BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Petition for Determination of Need for Citrus County Combined Cycle Power Plant	DOCKET NO. 140110-EI Submitted for Filing July 15, 2014

CALPINE CONSTRUCTION FINANCE COMPANY, L.P.'S
NOTICE OF FILING

Calpine Construction Finance Company, L.P. ("Calpine") hereby gives notice of filing the Direct Testimony of Paul J. Hibbard with Exhibits PJH-1 through PJH-8 in support of Calpine's positions regarding Duke Energy Florida, Inc.'s Petition for Determination of Need for the Citrus County Combined Cycle Power Plant.

Respectfully submitted this 15th day of July, 2014.

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I HEREBY CERTIFY that a true and correct copy of the foregoing was furnished to the following, by electronic delivery, on this 15th day of July, 2014.

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BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Petition for Determination Of Need for Citrus County Combined Cycle Power Plant, by Duke Energy Florida, Inc.	**DOCKET NO. 140110-EI Submitted for filing: July 14, 2014**

REDACTED

DIRECT TESTIMONY

OF

PAUL J. HIBBARD

ON BEHALF OF

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TABLE OF CONTENTS

IN RE: PETITION FOR DETERMINATION OF NEED FOR THE CITRUS COUNTY COMBINED CYCLE POWER PLANT, BY DUKE ENERGY FLORIDA, INC.
FPSC DOCKET NO. 140110-EI

DIRECT TESTIMONY OF PAUL J. HIBBARD

ON BEHALF OF

CALPINE CONSTRUCTION FINANCE COMPANY, L.P.

I. INTRODUCTION AND QUALIFICATIONS

Q: Would you please state your name, business address, and occupation?

A: My name is Paul J. Hibbard. I am a Vice President at Analysis Group, Inc. (AGI), an economic, finance and strategy consulting firm headquartered in Boston, Massachusetts, where I work on energy and environmental market, policy, and strategy engagements. My business address is 111 Huntington Avenue, 10th Floor, Boston, Massachusetts 02199.

Q: On whose behalf are you testifying?

A: I am testifying on behalf of Calpine Construction Finance Company, L.P., a subsidiary of Calpine Corporation (collectively "Calpine"), in support of its positions in Duke Energy Florida's ("Duke") Petition for Determination of Cost Effective Generation Alternative to Meet Need Prior to 2018 ("Petition"). Calpine owns and operates the Osprey Energy Center, which is located in Auburndale, Florida.

Q: Please describe your background and experience.

A: I have been with AGI for a total of almost seven years, first from 2003 to April 2007, and most recently, from August 2010 to the present. In between, from April 2007 to June 2010, I served as Chairman of the Massachusetts Department of Public Utilities ("DPU"). While Chairman, I also served as a member of the Massachusetts Energy Facilities Siting Board, the New England Governors' Conference Power Planning Committee, and the NARUC Electricity Committee and Procurement Work Group. I also served as State Manager for the New England States Committee on Electricity and as Treasurer to the Executive Committee of the 41-state Eastern Interconnect States' Planning Council.

From 2000 to 2003 I worked in energy and environmental consulting with Lexecon, Inc. Prior to working with Lexecon, I worked in state energy and environmental agencies for almost ten years. From 1998 to 2000, I worked for the Massachusetts Department of Environmental Protection on the development and administration of air quality regulations, State Implementation Plans and emission control programs for the electric industry, with a focus on criteria pollutants and carbon dioxide ("CO_2"), as well as various policy issues related to controlling pollutants from electric power generators within the Commonwealth. From 1991 to 1998 I worked in the Electric Power Division of the DPU on matters related to utility integrated resource planning and procurement, utility ratemaking, restructuring of the electric industry in Massachusetts, the quantification of environmental externalities, energy efficiency, utility compliance with state and federal emission control requirements, regional electricity market structure development, and coordination with other states on electricity and gas policy issues through the staff subcommittee of the New England Conference of Public Utility Commissioners.

As a consultant, I have worked on numerous engagements related to power sector production cost modeling; resource planning and procurement; macroeconomic analyses; wholesale power market design, operations, and impacts; generation/storage optimization modeling; natural gas infrastructure development and evaluation; and energy and environmental policy design and analysis. I hold an M.S. in Energy and Resources from the University of California, Berkeley, and a B.S. in Physics from the University of Massachusetts at Amherst. My curriculum vitae is attached as Exhibit No. ___(PJH-1).

II. PURPOSE AND SUMMARY OF TESTIMONY

Q: What is the purpose of your testimony?

A: The purpose of my testimony is to provide a quantitative and qualitative comparative evaluation of proposals currently before Duke Energy Florida ("DEF," or the "Company") and the Florida Public Service Commission ("Commission") to meet the estimated 470 megawatts of DEF's forecasted capacity and energy needs in the pre-2018 timeframe. Petition for Determination of Cost Effective Generation Alternative to Meet Need Prior to 2018, by Duke Energy Florida, Inc., Docket No. 140111-EI, Filed May 27, 2014 (hereafter "Petition"), at 11, ¶ 24. In particular, I have been asked by Calpine to compare the self-build proposal put forward by DEF – with a focus on DEF's proposed

Suwannee combustion turbines ("Suwannee CTs") – with the offer by Calpine to provide DEF a power purchase agreement ("PPA") followed by facility acquisition from Calpine's Osprey Energy Center ("Osprey" or "Osprey Facility") in Auburndale, Florida. I compare these proposals from the perspectives of (1) ratepayer impacts in terms of equivalent levelized cost of electricity ("LCOE"), cumulative present value revenue requirements ("CPVRR"), and considerations tied to risks borne by ratepayers; and (2) policy considerations related to power system reliability, investment and operational flexibility, and human health and environmental impacts.

Q: **Please summarize your testimony.**

A: In its Petition, DEF asserts that the Suwannee Simple Cycle and the Hines Chillers Power Uprate projects are "...the most cost effective options to fulfill DEF's capacity and energy needs prior to 2018." Petition at 1. I disagree. Based on my review of cost and risk factors, I find that from a ratepayer perspective the best option for DEF is to accept Calpine's offer of a five-year PPA and acquisition (in year six) of the Osprey Facility. DEF's modeling and analysis occur largely within a black box, appear to be oversimplified and structurally biased, and inherently – and inappropriately – favor the Company's self-build alternatives. A more careful, common-sense review of the customer impacts associated with the various options reveals that by moving forward as proposed by DEF, DEF's ratepayers will likely incur significantly greater costs and be exposed to significantly greater risks than they would if instead of building the

Suwannee CTs, Calpine's offer is accepted. I conclude that selecting Osprey is the best outcome for ratepayers based on (1) a fully transparent comparison of the levelized costs of various alternatives; (2) a recalculation of cumulative present value revenue requirements starting from DEF's own calculations, with only a few reasoned adjustments reflecting current conditions and correcting for mistakes in DEF's original analysis; (3) a critique of the lack of transparency and apparent flaws in DEF's modeling approach and documentation; and (4) consideration of the nature, characteristics, and magnitudes of risks born by ratepayers under DEF's self-build proposal, compared with selecting Calpine's offer. Specifically, I find that Calpine's offer:

- has a levelized cost of electricity equal to $85.30 compared to $168.70 for the Suwannee CTs, and
- represents a cumulative present value revenue requirement *benefit* of $133 million compared to DEF's self-build proposal.

In short, Calpine has made an offer to DEF that represents a low-cost, low-risk, reliable, efficient, and environmentally responsible resource choice. DEF's analysis of alternatives fails to appropriately capture these many value streams, overstates the value of their own self-build alternative (in particular the Suwannee CTs), and understates the value of the Calpine offer. A reasonable evaluation of these alternatives, a common-sense comparison of facilities' levelized costs, and a review of important reliability, health, environmental and policy factors suggests that the best – and most prudent – option for DEF's ratepayers would be for DEF to accept Calpine's offer. Based on my review of all of these factors, I conclude that, in the interest of ratepayers and the energy policy and economic interests of the State of Florida, the Commission should deny DEF's Petition because it does not represent the most cost-effective alternative and because it is not in the best interests of DEF's customers.

Q: Are costs and cost-related risks the only benefit of the Osprey Facility compared to the Company's self-build alternative?

A: No. DEF's self-build alternative – when compared to the purchase of power and subsequent acquisition of Calpine's Osprey Facility – suffers from a number of additional flaws from the perspectives of power system reliability, flexibility, and environmental impacts. These are fundamentally important considerations for the Commission, particularly during this time of significant uncertainty and change in the electric sector. These changes are tied to highly uncertain growth forecasts for peak load and energy consumption, pending and emerging federal requirements related to the air, water, and solid waste impacts of electric generating facilities, and significant developments in the pricing and transportation of natural gas (for heating, process needs, and power generation). As discussed further below, an acquisition of the Osprey Facility helps address these uncertainties and reduces ratepayer risk, through a set of benefits which include: (1) the relative value of more efficient combined cycle ("CC") capacity (like the Osprey Facility) – compared to combustion turbine-only capacity – to meet DEF's changing resource needs and system conditions across multiple operating modes (baseload, intermediate, and peaking); (2) the option value provided by the higher capacity of the Osprey Facility compared to the Suwannee CTs, which would allow for greater flexibility for DEF to alter the timing of major new capital investments in future years (such as the proposed Citrus County facility) should load growth and/or resource availability deviate from current expectations; and (3) the wide-ranging human health and environmental benefits that flow from using the already-built and operational, efficient, and low-emitting (in terms of emissions per megawatt-hour ("MWh")) Osprey capacity instead of the new-construction, relatively inefficient, and higher-emitting Suwannee CTs.

Q: Are you sponsoring any exhibits with your testimony?

A: Yes. I am sponsoring the following exhibits:

PJH-1	Curriculum vitae of Paul J. Hibbard
PJH-2	Calpine LCOE Model Sources and Assumptions
PJH-3	Levelized Cost of Electricity ($2014/MWh)
PJH-4	Levelized Cost ($2014/MWh) by Capacity Factor 2015-2043
PJH-5	Growth in Total Energy Demand and Potential Energy Generation from Generic Combined Cycle Units
PJH-6	Comparison of Osprey Capacity Factor and Starts, by Year, DEF Production Simulation Results, Scenario 5 Acquisition
PJH-7a, 7b	Adjustments to Cumulative Present Value Revenue Requirements
PJH-8	Emission Rates by Technology, Carbon Dioxide (CO_2) and Nitrogen Oxides (NOx)

Q: How is your testimony organized?

A: In Section III, I present my ratepayer impact analysis, including a transparent analysis of the levelized costs for each of the Calpine and DEF facilities in the pre-2018 resource procurement, an evaluation and recalculation of DEF's own conclusions with respect to CPVRR, a discussion of the shortcomings associated with DEF's analytic method and modeling effort, and a review of the significant risks ultimately borne by ratepayers under different scenarios. In Section IV, I address important considerations related to system reliability, planning and procurement flexibility, and human health and environmental impacts. Finally, in Section V, I summarize the conclusions I draw from my review of these factors.

III. CALPINE'S OFFER IS HIGHLY BENEFICIAL FROM THE PERSPCTIVE OF DEF'S RATEPAYERS

III.A OVERVIEW

Q: How is this Section organized?

A: In this Section, I address factors related to DEF's analysis of the value of competing resource options, from the perspective of DEF's ratepayers. Specifically, in Section III.B, I compare Calpine's proposal and DEF's proposed self-build projects on the basis of LCOE, presenting the analytic method, assumptions, underlying data, and results. The LCOE analysis – when presented clearly with the assumptions that go into the calculations – provides a fully transparent and straight-up comparison of the capital and operating costs of resources in the most relevant and understandable metric from a ratepayer's perspective – dollars per MWh of electricity generated over the life of the facility. The results demonstrate the clear and compelling benefit to ratepayers of the Osprey PPA/acquisition in comparison to DEF's self-build proposal, the Suwannee CTs.

In Section III.C, I first discuss various flaws of construction and execution that exist in the modeling and analysis that DEF used in its evaluation of resources in this docket. Despite these flaws, I demonstrate that even accepting DEF's analysis as the starting point, the Osprey Facility is the best from a CPVRR perspective when DEF's results are adjusted to correct certain mistakes and misrepresentations in the original calculations.

Finally, in Section III.D, I highlight the need for heightened attention in this docket to the different ratepayer risk factors and discuss differences in the risks borne by ratepayers between the options of moving forward with development, permitting and construction of the Suwannee CTs versus selecting the Osprey PPA/acquisition proposal offered by Calpine.

III.B. LEVELIZED COST OF ELECTRICITY

Q: Is it possible to construct an analysis that provides a clear and transparent comparison of proposals from the perspective of electric ratepayers?

A: Yes. One of the challenges in understanding DEF's analyses of resources proposed in this proceeding is the substantial level of opacity – or, put differently, the substantial lack of transparency -- in the way in which DEF has assembled competing resource portfolios, forecasted the build-out of its system over a very-long modeling time frame, and evaluated bids using a proprietary "black box" model. This does not mean that DEF's analysis is not valuable – it is. However, it is critically important that the Commission and stakeholders also have access to a robust *and transparent* quantitative analysis of bids considered by the Company and the Commission; one that allows for a more clear and objective understanding of the relative value of each proposal. One way to do this is through a clearly documented levelized cost of electricity analysis, in which the capacity, energy, and other cost elements in project proposals are translated into an equivalent dollars-per-megawatt-hour ($/MWh) metric, using consistent financial, market, and temporal assumptions across all proposals.

Q: What is the value of carrying out a LCOE calculation, and how have you approached the LCOE analysis in this instance?

A: In this docket, the Commission is being asked to determine whether DEF's selection of its self-build proposals, from among multiple proposals and resources with different terms, cost elements, technologies, and operational utilization factors, is in the best interests of its customers. Most importantly, the projects in this solicitation differ in at least two fundamental ways. First, they include, on the one hand, firm PPA and acquisition proposals from merchant generators (with multiple-year terms, pre-set power purchase and acquisition price points, and various operational and financial guarantees), and, on the other hand, self-build project cost estimates from the incumbent utility (with no term or cost guarantees from the ratepayer perspective). A comparison of bids under these circumstances must include a clear and transparent demonstration of how assumptions related to the different terms and payment structures affect the expected cost and value of different bids.

