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December 16, 2025

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.
Dkt. 20200234-EI

Dear Mr. Teitzman:

Enclosed for filing is Tampa Electric Company's Response to Staff's Eighth Data Request (Nos. 1-7), propounded via email on November 19, 2025.

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 Response, filed on behalf of Tampa Electric Company, has been furnished by electronic mail on this 16th day of December 2025 to the following:

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ATTORNEY

TAMPA ELECTRIC COMPANY
DOCKET NO. 20200234-EI
STAFF'S EIGHTH DATA REQUEST
REQUEST NO. 1
BATES PAGE: 1 - 3
FILED: DECEMBER 16, 2025

Please refer to "TECO's Microgrid Pilot Final Report", submitted on October 31, 2025 for the following data requests:

1. Refer to Section I of the BES Performance Results.

a. Refer to Table 2. Detail the identified causes of the "Total Time Spent on AC Grid". As a part of this response, provide of the amount of time (Home-Hours) associated with each identified cause.

b. Refer to Table 2. Detail the identified causes of the "Total Time Home Outage". As a part of this response, provide the amount of time (Home-Hours) associated with each identified cause.

c. Explain if customers would have service during an ATS Occurrence if TECO's AC Grid was unavailable.

ANSWER

a. Please see the table below for the requested information.

BlockBox Incident Cause		Total Hours
Home Inverter	Trip, Faults (Overloads, component failures)	1,711.2
	Fan Failure	1,624.8
	Emergency Power Off Malfunction	343.0
Enerdel Battery Storage	Low State of Charge ("SoC")	901.4
	Battery Failure	862.7
	Over-temperature	18.0
	High Cell Voltage	791.0
	Battery Communications Failure	52.2
Heila Controller	Memory Utilization	159.8
	Control System Failure	2,667.3
	Communications Failure	27.2
	Power Loss	56.0
Misc. Internal Protection	Battery off-gassing	73.0
	High Temp (Front Panel)	36.3
	Ground Fault	686.7
	High Water Level	197.6
	Arc Fault	42.7
	Automatic Transfer Switch ("ATS") Failures	39.8
	ATS Malfunction	5.0
	DC-DC Converter Failure	14.5
	Solar Communications Failure	2.4
	Loss of AC Voltage	46.2
	Smoke Detector Alarm	95.0
ATS Operations due to Community Energy Park ("CEP") Outage (SoC Instabilities)		6,178.2
Planned Miscellaneous Outage		24.3
Total Hours		**16,656.3**

b. Please see the table below for the requested information.

Date	Outage Hours	Comments
July 2022	26.8	ATS failed to operate due to lightning strikes
December 2022	1.5	Smoke detector malfunction due to logic error
March 2023	0.3	Result of planned work (isolation of energy)
October 2024	6.0	End of Hurricane Milton (low SoC before AC voltage was restored)
TOTAL	**34.6**	

c. No, the customer would not have service. The AC distribution system was built and connected in parallel with the BlockEnergy™ system ("BES"), employing an ATS to transfer to the AC distribution system if the DC distribution system was unavailable. If the ATS was switched to Tampa Electric's AC distribution system, and the AC distribution system was not available, the customer would have experienced an outage.

2. Refer to Section III of the BES Performance Results.

a. Please explain the calculation of the net energy reduction on the Company's AC distribution service of 97,752 kWh from BES generation, and associated reduction in AC distribution losses of 5,786 kWh, given the energy produced by the rooftop PV systems and BES NGG are 202,989 kWh (187,212 kWh + 15,777 kWh).

b. Detail the amount of energy (kWh) exported by the BES to TECO's AC grid.

c. Refer to Table 5. Identify and quantify (in terms of kWh) each source of energy loss included in the variance between the Total Energy Produced/Supplied and the Total Energy Consumption for the pilot program. As a part of this response, explain if the Company believes these energy loss sources were expected or unexpected.

d. Provide a comparison of the amount of losses that would have occurred on TECO's traditional AC System, identifying and quantifying (in kWh) each source of energy loss.

e. Provide a comparison of the amount of losses that would have occurred on TECO's traditional AC System with a Net Metering system, identifying and quantifying (in kWh) each source of energy loss.

ANSWER

a. The calculation for the net energy reduction was derived from the amount of energy at the grid tie. A grid tie is where Tampa Electric's AC line connects to the incoming inverters in the BlockEnergy™ Community Energy Park ("CEP"). The net energy reduction was calculated as follows:

Total Energy Consumption: 280,188 kWh
less Energy Supply from Tampa Electric's Grid: 212,455 kWh
plus Energy Dispatched to the AC Grid: 30,019 kWh (Pilot energy contribution to Tampa Electric's AC distribution system)

The calculated corresponding reduction in losses was a result of applying the average percentage of losses on the Tampa Electric AC distribution system to the calculated energy reduction.

b. Please see the table below for the requested information.

