

May 2, 2016

Via Electronic Mail and Federal Express

Ms. Luly Massaro
Division Clerk
Division of Public Utilities and Carriers
89 Jefferson Boulevard
Warwick, RI 02888

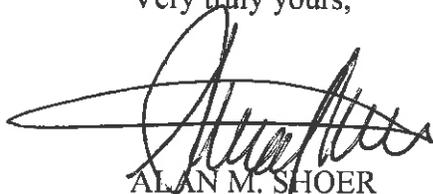
Re: *Invenergy, PUC Advisory Opinion, Docket No. 4609*

Dear Luly:

On behalf of Invenergy, enclosed please find an original and 7 copies of the redacted version and an original and 1 copy of the confidential version of Invenergy's Responses to the Division's Second Set of Data Requests to Validate CREC Claimed Benefits in the above docket.

Please let me know if you have any questions.

Very truly yours,



ALAN M. SHOER
ashoer@apslaw.com

Enclosures

cc: Service List (*via e-mail*)

**STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
BEFORE THE PUBLIC UTILITIES COMMISSION**

IN RE: INVENERGY THERMAL DEVELOPMENT :
APPLICATION TO CONSTRUCT AND OPERATE :
THE CLEAR RIVER ENERGY CENTER, PUBLIC : **DOCKET NO. 4609**
UTILITIES COMMISSION ADVISORY OPINION :

**INVENERGY THERMAL DEVELOPMENT LLC'S RESPONSES TO
THE DIVISION OF PUBLIC UTILITIES AND CARRIERS
SECOND SET OF DATA REQUESTS TO VALIDATE CREC CLAIMED BENEFITS**

**DR 2-1 Please provide the following List of Information Needed to Validate the CREC
 Claimed Benefits in connection with the following:**

Energy Price Reduction

1. Overview of Methodology used by PA
2. Version of AURORAxmp and Database Used
3. Study Area Footprint and Topology
 - a. Modeled control areas
 - b. Zones modeled within each control area
4. Transmission Linkages
 - a. Zonal transfer limits and the sources of information
 - b. Interface transfer limits (i.e., Multilinks) and the sources of information
5. Planned Backbone Transmission Projects in Each of the Modeled Control Areas
 - a. Transfer limits of each project with the sources of information
 - b. Assumed in-service date with the sources of information
6. Study Region Imports and Exports
 - a. Explain the methodology (e.g., using hourly fixed schedules based on historical flows)
7. HVDC lines with Adjacent Modeled Control Areas
 - a. Existing lines (e.g., CSC, Neptune)
 - b. Any new proposed projects (e.g., Northern Pass, NECPL, CHPE) with timing, capacity, etc.
8. Load Forecast
 - a. Specify the source of the load forecast in all modeled control areas (e.g., ISO-NE, NYISO, PJM)

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9. Generation Addition and Attrition
 - a. Provide the list of the new and planned for retirement resources for all modelled control areas and the source of the information
10. Fuel Price Forecast
 - a. Specify the sources for natural gas, oil, coal, and nuclear fuel price forecasts and describe any adjustments
11. Results in Excel Format
 - a. Provide the energy market price forecast (hourly, monthly, annually, on-peak, off-peak) without CREC and with CREC

INVENERGY RESPONSE 2-1: Energy Price Reduction

1. Overview of Methodology used by PA

RESPONSE: PA Consulting, Inc. ("PA") utilizes AURORA^{xmp1} for its production cost modeling to dispatch generation units to minimize total system cost. PA analyzes both fixed and future capital costs required to meet electric demand and ensure system reliability. In order to calculate energy price reductions, PA utilized the AURORA^{xmp} model (populated by PA with PA vetted data) for two scenarios: (1) with Clear River generating in the ISO-NE market; and (2) without Clear River generating in the ISO-NE market. All other assumptions remained identical between the two scenarios. Based on the model outputs of these two scenarios, PA calculated the difference in monthly on- and off-peak energy prices for the Rhode Island region and multiplied those by on and off-peak energy demand in the state (as forecasted in the ISO-NE CELT report, which is the same source utilized for the demand assumptions in the AURORA^{xmp} modeling).

