NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

In the Matter of a Renewal and Modification of a State Pollutant Discharge Elimination System ("SPDES") Permit Pursuant to article 17 of the Environmental Conservation Law and Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York parts 704 and 750 *et seq.* by Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC, Permittee,	**DEC # 3-5522-00011/00004** **SPDES # NY-0004472**
-and-	
In the Matter of the Application by Entergy Nuclear Indian Point 2, LLC and Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, LLC for a Certificate Pursuant to §401 of the Federal Clean Water Act.	**DEC # 3-5522-00011/00030** **DEC # 3-5522-00011/00031**

PRE-FILED SUR-REBUTTAL TESTIMONY OF ROBERT FAGAN RELATING TO THE AFRICAN AMERICAN ENVIRONMENTALIST ASSOCIATION'S EXHIBIT 18 ON BEHALF OF INTERVENORS RIVERKEEPER, INC., SCENIC HUDSON, INC., AND NATURAL RESOURCES DEFENSE COUNCIL, INC.

Q. Please state your name, business address and occupation.

A. My name is Robert M. Fagan. I am a Principal Associate at Synapse Energy Economics, 485 Massachusetts Ave., Cambridge, MA 02139.

Q. Have you previously provided testimony with respect to the above-captioned proceeding and appeal?

A. Yes. I have provided prefiled direct testimony, dated February 28, 2014, prefiled rebuttal testimony, dated March 28, 2014, as well as live testimony on the record before this Tribunal on April 11, 2014 in the above-captioned State Pollutant Discharge Elimination System ("SPDES") proceeding with respect to the potential impacts to electric power sector reliability, electric power sector air emissions, and electric power sector price impacts associated with the construction and operation of the closed-cycle cooling system configurations proposed by the New York State Department of Environmental Conservation (NYSDEC) and Entergy for the Indian Point nuclear power plant ("IPEC"), in order to inform the analysis being conducted in

connection with the above-captioned permit proceeding by NYSDEC under New York's State Environmental Quality Review Act (SEQRA). My educational and professional background and qualifications are described in my previous testimony and my full curriculum vitae, is presently in evidence as **Riverkeeper Exhibit 108**.

Q. Why is Riverkeeper offering your sur-rebuttal testimony?

A. I understand that the Tribunal has authorized Riverkeeper to offer prefiled sur-rebuttal testimony in response to an exhibit that was offered by the African-American Environmentalist Association ("AAEA") during the April 2014 adjudicatory hearings, AAEA Exhibit 18. Although AAEA Exhibit 18 was not offered or referred to in AAEA's prefiled testimony or report,[1] this exhibit presented AAEA's analysis with respect to specific power replacement resources and purported air emissions impacts associated with the closure of IPEC. I did not have the benefit of responding to this analysis in any capacity as of the time it was offered to the tribunal. Thus, my testimony herein responds to AAEA Exhibit 18 (which AAEA has broken up and sub-designated as AAEA Exhibits 18A through 18E), as well as the live testimony provided by AAEA's witnesses on April 17, 2014 during which AAEA Exhibit 18 was discussed and explained, and the documents identified as "reliance documents" which AAEA provided in connection with AAEA Exhibit 18 subsequent to offering AAEA Exhibit 18 at the hearing.[2]

Q. What have you reviewed and relied upon in preparation of this sur-rebuttal testimony?

A. In addition to materials I have previously identified as having reviewed and relied upon,[3]

[1] AAEA Exhibit 1, *Fish Eggs Versus Asthmatic Children In Harlem*, AAEA (February 2014); Rebuttal Testimonies of Norris McDonald, John McCormick, Derry Bigby, and Dan Durett Regarding Fish Eggs Versus Asthmatic Children in Harlem: Environmental Justice Issues Related to Closing Indian Point Energy Center, On Behalf of Intervenor African American Environmentalist Association (March 25, 2014).

[2] Excerpt Spreadsheet, file name: 2012 EIA Form 860 Indian Point 2 and 3, submitted by AAEA on April 22, 2014, now offered as **Riverkeeper Exhibit 181,** Excerpt Spreadsheet, file name: 2013 EIA Form 923 Indian Point, submitted by AAEA on April 22, 2014, now offered as **Riverkeeper Exhibit 182**, Excerpt Spreadsheet, file name: Form 923 6 Plants, submitted by AAEA on April 22, 2014, now offered as **Riverkeeper Exhibit 183**.

[3] *See* Direct Testimony of Robert M. Fagan Regarding Air Emissions and Electric System Reliability Impacts of Closed-Cycle Cooling, on Behalf of Intervenors Riverkeeper, Inc., Scenic Hudson, Inc., and Natural Resources Defense Council, Inc (February 28, 2014) at 15-17; Rebuttal Testimony of Robert M. Fagan Regarding Replacement Power Air Emissions and Electric System Reliability Impacts of Closed-Cycle Cooling, on Behalf of Intervenors Riverkeeper, Inc., Scenic Hudson, Inc., and Natural Resources Defense Council, Inc (March 28, 2014) at 40.

I have reviewed AAEA Exhibit 18, associated "reliance documents" identified and provided by AAEA, and the transcript of AAEA's witnesses' testimony from April 17, 2014 during the adjudicatory hearings on the issue of closed-cycle cooling.

Q. Are there any limitations to your sur-rebuttal testimony that you need to identify at the outset?

A. I understand that Riverkeeper has not yet cross-examined any of AAEA's witnesses and that the July 11, 2014 filing date for this testimony will pre-date Riverkeeper's cross examination of AAEA's witnesses. I obviously cannot respond to any subsequent testimony from AAEA's witnesses in connection with AAEA Exhibit 18 via the testimony herein.

