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CONFIDENTIAL

STATE OF FLORIDA
DIVISION OF ADMINISTRATIVE HEARINGS

IN RE: FUEL AND PURCHASED POWER COST RECOVERY CLAUSE WITH GENERATING PERFORMANCE INCENTIVE FACTOR,

Petitioner, Case No. 19-6022
20190001-EI

VS.

*,

Respondent.
_____/

CONFIDENTIAL PROPOSED RECOMMENDED ORDER OF THE OPC, PCS PHOSPHATE - WHITE SPRINGS AND THE FLORIDA INDUSTRIAL POWER USERS GROUP

An administrative hearing was conducted in this case on February 4-5, 2020, in Tallahassee, Florida before Lawrence P. Stevenson, an Administrative Law Judge with the Division of Administrative Hearings.

APPEARANCES

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STATEMENT OF THE ISSUES

This matter concerns costs incurred by Duke Energy Florida ("DEF" or "Duke") as a result of equipment failures and outages that occurred at DEF's Bartow combined cycle generating plant ("Bartow," or the "Plant"). The Florida Public Service Commission

("Commission" or "PSC"), the referring agency, identified the issues as Issues 1B and 1C in FPSC Docket No. 20190001-EI.

> Issue 1B is: "Was DEF prudent in its actions and decisions leading up to and in restoring the unit to service after the February 2017 forced outage at the Bartow plant and, if not, what action should the Commission take with respect to replacement power costs?"

The resolution of Issue 1B requires a determination of whether any action or inaction by DEF contributed to or resulted in replacement power costs DEF seeks to recover herein.

> Issue 1C is: "Has DEF made prudent adjustments, if any are needed, to account for replacement power costs associated with any impacts related to the de-rating of the Bartow plant? If adjustments are needed and have not been made, what adjustment(s) should be made?"

The resolution of Issue 1C turns on whether DEF met its burden of proof to demonstrate that DEF should recover the additional replacement power costs resulting from the ongoing 40 megawatt ("MW") reduction in output of Bartow Unit 4's Steam Turbine ("ST"). These issues are considered herein as the "Bartow issues."

PRELIMINARY STATEMENT

This matter arises from a fuel cost recovery clause proceeding currently pending before the Commission as FPSC Docket No. 20190001-EI ("Fuel Clause"). The Fuel Clause is a recurring, annual docket to which all investor-owned electric utilities serving customers in the state of Florida are parties. Through the Fuel Clause, utilities are permitted to recover reasonably and prudently incurred fuel costs. In the 2019 Fuel Clause, several

issues were raised and decided by the Commission. The Commission, however, did not address the Bartow issues at its 2019 Fuel Clause hearing, due to numerous claims of confidentiality with respect to the pre-filed testimony and exhibits of DEF witness Jeffrey Swartz and the Office of Public Counsel ("OPC") witness Richard Polich, as well as the proposed exhibits included on the parties' Comprehensive Exhibit List ("CEL").[1]

Due to the extensive and essential nature of the materials claimed by DEF and designated by the Commission as confidential, the Commission asserted it was impracticable to conduct direct or cross-examination before the Commission without extensive reference to confidential material. Pursuant to Section 366.093, F.S., the Commission has the statutory authority to declare documents confidential. The Commission asserts that it lacks authority to close a public hearing for conducting direct or cross-examination of witnesses for any reason, including to protect materials and topics it previously determined to be confidential. The Division of Administrative Hearings ("DOAH") is authorized to close a hearing to, among other reasons, preserve confidentiality. Consequently, Commission Chairman Graham requested this matter be referred to DOAH for an evidentiary hearing and issuance of a Recommended Order addressing the Bartow issues.

[1] OPC took no position as to the claim of confidentiality and continues to take no position as to confidentiality herein.

The Commission opened FPSC Docket No. 20190001-EI on January 2, 2019, and issued an order establishing procedure on February 13, 2019. The Commission held a prehearing conference on October 22, 2019 and issued a Prehearing Order on October 31, 2019. The Bartow issues previously were deferred from the 2018 Fuel Clause docket by agreement of the parties pursuant to Order No. PSC-2018-0610-EI at 1, 15, issued on December 26, 2018. At a partial final hearing on November 5, 2019, the Commission heard and disposed of all issues identified in its October 31, 2019 Prehearing Order, except the Bartow issues. The Commission issued a partial Final Order, PSC-2019-0484-FOF-EI, on November 18, 2019.

On December 23, 2019, the PSC record was transmitted from the PSC Clerk to the DOAH Clerk on two discs. Disc One contained non-confidential information and Disc Two contained information considered confidential by DEF. In addition to numbering that previously may have been applied to the documents, the two volumes were Bates numbered sequentially in the lower right corner of each page.

DOAH conducted an evidentiary hearing on the Bartow issues on February 4-5, 2020. The parties submitted a Revised CEL.[2] Joint Exhibits 1 through 52 were offered and received into evidence.

[2] The CEL was identified and received as Exhibit 114.

DEF presented the testimony of Jeffery R. Swartz. DEF's Exhibits 2-9, 80-82, and 100 were received into evidence.

OPC presented the testimony of Richard Polich, P.E., an expert in design of power generation systems, steam turbine generators, power supply planning, generation support services, rates and regulatory consulting, and financial analysis. OPC's Exhibits 68-75 and 100-109, 115, 116, and 118 were received into evidence. PCS Phosphate's Exhibits 112 and 113 were received into evidence. Florida Industrial's Exhibit 118 was received into evidence. Ruling was reserved on relevance and hearsay objections to any exhibit. Those objections are overruled, and the exhibits are given due weight pursuant to the Florida Administrative Procedure Act and the Florida Evidence Code, as applicable.[3]

The Transcript of the final hearing (abbreviated as "Tr." herein, citation to page and lines in the format PP:LL) was filed on February 24, 2020.

All statutory references are to the 2019 codification of the Florida Statutes, unless otherwise indicated.

[3] Exhibits admitted at hearing will be referenced in the format "Ex. at ___" (and any exhibit-specific page numbering will be used, while the Bates numbered page references will be used if it is the only numbering available and then with only the page numbers to the right of the uniform numbering convention cited.)