2. Version of AURORAxmp and Database Used

RESPONSE: PA utilizes version 12.0.1072 of the AURORA^{xmp} modeling tool to conduct its long-term fundamental forecast. AURORA^{xmp} is a power market simulation tool based on an hourly dispatch engine that models the dispatch of power plants in a chronological, multi-zone, transmission-constrained system and is widely used for electric market forecasting and resource valuation. AURORA^{xmp} is a fully customizable

¹ EPIS, Inc.

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database that combines a wide array of information including power plant units and associated characteristics, commodity prices, demand data, transmission topology as well as numerous other inputs. PA maintains and continually updates the database serving the AURORA^{xmp} model through a mix of both proprietary and publicly available information as well as inputs from EPIS, LLC the parent company that develops AURORA^{xmp}.

3. Study Area Footprint and Topology
 - a. Modeled control areas
 - b. Zones modeled within each control area

RESPONSE:

- a. Modeled control areas
Please see the "Topology Map" tab in the included .zip files ("Clear River Cost to Load_Demonstrative - Pre FCA 10.zip" and "Clear River Cost to Load - Demonstrative - Post FCA 10.zip", hereafter referred to collectively as the "DPUC Demonstratives").² PA models the entire Eastern Interconnect but only runs ISO-NE, NYISO and PJM markets with granular zones in this topology.
 - b. Zones modeled within each control area
Please see the Transmission (tabs in the Division of Public Utilities and Carriers ("DPUC") Demonstratives) for the zones modeled within ISO-NE, NYISO and PJM.
4. Transmission Linkages
 - a. Zonal transfer limits and the sources of information
 - b. Interface transfer limits (i.e., Multilinks) and the sources of information

² For completeness, PA has included documentation related to the analysis done prior to FCA-10 and documentation related to the analysis done post FCA 10 (which reflects the results in Ryan Hardy's pre-filed testimony, filed April 22, 2016), which provide the assumptions for the energy and capacity market savings that Invenergy Thermal Development LLC believes Levitan is referring.

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RESPONSE:

- a. Zonal transfer limits and the sources of information
Please see the Transmission tabs in the DPUC Demonstratives. The source of Invenergy Thermal Development LLC's ("Invenergy") transmission link information is based on PA load flow analyses.
- b. Interface transfer limits (i.e., Multilinks) and the sources of information
Please refer to the annual ISO-NE installed capacity report ("ICR") for the information that PA utilizes.

- 5. Planned Backbone Transmission Projects in Each of the Modeled Control Areas
 - a. Transfer limits of each project with the sources of information
 - b. Assumed in-service date with the sources of information

RESPONSE:

- a. Transfer limits of each project with the sources of information
Please see the Transmission tabs in the DPUC Demonstratives. The list of planned upgrades and timing is shown at the bottom left hand corner of each tab.
- b. Assumed in-service date with the sources of information
See above.

- 6. Study Region Imports and Exports
 - a. Explain the methodology (e.g., using hourly fixed schedules based on historical flows)

RESPONSE: Imports and exports in PA's fundamental model are manifest in two primary ways. First, during the course of long-term hourly dispatch simulations, AURORA^{XMP} estimates economic power flows between interconnected areas. These power flows are calculated each hour and are based on the relative economics of power generation between regions, subject to inputs for transmission capability, transmission losses and wheeling charges incurred to move power across regions. The ISO-NE market is interconnected directly to Quebec and the Canadian Maritimes, as well as NYISO.

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Through these interconnections, ISO-NE imports Canadian hydro power from the North with economic power flowing regularly in either direction with NYISO. The second manner in which imports and exports are captured in PA's fundamental modeling is through the impact to long-term supply and demand. Some imports and exports are treated as firm and may be associated with a long-term contract or can be dependably counted on to support reliability needs based on history or Forward Capacity Market commitments. Imports of this type are counted as a net increase to supply while exports are modeled as a net decrease to supply and can directly influence regional power needs and capacity prices. Import capability from Quebec is directly modeled as a net to the installed capacity requirement in ISO-NE under the region's capacity market structure, with the amount of this capacity varying each year, but usually set at approximately 1,000 MW. ISO-NE generally receives additional import supply from the participation of NYISO generators in the capacity market. However, amount of these imports varies from year-to-year based on economics.

