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TAMPA ELECTRIC
AN EMERA COMPANY

BEFORE THE
FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NO. 20210034-EI
IN RE: PETITION FOR RATE INCREASE
BY TAMPA ELECTRIC COMPANY

DIRECT TESTIMONY AND EXHIBIT
OF
J. BRENT CALDWELL

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

PREPARED DIRECT TESTIMONY

OF

J. BRENT CALDWELL

Q. Please state your name, address, occupation, and employer.

A. My name is J. Brent Caldwell. My business address is 702 N. Franklin Street, Tampa, Florida 33602. I am employed by Tampa Electric Company ("Tampa Electric" or "company") as Director, Planning and Fuels.

Q. Please describe your duties and responsibilities in that position.

A. My responsibilities include the long-term planning of Tampa Electric's energy resources to meet customer demand in an economic and reliable manner. I also oversee the optimization and trading associated with the planning and commitment of the system assets on a day-ahead basis.

Q. Please provide a brief outline of your educational background and business experience.

A. I received a bachelor's degree in electrical engineering from Georgia Institute of Technology in 1985 and a Master of Science degree in Electrical Engineering in 1988 from the University of South Florida. I have over 25 years of utility experience with an emphasis in state and federal regulatory matters, fuel procurement and transportation, fuel logistics and cost reporting, and business systems analysis. In 2017, I assumed responsibility for Portfolio Optimization, which includes unit commitment, near-term maintenance planning, and natural gas and wholesale power trading. In December 2018, I assumed the role of Director, Planning and Fuels, which added responsibility for long-term planning to my existing responsibilities.

Q. Have you previously testified before the Florida Public Service Commission ("Commission")?

A. Yes. I submitted written testimony in the annual fuel docket from 2011 through 2019. In 2015, I testified in Docket No. 20150001-EI regarding natural gas hedging. I have also testified before the Commission in Docket No. 20120234-EI regarding the company's fuel procurement for the Polk 2-5 Combined Cycle Conversion project and filed testimony in Docket No. 20130040-EI regarding fuel inventory levels in Tampa Electric's last rate case.

Q. What are the purposes of your direct testimony?

A. The purposes of my direct testimony are to describe and explain the prudence of constructing the company's Big Bend Modernization Project ("Big Bend Modernization"). This project is part of the company's ongoing process to promote safety, improve the customer experience, and become a cleaner and greener utility. I will describe the company's Big Bend Generating Station, the analysis we undertook before beginning Big Bend Modernization, why the project is prudent, and how the project will improve our customer experience and benefit our customers and the communities we serve. I will also explain why it is prudent to retire Big Bend Unit 3 in April 2023.

Q. How does your direct testimony relate to the direct testimony of other Tampa Electric witnesses?

A. My direct testimony addresses the prudence of Big Bend Modernization and the early retirement of Big Bend Unit 3. Tampa Electric's witness David A. Pickles describes how the Big Bend Modernization Project and early retirement of Big Bend Unit 3 fit into the company's overall Resource Plans and the costs and project status of Big Bend Modernization. He also describes the units of property associated with Big Bend Units 1, 2, and 3 that will be retired and the items of inventory that will become obsolete when our plans for Units 1, 2, and 3 have been executed.

Mr. Pickles will describe the changes underway at Big Bend Power Station. Tampa Electric witness Davicel Avellan will explain how those changes affect our depreciation and dismantlement rates and create a need to recover the undepreciated net book value of the portions of Big Bend Units 1, 2, and 3 to be retired and related obsolete inventory via capital recovery schedules.

Q. Have you prepared an exhibit to support your direct testimony?

A. Yes. Exhibit No. JBC-1, entitled "Exhibit of J. Brent Caldwell" was prepared under my direction and supervision. The contents of my exhibit were derived from the business records of the company and are true and correct to the best of my information and belief. It consists of four documents, as follows:

Document No. 1: Big Bend Modernization Photos and Artist Renderings

Document No. 2:	Big Bend Modernization Options Considered and Relative CPVRR Savings without Emissions Cost Savings
Document No. 3:	CPVRR by Component for Big Bend Modernization
Document No. 4:	CPVRR by Component from Big Bend Unit 3 Early Retirement

OVERVIEW OF BIG BEND GENERATING STATION

Q. Please describe Tampa Electric's generation assets.

A. Tampa Electric has three centralized thermal generation stations: Big Bend Station, Polk Power Station ("Polk"), and the H.L. Culbreath Bayside Power Station ("Bayside"). Big Bend Station, Polk and Bayside use fossil steam units, combined cycle units ("CC"), combustion turbine peaking units ("CT"), and an integrated gasification combined cycle unit ("IGCC") to generate electricity. Tampa Electric also has a fleet of solar photo voltaic ("PV") generation sites distributed across the service territory and a small battery energy storage device near Big Bend Station.

Q. Please describe Tampa Electric's Big Bend Power Station ("Big Bend").

A. Big Bend consists of four steam turbines and an aero-derivative combustion turbine. The steam turbine units were originally designed to operate on high-sulfur, pulverized coal from the Illinois Basin. The units became operational in 1970, 1973, 1976, and 1985 for Units 1, 2, 3, and 4, respectively. The company's last depreciation study in 2011 contemplated that each of the steam turbine units would be retired after useful lives of 65 years.