Second, the proposals in this solicitation include projects whose use in daily operations is fundamentally different from the standpoint of frequency, duration, and timing of commitment and dispatch. The Suwannee CTs will have a very different operational profile (infrequent, short-duration operations) than that of the Osprey and/or other CCs (more frequent operations and longer run times). A comparison of bids under these circumstances should create a transparent demonstration of how expectations or assumptions regarding resource use affect the expected cost and value of different bids.

LCOE analysis is able to capture these fundamental differences in a transparent manner, and enables a relatively straightforward and consistent comparison of bids. Below, I present a LCOE analysis of the DEF self-build projects and Calpine's proposal – the Osprey Facility – that are available to meet the needs of DEF's customers. My purpose for, and approach to, the LCOE analysis was to construct a fully independent, objective, and transparent analysis that treats all offers on an equal and fair basis.

The LCOE metric for each proposal represents the net present value of the expected annual revenue requirement – including the sum of variable and fixed operation and maintenance costs, capital costs, and the return on investment – divided by the estimated annual generation over the terms of the proposals. The LCOE calculation establishes annual costs in accordance with contract terms (in the case of PPAs), or using traditional calculations of annual revenue requirements (in the case of utility self-build or acquired units that would go into the utility's rate base), in order to create comparability across structural differences in proposal pricing and asset lives. In addition, the LCOE analysis accounts for differences in utilization between resource types through variable capacity factor inputs that determine average annual generation.

The LCOE analysis compares ratepayer impacts of each proposal under a user-specified set of capacity factor assumptions. While an LCOE analysis does not include dispatch simulation, and thus it does not quantify the economic and environmental benefits of displacing generation, ignoring such benefits would tend to underestimate the value of CC capacity relative to CT capacity, since the more efficient and more highly-utilized CC capacity would likely generate greater price and emission displacement than CT capacity. Thus the value of the Calpine proposal may be substantially better than indicated by its LCOE relative to the LCOE for the Suwannee CTs.

In short, and as discussed further below, the Strategist model is fairly impenetrable to most of those who are not actually running the model, generates results that are strongly dependent on assumptions and on how resources are configured in model runs, and thus in a sense provides the Commission with "take it or leave it" results. LCOE analysis, on the other hand, is a highly accessible, transparent and useful representation of the ultimate impacts on ratepayers, and thus provides an extremely valuable and important sanity check on the results emerging from black-box models.

Q: Please describe Calpine's proposal to Duke for power supply from the Osprey Facility as you have modeled it in your analysis.

A: For the purposes of my analysis, I have used Calpine's most recent offer, which is summarized in the direct testimony of Mr. Todd Thornton, Senior Vice President, Origination and Development for Calpine (hereafter, "Thornton Direct"). Specifically, I understand Calpine's most recent offer to include:

- A five-year PPA, starting January 1, 2015 and extending through December 31, 2019, with an initial capacity payment of [redacted] in 2015 escalating to $[redacted] in 2019. This price applies to the full 515 MW of Osprey's contracted capacity under the PPA; and
- An option for Duke to purchase the plant on January 1, 2020 for [redacted] in nominal 2020 dollars).

From the direct testimony of John Simpson (hereafter "Simpson Direct"), I understand that due to transmission system limitations, Osprey may not be able to provide the full capacity benefits of the facility (i.e., the 515 MW of contracted capacity under the PPA, and the 599 MW of total capacity available after Duke acquires Osprey) in every single hour of the year until construction of related transmission infrastructure upgrades are completed, even though it is likely to be able to provide up to full capacity *in the vast majority of the* hours of the year. In any event, the quantity of capacity that *can be* supplied on a firm basis prior to new transmission infrastructure – 249 MW – is sufficient to meet DEF's reliability need in the interim period. Nevertheless, for the purposes of the LCOE analysis, during the 5-year PPA period, I assumed annual capacity payments equal to the product of the proposed capacity payment and the contracted capacity (515 MW) to be provided under the PPA, as specified in the offer. This represents the maximum possible capacity payment obligation for DEF under Calpine's offer. Following an acquisition in 2020, I continue to calculate the LCOE using 515 MW of capacity. This is a conservative assumption that tends to undervalue the peaking capabilities of the Osprey Facility. I discuss – but do not quantify – the value of this additional duct-fired capacity for DEF ratepayers in Section IV below.

Q: Please summarize your understanding of DEF's self-build proposals.

A: DEF has proposed two separate projects to meet its generation supply needs before 2018. The Suwannee CTs are two combustion turbines with summer capacity of approximately 316 MW of summer capacity and 375 MW of winter capacity with an estimated in-service cost of $197 million. The Suwannee CTs would have an annual net operating heat rate of 10,197 Btu per kilowatt-hour. The Hines Chillers would add approximately 220 MW of capacity during summer conditions with little degradation of the heat rates of the Hines combined cycle units. The Hines Chillers would not add any capacity to DEF's system during winter peaking conditions. The estimated cost of the Hines Chillers is approximately $160 million.

Q: Please provide a summary of the results of the LCOE analysis you conducted.

A: I estimated the LCOE for the Osprey PPA/acquisition proposal, the Suwannee CT, the Hines Chillers, and the combinations of Suwannee/Hines and Osprey/Hines. I used information on capital costs, operating costs, financing costs, fuel costs, and pollutant emission costs that were provided in Mr. Borsch's testimony and responses to Calpine's interrogatories. For Osprey, I used the updated pricing offer details provided above. A summary of my assumptions is included as Exhibit No. __ (PJH-2) and described below.

Key results presented in Exhibit No. __ (PJH-3) include the following:

- Calpine's Osprey Facility PPA/acquisition offer has the lowest LCOE across all of the options after considering total capacity costs, transmission costs, and energy costs. Osprey's LCOE is 19 percent lower than the Hines Chillers and 49 percent lower than the Suwannee CTs.
- A combination of Osprey plus the Hines Chillers offers a lower LCOE than either the Hines Chillers alone or in combination with the Suwannee CTs.
- The Suwannee CTs have the highest LCOE of all three units, which is driven by the lower expected utilization and higher heat rate of a combustion turbine as compared to a highly efficient combined cycle unit.

Q: Please summarize the key assumptions in the LCOE analysis.

A: I relied on three key documents for the data used in this analysis. First, I obtained capital cost, operational data/heat rates for the self-build units, and capacity factors from Mr. Borsch's testimony. Second, I used pricing information for the Calpine PPA/acquisition from the updated terms offered on July 3, 2014 as described in the Thornton Direct. Third, I used data from the Strategist inputs and outputs provided to me as part of DEF's responses to Calpine's discovery requests. This included fixed O&M, variable O&M, start costs, natural gas transportation costs, and environmental costs for both the Osprey acquisition and the DEF self-build units.

For financial assumptions, I used DEF's current weighted average cost of capital ("WACC") for both return on rate base and the discount rate, and where appropriate, made conservative assumptions about asset lives and depreciation that would tend to increase the cost of the Osprey PPA/acquisition proposal relative to the Suwannee CTs. For income accounting, I assumed that assets followed a modified accelerated cost recovery ("MACR") schedule. I used a 20-year schedule for combined cycle and transmission assets and a 15-year schedule for combustion turbines, consistent with guidance found in IRS Publication 946.

Q: Please summarize key financial assumptions in the LCOE analysis.

A: Whenever possible, I used assumptions that would tend to disadvantage the Calpine offer relative to the DEF self-build proposals, and I have tried to present an analysis that accounts for the applicable regulatory accounting standards. For example, I assumed that all assets (including transmission) would be depreciated on a straight-line basis from the in service year to 2043, and that the return on rate base would be collected on the non-depreciated portion in each year. For the transmission direct connect, this period is likely too short, which will tend to increase the cost to ratepayers for this project in my analysis and disadvantage the Osprey bid as compared to the Suwannee CTs. In addition, I assumed a 35-year asset life, which means that not all costs are recovered within the 2043 study period. Again, this tends to underestimate the cost of the Suwannee CTs to ratepayers in my analysis.

For Osprey and Hines, I assumed useful lives through the end of the study period, which is equivalent to a total useful life of 40 years. I believe this is a reasonable assumption based on the operational longevity of DEF's generating assets. *See, e.g.*, Florida Public Service Commission Order No. PSC-10-0131-FOF-EI issued March 5, 2010, at 17, 19 (stating that "several of PEF's steam units and combustion turbines on its system have been in service for more than 40 years, and all are projected to be in service longer than 40 years," and concluding that "on balance, we find a minimum life span of 35 years shall be used in this proceeding for PEF's combined cycle units… PEF should likely experience life spans of 40 years or more…").

Finally, for AFUDC, I have made a simplifying assumption that all funds are placed in rate base at the weighted average cost of capital. This tends to underestimate the amount of monies that will be collected, since I understand that the AFUDC weighted average cost of capital is 7.44 percent. 14LGBRA-

NRGROG1-79-000005 – 000007 AFUDC Rate Change Schedules A-C_March 2010_Final.xlsx.

Q: Please describe your approach to assigning capacity factors to resources for the purpose of the LCOE analysis.

A: For the Suwannee CTs, I used the 9.3 percent capacity factor presented in Exhibit BMHB-2. For the combined cycle units, I used a [redacted] I also tested my results against a wide range of capacity factors. The conclusions I draw are robust to changes in expected output, even including unrealistic combinations of low capacity factors for CCs and high capacity factors for CTs. *See* Exhibit No. __(PJH-4).

Q: How can you determine whether the LCOE results are robust to changes in expected capacity factors for the different resource options?

A: The LCOE model determines the levelized cost of electricity for a given resource at an assumed annual average level of utilization. That is, in calculating the LCOE of $85.30/MWh for the Osprey PPA/acquisition (shown in Exhibit No. __PJH-3), I assumed an annual average capacity factor [redacted]. This determines in each year the total MWh of generation over which to spread the combined investment, fixed, and variable costs to arrive at the levelized cost on a per MWh generated basis. Appropriately, since future years are discounted, the capacity factor outcomes in early years weigh more heavily than later years in the lifetime LCOE calculation.

It is reasonable to ask whether the LCOE benefit of the Osprey Facility remains at lower capacity factors, and/or at higher capacity factors for competing proposals. Exhibit No. __(PJH-4) provides insight into this question by showing the LCOE in $/MWh for both Osprey and the Suwannee CTs as a function of annual average capacity factors (assumed or projected). For example, at the intersection of the horizontal and vertical dashed lines in Exhibit No. __ (PJH-4), you see that at a [redacted] the LCOE for the Osprey PPA/acquisition is $85.30/MWh. On the other hand, the dashed line higher on the curves, and to the left, shows that with the Suwannee CTs operating at an annual average capacity factor of 9.3 percent, the Osprey proposal has an equivalent LCOE at an annual average capacity factor of approximately [redacted]; further, at *any capacity factor greater than* [redacted] the Osprey proposal has a lower LCOE than the Suwannee CTs. Finally, as long as Osprey is expected to operate at an annual average capacity factor of about [redacted] or more, it will be better from an LCOE perspective than the Suwannee CTs operating at *any* capacity factor.

III.C. THE COMPANY'S EVALUATION OF COMPETING PROPOSALS

Q: DEF has used the Strategist optimization model to compare proposals in this proceeding. Should the Commission rely only on the Company's Strategist analysis?

A: Absolutely not. The decision made in this proceeding will affect ratepayer costs, risks, and system operations and reliability for decades. Given the importance of this decision, the Commission should carefully understand and consider the Strategist results. Given modeling limitations (discussed below), the Commission also needs to view the results within the totality of the evidence from all of the modeling and analyses presented by parties in this proceeding. This is particularly important given that Strategist is a proprietary "black box" model, one whose unit commitment and dispatch module is opaque and admittedly simplistic, in ways that are clearly of heightened importance in comparing technologies offered in this procurement. One value of the LCOE analysis I present is that it provides a fully transparent and straightforward assessment of the cost of proposals to ratepayers in a manner that provides the Commission with an additional analytical tool to inform its decision.

Q: Did you review the Strategist results and CPVRR estimates that DEF presented in this docket?

A: Yes. In particular, I reviewed the Strategist inputs and outputs that were provided to me in DEF's responses to Calpine Interrogatories 6 and 7, and that I understand to be associated with the Calpine Osprey Facility, known as PPA1 and Acquisition 2 in Exhibits BMHB-8,-9, and -10. Company witness Borsch asserts that Acquisition 2 had a $193 million CPVRR deficit compared to the DEF self-build option and that a PPA modeled from 2016-2021 and replaced by generic back-fill CC and CT units had a $129 million CPVRR deficit compared to the DEF self-build option. Mr. Borsch noted that the negative CPVRR in the acquisition case was "largely due to transmission system upgrades" required to incorporate the facility into the DEF system. Borsch Direct at 46. Notably, in Exhibit BMHB-9, Mr. Borsch also presented a range of CPVRR values for each bid. In this scenario, Acquisition 2 was modeled with a positive CPVRR of $39 million, under assumptions that are much closer in detail to the current Calpine offer being considered by DEF. (For example, this included a [redacted] "14LGBRA-NRGROG1-28-000001 – 000008 CONFIDENTIAL Results_Sensitivities_01212014A.xlsx") In Exhibit BMHB-10, Mr. Borsch presented a final, detailed economic analysis.

Q: What is your opinion on the Strategist results presented in this docket?