The pre-filed testimony, the testimony at hearing, the exhibits and the parties' proposed recommended orders have been considered and given due weight.

FINDINGS OF FACT

The Parties

1. The PSC is the single state agency authorized to implement and enforce Chapter 366, Florida Statutes ("F.S."), the law governing the regulation of public utilities, as defined in Section 366.02(1), F.S.

2. Petitioner, DEF is a "public utility" as defined in Section 366.02(1), F.S., and is therefore subject to the Commission's jurisdiction under Chapter 366, F.S.

3. Intervenor, OPC, is statutorily authorized to represent the Citizens in matters before the PSC, and to appear before other state agencies in connection with matters under the jurisdiction of the PSC. § 350.0611(1), (3), and (5), Fla. Stat. (2019). OPC represents the customers of DEF. Those customers are and will be responsible for paying the rates charged by DEF and ultimately approved by the Commission through the Fuel Clause, including any replacement power costs that are not disallowed herein.

4. Intervenor, PCS Phosphate - White Springs ("PCS Phosphate"), operates energy intensive phosphate mining and processing facilities in Hamilton County and is among the largest industrial customers receiving service from DEF.

5. Intervenor, Florida Industrial Power Users Group ("Florida Industrial") is an association comprised of large commercial and industrial power users within Florida. A substantial number of Florida Industrial members receive service from DEF.

DEF's Bartow Unit 4

6. DEF's Bartow Unit 4, the unit in question, is a "4x1" Combined Cycle ("CC") power plant composed of four Combustion Turbine ("CT") generators whose waste heat is used to produce steam that powers the ST manufactured by Mitsubishi Hitachi Power Systems ("MHPS"). Tr. 42:3-4; 47:4-11.

7. Between June 2009 and March 2012, comprising Period 1, Bartow Unit 4 was DEF's only 4x1 CC power plant. Tr. 185:2-186:6; 242:13-19.

8. The Bartow Unit 4x1 configuration means that each of four 180 megawatts ("MW") Siemens Type 501 F CTs are connected to a respective Heat Recovery Steam Generator ("HRSG"). The four HRSGs supply steam to the single ST. It is not necessary for all four HRSGs to provide steam to the ST at the same time. In fact, to achieve varying power levels required for system needs, DEF regularly cycled the HRSGs to ramp production up or down. Tr. 47:4-17; 237:2-20; 322:14-19.

9. Steam leaving the HRSGs is introduced to the ST at a high-pressure inlet into a high pressure ("HP") turbine. After returning to the HRSG, the reheated steam then enters an intermediate

pressure ("IP") turbine, and steam exiting the IP turbine is directed into the low pressure ("LP") turbine. Tr. 381.8-13.

10. The LP section of the ST is a tandem compound design in which steam enters the center of the turbine, moves through two opposing turbine sections, each of which is comprised of 4 sets of blades, and then exhausts into a Condenser. The final sets or rows of blades are 40" L-0 blades. Tr. 324:1-6; Ex. 70.

11. Each 40" L-0 blade is twisted, with a "root end" that connects it to the hub, a snubber at the mid-point, and a "Z-lock" at the tip. As the ST spins up to its operating speed of 3600 rpm, each blade elongates and starts to untwist. The snubbers and Z-locks are designed to contact each other and create a stabilizing central and outer ring. If a snubber or airfoil tip fails, the blades can vibrate and cause failure. Tr. 50:3-51:20.

12. MHPS originally designed and constructed the ST for another plant and owner. MHPS designed the ST to be installed in a "3x1" configuration (i.e., steam from 3 HRSGs would feed into the ST). MHPS's assessment of the physical capabilities and production output at the time of the original design of the ST was premised on a 3x1 configuration. Tr. 329:16-330:4; Ex.80 at 2.

13. Prior to purchase, DEF contracted with MHPS to evaluate the ST design conditions for use in a 4x1 configuration. Tr. 42:8-9; 163:4-8; Ex. 80 at 3.

14. A "heat balance" is an engineering analysis that calculates the predicted performance of a power plant based on various ambient conditions and operating parameters. The heat balance predicts, based on a set of variables, the performance and output of power plant equipment, such as a steam turbine. Tr. 121:21-122:11, 126:4-5, and 132:14-6. Any change in a variable will result in a distinct "heat balance" and resulting expected plant output or performance. Tr. 127:3-10.

15. Through the process of purchase related to the MHPS Asset Sale Agreement No. 270810 and Contract No. 270810, Amendment No. 005 dated January 2, 2008 (collectively "Contract No. 270810"), MHPS provided DEF with operating limits for the ST, including pressure and temperature limits for the HP and IP sections of the ST. At the time of DEF's purchase in 2008, MHPS also provided DEF with the ST's design limit which MHPS established as a maximum electrical output of 420 MW. Tr. 137:9-13; 330:8-11; Ex. 109 at Bates 12432, 12438; Ex. 116 at 21.

420 MW is the Operational Limit of the Bartow Steam Turbine Established by the Manufacturer

16. Mitsubishi established that 420 MW was the "design point" of the ST that it sold to DEF under Contract No.270810. This design point also is referenced as the "Steam Turbine Maximum Electrical Output" in Contract No. 270810. MHPS later confirmed that 420 MW is the "Operational Limit" at which the "Bartow steam turbine was

designed to operate." Tr. 82:21-83:1; Ex. 116 at 4, 21; Ex. 109 at Bates 12432, 12438.

17. During the design, construction and planning process for Bartow Unit 4 in 2006, DEF's employees responsible for obtaining company approval to build the Bartow CC plant told senior executives (who were responsible for determining the funding for the overall Bartow CC project) that they had obtained or "found" an already constructed 400 MW steam turbine [the MHPS ST] to use with four CTs and four HRSGs. Tr. 116: 18-24; Ex. 105 at Bates 6875.

18. Prior to the Bartow plant's commissioning in 2009, MHPS gave DEF operation limits in the form of "a Heat balance diagram providing max operation (420 MW) thermal conditions." Tr. 137:9-13; Ex. 116 at 21.