Q. What are AAEA Exhibits 18A-E?

A. According to AAEA witness Norris McDonald, AAEA Exhibits 18A-E present an "analysis of the particular power plants that could possibly have to replace power from Indian Point during a construction outage."[4] This analysis purportedly estimates what replacement power needs would be in New York City in the year 2013 if IPEC is unavailable, and assumes that IPEC provides thirty percent (30%) of its power to New York City. AAEA's analysis concludes that the absence of IPEC power generation would result in certain increases in NOx and CO_2, to support AAEA's claim that the closure of Indian Point will result in disproportionate negative impacts on air quality in environmental justice communities.

AAEA's Exhibit 18A lists the capacity, operating status, in-service year, fuel source, operating months and county location of a subset—that is, just 21 units from six plants—of the generation available to operate in the New York City load zone, also known as zone J of the New York

[4] CCC (McDonald Cross) atTr. at 9951:2-9. Despite this testimony, it is clear that in this proceeding AAEA has only offered testimony and evidence with respect to air quality impacts and replacement power issues associated with Entergy deciding not to implement closed-cycle cooling at IPEC and instead deciding to shut down the plant permanently. As I have previously indicated, I understand that Riverkeeper's position is that the shutdown of Indian Point is not properly relevant to a SEQRA review in connection with NYSDEC's April 2, 2010 Denial of Entergy's requested Clean Water Act Section 401 water quality certification., and any response to AAEA's analysis herein is without prejudice to Riverkeeper's position.

Independent System Operator's (NY ISO) dispatching construct. The total of summer capacity listed in Exhibit 18A is 4,487 MW.

AAEA Exhibit 18C consists of additional information for the six power plants listed in AAEA Exhibit 18A. In particular, AAEA Exhibit 18C contains the power plant capacity information for those six power plants plus an estimate of the net generation (in MWh) during the 2013 ozone season (by which AAEA presumes May 1 through September 30) for these same plants, their NO_X emission rate, and the total ozone season NO_X emissions. The energy and NO_X data are from the U.S. Energy Information Administration (EIA) form 923 reporting for 2013.

AAEA Exhibit 18D is AAEA's "Estimate of Additional NO_X During May through September to Replace the 30% of IPEC Power" while AAEA Exhibit 18E is AAEA's "Estimate of Additional CO_2 During May through September to Replace the 30% of IPEC Power." I interpret these to be AAEA's estimates of what replacement power needs would be in New York City if IPEC were out of service during the ozone season in 2013, and air emissions increases resulting therefrom.

Q. Has AAEA provided a technically-supportable estimate of the effects of a potential IPEC outage on either replacement power needs, or air emissions from power plants in New York City?

A. No, they have not. For a number of reasons, as I will describe in further detail below, AAEA's analysis as contained in the multiple parts to their Exhibit 18 is deficient on a number of fundamental levels. Consequently, there is no basis for, and I disagree with, AAEA's core assertions, indicated in Exhibit 18D:

1) that the six New York City power plants identified by AAEA would be expected to provide all the replacement power that may need to be sourced from New York zone J generation if IPEC was not available during May – September under a future IPEC outage scenario;
2) that replacement power needs (in terms of MWH requirements during May – September in New York zone J) would be as AAEA indicates in Exhibit 18D;[5]

[5] A close review of Exhibit 18D reveals that AAEA assumes an increased energy generation need in New York City during May-September of 2,583,480 MWH, or 2,583.48 GWh, equal to AAEA's column "I" total (9,357,743 MWh) minus column "C" (6,774,264 MWh).

3) that the AAEA-identified six power plants collectively would, thus, produce 1,353 tons of NO_X emissions during May – September; and

4) that the parts of New York City that contain those six AAEA-identified power plants would see an ozone season increase in NO_X emissions of 599 tons in the event that IPEC was out of service during May – September.

While AAEA's conclusions with regard to CO_2 emissions increases are similarly unreliable, my testimony here does not specifically address AAEA's claims with respect to CO_2 emissions. This is because my direct and rebuttal testimony has already addressed the overall effect of cooling tower construction outages on CO_2 emissions in New York State over time, under different resource scenarios, and because NO_X emissions are a pollutant of issue for local air quality impacts, whereas CO_2 emissions are not.

Q. Is estimating what the replacement power needs may be in New York City in 2013 a viable means of informing the question of replacement power needs in the event of an IPEC outage in a future year for cooling tower construction?

A. No, not without accounting for major electric system changes expected across the system over a number of years extending out at least to the latter part of this decade, since major infrastructure improvements are planned over that period and an outage at IPEC for the construction of cooling towers is not expected to occur until later years, around 2020.[6] Prior to year 2020 – and as early as 2016 – a number of changes to the electric power system are currently required to, or will otherwise likely, be in place. Primarily, additional transmission system support and additional regional generation resources will be installed. Also, additional demand side measures and additional solar photovoltaic (PV) energy resources in the New York City, Lower Hudson Valley, and Long Island zones will be in place. All of these changes can impact, and would require careful consideration in connection with, the assessment of replacement power needs in the event of an IPEC outage. By narrowly and erroneously focusing

[6] *See* CCC (Clubb Cross) at Tr. 12116:30 to 12118:17 (citing Appendix 6B to Entergy Exhibit 7) (in relation to Entergy's proposed Enercon cooling towers, indicating that it would take four years from the initiation of construction before a construction-related outage would occur); Tetra Tech, Inc., IPEC ClearSky™ Retrofit: Planning Schedule (March 27, 2014), **DEC Staff Exhibit 278** (in relation to DEC Staff's cooling tower configuration, indicating outage construction commencing in March 2024).

on the year 2013, AAEA does not account for any of these planned major electric system changes.