Q. What types of equipment are needed to support these pulverized coal generating units?

A. Big Bend has equipment to receive, unload, store, blend, and pulverize coal that is received by barge or by rail. Each unit also has emission control equipment, such as precipitators to capture particulate matter, flue gas desulfurization ("FGD") scrubbers to capture sulfur oxides, and selective catalytic reduction units ("SCR") to capture nitrous oxides. Big Bend Unit 4 was originally designed and built with most of this emission control equipment in 1985. The company later retrofitted Big Bend Units 1, 2, and 3 to add this equipment.

Q. Have the Big Bend units evolved in other ways?

A. Yes. The four Big Bend pulverized coal units were originally designed and built to consume high-sulfur, low-cost Illinois Basin coal. This fuel choice provided significant fuel cost savings to Tampa Electric customers because, historically, Illinois Basin coal was the lowest cost delivered fuel. However, since international demand for U.S. coal increased and non-conventional shale gas production caused the price of natural gas to decrease, natural gas became a more competitively priced option for electric generation.

In 2015, Tampa Electric first took advantage of the greater availability and lower price of natural gas and replaced oil with natural gas as the fuel used to start up Big Bend Units 1 through 4. This change significantly reduced the cost of fuel associated with unit startup.

In 2017, Tampa Electric went a step further by adding natural gas burners so that each unit could be partially operated on natural gas. Tampa Electric added additional natural gas burners to Big Bend Units 1, 2, and 3 so that those units can operate close to maximum dependable capacity ("MDC") on natural gas. This dual-fuel capability enabled the company to run the Big Bend units on natural gas when available and the pricing is advantageous. The ability to co-fire on natural gas also improved unit and system reliability since the Big Bend units do not need to be taken offline in the event of a coal handling issue.

Mr. Pickles provides additional details about the transformation of Big Bend Station in his direct testimony.

Overview of the Big Bend Modernization Project

Q. Please generally describe the Big Bend Modernization Project.

A. The Big Bend Modernization Project consists of three fundamental building blocks: (1) the retirement of Big Bend Unit 2 and all of its associated equipment, (2) the refurbishment of Big Bend Unit 1’s steam turbine and generator, and (3) replacement of Big Bend Unit 1’s boiler and coal processing equipment with two new GE 7HA.02 CTs and associated heat recovery steam generators (“HRSG”). Document No. 1 of my exhibit contains photographs and artist renderings of the project.

The Big Bend Modernization Project has two phases and will take approximately 42 months to complete. Mr. Pickles describes the activities and costs associated with the two phases and details of the project timeline in his direct testimony. He also explains that the project is on time and within budget.

Q. In general, what components of Big Bend Unit 1 will be retained and what components of Big Bend Units 1 and 2 will be retired?

A. Essentially all coal-related equipment and steam production equipment associated with Big Bend Unit 1 will be retired and all the equipment associated with the production of electricity from Big Bend Unit 1 will be retained. The equipment being retired from Big Bend Unit 1 includes coal mills, coal pulverizing equipment, coal injectors, the boiler, slag tanks, ash hoppers, precipitators, and the flue gas desulfurization scrubber.

The primary components being retained and modernized for Big Bend Unit 1 include the steam turbine, the generator, ductwork, fans, the cooling system, circulating pumps, and selective catalytic reduction equipment. With respect to Big Bend Unit 2, essentially all unit specific equipment will be retired.

Q. How will the capacity and heat rates for the modernized Big Bend Unit 1 compare to those of the original Big Bend

Units 1 and 2?

A. The Big Bend Modernization Project will increase the combined generating capacity for Big Bend Units 1 and 2 from approximately 800 MW to a winter capacity of 1,120 MW when the repowering is complete.

The Big Bend Modernization Project will also improve the generating efficiency at Big Bend. Prior to the Big Bend Modernization, Units 1 and 2 had operational heat rates of over 10,500 Btu/kWh. The modernized Big Bend Unit 1 will be the most efficient generating unit in the company’s fleet, with an expected operational heat rate of approximately 6,350 Btu/kWh, an efficiency gain of 40 percent. This means lower natural gas fuel volumes, lower energy costs, and lower emissions, which will result in savings for customers.

Q. What other operational benefits will the Big Bend Modernization Project bring to Tampa Electric’s system?

A. The modernizing of Big Bend Unit 1 will yield two other important improvements. First, Big Bend Unit 1 will have the ability to run in simple-cycle operation, combined-cycle operation, or a mix of the two, which will provide significant operating flexibility to meet rapidly changing system needs. In addition to flexible operational modes, the modernized Big Bend Unit 1 will be able to change its output much more quickly and vary its output over a much wider MW range than the existing Big Bend Units 1 and 2 can. With the evolving industry and changing load dynamics, having a unit with this amount of operational flexibility, especially as compared to 1970s-vintage pulverized coal steam turbines, will be critical for meeting current and future customer needs.

