Matthew R. Bernier
Associate General Counsel

September 26, 2019

**VIA ELECTRONIC FILING**

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

Re: *Fuel and purchased power cost recovery clause with generating performance incentive factor; Docket No. 20190001-EI*

Dear Mr. Teitzman:

On behalf of Duke Energy Florida, LLC ("DEF"), please find enclosed for electronic filing in the above referenced docket DEF's redacted Rebuttal Testimony of Jeffrey Swartz and redacted Exhibit Nos. ___(JS-2), __(JS-3) and __(JS-4).

Thank you for your assistance in this matter. Please feel free to call me at (850) 521-1428 should you have any questions concerning this filing.

Respectfully,

*s/Matthew R. Bernier*

Matthew R. Bernier
Matt.Bernier@duke-energy.com

MRB/mw
Enclosures

# CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true and correct copy of the foregoing has been furnished via electronic mail this 26th day of September, 2019, to all parties of record as indicated below.

*s/Matthew R. Bernier*
Attorney

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| Suzanne Brownless<br>Office of General Counsel<br>FL Public Service Commission<br>2540 Shumard Oak Blvd.<br>Tallahassee, FL 32399-0850<br>sbrownle@psc.state.fl.us<br><br>J. Beasley / J. Wahlen / M. Means<br>Ausley McMullen<br>P.O. Box 391<br>Tallahassee, FL 32302<br>jbeasley@ausley.com<br>jwahlen@ausley.com<br>mmeans@ausley.com<br><br>Steven Griffin<br>Beggs & Lane<br>P.O. Box 12950<br>Pensacola, FL 32591<br>srg@beggslane.com<br><br>Russell A. Badders<br>Gulf Power Company<br>One Energy Place<br>Pensacola, FL 32520<br>russell.badders@nexteraenergy.com<br><br>Holly Henderson<br>Gulf Power Company<br>215 S. Monroe St., Ste. 618<br>Tallahassee, FL 32301<br>holly.henderson@nexteraenergy.com<br><br>Kenneth A. Hoffman<br>Florida Power & Light Company<br>134 W. Jefferson Street<br>Tallahassee, FL 32301-1713<br>ken.hoffman@fpl.com<br><br>Jon C. Moyle, Jr.<br>Moyle Law Firm, P.A.<br>118 North Gadsden Street<br>Tallahassee, FL 32301<br>jmoyle@moylelaw.com<br>mqualls@moylelaw.com | J.R. Kelly / P. Christensen / T. David / S. Morse<br>Office of Public Counsel<br>111 W. Madison St., Room 812<br>Tallahassee, FL 32399-1400<br>kelly.jr@leg.state.fl.us<br>christensen.patty@leg.state.fl.us<br>david.tad@leg.state.fl.us<br>morse.stephanie@leg.state.fl.us<br><br>Ms. Paula K. Brown<br>Regulatory Affairs<br>Tampa Electric Company<br>P.O. Box 111<br>Tampa, FL 33601-0111<br>regdept@tecoenergy.com<br><br>Maria Moncada / Joel Baker<br>Florida Power & Light Company<br>700 Universe Blvd. (LAW/JB)<br>Juno Beach, FL 33408-0420<br>maria.moncada@fpl.com<br>joel.baker@fpl.com<br><br>James Brew / Laura Wynn<br>Stone Law Firm<br>1025 Thomas Jefferson St., N.W.<br>Suite 800 West<br>Washington, DC 20007<br>jbrew@smxblaw.com<br>law@smxblaw.com<br><br>Mike Cassel<br>Florida Public Utilities Company<br>1750 S. 14th Street, Suite 200<br>Fernandina Beach, FL 32034<br>mcassel@fpuc.com<br><br>Beth Keating<br>Gunster, Yoakley & Stewart, P.A.<br>215 South Monroe Street, Suite 601<br>Tallahassee, FL 32301<br>bkeating@gunster.com |

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

REBUTTAL TESTIMONY OF

JEFFREY SWARTZ

ON BEHALF OF

DUKE ENERGY FLORIDA

DOCKET NO. 20190001-EI

September 26, 2019

**Q. By whom are you employed and in what capacity?**

A. I am employed by Duke Energy Florida ("DEF" or the "Company") as Vice President – Generation.

**Q. Have you previously filed testimony in this docket?**

A. Yes, I filed testimony related to the February 2017 outage of the Bartow Combined Cycle ("Bartow CC") Steam Turbine ("ST") in this docket on March 1, 2019. Additionally, in last year's docket I filed testimony and sponsored DEF's Root Cause Analysis ("RCA") regarding the same outage, which was attached to my testimony as Exhibit No. __(JS-1). This exhibit was then incorporated by reference into my March 1, 2019 testimony in the present docket.