Month/Year	System Energy Supply to Grid (kWh)
June 2022	3,500
July 2022	9,399
August 2022	5,879
September 2022	4,275
October 2022	9,186
November 2022	5,631
December 2022	7,979
January 2023	11,611
February 2023	12,185
March 2023	12,743
April 2023	8,673
May 2023	8,529
June 2023	5,297
July 2023	2,858
August 2023	2,665
September 2023	5,069
October 2023	7,983
November 2023	7,512
December 2023	4,912
January 2024	5,171
February 2024	11,557
March 2024	8,995
April 2024	11,537
May 2024	5,023
June 2024	2,483
July 2024	1,642
August 2024	2,466
September 2024	4,118
October 2024	4,727
November 2024	7,429
December 2024	7,154
Total	208,188

c. Tampa Electric is not able to quantify or attribute the total losses to each source. Each device and component included in the BlockEnergy™ Pilot would contribute to the cumulative losses experienced during the Pilot period.

The main contributors of losses in the BlockEnergy System ("BES") would be:

a. BlockBox™
   i. Internal transformer
   ii. Incoming converter
   iii. Home inverter
   iv. Control System Power

b. DC Distribution Loop Cables

c. CEP
   i. Incoming Transformer
   ii. Incoming Inverters
   iii. Battery converters
   iv. Control System Power

In July 2023, BlockEnergy™ carried out an analysis of the static losses in the DC microgrid. This analysis provided estimated average losses from the BlockBoxes and the CEP, using the losses from those components listed above. The average energy loss per day was calculated to be 7.3 kWh for each BlockBox and 85 kWh for the CEP. Over the duration of this pilot, the total calculated losses were 332,729 kWh.

While higher losses in the BES are expected due to the number of multiple energy conversions compared to a traditional AC system, the losses in the BES were higher than expected. This was largely due to equipment in this first commercially available version of the technology. We expect losses can be reduced with more efficient components in future versions of the BES. DC distribution system losses become less relevant if those losses are supplied from within the DC system and not the AC distribution system, and if the overall economics of the DC distribution system are favorable.

d. Please see the following table for the comparison of losses that would have occurred on Tampa Electric's traditional AC system and the

BES. The sources of the BES energy losses are described in the company's response to 2(c), above.

Tampa Electric calculates transmission and distribution system losses annually, using the industry standard methodology. The average transmission losses for the years 2022 through 2024 were 1.54 percent. These losses occur on transmission facilities that exist between the generator step up transformers and the high voltage side of distribution substation transformers. The average distribution losses for the same period were 4.27 percent. These losses are from the high voltage side of a distribution substation down to and including the service transformer that serves the home. Tampa Electric is applying the total average loss factor of 5.8 percent (1.54 percent for transmission plus 4.27 percent for distribution) to the load consumed by the homes for the Pilot period, which yields the losses that would have occurred had the homes been served by Tampa Electric's traditional AC system

Loss Comparison Table (Estimated)				
System	kWh Used (Metered Home Usage)	PV Output (kWh)	Loss Factor (%)	Net Losses (kWh)*
BES	1,105,736	860,358	5.8	400,528
AC Transmission & Distribution System	1,105,736	0	5.8	64,243
*The total loss for the BES is 425,234 less the loss savings which represents the 5.8% of the reduction in energy supply coming from the grid. Loss savings occur when there is a reduction in energy that the grid did not need to supply.				

e. Tampa Electric does not have the data or a study for net metering systems and therefore cannot make a comparison. However, the average PV inverter has a loss factor of approximately 1 to 3 percent under optimal loading (i.e., below maximum capacity). When PV generation aligns with higher system loads, the resulting net loss reduction is materially smaller compared to an equivalent AC system as a result of generating at the location where the energy is used. Because PV energy is often exported to the grid during high-generation periods, when system loads may also be elevated, the loss factors during those periods may be higher than average, increasing the potential loss savings. Conversely, when customers import energy during non-PV hours, losses tend to be lower because these periods generally coincide with reduced system loads, such as

at night. The overall effect is typically a reduction in the average loss factor for Net Metering customers, which, depending on the size of the PV system, could even result in a negative average loss factor.

3. Refer to Section III of the BES Performance Results, page 8. Explain the calculation of the 10 percent variation in the solar energy measured with the test components versus the BES controller, including a diagram of the points of measurement. As part of your response, explain what factor(s) could have caused this variation showing increased solar generation.

a. Provide a revised version of Table 5 that reflects the calculated percent variation in the reported solar energy.

b. Detail the amount of CEP Battery activations from June 7, 2022 to December 31, 2024.