Q. What is your understanding of AAEA's assumption about the amount of power that would need to be replaced in New York City zone J in the event of a construction outage at IPEC?

A. AAEA Exhibits 18D and E state that "IPEC Units 2&3 deliver 30% Net Gen to Zone J," and AAEA witness, Mr. McCormick testified that he assumed that 30% of IPEC's power was going into Zone J.[7] Thus, AAEA assumed that replacement power in 2013 in zone J would have been required for 30% of the output of the IPEC units.

Q. Do you agree with this assumption?

A. No, this assumption is unsupported. If IPEC is not in service during the ozone season, for any reason, incremental "replacement" energy amounts from New York City zone J units would be much lower. While the exact amount of ozone season replacement power from zone J sources would depend on the year in which one is assessing an IPEC outage and on the resource mix and net load requirements at the time, AAEA has overestimated the amount of power that would need to be replaced in zone J. My previous analysis of air emissions impacts provides a more accurate estimation of power replacement needs, on an annual basis, in the event of an IPEC outage. In addition, for this sur-rebuttal testimony, I extracted the monthly data for generation from zone J from my original analysis, (as is summarized in Table 3 below of this sur-rebuttal), which reinforces my original findings.

Q. In your previous analysis of air emissions impacts from construction outages at IPEC, how did you estimate replacement power needs?

A. Unlike Mr. McCormick's arbitrary assumptions about replacement power needs, I used industry-standard economic dispatch models that respected the major transmission constraints in New York State and accounted for the economics of electric power dispatch, essentially

[7] Estimate of Additional NOx During May Through September to Replace the 30% of IPEC Power, **AAEA Exhibit 18D;** Estimate of Additional CO_2 During May Through September to Replace the 30% of IPEC Power, **AAEA Exhibit 18E**; CCC (McCormick Cross) at Tr. at 9990:8-11.

mirroring the manner in which the power system is actually dispatched. I accounted for anticipated changes in the electric power system in New York State, and conducted scenario assessment to test the effects under a range of future conditions representing different resource mixes.

Q. What did your previous analysis show with regard to replacement power needs in the event of an outage at IPEC?

A. In the Synapse report accompanying my direct testimony, Tables 1 and 2 listed the proportion of IPEC energy replaced with New York City zone J resources. Depending on the year and scenario considered, I computed replacement power needs in New York City that ranged from negative – meaning less generation from New York City units when IPEC was out of service – to as much as 26% of IPEC output for only the most conservative scenario in the year 2025. In the "base" scenario, comparing IPEC out of service in 2016 and making no changes to the level of energy efficiency or renewable resource deployment in the state, I estimated a replacement power need of 18% of IPEC required from zone J resources. The remaining need in that scenario comes from imports, and gas and coal resources from other New York State zones, including the Lower Hudson Valley, the Capital region, and northern and western New York State. In scenarios with higher levels of energy efficiency and renewable resources, less than 10% of replacement power needs come from New York City resources.

Q. What did extracting data from the May-September months show with regard to replacement power needs in the event of an outage at IPEC?

A. For two key scenarios, over the period of 2016-2019, our modelling data for the ozone season showed incremental zone J replacement energy (i.e., replacement power required from zone J units) that ranged from 5.1% to 10.8% of IPEC May-September energy in scenarios where IPEC was not in service in those months (as reflected in Table 3 below). Once again, such an estimate follows from a detailed economic redispatch of the system, as conducted with our PROSYM modeling. Notably, AAEA did not conduct any form of economic redispatch in arriving at its findings related to replacement power needs.

Q. Does AAEA's Exhibit 18 consider all of the generation capacity that is available to operate in New York City (NY ISO zone J) to be a source of replacement power for IPEC, if necessary?

A. No. AAEA Exhibit 18 only lists and considers 21 generating units from 6 power plants located in New York City zone J and does not consider all of the generation that is available to New York City. In reality, there are roughly 130 individual units from 26 power plants available to operate in New York City zone J.

Table 1 below lists the total generation capacity that was available to the New York City zone J, the summer MW rating of those units, and the actual 2013 annual energy produced by the units. It also includes the average annual capacity factor for the units, a measure of "headroom" for more energy production, on an annual basis. Some units have been aggregated into reasonable groupings of capacity – for example, there are 16 separate combustion turbine units at the Narrows location – those are grouped as a total of 283 MW.