**Q. Have your duties or responsibilities with the Company changed since you last filed testimony in this docket?**

A. No.

**Q. What is the purpose of your testimony?**

A. The overall purpose of my testimony is to rebut OPC witness Polich's incorrect conclusion regarding the root cause of the L0 blade failures. DEF acted prudently at all times with respect to the operation of the Bartow plant. I will clearly articulate why the Commission should reject Mr. Polich's argument that DEF should bear any replacement power costs related to either the Spring 2017 outage or operation of the Bartow plant with pressure plates in place of the L0 blades in the steam turbine.

**Q. Please provide a summary of your testimony.**

A. The Commission should reject Mr. Polich's opinion as to the cause of the steam turbine ("ST") blade failures because he disregarded or ignored key information. Specifically, he only considered operating conditions for the Period 1[1] failure and disregarded key facts obtained from later operating periods that contradict his ultimate opinion. As my rebuttal testimony and exhibits demonstrate, DEF operated the Bartow unit at all times within the operating parameters set forth by the steam turbine Original Equipment Manufacturer ("OEM").[2] After DEF initially discovered damage to the L0 blades, it consulted with the OEM and [redacted]. Mr. Polich ignores the fact that the [redacted]

[1] My testimony refers to various periods of operation, which are set forth in my Exhibit No. __ (JS-2), Table A.
[2] The OEM for the Bartow CC ST is Mitsubishi Hitachi Power Systems ("MHPS"). I will use "OEM" and "MHPS" in this testimony interchangeably.

[redacted][3] The basis for his opinion appears to be an earlier root cause analysis that was prepared without the benefit of the additional information learned from continued operation of the unit in later periods. Mr. Polich then concludes:

> If DEF had operated the ST at BCC in accordance with design output of 420 MW or less, I believe there is no engineering basis to conclude that the original L0 blades would not still be in operation today. Likewise, DEF would not have needed to undertake any of the subsequent outages to repair L0 blades, including the outage in February 2017 to replace the L0 blades with the pressure plate. Consequently, the BCC ST would currently be capable of producing its full output of 420 MW instead of being derated to 380 MW and operating with a less-than-optimal pressure plate.[4]

These statements completely fail to account for subsequent failures that occurred without the ST being operated over, or even at, 420 MW of output. Contrary to Mr. Polich's suggestion, it is evident that DEF operated the machine prudently at all times and made a prudent decision to install the pressure plate in the spring of 2017 to allow for event-free operation while a long-term path forward could be designed, tested, and implemented. For those reasons, the Commission should reject Mr. Polich's contention that DEF should not be permitted to collect the replacement power costs incurred as a result of the 2017 outage and operation with the pressure plate and should approve DEF's recovery of its costs as presented in its petitions and testimony in this docket.

**Q. Are you sponsoring any exhibits?**

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[3] DEF's "operation of the BCC ST beyond the ST's 420 MW design" caused the first blade failure. Polich Testimony, pg. 7, ll. 15-16.
[4] *Id.* at pg. 8, ll. 11-18.

A. Yes. I am sponsoring:

- Exhibit No. __ (JS-2) – *Exhibit No. __ (JS-1) Revised as to Confidentiality Only (Confidential)*;
- Exhibit No. __ (JS-3) – *Duke Energy Bartow ST 40" Upgrade Blade Test in Takasago Validation Rigor at MHPS (Confidential)*; and
- Exhibit No. __ (JS-4) – *Bartow RCA Summary, Sept. 22, 2017 (Confidential).*

