BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In Re: Petition for Determination of Need for an Electrical Power Plant in Okeechobee County by Okeechobee Generating Company, L.L.C.	)	DOCKET NO. 991462-EU FILED: MARCH 3, 2000

ORIGINAL

REBUTTAL TESTIMONY

OF

DALE M. NESBITT, Ph.D.

ON BEHALF OF

OKEECHOBEE GENERATING COMPANY, L.L.C.

VOLUME II
REBUTTAL TO SAMUEL S. WATERS

AFA 1
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Q: Please state your name and business address.

A: My name is Dale M. Nesbitt, and my business address is 27121 Adonna Court, Los Altos Hills, California 94022.

Q: Are you the same Dale M. Nesbitt who has previously filed direct testimony in this docket?

A: Yes, I am. I have filed direct testimony, and I am simultaneously submitting rebuttal testimony to the testimony of Dr. John H. Landon.

Q: What is the purpose of this rebuttal testimony?

A: The purpose of this rebuttal testimony is to rebut several erroneous assertions made in the direct testimony of Mr. Samuel S. Waters on behalf of Florida Power & Light Company.

Q: Mr. Waters says your reliability statements are flawed and that reliability calculations such as reserve margin calculations or loss of load probability calculations are needed to justify your statements. Please comment.

A: Let me provide a simplified illustrative probabilistic analysis of reliability as requested by Mr. Waters to show that his key reliability objections are patently wrong and highly misleading to the Commission. I have in the example assumed that all plants are the same size so that I do not have to carry the notational messiness of individualized

plant sizes. The simplifying assumption in no way compromises the generality or the applicability of the ultimate conclusions. At the conclusion of the technical development, I get to the bottom line, which is that the reliability assertions made by Mr. Waters related to the Okeechobee Project are incorrect.

Using the inferential notation of probability theory, suppose that there exists a fleet of n plants, and we calculate, using the individual plant availabilities, the probability that exactly r of those plants are up and running and available to operate but that exactly n-r of those plants are down due to force or unforced outage. Denote that probability

{r,n} = probability that exactly r plants are running given that the fleet consists of n plants.

This is not necessarily an easy probability to calculate, yet we will not have to actually calculate it to make the salient points we need to make to show why Mr. Waters is wrong.

Let us assume that at least R plants must be up and available for running in order to serve the market demand in a given hour. The probability that there are R or more plants up and available for running in order to meet the

demand for that hour is the probability that there are exactly R plants up, R+1 plants up, R+2 plants up, . . . , or all n plants up, i.e.,

$$\{\#\ \text{running} \geq R | n\ \text{plants}\} = \sum_{r=R}^{n} \{r,n\}$$

This is the correct formula for the probability that R or more plants will be running during the hour in question and therefore that there is no shortage during that hour. Let us now add one plant to the fleet mix with availability a, which we think of as the probability that the plant is up and available to run during the hour in question. We want to know what is the probability that R or more plants are running during the hour in question after the addition of the new plant to the fleet to create a fleet with n+1 plants in it. If we define the probability that there are exactly r of the expanded fleet of n+1 plants running, denoted {r,n+1}, we can use the probability expansion rule where the expansion is over whether the new plant is running or not to write

$$\{r,n+1\} = \{r,n+1,Y\} + \{r,n+1,N\}$$

where Y designates the event that the new plant is running and N designates the event that the new plant is not running. We then use conditional probability relationships to write

$$\{r,n+1\} = \{r,n+1|Y\}\{Y\} + \{r,n+1|N\}\{N\}$$

The first term {r,n+1/Y} is the probability that exactly r of the n+1 plants are running given that the new plant is running. This is just the probability that exactly r-1 of the original n plants are running, namely {r-1,n}. The second term {r,n+1/N} is the probability that exactly r of the fleet of n+1 plants is running given that the new plant is not running. It is therefore the probably that exactly r of the original plants are running {r,n} because the new plant is not. The probability that the new plant is running {Y} is a and the probability that it is not running {N} is (1-a). Making the requisite substitutions yields the expression.

$$\{r,n+1\} = \{r-1,n\}a + \{r,n\}(1-a)$$

The probability that at least R of the new fleet of n+1 plants is running given that the new plant has availability a

is therefore the probability that R, R+1, R+2,. . ., or n+1 plants are running, namely

$$\{\#\ \text{running} \geq R | n+1\ \text{plants}\} = \sum_{r=R}^{n+1} \{r, n+1\}$$