A: The key difference between a LCOE analysis and the Strategist model's CPVRR estimates is the incorporation of a production cost calculation in the Strategist analysis. LCOE analyses do provide insights into production cost impacts, in the sense that levelized costs are a function in part of the assumed capacity factors in the analysis. (As described above, in Exhibit No. PJH-__4, I present a chart that allows the Commission to see *explicitly* how different capacity factor assumptions or outcomes affect LCOE results.) Configured appropriately, production cost modeling can provide important insights and perspectives on resource operations and utilization over time, and on the likely value of resources on the system from an energy benefit perspective. However, in this instance, and based on the review of the information DEF has provided in this proceeding related to its Strategist analysis, I believe there are a number of questionable elements of the production cost component of that analysis that may seriously compromise the value of its results.

Q: Are you familiar with production cost modeling?

A: Yes. I have led or participated in numerous engagements as a consultant involving the use of production cost modeling to explore asset values and assess the cost or environmental impacts of various public policy choices. Specifically, in these projects we have used either Ventyx's Promod production cost modeling tool, or General Electric's GE MAPS tool. Both are transmission-constrained, hourly production cost modeling programs.

Q: Please explain your concerns with respect to the production cost elements of DEF's Strategist analysis in this case.

A: First, my understanding is that, in the interest of modeling time and integration with the other Strategist modules, the production cost modeling algorithm within Strategist is far more simplistic than standard production cost models – such as Promod and GE MAPS – that are more often used for investigative system dispatch simulation analyses. In particular, the Strategist model does not require an hourly dispatch approach (instead allowing the user to rely on a limited set of load representations, with results extrapolated into full-year calculations), nor does it dispatch the system with attention to constraints that may exist on individual transmission elements. Further, its representation of unit operational capabilities and the logic by which units are committed (or "turned on") and kept on in consideration of multi-hour variations in system load

- may fail to capture operational details that could be important in understanding the relative value of CC versus CT technologies on the Company's system.

In short, the quality or value of the Strategist production cost modeling results – in terms of unit capacity factors and unit production cost benefits – should be taken with a healthy degree of skepticism. In addition, the logic behind how units or resource portfolios are configured in the model, and how generic units are added over time, can obfuscate or wash out insights into the relative value of competing resource alternatives added today. Based on my review of the Strategist inputs and outputs provided to me in the course of this proceeding, I believe this is likely to be the case in this instance, and I have a number of serious reservations about other specific and key modeling choices – and thus the production cost modeling results – that affect CPVRR outcomes in this case.

For example, between 2018 and 2043, DEF included over 4,000 MW of generic combined cycle capacity in its Strategist modeling analysis, presumably to meet its 20 percent reliability margin and satisfy growth in retail peak load. However, this may represent an unwarranted and costly overbuilding of the system. While these generic CC additions meet the *peak load* requirements, their potential incremental contribution of energy vastly exceeds DEF's annual energy growth needs, as shown in Exhibit No. __ (PJH-5). The compound annual growth rate in the potential energy generation from these units, starting from the 2018 Citrus County addition, is 4.5 percent. This far exceeds the total energy demand growth rate of 1.0 percent over the 2014-2043 period. From a production cost perspective, this modeling choice has little or no impact on the value of the self-build Suwannee CTs, but tends to wash out the production cost value of Calpine's efficient CC capacity.

However, within the Strategist model, these generic units operate at a relatively high efficiency, with capacity factors between 60 and 80 percent, dramatically – and artificially – (1) reducing the utilization of Osprey (and other CC capacity on the system) and thus the positive energy benefit of that resource option, and (2) increasing the number of starts at Osprey by over 100 percent, increasing the cost of that resource option as shown in Exhibit No. __ (PJH-6).

In reality, the more prudent choice of resource additions from a ratepayer perspective would likely better utilize the energy capacity of the existing combined cycle fleet to meet growth in total energy requirements, probably using an optimized combination of more targeted CT and/or CC duct firing technology to meet future peak demand needs.

Q: Are you suggesting that DEF is committing to an over-build of expensive CC capacity in the future?

A: No. The addition of generic CC capacity is a modeling artifact. I would expect that over time as DEF's actual resource needs materialize, the Commission will expect DEF to select the best set of resources to meet growth in peak load and annual energy, in consideration of the load, resource, and cost expectations in place *at that time*. My point in raising this concern is to illustrate the way in which I believe future changes in infrastructure have been modeled in Strategist for this evaluation inappropriately and artificially discount the value of Osprey relative to the self-build option, and skew the CPVRR results in favor of the Company's proposed outcome.

Q: You have concluded that the production cost modeling component of Strategist likely understates the production cost benefit of Osprey relative to the competing self-build proposals. Can this be corrected without reconfiguration and re-running of the Strategist model at this time?

A: No, I do not believe it is possible to accurately "adjust" Strategist results after the fact for assumed differences in production cost modeling configurations. The only way to do this would be to re-run Strategist or – ideally – an alternative production cost modeling tool, under different scenarios and resource portfolios to develop a more accurate representation of the likely benefits and costs of competing proposals from a production cost perspective.

Q: Are there other elements of the Strategist modeling that may influence the results, and that can be adjusted after the fact?

A: Yes. There are a number of factors in the Company's CPVRR results tied to financial assumptions and the underlying capital and fixed costs of proposals that incorrectly represent the proposals before the Company and the Commission at this time. These factors can – and should – be corrected for the Commission to have an accurate portrayal of the impact of competing proposals on ratepayers. For example, the estimate of costs associated with transmission upgrades to fully capture the capacity value of the Osprey Facility is vastly overstated in the original CPVRR calculations. As described in the testimony of John Simpson, the actual cost to accomplish this – through a direct connect transmission upgrade that not only would allow integration of Osprey's full capacity to serve DEF's customers, but would also provide meaningful reliability benefits to the DEF and FRCC systems – is likely no more than $150 million, and could be less. Simpson Direct at 12. In addition, as described in the testimony of Todd Thornton, Calpine has reduced its acquisition sale price from $300 million to $[redacted] in 2020, accompanied by reduced capacity payments on a PPA from 2015 through 2019. Thornton Direct at 7-8. Since these factors only affect fixed costs and investments, they would not affect production cost modeling outcomes (which are a function of variable costs only). Thus, adjusted CPVRR results may be approximated by adjusting for different fixed cost and financial assumptions, holding all else equal.

Q: Have you evaluated the impact of these updated pricing changes on the CPVRR?

A: Yes, I have. Exhibit No.__ (PJH-7) highlights the results of these adjustments. In order to do this, I had to start with CPVRR results that DEF has already generated in this docket. Specifically, I start with DEF's CPVRR estimate of negative $193 million (compared with the self-build proposal) calculated for the acquisition of the Osprey Facility in 2014. After accounting for new estimates for the direct connect transmission upgrades, and including the CPVRR impacts of the acquisition and PPA costs of Calpine's current offer, and adjustments for gas reservation charges, I find that the CPVRR of an Osprey PPA/acquisition relative to the DEF self-build option is, at a bare minimum, positive $133 million.

Q: Do you believe this accurately captures the value to DEF's customers of the Osprey PPA/acquisition relative to DEF's proposed self-build projects?

A: No, I do not. In this recalculation, I only considered the impact of the timing and magnitude of capital costs on the total CPVRR. As described above, I believe that the way in which DEF structured its evaluation of proposals and calculated production cost costs and benefits likely understates the value of the Osprey Facility. This means that the negative $193 million starting point is, in my view, significantly overstated (i.e., more negative than it should be). Thus, if adjusted and corrected for the true dispatch value of the Osprey Facility, the positive recalculated CPVRR value for the Osprey PPA/acquisition would start at a less negative CPVRR number, and thus should significantly exceed the $133 million customer CPVRR benefit calculated for changes in generation and transmission capital costs and gas reservation adjustments presented in Exhibit No. __ (PJH_7).

Q: Please describe your capital cost adjustments to the CPVRR in greater detail.

A: In Exhibit No. __ (PJH-7), I made two adjustments to the capital costs for generation and transmission that I understand to have been included in Mr. Borsch's CPVRR estimates.

First, I estimated the impact of the new and lower acquisition price offered for the Osprey Facility. As noted in the testimony of Todd Thornton, Calpine provided DEF an updated offer including an acquisition price o[redacted] a closing on January 1, 2020. Accounting for the new PPA/acquisition offer required three steps.

The [redacted] sale price offers a significant value to ratepayers compared to the $300 million original sale price. In adjusting the CPVRR estimate for this new acquisition price, I first accounted for the impact on revenue requirements, including depreciation, return on rate base, and income taxes. I estimate that the impact of a $[redacted] reduction in sale price is equal to a net positive of [redacted] in CPVRR value.

Second, based on the information I reviewed, it appears that DEF originally modeled the acquisition purchase investment as happening in 2014. Duke Energy Florida, Inc., response to Calpine Construction Finance Company, L.P.'s First Set of Interrogatories to Duke Energy Florida, Inc. (Nos. 1-9), Competitively Sensitive Confidential Response 6a and 6l. (hereafter, "DEF IR"). However, pursuant to Calpine's offer, the asset purchase would be booked in 2020. Adjusting for this difference in terms of the time value of money, I estimated that an asset sale booked in 2020 instead of 2014 would result in an additional [redacted] benefit from a CPVRR perspective.

Calpine's current proposal also contains an initial five-year PPA prior to the acquisition starting at [redacted] in 2015, escalating to [redacted] in 2019. Thornton Direct at 7-8. Because I accounted for the acquisition in

2020, I added back into the CPVRR estimate the net present value of capacity payments under the updated PPA agreement. Pursuant to the terms of Calpine's offer, the capacity payments are based on the 515 MW of Osprey's contracted capacity under the PPA, even if prior to construction of the direct connect transmission upgrade DEF may not have access to the full capacity in certain hours of the year. The resulting total PPA capacity payments over this period are equal to approximately [redacted].

The net impact of these three adjustments is [redacted] in positive CPVRR benefits for ratepayers, as shown in Exhibit PJH-7A and PJH-7B.

Next, I also accounted for the lower estimates for transmission upgrades. Mr. Borsch included [redacted] in transmission costs for an acquisition scenario. DEF IR2. However, DEF's transmission expert Edward Scott noted that the best approach to integrating Osprey within DEF's system would be to establish a direct connection of Osprey to the DEF balancing authority area ("BAA") (the "direct connect" project), and that that could be completed with two new 230 kV transmission lines from Tampa Electric Company's Recker Substation to both the Kathleen and Haines City East substations at a total cost of approximately $150 million. Florida Public Service Commission, Docket No. 140111-EI, Direct Testimony of Ed Scott (hereafter "Scott Direct"), at ES-3, 2 of 4. Calpine's transmission expert John M. Simpson has confirmed that the cost of such a project is not likely to exceed this amount (and could be meaningfully less), and that in addition to addressing any DEF or third-party interconnection/upgrade requirements, such a direct connection would also provide a number of ancillary benefits to the DEF and Tampa Electric Company balancing authority areas. Simpson Direct at 15. I apply the same method as in the acquisition price adjustment above to estimate corrections to CPVRR for this lower transmission upgrade cost. In short, this improves the CPVRR of Osprey relative to the DEF self-build proposal by approximately [redacted].

The net impact of only these two adjustments for Calpine's updated PPA/acquisition offer and updated transmission cost estimates — is that an Osprey PPA/acquisition mix results in CPVRR benefits to ratepayers – relative to the DEF self-build proposal, of approximately [redacted]

Q: Are there other fixed costs in Strategist that the Commission should consider?

A: Yes, it appears that DEF has modeled Osprey with firm gas transport but failed to include a similar or comparable cost for the firm gas transportation service available to serve the Suwannee CT units. DEF IR6g and 10a. This creates issues of comparability, and puts Osprey at a cost disadvantage relative to the Suwannee CTs.

Q: What is the financial impact of including the costs for firm gas transportation service for some units but not for others?

A: The cost difference on a CPVRR basis is substantial. DEF modeled annual firm gas service for Osprey at [redacted] per year. DEF IR6g. On a net present value basis, this is equal to [redacted], assuming firm gas transportation costs are passed directly on to ratepayers. This single fact alone accounts for almost the full difference ascribed to an Osprey acquisition in this docket. DEF also included firm gas transportation service for an Osprey PPA scenario and the generic CT units that replace it in 2022.

However, I understand that DEF maintains long-term firm transportation agreements that support its existing plants and that DEF already has sufficient firm transportation for gas to the Suwannee location. Duke Energy Florida, Inc.'s Responses to NRG Florida LP's First Interrogatories Nos. 1-108 to Duke Energy Florida, Inc., Response 36. If this is indeed the case, then a true apples-to-apples comparison would allocate a portion of the existing firm fuel gas costs that would otherwise go to serve the new Suwannee CTs. That is, presumably DEF manages fuel commodity and transportation on a fleet-wide basis to minimize the overall cost of electricity generation to ratepayers, and optimizes existing commodity and transportation contracts across its fleet with this objective in mind. Yet in the analysis, DEF has existing natural gas transportation rights that are reserved to benefit their self-build unit in CPVRR calculations, but are not comparably credited to *a competing resource* that, if selected, would eliminate the need to assign such rights to the self-build resource.

In my view, this compromises the fairness of the resource evaluation, creates an unlevel playing field, and could contribute to solutions that are imprudent or not optimal from a ratepayer perspective. Because gas transportation contracts – are to some degree – transferrable products, DEF should be able to accommodate 320 MW of generation from *any* proposal in this docket under its existing gas transportation contracts. Therefore, in Exhibits PJH-__ 7a and 7b, I include an additional CPVRR adjustment of [redacted], which is equal to [redacted]

Q: What do you conclude based on your analysis?

A: Based on my review of a relatively simple set of adjustments to CPVRR results, I conclude that – even assuming that in all other ways DEF has appropriately modeled the resources compared in this procurement (which, as discussed above, I do not believe) – the Osprey PPA/acquisition is the best deal for ratepayers in terms of CPVRR.