Second, the repowered unit will be more reliable. CTs are inherently more reliable than the pulverized coal units, and the ability to run in simple-cycle and combined-cycle modes enhances the reliability of the unit and facilitates scheduling of maintenance.

Mr. Pickles provides additional details about the operational benefits of Big Bend Modernization, including how the project will complement the company's solar generation facilities, in his direct testimony.

Q. Has Tampa Electric executed a project like Big Bend Modernization before?

A. Yes, the Big Bend Modernization is just the latest example of Tampa Electric refurbishing and integrating existing generation assets with new technology to cost effectively meet customer growth needs and improve overall system efficiency. Tampa Electric repowered Gannon coal units 5 and 6 into Bayside Units 1 and 2 in 2003 and 2004. Just like the modernization of Big Bend Unit 1, new natural gas combustion turbines and heat recovery steam generators were integrated with a refurbished existing steam turbine and electrical generator to create a more efficient, more reliable, and more flexible natural gas combined cycle ("NGCC") unit. When Bayside 1 and Bayside 2 came online, they became the most efficient and most reliable units on the Tampa Electric system.

Tampa Electric used this process again in 2017 at Polk Station. The four existing combustion turbines at Polk Station were integrated with new heat recovery steam generators, a new steam turbine, and a new electric generator. As was the case when the Bayside project went in-service, when the Polk Unit 2 NGCC became the most efficient and most reliable unit on the system when it came online. Tampa Electric has proven the concept of using existing assets to create a new NGCC at a lower cost than building a whole new unit. The Big Bend Modernization is exactly the same concept and, when it comes online as a NGCC unit, will be the most efficient unit on the system.

Analysis Leading to Big Bend Modernization

Q. Please describe the industry trends that initiated the analysis the company performed before beginning Big Bend Modernization.

A. Tampa Electric regularly reviews the retirement horizon of its generation units. In the early to mid-2010s, this review took on an added sense of urgency for several reasons.

First, numerous environmental initiatives such as the Mercury and Air Toxics Standards, the Clean Power Plan, and the Coal Combustion Residuals rule cast significant uncertainty on the long-term cost and viability of pulverized coal units.

Second, by then Units 1 and 2 were over forty years old, and while the units can operate for the remainder of their 65-year depreciation lives, annual budgeting activities revealed rising capital investment and operating cost to maintain sufficient performance, reliability, and safety for these units.

Finally, technology advancements yielding greater efficiency and lower costs for NGCC generation, coupled with relatively lower cost natural gas produced from non-conventional production technologies, caused efficient NGCC generation to supplant pulverized coal generation, even for existing units, as a more cost-effective and emission-friendly generation choice.

Q. Please describe the process the company used to identify, select, and evaluate Big Bend Modernization.

A. The company started with a screening of options available at the Big Bend Station site to identify and select the best alternative for assets at Big Bend. The screening process, conducted in 2016, looked at multiple options for Big Bend Station including various retirement scenarios, various repowering configurations, and new build options. The screening process determined that the retirement of Big Bend Unit 2 coupled with the modernization of Big Bend Unit 1 into a NGCC was the best option for Tampa Electric customers.

Q. What were the primary factors that supported identification of the Big Bend Modernization as the right choice for customers?

A. Three main factors supported Big Bend Modernization as the right choice.

The first factor was the cost of continuing to operate Big Bend Units 1 and 2 on pulverized coal. While Units 1 and 2 have provided Tampa Electric low-cost energy for decades, their relative inefficiency, recent increases in fuel costs, emissions intensity, and increasing levels of investment required to operate the units safely and reliably opened the door for a life-cycle review.

The second factor was the cost savings associated with retaining and reusing existing assets through repowering of a Big Bend unit. Using Big Bend Unit 1's steam turbine, generator, cooling system, transmission infrastructure, land, and water rights made repowering both cost effective and executable.

The third factor was that the staged approach for bringing the two new CTs online in 2021 will (1) ease the operational challenges associated with removing 800 MW of generating capacity from service and (2) provide operational and reliability benefits to our system before the project will be finished.

Q. Once the modernization of Big Bend Unit 1 was selected for the Big Bend site, what other alternatives were considered?

A. Once the Big Bend Modernization Project was selected as the option at Big Bend, the Project was further tested against other resource alternatives available to the system. As it does each year, the company updated its load forecasts, fuel price forecasts, maintenance schedules, and other projections in the early summer of 2017 to prepare the company's 2018 projected fuel cost filing. The 2017 Ten-Year Site Plan with updated inputs became the base case for the analysis. Using these fully updated assumptions, the company compared Big Bend Modernization to the base case and several other expansion alternatives including options to build new generation and options to purchase power in the market.

Q. What did this comparison to other options show?

A. The comparison showed that the Big Bend Modernization Project is expected to provide $747 million of cumulative present value revenue requirement ("CPVRR") savings for customers compared to the base case. The evaluation also showed that the Big Bend Modernization Project was the lowest cost alternative by at least $50 million CPVRR.