Table 1. 2013 Summer Capacity,[8] Annual Energy, and Average Capacity Factor, by Plant Group, New York City Zone J Electric Power Resources

Units	Summer MW	GWh 2013	Annual Ave. Capacity Factor based on Summer MW
East River CC 1&2	288	2,465	97.9%
NYPA Astoria CC1&2 (2006)	464	3,370	82.9%
Brooklyn Navy Yard	261	1,857	81.1%
Ravenwswood CC 2004	218	1,471	77.0%
Astoria II CC3 and 4	544	3,084	64.8%
JFK cogen	118	637	61.4%
Astoria East Energy cc1 and cc2	555	2,796	57.5%
Linden Cogen (NJ)	754	3,083	46.7%
East River steam 6&7 Cogen	322	743	26.4%
NYPA Gowanus/Kent/Pouch GTs	171	343	22.9%
Arthur Kill 2 steam	338	670	22.6%
Bayonne Energy Center (NJ)	471	829	20.1%
Ravenswood steam 2	364	620	19.4%
Astoria 3/5 steam	754	1,065	16.1%
Arthur Kill 3 steam	500	685	15.7%
Ravenswood steam 1	366	427	13.3%
NYPA Vernon Blvd GTs	80	80	11.4%
Ravenswood steam 3	964	593	7.0%
NYPA Harlem Rv and Hellgate GTs	160	86	6.1%
Narrows GTs	283	123	5.0%
Astoria GTs circa 1970	506	58	1.3%
Astoria GT 01	15	1	1.1%
Gowanus GTs	551	54	1.1%
Ravenswood GT/Jet	322	27	1.0%
Arthur Kill GT 1	12	1	0.8%
ConEd 59th, 74th, and Hudson Ave GTs	78	2	0.2%
Grand Total NYC Zone J Generation, 2013	9,458	25,169	30.4%
Excluding AAEA Exhibit 18A Units	4,487		
Remaining Capacity Not in AAEA Exhibit 18A	4,971		

Source: NY ISO 2014 Gold Book, Table III data, summarized by Synapse. Capacity factor computed by Synapse.

Table 1 shows that there was roughly 9,458 MW available for operation in New York City in 2013. This 9,458 MW is 4,971 MW more than AAEA's estimate, which only assumes just 4,487 MW would be available to "replace" IPEC power in 2013. In 2013, New York City zone J units produced 25,169 GWh, or 25.169 million MWh.

[8] Power plants have "nameplate" ratings, and summer and winter ratings. Summer ratings can be limited by temperature concerns at power plants. Nameplate ratings are usually slightly higher than summer ratings.

Q. What is the significance of AAEA's exclusion of more than 4,900 MW of available summer capacity from its analysis?

A. This exclusion contributes significantly to the inaccuracies of the replacement power assessment conducted by AAEA. In particular, all 9,458 MW of zone J capacity would be available to operate in New York City during the summer months. AAEA has incorrectly restricted the set of units available to those with "Sufficient Summer Name Plate Capacity to Accommodate Replacement of the Lost IPEC MWH." AAEA's designation of plants with "sufficient summer name plate capacity" is misleading since all power plant zone J capacity has the potential to "accommodate" replacing IPEC power in the event of an outage. Mr. McCormick testified that he limited his power plant selection to those plants that provide baseload power and can "make up for the IPEC loss" and that he "eliminated" plants that provided smaller amounts of power.[9] However, economic dispatch of a system without IPEC would not exclude the ability of such units to provide replacement power, if, as, or when needed. There is no requirement to "match" the baseload character of IPEC's energy output with only baseloaded plants when considering "replacement" energy needs.

Q. So then, if replacement power is needed in the event of a closed-cycle cooling construction-related outage at IPEC, would that power necessarily come only from the six power plants AAEA has considered in its analysis?

A. No. It could come from *any* of the 9,458 MW of available zone J capacity.

Q. If replacement power is required from zone J resources, how would it be determined where that energy would come from?

A. The exact source(s) of replacement power would be determined according to both economics of dispatch and any New York City transmission congestion that may exist. Generally, economic dispatch determines the order in which any required "replacement" power would be sourced, and the presence (or absence) of transmission congestion could also affect the choice of replacement power. An economic dispatch of the resources in the New York State market would determine the makeup of energy across all resources in the event of an IPEC outage. That dispatch would reflect the presence of transmission constraints into and within

[9] CCC (McCormick Cross) at Tr. at 9980:21-9981:18; 9985:11-9986:2.

New York City, as well as relevant changes to and other realities of the New York State electricity grid and power system.

Q. How did AAEA Witness, Mr. McCormick, determine replacement power sources in the event of an IPEC outage?

A. Mr. McCormick did not conduct an economic dispatch model respectful of market economics and transmission constraints for a scenario involving an outage at IPEC. Instead, AAEA made unsupported assumptions about the level of replacement power needs required from New York City units, as discussed above, and then assumed that the replacement energy would come from a subset of the resources available to the NY ISO for dispatch in New York City. In particular, Mr. McCormick used an *ad hoc* mechanism that selectively identified six of the larger units in New York City to provide that level of replacement power. Mr. McCormick estimated what "headroom" (meaning what capability to turn up output) existed on those six plants during the summer of 2013, and then assumed that all the power was to be made up by the headroom remaining on those units.

Table 2 below lists all Zone J generation resources and highlights the resources that AAEA asserts would be used for replacement energy should an outage occur at IPEC. The last column is an indication of the amount of annual "energy headroom" that was available for all Zone J resources in 2013. AAEA did not assume that any of the other non-highlighted resources in this table would even be available to provide any replacement energy, despite the significant amount of "energy headroom" available for such resources. AAEA also made no assumptions that any new sources of generation or imports would be available.