The net effect of the adjustments I have described above – accounting solely for changes in capital costs for generation and transmission and fixed expenses related to gas reservation charges – has a total CPVRR benefit of $133 million. My adjustments reflect current conditions and a comparison of the two units that I believe is not only more appropriate, but is supported by DEF's own analysis in this docket. As I described above, Mr. Borsch also found that Acquisition 2 had a positive CPVRR of $39 million, under a scenario with a [redacted] million purchase price and [redacted] million in transmission costs, both of which are much closer in detail to the current Calpine offer being considered by DEF. "14LGBRA-NRGROG1-28-000001 – 000008 CONFIDENTIAL Results_Sensitivities_01212014A.xlsx"

Furthermore, as I describe below, Mr. Borsch also tested the sensitivity of his results to "construction cost[s]…, gas transportation contract risks, plant condition and maintenance risks, and transmission cost risks" among other things. The difference between the high and low sensitivity cases for the DEF self-build proposals was negative $176 million. To the extent that any of the DEF self-build proposals experience cost over-runs consistent with Mr. Borsch's assumptions, some portion of his negative $167 million and my positive $133 million CPVRR adjustments may be additive, suggesting even greater value to DEF ratepayers.

III.D. RATEPAYER RISKS

Q: In light of the fact that the proposals being reviewed by the Commission in this proceeding result from a competitive process, why do you think it is important to comment on ratepayer risks as part of your testimony?

A: In any competitive procurement involving utility and non-utility alternatives, it is vitally important that the Commission give due consideration to the different risks that procurement options have from the perspective of the utility's ratepayers. For decades, many public utility commissions – including this Commission – have required that utilities test self-build options through competitive solicitations in order to impose the discipline of competition on utility self-build project design and pricing. The goal of obtaining the best result for customers relies not only on competition to allow for discovery of the best offer prices from suppliers, but it also depends upon discovering and weighing any differences in the risk profile of the competitive offers. Price is certainly one aspect of getting the best deal for ratepayers; the development status and the terms and conditions under which a product is proposed at a particular price also affects the relative value of different competitive offers to consumers.

Q: Please explain further what you mean by the impact on consumers of the terms and conditions under which a product is supplied.

A: We see this relative "risk" principle at work often in the electric industry. Utilities must make decisions at one point in time about investments and other commitments that could be greatly affected by events that will occur much later, and which may or may not comport with the original expectations. Development uncertainty can lead to delays, changes in costs, and unexpected outcomes. Labor and material costs change. Fuel prices change. Public policy will change. Consumer habits change. Countless things can change, so that – after the fact – the original decision to select a particular power plant may end up looking like a very good deal or a very bad failure. Many of these conditions – variations in development status and permitting requirements, open versus guaranteed pricing, and uncertain versus guaranteed performance – are before the Commission in this case.

Q: In your view, does Calpine's proposal appropriately manage the risks related to new resource acquisition?

A: Yes. From a customer's perspective, the risk profiles of the various options available to DEF are significantly different. DEF, for example, seeks to pass through to ratepayers a return of and on the actual dollars of power plant investment (into utility rate base), including any cost overruns, provided the Company can demonstrate that any cost overruns "…were prudently incurred and due to extraordinary circumstances." DEF IR9, Docket No. 140110-EI. In other words, while DEF has provided an estimate of the costs to develop, permit and construct the Suwannee CTs – and that estimate is the basis for evaluating its proposal relative to other proposals – if the actual costs come in much higher, DEF surely expects to recover the additional costs unless the cost overruns could be proven to be due to incompetence or imprudence in project management. For the purposes of my analysis, I have assumed a $197 million total cost for the Suwannee CTs, even though there may still be uncertainty in DEF's expectation of ultimate costs. For example, as included in Exhibit BMHB-2, Schedule 9, as recently as January 2014 DEF estimated a total installed cost of $661.57/kW. Based on 316 MW of summer capacity, this equates to an installed cost of $209 million. In addition, it is not possible to know with certainty how reliably and efficiently the facility will operate when needed until it has been constructed and operated under normal and peak system conditions.

By contrast, the cost to ratepayers of accepting Calpine's offer of the PPA and acquisition for the Osprey Facility are fully known at this time. The acquisition price is set; the annual costs of the PPA are set; the operational heat rate and performance of the facility through the term of the PPA is guaranteed; additional variable costs associated with fuel transportation and operations and maintenance are known; and the condition of the plant – and its ability to operate reliably and at a high level of availability – have been demonstrated and established through operating experience.

This difference in risk profiles is an important consideration both from the perspective of risks borne by ratepayers, and from the perspective of how fairly resources have been compared in this docket. In effect, the Commission knows now with certainty what ratepayers will pay over time for power from the Osprey Facility, what performance Calpine is obligated to provide from the perspectives of capacity availability and operational performance over the term of the PPA, and what to expect in terms of plant operations and performance once the Osprey Facility is acquired by DEF. Also, as discussed in Section IV below, CC generation is a less risky proposition from a long-term market perspective because it more effectively hedges against uncertainty related to environmental policy, fuel price forecasts and longer-term market trends due to the fundamental difference between CC and CT units in terms of unit efficiency; that is, CC units like Osprey simply burn less fuel and emit lower quantities of pollutants per unit of energy generated.

In short, compared to DEF's proposal to construct the Suwannee CTs, from the perspective of ratepayers, Calpine's Osprey proposal can be viewed as a low-risk proposition that hedges ratepayer risk, via the terms of a binding, guaranteed contract with a firm acquisition price, to the maximum extent possible. In my view, this constitutes a meaningful difference in proposal attributes and allocation of risk, which should be factored into the Commission's decisions about which offers provide the best "price" and "value" to ratepayers.

Q: Did DEF evaluate any risks in its analysis?

A: DEF did not incorporate any consideration of self-build risks in its baseline evaluation of proposals in this procurement. Consequently, DEF's presentation of best-estimate CPVRR results of competing proposals – and its conclusion that the best option for ratepayers is the self-build proposal – are based on an evaluation process that does not factor in ratepayer risks. However, DEF does evaluate the potential impact of various risks in a modeling sensitivity. In Exhibit BMHB-9, Mr. Borsch presents the results of a sensitivity analysis related to construction cost risks, gas transportation contract risks, plant condition and maintenance risks, and transmission cost risks tied to the Suwannee and Hines projects. The result shows the self-build option incorporating potential downside project development and construction risks has a negative CPVRR of $167 million, relative to the base case. As I discussed in Section III.C above, this assessment is independent of the CPVRR adjustments I have made for the Osprey PPA/acquisition, which accounts for the current and known value of the Osprey acquisition price, updated transmission cost estimates, and sensitivity to gas transportation costs.

IV. CALPINE'S OFFER PROVIDES SUBSTANTIAL BENEFITS RELATIVE TO ALTERNATIVES FROM RELIABILITY, FLEXIBILITY, AND ENVIRONMENTAL PERSPECTIVES

Q: Are lower costs and reduced cost-related risks the only benefits of the Osprey Facility compared to the Company's self-build alternative?

A: No. Calpine's Osprey Facility – when compared to DEF's self-build alternative – provides a number of additional benefits not fully captured in LCOE or CPVRR analyses from the perspectives of power system reliability, flexibility, and environmental impacts. These are important considerations for the Commission at a time of significant uncertainty and change in the electric sector, with highly uncertain growth in peak load and energy consumption, pending and emerging federal requirements related to the air, water, and solid waste impacts of electric generating facilities, and significant developments in the pricing and transportation of natural gas (for heating, process needs, and power generation).

Q: Please describe the benefits of Osprey's more efficient CC capability relative to the CT capability of Suwannee.

A: To a certain extent, the LCOE and CPVRR analyses described above can reveal how the greater efficiency of CC technology (compared to CT technology) can provide benefits to DEF's system from a total production cost perspective. Yet there are a number of additional benefits of CC technology that flow from the greater efficiency of CC technology (compared to CT technology) tied to the roles that such facilities play in system operations. CT capacity is effective in providing capacity at times of system peak or otherwise when stressed system conditions require operation of peaking capacity. When committed, CT units can also provide load-following services to help the system operator meet instantaneous and longer-term variations in system load.

However, the contribution of CTs to load following and to otherwise helping manage variations in system conditions is restricted by the limited hours in the year that it is efficient to commit and operate these units. More efficient CC capacity is simply available far more to help meet system needs across a wider range of hours and system load conditions. As an efficient CC unit, Osprey would be able to help DEF meet customer demands in baseload, cycling and peaking modes. Further, Osprey would be available to provide load-following or reserve services across many more hours of the year, and under a greater variety of system load/generation configurations. For example, Osprey would likely be operating for well over 6,000 hours at various levels of output in the year to help meet system needs, compared to on the order of 1,000 hours or less for the Suwannee CTs operating at 10 percent capacity factor.

Q: Are there ancillary system benefits for DEF associated with the Osprey PPA/acquisition?

A: Yes. As noted earlier, and described in the testimony of John Simpson, the acquisition of the Osprey Facility will involve the construction of the "direct connect" transmission project, which will allow access to and availability of the full capability of the Osprey Facility in all hours of the year, and will address all system upgrade needs on DEF or third-party systems to ensure continued reliable operations. In addition, the direct connect transmission infrastructure will provide additional reliability benefits to the systems of DEF and the broader FRCC. Simpson Direct at 15. In contrast, selecting the Suwannee CTs will not involve any beneficial transmission system upgrades and will, in fact, require the retirement of existing generating capacity at the Suwannee location in order to accommodate interconnection of the new peaking facilities. Simpson Direct at 16-17.

Thus, by selecting Calpine's offer for the Osprey PPA/acquisition, DEF will (a) obtain a resource and system upgrades that can meet its stated resource needs at a cost that is in the best interest of ratepayers, (b) will do so in a way that will improve system reliability through strengthening transmission infrastructure, and c) access available efficient CC capability that can operate and contribute to system operations in far more hours of the year than the Suwannee CTs.

Q: Would acquisition of Osprey help DEF manage load and resource uncertainty in the coming years?

A: Yes. In Section III above, I describe my findings with respect to the relative cost benefits of DEF accepting Calpine's PPA/acquisition offer for the Osprey Facility. However, in addition to being a better deal for ratepayers at the outset, the Osprey PPA/acquisition would offer DEF important option value with respect to major future capital investments to meet customer needs over the next several years.

Q: Please explain what you mean by "option value."

A: Yes. In my view, there is a relatively high degree of uncertainty with respect to growth in DEF's system peak load and annual energy requirements in the coming years. While the coming retirements on DEF's system do appear to create a need for new capacity in the latter half of this decade, the magnitude and timing of that need are strongly dependent on (1) the quantity of capacity added in early years, (2) the actual level of peak load and annual energy growth compared to forecast quantities, and (3) the timing of retirement additions and resource additions. In this context, there is a potentially high "option value" in actions or decisions that can delay major capital investments.

By way of example, it is my understanding that the current air permits at Crystal River 1 and 2 allow the units to remain in operation through 2020, under the Mercury and Air Toxics Standard ("MATS") compliance limit using the site-wide averaging provision and activated carbon injection systems at CR4 and 5. Order No. PSC-14-0173-PAA-EI, Docket No. 130301-EI at 3. Delaying investment in (and recovery in rates of) the Citrus County CC units by just one year could mean $59 million in CPVRR benefits for ratepayers, even while accounting for the increased O&M expenses necessary to operate Crystal River with new pollution controls in place. (In this estimate, I did not, however, include any additional costs for changes in the 1-hour National Ambient Air Quality Standard ("NAAQS") for sulfur dioxide ("SO_2") emissions or 316(b) mitigation, as discussed in DEF responses to the Office of Public Counsel First Set of Interrogatories, Served July 1, 2014. In my view it remains unclear whether an additional year of operation would require additional significant costs beyond operational changes). Furthermore, the reliability concerns associated with outages or reductions related to CR4 and 5 that might impact the site-wide emissions averages may be reduced under a scenario with the full energy output of both Osprey and Hines available in 2019.

While this exercise means little if demand growth, retirement, and the timing of resource additions are known with certainty at this time, it can mean a great deal for ratepayers when, as now, the Company is proceeding with a major infrastructure turnover over a relatively short period of time.

Q: Why do you believe the Osprey PPA/acquisition could provide some option value for DEF and its ratepayers?

A: The Osprey PPA/acquisition may provide option value in the context of a combined view of both the pre-2018 procurement and post-2018 (i.e., the Citrus County CC units), in that it represents a resource (1) that is in operation, with no uncertainty regarding commercial operations, capabilities, or ability to contribute to system operations; (2) that is large enough to meet system needs through 2017 and possibly longer depending on how load and resource outcomes compare to current projections and plans; and (3) in combination with the construction of the Hines Chillers, could allow for some period of delay in the construction of the Citrus County CC capacity if peak load and annual energy requirements do not grow as fast as currently forecast by DEF.

Q: Have you concluded that the Company's forecasts of load/energy growth or the timing of resource addition and attrition are wrong?

A: No, I have not. The Company, the Commission, and stakeholders have all worked over the past several years to understand the potential timing of resource changes and the potential that changing economic factors will lead to rates of growth in peak load and energy requirements that depart from recent experience. I am not suggesting that the Commission second-guess those planning efforts. However, based on my experience over decades as a utility regulator and consultant, I recognize that the type of resource and forecast assumptions that go into the Company's determination of resource needs are just that – assumptions – and are almost certain to deviate from what actually transpires in the coming years. The Commission has recognized this fact in its ten-year site plan reviews, finding that in recent years, the absolute average error in retail energy sales forecasts has increased to almost 20 percent, and that even the best forecast errors have ranged between 1 and 3 percent. Review of the 2013 Ten-Year Site Plans, For Florida's Electric Utilities, Florida Public Service Commission, October 2013 at 20. Compounded over several years, these deviations can lead to significant variations in actual demand.

In consideration of this, any resource decision that has the potential to delay major investments can save ratepayers money in the long run, and thus provide an option value that should be considered in resource decision making. In the context of the pre-2018 resource need, Osprey provides some flexibility around the timing of commercial operation of the Hines Chillers projects. In the context of the post-2018 resource need, Osprey provides some flexibility around the timing of the Citrus County CC units.

Q: What do you conclude based on your consideration of these factors in the context of this procurement?