19. In 2006, DEF's engineer responsible for the design of the Bartow Project produced 300 heat balances for the plant and in consultation with MHPS, established heat balance cases 28 (showing 392 MW output) and 48 (showing 420 MW output)as the ST guaranteed performance or "Reference Heat Balance Diagrams of Combined Cycle Operations" under Contract No. 270810. Ex. 108 at 2437 - 2561; Ex.109 at Bates 12438; Tr. 127:23-129:8; 128:3-19; 130:13 - 131:5.

20. Based on Heat Balance case 48, Contract No. 270810 established that the expected maximum electrical output of the steam turbine was 420 MW and in section 4.1 expressly stated that the "steam

turbine and its generator have been designed and manufactured under the conditions of these reference Heat Balance Diagrams. Any changes and/or modifications to this proposal must be carefully studied by both the Buyer and the Seller. Seller has a right to the [sic] reject any unacceptable changes and/or modifications against these reference Heat balance Diagrams." Ex. 109 at Bates 12432-12439.

21. Heat balance case 48 only has 3 of the Bartow CT and HRSGs in operation and shows the steam turbine to be producing 420 MW. Because DEF had a fourth CT (and fourth HRSG) at Bartow, the 4x1 configuration had 25% more steam available than the ST needed to produce 420 MW, when compared to the 3x1 application for which the ST was specifically designed. TR. 303:15-306:2; Ex. 108 at Bates 2461.

22. Contract No. 270810 demonstrates that DEF bought the ST "as is" and the record does not contain any evidence that DEF asked MHPS -- before purchasing the ST -- if the ST could produce more than 420 MW even though DEF knew the Bartow plant had sufficient steam available to power the MHPS ST beyond 420 MW. Ex. 109 at Bates 12438; Ex. 108 at Bates 2461.

23. The performance guarantee test performed in 2009 to determine whether MHPS owed DEF liquidated damages revealed the ST was nominally rated at 402 MW; however, the result was recalibrated to 420 MW and thus, MHPS was compliant with Contract No. 270810. DEF

accepted the ST as being designed and constructed in accordance with the contract requirements. Ex. 104 at 44; Tr. 137:16-20.

24. The record contains no evidence that, before purchasing the ST, and prior to placing the ST in operation, or prior to the March 2012 outage, that DEF asked MHPS to increase the design limit or design point of the ST above 420 MW.

25. The record contains no evidence that, prior to the installation and operation of the ST, DEF sought a reassessment of the conditions that would have been required to safely operate the ST above 420 MW.

26. The record contains no evidence that, prior to the installation and operation of the Bartow CC plant, DEF asked for MHPS to increase the expected maximum electrical output of the ST to a level above the ST's 420 MW design and operating point to accommodate the 25% more steam that was available with a fourth CT and HRSG.

27. The Bartow steam generator converts steam energy into rotational force (horsepower) that in turn drives an electric generator. (Tr. 320:18) The generator purchased by DEF for the Bartow CC plant that was attached to the MHPS ST was manufactured by a different vendor and is rated at 468 MW (Tr. 278:1-4). The generator thus was capable of reliably producing more electrical output than the ST was designed to supply.

28. DEF placed the Bartow CC plant into commercial service in June 2009. Beginning later in 2009, DEF began operating the ST above 420 MW under varying system conditions. In total, DEF operated the steam turbine above 420 MW for a total of 2,972 hours, or 13.6% of the time based on the total of 21,734 operating hours between June 2009 and March 2012 comprising Period 1. Tr. 73:20-24; 108:21-24. Ex. 72; Ex. 80 at 5.

Outages and Failure Events

29. The Bartow Unit 4 experienced five outages or blade damage events between March 2012 and February 2017 involving the LP portion of the ST. All involved damage to the L-0 blades. Tr. 42:13-4; Ex. 80 at 5.

30. The five timeframes relevant to this matter are distinguished by the outages that occurred due to damage to the L-0 blades and the attempts made to repair the ST. These timeframes are referred to in the relevant reports as Periods 1, 2, 3, 4 and 5 and are defined in Table A at page 5 of Exhibit 80. Tr. 62:5-9.

31. The first outage, which started in March 2012 (at the end of Period 1), was planned and initiated for valve work and inspections. The March 2012 inspection of the ST revealed damage to LP turbine L-0 blade snubbers. The subsequent four outages were to replace the L-0 blades or resulted from failures of L-0 blades. Ex. 80 at 5.

32. Subsequent outages occurred on August 2014, April 2016, October 2016 and February 2017. Ex. 80 at 3, 5.

33. During Period 1, the original L-0 40" blade configuration was classified as a Type 1 L-0 blade. For operation during Period 2, MHPS installed re-engineered Type 1 L-0 blades on only the generator end of the LP turbine in April 2012. Ex. 80 at 5.

34. In December 2014 at the end of Period 2, even though no abnormal damage or wear was found, all of the L-0 blades, including the Type 1 and re-engineered Type 1 blades, were replaced by Type 3 (v1) blades. During this outage, inspection revealed that the blades showed wear; however, none of the L-0 blades, Type 1 and re-engineered Type 1 blades, had any damage. At the same time, MHPS conducted blade telemetry testing on the newly installed Type 3 (v1) L-0 blades with the goal of increasing the output of the ST to 450 MW. Tr. 364:2-18; Ex. 80 at 3, 5.

35. During a planned outage at the end of Period 3 in April 2016, new Type 3 (v2) blades with hard-facing on the mid-span snubber, as well as on the Z-lock contact surfaces, were installed; however, in October 2016, at the end of Period 4, a number of these blades experienced snubber and Z-lock failures and were replaced with re-engineered Type 1 blades in December 2016. Ex. 80 at 3, 5; Tr. 220-223.

36. The most recent incident occurred at the end of Period 5 in February 2017 and involved a forced outage and plant shutdown

caused by a fragment of a re-engineered Type 1 L-0 blade that dislodged and was propelled through the LP turbine causing damage to other internal components. At that point, DEF elected to remove all 128 L-0 blades from both sides of the LP turbine and installed a pressure plate that would enable the ST to run at a materially reduced output level of 380 MW. Ex. 80 at 5.

37. The re-engineered Type 1 blades DEF installed in May 2017 at the end of Period 5 were not identical to the Type 1 L-0 blades used in the LP turbine during Periods 1 and 2. Tr. 100:17-25; 25:12-15.