Table 2. New York City Electric Power Resources – 2013 – AAEA Plants Highlighted

Units	Summer MW	GWh 2013	Annual Ave. Capacity Factor based on Summer MW	Remaining Energy Headroom, Annual, GWh
East River CC 1&2	288	2,465	97.9%	54
NYPA Astoria CC1&2 (2006)	464	3,370	82.9%	697
Brooklyn Navy Yard	261	1,857	81.1%	432
Ravenwswood CC 2004	218	1,471	77.0%	440
Astoria II CC3 and 4	544	3,084	64.8%	1,678
JFK cogen	118	637	61.4%	401
Astoria East Energy cc1 and cc2	555	2,796	57.5%	2,068
Linden Cogen (NJ)	754	3,083	46.7%	3,524
East River steam 6&7 Cogen	322	743	26.4%	2,075
NYPA Gowanus/Kent/Pouch GTs	171	343	22.9%	1,151
Arthur Kill 2 steam	338	670	22.6%	2,291
Bayonne Energy Center	471	829	20.1%	3,295
Ravenswood steam 2	364	620	19.4%	2,571
Astoria 3/5 steam	754	1,065	16.1%	5,541
Arthur Kill 3 steam	500	685	15.7%	3,691
Ravenswood steam 1	366	427	13.3%	2,777
NYPA Vernon Blvd GTs	80	80	11.4%	620
Ravenswood steam 3	964	593	7.0%	7,849
NYPA Harlem Rv and Hellgate GTs	160	86	6.1%	1,314
Narrows GTs	283	123	5.0%	2,356
Astoria GTs circa 1970	506	58	1.3%	4,375
Astoria GT 01	15	1	1.1%	128
Gowanus GTs	551	54	1.1%	4,772
Ravenswood GT/Jet	322	27	1.0%	2,797
Arthur Kill GT 1	12	1	0.8%	103
ConEd 59th, 74th, and Hudson Ave GTs	78	2	0.2%	685
Grand Total	9,458	25,169	30.4%	57,684
Excluding AAEA 18A Units	4,487		Annual energy headroom without AAEA 6 plants:	33,504
Remaining Capacity Not in AAEA Exh 18A	4,971			

Source: NY ISO 2014 Gold Book, aggregation by Synapse.

Q. Can you please elaborate upon the flaws you observe with AAEA's approach for determining replacement power sources in the event of an IPEC outage?

A. As I've indicated, AAEA's approach is highly flawed since it does not abide by principles of economics and transmission, which would determine where power would come

from in the event of an outage at IPEC. There is no sound basis to support Mr. McCormick's arbitrary selection of six units as replacement power sources for an IPEC outage.

For example, two of the units selected by AAEA – Ravenswood and Astoria Generation – are little-used older units. AAEA has provided no support to indicate that a future-year economic dispatch of New York City in the absence of IPEC output would result in turning to those two particular units and increasing their output in the amounts assumed by AAEA to make up any shortfall. AAEA has not provided any support for an alternative dispatch that would call on those two units in the dramatic amounts that AAEA Exhibit 18D indicates. In fact, given the economics, our modelling did estimate how much those units would be "turned up" under different scenarios. Those results are reported in Table 4 below in this testimony, and the levels of increase are far lower than the AAEA estimate of almost doubling output (AAEA estimated a 90% increase in output for those two stations).

Of further note, AAEA counted all of the 1,912.8 MW of summer capacity at Ravenswood in its tabulation for capacity, yet it included, in its energy summary of 1,297,886 MWH of ozone season energy, only the energy provided by the older Steam units known as Ravenswood 1, 2 and 3. The energy output of the 4th Ravenswood unit – a new combined cycle unit – was excluded as "available" for more ozone season production. While this may be because the combined cycle unit was operating at roughly 85% capacity factor for the ozone season (based on EIA 923 data), it too had some "headroom" available in the ozone season that was not considered by AAEA. The newer combined cycle unit at Ravenswood has a much lower NO_X emission rate than the Ravenswood steam units, however, the older steam units were allocated all of the Ravenswood plant generation increase. Thus, in addition to all the concerns I've expressed with AAEA's overall method of replacement power estimation, AAEA has also likely overestimated the contribution of the older, steam-fired, higher-NO_X-emitting portion of Ravenswood and fully discounted the headroom available from the newer, lower-NO_X-emitting portion of the plant – along with discounting headroom from other plants not included by AAEA, as seen in Table 2.

In addition, Mr. McCormick's method is flawed since it did not test the effect of replacement power supply under any scenario where additional resources are added to New York State's electric power resource base. AAEA used a subset of units available for operation in New York City in 2013 as its starting point, but did not take into consideration any potential new gas-fired resource, either in New York City or in the Lower Hudson Valley. For example, AAEA did not consider the effect if the Champlain Hudson Power Express were to be in place in New York City or assess any shifts in demand-side resources or installation of incremental amounts of solar PV resources. Notably, Mr. McCormick also did not account for the presence of significant amounts of generation in New Jersey, directly connected to the New York system, and available to provide zone J replacement energy. For example, AAEA improperly failed to consider that either the Linden cogeneration plant or the Bayonne Energy Center could provide a portion of replacement energy in the event of an outage at IPEC.

Moreover, Mr. McCormick's determinations about replacement power also did not account for the effect of the new, forthcoming Transmission Owner Transmission Solution (TOTS) transmission projects, which will support additional energy flows from upstate and mid-state New York to New York City, and clearly affect which power replacement sources will be called upon to dispatch power to New York City in the event of lost generation from IPEC.

In sum, Mr. McCormick employed an arbitrary and unsupported methodology to determine replacement resources in the event of an outage at IPEC, which did not respect economics and other critical factors that dictate energy dispatch in New York City.

Q. What is the significance of AAEA's flawed methodology for determining replacement power needs and resources with respect to an outage scenario at IPEC?