A: Based on my review of these factors, I believe that a decision by the Commission to require that DEF accept Calpine's offer for the Osprey PPA/acquisition could provide substantial option value benefits for DEF's ratepayers, and introduces a key element of flexibility for DEF as it embarks on a major period of infrastructure turnover over the next several years. As noted above, I do not believe that considering this benefit is necessary to conclude that the Osprey proposal is the best deal for ratepayers. However, the potential for option value benefits increases the advantage of selecting the Calpine proposal in the pre-2018 procurement.

Q: Do you believe acquisition of the Osprey Facility – compared to the Suwannee CTs – can provide other benefits from a public policy perspective?

A: Yes. I believe that selecting Osprey in this acquisition would allow DEF and the State of Florida to capitalize on the wide-ranging human health, climate risk mitigation, and environmental benefits that flow from using an already-built and operational, efficient, and low-emitting (in terms of emissions per megawatt-hour) resource instead of a (by comparison) relatively inefficient and higher-emitting Suwannee CT project – one that while on an existing site, would still involve new construction activities. The relative impact of CT versus CC technologies from an emission perspective is presented in Exhibit No. __ (PJH-8).

This exhibit shows emission rates from each unit proposed in this solicitation on a pounds per MWh ("lb/MWh") basis. In other words, the exhibit provides a true apples-to-apples environmental comparison of the projects with respect to the level of emissions that result from production of an equivalent amount of energy. The emission rates for the Osprey Facility are lower than the Suwannee CTs by [redacted]b/MWh, or 33 percent for nitrogen oxides (NO_x), and [redacted]/MWh or 42 percent for CO_2. These emission rates are primarily a direct function of the relative energy efficiency (i.e., heat rates) of the respective projects; in simple terms, using less fuel per MWh results in less air pollution per MWh generated. In addition, by adding the Osprey CC resource at this time, DEF may realize additional emission reduction benefits to the extent that Osprey displaces output from less-efficient existing fossil-fueled resources on the DEF system.

V. CONCLUSIONS

Q: In your opinion, does DEF's self-build plan, i.e., constructing the Suwannee CTs and the Hines Chillers, represent the most cost-effective alternative for Duke's customers?

A: No, DEF's self-build projects are not the most cost-effective alternatives for DEF and its customers. I come to this conclusion because I find that DEF's modeling and analysis occur largely within a black box, appear to be oversimplified and structurally biased from a production cost benefit perspective, and inherently – and inappropriately – favor the Company's self-build alternative. A more careful, common-sense review of the drivers of ratepayer impact associated with the various options reveals that by moving forward as proposed by DEF, DEF's ratepayers will likely incur significant additional costs and risks than they would if instead of building the Suwannee CTs, Calpine's offer is accepted. Based on my estimates presented above, Calpine's value from a ratepayer perspective is at least a $133 million benefit relative to DEF's self-build proposal, it and could be significantly greater to the extent that the Company's self-build alternative ends up more expensive than current estimates.

Q: In your opinion, is the acquisition of the capacity of the Osprey Facility, through the combination of a 5-year PPA followed by direct acquisition of Osprey by DEF, as proposed to DEF by Calpine, a more cost-effective alternative for Duke's customers?

A: Yes, it is. I come to the conclusion that selecting Osprey is the best outcome for ratepayers based on (1) a fully transparent comparison of the levelized costs of various alternatives; (2) a recalculation of cumulative present value revenue requirements starting from DEF's own calculations, with just a few reasoned adjustments reflecting current conditions and correcting for mistakes in the original analysis; (3) a review of the lack of transparency and apparent flaws in DEF's modeling approach and documentation; and (4) consideration of the nature and characteristics of risks born by ratepayers under DEF's self-build proposal, compared with selecting Calpine's offer.

Q: In your opinion, did the Company adequately consider the relevant and significant non-cost factors associated with an acquisition of the Osprey Facility?

A: No, they did not. I find that selection of Calpine's proposed PPA/acquisition of the Osprey Facility would provide a number of additional benefits from the perspectives of power system reliability, flexibility, and environmental impacts. Specifically, I identify additional benefits that include (1) the relative value of more efficient combined cycle capacity (like the Osprey Facility) – compared to combustion turbine-only capacity – to meet DEF's changing resource needs and system conditions across multiple operating modes (baseload, intermediate, and peaking); (2) the option value provided by the higher capacity of the Osprey Facility compared to the Suwannee CTs, which would allow for greater flexibility for DEF to alter the timing of major new capital investments in future years (such as the proposed Citrus County facility) should load growth and/or resource availability deviate from current expectations; and (3) the wide-ranging human health and environmental benefits that flow from using the already-built and operational, efficient, low-emitting (in terms of emissions per megawatt-hour) Osprey capacity instead of the new-construction, relatively inefficient, and higher-emitting Suwannee CTs.

Q: Considering the results of the LCOE analysis, CPVRR analysis, and additional non-cost factors that you have identified in your testimony, what should DEF have done with respect to Calpine's proposals?

A: Considering both the economic results and the numerous additional factors that are not directly related to costs and cost-effectiveness, I believe DEF should have accepted – and should now accept – Calpine's offer.

Q: In your opinion, what action should the Commission take with respect to DEF's Petition?

A: The Commission should deny DEF's Petition. Calpine has made an offer to DEF that represents a low-cost, low-risk, reliable, efficient, and environmentally-responsible resource choice. DEF's analysis of alternatives fails to appropriately capture these many value streams, overstates the value of their own self-build alternative (in particular the Suwannee CTs), and understates the value of the Calpine offer. A reasonable evaluation of these alternatives, a common-sense comparison of facilities' levelized costs, and a review of important reliability, health, environmental and policy factors suggests that the best option for DEF's ratepayers would be for DEF to accept Calpine's offer.

Q: Does this conclude your testimony?

A: Yes.

Exhibit PJH-1
Curriculum Vitae

Paul J. Hibbard
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EDUCATION

Ph.D. program (coursework), Nuclear Engineering, University of California, Berkeley

M.S. in Energy and Resources, University of California, Berkeley
Thesis: Safety and Environmental Hazards of Nuclear Reactor Designs

B.S. in Physics, University of Massachusetts, Amherst

PROFESSIONAL EXPERIENCE

2010 - Present Analysis Group, Inc., Boston, MA
Vice President

2007 - 2010 MA Department of Public Utilities, Boston, MA
Chairman
Member, Energy Facilities Siting Board
Manager, New England States Committee on Electricity
Treasurer, Executive Committee, Eastern Interconnect States' Planning Council
Representative, New England Governors' Conference Power Planning Committee
Member, NARUC Electricity Committee, Procurement Work Group

2003 - 2007 Analysis Group, Inc., Boston, MA
Vice President
Manager ('03 – '05)

2000 - 2003 Lexecon Inc., Cambridge, MA
Senior Consultant
Consultant ('00 – '02)

1998 - 2000 Massachusetts Department of Environmental Protection, Boston, MA
Environmental Analyst

1991 - 1998 Massachusetts Department of Public Utilities, Boston, MA
Senior Analyst, Electric Power Division

1988 - 1991 University of California, Berkeley, CA
Research Assistant, Safety/Environmental Factors in Nuclear Designs

OTHER PROFESSIONAL ACTIVITIES

Advisory Board, Advanced Energy Economy (2011).

SELECTED REPORTS, TESTIMONY AND PRESENTATIONS

"Project Vigilance: Value of Ambri Batteries at Joint Base Cape Cod," Presentation to Raab Restructuring Roundtable, Boston MA, June 2014.

Hibbard, Paul and Todd Schatzki, *Further Explanation on Rate Calculations*, Memo to ISO New England Markets Committee on setting the compensation rate for the ISO Winter Program, May 28, 2014.

Hibbard, Paul J., Susan F. Tierney, and Pavel G. Darling, *Economic Impact of the Green Communities Act in the Commonwealth of Massachusetts: Review of the Impacts of the First Six Years*," March 4 2014.

Paul J. Hibbard and Andrea Okie, *Crediting Greenhouse Gas Emission Reductions from Energy Efficiency Investments: Recommended Framework for Proposed Guidance on Quantifying Energy Savings and Emission Reductions in Section 111(d) State Plans Implementing the Carbon Pollution Standards for Existing Power Plants*, Report for Environmental Defense Fund, March 2014.

"Climate Policy and the Economy," Presentation to 2014 JISEA Annual Meeting, NREL, Golden CO, March 2014.

Federal Energy Regulatory Commission, Docket Nos. ER14-1050-000 and ER14-1050-001, Testimony of Paul Hibbard and Todd Schatzki on Behalf of ISO New England Inc., February 12, 2014.

Hibbard, Paul, Steve Carpenter, Pavel Darling, Margaret Reilly, and Susan Tierney, *Project Vigilance: Functional Feasibility Study for the Installation of Ambri Energy Storage Batteries at Joint Base Cape Cod*, Report for demonstration project under the MassInnovate Program of the Massachusetts Clean Energy Center, February 2014.

State of Minnesota, Minnesota Public Utilities Commission, MPUC Docket No. E-002/CN-12-1240, Rebuttal Testimony of Paul Hibbard, October 18, 2013.

State of Minnesota, Minnesota Public Utilities Commission, MPUC Docket No. E-002/CN-12-1240, Direct Testimony of Paul Hibbard, September 27, 2013.

"Market Monitoring at US RTOs," Presentation to 12th Annual Gas and Power Institute, Houston, TX, August 2013.

Hibbard, Paul and Todd Schatzki, *Assessment of the Impact of ISO-NE's Proposed Forward Capacity Market Performance Incentives*, Report to ISO New England, September 2013.

Testimony of Paul J. Hibbard before the Massachusetts Department of Public Utilities on behalf of the Massachusetts Department of Energy Resources, DPU 13-07, May 31, 2013.

Testimony of Paul J. Hibbard before the House Committee on Energy and Commerce, Subcommittee on Energy and Power, *The Role of Regulators and Grid Operators in Meeting Natural Gas and Electric Coordination Challenges*, March 19, 2013.

Hibbard, Paul, Andrea Okie and Susan Tierney, *California's Advanced Energy Economy – Advanced Energy Business Leaders' Perspectives and Recommendations on California's Energy Policies*, Prepared for the Advanced Energy Economy Institute, February 2013.

Paul Hibbard, *Information from the Literature on the Potential Value of Measures that Improve System Reliability*, Memo to ISO New England, January 24, 2013.

Paul Hibbard, *Information on the Range of Costs Associated with Potential Market Responses to Address the Risks Associated with New England's Reliance on Natural Gas*, Memo to ISO New England, January 24, 2013.

Craig Aubuchon and Paul Hibbard, *Summary of Quantifiable Benefits and Costs Related to Select Targeted Infrastructure Replacement Programs*, Report for the Barr Foundation, January 2013.

Hibbard, Paul J., Andrea M. Okie, and Pavel G. Darling, *Demand Response in Capacity Markets: Reliability, Dispatch and Emission Outcomes*, The Electricity Journal, November 2012.

"The Electric Generation Landscape – A Marathon of Challenges," Presentation to SNL Generation Landscape, Chicago IL, October 2012.

"Economics, EPA, and Old Capacity…Bring Out Your Dead," Presentation to LSI Energy in the Northeast, Boston MA, September 2012.

Hibbard, Paul J., *Reliability and Emission Impacts of Stationary Engine-Backed Demand Response in Regional Power Markets*, Report to the U.S. Environmental Protection Agency on behalf of Calpine Corporation, August 2012.

"Uncertainty in Electricity Infrastructure Development – Key Drivers, International Context," Presentation to NCEA Annual Conference, Brainerd, MN, June 2012.

Hibbard, Paul J. and Todd Schatzki, *The Interdependence of Electricity and Natural Gas: Current Factors and Future Prospects*, The Electricity Journal, May 2012.

"Economic Impacts of RGGI," presentation to the New Hampshire Environmental Business Council, April 2012.

Testimony of Paul J. Hibbard before the California Legislature, *The Economic Impacts of RGGI's First Three Years*, California Select Committee on the Environment, the Economy, and Climate Change, March 27, 2012.

Testimony of Paul J. Hibbard before the New Hampshire Legislature, *RGGI and the Economy – Following the Dollars*, NH House Committee on Science, Technology, and Energy, February 14, 2012.

Testimony of Paul J. Hibbard before the Massachusetts Legislature, *RGGI and the Economy – Following the Dollars*, Massachusetts Senate Committee on Global Warming and Climate Change, February 13, 2012.

"Economic Impacts of RGGI: Following the Dollars," presentation (with Sue Tierney) to the California Business Climate Network, February 2012.

Hibbard, Paul J. and Susan F. Tierney, *Carbon Control and the Economy: Economic Impacts of RGGI's First Three Years*, The Electricity Journal, December 2011.

"Public Policy Transmission: Competition and Cooperation," presentation to the Energy Bar Association Renewables Subcommittee, Washington DC, November 2011.

"Competitive Markets and Wind Power: Challenge and Opportunity," presented to the Governors' Wind Energy Coalition, Washington DC, November 2011.

Hibbard, Paul J., Susan F. Tierney, Andrea M. Okie and Pavel G. Darling, *The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States; Review of the Use of RGGI Auction Proceeds from the First Three-Year Compliance Period*, November 15, 2011.

Testimony before the Pennsylvania Public Utilities Commission on Retail Opt-In Auctions, November 10, 2011.

"Interdependence and Opportunity: The Growing Link Between Electricity and Natural Gas," presentation to the COGA Energy Epicenter Conference, Denver CO, August 2011.

"Potomac River Generating Station: Update on Reliability and Environmental Considerations," with Pavel Darling and Susan Tierney, July 19, 2011.

Hibbard, Paul J., *Retirement is Coming; Preparing for New England's Capacity Transition*, Public Utilities Fortnightly, June, 2011

Schatzki, Todd, Paul Hibbard, Pavel Darling and Bentley Clinton, *Generation Fleet Turnover in New England: Modeling Energy Market Impacts*, June, 2011.

