESCRIBE THE VALUE AND BENEFIT THAT TIE-LINES OFFER.

A. Transmission Tie-Lines provide a wide range of benefits to interconnecting jurisdictions as they enable interconnecting jurisdictions access to generation capacity and load located within their respective interconnecting footprints. The following key benefits are generally associated with benefits of tie-lines and will be expanded on further in this testimony:

- Reduced planning reserve margin
- Access to or sharing of backup and as-needed generation capacity/energy between the two interconnecting jurisdictions. This value increases significantly as the interconnecting area(s) become larger (such as the case with the PJM interconnection):
    - Increased fuel diversity and/or sources of the same fuel
    - Diversity in gas pipelines
    - Reduced impact of fuel price and fuel market variations during extreme weather events.
- For upgrades to existing Tie-Lines, extension of life as represented by enhancement to upgraded transmission tie line useful life beyond its current state.
- Lower cost impact of outages due to availability alternate, higher tie-line capacity (upgrades)

- Resiliency enhancements under severe weather and extreme system operating conditions.

V. HOW DOES THE EVERETTS-GREENVILLE TIE-LINE UPGRADE BENEFITS DEP RATEPAYERS?

Q. PLEASE DESCRIBE THE IMPACTS OF HIGHER IMPORT CAPABILITY TO DEP ON DEP'S RESERVE MARGIN REQUIREMENTS.

A. In general, higher import capability from neighboring jurisdictions over transmission tie lines will lead to lower reserve margin requirements for the importing entity, DEP. This is a direct benefit to DEP ratepayers that is not accounted for part of the classical interconnection assessments and cost allocation process followed by DEP.

In its latest 2020 Integrated Resource Plan[2], DEP stated that the conclusions of its analysis related to reserve margin requirements under both an "Islanded Scenario" and the "Base Case" reflected the extremely high importance of tie-lines (and their flow capability) to neighboring entities in lowering DEP's reserve margin requirement. DEP's analysis shows that without accounting for tie-line capability to neighboring entities, i.e., the "Island Scenario", DEP's reserve margin

[2] Reference to DUKE's 2020 IRP https://desitecoreprod-cd.azureedge.net/_/media/pdfs/our-company/irp/202296/dep-2020-irp-full-plan.pdf?la=en&rev=956d92a25e334a75a892a56ef726e18e

requirements climb to 25.5% to satisfy a 0.1 Loss of Load Expectation[3] (LOLE) without "neighbor assistance", *i.e.*, imports from neighboring entities.

In its "Base Case" scenario analysis summary section[4], DEP states: "*Comparing Base Case results (19.25% reserve margin) to the Island Case (25.5% reserve margin) highlights the significant benefit of being interconnected to neighboring electric systems in the southeast.*"

Furthermore, in summarizing their conclusions for the "Base Case" analysis, DEP's 2020 IRP states in relation to the DEC reserve margin requirements: "*Base Case results for DEC showed that a 16.0% reserve margin is needed to meet a 0.1 LOLE. The higher physical reserve margin required for DEP compared to DEC is driven primarily by greater winter load volatility, and to a lesser extent less import capability.*"

It is clear accordingly and based directly on Duke Energy's analysis for DEP and DEC reserve margin requirements that the availability of tie lines to neighboring entities and generation capacity upstream, together with enhanced tie-line carrying capability (as demonstrated by the Everett-Greenville 230 kV line upgrade), would yield direct benefits to DEP rate payers through lowering reserve margin

[3] LOLE represents the number of hours per year in which and over the long-term, it is statistically expected that supply will not meet demand.

[4] Refer to page 67 of the DUKE IRP report – I do not have the link to this document please provide same as footnote 3

requirements and total generation costs. Although the current interconnection process assessment does not account for the widespread and multi-layered benefits of such upgrades, these benefits should not be simply ignored. In fact, in a recent Order accepting DEP's IRP, the North Carolina Utilities Commission required Duke, in preparing future IRPs and its plan for implementation of North Carolina H.B. 951, to "Refine import capability studies specifically for capacity purchase from PJM[.]"[5] Although Duke has not completed its quantification of the benefits of increasing import capabilities, this is a clear indication that the benefits of additional import capabilities cannot responsibly be ignored.

Q. WOULD THE GREENVILLE-EVERETT 230 KV UPGRADE ENHANCE DEP'S RATEPAYERS' ACCESS TO A LARGER AND MORE DIVERSE GENERATION POOL?