Q. Please further describe the other alternatives considered.

A. The other alternatives analyzed by the company, and their savings relative to Big Bend Modernization, are shown in Document No. 2 of my exhibit.

The options included building combustion turbines without retiring any Big Bend units (the base case), retiring both Big Bend Units 1 and 2 and building combustion turbines and converting them to combined cycle, and the Big Bend Modernization Project. Of these build options, the Big Bend Modernization process was the most cost-effective option driven largely by the reuse of existing steam turbine and generation assets, leveraging existing water rights, circulating water cooling assets and transmission assets, and immediate fuel savings from improved efficiency of the system.

The options also included buying power or existing generation facilities from the wholesale power market. The wholesale market options ranged from peaking power to full-requirements system power and also included solar photovoltaic purchase power options. The Big Bend Modernization Project was more cost-effective than all of the wholesale market purchased power options. Like the alternate build options, the wholesale power purchase options cannot overcome Big Bend Modernization's advantages of using existing rights and assets. Additionally, wholesale power projects have the additional hurdles of paying for transmission capacity on neighboring systems, paying for ancillary and balancing services, and have uncertainty regarding timing and impact of changing transmission and network dynamics.

Q. What are some of the key insights from the analysis?

A. First, avoiding the ongoing capital, operating, and maintenance expense associated with Big Bend Units 1 and 2 provides the foundation of benefits to customers. Second, combined cycle energy with its high efficiency and low-cost generation was the type of resource needed by the system and provides significant fuel cost savings to customers. And third, because of the reuse of existing generation equipment, existing transmission rights and equipment, and existing water rights and equipment, the Big Bend Modernization Project was the most cost-effective option for customers.

Q. Are there other aspects of the Big Bend Modernization Project that make it beneficial beyond the cost effectiveness analysis?

A. Yes, there are several benefits from the Big Bend Modernization Project. First, the Tampa Electric transmission and distribution system has been built and operated with a large portion of the capacity and energy being sourced from the Big Bend Station location. Building a new resource at a different location or buying power that is imported into the system creates new flows and dynamics that will likely increase operational costs and complexities. Second, the Big Bend Modernization Project provided certainty of execution. Permitting water use rights and securing or building new transmission capability is challenging, both from a cost certainty standpoint and a time to complete standpoint. Whether building new generation or buying from the wholesale power market, all options besides modernizing Big Bend Unit 1 have a much higher level of cost and timing risk associated with permits and transmission. And, third, modernizing Big Bend Unit 1 so that the company keeps a large, spinning generator on its system provides "inertia" that helps maintain voltage regulation, frequency regulation, and other ancillary services that maintain system stability and integrity that is difficult and expensive to provide from outside the system.

Q. Did the company conduct a formal request for proposals from the Florida wholesale power market?

A. Tampa Electric included numerous wholesale power alternatives in the options it considered, but it did not conduct a formal request for proposals. Since the analysis showed that no build or purchase options were likely to be more cost effective than the modernization project, and the other options lacked the previously mentioned benefits of reusing the existing generation and transmission infrastructure, the company moved forward with the project to capture its benefits for customers more quickly rather than risking delay and cost from a request for proposals.

Q. Did the company consider the value of reduced emissions in the assessment of the project?

A. Yes. The company calculated CPVRR savings with and without avoided emission costs. Using an industry-recognized forecast of the cost associated with emissions of CO_2, SO_2, and NOx, the company estimates that the Big Bend Modernization Project will avoid approximately $108 million of emission costs. As shown on Document No. 3 of my exhibit, the company estimates that the total CPVRR savings from Big Bend Modernization are $855 million when avoided emissions costs are included.

Q. Could energy conservation, load management, or other demand-side management programs have deferred or avoided the need for the Big Bend Modernization Project?

A. No. Demand-side management programs simply could not be implemented with the magnitude or the certainty needed to replace 800 MW of baseload generation. Even if cost-effective at that magnitude, demand-side management programs could not provide the operational flexibility provided by the quick start, rapid ramp rates, and transmission network support associated with Big Bend Modernization.

Q. What approvals were requested and received for Big Bend Modernization?

A. First, Tampa Electric had to get approval from Emera, Inc.'s Board of Directors and the Emera Finance Committee to assure funding of the project by Emera. The Board approved the project on February 18, 2018, and the Finance Committee approved the project on May 24, 2018.

Second, Tampa Electric filed a Site Certification

Application with the Florida Department of Environmental Protection on April 18, 2018. After extensive discovery and five days of hearings on March 11 through 15 of 2019, the administrative law judge issued an order on May 30, 2019 recommending approval of the project. The Governor and cabinet sitting as the Power Plant Siting Board approved the project on July 25, 2019.

Q. What is the status of the project?

A. Big Bend Modernization is on schedule and within budget. The total project cost for which Tampa Electric is seeking recovery is projected to be $893 million, including AFUDC, three million less than the $896 million, including AFUDC, used in the cost-effectiveness analysis. At $893 million, the cost of the project is approximately $800 per kW which is lower than all recent, similarly sized projects in Florida, further supporting that the project is the right choice for customers. More details about the status of the project are included in the testimony of Mr. Pickles.