"*Solar Development Incentives: Status of Colorado's Solar PV Program, Practices in Other States, and Suggestions for Next Steps,*" with Susan Tierney and Andrea Okie, June 30, 2011.

"The Balancing Act: Challenges in Traversing the Modernization of New England's Infrastructure," presentation to NECA Annual Conference, Mystic CT, May 2011.

"Renewables v. Gas: The Future of New England Infrastructure," presentation to the EBC Energy Seminar, Waltham, MA, April, 2011.

"Upcoming Power Sector Environmental Regulations: Framing the Issues About Potential Reliability/ Cost Impacts," presentation to Raab Restructuring Roundtable, Boston MA, October 2010.

"Carbon Regulation: Action and Convergence Spanning the Pond," presentation to Energy Smart Conference, Boston MA, October 2010.

"Renewables Development – A Tricky Time to be Placing Bets," presentation to NECA Renewables Committee, Boston MA, October 2010.

"Energy Infrastructure Challenges in the Current Policy Environment, A Wide Angle Point of View," presentation to NARUC, Providence RI, September 2010.

"Ensuring a Clean, Modern Electric Generating Fleet while Maintaining Electric System Reliability," with Susan F. Tierney, Michael J. Bradley, Christopher Van Atten, Amlan Saha, and Carrie Jenks. August 2010.

"Renewables Development – National Policies, New England Progress," presentation to National Association of State Energy Officials Annual Meeting, Boston MA, September 2010.

"Northeast US and Eastern Canada – Competitive Markets and Renewable Resource Development," presentation to LSI Conference on US/Canada Energy Transactions, Vancouver BC, August 2010.

"Renewables in the Northeast – Local Opportunities, National Context," presentation to Council of State Governments, Portland ME, August 2010.

"Deregulation and Sustainable Energy," class lecture, MIT (Jonathan Raab Energy Course), Cambridge MA, March 2010.

"Transmission for Renewables," presentation to Raab Restructuring Roundtable, Boston MA, March 2010.

"Federal Transmission Legislation," comments to Capitol Hill Briefing of the Coalition for Fair Transmission Policy, Washington DC, April 2010.

"Transmission Planning & Cost Allocation Alternatives under Order 890," comments to the Energy Bar Association's 64th Meeting, Washington DC, April 2010.

"US Electric Power Transmission: The Battle of the Jurisdictions," comments to CERAWeek 2010, March, 2010.

"New England Blueprint and the Federal Context," presentation to ISO-NE Consumer Liaison Group Meeting, Westborough MA, February 2010.

"Interconnection-Wide Planning and Renewable Energy," comments to the National Wind Coordinating Collaborative, Transmission Update Briefing, December 2009.

"Infrastructure Planning," comments to Northeast Energy and Commerce Association Power Markets Conference, Westborough MA, November 2009.

"Transmission for Renewables - Risks and Opportunities for the Northeast," Presentation to Governor's Clean Energy Innovation Forum, New Brunswick, NJ, October 2009.

"Renewable Energy Development – The Role of Markets and Planning," presentation to Northeast Power Planning Council General Meeting, Cambridge MA, September, 2009.

"Transmission Planning," comments to FERC Technical Conference on Transmission Planning Processes Under Order No. 890, Docket No. AD09-8-000, Philadelphia, PA, September, 2009.

"New England Governors' Blueprint – Purpose and Context," presentation to the Raab Restructuring Roundtable, Boston MA, September 2009.

"Wind, Transmission, and Federal Legislation," comments to MIT Wind Group, Cambridge MA, Fall, 2009.

"National Transmission Policy," comments to The Energy Daily's Transmission Siting Policy Summit, Washington DC, September 2009.

Testimony to the Massachusetts' Joint Committee on Telecommunications, Utilities and Energy Hearing to Review Implementation of the Green Communities Act, Boston MA, July 8, 2009.

"Federal Transmission Legislation," comments to the National Association of State Utility Consumer Advocates, Boston MA, July 2009.

"Renewable Energy Development - The Role of Markets and Planning," presentation to Governor's Wind Energy Coalition, Washington DC, July 2009.

"Transmission and Renewables: ISO and Regulator Perspectives" comments to the Raab Restructuring Roundtable, Boston MA, June 2009.

"Renewable Development In and For New England; Massachusetts' Perspective," presentation to Law Seminars International, Boston MA, June 2009.

"Roadmap to New Renewable Resources in New England," comments on New England Governors' Blueprint to NECPUC Annual Symposium, Newport, RI, May 2009.

"Comments of Chairman Paul Hibbard," presented to EBC Energy Seminar: New Transmission – The Key to Renewable Resource Integration in New England, Boston MA, April, 2009.

"Coordinating Wind and Transmission Development – Who Pays?" Comments to 2009 Platts Wind Power Development Conference, Chicago, IL, March, 2009.

"Integrating Energy and Environmental Regulations in Massachusetts," presentation to Northeast Sustainable Energy Association Building Energy Conference'09, Boston, MA, March, 2009.

"One Reason for the GCA: Energy Pricing in Massachusetts," presentation to the South Shore Coalition, Hingham MA, January 2009.

"Non-Reliability Transmission: State Choice and Control," presentation to the New England Conference of Public Utility Commissioners Transmission Group, Chelmsford MA, January 2009.

"Regulation and Renewable Energy Policy," panel moderator, Center for Resource Solutions National Renewable Energy Marketing Conference, Denver, CO, October, 2008.

"Energy Pricing in Massachusetts (...And What We Should Do About it)," presentation to Berkshire Gas Large Commercial and Industrial Customer Annual Meeting, Lenox MA, October, 2008.

"Conversation With Chairman Hibbard," presentation to New England Energy Alliance, Boston MA, September, 2008.

"Creating the Path: Delivering Clean Energy through Transmission Improvements," presentation to ISO-NE Lights, Power, Action Conference, Boston MA, September, 2008.

"Distributed Resources, the Decoupling Model, and the Green Communities Act," presentation to Raab Restructuring Roundtable, Boston MA, September, 2008.

"Resource Planning: The Contribution of Efficiency and Renewables in Massachusetts," presentation to Law Seminars International Renewable Energy in New England Conference, Boston MA, September 2008.

"Remarks to Economic Studies Working Group," ESWG Committee Meeting, Westborough MA, July 2008.

"Power Trade: Market Context and Opportunities," presentation to New England Governors' Council/Eastern Canadian Premiers' Energy Dialogue, Montreal Canada, May 2008.

"New England Transmission Investment," presentation to Municipal Electric Association of Massachusetts Annual Business Meeting, North Falmouth MA, April 2008.

"Bringing Power from the North," presentation to the Raab Restructuring Roundtable, Boston MA, February 2008.

"Natural Gas: Drivers of Supply, Demand, and Prices," comments to Guild of Gas Managers, November 2007.

"Generation and Demand Outlook for New England," presentation to NECA Dinner Meeting, Cambridge MA, September, 2007.

"Comments on ISO's Draft Regional System Plan," presentation to ISO Planning Advisory Committee, Boston MA, September 2007.

"Regulatory Pressures, Policy Opinions," presentation to Environmental Business Council, Boston MA, July 2007.

"Is New England Ensuring the Adequacy and Cost Effectiveness of the Region's Transmission Grid?" Panel moderator, New England Conference of Public Utility Commissioners Annual Symposium, Mystic CT, June 2007.

"Energy Regulation in Massachusetts – Concerns and Options," presentation to the Raab Restructuring Roundtable, Boston MA, June, 2007.

"View From the Regulatory Bench," comments to the New England Energy Conference and Exposition, Groton CT, May 2007.

"Energy for New England – The Demand, Supply and Price Context," presentation to Massachusetts Municipal Wholesale Electric Cooperative Annual Meeting, Boylston MA, May 2007.

"Demand Resources in New England: New Opportunities and Future Directions," Presentation at ISO-NE Annual Demand Resources Summit, Westborough MA, May 2007.

"Power Supply for the New England Region," presentation to the Boston Bar Association, Boston MA, March 2007.

"Fuel Supplies and the Need for Fuel Diversity: Forecast for Global Fuel Markets and the Likely Impact on Electric Generation in the Northeast," presentation to LSI Seminar on Resource Adequacy and Reliability in the Northeast, October 16, 2006.

"Consumers and Politicians Claim They Want Cheap, Reliable and Clean Energy – Do They Have the Will to Make That Happen?" – presentation to NAESCO New England Regional Meeting, September 28, 2006.

"The Need for New LNG Infrastructure in Massachusetts and New England: An Update," Report prepared for Northeast Gateway Energy Bridge, L.L.C., and Algonquin Gas Transmission, LLC, August, 2006.

"Natural Gas & LNG for New England: What's Needed & How To Get It," presentation to the Foundation for American Communications Meeting on *New England's Energy Needs – Who Pays and Who Suffers?*" May 17, 2006.

"Energy Policy Act Section 1813 Comments: Report of the Ute Indian Tribe of the Uintah and Ouray Reservation for Submission to the US Departments of Energy and Interior," (with Susan F. Tierney, and In Cooperation With The Ute Indian Tribe of the Uintah and Ouray Reservation), May 15, 2006.

"US Energy Infrastructure Vulnerability: Lessons From the Gulf Coast Hurricanes," Report to the National Commission on Energy Policy, March 2006.

"New England Energy Infrastructure – Adequacy Assessment and Policy Review" (with Susan F. Tierney), prepared for the New England Energy Alliance, November, 2005.

"Federal Legislative Developments in Energy," presentation to LSI Seminar on Energy in the Northeast, October 2005.

"The Benefits of New LNG Infrastructure in Massachusetts and New England: The Northeast Gateway Project," (with Susan F. Tierney), prepared for Northeast Gateway Energy Bridge, L.L.C., and Algonquin Gas Transmission, LLC, June, 2005.

"Climate Change Policy – New Business and Regulatory Risks," presentation to EnviroExpo & Conference, May, 2005.

"Carbon Cap & Trade Allocation Options – Practical Considerations," "Carbon Trading Program Emission Allowances: Practical Considerations for Allocation," and "Allocation of Carbon Allowances to Mitigate Electric Sector Costs," Reports to the National Commission on Energy Policy, May 2005.

"U.S. Energy Infrastructure: Demand, Supply and Facility Siting," Report to the National Commission on Energy Policy, November 2004.

"Comments of Susan F. Tierney and Paul. J. Hibbard on their own behalf," before the *Federal Energy Regulatory Commission, in the Matters of Solicitation Processes for Public Utilities (Docket No. PL04-6-000) and Acquisition and Disposition of Merchant Generation Assets by Public Utilities (Docket No. PL04-9-000),* on the role of independent monitors and independent evaluators in public utility resource solicitations, July 1, 2004.

"Energy and Environmental Policy in the United States: Synergies and Challenges in the Electric Industry" (with Susan F. Tierney), prepared for Le Centre Français sur les Etats-Unis (The French Center on the United States), July, 2003.

"Controlling China's Power Plant Emissions after Utility Restructuring: The Role of Output-Based Emission Controls" (with B.A. Finamore, N. Seidman, and T. Szymanski), *The Sinosphere Journal*, July 2002.

"Siting Power Plants in the New Electric Industry Structure: Lessons from California and Best Practices for Other States" (with S. Tierney), *The Electricity Journal*, June 2002.

“Siting Power Plants: Recent Experience in California and Best Practices in Other States” (with S. Tierney), prepared for The Hewlett Foundation and The Energy Foundation, February 2002.

“Setting and Administering Output-Based Emission Standards for the Power Sector: A Case Study of the Massachusetts Output-Based Emission Control Programs” (with N. Seidman and B. Finamore), prepared for the China Sustainable Energy Program, October 2001.

Before the Federal Energy Regulatory Commission, New England Power Pool and ISO New England, Inc., Docket No. ER01-2329, Joint Affidavit (with J. Besser) on behalf of the New England Renewable Power Producers Association, July 3, 2001.

“Output-Based Emission Control Programs – U.S. Experience” (with N. Seidman, B. Finamore, and D. Moskovitz), prepared for the China Sustainable Energy Program, May 2000.

“P2 and Power Plants: The Massachusetts Allowance Trading Program,” in *Proceedings of the National Pollution Prevention Roundtable*, March 2000.

“Safety and Environmental Comparisons of Stainless Steel with Alternative Structural Materials for Fusion Reactors” (with A.P. Kinzig and J.P. Holdren), *Fusion Technology*, August 1994.

“Utility Environmental Impacts: Incentives and Opportunities for Policy Coordination in the New England Region,” US EPA CX817494-01-0, RCEE Core Group, June 1994.

“Final Report: Code Development Incorporating Environmental, Safety, and Economic Aspects of Fusion Reactors,” UC-BFE-027, Fusion Environmental and Safety Group, University of California, Berkeley, 1991.