**Basic ST Operation**

**Q. Based on Mr. Polich's testimony, do you believe he understands how DEF controls the Bartow ST during operation?**

A. No, his testimony shows that he focuses on the MW output of the machine as the control mechanism, where in practice the output is simply the byproduct of operating the unit within the design parameters provided by the OEM. At multiple times in his testimony, Mr. Polich discusses the nominal nameplate rating of the Bartow ST (420 MW) as a "design output" or "design condition"[5] and indicates his belief that the 420 MW nameplate represents the unit's "maximum gross output."[6] However, thinking of the operating parameters of a ST solely in terms of MW output is either an over-simplification or miscomprehension of the true operating parameters of the unit and/or the myriad variables that can impact the unit's output. Despite the fact that Mr. Polich

[5] *See e.g., id.* at p. 8, l. 12; p.8, l. 10 ("generated output above the 420 MW design conditions"); p. 7, ll. 15-16 (noting the "ST's 420 MW design."); p. 8, l. 23--p. 9, l. 1 ("manufacturer's 420 MW design conditions."); p. 10, ll. 6-7 ("The ST was designed to produce 420 MW gross generation.").
[6] *Id.* at p. 12, l. 13.

indicates his awareness of the true design conditions that govern use of the ST,[7] he, nonetheless, returns to the erroneous conclusion that the nameplate capacity is a "maximum" output threshold that cannot be breached.[8] In actuality, the nameplate capacity is simply the OEM's expected output resulting from the operational parameters and other assumed values for variables that are given to fluctuation (such as ambient temperature, humidity, temperature of cooling water, etc.), not a design basis criteria for operating the ST.[9]

**Q. If the ST operating parameters are not centered on its output. what are the operating parameters established by the OEM for the Bartow ST?**

A. When the ST was commissioned in 2009, the operating parameters were established by the Mitsubishi ST operating manual as related to steam flow through the ST. When DEF realized that operating parameters allowed for additional steam to flow through the ST, resulting in additional megawatts for DEF's customers while staying within those parameters, DEF started increasing the steam flow through the ST staying within the known operational parameters. After the [redacted].

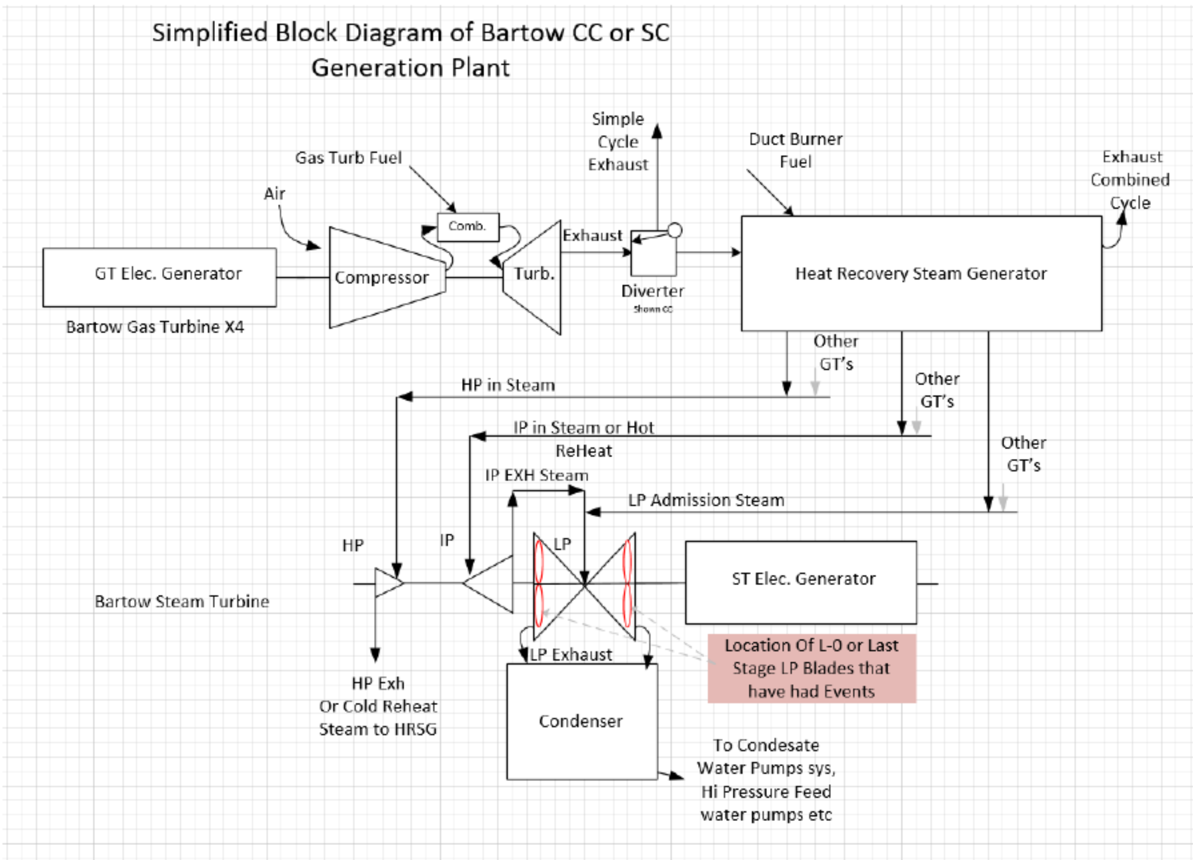
[7] *See id.* at p. 11, ll. 11-17.