Building Big Bend Modernization is Prudent

Q. Is Big Bend Modernization prudent, and what benefits does it provide to Tampa Electric and its customers?

A. Yes. The Big Bend Modernization Project is prudent and provides numerous benefits to Tampa Electric and its customers. The benefits generally include avoided investments of capital and operating costs for two aging pulverized coal units, greater reliability and flexibility of the company's generating system, fuel savings from improved generating efficiency, lower emissions, reduced water consumption and wastewater, and, finally, continued support of the winter population of manatees. More specifically:

1. Construction and operation of Big Bend Modernization and the related replacement of the portions of Units 1 and 2 to be retired is prudent because the project and associated retirements was the best available option and will yield a $747 million CPVRR savings to customers compared to the base case, without avoided carbon emission costs and $855 million with.

2. The repowered Big Bend Unit 1 will be the most efficient generating unit in the company's fleet, with an expected operational heat rate of approximately 6,350 Btu/kWh. This means lower natural gas fuel volumes, lower energy costs, and lower emissions, which will result in savings for customers.

3. The retirement of portions of Big Bend Unit 1 and all of Big Bend Unit 2 will allow the company to avoid spending an estimated total of $293 million CPVRR of capital to keep Big Bend Units 1 and 2 operating for the remainder of their Commission-approved lives.

4. Having removed Big Bend Unit 1 from commercial service in June 2020, the company will avoid making the approximately $151 million CPVRR of capital expenditures needed to keep Big Bend Unit 1 in service in its current form until its planned retirement date of 2035.

5. Removing Big Bend Unit 2 from commercial service in December 2021 will allow the company to avoid making the approximately $142 million CPVRR of capital expenditures needed to keep Big Bend Unit 2 in service until its planned retirement date of 2038.

6. The project will re-use much of the existing Big Bend Unit 1 infrastructure such that it moderates the dollar value of retired assets subject to a special capital recovery schedule and related customer rate impacts.

7. The project will improve the company's overall generating system reliability. It will also make the Big

Bend Station generating units more reliable on a stand-alone basis. The annual Net Equivalent Availability Factor ("EAF") for Units 1 and 2 in 2019 were less than 70 percent. The company expects the EAF for the repowered Big Bend Unit 1 to be approximately to be 93 percent in combined cycle mode and 98 percent in simple cycle mode.

8. The company will burn less coal, use less water, and generate less wastewater than under the status quo, making Tampa Electric cleaner and greener.

9. The project will lower the company's emission of CO_2, SO_2, and NO_X relative to current levels and levels projected for the future.

10. The project will enable the company to moderate the amount of money it must spend on solid fuel before Big Bend Modernization is complete while maintaining an acceptable level of warm water discharge to the existing manatee sanctuary.

11. The project will complement the company's approved solar projects by providing winter reserve margin, 24-7 energy, and regulation support for the solar generation, which is an intermittent resource. The flexibility and

“following” ability inherent in the repowered Big Bend Unit 1 will effectively complement the company’s utility scale solar generation. The repowered Big bend Unit 1 will be able to quickly offset the variability of solar plants as weather conditions change by ramping up or reducing output.

12. The project will allow the company to reduce O&M expenses at Big Bend through staffing reductions and other means as explained further in the direct testimony of Mr. Pickles.

13. The project will enhance safety by making Big Bend an inherently safer work environment by eliminating the complex and aging equipment related to coal handling and coal generation associated with Big Bend Units 1 and 2.

Q. Did the company identify the costs of not moving forward with Big Bend Modernization, and, if so, what were they?

A. Yes. If the company chose not to modernize Big Bend, the alternative would be to serve customers using a traditional expansion plan that adds simple-cycle combustion turbines. Under this approach, Tampa Electric and its customers would incur additional costs of $747 million CPVRR. This approach would also impose other costs and burdens on Tampa Electric and its customers, such as greater water usage, higher emissions, and lower reliability. Perhaps most importantly, Tampa Electric and its customers may have missed out on the opportunity afforded by Big Bend Modernization, to advance the system with new, more efficient technology.

Q. How will Big Bend Modernization benefit Florida and the communities Tampa Electric serves?

A. Big Bend Modernization will benefit Florida and the communities Tampa Electric serves by materially improving the electrical grid with higher efficiency, lower emissions, greater reliability, and greater operational flexibility. The project achieves these benefits while reusing most of the existing Big Bend Unit 1 generation assets, water rights, and transmission infrastructure.

Q. How does the project complement the company's investment in utility scale solar?

A. Tampa Electric is committed to cost-effectively reducing its impact on the environment and solar PV generation is an important component of this commitment. Customers want Tampa Electric to incorporate as much cost-effective solar energy as can be managed reliably. By its very nature, solar energy is non-dispatchable, meaning it produces energy when the solar radiance is available, not necessarily when the utility needs it. Similarly, solar energy output is erratic, with wide, frequent swings as clouds pass overhead.