Exhibit PJH-2
Calpine LCOE Model Sources and Assumptions

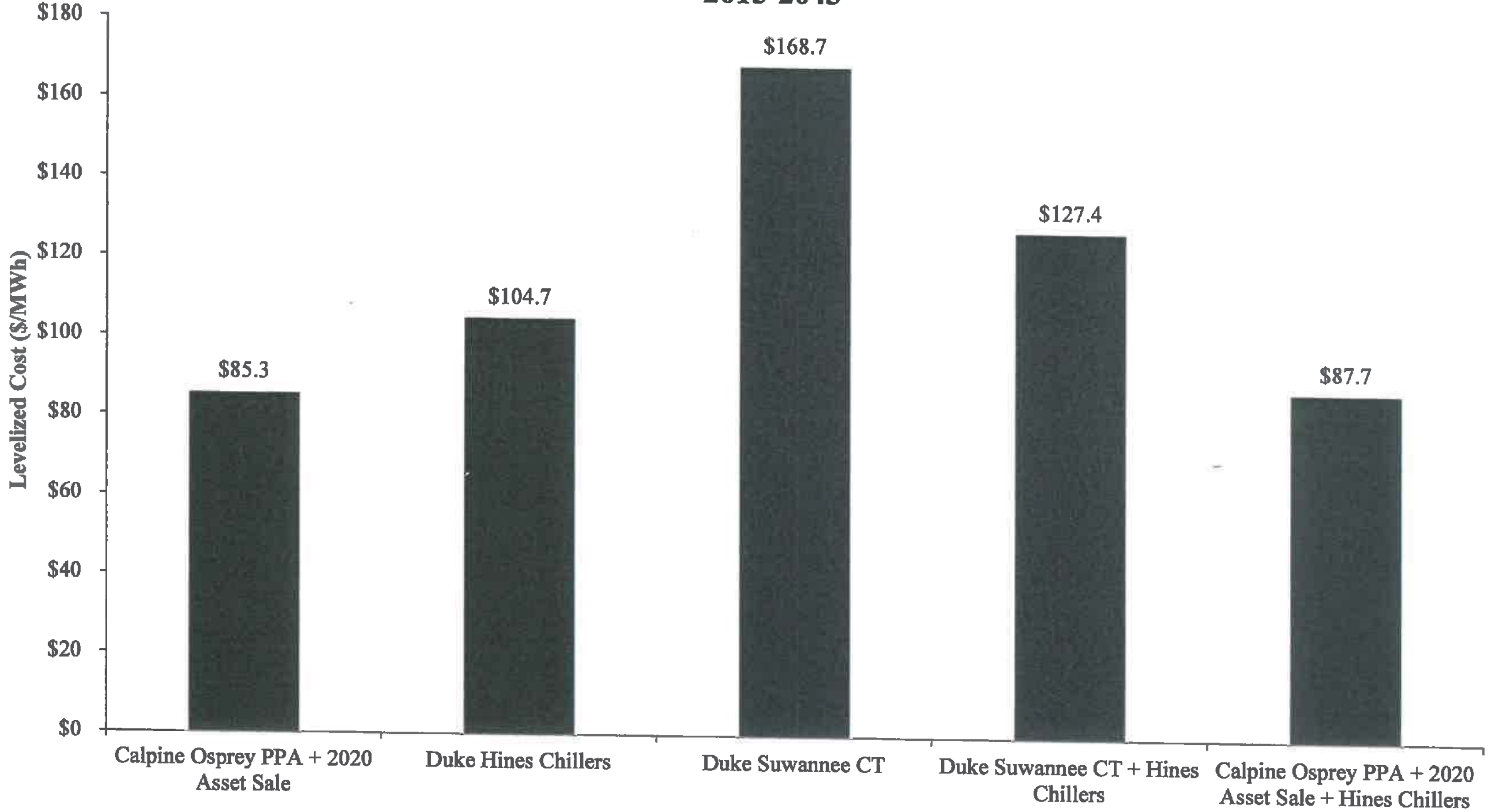
Variable	Unit(s)	Assumption	Source
Timing	Osprey	2015-2019 (PPA) 2020 - 2043 (Sale)	Calpine Bid
	Suwannee	Built 2016, 2043 End Date	
	Hines Chillers	Built 2017, 2043 End Date	Duke Proposal
Capacity	Osprey	515 MW	Calpine Bid
	Suwannee	316 MW	BMHB-2 (Summer Capacity)
	Hines Chillers	165 MW	
Capacity Factor	Osprey	[redacted]	[redacted]
	Suwannee	9.3%	BMHB-2
	Hines Chillers	[redacted]	
Capital Costs/ Capacity Price ($2016)	Osprey	$175 Million ($2020, Sale)	[redacted]
	Suwannee	$197 Million	
	Hines Chillers	$160 Million	Borsch Direct Testimony, Docket No 140111-EI
Heat Rate	Osprey	[redacted]	Calpine Bids (PPA) Thornton Direct Testimony, Docket No. 140111-EI (Sale)
	Suwannee	10,197 Btu/kWh	BMHB-2
	Hines Chillers	7,222 Btu/kWh	SNL Financial
Financial Assumptions	Return on Equity	10.5%	BMHB-1, p.48
	Return on Debt	3.75%	
	WACC	6.46%	
	Tax rate	35.26%	
MACRS Schedule	Osprey	20 year from IRS	IRS - Publication 946
	Suwannee	15 year from IRS	
	Hines Chillers	20 year from IRS	
Transmission Capital Costs	Osprey	$150 Million	Scott Direct Testimony, Docket No 140111-EI
Fixed O&M Costs ($)	Osprey (Sale only) Suwannee Hines Chillers	Forcasted 2015 - 2043	Strategist Input, Response to IR6
Variable O&M Costs ($)	Osprey PPA	From Bid, escalated	Calpine Bid
	Osprey Sale, Suwanne	Forcasted 2015 - 2043	Strategist Input, Response to IR6
	Hines Chillers	Forcasted 2015 - 2043	Strategist Output, IR7
Start Cost ($/start)	Osprey	[redacted]	Calpine Bid
	Suwannee	Forcasted 2015 - 2043	Strategist Output, IR7
Number of Starts	Osprey Suwannee	[redacted]	[redacted]
Natural Gas Price ($/MMBtu)	All	Forcasted 2015 - 2043	Strategist Input, Response to IR5
Gas Transportation Costs ($/ MMBtu)	Osprey	$0.55 per MMBtu	Calpine Bid
CO2 Emissions Intensity (lbs / MMBtu)	All	117.08 lbs/MMBtu	Strategist Input, Response to IR10
NOx Emissions Intensity (lbs / MMBtu)	Osprey	0.0115 lbs/MMBtu	SNL
	Suwannee	0.0106 lbs/MMBtu	DEF Response to NRG, No 27
	Hines Chillers	0.0100 lbs/MMBtu	Strategist Input, Response to IR10, Hines 2
Environmental Costs	All	Forcasted 2015 - 2043	Strategist Input, Response to IR4 and IR11

Sources:

[1] Response to Question 4, Schedule from DEF's Response to Calpine's 1st Interrogatories, Docket No. 140111, June 16, 2014, 14LGBRA-CALPINE1-4-Doc 1 Docket_140111-EI_Q4.xlsx.
[2] Response to Question 5, Corrected Schedule from DEF's Response to Calpine's 1st Interrogatories, Docket No. 140111, June 20, 2014, 14LGBRA-CALPINE1-5-DOC 1 CONFIDENTIAL Docket_140111-EI_Q5 (2).xlsx.
[3] Response to Question 6, Corrected Schedule from DEF's Response to Calpine's 1st Interrogatories, Docket No. 140111, June 20, 2014, 14LGBRA-CALPINE1-6-DOC 1 CONFIDENTIAL Docket_140111-EI_Q6.xlsx.
[4] Response to Question 7, Corrected Schedule from DEF's Response to Calpine's 1st Interrogatories, Docket No. 140111, June 20, 2014, 14LGBRA-CALPINE1-7-DOC 4 CONFIDENTIAL Docket_140111-EI-Q7- Self Build P5.xlsx.
[5] Response to Question 10, Schedule from DEF's Response to Calpine's 2nd Interrogatories, Docket No. 140111, June 24, 2014, 14LGBRA-CALPINE2-Q10b-000001 - 000004 Emission Rates 2013_0927.xlsx.
[6] Response to Question 11, Schedule from DEF's Response to Calpine's 2nd Interrogatories, Docket No. 140111, June 24, 2014, 14LGBRA-CALPINE2-Q11-000005 - 000006 Allowance Pricing 2013_0929 (2).xlsx.
[7] Direct Testimony of Benjamin M.H. Borsch, on Behalf of Duke Energy Florida, Inc., In re: Petition for Determination of Cost Effective Generation Alternative to Meet Need Prior to 2018. Florida Public Service Commission Docket No. 140111-EI, May 27, 2014, Exhibit BMHB-1 and 2.
[8] Direct Testimony of Edward Scott, on Behalf of Duke Energy Florida, Inc., In re: Petition for Determination of Cost Effective Generation Alternative to Meet Need Prior to 2018. Florida Public Service Commission Docket No. 140111-EI, May 27, 2014, Exhibit ES-3.
[9] SNL Financial.
[10] Duke Energy Florida, Inc.'s responses to NRG Florida LP's First Interrogatories Nos. 1-108 to Duke Energy Florida, Inc., No. 27.

Competitively Sensitive Confidential Information

Exhibit PJH-3
Levelized Cost of Electricity ($2014/MWh)
2015-2043



Notes:

Annual average capacity factors are assumed to be [redacted] for Osprey, 9.3% for Suwannee, and [redacted] for the Hines Chillers.

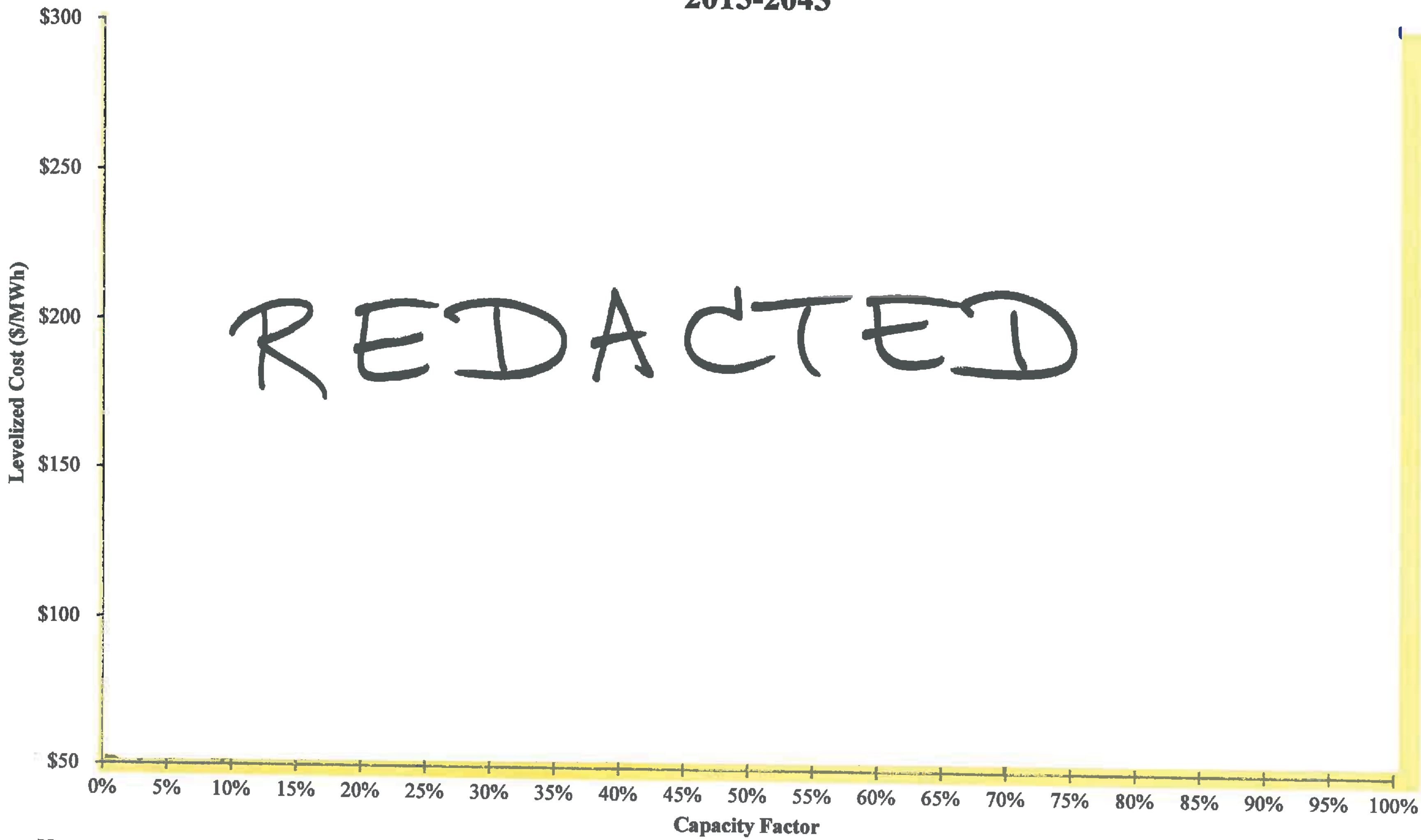
[redacted]

The Osprey LCOE includes $150 in transmission costs.