[8] *See id.* at p. 12, ll. 17-19.

[9] Considering Mr. Polich's position that the ST had a MW output maximum that could not be breached without risking damage to the unit, it is noteworthy that he does not assign a similar "absolute maximum" to the other components of the Bartow CC. *See id.* at p. 9, ll. 21-22 (noting the "Non-steam augmented power output of each CT is in the range of 180 MW."); p. 10, ll. 9-10 (noting the "generator output appears to have an upper gross generation limit of about 465 MW at a 0.95 power factor . . . ").

[redacted]

For the time-period that the Bartow ST has been operating with the installed pressure plate, [redacted]




**Q. Did DEF operate the Bartow ST within the operating parameters established by the OEM?**

A. Yes. Starting with commissioning and Period 1, DEF has followed all the known operational limits for the steam turbine. Post-Period 1, DEF has made every reasonable attempt to maintain the LP inlet pressure limit in place for the given Period. [redacted]

[redacted] but operators adjusted the CTs and HRSG duct burner outputs to minimize time in the zone as they strove to maintain a high output and benefit from the steam turbine without compromise to the LP turbine. MHPS's instructions on time in the [redacted]

**Q. If the plant operators do not control the ST by trying to reach a given level of MW output, how is the unit controlled?**

A. The ST is "controlled" by adjusting the output of the four combustion turbines ("CTs"). For example, in a 1x1 configuration (one CT and heat recovery steam generator ("HRSG") providing steam to the ST), the ST would receive enough steam to produce approximately 100 MW; in a 2x1 configuration, the ST would receive the steam

[10] The chart titled "Excessive Steam Flow" found in Appendix B of Exhibit No. __ (JS-2), shows the hours the unit was operated in the [redacted] for the respective Periods.

equivalent to approximately 200 MW; in a 3x1 configuration, the ST would produce about 300 MW; and for 4x1 configuration, the ST would produce about 400 MW. In order to produce more megawatts, the auxiliaries (duct burning and Power Augmented Steam ("PAG")) would be used. These auxiliaries are described in more detail below.

The ST is a follower much like a trailer follows a truck. In this example, the trailer can only go as fast as the truck that is pulling it and can only turn if the truck makes a turn. The four CTs exhaust into their respective HRSGs, the four HRSGs produce steam for the three sections of the ST. The HRSG produces high pressure ("HP") steam, intermediate pressure ("IP") steam, and low pressure ("LP") steam. The HP steam enters the HP section of the ST, the IP steam enters the IP section of the ST, and the LP steam in the HRSG enters the LP section of the ST. The LP section of the ST also receives exiting steam from the IP section of the turbine. During the commissioning process, the ST is "matched" with the three steam pipes (HP, IP, LP) coming from the four HRSGs to produce the output of the machine in Megawatts. The output of the ST in megawatts is a product of the steam pressure and flow. If the operator wants to reduce the steam pressure and flow through the ST (i.e., to produce less Megawatts), the operator reduces the CTs' output and thus the steam passing through the ST (and the megawatts produced) is reduced after a short lag in time for the energy to dissipate. The operator can also produce more output from the ST by adding duct burning within the HRSGs to produce more heat and therefore steam that is ultimately passed through the ST. The operator can also use PAG, another auxiliary, to produce more output from the power block. At first, PAG actually extracts steam from the IP section of the ST using the steam in the CTs like a supercharger in a car and raising the output of the CT generators. If the operator uses PAG, the output of the ST is initially reduced until duct burning is introduced to produce more steam in the HRSG to send to the ST, raising the output of the ST generator.