7. HVDC lines with Adjacent Modeled Control Areas
 - a. Existing lines (e.g., CSC, Neptune)
 - b. Any new proposed projects (e.g., Northern Pass, NECPL, CHPE) with timing, capacity, etc.

RESPONSE:

- a. Existing lines (e.g., CSC, Neptune)

ISO-NE is interconnected to neighboring regions through a combination of both AC and HVDC ties. Two HVDC ties currently exist between New England and Quebec with an additional line interconnecting ISO-NE and NYISO. These include the Hydro Quebec Phase II line with 1,400 MW of import capability into ISO-NE's Central Massachusetts zone, the 200 MW Hydro Quebec High Gate line which interconnects with the Vermont Zone and the Cross Sound Cable which provides 330 MW of export capability between southwest Connecticut and NYISO Zone K. PA's transmission assumptions for the HVDC interconnections are informed by annual transmission studies conducted by ISO-NE and reported in the annual Installed Capacity Requirements report.

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- b. Any new proposed projects (e.g., Northern Pass, NECPL, CHPE) with timing, capacity, etc.

PA does not assume any future HVDC lines in its base case assumptions. While PA considers all announced projects, new transmission lines must meet an array of criteria before they are considered firm, including securing permits, financing, etc.

- 8. Load Forecast
 - a. Specify the source of the load forecast in all modeled control areas (e.g., ISO-NE, NYISO, PJM)

RESPONSE: The sources of the load forecasts are included in the DPUC Demonstratives on the "Supply-Demand" tab.

- 9. Generation Addition and Attrition
 - a. Provide the list of the new and planned for retirement resources for all modelled control areas and the source of the information

RESPONSE: Lists of the ISO-NE firm additions and retirements are included in the DPUC Demonstratives on the "Firm Additions" and "Firm Retirements" tabs. Given that additions and retirements in other adjacent ISOs only have a tangential effect on the energy and capacity dynamics of the ISO-NE market, PA has not included firm additions and retirements for those markets. Not including firm additions and retirements is consistent with how PA generally only reports detailed results for the ISO of focus projects in which it engaged.

- 10. Fuel Price Forecast
 - a. Specify the sources for natural gas, oil, coal, and nuclear fuel price forecasts and describe any adjustments

RESPONSE: The fuel price projections and sources are listed in the DPUC Demonstratives on the "Fuel Price Projections" tab.

- 11. Results in Excel Format

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- a. Provide the energy market price forecast (hourly, monthly, annually, on-peak, off-peak) without CREC and with CREC

RESPONSE: The energy market price forecasts are included in the DPUC Demonstratives on the "Market Price Projections" and "Monthly Power Price Projections" tabs. PA's standard output from the AURORA^{xmp} model only reports monthly and annual on-and off-peak pricing, not hourly.

RESPONDENT: Ryan Hardy, PA Consulting, Inc.

DATE: May 2, 2016

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DR 2-2 Please provide the following List of Information Needed to Validate the CREC Claimed Benefits in connection with the following:

Capacity Price Reduction

1. Overview of Methodology used by PA
2. Capacity Market Model
 - a. Provide a description of the model
 - b. Explain how exactly capacity clearing engine operates in the model (e.g., how non-rationable offers are handled)
3. Provide all Key Assumptions used in the Capacity Market Model
 - a. Peak demand forecast
 - b. Supply curve slope where it crosses the demand curve
 - c. Provide the modeled supply and demand curves for FCA-10, FCA-11, FCA-12 and FCA-13 without CREC and with CREC
4. Results in Excel Format
 - a. Provide clearing prices in FCA-10, FCA-11, FCA-12 and FCA-13 without CREC and with CRE

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INVENERGY RESPONSE 2-2: Capacity Price Reduction

1. Overview of Methodology used by PA

RESPONSE: PA's capacity price forecast reflects technical parameters in the near-term, transitioning to a fundamental Net CONE methodology in the long-term. Near-term capacity prices are derived based on the following: (1) PA's proprietary view of installed capacity and incremental capacity additions and retirements (i.e., total capacity); (2) ISO-NE peak demand and (3) FCA demand curve parameters. In the long-term (i.e., the first year new generic capacity is added to the system to meet the target reserve margin), capacity prices are based on the Net CONE of the marginal capacity resource, typically a natural gas-fired combined cycle.