Docket No. 140110-EI
Levelized Cost of Electricity
PJH-3, Page 1 of 1

Competitively Sensitive Confidential Information

Exhibit PJH-4
Levelized Cost ($2014/MWh) by Capacity Factor
2015-2043

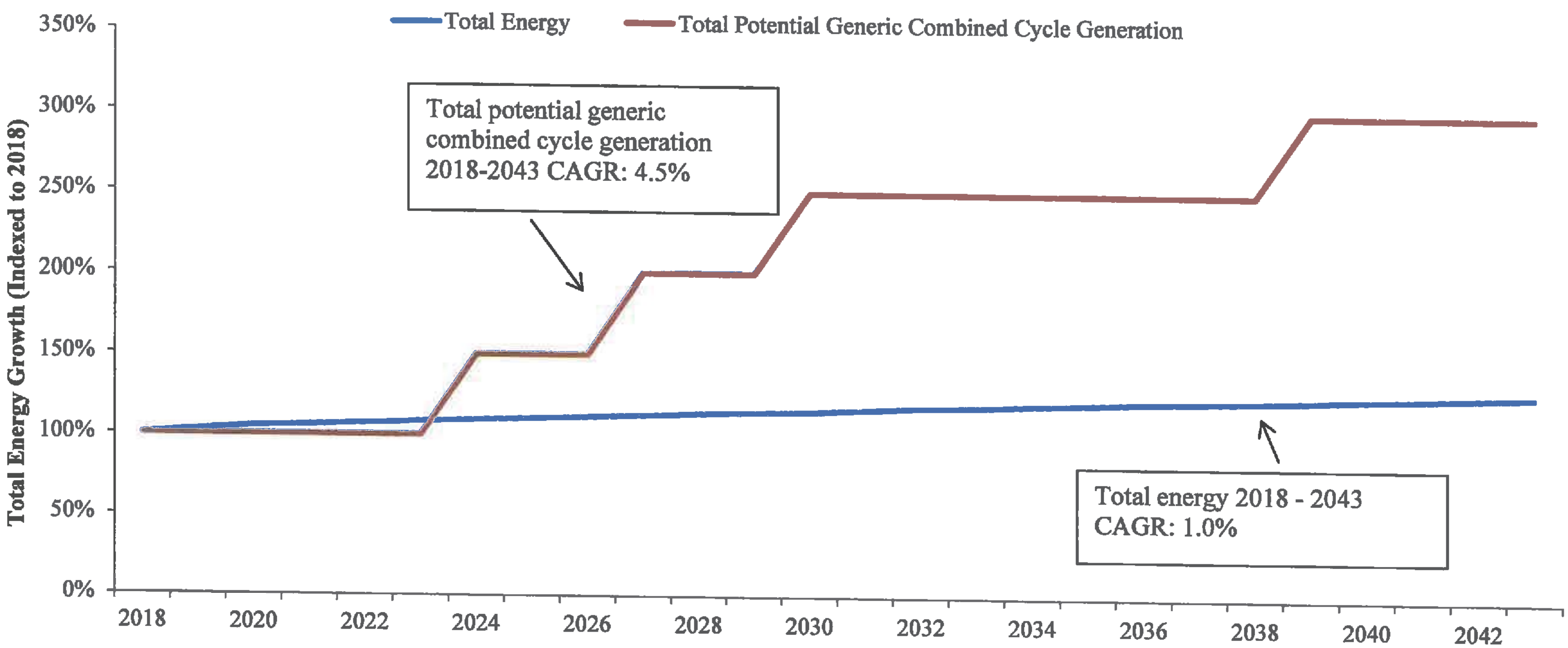


Notes:
The Osprey LCOE estimate includes a PPA starting in 2015 for 515 MW, with an acquisition in 2020 at [redacted]
The Osprey LCOE estimate includes $150 million in transmission costs.

Docket No. 140110-EI
Levelized Cost by Capacity Factor
PJH-4, Page 1 of 1

Exhibit PJH-5

Growth in Total Energy Demand and Potential Energy Generation from Generic Combined Cycle Units



Notes:
Total energy demand and potential energy generation are indexed to 2018 values.
Between 2018 and 2043, 4,758 MW of generic combined cycle capacity is added, assuming 793 MW summer capacity per unit.

Sources:
[1] Direct Testimony of Benjamin M.H. Borsch, on Behalf of Duke Energy Florida, Inc., In re: Petition for Determination of Cost Effective Generation Alternative to Meet Need Prior to 2018. Florida Public Service Commission Docket No. 140111-El, May 27, 2014, Exhibit BMHB-2.
[2] Duke Energy Florida, Inc., response to Calpine Construction Finance Company, L.P.'s First Set of Interrogatories. (Nos. 1-9), Competitively Sensitive Confidential Response 7.

Exhibit PJH-6

Comparison of Osprey Capacity Factor and Starts, by Year
DEF Production Simulation Results, Scenario 5 Acquisition

Notes:
Data is from Scenario 5, Acquisition 2, modeled as -$193 m CPVRR relative to the DEF self-build proposal.
[redacted]

Source:
[1] Duke Energy Florida, Inc., Response to Calpine Construction Finance Company, L.P.'s First Set of Interrogatories. (Nos. 1-9), Competitively Sensitive Confidential Response 6b and 7.

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Exhibit PJH-7a
Adjustments to Cumulative Present Value Revenue Requirement
$2014 millions

	Original Value	Updated Value	CPVRR Impact
Duke Energy Florida Estimate			($193)
Fixed Cost Adjustment			
Updated PPA/acquistion offer	$300	[redacted]	[redacted]
Updated Estimate for Direct Connect Transmission Costs	[redacted]	$150	
Gas Reservation Charge Adjustment			
Net Adjusted CPVRR:			**$133**

Notes:
These adjustments include updates to fixed costs and other financial transactions, which are not expected to impact production cost modeling and energy dispatch outcomes.

CPVRR impact is -$193 m relative to DEF's self-build proposal. Adjustments are estimated assuming a 6.46% weighted average cost of capital with all assets fully depreciated by 2044. CPVRR adjusted impact includes estimated adjustments to rate base, depreciation, and deferred income taxes for capital expenses.
Estimate assumes a 5-year PPA for 515 MW, with capacity price payments starting at [redacted] 2015 escalating to [redacted] in 2019.

Sources:
[1] Exhibit BMHB-8, Acquisition 2.
[2] Direct Testimony of Todd Thornton, In re: Petition for Determination of Cost Effective Generation Alternative to Meet Need Prior to 2018 for Duke Energy Florida, Inc., Docket No. 140111-EI, submitted July 14, 2014, at 8.
[3] Duke Energy Florida, Inc.'s Responses to Calpine Construction Finance Company, L.P.'s First Set of Interrogatories. (Nos.1-9), Submitted June 16, 2014. Response 6a and g.

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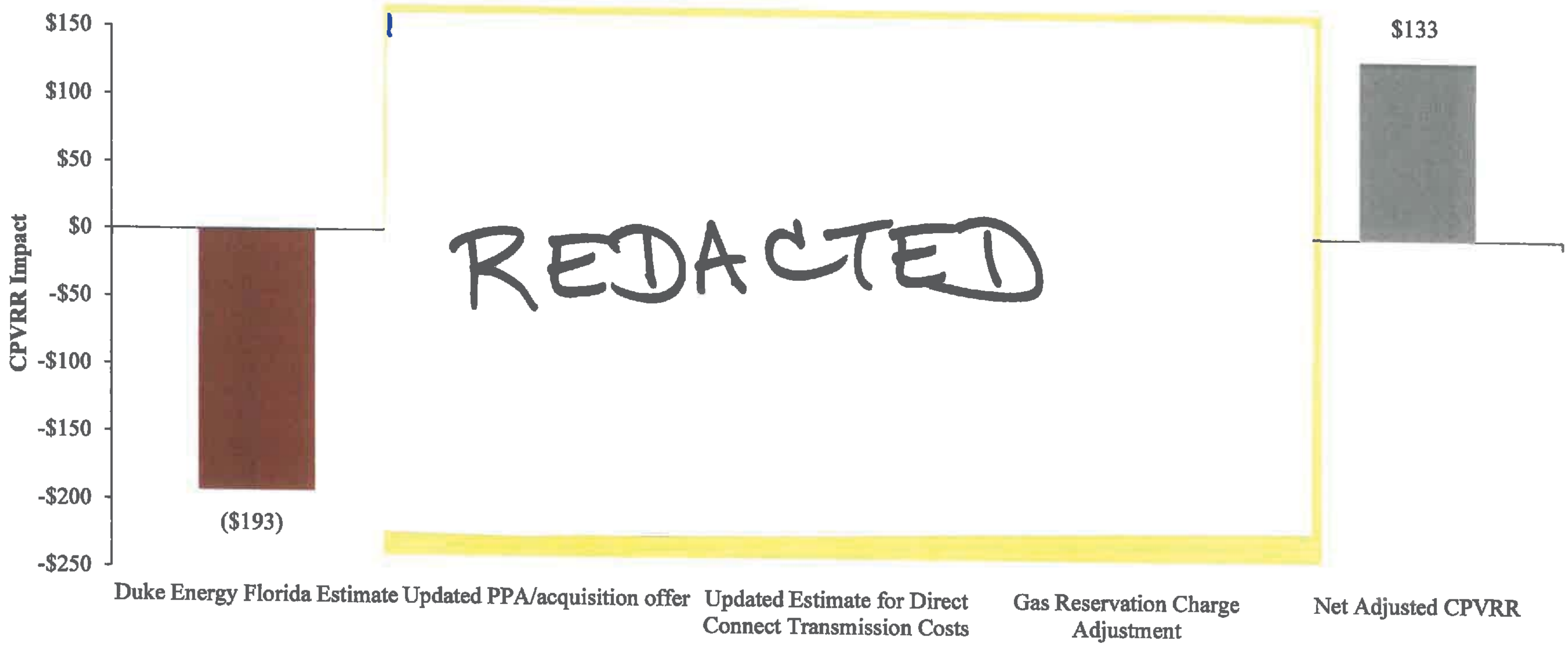
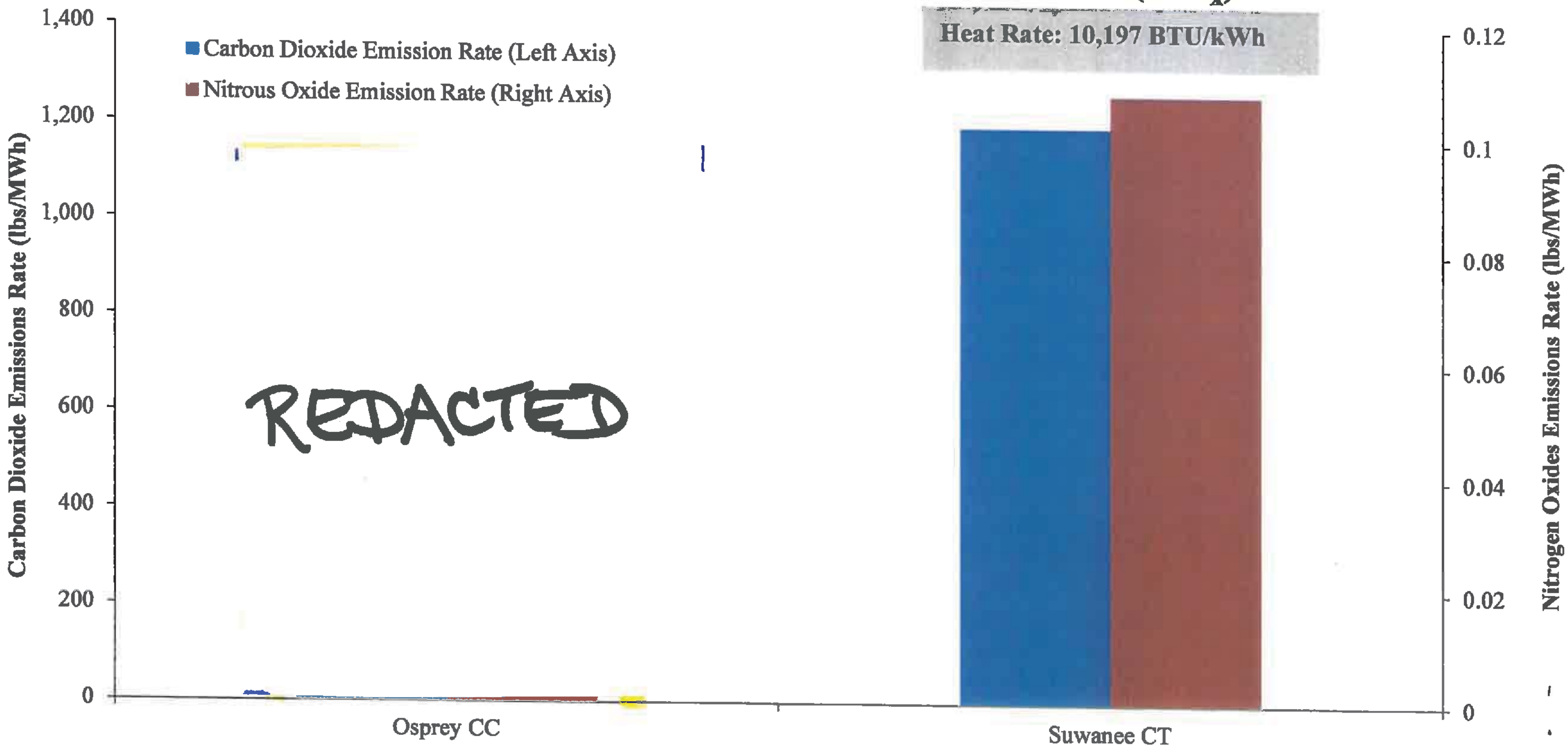
Exhibit PJH-7b
Adjustments to Cumulative Present Value Revenue Requirement
$2014 millions



Notes:
These adjustments include updates to fixed costs and other financial transactions, which are not expected to impact production cost modeling and energy dispatch outcomes.
CPVRR impact is -$193 m relative to DEF's self-build proposal. Adjustments are estimated assuming a 6.46% weighted average cost of capital with all assets fully depreciated by 2044.
CPVRR adjusted impact includes estimated adjustments to rate base, depreciation, and deferred income taxes for capital expenses.
Estimate assumes a 5-year PPA for 515 MW, with capacity price payments starting at [redacted] 2015 escalating to [redacted] 2019.

Sources:
[1] Exhibit BMHB-8, Acquisition 2.
[2] Direct Testimony of Todd Thornton, In re: Petition for Determination of Cost Effective Generation Alternative to Meet Need Prior to 2018 for Duke Energy Florida, Inc., Docket No. 140111-EI, submitted July 14, 2014, at 8.
[3] Duke Energy Florida, Inc.'s Responses to Calpine Construction Finance Company, L.P.'s First Set of Interrogatories (Nos.1-9), Submitted June 16, 2014. Response 6a and g.

Exhibit PJH-8
Emission Rates by Technology
Carbon Dioxide (CO_2) and Nitrogen Oxides (NO_x)



Note:
Emission rate is calculated as emission factor (lbs/MMBTU) multiplied by assumed heat rate (BTU/kWh).

Sources:
[1] Duke Energy Florida, Inc., response to Calpine Construction Finance Company, L.P.'s Second Set of Interrogatories (Nos. 110-11), 10QB. "14LGBRA-CALPINE2-Q10b-000001 - 000004 Emission Rates 2013_0927.xlsx."
[2] Duke Energy Florida, Inc.'s responses to NRG Florida LP's First Interrogatories Nos. 1-108 to Duke Energy Florida, Inc., No. 27.
[3] SNL Financial.