The ST has two (2) High Pressure stop valves and two (2) Control Valves. When the ST is online and steady state, all four (4) of these valves are open and stay open – no matter what configuration the station is operating in (i.e., 4x1, 3x1, 2x1, or 1x1). A combined cycle plant does not modulate its control valves to limit ST load, the control valves are only used in startup or shutdown to maintain system pressure above a minimum value. There are two automatic sub-systems associated with the ST to prevent too much steam from entering any of the sections of the ST (HP, IP, and LP): the “sky vents” and the condenser bypass system. The sky vents are located on the top of the HRSGs, and they sense pressure in the HRSG and can release steam from the HRSG in the event pressure rises above its setpoint. Use of the sky vents only occurs during an emergency or unit startup. The condenser bypass system is an automatic system designed to blend the HRSGs into and out of the ST. As the name suggests, the condenser bypass system takes steam from the HRSG and, instead of the steam entering the ST, it bypasses the ST and feeds directly into the condenser. The steam path described here can be traced through the diagram attached to Mr. Polich’s testimony as Exhibit No. __ (RAP-3).

In summary, the operator controls the CTs and the output of the CTs determine the output of the ST. The operator's job is to make sure that the ST is operating as efficiently as possible, producing the most output for our customers as possible, within the steam pressure and flow limits (operating parameters) established by the OEM.

**Prudent Operation of the Bartow CC for DEF's Customers**

**Q. Is the distinction between operating to achieve a desired MW output as Mr. Polich describes and following the operating guidelines as you are describing important?**

A. Yes, it is important because operating with an eye to the proper operating conditions allows an operator to maximize a unit's efficient output for customers. As Mr. Polich notes, the Bartow CC is one of the most efficient and lowest-cost generation units in DEF's generation fleet. Therefore, it is prudent for DEF to maximize its output for customers' benefit, so long as the operating conditions prescribed by the OEM are complied with. Hence, when DEF became aware the unit was not being maximized according to the OEM's operating pressure, steam flow, and temperature guidelines, the prudent course of action for the Company was to bring the unit's operation into line with those guidelines – regardless of whether DEF was achieving the nameplate output previously.

If DEF were to operate the Bartow ST, or any other unit, according to Mr. Polich's concept of never breaching the nameplate "maximum" output, its customers would potentially experience higher costs. A simple way to illustrate the point is to consider winter versus summer operation. Due to cooler temperatures and denser, heavier air conditions, a given unit can produce more MWs of output during the winter while operating within the same parameters as summer operation. Following Mr. Polich's logic, if DEF operated the unit during the winter without changing any of the operation parameters (e.g., no additional steam is being produced and put through the machine) and the output increased from 419 MW to 421 MW,[11] DEF would be required to "back off" operations in order to get the unit's output down below nameplate capacity; this would "cost" customers the opportunity to receive the otherwise free differential in output and would run counter to the goals of maximizing efficiency and value to customers.

**Q. Did DEF's customers benefit from the Bartow ST producing more than 420 MW during Period 1?**

A. Yes. When the Bartow ST was generating more than 420 MW during Period 1, it logically would have been dispatching in higher economic order than other generation. Accordingly, DEF avoided operating or buying more expensive generation, and DEF's customers received the benefit of this lower-cost power generation. This is of course how DEF should operate its generating fleet, as I describe above. In general, if DEF were to operate its fleet in the manner described by Mr. Polich, DEF would not be allowed to operate its units, including Bartow CC, in the most efficient manner. This would result in higher energy costs for DEF's customers due to the need to generate or

[11] Although in this example, the hypothetical increase in output for the ST during winter operation is set at 2 MW, in practice winter operations with no change in operation parameters can result in an approximate 95 MW increase for the Bartow CC, with approximately 15 MW of the increase attributed to the ST.

purchase higher cost energy, which is currently being served through lower-cost efficient unit operation.