38. DEF did not provide any documentation that demonstrates it communicated with MHPS about operation of the ST in excess of 420 MW, until after the failure of the L-0 blades was discovered in March 2012. Tr. 320:22 - 321:2; 365:23 - 366:2.

39. Mr. Polich testified that, if DEF had operated the ST at the Bartow Unit 4 in accordance with the design output of 420 MW or less, that there is no engineering basis to conclude that the original L-0 blades would not still be in operation today. Tr.321:11-13.

40. The February 2017 outage duration of approximately 60 days resulted in DEF incurring a stipulated amount of replacement power costs of $11.1 million due to the loss of the approximately 380-390 MW then being provided by the ST. Tr. 339:14-21.

41. The pressure plate applied by DEF limited the output of the ST to 380 MW, and the loss of the capability of the ST from May 2017 to October 2019 caused DEF to periodically incur higher replacement power costs associated with the inability to produce more than 380 MW from the ST. Tr. 250:5-15; 321:19-21.

DEF's Root Cause Analyses

42. Beginning in 2012, DEF conducted root cause assessments relating to each of the L-0 blade failures in the Bartow ST LP section. MHPS prepared a root cause assessment, dated September 2017, in which it determined that excessive blade vibration, or "flutter," was detected, particularly during high energy blending when ramping up to the Bartow plant's full 4x1 operation. Tr. 57:3-8; Ex. 82 at 5-6.

43. MHPS concluded that high LP loading and bypass operations at high loads (highly correlated to operation of the ST above 420 MW (Tr. 111:21 - 112:10))were the primary cause of the L-0 blade failures at Bartow that were not experienced in other plants that utilized the same type of MHPS steam turbine. Ex 82 at 5; Ex. 73 at 3.

44. After the discovery of the blade damage in March 2012, DEF began a years-long RCA process that ended with the February 6, 2018 report that is exhibit JS-2 (Ex. 80). Tr. 57:3-8.

45. On February 6, 2018, DEF released its version of the root cause analysis ("RCA") for the L-0 blade failures in 2012, 2014,

2016 and 2017. DEF's assessment agreed that excessive vibration which the L-0 blades could not accommodate was the proximate cause of the blade failures. Noting that L-0 failures continued to occur even after steam inlet pressure and condenser backpressure limitations were imposed, DEF believed that the blade design failed to provide adequate design margin for 4x1 operation. Tr. 71:20-72:14; Ex. 80 at 2,15.

46. During the eight-year period in which the series of L-0 blade failures and events occurred, DEF worked both independently and with MHPS on root cause analyses of the blade failures. Ex. 80 at 1.

47. Both DEF and MHPS produced multiple root cause analysis report documents. Due to the timing of the blade failures over the six-year period from March 2012 to February 2018, DEF was able to produce only one final RCA report document instead of separate root cause analysis reports for each individual blade failure. Tr. 69:10-13; 216:11-14; Exs. 80; 115.

48. MHPS's analyses determined that the cause of blade damage in Period 1 was DEF's overloading of the LP section based on operation of the ST at 450 MW, which is over the design point of 420 MW. Ex. 116 at 4.

49. In its root cause report, MHPS stated that "LP [low pressure] loading plus Bypass Operation at high load were identified as the primary root causes for the Bartow 40" L-0 blade reliability

differences from the global fleet [of comparable MHPS 40" L-0 blades]." Ex. 82 at 5.

50. After the February 2017 outage, DEF formed three working groups: (1) a root cause team to investigate and prepare a root cause analysis of the February 2017 outage; (2) a restoration team to bring the ST back online; and (3) a long-term solution team for operation of the ST. Tr. 42:19-22.

51. The RCA contained in Exhibit 80 is DEF's principal piece of evidence offered in support of DEF's position that it acted prudently at all times in operating the ST. Tr. 56:12-57:2.

52. DEF's RCA process was one "iterative and continuous" and "big, long root cause analysis process" over the period 2012 through February 6, 2018 and no final DEF RCA report was produced until then because blade damage events interceded before a final document could be produced. Tr.59:21-24; 69:10-18.

53. Throughout the lengthy RCA process DEF maintained draft and working documents produced to support the final RCA report, as a matter of company practice and in the normal course of business. Tr.65:12-17; 89:3-21.

54. DEF did not consider the documents in Exhibit 115 to be drafts of the RCA report but instead "working papers that summarize what the root cause team is doing." Tr. 90:10-20.

55. The RCA working documents were maintained as a part of DEF company practice by Jake English, who was lead engineer on the RCA Process. Tr.68:1-11.

56. The working documents contained in Exhibit 115 reflect the opinions of Duke engineers contemporaneous with the date of the documents while they were working on the root cause analysis process. Tr. 90:10-20.

57. Most of the root cause working documents contained in Exhibit 115 were prepared by DEF engineers in late 2017 – well after the blade failures that were discovered in March 2017 at the end of period 5. Ex. 115.

58. As late as October 15, 2016, Duke Engineering agreed that the heat balances and other documentation supplied with the ST before 2008 contained the limitations in turbine output. Those limitations provided to DEF in 2008 provided an operational limit of 420 MW based on the MHPS design point and the expected maximum electrical output. Tr. 161:7-162:5; Ex. 115 at 19. See, also Tr.82:21-83:1; Ex. 116 at 4, 21; Ex. 109 at Bates 12432.

59. As late as June 26, 2017, Duke Engineering maintained "after months of study … that low pressure (LP) turbine back-end loading" (15,000 lb/hr/ft.2) was one of "the most significant contributing factors toward root cause of the history of Bartow Unit 4 L-0 events." Tr. 86:16 – 88:19; Ex. 115 at 23, 29, 39, 59, 67, 75, 123, 137, 153, 165, and 179.

60. The DEF RCA working documents contained in Exhibit 115 uniformly demonstrate that during the RCA process before and after the Period 5 event, "Duke Engineering" consistently identified excessive steam flow in the LP turbine as one of the "most significant contributing factors" toward blade failure over the history of the ST as L-0 events. This was the same conclusion that MHPS reached. Tr. 86:16- 88:19; 112:4-10; Ex. 73 at 3; Ex. 115 at 23, 29, 39, 59, 67, 75, 87, 97, 109, 123, 137, 151, and 165; Ex. 73 at 3; Ex. 116 at 4.