The Big Bend Modernization Project will replace two aging pulverized coal units that have limited output range and are slow to vary output with two state-of-the-art combustion turbines that can start quickly, ramp rapidly, and generate across a wide MW range. While the Big Bend Modernization Project is not solely intended to support solar, its presence on Tampa Electric's system will improve our ability to use existing solar resources and add additional utility scale solar generation as discussed in the testimony of Mr. Sweat and Mr. Aponte.

Q. Will the project provide a capacity benefit for the company?

A. Yes. With a winter capacity of 1,120 MW, compared to about 800 MW for existing Big Bend Units 1 and 2, Big Bend Modernization will provide approximately 300 MW of incremental, reliable, and flexible generating capacity.

The cost of the modernization is more than offset by cost savings from using existing assets from Big Bend Unit 1, fuel savings from improved efficiency, and redeployment of capital and O&M to new technology instead of maintaining aging coal units.

Q. Will the Big Bend Modernization Project advance the company’s three areas of strategic focus - safety, customer experience, and being cleaner and greener?

A. Yes. The project will support all three areas of strategic focus.

The project will enhance safety by making Tampa Electric’s Big Bend Station an inherently safer work environment by removing complex aging equipment used for coal handling and coal-fired generation associated with Units 1 and 2.

The project will enhance the customer experience because customers will receive increased reliability and lower costs for their electrical service.

The project will allow the company to make significant progress on its goal of running a cleaner and greener generating fleet by replacing two pulverized coal units with a much more efficient, reliable, and flexible NGCC unit with lower emission levels, water consumption levels, and solid waste like coal combustion residuals. As I previously mentioned, the increased reliability and flexibility of repowered Big Bend Unit 1 will enhance the company's ability to accommodate increasing levels of zero-emission, zero fuel cost solar generation.

Q. Will Big Bend Modernization increase the company's need for natural gas?

A. Yes, but not as much as one might expect. First, Tampa Electric would need more gas pipeline capacity if the energy to be generated by the modernized Big Bend Unit 1 would be generated from existing, less efficient units. When Big Bend Units 1 and 2 are fueled with natural gas, it requires nearly twice as much natural gas commodity and pipeline capacity for the same amount of electrical energy from the modernized Big Bend Unit 1. Even if Big Bend Units 1 and 2 are operating on coal, their much lower availability factor means that frequently the energy they produce must be replaced with natural gas burned in the inefficient Big Bend units or in other gas units on the Tampa Electric system. While the very efficient and very reliable modernized Big Bend Unit 1 may increase the average daily need for natural gas supply and pipeline capacity, it eliminates the unpredictable spikes in gas supply and pipeline capacity demands associated with the units it replaces. Overall, Tampa Electric’s reliance on natural gas increases with the project, but the ultimate management of that natural gas demand improves significantly.

Q. Is it prudent to retire portions of Big Bend Units 1 and 2 as part of Big Bend Modernization before the retirement date used when preparing the company’s last-approved depreciation rates?

A. Yes. Early retirement of parts of Big Bend Unit 1 and all of Unit 2 are necessary parts of Big Bend Modernization, so the early retirement of portions of Big Bend Unit 1 and all of Unit 2 is prudent for the same reasons Big Bend Modernization is prudent. The early retirements associated with Big Bend Modernization will lower fuel costs, reduce future capital costs, and moderate operating costs at Big Bend. The cost effectiveness analysis benefits are over and above recovery of the remaining undepreciated value of the retired assets. It is clearly in Tampa Electric’s customers’ best interest to retire these assets before their planned retirement dates as part of the project.

The Big Bend Units 1 and 2 assets to be retired in conjunction with Big Bend Modernization, their undepreciated net book values, and the company's proposed accounting treatment for those assets are discussed in the direct testimony of Mr. Pickles and Mr. Avellan.

Q. How does the Project fit into the company's ten-year site plan?

A. The Big Bend Modernization Project strengthens the foundation upon which Tampa Electric provides energy for our customers as compared to the coal units that are being retired and modernized. In addition to improving the system's ability to accommodate solar, this improved foundation enables Tampa Electric's generation expansion plan to incorporate distributed energy resources such as solar photovoltaic, energy storage, and reciprocating engines more easily. These emerging technologies provide opportunities to improve reliability, improve resiliency, reduce emissions, reduce energy losses, adapt quickly to changing needs, and avoid transmission and distribution investments. The Big Bend Modernization Project improves the Tampa Electric generation portfolio now and into the future.

Early Retirement of Big Bend Unit 3 is Prudent

Q. Please describe Big Bend Unit 3.

A. Big Bend Unit 3 is a pulverized coal-fired steam unit. It was placed in service in May 1976. It has a name-plate capacity of 445.5 MW and has summer and winter capability of 395 MW and 400 MW, respectively. The expected retirement date reflected in the company's 2011 Depreciation Study is 2041.

Big Bend Unit 3 has been maintained, operated, and upgraded across those five decades to comply with ever evolving and increasingly demanding environmental constraints. Some of its primary emissions control equipment includes particulate matter collectors, flue gas desulfurization scrubbers, nitrogen oxide selective catalytic reduction equipment, pre- and post-water treatment plants, and coal combustion residual handling equipment. The company has replaced the heavy oil igniters on Big Bend Unit 3 with natural gas igniters and added additional natural gas burners to allow operation with natural gas as either a supplement or as an alternative to coal.

