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November 21, 2024

VIA: ELECTRONIC MAIL

Mr. Adam J. Teitzman
Commission Clerk
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, Florida 32399-0850

Re: Petition of Tampa Electric Company for approval of Direct Current Microgrid Pilot Program. Annual Status Report
Dkt. 20200234-EI

Dear Mr. Teitzman:

Enclosed for filing is Tampa Electric Company's Direct Current Microgrid Pilot Program Annual Status Report.

Thank you for your assistance in connection with this matter.

Sincerely,

Malcolm N. Means

MNM/bml
Enclosure
cc: All Parties of Record (w/attachment)
TECO Regulatory Department

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true and correct copy of the foregoing Status Report, filed on behalf of Tampa Electric Company, has been furnished by electronic mail on this 21st day of November, 2024 to the following:

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ATTORNEY

TAMPA ELECTRIC'S

MICROGRID PILOT ANNUAL REPORT

June 1, 2023 through May 31, 2024
Operational Period: Year 2

November 21, 2024

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INTRODUCTION

On June 30, 2021, the Florida Public Service Commission ("PSC") approved Tampa Electric's Request for Approval of its microgrid pilot program ("Pilot") that involves the use of the Block Energy System ("BES") supplied, installed, and commissioned by BlockEnergy™ LLC (formerly Emera Technologies, LLC). The BES connects 37 homes in the Hillsborough County Community of Medley at Southshore Bay, built by Lennar Homes, LLC ("Lennar"). The BES is comprised of:

a) a buried DC loop;
b) a Community Energy Park ("CEP") containing a large battery, two natural gas fired generators, a control enclosure, and an interconnection to Tampa Electric's distribution grid; and
c) an average of 7.83 kW-DC of rooftop solar photovoltaic ("PV") panels and a BlockBox™ containing 17.75 kWh of battery storage and other equipment at each house. Each BlockBox™ has an inverter to convert direct current ("DC") microgrid power to alternating current ("AC") power for use inside the home. The BES is backed up by a traditional underground AC distribution system connected in parallel to the BES at each home for the purposes of the Pilot.

The overall objective of the Pilot is to test the capability of the BES to provide power to residential homes with a high level of renewable energy while providing superior reliability and resiliency. Tampa Electric expects that the BES will achieve the following objectives:

1) isolate homes from upstream AC distribution system disturbances with no interruption to the customer;
2) integrate high levels of renewable energy, with a target of more than 60 percent of the total energy used by the homes coming from the BES solar panels; and
3) eliminate impacts on the transmission and distribution system during peak demand periods from the addition of the 37 homes.

Tampa Electric expects to demonstrate the following benefits by the end of the Pilot:

1) increased renewable energy penetration;
2) reduced system losses;
3) reduced generation capacity costs;
4) reduced system transmission and distribution capacity costs;
5) reduced energy costs; and
6) increased reliability.

SUMMARY

Tampa Electric's BES Pilot went in-service on May 27, 2022 and has been operational for two years. For purposes of this report, the operational period ("Reporting Period") is June 1, 2023 through May 31, 2024. This is the second year that the BES Pilot has been fully operational. Throughout year two, the BES Pilot has maintained the same level of performance as the previous year and has continued to meet the three primary objectives. Tampa Electric's understanding of microgrid design and operational performance has advanced with valued learnings that can be applied to other grid edge applications. There were no significant weather events in this reporting period which caused extended outages on the portion of the AC distribution network connected to the pilot. While Hurricane Idalia made landfall north of the greater Tampa Bay region on August 23, 2023, it did not have a material impact on the AC distribution in the southern portion of Hillsborough County where the pilot is located. The pilot continued to demonstrate the ability to maintain electric service during occasional outages on those AC circuits connected to the pilot homes.

Throughout the Reporting Period, Tampa Electric maintained a high level of customer engagement as changes were made to the local home BES equipment or the broader pilot microgrid itself. Prior to any large storms that were forecast to impact Tampa Electric's operating territory (including Hurricane Idalia), our Customer Experience team provided the pilot homeowners with regular updates on efforts to harden the pilot microgrid to ensure that the AC energy being delivered to their homes would not be impacted.