61. Several of the root cause working papers in Exhibit 115 contained the following similar statements that changed slightly though editing, but were maintained as consistent opinions, which show the Duke engineers working on the team believed that, while excessive steam flow could not be attributed to other Periods, for Period 1, it ***was*** a significant contributing factor to the damage that occurred in Period 1:

On October 12, 2017:

> While Duke Engineering agrees that back-end loading should be considered a significant contributing factor toward the root cause, one cannot definitively conclude that it has been the failure driving mechanism of all five (5) of the documented L-0 events. As Appendix A illustrates, ***Periods 2, 4 and 5*** saw operating hours in the "avoidance zone" of 1 hour, 1.15 hours and 0 hours, respectively. This indicates that back-end loading was not the cause of any of the reported blade indications/failures ***during those periods*** of operation. (Ex. 115 at 125.)

On October 12, 2017 (minor edits made without changing the substance):

> While Duke Engineering agreed that back-end loading should be considered a significant contributing factor,
>
> ***
>
> This indicates that back-end loading was not the cause of any of the reported blade indications/failures ***during those periods*** of operation. (*Id.* at 139.) (Redline edits represent the original edits)

On October 17, 2017:

> While Duke Engineering agreed that back-end loading should be considered a significant contributing factor
>
> ***
>
> This indicates that back-end loading was not the cause of any of the reported blade indications/failures ***during those periods*** of operation. (*Id.* at 180.)

(Emphasis added.)

62. The precursor to Exhibit 80, Table A in the root cause working papers, showed 420 MW as an "output rating" in the "key notes" section under Period 1, and this terminology was included in each root cause working paper until the final RCA document was prepared. See, e.g. Ex. 115 at 27.

63. When DEF prepared the final RCA report, DEF changed, with no explanation, the table category from "Operating Restrictions" to "MHPS IP Exhaust Pressure Operating Limits." Ex. 80 at 5, (far left-hand row headings, fourth heading under the heading "Date").

64. OPC's engineering expert, Richard Polich, testified that "the 2017 outage and subsequent derate (or reduction in output) of 40

MW were the result of DEF imprudently operating the ST in excess of the manufacturer's 420 MW design conditions." Tr. 321:22-322:1.

65. DEF and MHPS agreed that the ST, and specifically the L-0 blades in the LP turbine, would need to be re-designed for the ST to be able to produce 450 MW. Tr. 151:12-153:24; 195:8-196:7; Ex. 106.

66. When DEF solicited proposals to implement a long-term solution, they received one blade replacement proposal (from MHPS) and two steam path retrofit proposals (from GE and Siemens). Ex. 112 at Bates 1604.

67. No other comparable MHPS steam turbine in the world has had its L-0 blades prematurely (after only 11 years of operation) replaced due to flutter-induced damage or had to have its LP steam path replaced. Tr.202:18-203:11.

68. In 2018, DEF solicited proposals to repair or replace the Bartow ST, and to design the repair to allow reliable operation to support 450 MW of electrical output from the generator. DEF subsequently selected MHPS's proposed upgraded and re-designed 40" L-0 blades. In fashioning its blade upgrade, MHPS observed:

> The Steam Turbine applied at Bartow was originally designed for 420 MW as a tandem compound unit with a double flow LP section, while the 4 on 1 fired configuration produces steam for 450 MW.

> The original blade loading limit of the 40" L-0 blades did not allow the unit to produce 450 MW, resulting in blade modification and testing.
>
> In the following 3 years, multiple forced outages were experienced due to last stage blade damage caused by high load stimulus and high energy blending in the 4 on 1 configuration which was not fully understood until conducting an elaborate collaborative RCA.

Ex. 81 at 2.

69. The Period 7 (2019) blade upgrade is supposed to rectify this circumstance by allowing reliable operation at the steam temperatures and pressures required for the ST to produce 450 MW. The upgraded 40" L-0 blades were installed in late 2019; however, as of the date of the hearing in this matter, DEF has no operating experience running the ST with the upgraded blades at higher power levels. Tr. 252:1-253:14.

DEF's Operation of Bartow and Blade Failures were Unique Among the Similar MHPS Units Worldwide

70. MHPS is one of the world's principal manufacturers of steam turbines. Of the 32 MHPS steam turbines worldwide with a combined 55 rows of 40" L-0, only the Bartow steam turbine experienced L-0 40" blade failures caused by excessive blade vibration. Tr. 179:7-11; Ex. 104 at 14; Ex. 115 at 180.

71. During Period 1, the Bartow ST had the highest L-0 blade loading among the comparable 40" L-0 MHPS steam turbine fleet worldwide. Ex. 103 at 55.

72. All other comparable MHPS steam turbines experienced loadings on the L-0 40" Blades at an average of 12,000 lb/hr-ft^2 and as high as 15,000lb/hr-ft^2 Ex.80 at 6.

73. DEF's decision to operate the ST to produce an output of 450 MW caused the blade loadings on the Bartow L-0 40" blades to reach 17,000 lb/hr-ft^2, which is 41.6% higher than the MHPS L-0 fleet average of 12,000 lb/hr-ft^2. [5,000/12,000 = 41.6%] Tr. 108:5-10.

74. The DEF Root Cause Analysis report does not provide an explanation as to why a lack of blade design margin can be the root cause of all the Bartow L-0 events if, worldwide, no similar MHPS steam turbine blade has experienced similar problems. Exs. 80 and 115.

DEF and MHPS had No Experience with CC Operations at the Bartow Steam Loading Levels

75. Duke Energy, including DEF, had no experience running a 4x1 combined cycle plant anywhere in its generation fleet, prior to buying the ST and during Period 1. More importantly, neither Duke nor MHPS had any experience operating an ST at the loading levels required to produce 450 MW. Tr. 185:25-186:6; 303:15-17; Ex. 73 at 19.

76. In 2013 MHPS stated that it had no data on, nor had ever experienced, loading on L-0 40" blades greater than 15,000 lb./hr./ft.^{2}. Ex. 104 at 89, 90.