Despite this fuel flexibility and exceptional emission control, it is prudent to retire Big Bend Unit 3 in April

2023, which is before the retirement date used in the company's 2011 depreciation study.

Q. How did the company conclude that it would be prudent to retire Big Bend Unit 3 earlier than planned?

A. As previously noted, the company began evaluating what actions would be in the best interest of its customers with respect to the future of the steam turbine units at Big Bend Station in 2016. The Big Bend Modernization Project was the culmination of this process. During that process, the retirement of Big Bend Unit 3 before its current expected retirement date was identified as another opportunity to benefit our customers.

The Integrated Resource Plan prepared by the company in late-2019 and early-2020 once again confirmed the early retirement of Big Bend Unit 3 and recommended the action. The decision and timing of the retirement of Big Bend Unit 3 was ultimately finalized in late 2020. In October 2020, the company concluded that it would be in the best interest of its customers to retire Big Bend Unit 3 in April 2023.

Q. Why is the early retirement of Big Bend Unit 3 prudent and in the best interest of customers?

A. Early retirement of Big Bend Unit 3 is prudent from an economic perspective, an environmental risk perspective, and an operational perspective.

Economically, Tampa Electric projects that customers will save nearly $299 million on a CPVRR basis from the retirement of Big Bend Unit 3, as shown in Document No. 4 of my exhibit. These savings come primarily from reduced investment needed to maintain and operate a 1970's vintage coal-fired unit. Fuel savings and variable O&M expense reductions round out the overall economic benefit.

Environmentally, the energy that would be provided by Big Bend Unit 3 with a heat rate of about 11,000 Btu/kWh will instead be produced by a NGCC generator with a heat rate of about 7,000 Btu/kWh which is an efficiency improvement of over 35 percent. Since less fuel will be consumed, fewer emissions will be created. Due to the relative prices for natural gas and coal, Big Bend Unit 3 currently operates on natural gas. Emission reductions from the early retirement of Big Bend Unit 3 would be even greater compared to a scenario where Big Bend Unit 3 burns coal or if the replacement generation comes from solar or some other emission-free resource.

Operationally, Big Bend Unit 3, like all coal-fired steam turbine units, was built to be a baseload unit, meaning it is designed to be turned on and left on around-the-clock for multiple days or even months in a row. Changing energy use patterns by our customers and the addition of intermittent resources on our electric system require that the company's generation portfolio be more flexible, able to follow the variation in load, and react to changing output from solar resources. For these reasons and because aged, coal-fired assets are inherently less reliable compared to modern gas-fired generation technology, Big Bend Unit 3 no longer fits the operational needs of Tampa Electric and its customers' demands.

Q. What are the costs and proposed accounting treatments associated with the early retirement of Big Bend Unit 3?

A. The Big Bend Unit 3 assets to be retired in 2023, their undepreciated net book values, and the company's proposed accounting treatment for those assets are discussed in the direct testimony of Mr. Pickles and Mr. Avellan.

SUMMARY

Q. Please summarize your direct testimony.

A. The Big Bend Modernization Project is important to Tampa Electric and its customers. The project will provide $747 million of CPVRR savings compared to an optimized expansion plan that does not retire and calls for the continued refurbishment of existing coal-fired units. The project was identified and selected through an extensive screening and analytic process and is the most prudent option as compared to numerous other new construction and market options.

In addition to its compelling economics, Big Bend Modernization will improve system efficiency as it will be the most efficient dispatchable unit on the system. It will improve system environmental performance by significantly lowering air emissions, water consumption, and wastewater production. The project will improve overall system reliability and operational flexibility by replacing two 1970's vintage pulverized coal units with state-of-the-art, responsive, and reliable combustion turbines and heat recovery steam generator integrated with the Big Bend Unit 1 generation equipment. The Big Bend Modernization Project is a foundational element of Tampa Electric's plan to provide service to its customers in an affordable, reliable, and environmentally responsible manner.

Likewise, the early retirement of Big Bend Unit 3 is prudent from an economic perspective, an environmental risk perspective, and an operational perspective and will provide demonstrable benefits to Tampa Electric and its customers.