A. Yes. The Everetts-Greenville 230 kV upgrade would immediately enhance the tie line MVA capacity to 1047 MVA (1204 MVA short term/emergency) from the existing 478 MVA rating. The upgrades more than doubles the existing capacity. This upgrade will allow higher flows over the tie line, whether those flows are associated with renewable energy or other generating assets at times when renewable energy is not available. The enhanced tie line capability will be there for utilization by available generation capacity that would economically flow from

[5] Order Accepting Integrated Resource Plans, Reps and CPRE Program Plans with Conditions and Providing Further Direction for Future Planning, NCUC Docket No. E-100, Sub 165 (Nov. 19, 2021).

the PJM interconnection through the Greenville-Everetts line towards DEP as well as in the opposite direction when conditions allow.

Regardless of whether DEP is currently procuring the renewable energy associated with the Macadamia LLC facility (or other renewable generation facilities within the PJM footprint), the flow of the low-cost and economically efficient generation towards DEP could be a benefit. The Everett-Greenville Tie-Line upgrade will make available to DEP loads additional generation capacity that may have not been otherwise competing/available to the energy and capacity markets serving the DEP loads. This increased access to generation resources, either to renewable assets (such as Macadamia) or other existing and future assets within the PJM footprint may have a favorable impact on DEP due to increased capacity offering and higher competition.

In addition, the higher tie-line capacity would support higher capacity and energy flows between PJM and DEP and would allow DEP rate payers access to a diverse generation pool from fuel type, technology and an expanded gas pipeline infrastructure perspectives. The market impacts could likely prove to be well above the $10M upgrade cost of upgrading the existing Everett-Greenville 230 kV line. It is to be noted that the planning studies conducted to assess the impact of the Macadamia generating facility do not capture such benefits nor quantify the identified upgrades value to rate payers in either the short or long-term planning horizons.

Q. DOES THE PROPOSED EVERETTS-GREENVILLE 230 KV TIE-LINE UPGRADE ENHANCE THE USEFUL LIFE OF THE EXISTING ASSET?

A. Yes. The proposed upgrade to the Everetts to Greenville 230 kV tie line would rebuild approximately 1.87 miles of the 230 kV line. This upgrade will enhance the life span of the existing assets towards the 40 to 60-year life span normally expected following such an upgrade. Without this upgrade, rate payers would be responsible for the eventual upgrade through DEP's tariff associated with asset maintenance and replacement.

Q. **COULD YOU EXPLAIN THE BENEFITS OF ENHANCED TIE-LINE CAPACITY TO DEP'S RATEPAYERS IN TERMS OF RESILIENCY AGAINST EXTREME EVENTS?**

A. Extreme events do occur, impacting power system operation, and potentially resulting in significant interruptions to load customers and delayed system restoration times. These events, although not as commonly occurring as single contingency events (which are typically analyzed as part of the interconnection process for reliability purposes) have occurred in the past, and will continue to occur in the future, potentially with greater frequency due to climate change.

It is not possible to protect a system 100% against those extreme events. However, due to high positive impact of tie lines on reducing the impact of and facilitating recovery from these events, the value and benefits of added resiliency due to key transmission system upgrades, such as tie-line capability enhancements, needs to be

taken into account. The enhanced capability, by means of a capacity upgrade, to a tie-line like the Greenville-Everetts 230 kV line, will add additional capacity to an existing interconnection path between DEP and PJM. In the event of interruption of service to other tie-lines, the added capacity would provide additional room for power to flow between the two jurisdictions, minimizing the impacts of such events. The additional capacity made available by the proposed Everetts to Greenville tie line upgrade will also enhance the overall energy and capacity flow capability between the two neighboring entities (PJM and DEP) under loss of generation resources at either side, regardless of the initiating event causing the generation outage.

The reliability benefit of such regional and interregional transmission interties has been well documented, studied and accepted by the industry[6]. As an example, analysis of the recent generation shortage event in ERCOT demonstrates the value of investing in enhancing intertie capability, not only for resiliency and reliability purposes but also to limit the economic impact of these extreme events[7].

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes.

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[6] Brattle Group - Recognizing the Role of Transmission in Electric System Resilience, May 8, 2018, available at https://wiresgroup.com/recognizing-the-role-of-transmission-in-electric-system-resilience/.

[7] Grid Strategies, "Transmission Makes the Power System Resilient to Extreme Weather," July 2021, available at https://acore.org/wp-content/uploads/2021/07/GS_Resilient-Transmission_proof.pdf.