Settlement of Claims in August 2018 Contradicts DEF's RCA Conclusion

77. DEF concluded in its final RCA document that the cause of the ST problems was a flaw in design margin attributable to MHPS. DEF, nevertheless, executed an August 13, 2018 document entitled "Mutual Release, Covenant Not to Sue, and Settlement Agreement Between Duke Energy Florida LLC and Mitsubishi Hitachi Power Systems, Inc." ("2018 Settlement"). In this 2018 Settlement Agreement, DEF and MHPS agreed that the L-0 blades needed to be re-designed to produce 450 MW. In that same document, DEF also settled with MHPS and surrendered its rights to any claims against MHPS that it might have had under Contract No. 270810. Ex. 106 at 3,7.

78. In the 2018 Settlement, DEF agreed and acknowledged that 420 MW was an output limit of the ST at the time Bartow Unit 4 was commissioned in June 2009. Ex. 106 at 1.

79. The 2018 Settlement was executed on DEF's behalf by Anthony Salvarezza who was involved in the RCA Process. Tr.92:23 - 93:1; 195:19-21; Ex.106 at 11.

80. DEF seeks to recover from its customers the losses that should have been sought from MHPS (if MHPS was at fault); however, such a claim was waived by the 2018 Settlement. Ex. 106 at 3, 7.

81. MHPS insisted that the ST was not designed to operate above 420 MW, and DEF regularly operated the ST above 420 MW from 2009

to 2012 (neither of these facts are in material dispute, see, e.g., Ex. 116 at 21; Tr. 73:20-24; Ex. 72). DEF did not contest MHPS's assessment that vibration caused by operation at high load levels, particularly when moving to the 4x1 configuration was the primary root cause of the blade damage first observed in 2012. Indeed, DEF concedes that it initiated operation at higher loading levels and above 420 MW on its own initiative and did not seek advice from MHPS until the blade damage had begun to occur. Tr. 148:13-152:5.

Concept of Power Factor in Rating the ST's Output is Misplaced and Misleading

82. The concept of "power factor" was introduced into this case for the very first time at the hearing by Mr. Swartz who suggested that the power factor variable employed in the heat balance cases relied upon by DEF and MHPS indicated that output levels greater than 420 MW were permissible. Tr. 143:4-10; 354:16-355:20.

83. DEF did not present any evidence related to the ST power factor applicable to Period 1 when the ST was actually generating over 420 MW during a time that MHPS had established that DEF was operating the ST above the design and operational limit. Tr. 355:14-20; Ex. 73 at 3; Ex. 116 at 21.

84. The record contains no evidence that, during the five-year long, continuous, iterative RCA process, along with statements by DEF engineers and MHPS that the 420 MW output was a design limit, Duke engineers ever identified or suggested that the power factor

of .949 in the heat balance case 48 indicated that a design limit of 420 MW was actually the equivalent of a number greater than 420 MW. Ex. 115 at 19; Ex. 73 at 21.

85. (1) MHPS's characterization of 15,000 lb./hr./ft.^{2} as a loading limit (Ex. 80 at 6), (2) Duke Engineering's October 15, 2016 characterization of the heat balances as containing an output limit (Ex. 115 at 19), (3) DEF's documented efforts to have MHPS increase the steam turbine output to 450 MW through blade design modifications (Ex. 106 at 1) and (4) the limitation in generator output to 468 MW[4] are all inconsistent with DEF's assertion that the power factor of .949 meant that operation of the ST above 420 MW was contemplated by MHPS.

86. The reference to the 450 MW in the 2018 Settlement as a "minimum" by Mr. Swartz (Tr. 288:18 - 24) is contradicted by the fact that the generator limit is 468 MW, given that 450 MW at .949 power factor would mathematically yield the equivalent of 473 MW of horsepower [450/.949 = 473].[5]

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[4] If, based on the power factor of .949, DEF had the ability to operate above the MHPS-established design limit of 420 MW, designing the replacement L-0 blades to achieve 450 MW output would exceed the known capacity of the generator (468 MW) and the excess would be unusable and the effort and spending would be wasted.

[5] See, Footnote 3.

Replacement Power Costs

87. The uncontroverted evidence shows that the replacement power costs stemming from the April 2017 outage are $11.1 million. Tr. 339:14-21; 68:24-369:10; Ex. 117.

88. Further, evidence adduced at hearing shows that the replacement power costs by year resulting from the de-rating of the ST while it operated with the pressure plate are $1,675,561 (2017), $2,215,648 (2018) and $1,125,573 (2019) for a total of $5,016,782. Tr. 340:1-22.

89. The total replacement power costs incurred as a result of DEF's operation of the ST in Period 1 are $16,116,781 (without considering interest). Tr. 322:1-3; 341:1-4.

CONCLUSIONS OF LAW

Jurisdiction

90. DOAH has jurisdiction over the subject matter and the parties to this action in accordance with Sections 120.569 and 120.57(1), F.S.

91. Pursuant to Section 366.06, F.S., the Commission has "the authority to determine and fix fair, just, and reasonable rates." § 366.06(1), Fla. Stat. The PSC's ratemaking authority includes authority to examine fuel cost expenditures and to approve cost recovery of utilities' reasonable and prudent fuel expenses through the Fuel Clause. *Citizens of State v. Graham*, 191 So. 3d 897, 901, (Fla. 2016).

Burden of Proof

92. The Petitioner, DEF, has the burden to demonstrate its entitlement to the fuel cost adjustments requested. *Fla. Power Corp. v Cresse*, 413 So. 2d 1187, 1190 (Fla. 1982); Tr. 11:15-12:5.

Criteria for Approval of Fuel Cost Recovery

93. The principles of cost recovery underlying the fuel clause under the jurisdiction of the Commission date at least as far back as the 1950s. See e.g. *In re Application of Florida Power Corporation for recovery of fuel costs adjustment*, Docket No. 5098-EU, Order No 2515 (F.P.S.C., Aug. 22, 1957).