A. AAEA's flawed methodology has resulted in an overestimation of increases in air emissions in New York City in the event of an outage scenario at IPEC. By overstating power replacement needs, focusing on just six plants – two of which are particularly older and dirtier than NYC's portfolio of resources – and ignoring fundamental economic dispatch principles,

AAEA's analysis results in conclusions about purported additional air pollution that are simply unfounded.

By way of example and not of limitation, the assignment of a significant amount of replacement energy to Ravenswood and Astoria Generation – little-used older units which have relatively large NO_X emission rates – resulted in the large NO_X increase AAEA estimates in their Exhibit 18D.[10] AAEA's subjective, selective allocation of replacement power to only the older, higher-NOx emitting steam units as opposed to other, and in some cases newer, resources in zone J results in overstated increases in emissions in NYC.

Q. Have you analyzed emissions impacts from New York City plants on a unit-specific basis?

A. Yes. The aggregate effect of unit-specific dispatch results are shown in the results reported in my direct and rebuttal testimonies. Those effects were shown for an annual period, for different years as presented in my testimonies, and for different resource scenarios. We have subsequently, in response to receiving Exhibit AAEA 18, extracted monthly data from our prior modeling, on a unit-specific basis, for New York City area units to assess ozone season results. Table 3 below shows the NOx emissions results[11] of our modeling for three different scenarios: IPEC in service (base case), IPEC out of service with no changes to energy efficiency and renewable resource deployment (scenario 11), and IPEC out-of-service with higher levels of energy efficiency and renewable resource deployment (scenario 14):

[10] Zone J Plant Data of Sufficient Summer Name Plate Capacity to Accommodate Replacement of the Lost IPEC MWH, **AAEA Exhibit 18C**; Estimate of Additional NOx During May Through September to Replace the 30% of IPEC Power, **AAEA Exhibit 18D**.

[11] I focus on NO_X emissions in this testimony, since that is a local pollutant of interest concerning replacement power sources. As noted, and as amply demonstrated in my previous analysis, similar flaws and overestimations exist in relation to AAEA's CO_2 emissions analysis.

Table 3 – Electric Power Sector Modelled Zone J (NYC) Energy (GWh) and NO_X Emissions for the May – September period for 2015 through 2019

	May-Sept. NOX emissions Zone J units (NYC), tons			May - Sept. energy Zone J Units (NYC), GWh			GWh Deltas		NOX Deltas			GWh delta -% of IPEC	
	Scen. 1 IPEC In Service	Scen. 11 IPEC Out of Service	Scen. 14 IPEC Out of Service	Scen. 1	Scen. 11	Scen. 14	Scenario 11 minus scenario 1	Scenario 14 minus scenario 1	Scenario 11 minus scenario 1	Scenario 14 minus scenario 1	IPEC summer months 2013 GWh	Sc. 11 - 1	Sc. 14 - 1
2015	2,209	2,209	1,719	13,587	13,587	12,436	-	(1,151)	-	(490)	7,349		
2016	2,082	2,690	2,408	13,899	15,324	14,596	1,425	697	608	326	7,349	9.5%	8.3%
2017	1,710	2,252	1,964	14,062	15,644	14,852	1,582	790	542	254	7,349	10.8%	7.4%
2018	1,008	1,409	1,140	15,319	17,191	16,030	1,872	711	400	132	7,349	9.7%	5.4%
2019	978	1,354	1,065	15,366	17,170	15,903	1,804	537	377	87	7,349	7.3%	5.1%

Source: Synapse PROSYM modelling, monthly outputs, scenarios 1, 11, 14

Q. Please describe the information in Table 3.

A. The second grouping of columns of Table 3 ("May – Sept. energy Zone J Units (NYC), GWh") reports the level of energy output (in gigawatt-hours, or GWh) of the aggregate of NY ISO zone J (New York City) resources (which include the Linden cogeneration plant and the Bayonne Energy Center in New Jersey) in each of the May-September periods for 2015 through 2019. This is reported for three scenarios: one with IPEC in service (scenario 1), and two with IPEC out of service in those months (scenario 11 and scenario 14). As with my previous testimony, scenario 11 assumes the same baseline assumptions for energy efficiency and renewable energy deployment in New York State and scenario 14 assumes higher levels of energy efficiency and renewable resource deployment. The first grouping of columns of Table 3 shows the level of NO_X emissions, in tons, associated with this electric output. Next, in the column listed as "GWh Deltas" the table shows the level of replacement energy required in zone J during scenarios with IPEC out of service (scenarios 11 and 14), and in the column listed as "NOx Deltas," the table shows the increase in NO_X emissions associated with this replacement power. In the last three columns, the table lists May-September 2013 IPEC output,[12] and shows the "GWH Deltas" as a fraction of this IPEC production.

[12] From AAEA's Exhibit 18B, and checked by Synapse with US EIA form 923 data.

Q. Do your results differ from those of AAEA?

A. Yes. As already discussed above, the extracted data as reflected in Table 3 indicates replacement energy amounts much lower than AAEA's estimate that 30% of IPEC output must be made up by New York City resources. Moreover, the data also shows that NO_X emission levels change over time, and, as seen in my previous testimonies, by 2018 NO_X emissions in New York City are lower than they were in 2015 with IPEC out of service and even without considering scenarios with increases in energy efficiency and renewable energy deployment. In future years, NO_X emissions in NYC in the May-September period with IPEC out of service would continue to be considerably lower than emissions in 2015 with IPEC in service.

Q. Have you analyzed emissions impacts from the six generating units identified by AAEA as replacement sources in the event of an IPEC outage, in comparison to the data reported in AAEA Exhibit 18D?