A benefit of the BES architecture is its ability to integrate within Tampa Electric's AC distribution system while not depending on the grid for firm power during periods of peak loads. The BES Pilot control system was configured to zero tie line flows from the Tampa Electric's system during peak periods; and to date, the Pilot has met the objective of eliminating impacts from the 37 homes to Tampa Electric's transmission and distribution systems during periods of peak demand.

Efforts to modify the BES controls continued through this reporting period. While new operational issues that arose during this reporting period were resolved; resolution of the carry-over issues that arose in the previous reporting period continued to be a challenge. Through our continued focused efforts, it became apparent that these carry-over issues were related to limitations in the ratings of certain power delivery components and could not be fully resolved due to limitations of the primary BES equipment or the capabilities of the control system. These limitations are further elucidated in this report.

BES PERFORMANCE RESULTS: YEAR 2 (JUNE 1, 2023 TO MAY 31, 2024)

The data and information presented below will demonstrate the achievements made in this reporting period as they relate to the Pilot objectives.

I. Energy Supply Reliability and Availability

The unique topology of the BES makes it difficult to assess the reliability of the energy supply to the homes in the Pilot using traditional AC reliability indices such as SAIDI, SAIFI and CEMI-5. Instead, the performance of the BES is evaluated against the "Availability" of the BES to provide energy to each of the homes.

Availability is defined as the ratio of total number of hours in a reporting period that all homes were supplied from the BES to the total number of hours for all homes in that same period.

$$Availability, BES = \frac{Total\ \#\ hours\ that\ all\ homes\ were\ connected\ to\ BlockEnergy}{Total\ \#\ hours\ per\ week\ for\ all\ homes\ (37\ homes\ x\ 24\frac{hrs}{day} x\ 7\ days)}$$

This metric was calculated weekly and was a valuable tool in identifying performance issues or trends and resolving them in a timely manner.

The results shown in Table 1 show an overall availability that includes the impact of those carry-over issues first realized in Year 1, along with other issues that were experienced in this Reporting Period (described later in this report under "***Operational Experiences For Year 2 (Reporting Period).***" The number of Automatic Transfer Switch ("ATS") Occurrences represents the frequency of switching the home energy source from the BES to Tampa Electric's AC grid.

As presented in these tables, the reliability of the BES has improved over the past reporting period. Looking ahead, Tampa Electric expect the BES to maintain these reliability performance levels through the end of the Pilot Period.

Cumulative System Availability				
Item	**Total Time Spent AC Grid**	**Total Time Home Outage**	**Total Time Spent on BES (Availability)**	**# of ATS Occurrences**
Home-Hours	4,988.50	28.8	281,566.7	**365**
Percent	1.74%	0.01%	98.25%	

Table 1: Cumulative System Availability, June 7, 2022 to May 31, 2023

Cumulative System Availability (June 1, 2023 to May 31, 2024)				
Item	Total Time Spent AC Grid	Total Time Home Outage	Total Time Spent on BES (Availability)	# of ATS Occurrences
Home Hours	3,100.6	0.0	325,008	150
Percent	0.94%	0.0%	99.06	

Table 2: Cumulative System Availability, June 1, 2023 to May 31, 2024

II. Ability to Ride Through AC System Disturbances

There were no outages on Tampa Electric's primary AC supply to the Pilot homes (Circuit 13305) during this Reporting Period. Tampa Electric confirmed that none of the 37 homes connected to the BES experienced a power outage during the AC recorded outages for Circuit 14146, as listed in Table 3.

Circuit 13305 Pilot Lateral Outages (Underground AC Service to Homes)			
Date (month/day)	Duration (hummus)	Duration (min)	Time
No outages	0:0:0	0.0	N/A

Circuit 14146 Pilot Lateral Outages (Overhead Service to the CEP)			
Date (month/day)	Duration (hh:mm:ss)	Duration (min)	Time
7/10/23	0:1:47	1.78	9:03 PM
12/8/23	0:23:57	23.95	12:58 PM

Table 3: List of Tampa Electric AC Circuit Outages on Circuits Connected to the BES, June 1, 2023 to May 31, 2024

Comparison of the outage dates and times with the status of the main DC loop confirmed that the loop also was unaffected by these outages on Circuit 14146.