94. "The fuel cost adjustment clause is a cash flow mechanism to allow utilities to recover costs for unanticipated changes in fuel costs between ratemaking proceedings." *Id.*

Pursuant to Chapter 366, F.S., and Commission rule, a petition for recovery of fuel costs must demonstrate that the costs for which recovery is sought were reasonably and prudently incurred. A petition for fuel cost recovery may seek recovery of costs to replace power that would have been generated by an out-of-service power plant if such costs are reasonably and prudently incurred. *In re: Fuel and purchased power cost recovery clause with generating performance incentive factor,* Docket No. 110001-EI; Order No PSC-2011-0579-FOF-EI, (F.P.S.C., December 16, 2011).

95. To carry its burden of demonstrating entitlement to recover the fuel cost adjustments requested, DEF must "show that the excess

costs incurred [replacement power costs] were reasonable and were not the fault of management." *Fla. Power Corp. v Cresse at* 1191. It would follow then that, losses occasioned by a utility's mismanagement or imprudent operation in excess of a key design limitation are not reasonably and prudently incurred fuel costs.

96. "Simple production of cost records and documentation cannot satisfy the requirements imposed on a utility in a true-up proceeding" such as this one. *Id.* To be prudent, an action or decision must be "what a reasonable utility manager would have done in light of conditions and circumstances which were known or reasonably should have been known at the time decisions were made." *Southern Alliance v. Graham*, 113 So. 3d 742, 750, 2013 Fla. PSC-11-0547-FOF-EI.

DEF's Actions Were Not Reasonable or Prudent

97. The competent substantial evidence of record demonstrates that DEF knew or should have known that the design and operational limit of the ST was 420 MW, as specified by MHPS, regardless of the amount of steam DEF had available. ¶¶ 12-15, 26-28, 58, 62, 64, 65, 68, 77-79, 81, *supra*.

98. The competent substantial evidence of record shows that the ST blades were designed for a 3x1 CC configuration and not the DEF Bartow 4x1 set up. DEF's conclusion in its Root Cause Analysis that the ST L-0 40" blades failed due to inadequate blade design margin under expected operating conditions at Bartow's 4x1 CC

plant, disregards the circumstances for which the blades were actually designed. ¶¶ 20-26, *supra*.

99. No other comparably sized MHPS steam turbine worldwide had experienced L-0 blade failures like those experienced at Bartow. This evidence contradicts the DEF RCA conclusion and instead supports the conclusion that DEF's operation and not blade design were to blame for the Period one failure. ¶¶ 49, 66, 67, 70-76, *supra*.

100. Given that DEF has the burden to prove it acted prudently, the DEF RCA cannot satisfy DEF's burden. While the RCA focuses entirely on what it asserts is a lack of L-0 blade design margin, this assertion is contradicted by the preponderance of the evidence. A design flaw cannot reasonably be proven, given the unrebutted evidence that (1) no other similar MHPS Steam turbine experienced similar blade failures or was operated at the Bartow steam loading levels up to 41.6%. higher, or (2) that Contract No. 270810 established that the blades were not designed for the Bartow steam loadings and that MHPS had established that 420 MW was the operational limit of the ST. For these reasons, the DEF RCA lacks credibility. ¶¶ 10-13, 26-28, 49, 58, 62, 65-68, 70-77, 58, 62, 64, 65, 68, 71-73, 77-78, *supra*.

101. The credible evidence of record shows that DEF's root cause engineering team specifically and unequivocally acknowledged that excessive steam pressure was a substantial contributing factor to

the L-0 blade problems during Period 1 (the period ending in early 2012). These findings were consistent with the manufacturer's findings and impeach DEF's later RCA conclusion that the blade design was to blame for the failures in all five Periods, and thus the RCA lacks credibility. ¶¶ 42,48,49,59,60,61,64, *supra*.

102. DEF determined on its own initiative to operate the ST at steam pressures producing more than 420 MW and without first consulting with the ST manufacturer, MHPS. ¶¶ 24-26, 28, 73, *supra*.

103. MHPS advised DEF that it had no experience with the operation of a low pressure ST at the excessive steam flows that DEF imposed on the L-0 blades at Bartow Unit 4. This is evidence that DEF's operation of the ST in Period 1 exceeded the design point, design limits and Operational limits established by MHPS. ¶¶ 75, 46, *supra*.

104. DEF lacked any operational experience with a gas-fired CC plant operating in a 4x1 configuration or the loadings required to produce output from the ST above 420 MW. DEF's decisions to operate the ST above 420 MW without first consulting with MHPS were imprudent because DEF should have known that operating the ST above the design limit or design point of 420 MW was not studied or contemplated by MHPS. For this reason, DEF should have proceeded cautiously and to not exceed the ST'S manufacturers established operating limit of 420 MW. ¶¶ 16-20, 75, 76, *supra*.

105. The DEF and MHPS discussions regarding the operation and reliability of the Bartow LP turbine focused on the adequacy of the LP turbine's L-0 blades to accommodate expected loadings on those blades, particularly during high energy bypass operations. The concept of "power factor" as applied in the various "heat balance" cases, while relevant to the conversion of steam energy to electric output, had no material bearing on the issues that DEF and MHPS looked to resolve. ¶¶ 46-49, 58-61, *supra*.

106. DEF's assertion at hearing that operating at the .949 power factor assumed in the reference heat balance case implied an electric output of 448 MW with steam available to produce 420 MW misses the mark since both DEF and MHPS were focused on steam input to the LP turbine and the effect of high loadings on the L-0 blades. Accordingly, the concept of "power factor", belatedly introduced, is not persuasive in this decision. ¶¶ 82-85, *supra*.

107. The DEF proposition of "power factor" as overriding the substantial evidence presented that 420 MW was a design and operational limit is flatly contradicted by the significant efforts of DEF to have MHPS design blades that would allow it to achieve a 450 MW output from the ST. If a power factor of .949 was then applied to that number, the ST would achieve an unusable horsepower output above the limits of the generator. DEF did not explain this discrepancy and DEF's "power factor" lacks merit. ¶¶ 85, 86, *supra*.

108. The competent substantial evidence of record demonstrates an engineering consensus that vibrations associated with high energy loadings were the primary cause of the L-0 blades failures. DEF failed to satisfy its burden to demonstrate that its actions in operating the ST in Period 1 did not cause or contribute significantly to the vibrations that repeatedly damaged the L-0 blades, resulting in the 2017 outage in Period 5. ¶¶ 12-15, 20-28, 39, 42, 48, 49, 58-61, 62, 64, 65, 68, 77-79, 81, *supra*.