A. Yes. In response to the misleading and inaccurate figures reported in AAEA Exhibit 18D, I have generated Table 4 below, which shows Synapse's modelling results for the six plants identified by AAEA, and for the rest of the zone J units, for the May-September periods for 2015, 2017, and 2019. The table lists energy production (in GWH), capacity factors for the plants for the May-September period ("CF", a measure of "headroom" available), NO_X emissions, and lastly, analogous to results I reported in Table R3 of my previous prefiled written rebuttal testimony, NO_X emission changes for scenarios 11 and 14 relative to the baseline scenario 1, and relative to 2015 emission levels:

Table 4 – Unit Specific Output and Emissions in Zone J for May-September period in 2015, 2017, 2019

		Energy Production & CF, May-September, GWh						NOx Emissions, Tons, May-September			Change in NOX Emissions, %, from Sc. 1		Change in NOX Emissions, %, from 2015	
MW, Sum	**2015**	Sc. 1	CF	Sc. 14	CF	Sc. 11	CF	Sc. 1	Sc. 14	Sc. 11	Sc. 14 - 1	Sc. 11 - 1	Sc. 14 - 1	Sc. 11 - 1
464	500 MW CC	1,333	78.7%	1,240	73.2%	1,333	78.7%	29	27	29	-7%	0%	-7%	0%
555	Astoria Energy	1,750	86.4%	1,704	84.1%	1,750	86.4%	39	38	39	-3%	0%	-3%	0%
544	Astoria Energy II	1,659	83.6%	1,575	79.3%	1,659	83.6%	59	56	59	-5%	0%	-5%	0%
261	Brooklyn Navy Yd	681	71.5%	663	69.6%	681	71.5%	21	20	21	-2%	0%	-2%	0%
1,694	Ravenswood Steam	1,322	21.4%	975	15.8%	1,322	21.4%	488	361	488	-26%	0%	-26%	0%
389	Astoria Gen Station (3+GT1)	366	25.8%	258	18.2%	366	25.8%	162	113	162	-30%	0%	-30%	0%
5,551	All Other Zone J Generation	6,477	32.0%	6,023	29.7%	6,477	32.0%	1,412	1,104	1,412	-22%	0%	-22%	0%
9,458	Zone J Total	13,587	39.4%	12,436	36.0%	13,587	39.4%	2,209	1,719	2,209	-22%	0%	-22%	0%
3,907	AAEA Six Plant Total	7,111		6,414		7,111		797	615	797	-23%	0%	-23%	0%
	2017	Sc. 1	CF	Sc. 14	CF	Sc. 11	CF	Sc. 1	Sc. 14	Sc. 11	Sc. 14 - 1	Sc. 11 - 1	Sc. 14 - 1	Sc. 11 - 1
464	500 MW CC	1,227	72.5%	1,260	74.4%	1,335	78.8%	27	27	29	3%	9%	-5%	1%
555	Astoria Energy	1,702	84.1%	1,739	85.9%	1,774	87.6%	38	39	39	2%	4%	-1%	1%
544	Astoria Energy II	1,554	78.3%	1,645	82.9%	1,698	85.6%	55	58	60	6%	9%	-1%	2%
261	Brooklyn Navy Yd	649	68.1%	634	66.6%	651	68.4%	20	19	20	-3%	1%	-7%	-4%
1,694	Ravenswood Steam	1,030	16.7%	1,253	20.3%	1,539	24.9%	382	463	570	21%	49%	-5%	17%
389	Astoria Gen Station (3+GT1)	274	19.3%	323	22.8%	400	28.2%	114	135	167	18%	47%	-17%	3%
5,551	All Other Zone J Generation	7,626	37.7%	7,998	39.5%	8,246	40.7%	1,075	1,223	1,366	14%	27%	-13%	-3%
9,458	Zone J Total	14,062	40.8%	14,852	43.0%	15,644	45.3%	1,710	1,964	2,252	15%	32%	-11%	2%
	AAEA Six Plant Total	6,436		6,854		7,398		635	741	886	17%	39%	-7%	11%
	2019	Sc. 1	CF	Sc. 14	CF	Sc. 11	CF	Sc. 1	Sc. 14	Sc. 11	Sc. 14 - 1	Sc. 11 - 1	Sc. 14 - 1	Sc. 11 - 1
464	500 MW CC	830	49.0%	889	52.5%	1,061	62.7%	18	19	23	8%	29%	-33%	-20%
555	Astoria Energy	1,548	76.5%	1,579	78.0%	1,655	81.8%	34	35	37	2%	7%	-10%	-6%
544	Astoria Energy II	1,240	62.5%	1,332	67.1%	1,512	76.2%	44	47	54	8%	22%	-20%	-9%
261	Brooklyn Navy Yd	549	57.6%	554	58.2%	576	60.5%	17	17	18	1%	5%	-18%	-15%
1,694	Ravenswood Steam	447	7.2%	542	8.8%	774	12.5%	167	203	288	22%	72%	-58%	-41%
389	Astoria Gen Station (3+GT1)	106	7.5%	133	9.4%	194	13.7%	44	56	81	25%	82%	-66%	-50%
5,551	All Other Zone J Generation	10,647	52.6%	10,874	53.7%	11,398	56.3%	654	688	855	5%	31%	-51%	-39%
9,458	Zone J Total	15,366	44.5%	15,903	46.1%	17,170	49.8%	978	1,065	1,354	9%	39%	-52%	-39%
	AAEA Six Plant Total	4,719		5,029		5,772		324	377	499	16%	54%	-53%	-37%

Source: Synapse PROSYM modelling, monthly outputs, scenarios 1, 11, 14.