**<u>Root Cause of the L0 Blade Failure</u>**

**Q. If the LO blade failures were not caused by operation of the unit beyond 420 MW, what was the cause?**

A. As explained in my previous testimony and more thoroughly in Exhibit No. __ (JS-1) and Exhibit No. __ (JS-2), the root cause of the blade failures, including the Period 1 failure Mr. Polich focused on in his testimony, was the [redacted], as seen on page 12 of my Exhibit No. __ (JS-4). Said differently, the [redacted]. I suspect that one of the reasons Mr. Polich reached his conclusion, which disregards the information gleaned from later operating periods, is because he chose to focus solely on Period 1 operation and he relied on early RCAs provided by the OEM rather than later-produced documents that benefited from this additional information such as DEF's RCA (Exhibit

No. __ (JS-2)) and MHPS' confidential documents, attached as Exhibit Nos. __ (JS-3) and (JS-4). As can be seen from Exhibit No. __ (JS-3), MHPS recognized that its early RCAs did not identify the correct root cause of the damage. MHPS states [redacted]

**Q. Why is the later-Period operating information important to understanding what occurred in earlier Periods?**

A. Because as DEF and the OEM moved through the operating periods and learned more information, the information and conclusions derived were incorporated into later [redacted] At multiple times in his testimony, Mr. Polich states a variant of his conclusion: "If DEF had operated the ST at BCC in accordance with the design output of 420 MW or less, I believe there is no engineering basis to conclude that the original L0 blades would not still be in operation today."[13] Indeed, Mr. Polich opined that DEF had not "demonstrated that the original

[12] Exhibit No. __ (JS-3), page 2, bullets 2 & 3.

[13] Polich Testimony, p. 8, ll. 11-13; *see also id.* at p. 22, ll. 11-13 ("DEF has failed to demonstrate that had it operated the ST within original design conditions the original blades would still be in operation."); *infra* note 8.

L0 blades would have experienced even minimal degradation" had the unit been operated "at or below the original design output of 420 MW."[14]

These statements, and the general conclusion he reaches in his testimony, are conclusively refuted by the Period 5 operating experience. As shown on Exhibit No. __ (JS-2), specifically Table A on page 5 of 18, in Period 5 the ST was operated with the same [redacted] The contrast between the results found in the two Periods shows why Mr. Polich's conclusion is inaccurate. In Period 1, DEF operated the Bartow unit from June 2009 to March 2012 according to the OEM's original operating conditions (steam pressures, flows, and temperature – not to a maximum MW output), and as Mr. Polich points out, the unit achieved as much as 457.6 MW[15] before DEF discovered blade damage in 2012. In Period 5, DEF operated the Bartow unit [redacted], specifically a [redacted],[16] that resulted in the ST achieving a maximum of 402.1 MW of output.[17] Nonetheless, even with the [redacted], the blades failed after only 1,561 hours of operation leading to the February 2017 outage.[18]

This information is crucial to understanding the root cause of the failures, including the Period 1 failure. As noted above, during both Periods 1 and 5 the ST operated with the

[14] *See id.* at p. 21, ll. 16-18.
[15] *See id.* at p. 15, l. 21; Exhibit No. __ (RAP-5).
[16] Exhibit No.__ (JS-2), Table A.
[17] Exhibit No. __ (RAP-5).
[18] Exhibit No. __ (JS-2), Table A.

[redacted]

Simply put, Mr. Polich's contention that the [redacted] blades from Period 1 would still be in operation, without even minimal degradation, had DEF only operated the unit at or below 420 MW of output and that "all subsequent outages and derates since 2012 have their origin in the operation of the ST in excess of 420 MWs"[21] has been conclusively refuted by the Period 5 experience – Mr. Polich may not "believe there is [any] engineering basis to conclude" otherwise, but the facts and experience gained in Period 5 cannot be ignored.

**Q. Mr. Polich also contends, based on his conclusion that DEF's operation of the ST caused the original failure, that "all subsequent outages and derates since 2012 have their origin in the operation of the ST in excess of 420 MW." Do you agree with this statement?**

A. No. As discussed above, this is contradicted by the evidence of the later-Periods. However, if one were to assume for the sake of argument that Mr. Polich is correct, and DEF improperly operated the machine leading to the 2012 failure, that would not

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[19] *See* Exhibit No. __ (RAP-8), page 4 of 12, for an explanation on the [redacted]. Contrary to the assertions in Mr. Polich's testimony, *see, e.g.,* p. 22, l. 15, [redacted] were never installed in the Bartow ST. *See* Exhibit No. __ (JS-2), Table A or Exhibit No. __ (RAP-7), page 3 of 16, for discussions of the [redacted]

[20] *See* note 8, *supra*.