2. Capacity Market Model

- a. Provide a description of the model
- b. Explain how exactly capacity clearing engine operates in the model (e.g., how non-rationable offers are handled)

RESPONSE:

- a. Provide a description of the model

PA's capacity market model is used for the near-term portion of PA's capacity price forecast. The model incorporates three primary assumptions: (1) installed capacity differentiating between new and existing capacity; (2) ISO-NE peak demand and (3) FCA demand curve parameters. Installed capacity (including incremental additions and retirements) is based on PA's proprietary view. ISO-NE peak demand is based on the 2015 Capacity, Energy, Loads and Transmission ("CELT") Report and used to develop a given FCA's NICR value. FCA demand curve parameters are based on the existing construct (i.e., FCA 10), with adjustments beginning in FCA 11 to reflect PA's view of Net CONE. Existing capacity resources are assumed to bid into the FCA as price-takers, whereas new capacity resources are assumed to bid at the greater of (1) the estimated resource-specific offer floor price and (2) the price associated with the fundamental intersection of the FCA's supply and demand.

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- b. Explain how exactly capacity clearing engine operates in the model (e.g., how non-rationable offers are handled)

The capacity clearing engine is applicable during the technical period of the capacity price forecast (e.g., prior to when new generic capacity is added to the system to meet the target reserve margin). The clearing prices during this time period are calculated based on the bidding behavior of new and existing capacity resources; wherein the aggregate amount of new and existing capacity participating in the FCA is based on PA's proprietary view. New capacity resources are projected to bid at the greater of (1) the price associated with the fundamental intersection of the FCA's supply and demand and (2) resource-specific offer floor price, while existing capacity resources are assumed to bid as price-takers. The bid price of the marginal capacity unit determines the FCA clearing price.

- 3. Provide all Key Assumptions used in the Capacity Market Model
 - a. Peak demand forecast
 - b. Supply curve slope where it crosses the demand curve
 - c. Provide the modeled supply and demand curves for FCA-10, FCA-11, FCA-12 and FCA-13 without CREC and with CREC

RESPONSE:

- a. Peak demand forecast:

The peak demand forecast is included in the "Supply-Demand" tab of the DPUC Demonstratives.

- b. Supply curve slope where it crosses the demand curve:

PA's demand curve reflects the ISO-NE published curve for FCA 10 and makes adjustments for FCA 11+ (i.e., upward and downward) based on PA's view of the reference technology's net cost of new entry ("Net CONE"). For the avoidance of doubt, PA does not change the shape (or "kinks") of the curves for future FCAs.

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Due to the proprietary nature of the information contained within the PA model's curves, PA is unable to provide this data.

- c. Provide the modeled supply and demand curves for FCA-10, FCA-11, FCA-12 and FCA-13 without CREC and with CREC:

Key assumptions such as installed capacity, incremental capacity additions/retirements and peak demand are provided in the "Supply-Demand," "Firm Additions," and "Firm Retirements" tabs of the DPUC Demonstratives. Due to the confidential and proprietary nature of the information contained within the PA model's curves, PA is unable to provide the specific supply and demand curves.

- 4. Results in Excel Format
 - a. Provide clearing prices in FCA-10, FCA-11, FCA-12 and FCA-13 without CREC and with CREC

RESPONSE: The clearing prices are included in the DPUC Demonstratives on the "Capacity Prices - DY" tab.

RESPONDENT: Ryan Hardy, PA Consulting, Inc.

DATE: May 2, 2016

INVENERGY THERMAL DEVELOPMENT LLC
By its Attorneys,

/s/ Alan M. Shoer

Alan M. Shoer, Esq. (#3248)
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Dated: May 2, 2016

CERTIFICATE OF SERVICE

I hereby certify that on May 2, 2016, I delivered a true copy of the foregoing responses to the Division of Public Utilities Data Requests via electronic mail to the parties on the attached service list.

/s/ Alan M. Shoer

TABS

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CONFIDENTIAL