Substituting the expression for {r,n+1} into the expression yields the equation

$$\begin{aligned}
\{\#\ \text{running} \geq R | n+1\ \text{plants}\} &= \sum_{r=R}^{n+1} \{r-1,n\}a + \{r,n\}(1-a)\} \\
&= a\sum_{r=R}^{n+1}\{r-1,n\} + (1-a)\sum_{r=R}^{n+1}\{r,n\} \\
&= a\{R-1,n\} + a\{R,n\} + \ldots + a\{n,n\} \\
&\quad + (1-a)\{R,n\} + \ldots + (1-a)\{n,n\} + (1-a)\{n+1,n\} \\
&= a\{R-1,n\} + \sum_{r=R}^{n}\{r,n\} + (1-a)\{n+1,n\}
\end{aligned}$$

The very last term is zero because it is impossible to run n+1 of n plants. Therefore, the sought after equation for the difference in reliability after the one new plant with reliability a is added is

$$\begin{aligned}
\{\#\ \text{running} \geq R | n+1\ \text{plants}\} &= a\{R-1,n\} + \sum_{r=R}^{n}\{r,n\} \\
&= a\{R-1,n\} + \{\#\ \text{running} \geq R | n\ \text{plants}\}
\end{aligned}$$

If we look back at the equation for the probability that at least R or more of the original fleet of n plants are running, we can write the critically important formula

$$\{\#\ \text{running} \geq R \mid n+1\ \text{plants}\} = a\{R-1,n\} + \{\#\ \text{running} \geq R \mid n\ \text{plants}\}$$

which can be rewritten in terms of the gain in system reliability when the fleet has n+1 plants rather than n plants, the newest plant having reliability a

$$\{\#\ \text{running} \geq R \mid n+1\ \text{plants}\} - \{\#\ \text{running} \geq R \mid n\ \text{plants}\} = a\{R-1,n\}$$

This formula completes the technical development.

The foregoing formula directly and thoroughly refutes the argument by Mr. Waters that the Okeechobee Project does not increase reliability. The Project unequivocally increases reliability in that it increases the probability that there are at least R plants running no matter what the incremental reliability of the OGC plant. There is no question the entry of the Project systematically and positively contributes to FRCC system reliability. The formula clearly and unequivocally implies the following:

1. The reliability of the system goes up with the addition of any plant whose availability a is strictly greater than zero. No matter what the incremental reliability of the newly entering plant, the reliability of the system always increases. Period. There is no refuting the fact that when one moves from a fleet of n plants to a

fleet of n+1 plants with the additional plant having a reliability of a, as long as a is positive (i.e., nonzero), the probability that at least R plants or more are running is strictly (in a mathematical sense) larger. The loss of load probability (which is advocated by Mr. Waters as an appropriate and correct measure of reliability) is strictly decreasing. This is a standard, elementary result from reliability theory, and it generalizes to the more complex situation in the Florida market directly.

2. The reason the reliability of the system increases is that when the new plant is operating, the old system can get by with operating one less plant, with no loss in reliability! The old system does not have to be collectively as reliable as it did without the new entrant. The probability that the old system can sustain one less plant in available operating condition is higher. This is obvious. The reason that incremental reliability systematically improves with new entry such as OGC is that it allows the old system to be "one plant less reliable" than it would otherwise have to be, and the odds that the old system can sustain a state that is "one plant less reliable" are strictly positive.

3. It is not necessary to have the reliability of the new plant be 100 percent in order to increase overall system reliability, and it is not even necessary to have the

reliability of the new plant be "best in class" to increase overall system reliability. No matter what the reliability of the new entrant, it systematically increases overall system reliability. The increase in reliability of the system is proportional to the availability of the new plant and to the probability that the old system can run with one fewer plant.

Lest the Project's opponents argue that the example here is too simplistic because it does not consider different plants sizes and the like, I will point out that the example generalizes to all such situations directly. The addition of a new plant increases system reliability no matter what its incremental reliability is as long as it is positive. Mr. Waters' testimony is profoundly misleading and in error. There is no "plant availability race" on in Florida, there is no "Kentucky Derby of plants based on availability factor," and there need not be any such race. There is no notion that only the "best in class" in an availability sense should have any preference. All incremental entrants in the 90 plus percent reliability range add so substantially to the overall reliability of the FRCC system that there is no need to discriminate. It is better simply to simply authorize another merchant plant than it is to measure reliability differences between individual plants with a caliper. Granting the requested need determination for the Okeechobee

Generating Project is a sound second step along that path that was properly initiated with the Commission's approval of the Duke New Smyrna Beach Power Project last year.