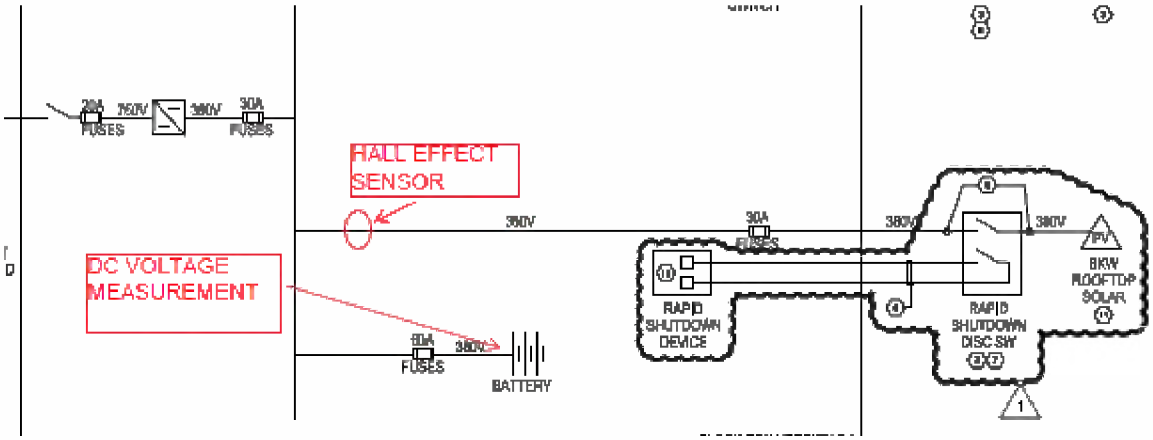
ANSWER

The factors influencing the 10 percent solar variation are the different methods used by the BES Heila control system versus the independent data logger and the corresponding difference in data sampling rates.

The BES was designed to capture photovoltaic ("PV") energy measurements at each BlockBox™ by measuring the PV DC current [at the hall effect sensor] and voltages within the BlockBox™. This data was sampled by the Heila control system (at 1.0 Hz), and the kWh energy was then calculated by the Heila control system.

To validate this data, a DC data logger was connected to the BlockBox™, to independently measure the same DC currents and voltages. The datalogger sampled the measurements at 10 kHz. The comparison of the current and voltage waveforms between the design approach and data logger showed a variation of approximately 10-12 percent. Tampa Electric considered the measurements from the data logger to be more accurate given the difference in sampling rate and the direct bus terminal connection for measuring DC voltage.

Please see the diagram below.



a. Please see the table below for the 10 percent reduction in PV energy and its impact on the remaining results.

Energy Produced / Supplied (kWh)		
Rooftop Energy		
Energy Produced (PV)	Energy Dispatched to AC Grid	Net Energy Available to Home ** (see note below)
860,358	208,188	747,795
Energy Supplied from Tampa Electric's AC Grid		835,553
Energy Supplied from BES NGG		43,247
Total Energy Produced /Supplied		1,530,970
Energy Consumed by Homes (kWh)		
Total Energy Consumption		1,105,736
Variance		425,234

b. The CEP batteries were continuously and autonomously discharged and charged throughout the Pilot period, as needed, to provide voltage-support regulation and to maintain a reliable and secure source of energy to the BlockBoxes and, ultimately, to the homes.

4. Refer to Section VI of the BES Performance Results.

a. Detail the number of Natural Gas Generator (NGG) activations that are associated with the NG Energy Consumption from June 7, 2022 to December 31, 2024.

b. Detail the amount of CEP Battery activations from June 7, 2022 to December 31, 2024.

ANSWER

a. The natural gas generators were activated 265 times from the period June 7, 2022 through December 31, 2024.

b. Please see Tampa Electric's response to Data Request No. 3(b), above.

5. Refer to Sections III and VI of the BES Performance Results.

a. Explain the difference between values reported for Energy Supplied from BES NGG on Table 5 and the Actual NGG Output on Table 8.

b. Provide the resulting capacity factor of the NGG.

ANSWER

a. Please see below for the revised table. Upon further review, Tampa Electric found an error in the calculation included in the annual report. Page 10 / Table 8 will be corrected in the revised Microgrid Pilot Final report.

NG Energy Consumption Total Reporting Period to Date	
Forecasted NGG Output (kWh)	Actual NGG Output (kWh)
58,740	15,777

b. Each natural gas generator is rated for 180 kW. Over 30 months, this translates into a capacity factor of 0.5%.

6. Refer to Customer Engagement on page 14 and Figure 4. Did TECO's Customer Survey include any question(s) that obtained what amount of additional charges participants would be willing to pay for the Microgrid Program?

ANSWER

Yes. Tampa Electric asked Pilot participants if they believed the reliability of the microgrid would be worth an additional charge on their monthly bill. Approximately 75 percent of the Pilot survey respondents indicated they were not willing to pay an additional charge.

7. Refer to Commission Order No. PSC-2021-0237-PAA-EI. The reporting requirements detailed in the Commission Order specify that TECO's final report should include, among other information, both quantitative and qualitative analysis that would compare the cost of providing local distribution service from a DC microgrid to the cost of a standard AC system. Provide a revised version of "TECO's Microgrid Pilot Final Report" that includes a quantitative analysis to satisfy this reporting requirement.

ANSWER

Tampa Electric will be filing its revised Microgrid Pilot Final Report on December 17, 2025.