III. Reduction in System Losses

For this Reporting Period, the net energy reduction on Tampa Electric's AC network, including home energy reduction and net AC energy across the CEP grid tie was 179,486 kWh with a corresponding reduction in AC system losses of approximately 10,625 kWh.

The cumulative BES energy flows for the Reporting Period are provided in Table 4. The data shows a net difference between total energy produced/supplied and energy consumed of approximately 236,000 kWh. Extensive testing and monitoring of the energy sources, with particular focus on the rooftop PV array solar energy, revealed a variation of approximately 10 percent in the energy measured with test components compared to the solar energy as calculated by the BES controllers. This variation corresponds to an

approximate 38,688 kWh reduction in the reported aggregated solar energy, resulting in an adjusted net difference of 197,763 kWh. Tampa Electric considers this latter figure to be the best approximation of the total losses experienced across the BES during the Reporting Period.

Energy Produced / Supplied (kWh)		
Rooftop Energy		
Energy Produced (PV)	Energy Dispatched to AC Grid	Net Energy Available to Home ** (see note below)
388,688	78,579	310,109
Energy Supplied from Tampa Electric's AC Grid		333,387
Energy Supplied from BES NGG		13,715
Total Energy Produced /Supplied		657,211
Energy Consumed by Homes (kWh)		
Total Energy Consumption		420,579
Variance		236,632

Table 4: Cumulative Energy Metrics, June 1, 2023, to May 31, 2024

** The Battery Energy Storage in the CEP was managed by the control system, drawing energy from Tampa Electric's AC grid and / or rooftop PV arrays as required. The BES does not afford a means to differentiate this energy use, thus the PV energy available to the homes as reported is to be treated as more of an approximation.

IV. Integrate High Levels of Renewable Energy

Table 5 shows the actual household electrical load and rooftop PV generation for the Reporting Period.

	Actual Home Electrical Load (kWh)	Actual PV Energy Output (kWh)	PV Energy as a % of Home Electrical Load
Total Reporting Period to Date	404,579	388,688	92.42%

Table 5: Actual Household Electrical Load, PV Energy Output, June 1, 2023, to May 31, 2024

The tables above show that the rooftop PV solar arrays were able to produce the equivalent of approximately 92 percent of the electrical energy requirements of the homes in the Pilot for the Reporting Period.

V. Reduce TECO System Impacts During the Peak

The BES did not add load to Tampa Electric's AC system during peak load conditions. The BES is programmed to maintain zero energy flow from the AC grid tie at the CEP during Tampa Electric's identified peaks between 5:00 p.m. and 6:00 p.m. EST during June through August and between 7:00 a.m. and 8:00 a.m. EST during January through March to demonstrate compliance with this performance goal.

VI. Natural Gas Energy Consumption

Table 4 shows the actual kWh energy imported into the BES from the AC Grid. The energy produced from the Natural Gas Generators ("NGG") is shown in Table 5.

Natural Gas Energy Consumption	
Forecasted NGG Output (kWh)	**Actual NGG Output (kWh)**
225,821	**13,715**

Table 5: Natural Gas Energy Generation, June 1, 2023, to May 31, 2024

The design objective with dispatching NGGs was to serve the DC microgrid at its BlockHome loads when Tampa Electric's AC grid was not available, as well as when economically favorable versus the cost of imported energy from the grid. This feature was not included in the initial software releases of the BES power optimization controls; BlockEnergy™ were not able to add the required economic dispatch programming to its energy management and optimization software controls .

OPERATIONAL EXPERIENCES FOR YEAR 2 (REPORTING PERIOD)

a) As noted in the company's last annual report, Tampa Electric and Block Energy evaluated the capacity of the system to accommodate Level 2 electric vehicle charging. This evaluation is now complete, and the company concluded that the inherent limitations for kW load capacity and transient overload performance of the BlockBox™ would not accommodate the Level 2 charging.