Q. Does this conclude your prepared direct testimony?

A. Yes, it does.

EXHIBIT

OF

J. BRENT CALDWELL

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BIG BEND MODERNIZATION PHOTO AND ARTIST RENDERING

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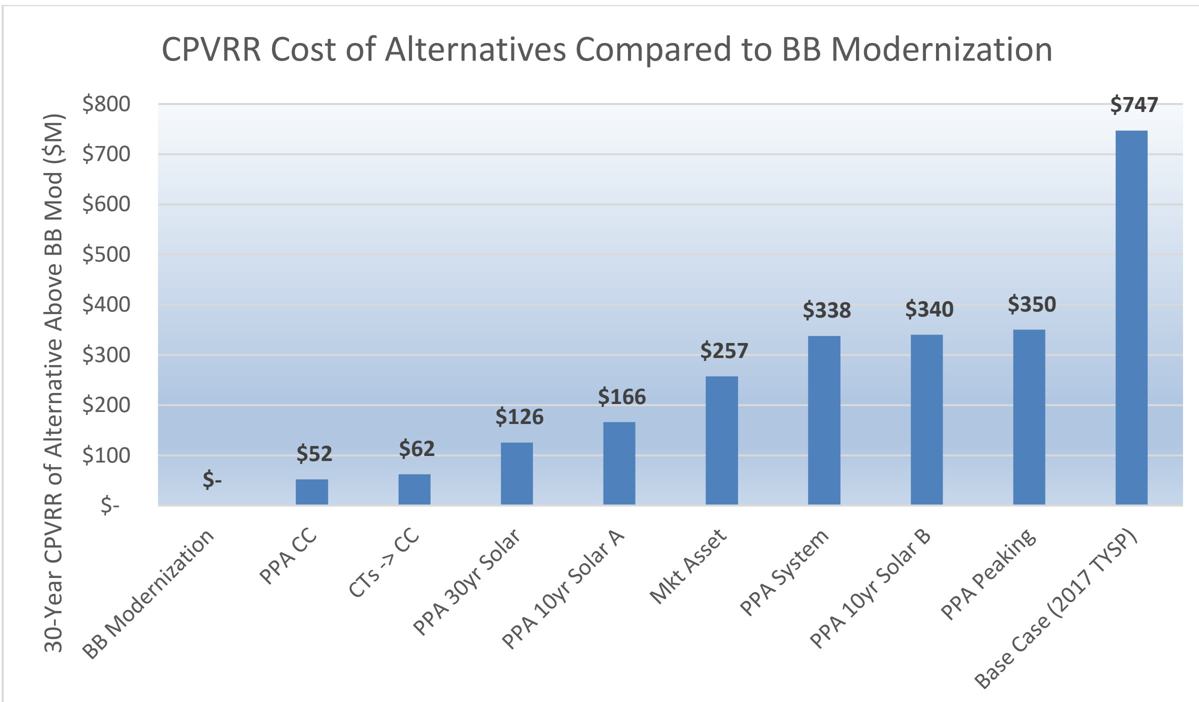
BIG BEND MODERNIZATION OPTIONS CONSIDERED AND RELATIVE CPVRR SAVINGS WITHOUT EMISSIONS COST SAVINGS



CPVRR BY COMPONENT FOR BIG BEND MODERNIZATION

Staged Modernization with 600 MW of Solar - July 2017 Fuel & Load

Revenue Requirements (2017 $000)	Reference BB 1 - 4 on Coal with 600 MW of Solar	Staged Modernization with 600 MW of Solar	Delta
Capital RR - Other New Units	2,528,860	2,750,787	221,927
VOC - Existing Units	447,343	349,202	(98,141)
VOC - Future Units	112,190	274,192	162,003
FOM - Future Units	136,385	186,800	50,415
System Fuel	12,900,671	12,669,994	(230,678)
System Capacity	19,273	20,276	1,003
RR of BB1 to 4 Capital Additions - OEOL	1,320,614	903,088	(417,526)
Big Bend FOM	1,693,215	1,257,056	(436,160)
Big Bend Return on Rate Base - OEOL	1,201,896	1,201,896	-
Big Bend Depreciation - OEOL	717,504	717,504	-
RR of Land for Solar	118,896	118,896	-
Sub Total w/o NO_X or CO_2 Cost	21,196,849	20,449,692	(747,157)
Plus NO_X Cost	77,704	56,457	(21,246)
Plus CO_2 Cost	980,611	893,787	(86,824)
Total w/ NO_X & CO_2 Cost	22,255,164	21,399,936	(855,228)

CPVRR BY COMPONENT FROM BIG BEND UNIT 3 EARLY RETIREMENT

Big Bend 3 Early Retirement Analysis Summary

Revenue Requirements (2019 $000)	Reference Case BB3 on Coal Starting in 2024 until OEOL	BB3 Early Retirement in 2023	Delta
Capital RR - Other New Units	3,845,187	3,845,187	-
System VOM	596,965	586,959	(10,007)
FOM - Future Units	662,078	662,078	-
System Fuel	9,998,743	9,984,971	(13,772)
System Capacity	-	-	-
RR of BB3 Capital Additions	170,503	9,960	(160,543)
Big Bend FOM	808,679	694,298	(114,381)
Big Bend Return on Rate Base	1,105,197	1,105,197	-
Big Bend Depreciation	756,868	756,868	-
RR of Land for Solar	94,380	94,380	-
Sub Total w/o NO_X or CO_2 Cost	18,038,600	17,739,898	(298,703)
Plus NO_X Cost	5,095	5,095	-
Plus CO_2 Cost	939,287	915,720	(23,567)
Total w/ NO_X & CO_2 Cost	18,982,982	18,660,712	(322,269)

Notes:
- 2020 TYSP Expansion
- Summer 2020 Fuel and Load Forecast (2021 GFI)
- Reference case is BB3 on gas until end of 2023, coal starting in 2024 until original end of life in 2041