Q. What does Table 4 indicate?

A. First, as discussed above, Table 4 indicates that, according to economic dispatch modeling of scenarios without IPEC, increases in generation at the AAEA-identified six plants is much less than AAEA projected in its Exhibit 18D. In particular, generation increases at the Ravenswood steam and Astoria steam plants is limited in all years: for example, in 2017, Ravenswood steam increases its output from 1,030 to 1, 253 GWh in scenario 14, and to 1,539 GWh in scenario 11. This increase – of either 223 GWh, or 509 GWh, is far lower than AAEA's assertion of an increase of 1,168 GWh. Table 4 shows that significant "headroom" exists, and is utilized, at other plants in zone J besides the AAEA-identified six plants.

Second, the table indicates that during the ozone season, NO_X emissions from zone J plants continue to decline over time. In 2017, NO_X emissions in zone J would range from 11% less, to 2% more, than is seen in 2015. In 2019, while NO_X emission levels relative to scenario 1 range from 9% to 39% higher, in both scenarios (11 and 14) absolute NO_X emission levels are dramatically lower than is seen in 2015, prior to any IPEC outage. Notably, the table also shows that NO_X emissions at AAEA's identified plants are far lower than the 1,353 ton level that Exhibit 18D indicates.

Q. Based on your review of Exhibit AAEA 18, do you have an opinion regarding AAEA's conclusion that the unavailability of power from IPEC would result in disproportionate air quality impacts on specific environmental justice communities?

A. This position is unfounded. AAEA's analysis is flawed as it does not represent technically what will occur under any IPEC May to September outage. AAEA has not showed that specific power plants located in EJ communities will actually increase output, disproportionately relative to other plants, and lead to disproportionate impacts. My analysis shows overall decreases in NO_X emissions over time, and for any periods or scenarios where modelling does show NO_X increases, not only are they temporary, but they also cannot be characterized as disproportionate since resources all over zone J, including in New Jersey and the borough of Staten Island, would be called upon under scenarios where zone J increases are needed. My testimony also demonstrates that AAEA's assertions significantly exaggerate the zone J output that would be needed under IPEC outage scenarios.

My testimony herein focuses on the available New York City replacement power sources and the anticipated economic dispatch of those power sources in response to an anticipated need for replacement power which appropriately considers additions of new generating capacity, transmission improvements and demand-side management measures. That analysis has enabled me to highlight AAEA's overestimation of expected NOx emissions resulting from an outage at Indian Point (*see* Table 3 and Table 4). The accompanying sur-rebuttal testimony of Riverkeeper witness John Hinckley further addresses in detail the effect which increased power generation in New York City resulting from outages at Indian Point could reasonably be expected to have on air quality in New York City.

Q. Does this conclude your sur-rebuttal testimony?

A. Yes.

Supplemental Bibliography

AAEA Exhibit 1, *Fish Eggs Versus Asthmatic Children in Harlem*

AAEA Exhibit 18, "Supplemental Data," including:

- AAEA Exhibit 18A: 2012 Form EIA-860 Data – Schedule 3, 'Generator Data' (Operable Units Only)
- AAEA Exhibit 18B: EIA-923 Monthly Generation and Fuel Consumption Time Series File, 2013 December, and Indian Point – 2012 Form EIA-860 Data – Schedule 3, 'Generator Data' (Operable Units Only)
- AAEA Exhibit 18C: Zone J Plant Data of Sufficient Summer Name Plate Capacity to Accommodate Replacement of the Lost IPEC MWH
- AAEA Exhibit 18D: Estimate of Additional NOx During May Through September to Replace the 30% of IPEC Power
- AAEA Exhibit 18E: Estimate of Additional CO2 During May Through September to Replace the 30% of IPEC Power

EIA Form 923 data for 2013 (provided by AAEA)

EIS Form 860 Data for 2012 (provided by AAEA)

Emissions & Generation Resource Integrated Database (eGrid) 2010 Generator File (provided by AAEA

Excerpt Spreadsheet, file name: 2012 EIA Form 860 Indian Point 2 and 3, submitted by AAEA on April 22, 2014

Excerpt Spreadsheet, file name: 2013 EIA Form 923 Indian Point, submitted by AAEA on April 22, 2014

Excerpt Spreadsheet, file name: Form 923 6 Plants, submitted by AAEA on April 22, 2014

In the Matter of Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC For a SPDES Permit Renewal and Modification (DEC No: 3-5522-00011/00004; SPDES No. NY-0004472) and Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. Joint Application for CWA § 401 Water Quality Certification (DEC App. Nos. 3-5522-00011/00030; 3-5522-00105/00031), New York State Department of Environmental Conservation Adjudication Hearing Transcript (April 17, 2014) at Tr. 9917-10023.

NY ISO, 2014 Loads and Resources "Gold Book" (March 31, 2014), *available at*, http://www.nyiso.com/public/webdocs/markets_operations/services/planning/Documents_and_Resources/Planning_Data_and_Reference_Docs/Data_and_Reference_Docs/2014_GoldBook_Final.pdf

Synapse, PROSYM Monthly Modelling Outputs, 2014

Rebuttal Testimony of John McCormick Regarding Energy and Air Quality Impacts and Environmental Justice Issues Related to Closing Indian Point Energy Center, on behalf of Intervenor African American Environmentalist Association (March 26, 2014)