   As detailed in the previous annual report, the solution to this incompatibility is for switching from the BES supply to Tampa Electric's AC supply during EV charging. This switch results in a short duration power interruption of less than one second, also known as a "momentary." The "momentaries" can be an inconvenience to the homeowners because they require resetting clocks and Wi-Fi modems. Keeping homes with Level 2 charging on the BES supply would result in multiple "momentary" events. The solution was to keep the home on Tampa Electric's AC

supply, with the provision to switch back to the BES supply for storms and other severe weather events.

b) As noted in the company's last annual report, starting motor-driven household loads such as pool pumps and air conditioning units continues to result in "momentaries" as defined in (a) above. These momentary outages are related to inherent limitations for kW capacity and transient overload performance of the BlockBox™. Work has continued to resolve this performance issue; however Tampa Electric is still experiencing momentary outages under normal household energy usage conditions due to the inherent limitations to accommodate transient household motor starting energy flow.

c) Over This Reporting Period, the Pilot has continued to experienced failures of the controllers in the BlockBox™ at the homes, as the company noted in the last annual report. BlockEnergy™ promptly replaced and retested these controllers when they failed. Tampa Electric is assessing each failure in collaboration with BlockEnergy™ to determine a possible common-mode failure mechanism for these events; however, as of the date of this Report no such mechanism has been identified.

d) The occurrence of microgrid outages due to varying PV energy levels at the homes continues to be an issue. The BES nonetheless continues to demonstrate the built-in resilient features that minimize impacts to the energy supply to the homes.

   Adjustments have been made to tuning parameters at the BlockBox™ and CEP to address this issue with limited success. As of the date of this Report, a robust solution involving a combination of parameter tuning and changes to the BES overarching software controls has not yet been realized and given the implications to the structure and architecture of the BES control system, it is unlikely that a solution will be realized in the remaining term of the Pilot Period.

CUSTOMER ENGAGEMENT

Customers participating in the Microgrid pilot enjoy personalized, round-the-clock service from Tampa Electric. Our 'concierge' approach allows them to quickly address concerns and share plans, such as building a pool, that may impact their load profile and energy requirements.

By actively engaging with our customers, we can proactively monitor their needs and anticipate necessary adjustments with battery capacity needs. This concierge approach to customer interactions was extremely beneficial when a customer was planning to

purchase an electric vehicle. The customer proactively emailed Tampa Electric to share his plans, and due to the interaction, they did not install a Level 2 charger.

In another instance, a customer needed a copy of the easement to provide to their insurance company, confirming that the panels were the property of Tampa Electric. Through our engagement, we were able to provide the original agreement, facilitating her successful acquisition of the insurance policy.

In our ongoing communication regarding the Microgrid pilot, we prioritize transparency and responsiveness to ensure our customers feel valued and informed at every step. We actively seek participant feedback and address any concerns, tailoring our support to meet their unique needs. By providing regular updates and personalized interactions, we foster a collaborative environment that empowers our customers and enhances their overall experience. Our commitment to exceptional service is reflected in our dedication to listening to our customers and adapting our approach based on their insights, ensuring they are not just participants but partners in this innovative journey.

Tampa Electric will survey customers during the third year, and the results will be included in the company's report.

COSTS

Table 6 highlights the operating costs incurred by BlockEnergy™ during the second year of Pilot performance. Tampa Electric incurred $0 in operating costs for the Pilot because the contract requires BlockEnergy™ to provide those services during the Pilot without payment.

	June 2023 – May 2024	Cumulative Total as of May 31, 2024
Labor: Fixing an issue/outage	[redacted]	
Materials		
Operations and Maintenance		
Labor: System Requests/Enhancements		
Materials: System Requests/Enhancements		
Project Requests		
Total Operating Expenses		

Table 6: Year 2 Operating Costs, June 1, 2023, to May 31, 2024

WRAP-UP AND NEXT STEPS

The BES Pilot has made substantial progress toward meeting the three primary objectives and the company has gained some invaluable learnings from this Pilot experience that will better position the company for future innovative technology initiatives. The system limitations in terms of resiliency response to varying normal household energy usage as described herein, and the anticipated requirement for continued response to the consequences of these resiliency response limitations have prevented the system from achieving some of the important continuous and reliable energy objectives it was to achieve within the Pilot Period to date. Tampa Electric is evaluating all options regarding the Pilot's continuation and will provide another update in 2025. As ordered in PSC-2021-0237-PAA-EI, issued on June 30, 2021, in Docket No. 20200234-EI, Tampa Electric will survey the Pilot customers regarding the value provided and if they would be willing to pay a premium for this service. This survey will occur during the third year of the Pilot performance.