[21] *See* Polich Testimony, p. 22, ll. 10-11.

establish a causal link between the original blade failure and subsequent outages – nor does Mr. Polich suggest one. Rather, he offers a conclusory statement that ignores everything that occurred from Period 2 forward. In Periods 2-5, DEF operated the unit according to the OEM's [redacted] Mr. Polich does not attempt to challenge these facts, rather he falls back on the logical fallacy of "because the later events followed the first, the first event must have caused them."

Therefore, even if the Commission were to determine Mr. Polich was correct regarding operation of the unit in Period 1, he has provided no basis to conclude and it does not logically follow that the remaining outages and derates were caused by, or naturally flow from, that event.

**Q. Are there other areas of Mr. Polich's testimony, beyond his conclusion regarding the root cause of the failures, where you disagree?**

A. Yes. I disagree with Mr. Polich's contention that DEF was somehow required to, or imprudent not to, discuss its operation of the Bartow ST with the OEM, specifically regarding the MW output being achieved. As discussed herein, Mr. Polich's focus on this lack of communication is a symptom of his focus on the nameplate rating as a "maximum" output and failure to accept that units such as the Bartow ST are operated based on steam pressures and flows, which is standard industry procedure, and that the output is simply a byproduct of that operation. With that understanding, it becomes clear that no communication with the OEM regarding output was warranted or to be expected for normal operations within the operating parameters. [redacted]

I also disagree with Mr. Polich's speculative assertion that "[i]f DEF had discussed operation of the ST above 420 MW with MHPS prior to the initial operation at higher load, the problems encountered with the ST at BCC likely would have been avoided."[22] In order to make this assertion, Mr. Polich has to assume a number of premises that are either dubious or, given the experience of Period 5, we know to be outright wrong. [redacted]. Second, assuming DEF determined from that communication that operation of the ST needed to be curtailed, the experience of Period 5 cannot be ignored: operation at reduced steam flows and pressures resulted in significant blade damage and the February 2017 outage.

**<u>Installation of the Pressure Plates</u>**

**Q. Are there any other areas of Mr. Polich's testimony with which you disagree?**

[22] Polich Testimony, p. 22, l. 22 – p. 23, l. 1.

A. Yes, I disagree with the assertion that operation of the ST with the pressure plates installed has truly resulted in any lost MW when compared to the results achieved prior to their installation. After the February 2017 outage, DEF worked with the OEM to identify and implement an interim solution that would allow the ST to resume operation, ultimately resulting in the installation of a pressure plates in place of the L0 blades on March 22, 2017. The plates allow the ST to operate, thus increasing the energy output of the Bartow CC above what was possible in simple cycle mode while a long-term path forward could be designed, tested, and implemented.

[redacted], [redacted]

I believe DEF's decision to install the plates was prudent at the time it was made, and I think the results have benefitted customers as opposed to causing additional costs due to downtime from further L0 blade issues or potential catastrophic failure. Therefore, I do not believe the Commission should order a refund of any costs incurred due to operations after the plates' installation.

**Q. Mr. Polich has calculated replacement power costs that he contends should be refunded to customers due to operation of the Bartow CC with the pressure plates. Do you agree with his calculation?**

A. Setting aside my belief that DEF's prudent actions should not result in a refund of replacement power costs, if the Commission were to order a refund of replacement power costs due to operation of Bartow CC with the pressure plates, I disagree with Mr. Polich's inflated calculations.[23] He contends that operation of the ST from April 2017 through August 2019 has cost customers approximately $5.74M.[24] In response to a discovery request from OPC, DEF calculated the actual replacement power costs for the MWh's not produced at Bartow for the period (owing purely to the derate, ignoring the question of prudence) of $1,168,613.

Based on DEF's analysis of his calculation as he described his method,[25] and using the values he included in Exhibit No. __ (RAP-9), DEF has identified a number of issues that Mr. Polich's analysis fails to capture. For example, his analysis appears to fail to consider what configuration the Bartow CC was operating in at a given time, potential system constraints impacting dispatch of the unit (including transmission reliability restrictions),[26] ambient temperature conditions, plant conditions such as feedwater

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[23] On page 25, lines 10-17, Mr. Polich describes a situation where DEF showed no replacement power costs for an 11-hour window on June 1, 2017. DEF believes Mr. Polich was referring to July 1, 2017, as the other metrics he cites align with that date.