I should point out that Mr. Waters and Mr. Landon have completely and systematically ignored another salient result of reliability theory. It is redundancy of supply, i.e., parallelism, that augments reliability. It is not the individual unit reliability that is the leading term. It is the addition of several new units to the system which makes it highly unlikely that all of them will be down at once. That is the reason reliability increases so markedly when new merchant plants such as the Project are added. I would also reiterate that the Project has a systematically higher incentive for reliability than utility owned plants because OGC makes zero money unless it is available, operating, and generating margin.

Q: Does the existence or absence of a contract for the sale of firm capacity and energy have any bearing on whether a plant's presence enhances reliability?

A: No. Whether there might exist a contract is irrelevant to increased reliability. To illustrate, suppose in the extreme situation there were 50,000 MW of $7/MWH power that could be delivered in whole or in part in the FRCC with probability 1-1/1,000,000 located right in the center of the FRCC but that

it was impossible to contract for any of it. Would that be "unreliable" power in Mr. Waters' view because of the lack of a contract? Would Mr. Waters ask the Commission to ignore that power altogether because his own company declined to sign a contract for it so that they could sell their much higher embedded cost power to FRCC customers? I sincerely doubt it. Quite the contrary, that power would be considered firm, and the Commission and all FRCC customers would quickly and completely avail themselves of it. There would be no talk of unreliability because of lack of a contract. The OGC plant is simply a less extreme case of the obvious--it increases reliability--but it is quite analogous to the extreme example painted here. The Okeechobee Project is reliable, it is much more incentivized to be there during time of peak, and it systematically increases FRCC system reliability.

Q: On page 6 of his testimony, Mr. Waters calls for a reserve margin analysis and argues that your statements about reserves are incorrect for lack of a contract. Please comment.

A: I do not agree with Mr. Waters. Total capacity is and should be recognized as including productive plus reserve capacity. All capacity in place is and should be counted in reserves,

at least from the Commission's perspective. So should the Project when it is built in the FRCC.

Q: Mr. Waters makes analogous comments to Dr. Landon related to comparative analysis of new entrants. Does your rebuttal of Dr. Landon pertain to Mr. Waters as well?

A: Yes. I would particularly reiterate my comments that the Altos model systematically competes everything against everything else and that it focuses on the wholesale market in the FRCC, not the retail market. Moreover, I would reiterate that Mr. Waters' and Dr. Landon's suggestion for a comparative analysis is predicated on a baseless assumption, namely that the construction of the Okeechobee Generating Project is mutually exclusive to the construction of another plant.

Q: Mr. Waters argues that reliability calculations should be utility specific. Please comment.

A: Mr. Waters' suggestion is parochial and myopic, and it ignores the Commission's fundamental role of promoting the public interest of the entire State. If you know that the entry of a new merchant such as the Okeechobee Project systematically adds positively to reliability in the State by creating more supply available to serve the same demand, there is very little to be gained from figuring out and

debating exactly and precisely who benefits and to what degree from such reliability increase. The fact that there is a net positive increase should be enough for the Commission to rule that there is in fact a net positive reliability benefit to some or all of the electricity customers in Florida. Allocating that benefit among various classes of Florida and non-Florida customers, transporters, and/or generators is a happy subject for a later proceeding (if at all).

Increased reliability, just like lower price, is "manna from heaven" that appears in the FRCC by the good graces of the entry of the Project. OGC takes all the risks and pays all the costs, and the FRCC gains lower price and increased reliability. Why waste the time to apportion it with a caliper? I see no reason. The fact that it is large and it is there is enough to justify entry of the Project.

Q: Mr. Waters argues at page 16 of his testimony that OGC is not "suggesting an appropriate Peninsular Florida reserve margin criterion and without ever explaining why its unit is appropriately considered in a reserve margin calculation since it is not committed by contract." Please comment.

A: My rebuttal testimony herein explains why and how the Project contributes a net positive benefit to reliability in Florida whether or not there are any contracts for its inputs or

outputs. Contracts are not a necessary condition for reliability. I should point out that in the context of a robust, competitive, efficient wholesale market, no one has to specify what the "reliability criterion" is. I believe that merchant capacity like that provided by the Okeechobee Generating Project should be counted in a Peninsular Florida reserve margin calculation that the Commission would consider because the probability of its being available and serving in Peninsular Florida at the time of summer and winter peaks (which are the standard reference points for calculating and evaluating reserve margins) is very close to 1.0. Practically speaking, the probability of the Okeechobee Generating Project being available and serving Peninsular Florida during summer and winter peaks should be evaluated as 1.0 minus the Project's forced outage rate, i.e., the same as any other unit, regardless of its ownership status.

Q: Does this conclude your rebuttal testimony as to Mr. Waters?

A: Yes, it concludes this portion of my rebuttal testimony.