109. It is reasonable to conclude that, absent the improper operation of the ST by DEF in Period 1 and given the experience of the other MHPS steam turbines worldwide, DEF's L-0 blades would still be in service. The serial blade failures would never have occurred and the outage that led to the challenged replacement costs would also not have occurred. ¶¶ 39, 49, 66, 67, 70-76, *supra*.

110. The applicable standard for prudence review is how a prudent and reasonable utility manager operating a new steam turbine under the conditions and circumstances which were known or reasonably should have been known at the time decisions were made in 2008 through 2012 would have operated the ST. Based on that standard, it was unreasonable for DEF to regularly supply steam to the ST at the higher energy levels to operate the ST above the design point or limit of 420 MW. Moreover, since the ST was never designed by MHPS for the 2009 DEF plant in which it was installed and

especially having only the information that was available to DEF at that time, a reasonable and prudent utility manager would not have operated the ST to generate electricity significantly above the manufacturer's design point or limit of 420 MW, a design limit which was unequivocally communicated to DEF. ¶¶ 16-25, *supra*.

111. Even if one were to conclude that MHPS had some fault in the efforts to design blades that ultimately failed in Periods 3-5, counsel for PCS Phosphate correctly summarized (at Tr. 420-421) the factual scenario related to the interplay of the excessive steam throughput and the problems MHPS encountered with the various blade designs and its impact on the costs at issue:

> It's conceded as fact that the root cause of the Bartow low pressure turbine problems is excessive vibrations caused repeatedly over time. The answer to the question is was this due to the way Duke ran the plant or is it due to a design flaw?
>
> Well, the answer is both. The fact is that Duke bought a steam turbine that was already built for a different configuration that was in storage, and then hooked it up to a configuration, a four-by configuration that it knew could produce much more steam than it needed. It had a generator that could produce more megawatts, so the limiting factor was the steam turbine.
>
> On its own initiative, it decided to push more steam through the steam turbine to get more megawatts until it broke.
>
> ***
>
> Duke clearly was at fault for pushing excessive steam flow into the turbine in the first place. The repair which has been established which may or may not work, but the early operation clearly impeded Duke's ability

> to simply claim that Mitsubishi was entirely at fault. And under those circumstances, it's not appropriate to assign the cost to the consumers.

112. Credible, competent substantial evidence supports the conclusion that DEF did not exercise reasonable care in operating the ST in a configuration for which it was not designed and under circumstances which DEF knew or should have known required it to have proceeded cautiously with engineering analyses supporting the operation of the ST above 420 MW. ¶¶ 16-25, *supra*.

113. Although the conclusions that DEF failed to meet its burden of proof are dispositive, the 2018 Settlement also is troubling. If DEF was correct that it was not at fault -- a position not supported by the record of this proceeding -- and thus may have succeeded in a legal claim against MHPS, the execution of the settlement was itself imprudent. To the extent that DEF was imprudent in operating the ST in Period 1, but not in Periods 2 - 5, execution of the 2018 Settlement alone would constitute imprudence and should not entitle DEF to recover the requested costs from its customers. DEF presumably made a decision to forego the opportunity to recover the costs from the ST manufacturer and factored that into the decision to settle with MHPS. A failure to factor these costs into the settlement in light of the conditions and circumstances that DEF knew or reasonably should have known at the time the decisions were made is not reasonable or prudent. The 2018 Settlement severely undermines what evidence DEF

proffered on its blade design position and effectively thwarts DEF from carrying its burden in this case. Under these circumstances, it is unreasonable that the innocent customers should be made the insurers of last resort for the utility. The 2018 Settlement, with no admission of liability by either of the two parties, makes it impossible for DEF to carry its burden of showing that the requested costs were prudently incurred. ¶¶ 77-81, *supra*.

114. DEF's operation of the ST above the 420 MW operational limit also may have impaired DEF's ability to pursue claims against MHPS and forced its hand in entering into the 2018 Settlement for what DEF maintains were design flaws with the blades that were put on the ST after Period 1.

115. Given DEF's failure to meet its burden, a refund of replacement power costs is warranted. At least $11.1 million in replacement power was required during the Period 5 outage. *This amount* should be refunded to DEF's customers. ¶¶ 40, 41, 87, *supra*.

116. DEF failed to carry its burden to show that it was prudent in its actions of operating the ST above 420 MW in Period 1 and thus failed to carry its burden of proof to demonstrate that the Period 5 blade damage and the required replacement power costs were not consequences of DEF's imprudent operation of the ST in Period 1.

117. DEF failed to carry its burden by a preponderance of the evidence to show that it was prudent in its decisions leading up

to, and in restoring the ST to service after, the February 2017 forced outage at the Bartow plant. ¶¶ 16-28, *supra*.

118. Any extended derate of the ST that caused customers to pay for replacement power for the 40 MW lost due to the installation of the pressure plate was also a consequence of the imprudent operation of the ST in Period 1 and requires a refund of replacement costs incurred from the point after the ST came on line in May 2017 until the beginning point of the planned Fall of 2019 outage to replace the pressure plate with what has been labeled Period 7 blades. Mr. Polich provided a reasonable basis and calculation for the costs related to this loss of ST productivity - when the ST's power would have been needed. For this reason, the amount to be refunded should be increased by $5,016,782. ¶ 88, *supra*.

119. The total amount to be refunded to customers as a result of the imprudence of DEF's operation of the ST in Period 1 is $16,116,782, without considering interest. ¶¶ 40, 41, 87, 88, 89, *supra*.

120. The question presented by Issue 1C is moot based upon the conclusion in response to Issue 1B.

CONCLUSION

Based on the foregoing Findings of Fact and Conclusions of Law, it is RECOMMENDED that the Public Service Commission enter a final order that DEF may not recover, and thus should refund, the

$16,116,782 for replacement power costs resulting from the ST outages through October 2019.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true and correct copy of the foregoing has been furnished to the following parties as indicated on this 20th day of March, 2020.

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