[24] $2,005,536 (2017) + $2,545,049 (2018) + $1,189,552 (2019) = $5,740,137. *See id.* at p. 27, ll. 5, 12, & 20. It should also be noted that Mr. Polich stated Mr. Menendez's testimony in Docket No. 20180001-EI provide the costs of the 2017 Spring outage at $11.1M – this is the system number; the retail portion of the total costs is approximately $11.0M. *See* Document No. 07025-2018, Docket No. 20180001-EI, at p. 7, ll. 1-2.

[25] *See* Polich Testimony, p. 24, ll. 1-20.

[26] For example, there was no replacement power purchased on July 1, 2017 (discussed on page 25 of Mr. Polich's testimony) because the unit was not being dispatched high enough in the order to require replacement power.

limitations and any other environmental limits, to name a few. Failure to account for these additional factors results in an artificially high estimate of the replacement power costs for the MWh's not produced at Bartow. Therefore, DEF's estimate of replacement power costs, which takes into consideration these factors, is a more accurate estimate.

**Q. Does that conclude your testimony?**

A. Yes.

## Executive Summary

Over the past 3 plus years, Duke Energy Florida LLC (Duke), at times working independently and at times together with Mitsubishi Hitachi Power Systems (MHPS), undertook a root cause analysis (RCA) of the cause(s) for the Unit 4S L-0 blade cracks and failures that occurred during normal station operations at Bartow Station. [redacted]

REDACTED

[redacted]

## Historical Overview

Bartow is a 4x1 CC Station with a steam turbine (ST) manufactured by MHPS. The ST was purchased from Tenaska Power Equipment, LLC (Tenaska) which intended to use it for a 3x1 CC with a gross output of 420MW. The ST was never delivered to Tenaska and remained with MHPS in a warehouse in Japan until Duke purchased the unit in 2006.

[redacted]

Before the ST was purchased by Duke, Duke contracted with MHPS to evaluate the ST design conditions and to update heat balances for a 4x1 CC configuration. MHPS updated the heat balances for use in a 4x1 CC configuration. CC units blend steam from the combustion turbines (CT) as they start-up and/or shut-down with steam to the ST. These blending events, which are a common occurrence for CC units, result in brief periods of higher steam temperatures and flows into the condenser near the ST L-0 blades.

Since commissioning of the Bartow ST in 2009, there have been five (5) events involving L-0 blade failures and/or replacements as described, below.

Each 40" MHPS steel blade is twisted with a "root end" that connects it to the hub, a snubber at the mid-point or mid-span, and a shroud with airfoil tips at the top. While the ST spins up to its operating speed of 3600rpm, each blade elongates and starts to untwist. The snubbers and airfoil tips are designed to contact each other and create a stabilizing central and outer ring. [redacted]

REDACTED

[redacted]

REDACTED

## Table A: Bartow L-0 Events Summary

| | Period 1 | Period 2 | Period 3 | Period 4 | Period 5 |
|---|---|---|---|---|---|
| Date | June 2009 to March 2012 | April 2012 to August 2014 | December 2014 to April 2016 | May 2016 to Oct 2016 | December 2016 to February 2017 |
| Service Duration | ~34 Months | ~28 Months | ~17 Months | ~5 Months | ~2 Months |
| [redacted] | | | | | |
| Information Shared with MHPS | Duke provided all requested PI data. | Duke provided all requested PI data. | Duke provided all requested PI data. | Duke provided all requested PI data. | Duke provided all requested PI data. |

[redacted]

REDACTED



[redacted]

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[redacted]

[redacted]

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[redacted]

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[redacted]

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[redacted]

REDACTED

[redacted]

REDACTED

[redacted]

REDACTED

[redacted]

[redacted]

CONCLUSION:

[redacted]

[redacted] This RCA report is Duke's product and presents its view of the root cause based on all inputs received.

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[redacted]

REDACTED



[redacted]

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Duke Energy Florida
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Exhibit No. ___(JS-3)

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**Pages 1 through 22 are confidential in their entirety.**

Docket No. 20190001
Duke Energy Florida
Witness: Swartz
Exhibit No. ___(JS-4)

# REDACTED

**Pages 1 through 35 are confidential in their entirety.**